INCT Climate Change Phase 2

(INCT MC Phase 2)

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Year 2 Report

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CEMADEN

INDEX

EXECUTIVE SUMMARY

J. Marengo, T. Ambrizzi, E. Assad, E. Mendiondo, E. B. Pereira, R, Schaeffer, E. Rangel, U. Confalonieri, R. Alvala, R, Rodrigues, M. Barata, E. Haddad, J. Feres, P. Nobre, S. Chou, A. Amorim, S. Dias, M. Bustamante, P. Artaxo, A. Szklo, S. Margulis

Main results of the INCT MC Phase 2 by component from Year 2

This Executive Summary shows the results up to Year 2 of the INCT MC Phase 2. Different from the Report of year 1 we have included this summary and the contributions of all components of the project and not just the FAPESP funded. Since the project was submitted in 2014 and approved in 2017, some objectives have changed or new objectives have been included. Futhermore, some new partnerships have also been established.

E.1. Food security

The most important results obtained in the INCT MC Phase 2 sub-component agriculture, in 2019, was to finalize the organization of spatial data, relating to land use, and simulate the water balance for all Brazil, in a regular grid of 25 km, for the years 1986-2005, 2005-2015, 2020-2030 and 2030-2040, using the HADGEM2-ES model. In the case of the mapping of land use, the class of interest is anthropism, having sub-class, agriculture and pasture, which are already separated. Thus, to verify if there will be a reduction of food supply by 2040, the estimate will be made in the polygons that involve the class anthropism. In the result of the water balance, the maps of the water deficit already indicate which areas will be most affected by the increase in temperature and reduction of rainfall. In general, 85% of crop productivity depends directly on the greater or lesser water deficiency in the soil (Figure E.1). Main partners are EMBRAPA, UNICAMP/CEPAGRI, INPE, EMBRAPA,UNICAMP/IE, LAPIG/UFG e UFV.

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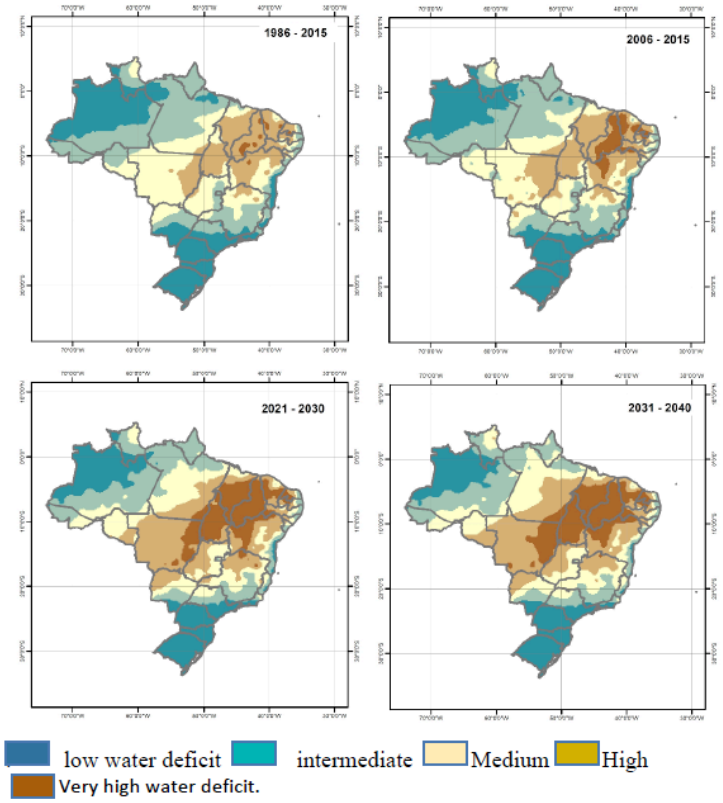


Figure E.1 Maps of water deficiency for the periods 1986-2015, 2006-2015, 2021-2030 and 2030-2040 (Embrapa Informatica Agropecuária 2019)

Key publications:

Pugliero, VS, Zanetti, MR, Assad, ED (2018) Diagnóstico ambiental: quantificação do passivo em app hídrica nos municípios da caatinga na Bacia do São Francisco, II SIMPÓSIO DA BACIA HIDROGRÁFICA DO RIO SÃO FRANCISCO. Desafios da Ciência para um novo Velho Chico, II Simpósio da Bacia Hidrográfica do Rio São Francisco – 3 a 6 de junho de 2018 - Aracaju, Sergipe

E.2. Water security

The synergy and dialogue among researchers of with all Brazilian states and foreign institutions is shown in Figure 1. These achievements were developed through strategies of: (1) organization of international and national meetings, workshops and management activities, (2) new cofunding of grant projects for interdisciplinary, intersectorial and interinstitutional dialogue for sharing knowledge around INCT MC Phase 2's goals, (3) optimization of capacity building inside and outside the INCT Phase 2's subcomponents with other INCT Phase 2's groups and CEPIDs), (4) submission of new grant proposals and publication of co-authoring manuscripts in peer-review journals with editorial boards, (5) identification, selection and retention of early-career scientists promoting INCT Phase 2's objectives and action plan, in cooperation with USP INCLINE and CNPq Group; (6) following and updating the internal time table. Therefore the most relevant achievements were related to INCT Phase 2's water security outreach and dialogue with decision makers and stakeholders around water security at municipality and river basin scales (2019-2035).

For science, a new South American runoff modelling paper introduced a fully-shared database for all INCT Phase 2's water security groups, thereby validating modelling in nested scales and demonstrative pilot projects. For policy, the Brazil's National Water Security Plan (PNSH, ANA) was finally released; with achievements and questions previously formulated by INCT MC Phase 2's water security researchers. Finally, related to communication, INCT MC Phase 2's water security groups fostered a Brazilian Dialogue Alliance for a new School of Advanced Studies on Water & Society Under Change (CAPES EAE). This dialogue has accelerated interdisciplinary dialogue through a series of Lectures, Workshops and Seminars on Socio-Hydrological Observatories for Water Security (SHOWS) for the PNSH 2019-2035, also engaging other INCT MC Phase 2's subcomponents and world-class institutions. The work was developed by USP, INPE, CEMADEN, UFPE, FUNCEME, UFCG, UFRGS, ANA.

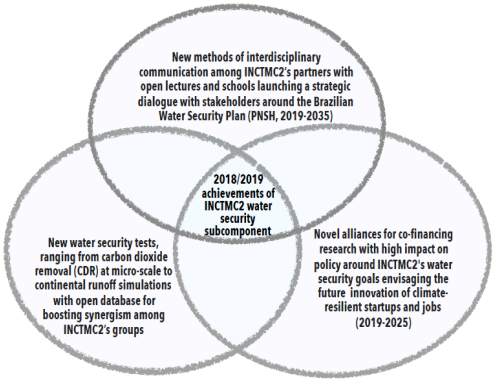


Figure E.2. Main achievements of the INCT MC Phase 2's water security subcomponent in 2018/2019.

Climate-sensitive & LULC scenarios (1990, 2010 & 2035) showed not only recovering water yield fluxes but also restoring water quality regimes, if feasible Ecosystem-based Adaptation strategies were applied at headwaters of Cantareira System, contributing with Sao Paulo Metropolitan Region Supply System (Figure E.3)

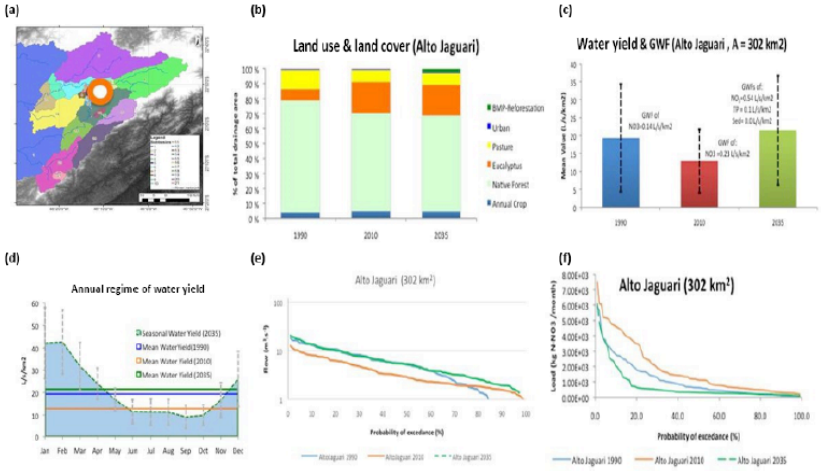


Figure E.3. Synthesis chart of case study of the Upper Jaguari sub-basin (drainage areaD 302 km2). (a) Localizationof the drainage areas at the Cantareira system; (b) LULC conditions for scenarios S1 (1990), S2 (2010) and S2CEbA (2035); (c) comparison of water yields simulated for conditions of S1, S2 and S2CEbA; (d) water yield scenarios compared with intra-annual regime of S2CEbA scenario; (e) comparison of duration curves of flows for S1, S2 and S2CEbA conditions; (f) duration curves of N-NO3 loads for S1, S2 and S2CEbA. (Tafarelllo et al 2018)

Key publications:

Macedo MB, Ferreira do Lago CE, Mendiondo EM (2019) Stormwater volume reduction and water quality improvement by bioretention: Potentials and challenges for water security in a subtropical catchment, Science of the Total Environment 647 (2019) 923–931

Taffarello D, R Srinivasan, G Samprogna Mohor, J Bittencourt Guimarães, M Calijuri, EM Mendiondo (2018) Modeling freshwater quality scenarios with ecosystem-based adaptation in the headwaters of the Cantareira system, Brazil, Hydrol. Earth Syst. Sci., 22, 4699–4723, 2018

E.3. Energy security

Trends analysis studies were carried out on the frequency of occurrence of extreme wind speed events in the state of Santa Catarina. The objective is to investigate trends in the frequency of extreme winds and their impact on the state's electrical system. One of the achievements of this on-going study was to understand how combined events of high-temperature and lulls limit the dispatch of transmission lines. Another achievement was the improvement in the estimation of the solar energy resource in tropical regions from the BRASIL-SR satellite model, using an unprecedented statistical approach. The study significantly improved the results of the incident solar radiation model for the rainy and dry seasons in Brazil. As for the solar radiation forecast, substantial advances in the implementation of the WRF-Solar model and the vectorization of satellite images were achieved as part of the development of a new integrated solar energy forecasting method in degraded areas (Figure E.4). Preliminary observational evidence of cloudiness and the effect of lake breeze on Brazilian reservoirs pointed to possible gains in the exploration of wind and solar energy in a hybrid combination with hydroelectricity.

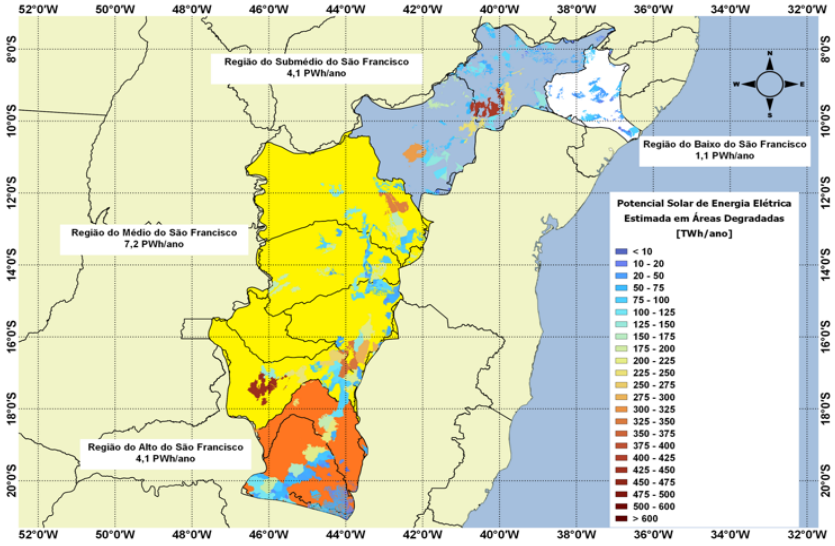


Figure E.4. Potential of Solar Electric Energy estimated in degraded areas (produced with data from Lima et al., 2019)

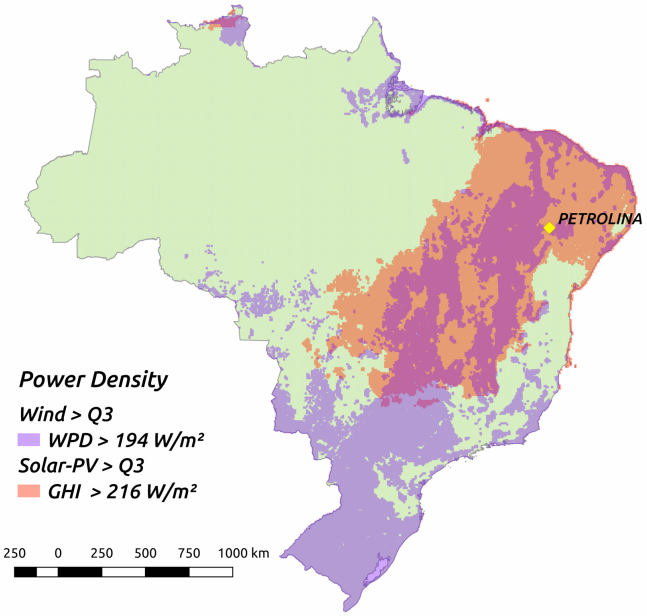


Figure E.5. Overlapping regions above Q3 percentile for wind and solar power complementarity in Brazil. (Gonçalves, et al., 2019)

Significant improvements made in the various Integrated Assessment Modelling tools developed and used by the team at COPPE, which were well reflected in the vast list of publications in peer-reviewed, international journals during the period. In particular, the Brazil Land-Use and Energy Systems (BLUES) model and the Total-Economy Assessment (TEA) model, a global computable general equilibrium (CGE) model, were finalized and now are fully operative, providing two unique tools in the country for modelling climate mitigation pathways with very high granularity for both energy and land-use technologies. The groups at CCST/INPE and COPPE/UFRJ, together with partners from UNIFESP worked in various aspects of energy sources and variability.

Key publications:

Simioni T, R Schaeffer (2019) Georeferenced operating-efficiency solar potential maps with local weather conditions – An application to Brazil, Solar Energy 184 (2019) 345–355

González-Mahecha RE, AFP. Lucena, A Szklo, P Ferreira, AIF Vaz (2018) Optimization model for evaluating on-site renewable technologies with storage in zero/nearly zero energy buildings, Energy & Buildings 172, 505–516.

Lima F. J. L.; F. R. Martins; R. S. C.; A. R. Gonçalves; A. P. P. Santos e E. B. Pereira - The seasonal variability and trends for the surface solar irradiation in northeastern region of Brazil. Submitted to Sustainable Energy Technologies and Assessments (2019)

Nobre, P.; Pereira, E.B.; Lacerda, F.F.; Bursztyn, M.; Faddad, E. A. and Ley, D. (2019) Solar smart grid as a path to economic inclusion and adaptation to climate change in the Brazilian Semiarid Northeast (in press) doi: 10.1108/IJCCSM-09-2018-0067

Goncalves, A. R; Casagrande, M. S. G.; Costa, R. S.; Martins, F. R.; Lima, F. J. L.; Pereira, E. B. Assessing Complementarity of Wind and Solar Resources for Hybrid Projects in Northeastern Brazil. Proceedings of 6º International Congress of Energy Meteorology, Copenhagen, 2019.

E.4. Natural disasters, impacts on physical infrastructure in urban areas and urban development

The results obtained in the scope of the sub-component "Natural Disasters, Urban Areas, Infrastructure, and Urban Development" of the INCT MC Phase 2 allowed a better understanding of the physical mechanisms that lead to extreme events in several regions in Brazil, their impacts on hydrography and vegetation. Atmospheric blocking remotely forced by tropical convection over the Indian and Maritime Continent prevents the establishment of the South Atlantic Convergence Zone during austral summer. As a consequence, severe droughts occur in west-central and southeastern Brazil. These droughts can cause water shortages such as the event that occurred in São Paulo city during the summer of 2013/14 and energy shortages such as the event during 2001. Moreover, the droughts also impact food supplies. Therefore, they threat our water, food and energy security. The same mechanism also leads to marine heat waves over the South Atlantic that affects coastal urban zones through disruption of fisheries and aquaculture. In southern Brazil, there has been a change on the causes of extremes of precipitation. This mechanism also leads to marine heat waves over the South Atlantic.

In Northeast Brazil, the impacts of extreme precipitation in the water availability of the pilot reservoir pointed out that seven drought events were identified for Castanhao drainage basin in the State of Ceara during 1981-2017, with a cumulative duration of 176 months. Regarding severity, this was approximately 130 (Sum of SPI). The most severe drought events occurred between 1982 and 1994, with a cumulative severity of -60. The droughts events in this period were associated with El Niño events (1982–1983 and 1992–1993). The statistical performance (Nash = 0.72 and RMSE =83 hm^3, equivalent to 1%) indicates the good quality of the simulation, pointing the possibility of the usage of this method for the simulation of the evolution of the storage level in the Castanhão reservoir (Figure E.6). This preliminary study highlights the fragility of this system in providing water resources in order to efficiently meet the demands of the region during the long dry periods. In this context, the hydrological projections of this study can subsidize the management and strategic planning of water resources. Considering the climate changes projected for the Northeast of Brazil (Marengo et al., 2019), with less frequent and smaller quantities of rain, as well as the increase of the temperatures, it is necessary to increase the resilience, including changes in population habits and the capacity of answers of the metropolitan region of Fortaleza, fundamental aspects to face future challenges.

Long-term trends of precipitation were obtained for the main river basins in Brazil (Figure E.6) and the preliminary conclusion is that the trends in precipitation are consistent with streamflow, showing the important role of climate variability and change on streamflow. This analysis also provides an evaluation of susceptibility of cities to extremes of precipitation and streamflow.

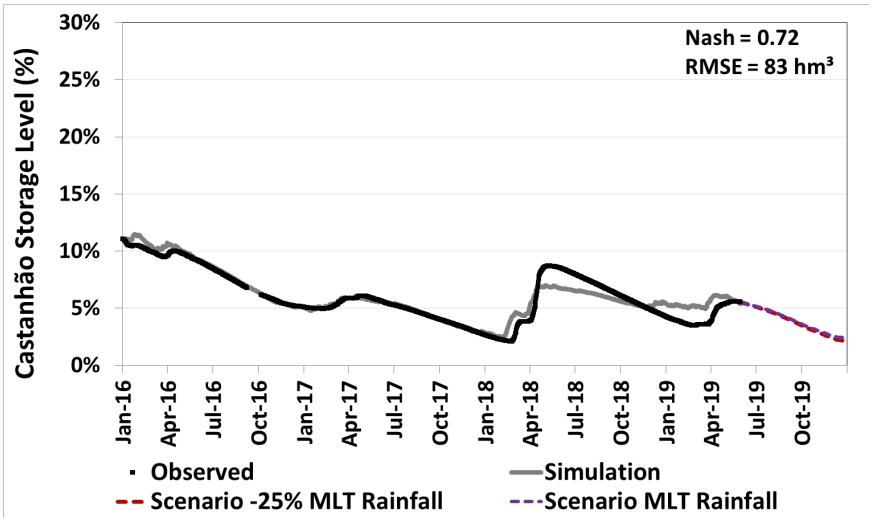


Figure E.6 – Storage level of Castanhão reservoir, in Ceará State. Black line represents the observed data; gray line represents the simulation using the observed rainfall and evapotranspiration; purple and red dashed lines represent projections for a future period using the Mean Long Term (MLT) rainfall and -25% of the MLT Rainfall, respectively. (Elaborated by Cemaden).

From Figure E.7, it is recognized that over the last decade, hydrometeorological extremes have become more frequent and intense in Brazil, with records of significant socioeconomic impacts and losses of human lives in Brazil, leading to the need of strengthening of disaster risk management at local levels. In 2010, the number of people affected by natural disasters in Brazil was about 96 million in contrast to recently period, when approximately 123 million were affected by direct or indirect damages. During the last decade, more than half a million people have been made homeless by landslides and floods mainly. An expressive part of affected people is in the Southeast region, which accounts approximately 66% of the total disasters occurred in the country. In terms of cost, events such as landslide in Rio de Janeiro (e.g. mountain range in 2011) totaled approximately U$ 2 billion with at least 780 million for rebuilding.

Young et al (2019) shows thatthe primary concern of decision makers in Brazil is related to flood and landslide, which is almost equally divided between them. Flood risk is pointed out by 77% of respondents as the most frequently event addressed in planned measures followed by landslides (Figure E.8). Flood tends to be larger in sealed urban areas because with less water storage capacity and more rapid runoff, water level rises quickly during storms with higher peak discharge rates than vegetated areas. In the same way, landslides can be triggered by heavy rain mainly in the mountains where excessive runoff and interruption of tributaries occurs due to barriers such as stones, tree trunks, bridges. This natural disaster affects people living in vulnerable areas and is one of misfortune that kills more people in the country, particularly in Southeast Brazil.

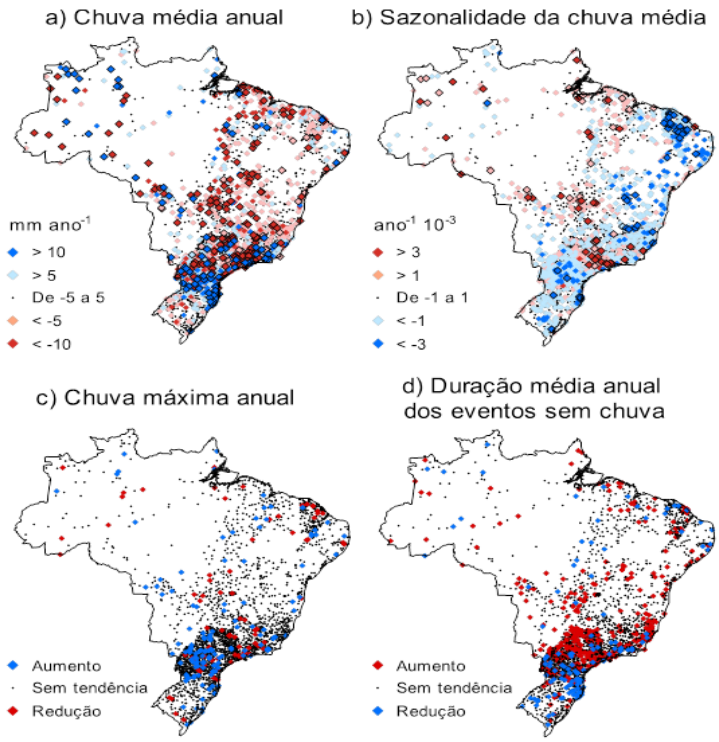


Figure E.7 - Long-term trends of precipitation: (a) Mean annual precipitation, (b) seasonality of mean precipitation, (c) maximum annual precipitation, (d) annual mean duration of dry spells. Diamonds with black contours in (a) and (b) and colored circles in (c) and (d) show trends statistically significant at the 95% confidence level according to Mann-Kendall test. (Chagas 2019)

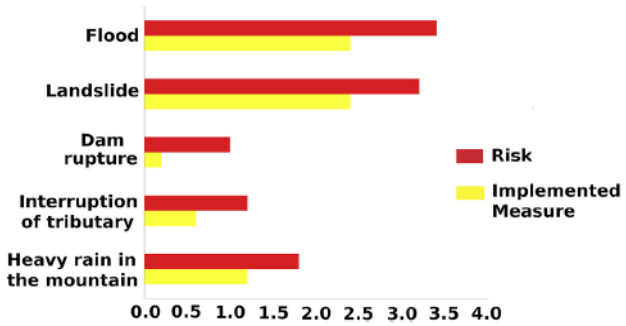


Figure E.8. Risk level and respective measure implementation (Young et al 2019)

Participant institutions are CEMADEN, UNICAMP, UFSC, FIOCRUZ-RJ, ANA, Secretaria de Agricultura familiar e Cooperativismo/MAPA, SUDENE

Key publications:

Cunha AP, V Marchezini, DP Lindoso, D Pereira, S Saito, RCS Alvalá, (2019) The challenges of consolidation of a drought-related disaster risk warning system to Brazil. Sustainability in Debate, 10, 43-76.

Marengo JA, AP Cunha, WR Soares, RR Torres, LM Alves, SSB Brito, AL Cuartas, K Leal, G Ribeiro Neto, RCS Alvalá, AR Magalhães (2019) Increase risk of drought in the semiarid lands of northeast brazil due to regional warming above 4 °c. In: carlos a. nobre: Jose A. Marengo; Wagner R. Soares, (Eds.). Climate Change Risks in Brazil. 1st Ed. Springer International Publishing, 2019, p. 181-200.

Young AF, JA Marengo, JOM Coelho, GB Scofield, CC de Oliveira Silvab, CC Prieto (2019) The role of nature-based solutions in disaster risk reduction: The decision maker's perspectives on urban resilience in São Paulo state, International Journal of Disaster Risk Reduction, 39, 101219

Chagas, V.B.P. (2019) Mudanças nos regimes de chuva e vazão no Brasil, de 1980 a 2015. 2019. 159p. Dissertação (Mestrado em Engenharia Ambiental) - Programa de Pós-Graduação em Engenharia Ambiental, Universidade Federal de Santa Catarina, 2019.(http://www.labhidro.ufsc.br/Artigos/dissertacao_vinicius.pdf)

E.5. Impacts on Brazilian ecosystems in view of changes in land use and biodiversity.

Deforestation rates have declined substantially across the Brazilian Legal Amazon (BLA) over the period from 2000-2013. However, reductions in fire, aerosol and carbon dioxide have been far less significant than deforestation, even when accounting for inter-annual variability in precipitation. Our observations and analysis support a decoupling between fire and deforestation that has exacerbated forest degradation in the BLA. Basing aerosol and carbon dioxide emissions on deforestation rates, without accounting for forest degradation will bias these important climate and ecosystem-health parameters low, both now and in the future (Figure E.9). Recent increases in deforestation rate since 2014 will enhance such degradation, particularly during drought conditions, increasing emissions of aerosol and greenhouse gases. Given Brazil's committed Nationally Determined Contribution under the Paris Agreement, failure to account for forest degradation fires will paint a false picture of prior progress and potentially have profound implications for both regional and global climate. The main partners are USP, UNB, INPE, UFAM, and Max Planck Institute from Germany.

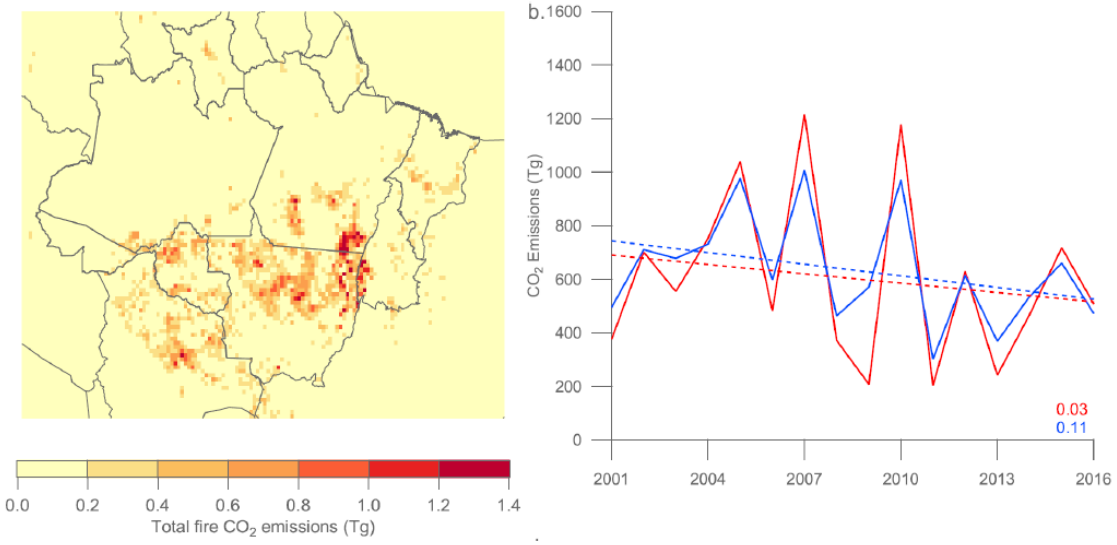


Figure E.9. Carbon dioxide emissions from all fire emission classes from 1997-2017. (a) CO2 emissions averaged over the main biomass burning months (August-October) on a 0.25 degrees pixel grid. (b) Time series and trends in carbon dioxide emissions. (From PRODES deforestation areas jointly with the fire-related carbon dioxide emissions from the Global Fire Emissions Database GFED4). Broken thin blue and red lines represent linear trends in Figure b.

Biomass estimates for the Amazon biome, which comprises almost half of the country (4,196,943 km2), were based primarily on the forest inventory from the RadamBrasil project and IBGE previous vegetation map. RadamBrasil covered nine plant physiognomies, which account for approximately 90% of the Amazon biome. The biomass stock of other 20 plant physiognomies in the biome (not covered by the RadamBrasil inventory) was estimated based on values found in the scientific literature. The figure summarizes the processes 208 used to generate regional biomass estimates in the Amazon biome. RadamBrasil plots had their basal area and biomass calculated. Inverse distance weighting (IDW) interpolation was then performed to generate a continuous surface of basal area for the entire Amazon biome (Figure E.10)

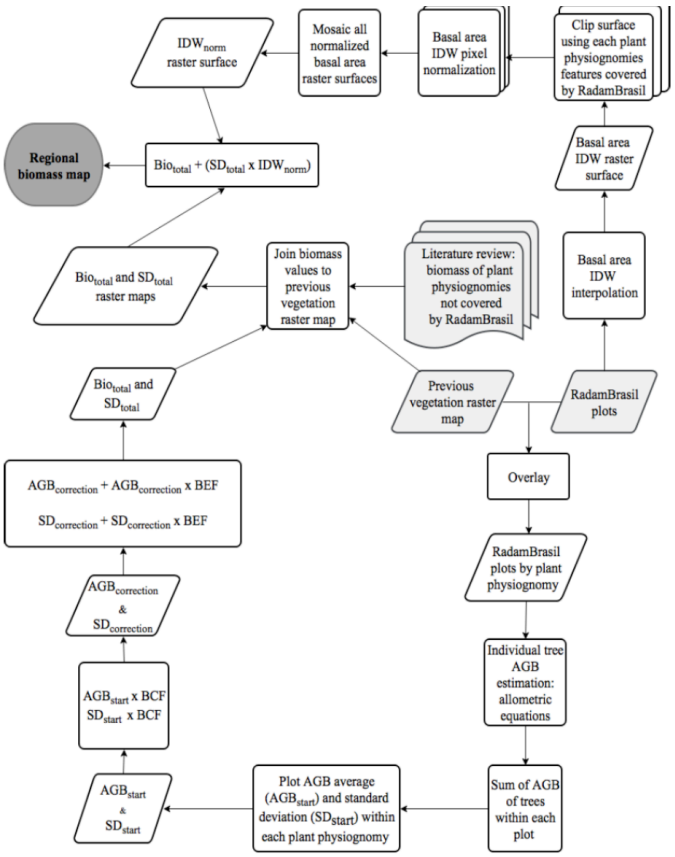


Figure E.10 Processes used to produce regional biomass estimates in the Amazon biome. AGB indicates above ground biomass: BCF, bias correction factor, IDW: inverse distance weighted (Bustamante et al 2018)

Key publications:

Andreae, MO, A Afchine, R Albrecht, BA Holanda, P Artaxo, HM Barbosa, S Borrmann, MA Cecchini, A Costa, M Dollner, D Fütterer, E Järvinen, T Jurkat, T Klimach, T Konemann, C Knote, M Krämer, T Krisna, LAT Machado, S Mertes, A Minikin, C Pöhlker, ML Pöhlker, U Pöschl, D Rosenfeld, D Sauer, H Schlager, M Schnaiter, J Schneider, C Schulz, A Spanu, VB Sperling, C Voigt, A Walser, J Wang, B Weinzierl, M Wendisch, H Ziereis (2018) Aerosol characteristics and particle production in the upper troposphere over the Amazon Basin. Atmospheric Chemistry and Physics, 18, 921–961, 2018.

Bustamante, MMC, JSO Silva, RZ Cantinho, JZ Shimbo, PVC Oliveira, MM Santos, CA Nobre (2018) Engagement of scientific community and transparency in C accounting: the Brazilian case for anthropogenic greenhouse gas emissions from land use, land-use change and forestry. Environmental Research Letters, 13(5), 055005.

E.6. Health and climate change

For the second year of the INCT MC Phase 2, the part of the project related to the drought and health index, analyzed the main variables related to vulnerability in the semi-arid region. The studied area, treated as a pilot, included 65 municipalities in the states of Pernambuco, Piauí and Bahia. Factor analysis showed that five factors explained 85.99% of the variance. The configuration of the variables in each factor allowed to classify them in the following dimensions: i) social & health infrastructure (factor 1); (ii) demographics and infectious diseases (factor 2); iii) environmental health (factor 3); iv) dengue (factor 4); and v) water availability and health (factor 5). The second factor includes the variables related to the demography and infectious diseases dimension. It is positively related, for instance, to the variable American visceral leishmaniasis (AVL). The construction of the Vulnerability Index of Drought and Health (VIDH) was based on the results obtained in the factorial analysis. The loads obtained in each factor were considered to assemble the regression equations and generate the values of the indices. In Piaúi American Visceral Leishmaniasis is an important public health issue. The above studies are complimentary and point to the process of AVL expansion in Brazil and the roles of climate and social vulnerability in this process.

Figure E.11 shows the area of potential expansion of *Lutzomyia longipalpis*, vector of American Visceral Leishmaniasis (AVL), in southern Brazil, where the climate will be more favorable to its occurrence in the middle of the XXI century, according to both climate change scenarios (RCP 4.5 and RCP 8.5). For the AVL vectors, the state with the largest expansion area was Santa Catarina (25.3% of the territory will gain climatic suitability for the vectors in the future) and with a larger area of contraction in Amazonas (53.3% of the territory will lose climatic suitability for the vectors in the future). The potential distribution areas of the vectors in these current scenarios were overlaid with the potential distribution areas of the respective human diseases, ACL and AVL . For AVL, about 68% of the potential distribution of the disease was overlapped by the potential distribution of *L. longipalpis* with the remaining 32% indicative of gaps in the occurrence of these vectors in the North and South regions. These shortcomings may represent a lack of field studies or insufficient published data. Main partners are FIOCRUZ, UFMG.

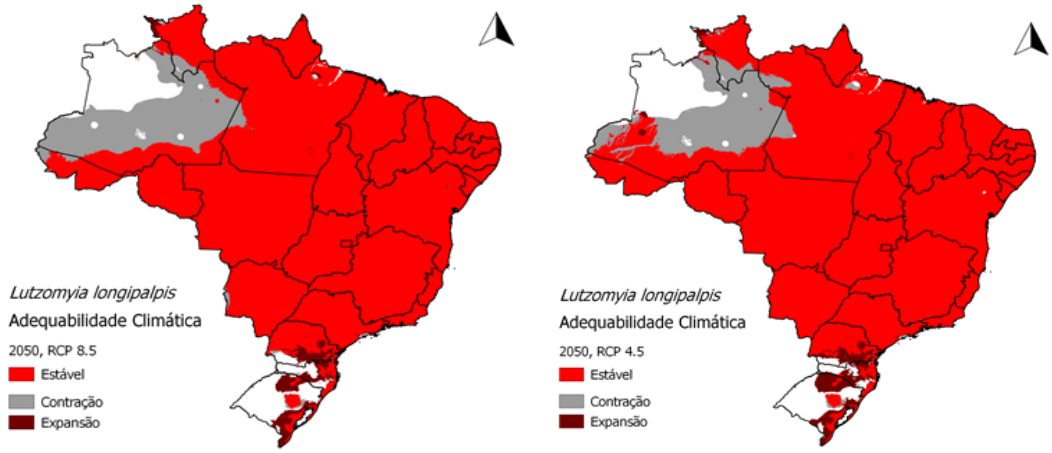


Figure E.10. Climatic suitability for *Lutzomyia longipalpis,* the main vector of American Visceral Leishmaniasis according to the climate change scenarios RCP 4.5 (right) and RCP 8.5 (left). (Bruno M. Carvalho & Elizabeth Rangel, Instituto Oswaldo Cruz, FIOCRUZ)

Key publications:

Falcão de Oliveira E, EAB Galati, AGd Oliveira, EF, Rangel. BMd Carvalho (2018) Ecological niche modelling and predicted geographic distribution of Lutzomyia cruzi, vector of Leishmania infantum in South America. PLoS Negl Trop Dis 12(7): e0006684. https://doi.org/10.1371/ journal.pntd.0006684

E.7 Economy and impacts in key sectors

The most important result achieved by the group of the INCT MC Phase 2 during the second year of the project is related to the developing of a unique database at the municipality level to be used by various modelling initiatives related to some of the on-going projects. It is now possible to develop interregional input-output systems for various regional settings in Brazil to be further used to calibrate CGE models. Such database is to be used in year 3 to calibrate a model for Brazil's semiarid and a model to São Paulo Metropolitan Region. In the former case, a study on the economic impacts of droughts will be developed; in the latter case, the model will be integrated with hydrological models developed by the subcomponent Water Security. The regionalization method has been tested and implemented in different countries (Figure E.12). The work was developed in collaboration with USP, CEMADEN, IPEA, and INPE.

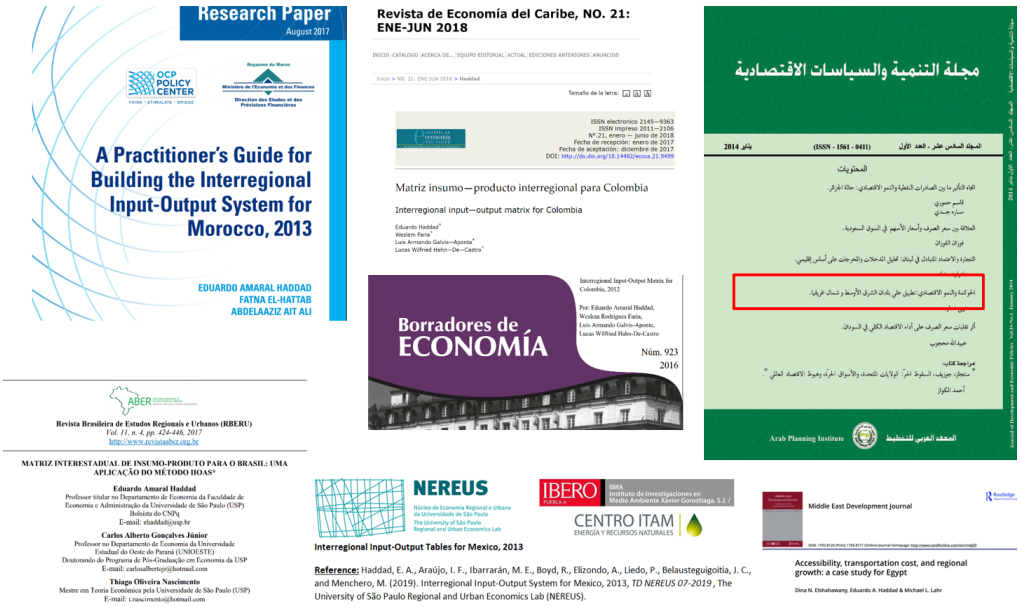


Figure E.12 Applications of the regionalization method for different countries developed by the research team (Brazil, Morocco, Mexico, Colombia, Greece).

Key publications:

Haddad E, N Lozano-Gracia, E Germani, R Vieira, S Nakamura, E Skoufias, B Alves (2019) Mobility in Cities: Distributional Impact Analysis of Transportation Improvement in São Paulo Metropolitan Region Regional, *Transport Policy*, 73, 125-142.

Vale, VA, FS Perobelli, AB Chimeli (2018) International trade, pollution and economic structure: Evidence on CO2 emissions for the North and the South." Economic Systems Research, 30:1, 1-17.

E.8. Modelling the earth system and production of future climate scenarios to study Vulnerability, Impacts and Adaptation

During the second year of activities of INCT-MC2, its modeling component has reached higher levels of both technological and scientific achievements. Technologically, the Modeling Component has reached the version 2.9 of its BESM coupled global climate model (with the use of an upgraded version of the ocean model, MOM5 coupled to the newest version of CPTEC global atmospheric model, BAM1.0). Scientifically, 1,000+ years long run of the BESM model under the assumption of a warmer climate revealed the reduction, and eventual reestablishment of the Atlantic Meridional Overturning Circulation (AMOC). Looking into the future, the new version of BESM2.9 is being used to compute the Brazilian scenarios for CMIP6, whose preliminary results were presented at CMIP6 Model Diagnosis Workshop in Barcelona, Spain in March 2019 (Nobre et al. 2019). The climate change scenarios computed by the Modeling Component of INCT-MC2 are being utilized by several research groups in Brazil within INCT-MC2, as well as among other INCTs.

The Regional Earth System Model (RESM), based on the Eta Regional Climate Model, is being developed in parallel with the BESM. The Eta has the restart functionality of the model revised in order to operate with the FMS coupler as used by BESM. Other physics processes, such as radiation, land-surface, and dynamic vegetation, have been coupled and updated in the Eta RCM (Figure E.13). The modifications follow the new coding structure of the model.

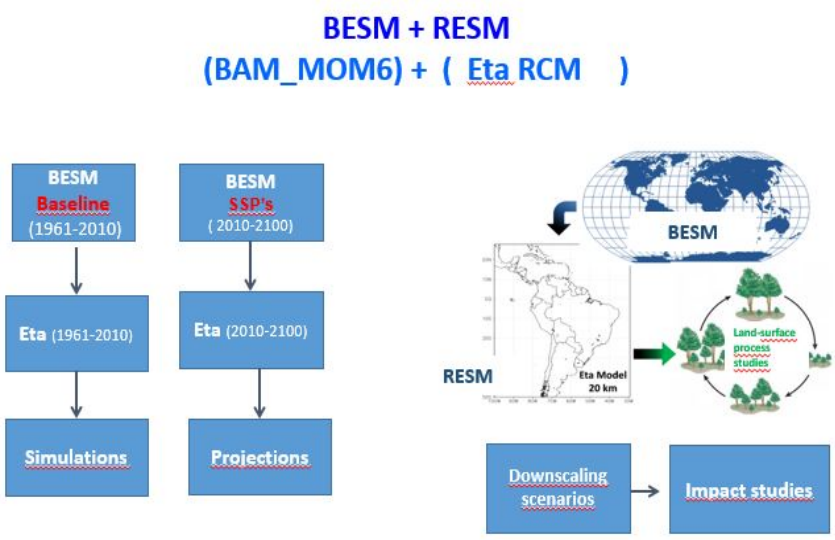


Figure E.13 Model strategy for the BESM and RESM runs for this component for future clomate change projections.

Key publications

Veiga SF, P Nobre, E Giarolla, V Capistrano, M Baptista Jr, AL. Marquez, SN Figueroa, JP Bonatti, P Kubota, CA Nobre (2019)The Brazilian Earth System Model ocean–atmosphere (BESM-OA) version 2.5: evaluation of its CMIP5 historical simulation, Geosci. Model Dev., 12, 1613–1642.

Nobre P, EB Pereira, FF Lacerda, M Bursztyn, E Haddad, D Ley (2019) lar Smart Grid as a Path to Economic Inclusion and Adaptation to Climate Change in the Brazilian Semiarid Northeast, International Journal of Climate Change Strategies and Management, in press.

E.9. Communication, dissemination of knowledge and education for sustainability.

The work developed by cross cutting theme Communication, knowledge diffusion and education for sustainability of the INCT MC Phase 2, in Year 2 involved analysis of the narrative, discursive and sensorial operations of many materials for the communication of climate change aiming the evaluation of the effectiveness of communication and education politics. The studies indicate that there is a predominance in bets that seek to persuade and to convince the public. These bets can result in a simplification of a supposedly didactic nature that makes difficult an effective dialogue on the relation between human activities and the future of the planet. Among other activities in Year 2, it is shown in the analysed materials to convince and persuade the public often falls to words, images and sounds marked by denunciations and judgments, abstractions and generalizations in which the human being is separated, above and outside nature, he is placed as a villain or savior. This anthropocentric perspective, that predominates in the communication of science, is based on the same ontological and epistemological assumptions that have generated the climate crisis. The work was developed by UNICAMP in collaboration with USP, Unesp, Unifesp, UEFS, IF Baiano, UFRN, UFC, UFRJ, UFSC.

Instead of convincing the public we have looked for possibilities of co-creation with the public of images, words and sounds that generate new sensibilities and escape of the environmental catastrophic and anthropocentric perspectives of the mass media. It is one of the aims of the Transversal Theme of Communication. Figure E.14 shows an image resulting from workshop with embroiderers.

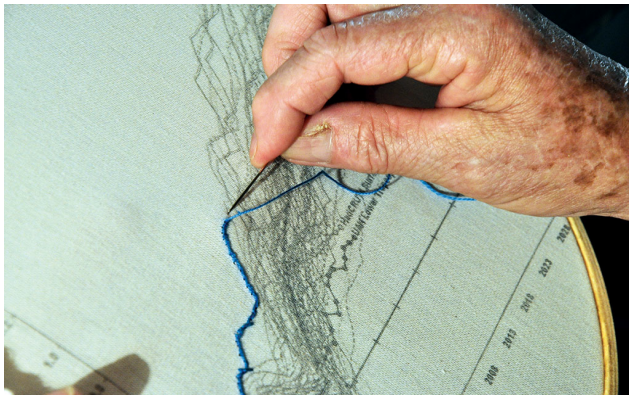


Figure E.14. Perception of global warming by embroiderers

Key publications

Dias S, C Rodrigues, F Pestana (2019) Entre limites abre-se um mar: fazer escuta para novos possíveis na política de comunicação das mudanças climáticas. In: Kanashiro, M.; Manica, D. (Org.). Ciências, culturas e tecnologias: divulgações plurais. Rio de Janeiro: Bonecker, 2019.

Dias S, S Wiedemann, S, C Amorim, A. C. (Org.) Conexões Deleuze e Cosmopolíticas e Ecologias Radicais e Nova Terra e… Campinas: ALB, ClimaCom, 2019.

Summary of activities and scientific production of participants of the INCT MC Phase 2 project (researchers, students, post doctors, and other collaborators) during Year 2 of the project

Events organized by the INCT MC Phase 2 and its components with interaction among sub components of the project in Year 2	42
Public hearings (Brazilian Federal Congress-Camara e Senado)	3
Participation in scientific events relevant to the INCT MC Phase 2 with accepted abstracts or presentations	139
List of publications and technical reports	168
Fellowships (bolsas) granted by FAPESP and other funding agencies in Year 2 (including students) relevant to the INCT MC Phase 2	18
Students working with the components of the project	24
Other activities (Interviews, press releases)	14
FAPESP Projects associated to the INCT MC Phase 2	8
Coordination meetings (Steering Committee, coodinators) from the INCT MC Phase 2 and with other INCTs	6

INCT Climate Change Phase 2
(INCT MC Phase 2)

1. Overview

The INCT for Climate Change Phase 2 (INCT MC Phase 2) aims to implement and develop a comprehensive network of interdisciplinary research on global change and sustainability, and is based on the cooperation between about 30 research groups from all regions of Brazil and 4 international research groups, involving in its entirety over approximately 350 researchers, students and collaborators and establishing itself as one of the largest networks of environmental research developed in Brazil.

The development of the INCT MC Phase 2 scientific agenda will provide optimum conditions for the country to develop scientific excellence in various areas of global environmental change and its implications for sustainable development, especially when you consider that the economy of developing nations is strongly associated with renewable natural resources, as is strikingly the case in Brazil. The emphasis on the impacts of global climate change on agriculture, health, renewable energy, urban development, and natural disasters such as central themes integrated with environmental modelling, the economics and the communication of these impacts to the public, scientific community and academic sector, industry business and government can contribute to maintain excellence in activities in Science & Technology & Innovation as the axis of sustainable environmental development, with an integrative and innovative character.

This project includes knowledge transfer using instruments that go beyond only scientific articles, but producing audio-visual, web tools, and other outlets that allow a scientific education of the population, improving the impact of Brazilian science and also a greater international integration of Brazil in environmental negotiations.

2. Objectives and goals

From the submission of the proposal in 2014, some of the original objectives have changed or new objectives have been added.

- To implement and develop a comprehensive network of interdisciplinary research on global environmental change and sustainability
- To develop actions aimed at assessing adaptation to environmental changes and the transformation to sustainability, to reflect the vulnerabilities and resilience trajectories and propose ways in adapting to these changes, especially in relation to decision in the political sphere.
- To merge science with education from primary to the post-graduate levels.
- To provide an overview of issues related to sustainability and environmental-social-corporate responsibility, in order to facilitate the participation or even the implementation of activities in different areas of management of public and private institutions and their relationships with stakeholders.
- To maintain excellence in activities in Science & Technology & Innovation as the structural axis of sustainable environmental development, with an integrator and innovative character.
- To transfer knowledge using instruments that go beyond only scientific articles, but producing audio-visual material, web tools, and other outlets that allow the development of a scientific culture in society, improving the impact of Brazilian science and enabling increased international insertion of Brazil in environmental negotiations.
- To develop a research agenda in global change to identify and understand the current impacts of climate variability on natural and human systems in Brazil;
- To enhance and expand the scope of studies on global changes and their impacts on important sectors to the economy of Brazil.

- To engage and educate society, aiming to increase the resilience of these sectors.
- To sensitize the public perception of science and technology in relation to global change and impacts on society.
- To contribute prominently in the research and development of the National Plan on Climate Change and the National Adaptation Plan to Combat Drought and Desertification, in partnership with federal, state and international research programs on global change
- To produce publications and model data that can be used to provide scientific contributions for the IPCC AR6, special reports of the Brazilian Panel of Climate Change and the Fourth National communication of Brazil to UNFCCC.

3 Coordination

Coordinator: Jose A. Marengo, Researcher, Level 1 A-CNPq, CEMADEN, and Sao Paulo
Vice-Coordinator: Tercio Ambrizzi, Researcher, Level 1 A-CNPq, IAG USP, Sao Paulo

-Steering Committee

Name	Field of work	Institution	e-mail
Jose Antonio Marengo Orsini	Project's coordinator. Climate modelling, impacts and vulnerability assessments	CEMADEN	jose.marengo@cemaden.gov.br
Tercio Ambrizzi	Vice-coordinator, Climatology, climate studies, water security	IAG USP	ambrizzi@model.iag.usp.br
Paulo Nobre	Oceanic and coupled atmosphere-ocean modelling	CPTEC INPE	pnobre@cptec.inpe.br
Roberto Schaeffer	Energy and climate change	COPPE UFRJ	roberto@ppe.ufrj.br
Paulo Eduardo Artaxo Neto	Environmental physics, Amazonia, and climate change	IF USP	artaxo@if.usp.br
Eduardo Mario Mendiondo	Hydrology and water security	USP EESC	emm@sc.usp.br,
Ulisses E C Confalonieri	Health and climate change	CEDEPLAR UFMG e FIOCRUZ	uconfalonieri@gmail.com
Eduardo Haddad	Economy of climate change	FEA USP	ehaddad@usp.br

All members of the Steering Committee (CG) are also coordinators of the Associated Laboratories. The Federal University of the Sate of Santa Catarina (UFSC) and the State University of Campinas (UNICAMP) are also Associated Laboratories. Associated Laboratories are those centers whose members are part of the CG but are not part of the group that is submitting the proposal. The progress of the Project will be monitored by a Scientific Committee (CC), that is constituted by the coordinators of the sub components (themes) and from the cross cutting activities.

-Coordinators of each component of the INCT MC Phase 2

Duties	Coordinators (institution, state)	Activities to be developed in the Project
Coordinator	J. Marengo (CEMADEN, SP)	Coordination of the project, climate modelling, impacts and vulnerability assessments, extremes, adaptation, leader of the CG e CC.
Vice-coordinator	T.Ambrizzi (IAG USP, SP)	Vice-coordinator of the project, climatology, climate studies, water security, member of the CC and CG.

Subcomponents or cross cutting themes	Coordinators (institution, state)	Activities to be developed in the Project
Water Security*	E.Mendiondo (EESC USP, SP)	Hydrology, water security, risk assessments, subcomponent coordinator, member of the CG
	S. Montenegro (UFPE, PE)	Hydrological modelling in urban and rural areas, in the Brazilian semiarid, coordinator of sub component,
Food Security*	E. D. Assad (EMBRAPA, SP)	Food security, agriculture modelling, coordinator of sub component
Energy Security*	R. Schaeffer (UFRJ, RJ)	Energy and climate change, coordinator of sub component and member of the CG
	E. B. Pereira (CCST INPE, SP)	Renewable energies, energy and climate change. Wind energy and solar potential scenarios, coordinator of sub component
	A. Szklo (UFRJ, RJ)	Energy and climate change, coordinator of sub component =
Human health	U. Confalonieri (UFMG-FIOCRUZ, MG)	Health and climate change, vulnerability and climate-health, coordinator of sub component, member of the CG.
	E. Rangel (UFMG-FIOCRUZ, MG)	Health and social communication, education, coordinator of sub component
Economy and impacts on key sectors *	E. Haddad (FEA USP,SP),	Economics of climate change, coordinator of cross cutting theme, member of the CG e
	S. Margulis (IPEA, DF)	Economics of climate change, coordinator of cross cutting theme,
	J. Feres (IPEA, DF),	Economics of climate change, coordinator of cross cutting theme,
Communication, knowledge diffusion and education for sustainability *	A. Amorim (UNICAMP, SP)	Linguistics, scientific communication, coordinator of cross cutting theme,
	S. Dias (UNICAMP, SP)	Education – knowledge and art, coordinator of cross cutting theme,
Modelling the Earth System, generation of future climate change scenarios for impacts-vulnerability-adaptation studies*	P. Nobre (CPTEC INPE, SP)	Oceanic and coupled ocean-atmosphere model development, BESM-Brazilian Earth System Model, coordinator of cross cutting theme, member of the CG.
	S. Chou (CPTEC INPE, SP),	Regional climate modelling, high resolution future climate change scenarios, coordinator of cross cutting theme
Natural Disasters, urban areas, physical infrastructure and urban development*	R. Alvalá (CEMADEN, SP)	Natural disasters, impacts and risk assessments, coordinator of cross cutting theme,
	R. Rodrigues (UFSC, SC)	Natural disasters, coastal regions, coordinator of cross cutting theme,
	M. Barata (FIOCRUZ, RJ)	Climate change and urban development, resilient cities, coordinator of cross cutting theme
Impacts on Brazilian ecosystems in view of changes in land use and biodiversity*	P. Artaxo (IF USP, SP)	Environmental physics, Amazonia, coordinator of cross cutting theme, member of the CG
	M. Bustamante (UNB, DF)	Greenhouse gases emission inventories, studies on the cerrado area, coordinator of sub component
Water Security*	E.Mendiondo (EESC USP, SP)	Hydrology, water security, risk assessments, subcomponent coordinator, member of the CG
	S. Montenegro (UFPE, PE)	Hydrological modelling in urban and rural areas, in the Brazilian semiarid, coordinator of sub component,
Health and climate change	Ulisses Confalonieri (Centro de Pesquisas René Rachou, FIOCRUZ-MG)	Health and climate change, vulnerability and climate-health, coordinator of sub component, member of the CG.
	Elizabeth Rangel (Instituto Oswaldo Cruz, FIOCRUZ-RJ)	Health and social communication, education, coordinator of sub component

(*) Institutions located in the State of Sao Paulo

4. Organizational structure

Considering the objectives of the INCT MC Phase 2, the project is organized in six thematic lines (or subcomponents):

1 Food security;
2 Water security;
3 Energy security;
4 Health and climate change;
5 Natural disasters, impacts on physical infrastructure in urban areas and urban development;
6 Impacts on Brazilian ecosystems in view of changes in land use and biodiversity.

All these components are connected via 3 integrative or crosscutting themes:

7 Economy and impacts in key sectors;
8 Modelling the earth system and production of future climate scenarios to study Vulnerability, Impacts and Adaptation-
9 Communication, dissemination of knowledge and education for sustainability.

The coordinator's work is aimed at building mechanisms and interaction considering the scientific basis of the different components and crosscutting themes and scenarios and models to support the development of strategies and trajectories for adaptation, resilience and global environmental change and pathways to sustainability in Brazil. For such integration, specific activities with the coordinators of each component and each cross-theme workshops and scenarios, along with the political spheres (when appropriate) will be the responsibility of such coordination, and will be directed to the construction in a participatory manner among different stakeholders (scientific community, decision makers) in order to promote adaptation, resilience and sustainability under environmental changes.

The purpose of the integrative themes is to work with `the different components, cross-cutting themes, and models and scenarios, aims to generating scientific information on the impacts of global environmental change on key sectors for integrated manner throughout the project (1) provide adaptive stock options; (2) pinpoint areas in sectors where policy decisions need to consider `climate change more urgently; (3) propose trajectories of adaptation in different sectors and focusing on building resilience to optimize or (4) point or map priorities for adaptive actions, helping the country in key sectors, for more resilient and adapted trajectories of climate change in order to promote sustainability on a national scale. So far, in 2018-2019 the Communications component has been interacting with some other groups of the project to establish strategies of dissemination of the products and results of each component.

It is expected that the coordination and integration activity would include a series of workshops from each component and two conferences, followed by interviews and process assessments and analyses of the partial results of each component, and consecutively thereafter to be assessed and worked together between members of the INCT MC Phase 2, and some guests from government, the decision makers in such specific workshops. The results of each workshop will provide important subsidies in the political sphere by helping in the development of appropriate adaptation measures that fit the reality and particularities of different regions of the country.

The legacy of the INCT MC Phase 2 will be on the same line as its predecessor INCT MC Phase 1: Contributions to the IPCC AR1.5 and IPCC AR6, the special reports of the Brazilian Panel on Climate Change on coastal cities and biodiversity, the special report of adaptation to climate change in Ibero-American countries by the RIOCC and the impacts and vulnerabilities studies for the Fourth National Communication of Brazil to the UNFCCC.

The INCT MC Phase 2 is closely linked with other research networks in federal and state

climate change. Firstly, is directly associated with the Rede Clima (redeclima.ccst.inpe.br), a program of MCTIC, and its structure will cover the scientific and technological aspects of interest this Network. It is also associated with several research projects in climate change, in particular the FAPESP Research Program on Global Climate Change (PFPMCG), the research networks in São Paulo INCLINE (Center for Research Support in Climate Change) and CEPED (Centre Studies and Research on Disaster) coordinated by the USP. CEMADEN has allocated a secretary in support of the managing activities of the INCT MC Phase 2.

The development of the proposed research agenda provides optimal conditions for scientific excellence in various areas of global environmental changes presented in Figure 1 and its implications for the sustainable development of Brazil, especially when one considers that the growth in developing nations is closely related to exhaustible natural resources.

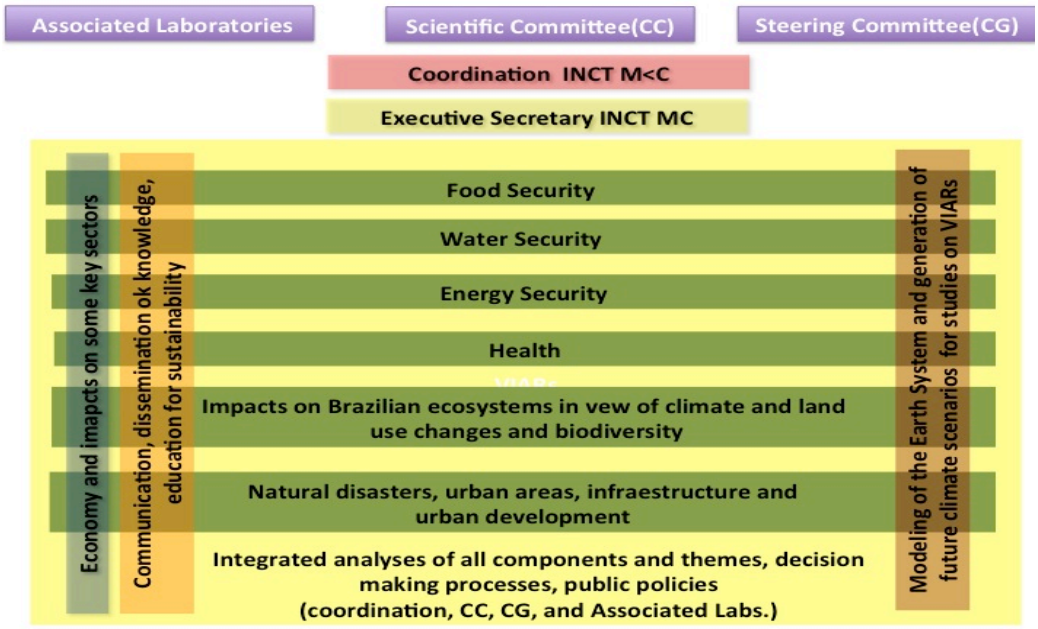


Figure 1. Structure of the new INCT MC Phase 2

Figure 2 displays the national and international scope of the project and shows that there are several groups of consolidated and unconsolidated research that will benefit by participating in this research network. Figure 2 shows that this project plans INCTs closely with other networks and national and international research related to issues of global change and sustainability, and expects to generate scientific products that can help in large studies such as IPCC and PBMC and can also help in international environmental negotiations.

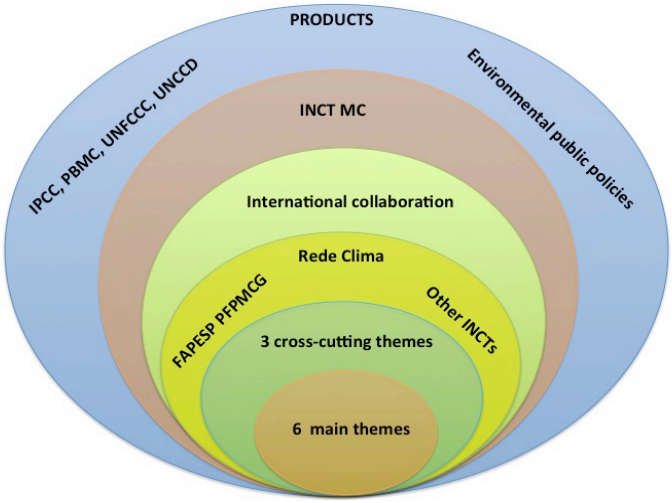


Figure 2. Scope of the INCT MC Phase 2 at the national and international level

In Year 2 of the project, scientific interactions and integration of results will be obtained primarily by conducting scientific meetings of various kinds, either totally or partially dedicated to the project. The Scientific Committee and the Steering Committee (CG) shall meet at least once a year (in person), and can meet via Skype or webinar as many times as necessary. We met once in November 2018 at the FEA USP. In June 2018 we presented the INCT-MC Phase 2 at the Brazilian Congress-*Camara dos Deputados and Senado,* together with other initiatives on climate change.

5. Reports by component

In the following we focus on the reports from each sub component and crosscutting component, showing main results and activities developed in Year 2 of the project. We also include information on new team members coming into the project, explain some changes in the coordination of the components if that is the case and plans for Year 2. All information on scientific production and activities from each of the components (workshops, publications, participation in events, use of the BC and RT, fellowships [*bolsas*]) are listed in upcoming sections. The report is from activities developed by all components of the project.

5.1 Food security

The climatologic data were raised, organized and standardized for all Brazilian territory. The variables are: reference evapotranspiration, (ETo), precipitation (mm), minimum temperature (°C), maximum temperature (°C), solar radiation (kWh/day/m²), relative humidity (%), wind speed (m/s) from 01/01/1980 to 31/12/2015 (XAVIER, 2016). Other climatologic that contains future precipitation (mm), minimum temperature (°C), maximum temperature (°C) was obtained from HADGEM2-ES model from 1970 to 2100.

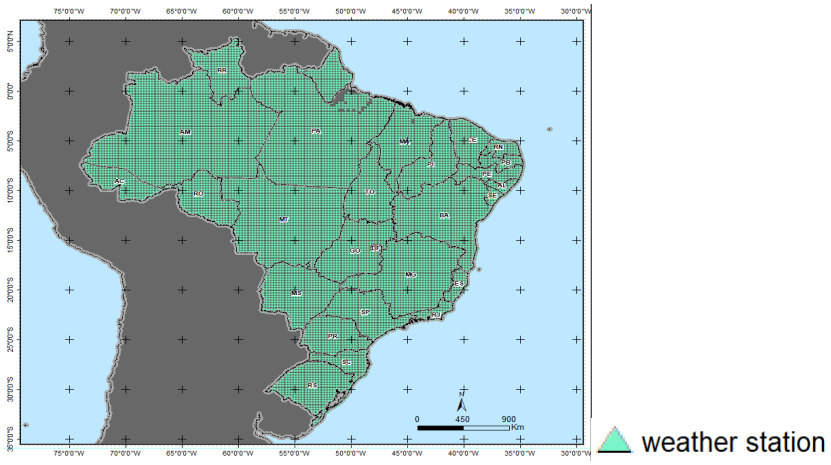


Figure 3: Geo-referenced stations Hadgen and Xavier.

Both databases, Xavier and HADGEM2-ES, were compared with measured climatology data through the Kolgomorov-Smirnov (K-S) method that testified the degree of agreement between measured data and observed data.

Supported by K-S method, the water balance for each weather station was made for the periods: 1986-2015, 2006-2015, 2021-2030 e 2030-2040. The spatialization to evaluation of water deficiency for all Brazilian territory along the years was made through the ordinary krigging tool within Geographic Information System (GIS).

In the first year of project, the land use bases (FBDS, 2015; Mapbiomas, 2015) were organized and resampled to the same spatial resolution to obtain accuracy through the kappa index. The layers of agriculture and pasture for Mata Atlântica and Cerrado biome were generated of intersection of anthropic areas (FBDS, 2015) and pasture areas (LAPIG, 2015). Polygons of that result and larger than 10ha were defined as pasture. The agricultural layer is others polygons in anthropic areas (FBDS, 2015) just in counties that exists any agricultural production indicated in IBGE.

The database: climatology and agricultural and pasture areas will be used for analyse the impact of climate change on the productivity of Brazil's main crops as well as on livestock production.

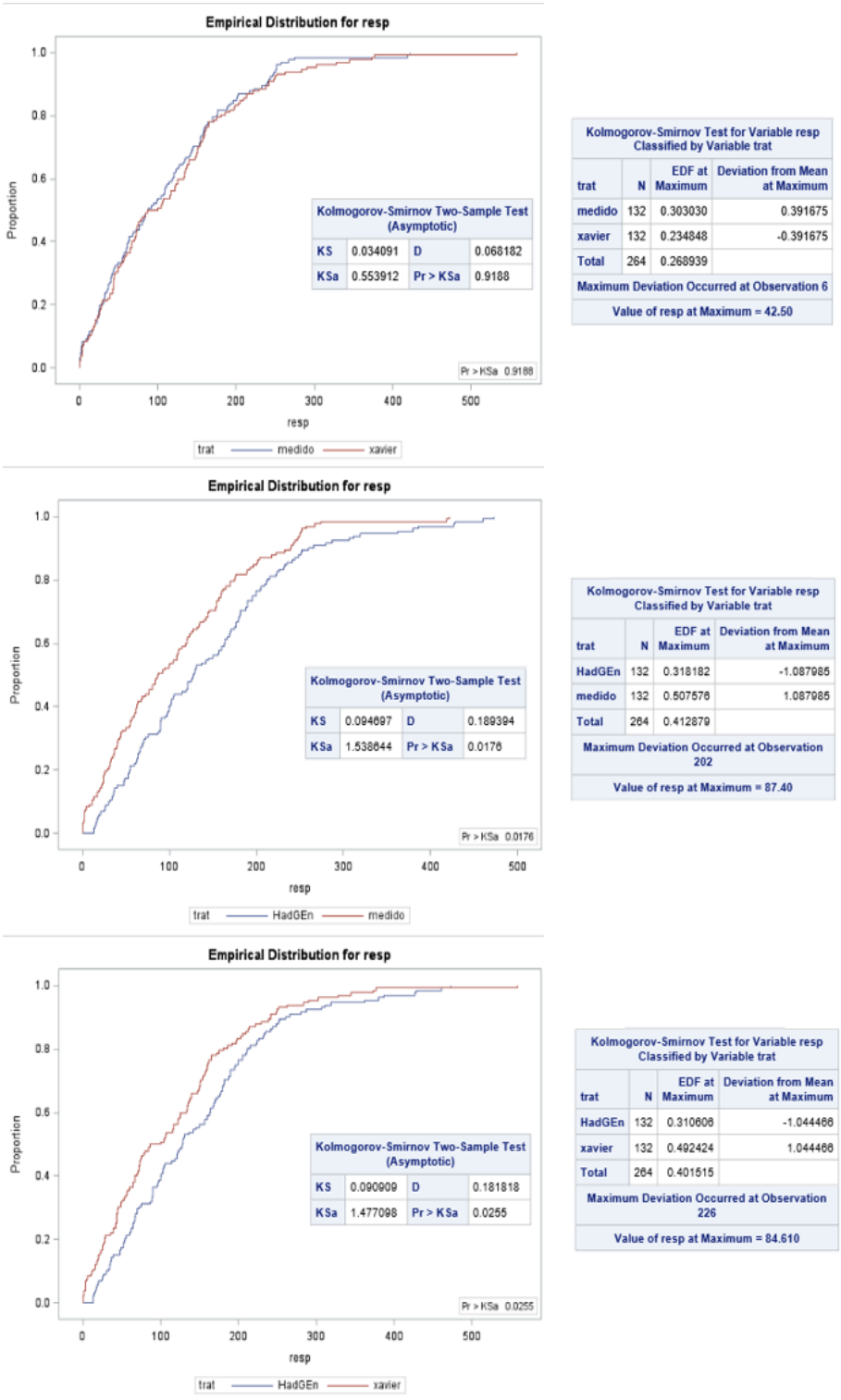


Figure 4: K-S concordance test within SAS System

The most important results obtained in the INCT MC Phase 2 sub-component agriculture, in 2019, was to finalize the organization of spatial data, relating to land use, and simulate the water balance for all Brazil, in a regular grid of 25 km, for the years 1986-2005, 2005-2015, 2020-2030 and 2030-2040, using the HADGEM2-ES model.

In the case of the mapping of land use, the class of interest is anthropism, which two sub-class, agriculture and pasture, which are already separated. Thus, to verify if there will be a reduction of food supply by 2040, the estimate will be made in the polygons that involve the class anthropism. In the result of the water balance, the maps of the water deficit already indicate which areas will be most affected by the increase in temperature and reduction of rainfall. In

general, 85% of crop productivity depends directly on the greater or lesser water deficiency in the soil.

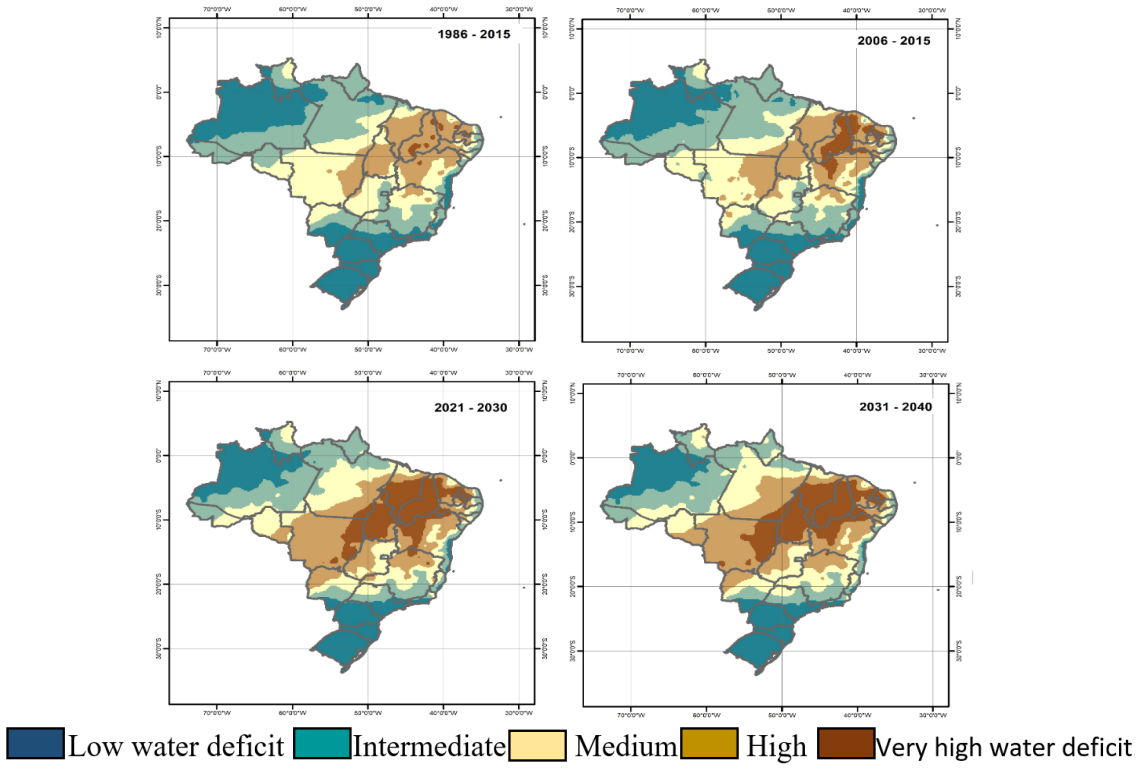


Figure 5: Maps of water deficiency for the periods 1986-2015, 2006-2015, 2021-2030 and 2030-2040

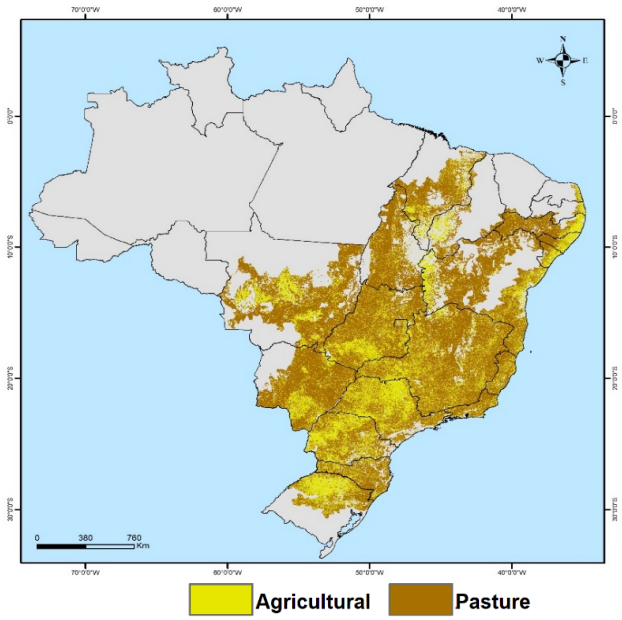


Figure 6: Agricultural and pasture areas along Brazil

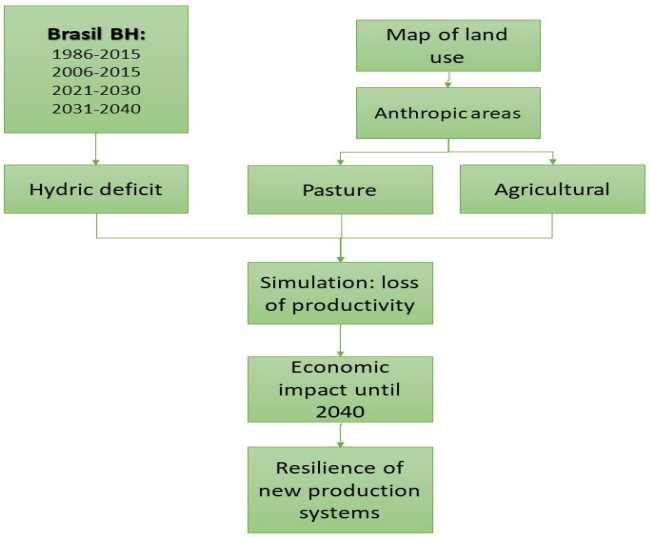


Figure 7. Flowchart of the next steps of the food security project

5.2 Water security

The objective of the subcomponent remains the same:

"*To analyse indicators of water security in major Brazilian basins associated with climate change to propose adaptation strategies that promote resilience and sustainability of user sectors of water resources.”*

In this second year, we have focused on the development of diverse strategies, ranging from experimental and modelling to governance, also to produce quantitative outputs associated with the impacts of climate change (CC) and land use and cover change (LULC). Thus, in this second year we continued to outline the areas recommended and with more attention in year 1 (see Report of Year 1): (i) introducing more feasible framework of dialogue through Socio-Hydrological Observatory for Water Security-SHOWS; (ii) performing regional modelling and uncertainty of predictions; (iii) initial tests of SHOWS through understanding risk perception and enigma of peoples’ memory using socio-hydrology under climate change, (iv) kick-off an international School of Advanced Studies on Water & Society under Change (SASW&SC), chaired by a network of INCT MC Phase 2 water security’s institutions, and (v) outreach of cutting-edge solutions of water security under climate change with local action plans on the nexus “water-energy-food-biodiversity-health”.

We have also started the development of specific projects within the INCT MC Phase 2, complementing the funding received. In this context, the following projects funded by FAPESP and CAPES should be mentioned: (i) Assessing the key-factors to water-energy-food recycling through bio retention practices in different scales and climates (PhD Scholarship Abroad, 2019/05129-8); (ii) New method of valuation of hydrological services using water supply and demand duration curves under climate change (Science-in-Undergraduate; 2018/22195-1); (iii) Sizing, economic analysis and dynamic-modular design of bio retentions from the perspective of climate change and land use (M. Sci., 2018/20865-0); (iv) UK-Brazil collaboration for investigating the nexus between water, health and urban resilience (SPRINT, 2018/08413-6); (v) Understanding risk perception and enigma of peoples' memory through social-hydrology (UK Acad; 2018/03473-0); (vi) LULC and potential impacts in the current and future water security in Piracicaba, Capivari & Jundiaí river basins (Tech. Training; 17/24444-6); (vii) A new generation of Sustainable Urban Drainage Systems (SUDS): decentralized and recycling alternatives for the security of water-energy-food nexus (Regular Project; 2017/21940-2); (viii) School of Advanced Studies of Water and Society Under Change - SASW&SC, (EAE-CAPES 88887.198360/2018-00).

In the period 2018/2019, we have organized regional and international workshops and schools related to water security (with focus on Sustainable Development Goals-SDGs, detailed in Appendix 1, Item a.1 Open Communications to the Wide Audience) and hosting Municipality Water Security Boards (detailed in Appendix 1, Item a.2 “Science-and-Policy Boards”).

-Main achievements

Therefore, relevant achievements were related to INCTMC’s water security outreach and dialogue with decision-makers and stakeholders around water security at several spatiotemporal scales, from continental river basins downscaled to municipality and micro-scales, all relevant for the Brazilian National Plan on Water Security (PNSH, 2019-2035).

Advances in water security at continental and regional scales

For science, one important result, at regional and continental scales, was a new South American runoff modelling (Siqueira et al, 2018; Fig.8) with a fully shared database, thereby validating modelling in nested scales and demonstrative pilot projects for all INCTMC2’s water security groups. Siqueira et al (2018) extended a regional, fully coupled hydrologic–hydrodynamic model (MGB; Modelo hidrológico de Grandes Bacias) to the continental domain of South America and assessed its performance using daily river discharge, water levels from independent sources (in situ, satellite altimetry), estimates of terrestrial water storage (TWS) and evapo-transpiration (ET) from remote sensing and other avail- able global datasets. In addition, river discharge was compared with outputs from global models acquired through the eartH2Observe project (HTESSEL/CaMa-Flood, LISFLOOD and WaterGAP3), providing the first cross-scale assessment (regional/continental × global models) that makes use of spatially distributed, daily discharge data. A satisfactory representation of discharge and water levels was obtained (Nash–Sutcliffe efficiency, NSE > 0.6 in 55 % of the cases) and the continental model was able to capture patterns of seasonality and magnitude of TWS and ET, especially over the largest basins of South America.

-Advances in water security at local scales

At micro-scales, Low Impact Development (LID) and Sustainable Urban Drainage Systems (SUDS) practices are decentralized alternatives for flood mitigation and prevention. Recently, LID/SUDS potential has increasingly been studied in terms of stormwater harvesting and Soil Carbon Enrichment (SCE), as a special method of Carbon Dioxide Removal (CDR). However, there is still a lack of knowledge about potentialities of LID/SUDS in SCE/CDR rates, especially in subtropical climate regions. Macedo et al (2019), using a LID/SUDS bioretention experiment under natural rainfalls, compared input/output rates of several pollutants, i.e. COD, PO4, NO3, NO2, NH3, Fe, Zn and Total Organic Carbon (TOC; Fig. 9). They found LID/SUDS bio retention presents a good runoff reduction capacity (mean efficiency of 70%), with TOC-driven SCE rates ranging between 23% to 78%.

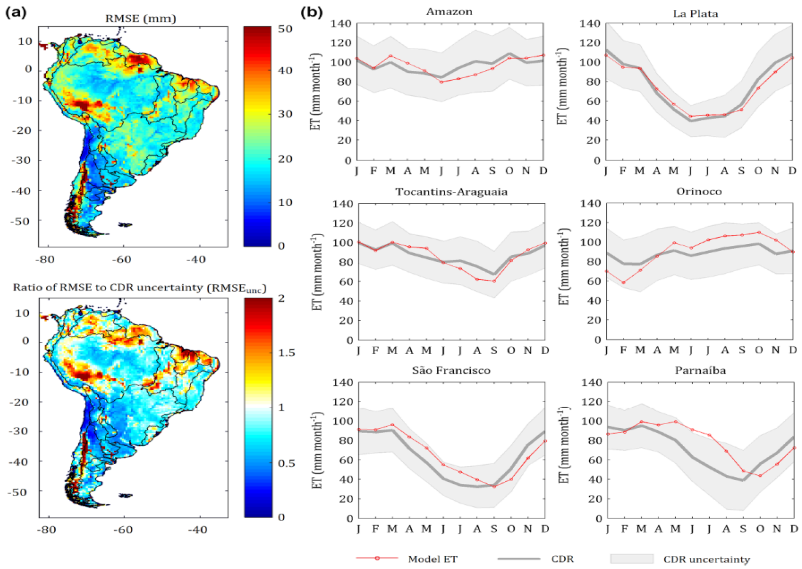


Figure 8. Comparison between MGB and CDR ET estimates in terms of RMSE (a) and seasonality for major South American basins (b). The light grey area represents the proxy of the CDR uncertainty, i.e., the mean deviation of all datasets (within CDR) from the ensemble mean (Zhang et al., 2018). Source: Siqueira et al (2018)

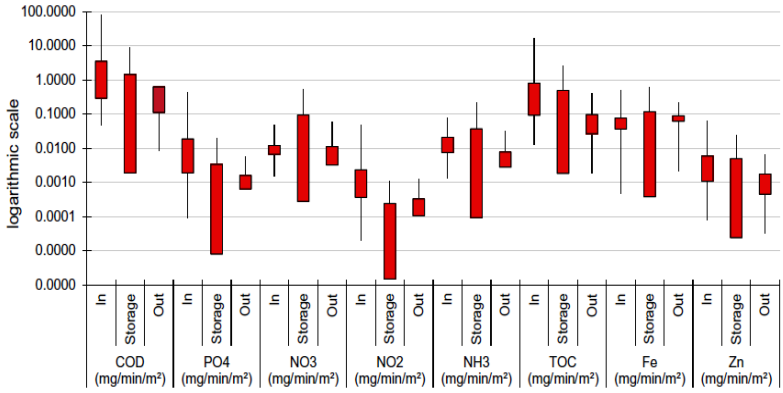


Figure 9. Estimates of soil carbon enrichment through TOC removal and other water pollutants using a LID/SUDS bio retention experiment under subtropical climate (Macedo et al, 2019).

- Calibration and validation, spatially-distributed, of hydrological processes, under non-stationarity for several scales, land uses, and biomes.

The main results lie into modelling efforts of hydrological processes under two extreme conditions: flooding and droughts. Both of these lines of investigation had the vision of producing appropriate modelling approaches to be coupled with climate projections in medium- and long-term. The analysis of the models behaviour and performance in these conditions was also given particular attention, so that to minimize the associated uncertainties when simulating the hydrological extremes under future climate scenarios.

Relevant new insights and modelling improvements have been produced in the theme of flood extreme events (Falck et al., 2018, Tomasella et al., 2018a, Fleischmann et al., 2019abc, Fassoni-Andrade et al., 2018, Lopes et al., 2018, Siqueira et al., 2018, Zhang et al., 2018). Also, rainfall intensity-duration-frequency curves, very relevant to the design of hydraulic structures to cope with extreme flood events were also addressed, as well as hyetograph patterns under distinct climate conditions, to be able to assimilate projections of future climate (Barbosa et al., 2018, Rabelo et al., 2018, Lago et al., 2019). In a thread more related to drought characterization and forecasting, new results were produced on drivers and forecasting of the rainy season in the semi-arid Northeast Brazil - NEB (Hounsou-Gbo et al., 2019, Pinheiro et al.,

2018a, Delgado et al., 2018, Pils et al., 2018, Pereira et al., 2018).

-Simulation of calibrated models, coupling with climate models of medium-and long-term, for prospecting indicators of vulnerability and risk of hydrological extremes under future scenarios

Regarding the goal "Prospecting indicators of vulnerability and risk of hydrological extremes", activities of the water security subcomponent have focused on the desertification trends (Tomasella et al., 2018b; Vieira et al., 2018), changes in the spatial-temporal patterns of droughts (Cunha et al., 2018) and water demands estimation (Gondim et al., 2018) in the NEB. Several approaches, such as remote sensing-based index, rain-gauge-based standardized precipitation index (SPI) and Google Earth Engine, were employed in these studies. The results highlight the importance of analysing droughts at the NEB using data with a higher spatial resolution for impact assessment and to guide mitigation actions. A soil quality index (SQI), developed in experimental units in the NEB, for agro ecological and conventional irrigated agricultural was proposed as a useful tool that can be applied in decision making on land use and management. SQI is an indicator aiming at the environmental sustainability of irrigated agricultural systems maintaining the ability of the soil to sustain food production in agricultural systems in the semi-arid region (Santiago et al. 2018). Related study explored the leaching and contamination potential of pesticides and tested a series of indices as indicators of their transportation in the environment (Marques et al., 2019), and the challenges of integrated analysis of water quality and quantity in river basins with limited monitored data (Marques et al., 2019). A high performance, data-centric and user-oriented scientific computing platform was developed and implemented to enable local to regional analysis of hydrological variables related to climate change (Fiore et al., 2019).

-Evaluation of new adaptation strategies for water security for multiple uses under nonstationary conditions using classical indicators and new tools for risk transfer of hydrological extremes.

Strategies for water security were proposed based on conceptual and numerical hydrological models for a number of case studies over the country. A conceptual model of the behaviour of groundwater piezometric levels and electrical conductivities was the basis for designing managed aquifer recharge strategies in the Recife Metropolitan Region (Coelho et al., 2018). Hydrological models, such as the Soil and Water Assessment Tool (SWAT), were instrumental for producing and assessing freshwater quality scenarios for ecosystem-based adaptation (Tafarello et al., 2018; Viana et al., 2018). Also Sarmento-Buarque et al (2019; under review) provided the first sociohydrological model on urban floods, with elements of coupling to climate change scenarios from INCT MC Phase 2.

For policy*,* the Brazil's National Water Security Plan (PNSH; ANA, 2019) was finally released; with achievements and questions previously formulated by INCT MC Phase 2's water security researchers. Related to communication, and according to INCT MC Phase 2 water security goal 5 "*New disciplines of water security in graduate programs, including interdisciplinary seminars and crosscutting training courses for public-and-private sectors*", INCT MC Phase 2's water security groups from UFPE, UFCG and EESC-USP created a network, open to other INCT MC Phase 2's groups, for a new School of Advanced Studies on Water & Society Under Change (SASW&SC/CAPES EAE, 2018). This SASW&SC has accelerated interdisciplinary dialogue, with a series of Lectures, Workshops and Seminars on Socio-Hydrological Observatories for Water Security (SHOWS) for the PNSH 2019-2035, also engaging other INCT MC Phase 2 subcomponents and world-class institutions. Also, this SASW&SC did start policy workshops with business leaders, policymakers, scientists, insurers and investors to discuss and debate how Brazilian and international organisations can understand, manage and mitigate climate-related water risks. (Figure 10)

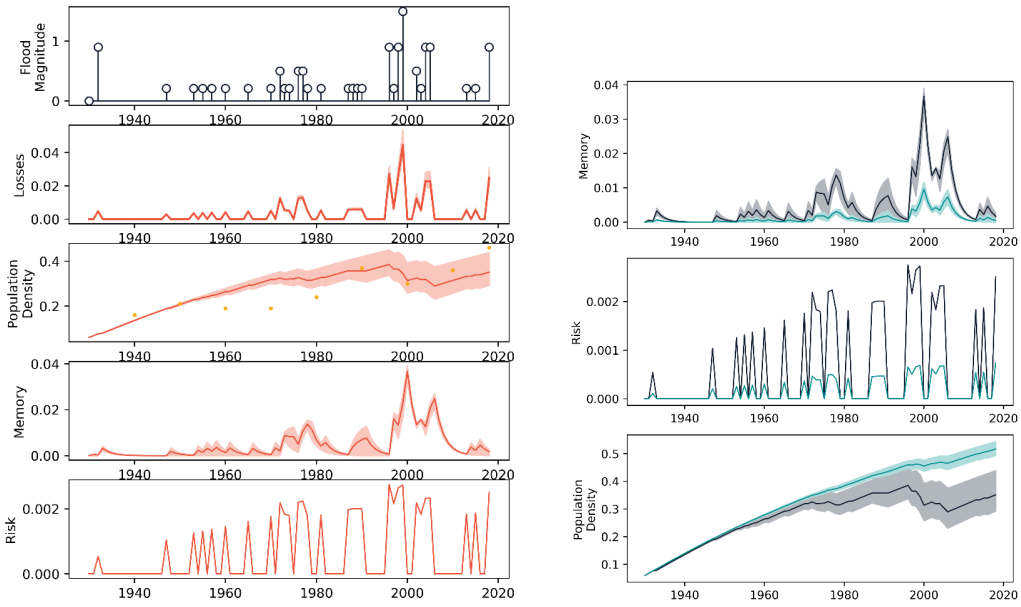


Figure 10. Sociohydrological model outputs on urban flood risk, under validation during the SASW&SC-CAPES-Water Security (Sarmento-Buarque et al, 2019)

- Modeling freshwater quality scenarios with ecosystem-based adaptation in the headwaters of the Cantareira system, Brazil

Climate-sensitive & LULC scenarios (1990, 2010 & 2035) showed not only recovering water yield fluxes but also restoring water quality regimes, if feasible Ecosystem-based Adaptation strategies were applied at headwaters of Cantareira System, contributing with Sao Paulo Metropolitan Region Supply System (Figure 11)

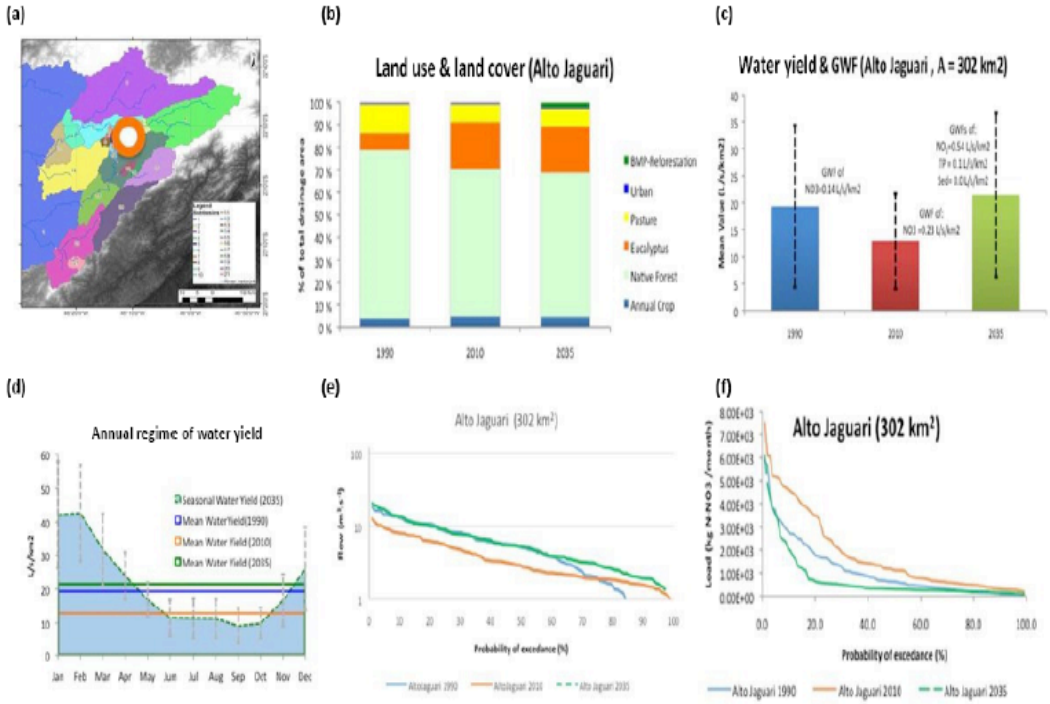


Figure 11. Synthesis chart of case study of the Upper Jaguari sub-basin (drainage areaD 302 km2). (a) Localization at the drainage areas of the Cantareira system; (b) LULC conditions for scenarios S1 (1990), S2 (2010) and S2CEbA (2035); (c) comparison of water yields simulated for conditions of S1, S2 and S2CEbA; (d) water yield scenarios compared with intra-annual regime of S2CEbA scenario; (e) comparison of duration curves of flows for S1, S2 and S2CEbA conditions; (f) duration curves of N-NO3 loads for S1, S2 and S2CEbA.

Although the role of vegetation on streamflow has been widely studied, very few investigations have been reported in Brazil with control nutrient sources, transportation and delivery. Moreover, further field and modelling research is needed when integrating LULC and EbA through hydrologically distributed models. Thus, future research could clarify the influence of vegetation on water quality and the role of anthropogenic and natural drivers in ecohydrologic processes on a catchment scale.

5.3 Energy security

Objective

To assess the extent to which Brazil's socioeconomic development and the associated increase in energy use are compatible with the objectives of a less carbon-intensive and environmentally sustainable economy.

-Integrated Assessment Models

The main results of the energy component since June 2018 have been the continuous development of three different Integrated Assessment Models by the COPPE team: the national Brazil Land-Use and Energy Systems (BLUES) model, the global Computable Framework for Energy and the Environment (COFFEE) model, and the global Total-Economy Assessment (TEA) model. These have been the most important products from COPPE. Assessments performed with the aid of these and other specific models allowed the publication of 10 papers in JCR indexed journals and an outstanding participation with 6 presentation posters in the Eleventh Annual Meeting of the Integrated Assessment Modelling Consortium (IAMC), held in Seville, Spain, in October 2018.

The Brazilian contribution of cumulative amount of CO2e for the period 2010-2050 was obtained through the global model COFFEE (***C****omputational* ***O****ptimization* ***F****ramework* ***F****or* ***E****nergy and the* ***E****nvironment*) (Rochedo, 2016). The Brazilian carbon budget was estimated at 18 GtCO2 (1.5°C) and 24 GtCO2 (2°C). The emission budgets were introduced in the national BLUES model. Thus, three scenarios were simulated:

•Baseline scenario,

•1.5°C scenario

•2°C scenario.

Outputs for the energy sector were analysed and the water use (withdrawal and consumption) was quantified for each scenario (Figure 12)

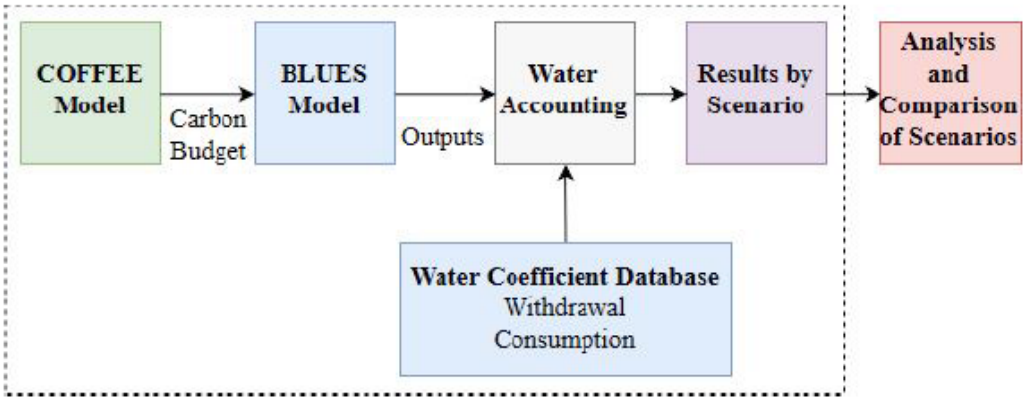


Figure 12. Methodological Procedure

Another achievement was the improvement in the estimation of the solar energy resource in tropical regions from the BRASIL-SR satellite model, using an unprecedented statistical

approach. The study significantly improved the results of the incident solar radiation model for the rainy and dry seasons in Brazil. As for the solar radiation forecast, substantial advances in the implementation of the WRF-Solar model and the vectorization of satellite images were achieved as part of the development of a new integrated solar energy forecasting method in degraded areas (Figure 13).

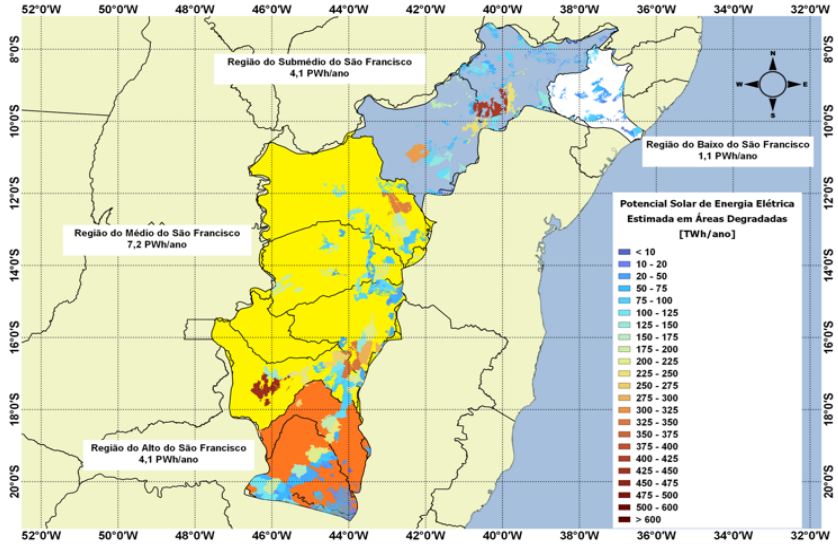


Figure 13. Potential of Solar Electric Energy estimated in degraded areas.

Trends analysis studies were carried out on the frequency of occurrence of extreme wind speed events in the state of Santa Catarina. The objective is to investigate trends in the frequency of extreme winds and their impact on the state's electrical system. One of the achievements of this ongoing study was to understand how combined high-temperature and lull events limit the dispatch of transmission lines. Another achievement was the improvement in the estimation of the solar energy resource in tropical regions from the BRASIL-SR satellite model, using an unprecedented statistical approach. The study significantly improved the results of the incident solar radiation model for the rainy and dry seasons in Brazil and also allowed the generation of scenarios for implementing solar power technology in degraded areas (Figure 14). As for solar radiation prediction, substantial advances in the implementation of the WRF-Solar model and the vectorization of satellite images were achieved as part of the development of a new integrated solar energy forecasting method. Preliminary observational evidence of cloud cover and the effect of lake breezes on Brazilian reservoirs pointed to potential gains in wind and solar energy exploration in a hybrid combination with hydroelectricity. The study of complementarity between solar and wind sources should also be pointed out as an important ongoing study, as shown in Figure 13.

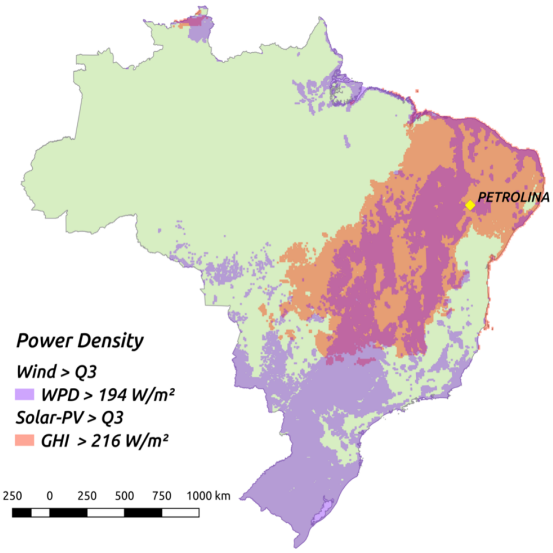


Figure 14. Overlapping regions above Q3 percentile for wind and solar power complementarity in Brazil. (Gonçalves, et al., 2019)

-Impacts of climate change on solar and wind energy resources

The evaluation of the effects of climate change on the solar and wind energy resources requires the assessment of the uncertainties of the numerical models used by the LABREN/INPE and the UNIFESP/IM research teams. This required a thorough survey and data quality control of observed wind and solar radiation data from different bases, such as the SONDA Network, airport data (METAR), INMET and INPE public databases.

Statistical analyses are also being performed using results from climate models and reanalysis data for wind velocities at 10 m above the surface and data from solar radiation incident on the surface to investigate the differences and similarities between them for the current climate scenario on a monthly scale (Baseline Eta-CPTEC and HadRM3P). This study is important to evaluate the ability of climate models to produce estimates with probability distribution similar to those observed in the reanalysis data. After this evaluation, we performed statistical refinements in monthly climate models to eliminate systematic errors and produce more reliable estimates of solar and wind energy. This is necessary because global climate models provide simulations for large-scale phenomena but require refinement to yield greater representativeness to local estimates.

We have applied these methods of bias removal to the climatic projections, quantifying impacts on the average values and variability (frequency distribution) of wind and solar irradiation in future scenarios.

-Thermal comfort and energy performance in urban areas:

Another activity carried out by the LABREN/INPE team within this theme was the assessment of the thermal performance of urban surfaces from a consolidated spectral database. Climatic changes induced by global warming will change energy use patterns in cities. More frequent heat waves should intensify urban heat islands and energy consumption for summer cooling, leading to higher greenhouse gas emissions. This study aims to identify the spatial correlation between spectral characteristics, surface temperature, and built environment to characterize areas that might be considered “hot spots” or “heat sinks” in urban microclimate. To achieve this objective, we created a georeferenced spectral database to estimate and map surface temperature (TS) and spectrally characterize the study area using emissivity (ε), albedo (a), fractionated vegetation cover (FVC) and index (NDWI) as proxies.

-*Modelling applied to renewable solar energy resources:*

The activities are being developed with the objective of improving the BRASIL-SR radiative transfer model for the evaluation and prediction of the solar resource in the Brazilian territory. This task has been carried out by the LABREN / INPE team in collaboration with UNIFESP / IM. The objective is to improve the determination of the effective cloud cover parameter of the model, calculated from the satellite data. The effective cloud cover parameter is obtained from the visible radiations attributed to the clear and overcast sky and the actual radiance detected by the satellite at the time of estimation. However, very high visible radii can be observed frequently in tropical regions, associated to clouds with high vertical development. For these regions, estimating the visible radiance of the satellite associated with cloudy conditions as a function of the maximum radiance can lead to an overestimation of this parameter and, consequently, errors in the evaluation of the surface irradiance, as well as errors in the diffuse irradiance partition. In order to improve the evaluation of the solar energy resource in tropical regions, the value of visible radiation from the satellite to cloudy conditions was adjusted on a regional scale using normal direct irradiation (DNI) observations at 22 SONDA / INPE and INMET stations distributed throughout Brazil.

-*Influence of spectral distribution in Photovoltaic production:*

Studies on the impacts of spectral solar radiation on the performance of photovoltaic modules in Brazil are also part of the activities of this period carried out by the LAC/INPE team in collaboration with the LABREN/INPE. The spectrum of solar radiation changes as the atmospheric components vary over time and with the region. As photovoltaic modules are spectrally selective devices, some spectral regions have better conversion yield than others and therefore the variations presented by the solar spectrum impact on the overall efficiency of the photovoltaic modules.

-*Solar energy and the Nexus water, energy and food: case studies*

Based on the concept of water-energy-food Nexus, the research aims to quantify the results of introducing solar electricity generation, complementary to hydroelectricity, at Sobradinho Dam, in order to analyse its influence on the water use and conservation at Petrolina-Juazeiro region, located at semiarid region of Sao Francisco Basin. Since June 2018, the research activities of the LABREN/INPE team were focused on collecting data on water consumption, production of main cultures in agriculture sector, and electricity generation for the national grid in the area of study. The collected data are being organized in the Water Assessment and Planning System (WEAP) model software to project future scenarios of resources availability in the region. The results from the scenarios modelling, expressed in water, energy and food safety indicators, will support the analysis of integrated resource management strategies.

-*Photovoltaic generation:*

The construction of hydroelectric reservoirs induces extensive changes in the local environment. The replacement of extensive natural forest areas by flooding causes intense thermal gradients between the flooded area and the surrounding territory due to altered albedo, roughness and surface energy balance. This triggers lake breezes which, associated with surface divergence, create subsidence in the flooded area due to the downward component of the induced thermal circulation, which limits upward vertical flows, with potential to reduce, for example, evaporation of the reservoir and cover of clouds. The meteorological information was integrated and analysed by the LABREN/INPE team in collaboration with UNIFESP/IM and UNIFEI to identify and characterize the lake breeze in selected tropical reservoirs and to assess its potential impact on the local atmospheric environment. From a more applied point of view, this activity intends to demonstrate that there may be a gain in energy production for floating photovoltaic panels due to the combined effect of lower cloud cover in the areas of hydrological reservoirs and the effect of increasing efficiency due to cooling to water. Not to mention the mitigating effect of lake evaporation due to the floating panels.

-Solar smart grid and economic inclusion in the Brazilian Northeast:

Another study was aimed to exploit the abundance of solar energy resources for socioeconomic development in the semi-arid North-eastern Brazil as a potent adaptation tool to global climate change. It points out a set of conjuncture factors that allow us to foresee a new paradigm of sustainable development for the region by transforming the sun's radiant energy into electricity through distributed photovoltaic generation.

-Development of climate risk analysis in infrastructures:

Changes in the future climate can have a significant impact on the frequency of extremes than on the average value of an environmental variable itself. This type of event usually brings diverse losses to society, such as breakdowns, damages to roofs, buildings, bridges, tree falls and eventually power transmission towers, which implies economic losses and risks to infrastructure and public safety. Thus, the LABREN/INPE team in conjunction is carrying out trend analysis studies with UNIFESP/IM on the frequency of occurrence of extreme events of wind speeds that may cause impacts, with a specific focus on the state of Santa Catarina. These studies also aim to analyse trends in the frequency of occurrence of combined events of calm weather and high temperatures, which limit the dispatch capacity of the transmission lines. Numerical methods are being used to reliably provide this information on the occurrence of extreme wind speed events, taking as a starting point the climatic projections produced using global and regionalized climate models on Brazil, specifically regionalized by the Eta- 20km (forced by global models HadGEM2-ES, MIROC5 and CanESM), Eta-5km-SC (forced by global models HadGEM2-ES) and HadRM3P-25km (UK Met).

5.4 Natural disasters, impacts on physical infrastructure in urban areas and urban development

This report presents a summary of the activities carried out during the second year of the project, in particular related to the creation of a preliminary database including environmental, physical, socioeconomic and historical data of occurrences of natural disasters for pilots municipalities, which are essential for the development of studies associated to the interface between extreme events, adaptation and risk management of natural disasters. Also, this report integrates the researches/contributions conducted during year 2 by the (i) group from Federal University of Santa Catarina, coordinated by Dr. Regina Rodrigues Rodrigues; (ii) group from Oswaldo Cruz Foundation (Fiocruz), coordinated by Dr. Martha Barata. Additionally, the schedule for the next step is presented, in order to reach the general objective of the sub-component. In this section, the main advances developed during the second year of activities are presented, including interaction with another sub-project, as well as contributions from the three institutions involved: CEMADEN, UFSC, FIOCRUZ.

As an additional activity, a workshop was held on February 02, 2019, with the coordinators of the "Economy and Impacts in key Sectors" sub-project, in order to discuss (i) integration of studies/products of droughts in the Northeast of Brazil generated in CEMADEN, with economic models; (ii) studies focusing on the impacts of extreme rainfall on the Metropolitan Region of São Paulo (RMSP), using rainfall data from CEMADEN with traffic data from Uber Platform.

Concerning the environmental and physical variables selected for the specific studies conducted during the year 2, as well as some preliminary results, are detailed below.

-Database including environmental, physical, socioeconomic and historical data of occurrences of natural disasters for pilots municipalities.

Environmental and physical variables

-Meteorological data

The interpolated meteorological data used in this study include measurements acquired from the Project PROCLIMA (http://proclima.cptec.inpe.br/) of the INPE, INMET and CEMADEN, and the Regional Centers of Meteorology. The spatial distribution of the **171** weather stations selected was associated with the pilot area previously identified for drought characterization (Figure 15). Rigorous quality inspection was carried out for the daily precipitation and evapotranspiration data. The interpolation of the data from the weather stations into a regular grid with 5 km resolution was performed using "krigging" developed by Matheron (1969).

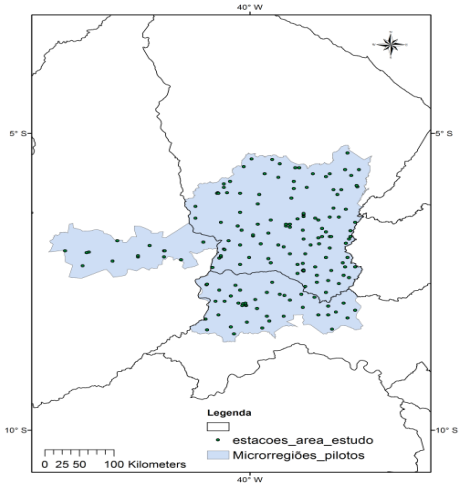


Figure 15 - Spatial distribution of weather stations selected for the drought characterization.

-Vegetation Health Index (VHI)

The VHI is an additive combination of the Vegetation Condition Index (VCI) and the Temperature Condition Index (TCI), which is of comparable magnitude. VCI is obtained by normalizing the Normalized Difference Vegetation Index (NDVI) values by their multi-year absolute minimum and maximum values in the analysed period. The VCI not only reflects the spatial and temporal vegetation variability, but also allows quantifying the impact of weather and climate on vegetation. In addition, VCI captures rainfall dynamics better than NDVI particularly in geographically heterogeneous areas. Recognizing that local surface temperature (LST) provides useful information about vegetation condition, Kogan (2000) adapted the VCI normalization approach to LST and developed the temperature condition index (TCI) based on brightness temperature (BT) values. The TCI provides an opportunity to identify subtle changes in vegetation health due to thermal effects as drought proliferates when moisture shortage is accompanied by high brightness temperature. Table 1 includes the drought severity classes for VHI, as defined by Kogan (2000).

Table 1- Drought severity classes for VHI (Kogan, 2000)

Severity Class	**VHI**
Normal	100 > VHI > 40
Mild Drought	30 < VHI ≤ 40
Moderate Drought	20 < VHI ≤ 30
Severe Drought	10 < VHI ≤ 20
Extreme Drought	0 < VHI ≤ 10

Overall, the combined utilization of the NDVI (VCI) and BT (TCI) is based on the strong negative correlation between those two variables, due to the increase in evaporation with a

decrease in soil moisture, caused by higher temperatures, which results in a decline of vegetation cover, where water is the main limiting factor for vegetation growth. Thus, the VHI has been widely considered in different applications, such as drought detection, assessment of drought severity and duration, drought-related losses of crop and pasture production, wildfire risk and early drought warning. The National Oceanic and Atmospheric Administration (NOAA; www.star.nesdis.noaa.gov/smcd/emb/vci/VH/vhftp.php) provide a VHI product weekly. For the drought scenarios under climate variability and change, we used the VHI at 4 km spatial and 7-day composite temporal resolution, from 1982 to 2016.

-Water storage information of reservoirs

The information on the operation and storage levels of the main reservoir in Brazil (size over 10 hm^3), for water supply and hydropower generation were obtained from the Reservoir Monitoring System – SAR, tool developed and managed by the National Water Agency - ANA. For the Northeast region we also obtained reservoir (Açudes) information from the Olho Água data platform, managed by the National Institute of the Semiarid - INSA and the Federal University of Campina Grande - UFCG. The information about the water demand was obtained in the portal of the National System of Information on Water Resources - SNIRH[1].

Socioeconomic data and historical occurrences of natural disasters

-BATER data associated to the pilot municipality

The original database produced by IBGE and CEMADEN (2018) allows the advance of knowledge of disaster at-risk population in Brazil. A statistical territorial base of risk was developed by the association of census data with landslide and flood risk maps, for the first time in Brazil (Dias et al., 2018). The exact intersection between the original polygons was not possible to obtain due to the differences among their geometries. Therefore, a territorial generalization was created called as: Statistical Territorial Base of Risk (BATER). Even though, BATER does not represent exactly the total population, which was living into those risk areas, it was possible to estimate them. The database is composed by (i) 183 variables that could make possible to identify the residents' profile (age, gender, literacy among others); and by 135 variables for the identification of housing characteristics, for instance, electricity, sanitation, water and waste collection access (Assis et al, 2018).

The areas of geological restriction for occupation were taken into consideration for the delimitation of the BATER for the municipality of Blumenau. However, the delimitation from other municipalities used only geologic risk sectors. Then, the BATERs from Blumenau considered the following three classes: i) restricted areas, where it is forbidden any type of construction; ii) areas released with restriction and iii) areas in study, which require detailed geological/geotechnical maps (Blumenau, 2010). In contrast, the risk sectors contemplated only the limits of areas prone to be affected by natural processes or human actions (CPRM, 2019).

In general terms, the results of the socioeconomic and environmental variables of Blumenau do not consist in an alarming problem, in comparison to other Brazilian municipalities. In this section, it is reported the results analysis in gender, age and level of education. According to the 2010 Census, Blumenau presented a total of 309,011 residents (IBGE, 2010). The amount of population exposed at-risk areas in Blumenau was about 78,371 people, which represents 25.3% from the total, counting on 38,569 men and 39,802 women, then, there were no significant differences between the genders (Figure 16). The analysis of the age groups shows that elderly (up to 60 years old) and children (under 5 years old) correspond to 9% and 8% in Blumenau. These figures follow the Brazilian averages, which correspond to 8.5 and 9%, respectively. Nevertheless, considering the level of education, only 2% from the head of household from Blumenau, was illiterate, which was below the 9.6% national rate in 2010 (IBGE, 2011).

[1] http://www3.snirh.gov.br/portal/snirh/snirh-1/acesso-tematico/usos-da-agua

The variables of houses at-risk areas environmental characteristics also follow the pattern of the municipality averages. According to the sanitation data, only 11.3% of the houses had inadequate access, for instance: by river, rudimentary tank or ditch ones. The residences without access by water from the general supply network had a similar proportion, with only 8%. The lack of waste collection was registered by only 4% of the households.

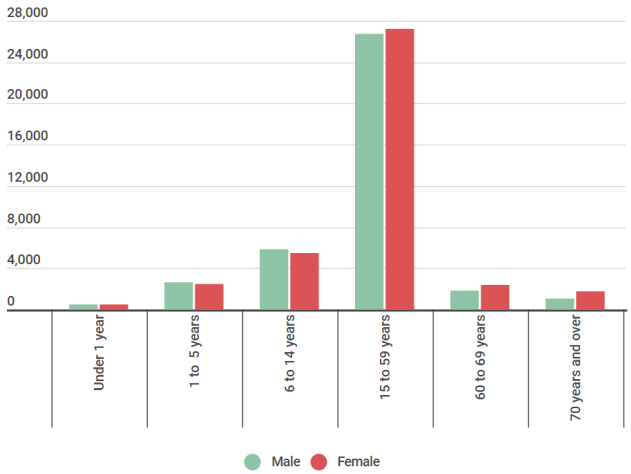


Figure 16 – Blumenau at-risk population distribution, by age and gender

-Historical disaster database

In the scope of this project, a Historical Disaster Database (HDD) as a compilation of data about the negative effects of natural events over the population, which characterizes a disaster occurrence was considered. Each occurrence, and therefore each document of the Integrated Disaster Information System (S2ID) database, is related to a type of event, according to the Brazilian Code of Disasters - COBRADE (BRASIL, 2012); and those data are grouped in five typologies of variables: human (HD), material (MD), economic (FD), social (SD) and environmental (ED), like proposed by the S2ID classification. A HDD is being making for the pilot municipalities, using the Disaster Inventory System (DesInventar) and S2ID documents from 1970 to 2016. The DesInventar includes a set of tools for construction, management and analysis of multiscale (put an emphasis on local scale) and Open-Access HDDs, it is a conceptualization, methodology and online-free software.

It is possible the cost analysis (human, material, economic, social and environmental costs) of the occurrences show the more suitable judgment for a hierarchical organization of the events that provoke disasters in Brazil. But now we can advance with some preliminary information regarding one of the pilot municipalities of this study. The data for Blumenau, for example, shows the flash flood is a critical natural event for this locality, in terms of its historical recurrence, it is, 47% of all documents analysed. The three more destructive flash floods occurred in November of 2008, January and March of 2011. The S2ID data shows its social-economic negative effects, (i) Human **HD:** 160,191 affected people (35,155 directly and 125,036 indirectly); (ii) Economic effects **MD, FD, SD** and **ED:** see Table 2.

Table 2 - Negative effects by economic segment of critical flash-flood (Blumenau).

Currency (2019)	**MD**	**FD***	**SD**	**ED***
R$	2,570,001,580.88	50,729,678,328.71	97,409,324.98	853,841,018,838.94
US$	652,268,110.17	12,875,226,092.92	24,722,551.45	216,705,418,349.52

*Values for this variable concerning 2008 only.

-Operational disaster database

The survey consists of a CEMADEN routine that has developed an internal database of landslide and hydrological events, which is continuously updated. The main proposal of this database is to support the evaluation of the alerts issued by the Center, as well as to provide information for the continuous improvement of the decision-making process. This initiative is also part of the CNPq Project 427353/2016-5 entitled "*National survey of events induced by climatic extremes of precipitation to determine critical thresholds*". The compiled information, records from 2011 to 2016, was spread over a wide variety of sources and formats, making it difficult to be assessed as a whole. Therefore, this project aimed at the development of a method to facilitate the structuring of a national database of floods and landslide events adequately categorized taking into account the types of processes and its characteristics. A set of criteria was created in order to aid analysts to interpret and transcribe the original heterogeneous information into a single database and creating a system that classify the events based on its type and magnitude, accuracy and level of impact (Bernardes, personal communication). The main sources of information are questionnaires answered by municipalities' civil defence, daily reports from Brazilian Center for Risk and Disasters Management (CENAD), institution databases, news reports and online media. The available information was organized into the following main parameters: type and date of the event, magnitude, location, time, accuracy of location, accuracy of time, impact (affected people).

This database is a useful tool for finding vulnerability hotspots due to the wealth of information at the municipal level. These hotspots will be better explored in the future stages of the project, from socioeconomic and environmental data, aiming to understand the causal relationships that are determinant for the disasters occurrences. This information and the analysis will be considered as the basis for the targeting of disaster risk reduction actions and adaptation measures.

-Analysis of extreme events

The research conducted during year 2 allowed a better understanding of the physical mechanisms that lead to extreme events in several regions in Brazil, their impacts on hydrography and vegetation. Atmospheric blocking remotely forced by tropical convection over the Indian and Maritime Continent prevents the establishment of the South Atlantic Convergence Zone during austral summer. As a consequence, severe droughts occur in the west-central and southeastern Brazil. This mechanism also leads to marine heat waves over the South Atlantic. In southern Brazil, there has been a change on the causes of extremes of precipitation. During 1979-1999, El Niño events were associated with floods in the south, in particular along the Itajaí Açu River. For 2000-2015, however, this is no longer the case. Long-term trends of precipitation and streamflow were obtained for the main river basins in Brazil (Figures 17 and 18, respectively) and the preliminary conclusion is that the trends in streamflow are consistent with the precipitation trends, showing the important role of climate variability and change on streamflow. This analysis also provides an evaluation of susceptibility of cities to extremes of precipitation and streamflow. The resilience of the Amazon forest was also evaluated and the results show that the resilience of the forest is higher in areas where the rainfall is more variable.

Long-term trends of precipitation were obtained for the main river basins in Brazil (Figure 15) and the preliminary conclusion is that the trends in precipitation are consistent with streamflow, showing the important role of climate variability and change on streamflow. This analysis also provides an evaluation of susceptibility of cities to extremes of precipitation and streamflow.

From Figure 19, it is recognized that over the last decade, hydrometeorological extremes have become more frequent and intense in Brazil, with records of significant socioeconomic impacts and losses of human lives in Brazil, leading to the need of strengthening of disaster risk management at local levels. In 2010, the number of people affected by natural disasters in Brazil

was about 96 million in contrast to recently period, when approximately 123 million were affected by direct or indirect damages. During the last decade, more than half a million people have been made homeless by landslides and floods mainly. An expressive part of affected people is in the Southeast region, which accounts approximately 66% of the total disasters occurred in the country. In terms of cost, events such as landslide in Rio de Janeiro (e.g. mountain range in 2011) totaled approximately U$ 2 billion with at least 780 million for rebuilding.

Young et al (2019) shows thatthe primary concern of decision makers in Brazil is related to flood and landslide, which is almost equally divided between them. Flood risk is pointed out by 77% of respondents as the most frequently event addressed in planned measures followed by landslides (Figure 20). Flood tends to be larger in sealed urban areas because with less water storage capacity and more rapid runoff, water level rises quickly during storms with higher peak discharge rates than vegetated areas. In the same way, landslides can be triggered by heavy rain mainly in the mountains where excessive runoff and interruption of tributaries occurs due to barriers such as stones, tree trunks, bridges. This natural disaster affects people living in vulnerable areas and is one of misfortune that kills more people in the country, particularly in Southeast Brazil.

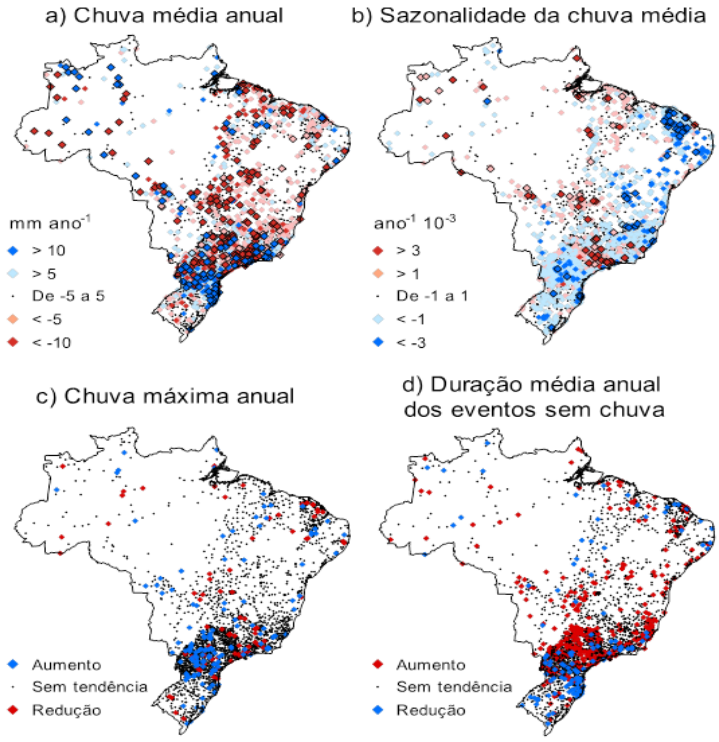


Figure 17 - Long-term trends of precipitation: (a) Mean annual precipitation, (b) seasonality of mean precipitation, (c) maximum annual precipitation, (d) annual mean duration of dry spells. Diamonds with black contours in (a) and (b) and colored circles in (c) and (d) show trends statistically significant at the 95% confidence level according to Mann-Kendall test. (Chagas 2019)

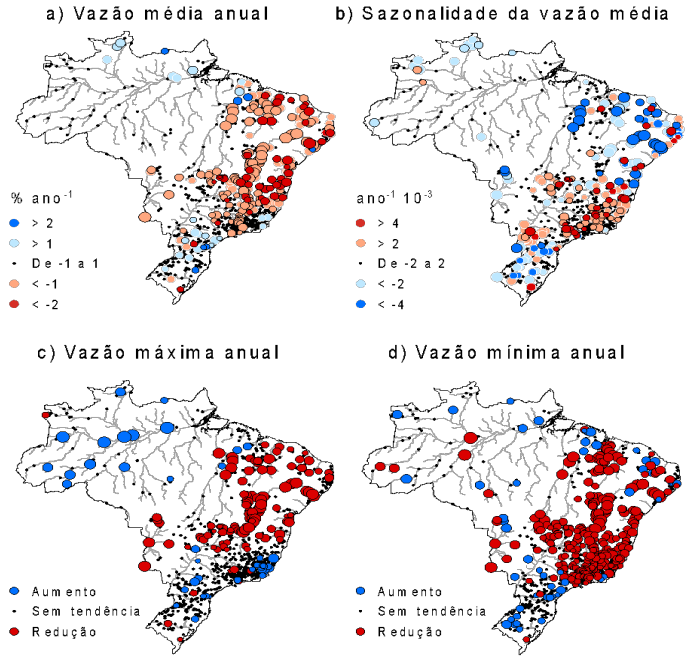


Figure 18 - Same as Figure 15, except for streamflow. (Chagas 2019)

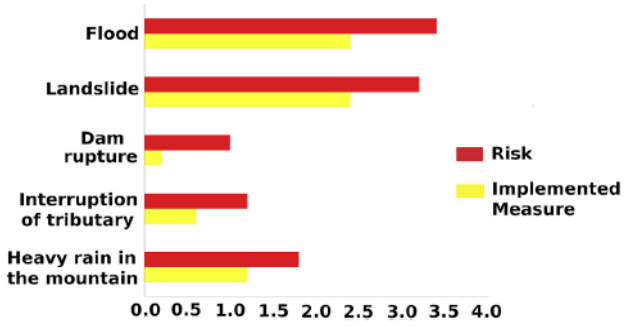


Figure 19. Risk level and respective measure implementation (Young et al 2019)

-Reservoir (Açudes) description.

Based on the evaluation of the recurrence of drought events in recent years in the Brazilian semiarid region, six reservoirs (açudes) were selected for the study of the impact of drought on water supply, activities carried out in year 1 of the project. The drainage basins of these reservoirs are located in areas with drought recurrence above 25 events between 1981 and 2016. The reservoirs selected were: (i) Orós and Castanhão in the State of Ceará, with a storage capacity of 1.940 and 6.700 hm^3, respectively, being the Castanhão the largest reservoir of the semiarid; (ii) Chapéu and Entremontes in the State of Pernambuco, with a storage capacity of 188 and 339 hm^3; (iii) Piaus and Bocaina in the State of Piauí, with a storage capacity of 20 and 106 hm^3, respectively.

Figure 20 presents the average monthly storage levels of the reservoirs, and it can be observed the failures in the monitoring of the Chapéu and Entremontes reservoirs, in the State of Pernambuco, which may compromise future analyzes. The reservoirs located in the states of Ceará and Piauí have fewer gaps in their time series. For the Orós reservoir, the oldest of the pilot reservoir, there is a gap in its monitoring between 1984 and 1997. Bocaina, inaugurated in 1997, is the second oldest reservoir. The remaining reservoirs were built after 2005.

There is a decline in the water reserves of all reservoirs at the beginning of 2012. This fact was due to the meteorological drought event, which began in December 2011 and extended for almost 7 years, constituting one of the most severe droughts of the region (Brito et al., 2017).

This climate change was associated with an anomalously warm tropical North Atlantic Ocean implying in a northward position on the Intertropical Convergence zone - ITCZ, which in turn leaded drought to the Brazilian Northeastern (Marengo et al., 2013, 2017; Rodrigues and McPhaden, 2014).

In addition to the sharp decline in water reserves, it is possible to note that the historical series of reservoir storage levels are not stationary (Figure 21). Castanhão presents a period between 2004 and 2007 in which the storage level oscillated around 60%. Following this, between 2008 and 2011, it oscillated around 80% and, in the sequence, in 2012, decreases sharply, fluctuating in the 30% range, reaching a minimum of 2.1% in February 2018. For the Bocaina reservoir, the storage level remained in the range of 55% between 2000 and 2003, followed by an oscillation around of 75% between 2004 and 2011, and soon thereafter declined steeply, starting to oscillate around 25% between the years 2013 and 2018.

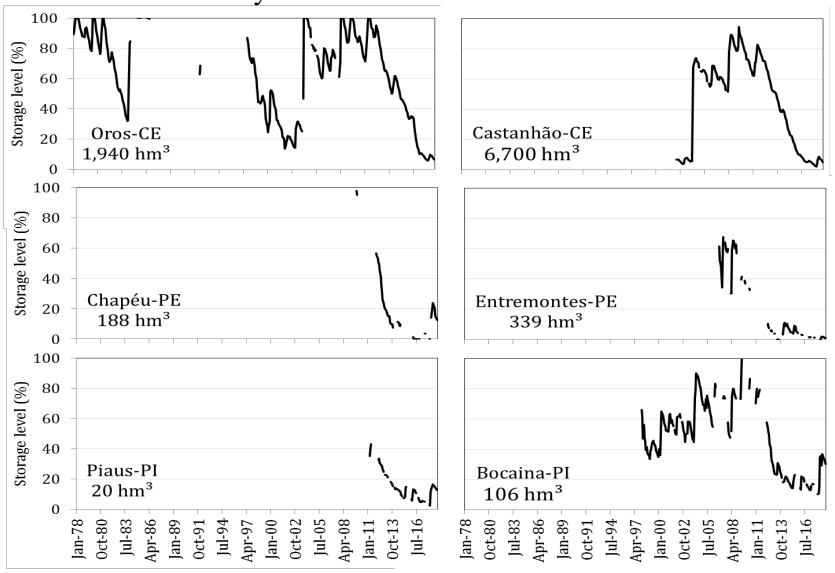


Figure 20 - Storage level of the pilot reservoirs for the study of the droughts impacts on the Northeastern region of Brazil.

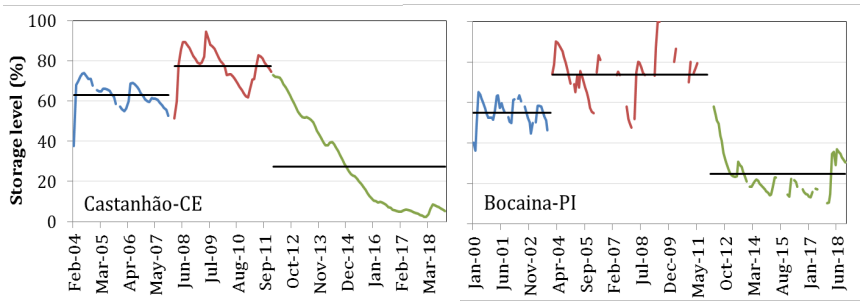


Figure 21 – Storage level of *Castanhão* (left), located in *Ceará* State and *Bocaina* (right), located in *Piauí* State.

In order to start the evaluation of the water shortage impact, Castanhão was chosen. The selection of this reservoir was based on the availability of storage level data, as well as on the great impact that the last event of drought caused in the reservoir, leading the system into crisis, remaining below 10% of storage since 2016.

Inaugurated in 2003, the Castanhão reservoir was built in order to ensure water reserves to face the irregularity of the rainfall and to meet the demands of the increasing population of the metropolitan region of Fortaleza - MRFortaleza (Figure 22). With storage capacity of 6,700 hm³, it presents a regularized flow of approximately 30.21 $m^3 s^{-1}$, constituting the largest reservoir in the Northeast. Its drainage basin on the Jaguaribe River, with approximately 45,310 km², also has another large reservoir, Orós, with a storage capacity of 1,900 hm³. The water resource is transposed from the Castanhão reservoir to the MRFortaleza through the "EIXÃO

DAS ÁGUAS", a set of canals, pipelines and tunnels, distant 255 km, designed for a 22 m³ s-1 flow.

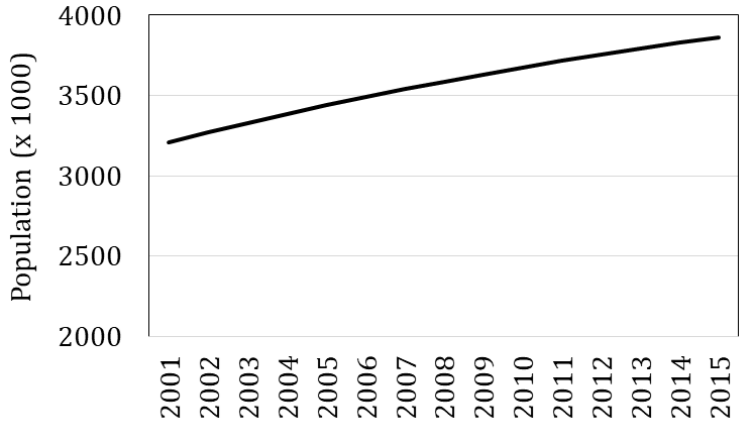


Figure 22 – Population of the metropolitan region of Fortaleza. Data source: https://seriesestatisticas.ibge.gov.br/series.aspx?no=10&op=0&vcodigo=PD335&t=populacao-residente

-Characterization of drought events over Castanhão Basin

As highlighted in the year 1 report, the delimited study area to the Drought Impact Assessments includes a total of 157 municipalities (Figure 23). However, in a preliminarily way, analyzes of the extreme precipitation events were carried out for the Castanhão drainage basin, which is inserted into the study area.

The drought characterization was derived from monthly Standardized Precipitation Index (SPI-12) data from 1981 to 2016. The SPI is the number of standard deviations from the mean at which an event occurs. Thus, the 12-month SPI value provides a comparison of accumulated precipitation over that specific 12-month period with the mean precipitation total for the same annual period as calculated over the full study period. Figure 23 shows the monthly time series of area average SPI over Castanhão Basin. It should be noted that dry events are more recurrent than wet events in the Basin, especially after the 1990s. Visual analysis shows the major severe droughts that impacted the region, namely, 1982–1983, 1992–1993, 1997–1998, and 2012–2016. Among those events, the large drought of 2012–2016, considered to be the largest drought, both in magnitude and duration, of the last three decades (Brito et al., 2017; Marengo et al., 2017; Cunha et al., 2018). Cunha et al., (2018) showed that the 2012–2013 drought was characterized by widespread impacts, reaching 46% of the NEB land area. The beginning of this drought event (2011–2012) was associated with negative SST anomalies in the central Pacific (La Niña) concomitant with positive SST anomalies in the tropical North Atlantic, which favoured a northward migration of the ITCZ (Rodrigues and McPhaden, 2014). During 2015–2016, on the other hand, a strong El Niño event increased and prolonged the effects of the drought (Marengo et al., 2017a, 2017b).

It is important to assess the severity, duration and frequency of drought events, because it is related to the impacts on the ecosystems, agriculture/livestock and the hydrological cycle. For this purpose, the previous methodologies developed by Spinoni et al. (2014; 2015) will be adapted. From SPI, drought begins when SPI is less than or equal to −1 and it ends when SPI returns to positive values. Once a drought event has been determined, the start and end, drought duration (DD) and drought severity (DS) were obtained. DD is equal to number of months between its start (included) and end month (not included). DS is absolute value of integral area between line index and horizontal axis (SPI=0) from start to termination month of drought. Table 2 shows the main results about the drought characterization for Castanhão drainage basin. During 1981-2017, seven drought events were identified, with a cumulative duration of 176 months. Regarding severity, this was approximately 130 (Sum of SPI). The most severe drought

events occurred between 1982 and 1994, with a cumulative severity of -60. The droughts events in this period were associated with El Niño events (1982–1983 and 1992–1993).

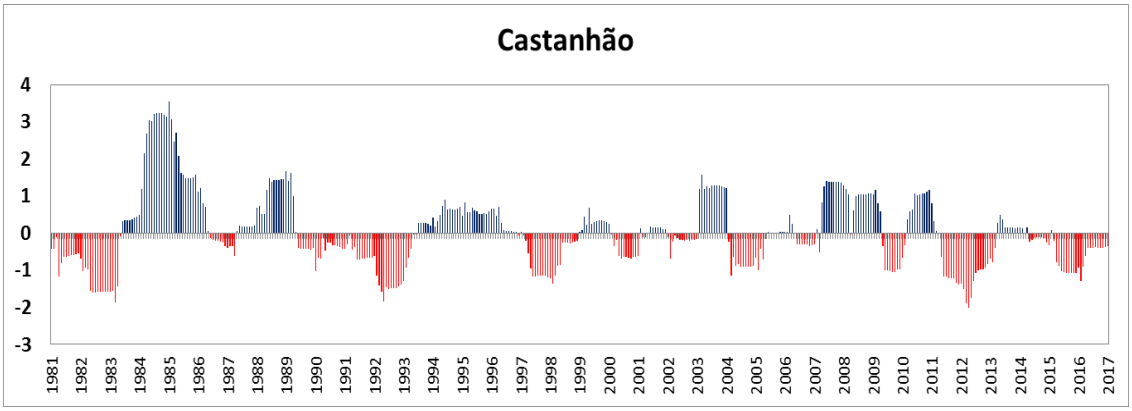


Figure 23 – Monthly time series (1981-2016) of area average SPI-12 over the Castanhão Basin.

Table 3 - Drought characterization for Castanhão drainage basin.

Event	Accumulated Duration (months)	Severity
03/1982-09/1984	31	-28.99
12/1990-12/1994	48	-32.01
04/1998-01/2000	22	-16.30
02/2005-01/2007	24	-11.81
05/2010-01/2011	9	-8.07
05/2012-03/2014	23	-26.13
05/2016-12/2017	20	-14.67

-Impacts of extreme precipitation in the water availability of the pilot reservoir

In the context of meteorological droughts, it is important to analyse the water availability in the reservoirs in order to manage and/or mitigate the conflicts by the multiple water uses. So, this section aimed to simulate the evolution of the storage level for the Castanhão reservoir, the pilot for the year 2 of this project, in order to obtain projections associated with several rainfall scenarios for a future period. The simplified water balance was used for this purpose, as shown in Equation 1:

$$S_t = S_{t-1} + R * f1 - PET * f2 - deflu \qquad \mathbf{1}$$

where S_t and S_{t-1} represent the storage level on the present and past time steps, respectively, R refers to the rainfall, PET refers to the potential evapotranspiration and $deflu$ refers to the outflow plus the water extraction for consumptive uses[2]. $f1$ and $f2$ is correction factors to convert total rainfall into effective rainfall and PET into actual evapotranspiration, respectively. Both of these factors are seasonal classified, i.e., there are values for wet and dry seasons.

The water balance was calculated in daily time step. In order to calibrate and validate the methodology described above, historical series of rainfall and evapotranspiration, information about water demand, as well as historical series of the storage level of the reservoir were used.

Preliminary results are presented in Figure 24. The statistical performance (Nash = 0.72 and RMSE =83 hm³, equivalent to 1%) indicates the good quality of the simulation, pointing the

[2] Consumptive uses draw water from the source for its destination, such as irrigation, industrial uses and human supplies. More information in: http://www3.snirh.gov.br/portal/snirh/centrais-de-conteudos/central-de-publicacoes/anamanualdeusosconsuntivosdaaguanobrasil.pdf

possibility of the usage of this method for the simulation of the evolution of the storage level in the Castanhão reservoir.

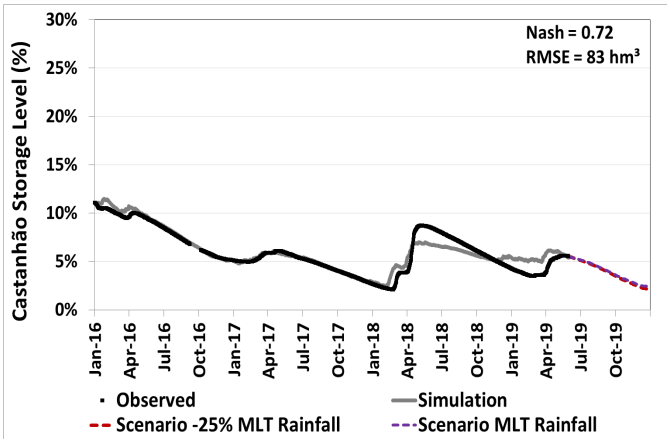


Figure 24 – Storage level of Castanhão reservoir, in Ceará State. Black line represents the observed data; grey line represents the simulation using the observed rainfall and evapotranspiration; purple and red dashed lines represent projections for a future period using the Mean Long Term (MLT) rainfall and -25% of the MLT Rainfall, respectively. (Elaborated by Cemaden).

This preliminary study highlights the fragility of this system in providing water resources in order to efficiently meet the demands of the region during the long dry periods. In this context, the hydrological projections of this study can subsidize the management and strategic planning of water resources. Considering the climate changes projected for the Northeast of Brazil (Marengo et al., 2019), with less frequent and smaller quantities of rain, as well as the increase of the temperatures, it is necessary to increase the resilience, including changes in population habits and the capacity of answers of the metropolitan region of Fortaleza, fundamental aspects to face future challenges.

-Impacts caused by landslides due to extreme precipitation events, in the context of climate change

In the first year of the project, Blumenau was considered one of the most critical municipalities for the landslides-related disasters. The analysis was based on disasters database and, also, considering the increasing of the extreme precipitation events for the 2011-2040, indicated by the Potential Impact Index. A new map was developed to show regionally the spatial patterns of the results (baseline and future), including the trends of Eta-MIROC 5 and Eta-HADGEM 2 ES projections, as shown on Figure 25.

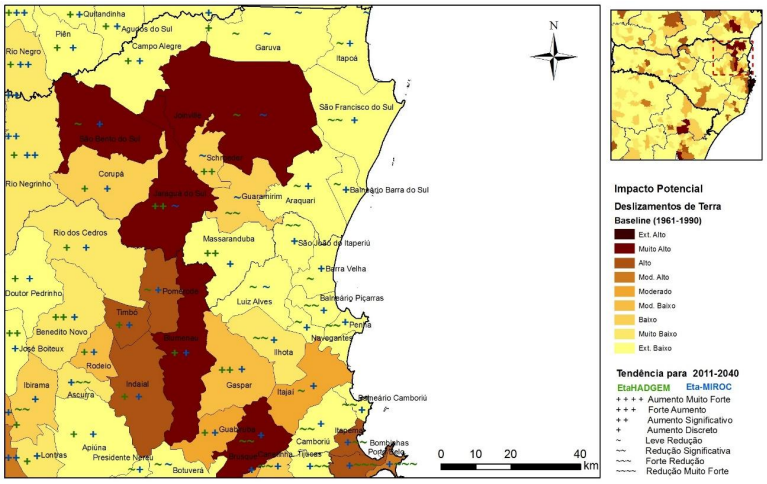


Figure 25 - Results of Potential Impact Index for the 1961-1990 period (background, yellow-brown scale) and trends for the 2011-2040 using Eta-Miroc 5 and Eta-HadGEM2 ES projections (+ and - symbols).

This result shows that there are other municipalities with high and very high Potential Impact (dark brown), although Blumenau is the only case where the two climate models indicated the increase of extreme precipitation events. Thus, in the second year, we focused to develop a diagnosis for Blumenau, taking into account the database of impacts caused by landslides during the last years (2016-2019). In the current stage of the project, the occurrences of landslides events were overlapped on a Risk Index, which was elaborated specifically for this project. This index was composed based on (i) population density data (provided by IBGE, in shapefile with statistical grid of 200 m x 200 for urban areas and 1 km x 1km for rural areas); (ii) slope/declivity (5m resolution, provided *by Secretaria de Desenvolvimento Sustentável de Santa Catarina*, 2013), and (iii) map of susceptibility to landslides (1: 50.000, provided by IPT and CPRM, 2015) according to the Equation 2:

$$Risk = (Slope \times Susceptibility \times Population\ Density) \quad 2$$

The occurrences were evaluated considering the accuracy of its location, according to the following criteria: **high accuracy** - when the exact address of the occurrence was reported; **medium accuracy** - cases that only the street name is known; and **low accuracy** - when the information refers to the neighbourhood name. Aiming a better visualization and analysis, the occurrences with medium precision were placed in the median point of the street that was reported and a buffer of 200 m was applied. For the cases of low precision, the register considered the centroid of the reported neighbourhood and a buffer of 1km were applied. The occurrence of high precision appears highlighted, but with no buffer due to its exact location.

The database for Blumenau is composed of 29 occurrences for the analysed period (2016-2019), being 1 of high 16 of medium and 12 of low accuracies, as shown in Figure 18. When the occurrences were overlaid to the Risk index, it was noticed that the most have adherence with the highest risk categories: 21 cases are exactly on or up to 300m from a place classified with high or very high risk. The remaining 8 occurrences are located up to 600m from a high or very high risk site, being 6 of that with low accuracy of the location, suggesting the low spatial correlation may be more related to the lack of information of the event location than with the Risk index.

The Blumenau database, consisting of 29 occurrences in the analysed period (2016-2019), presents 1 high, 16 medium and 12 low accuracies, as shown in Figure 26. When the occurrence was overlapped on the Risk Index, it was observed that most of them had adherence to the categories of higher risk, that is, 21 cases are exactly at or up to 300m from a place classified as high or very high risk. The other 8 occurrences were located at 600m from a high or very high-risk site, 6 of them with low accuracy of the site. This result suggests that the low spatial correlation may be more related to the lack of information of the local of the event, than with the Risk Index.

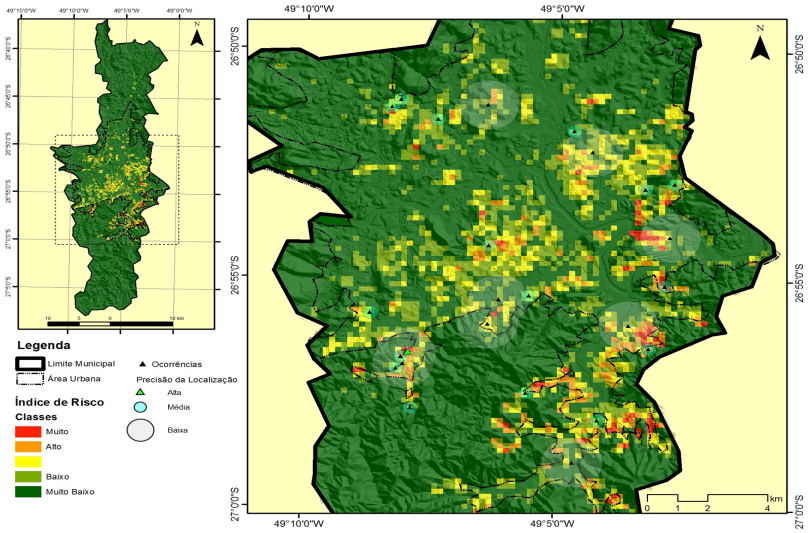


Figure 26- Landslide Risk Index and occurrences database for Blumenau, SC.

Although the analysis presented is preliminary, the results suggest that densely populated areas on steep slopes are key factors for explaining the impacts in recent years, since anthropogenic interventions (cut and fill slopes, unplanned urban drainage systems, overloading, etc.) increase slope instability. Such a relationship is also widely highlighted in the literature; so, the confirmation at this stage is important, since the next steps will consider these characteristics for the proposition of risk reduction actions and adaptation measures.

-Additional Contribution - Semi-Automated Definition of Multiple Rainfall Thresholds

In Brazil, municipalities impacted by mass movements associated with periods of intense precipitation are recurrent, which cause significant human and economic losses. In order to define critical thresholds capable of triggering landslides, especially for use in early alerts, efforts are expended in identifying rainfall intensity–duration thresholds. In this context, Rossi et al (2019) used the MaCumBa (Massive CUMulative Brisk Analyser) software to identify rainfall intensity–duration thresholds capable of triggering landslides in the most affected municipalities of the Mountain Region of Rio de Janeiro State. This methodology can be applied in other municipalities monitored by CEMADEN, establishing for each one four levels of alert, based on the intensity–duration thresholds. According to the authors, the methodology allows the updating of the thresholds as new landslide events are incorporated, together with rainfall data at the time of occurrence. Thus, the methodology will be also replicated to define the standby thresholds for Blumenau, SC.

5.5 Impacts on Brazilian ecosystems in view of changes in land use and biodiversity.

The Ecosystem component focus on environmental issues associated with climate change in the Amazonia and Cerrado Biomes. In the Amazonian ecosystem, the focus is on the use of the ATTO tower Platform, as well as general issues associated with land use change and deforestation impacts.

-Drivers of deforestation and carbon dioxide emissions in Amazonia

Deforestation rates have declined substantially across the Brazilian Legal Amazon (BLA) over the period from 2000-2013. However, reductions in fire, aerosol and carbon dioxide have been far less significant than deforestation, even when accounting for inter-annual variability in precipitation. Our observations and analysis support a decoupling between fire and deforestation that has exacerbated forest degradation in the BLA. Basing aerosol and carbon dioxide emissions on deforestation rates, without accounting for forest degradation will bias these important climate and ecosystem-health parameters low, both now and in the future. Recent increases in deforestation rate since 2014 will enhance such degradation, particularly during

drought conditions, increasing emissions of aerosol and greenhouse gases. Given Brazil's committed Nationally Determined Contribution under the Paris Agreement, failure to account for forest degradation fires will paint a false picture of prior progress and potentially have profound implications for both regional and global climate.

As well as aerosol, biomass burning produces substantial emissions of long-lived greenhouse gases, particularly carbon dioxide and methane. From 2007-2016, global land-use change emissions, of which deforestation is a major component, contributed 1.3 ±0.7 GtC y-1 compared to 9.4±0.4 GtC yr-1 from fossil fuels and industry. According to figures submitted to the United Nations Framework Convention on Climate Change (UNFCCC), the Land Use, Land-Use Change and Forestry sector accounted for 78-80% of Brazil's annual carbon dioxide emissions from 1990-2005, before falling to 42% in 2010.

Deforestation rates have declined from 2004 onwards but total fire counts and burned area have exhibited a much slower decline. Altered fire dynamics driven by deforestation and forest degradation have been identified as significant contributing factors to these observed trends. Feedbacks in the fire dynamics of closed canopy tropical forests increase future fire susceptibility, fuel loading and fire intensity, leading to accidental fires potentially causing more deforestation than intentional clearing in some regions. From 1998-2006, fire occurrence actually increased in 59% of the area that experienced reduced deforestation rate. This was ascribed to slashing and burning of secondary forests in already deforested areas that are not monitored by the o official Instituto Nacional de Pesquisas Espaciais (INPE) deforestation assessments, as well as the continuous enlargement of forest edges and the increasing area of secondary forest cover that is more susceptible to fire. Such feedbacks have resulted in many fires in the Amazon no longer originating from deforestation itself, but from managed agricultural lands and those that escape from these managed lands. Prior to the establishment of the Action Plan for Prevention and Control of Deforestation in Amazonia (PPCDAm) in 2004, deforestation explained 84% of active fire detections. Once the PPCDAm was implemented, this fell to only 47% over the period from 2004-2015. From 2003-2015, there has been a significant positive trend in the number of active fire counts per square kilometer deforested, with peaks in active fire counts more associated with extreme drought events than deforestation. The most significant increases were in areas with only limited deforestation, suggesting that fires associated with forest degradation are becoming increasingly important.

Previous work has established that the magnitude of the regional aerosol burden is strongly controlled by the intensity of the biomass-burning season. However, trends in the aerosol burden and associated properties over the recent period of steep deforestation decline and de-coupling between deforestation and fire have received less scrutiny. Long-term satellite measurements of carbon monoxide (CO) have shown a negative trend that has been ascribed to falling deforestation rates, while also illustrating substantial increases in CO during drought years. Satellite measurements of aerosol optical depth (AOD) over the period from 2001- 2012 indicate enhanced AOD in drought years coupled with a negative trend overall, which was ascribed to declines in deforestation fires. Carbon emissions in Amazonia are strongly associated with fire and are thus prone to the same changes in fire dynamics and processes outlined above.

Figure 27 presents the annual cycle in rainfall, deforestation, fire, burned area and AOD across the BLA and major biomass burning states Strong seasonality is observed for fire counts, burned areas, Aerosol Optical Depth (AOD) and CO2 emissions.

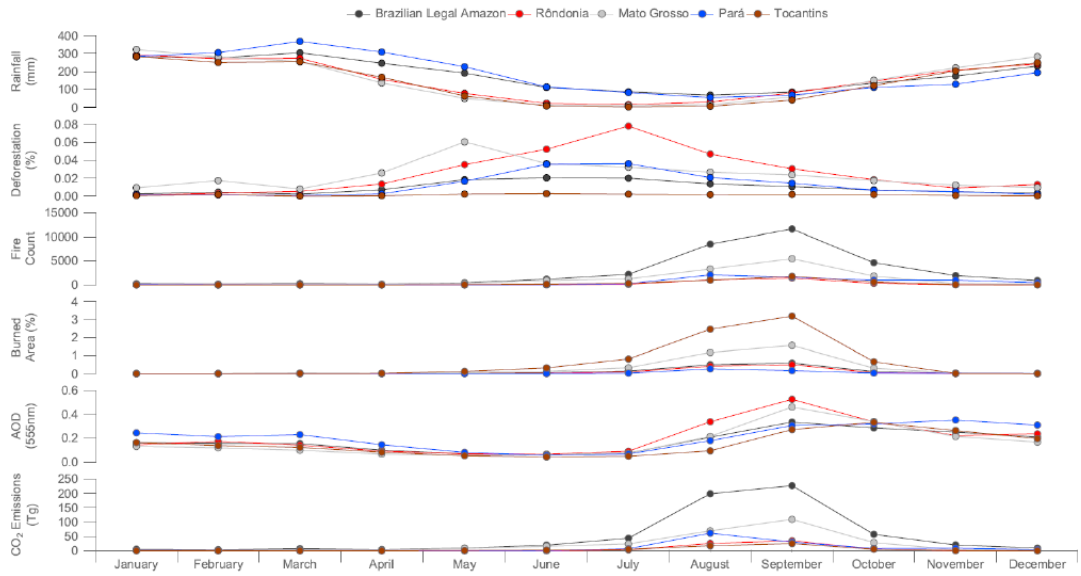


Figure 27 - Monthly averages of rainfall, deforestation, fire count, burned area, Aerosol Optical Depth (AOD) and fire-related carbon dioxide emissions in the Brazilian Legal Amazon (BLA) and states where significant annual fire occurs (Rondônia, Mato Grosso, Pará and Tocantins). Data from 1997-2017.

CO2 emissions were calculated from PRODES deforestation areas jointly with the fire-related carbon dioxide emissions from the Global Fire Emissions Database (GFED4). The emissions are categorized from the several fire types separately. Figure 28a shows the geographical distribution of emissions, and figure 28b shows the time series. High annual variability is observed for both precipitation adjusted and raw data. The observed decrease in CO2 emissions is however not statistically significant (R2=0.03)

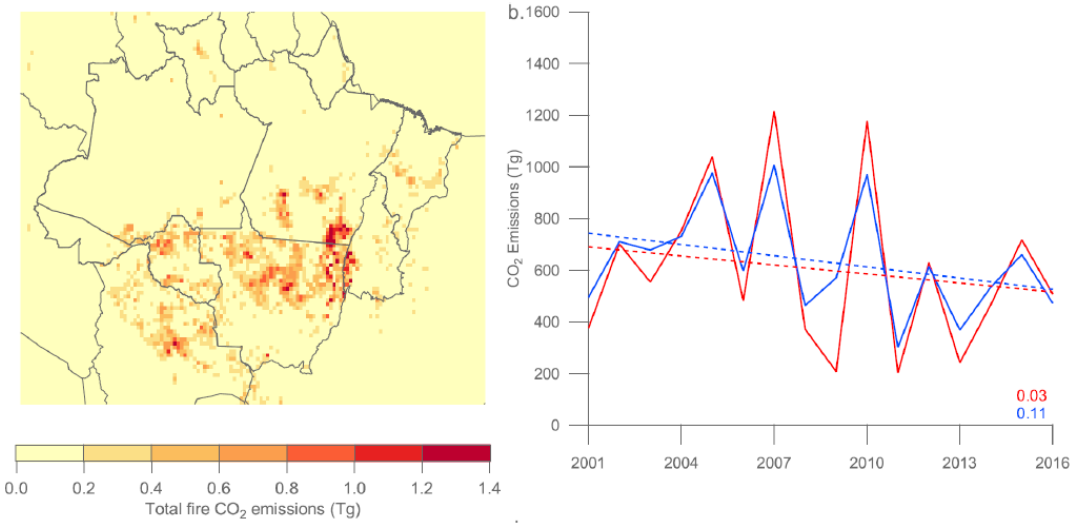


Figure 28. (a) Carbon dioxide emissions from all fire emission classes from 1997-2017. (a) CO2 emissions averaged over the main biomass burning months (August-October) on a 0.25 degrees pixel grid. (b) Time series and trends in carbon dioxide emissions. (From PRODES deforestation areas jointly with the fire-related carbon dioxide emissions from the Global Fire Emissions Database GFED4).

-Trace gases and aerosols measurements at the ATTO tower

As part of this INCT-MC2 project we are doing continuous trace gases and aerosol measurements at the ATTO (Amazon Tall Tower Observatory) tower. The ATTO site is located in one of the most pristine sites in continental areas in the world, with coordinates at S 02° 8' 38.8", W 58° 59' 59.5". At this site, a German-Brazilian scientific cooperation had already built a 325 meters tall tower. The site is already fully operational, and aerosol and trace gases are being measured starting in July 2017 at the 325 m tall tower. Figure 29 shows pictures of the ATTO tower.

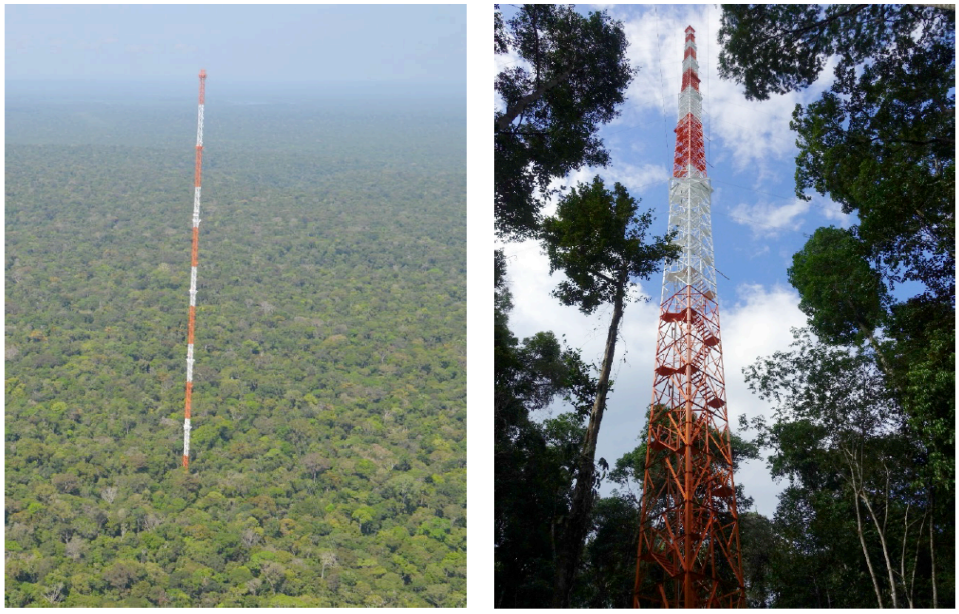


Figure 29. The ATTO 325 meters tall tower in Central Amazonia. Top of the tower as well as profiles for trace gases and aerosols will be measured continuously over 5 years of this project.

Table 4 show the extensive instrumentation to measure aerosol, trace gases, radiation fluxes and cloud properties at the ATTO site. Several groups are responsible for the data analysis, and a site at INPA and at Max Planck distribute the data for the researchers. Figure 30 shows the time series obtained for 2018 and Figure 31 shows the data collected so far in the wet season of 2019. It is possible to observe several episodes of aerosol transport from Africa to Central Amazonia from February to April 2019. Sahara dust aerosol (that scatters light) and African biomass burning aerosols were clearly measured at ATTO site.

Table 4 - Instrumentation to measure aerosol, trace gases, radiation fluxes and cloud properties at the ATTO site.

Cloud Condensation Nuclei CCN from DMT – Droplet Measurement Technology.	8 levels of Eddy Correlation System – Latent and sensible heat fluxes
Nephelometer from TSI model 3563	Microwave Radiometer
Particle/Soot Absorption Photometer – PSAP – Spectral light absorption	Downwelling Radiation
TSI 3776 Condensation Nuclei Counter	Shaded Black and White Pyranometer
Aerodyne Aerosol Chemical Speciation Monitor (ACSM)	Normal Incidence Pyrheliometer
Photo-Acoustic Soot Spectrometer (PASS-3)	8 levels of 3D Anemometers
Ultra-High Sensitivity Aerosol Spectrometer (UHSAS)	Vaisala Ceilometer (range ~7 km)
PTR-MS Real-time VOC	Vertically Pointing Cloud Radar (94 or 35 GHz)
Carbon Monoxide Analyzer from Picarro	Total Sky Imager for cloud cover
Trace Gas – O_3 , SO_2 , NOx	Narrow Field of View Radiometer
Optical particle counter – OPC	Precision Infrared Radiometer
Aethalometer AE33 for Black Carbon	Precision Spectral Radiometer
Single Particle Soot Photometer (SP2)	Infrared Thermometer
Total column of CO, CO2 and CH4	Surface Meteorology
Cimel Sun Photometer for AOD	Barometer
Micropulse Lidar with Dual Polarization	Temperature and Humidity Sensor
Doppler Cloud Lidar	Upwelling Radiation
Scanning Mobility Particle Sizer (SMPS)	Multiangle Absorption Photometer (MAAP)

Disdrometers (JOSS, Parsivel and Thies)	Real time total carbon analyzer
SIPAM S-band radar	1290 MHz Radar Wind Profiler (RWP)

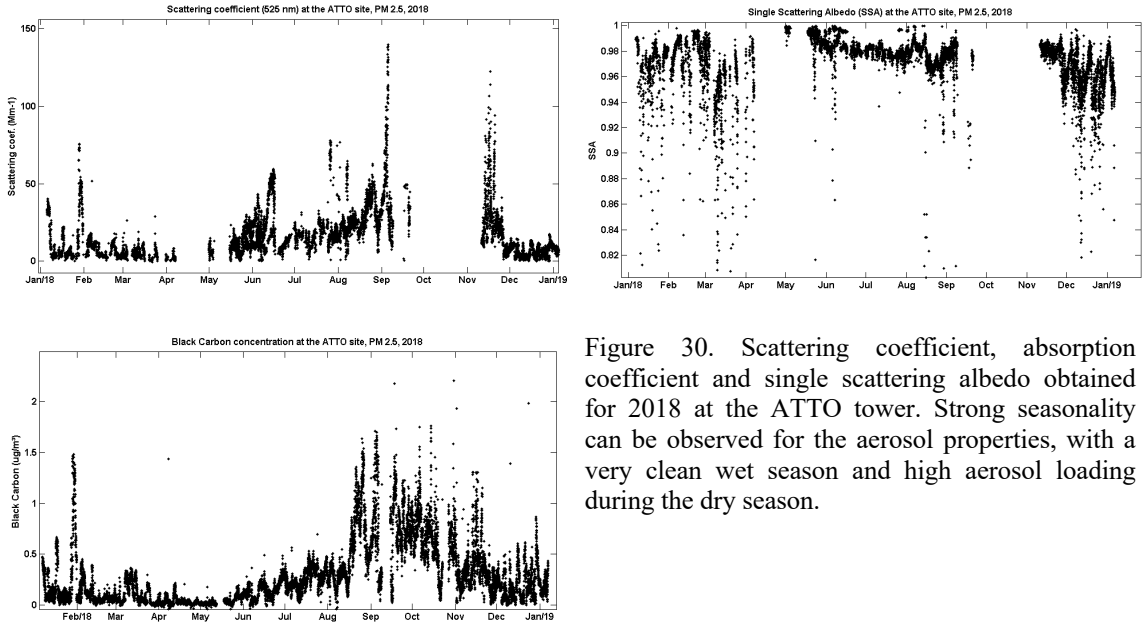


Figure 30. Scattering coefficient, absorption coefficient and single scattering albedo obtained for 2018 at the ATTO tower. Strong seasonality can be observed for the aerosol properties, with a very clean wet season and high aerosol loading during the dry season.

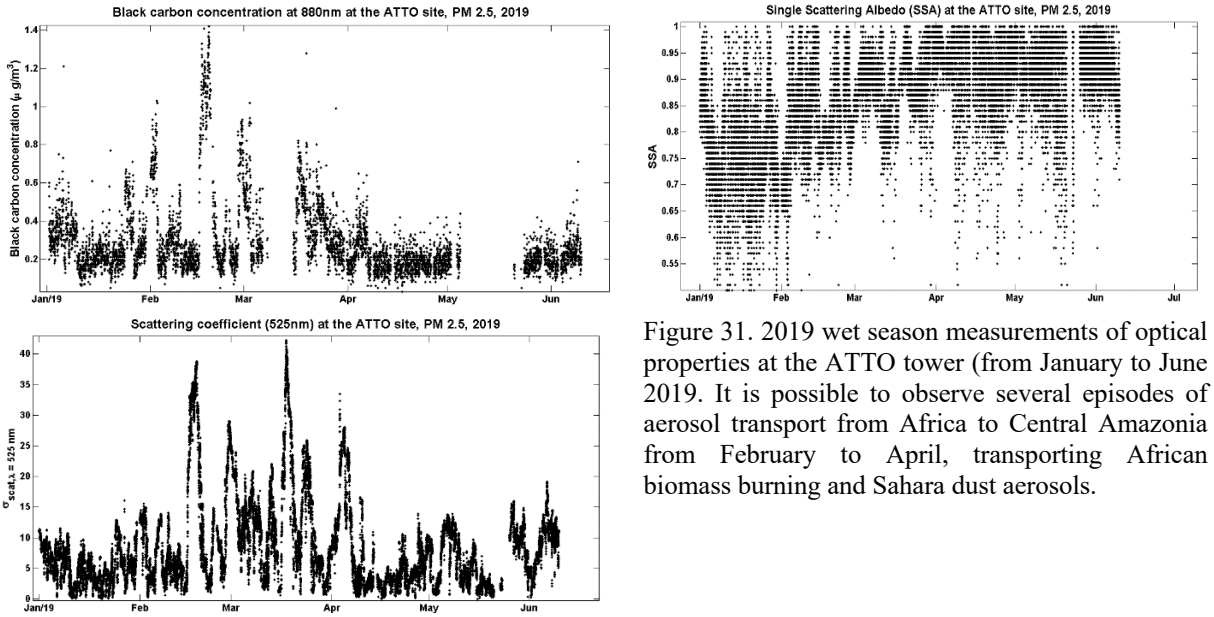


Figure 31. 2019 wet season measurements of optical properties at the ATTO tower (from January to June 2019. It is possible to observe several episodes of aerosol transport from Africa to Central Amazonia from February to April, transporting African biomass burning and Sahara dust aerosols.

-Activities

Organization of the international workshop Identifying Biodiversity Tipping points in the Cerrado ecoregion and the implications for ecosystem services.

Title: A social-ecological approach to identify and quantify biodiversity tipping points in South America's seasonal dry ecosystems

Scientific support for the elaboration of the 4th National Inventory of Emissions and Removal of the GHG

Preparation of new biomass map for the Cerrado biome that it is the second largest biome in Brazil and presents high deforestation rates.

5.6 Health and climate change

At the second year of the project, the potential distributions of the remaining leishmaniasis vector species were modelled (*L. wellcomei*, *L. complexa*, *L. umbratilis*, *L. migonei*, *L. longipalpis* and *L. cruzi*). Figure 32 shows the area of potential expansion of *L. longipalpis*, vector of American Visceral Leishmaniasis (AVL), in southern Brazil, where the climate will be more favourable to its occurrence in the middle of the XXI century, according to both climate change scenarios (RCP 4.5 and RCP 8.5).

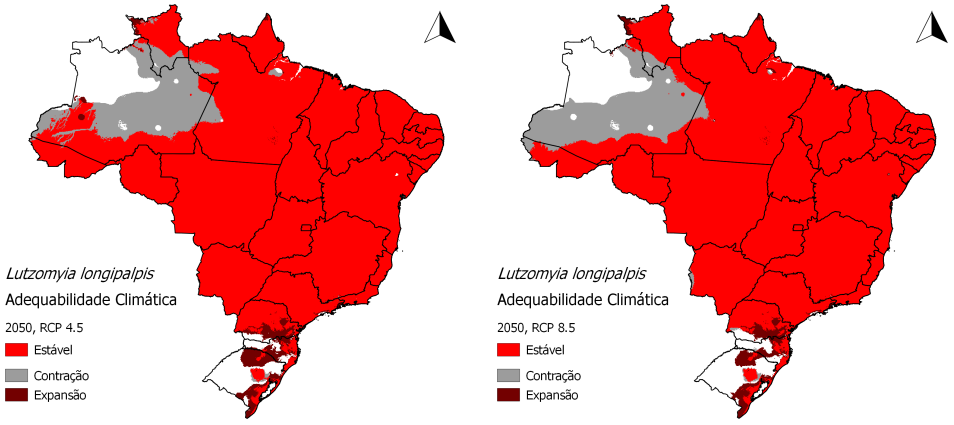


Figure 32: Climatic suitability for *Lutzomyia longipalpis*, the main vector of American Visceral Leishmaniasis according to the climate change scenarios RCP 4.5 (left) and RCP 8.5 (right).

In a preliminary evaluation, the percentage of the territory of each Brazilian state that will gain (expansion) or lose (climax) climate suitability for the vectors in the future, according to the scenario RCP 8.5 (Figure 33), was quantified. For the AVL vectors, the state with the largest expansion area was Santa Catarina (25.3% of the territory will gain climatic suitability for the vectors in the future) and with a larger area of contraction, Amazonas (53.3% of the territory will lose climatic suitability for the vectors in the future).

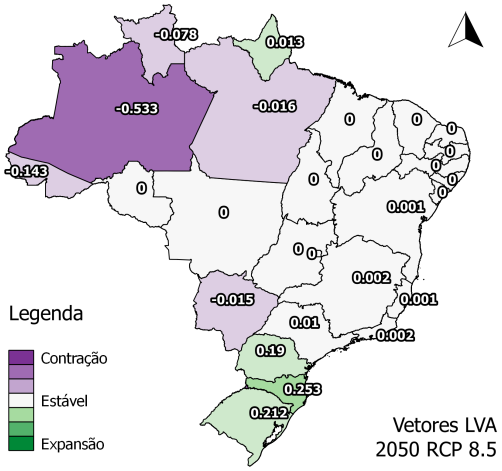


Figure 33. Percentage of the state territory that will gain (expand) or lose (climax) climate suitability for American Visceral Leishmaniasis vectors (*Lutzomyia longipalpis* and *L. cruzi*), according to the RCP 8.5 scenario.

For the American Cutaneous Leishmaniasis (ACL) vectors, the scenario for the state of Amazonas presented a small increase of areas of climate suitable to the vectors (5.1%) (Figure 34).

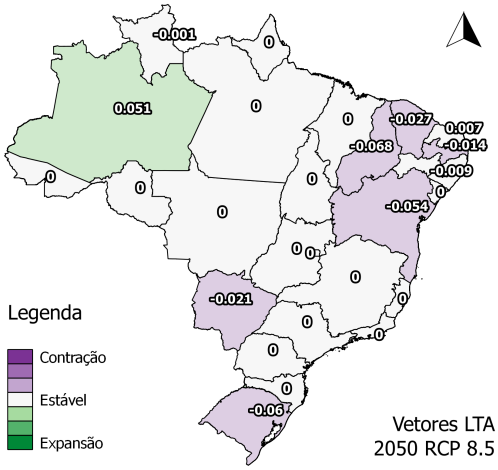


Figure 34. Percentage of the state territory that will gain (expand) or lose (climactic) climatic suitability for American Cutaneous Leishmaniasis vectors (*Lutzomyia flaviscutellata, L. whitmani, L. intermedia, L. neivai, L. wellcomei, L. complexa, L. umbratilis* and *L. migonei*), according to the RCP 8.5 scenario.

In order to have a better representation of the current scenario of the potential distribution of these vectors, vegetation (NDVI) and elevation were included as predictors alongside the previously used climatic variables in the ecological niche models (Figures 35 and 36). *Lutzomyia whitmani* was recorded in the largest number of municipalities (643), followed by *L. longipalpis* (445), *L. migonei* (436), *L. flaviscutellata* (234), *L. intermedia* (162), *L. neivai* (136), *L. umbratilis* (83), *L. cruzi* (53), *L. complexa* (47) and *L. wellcomei* (27).

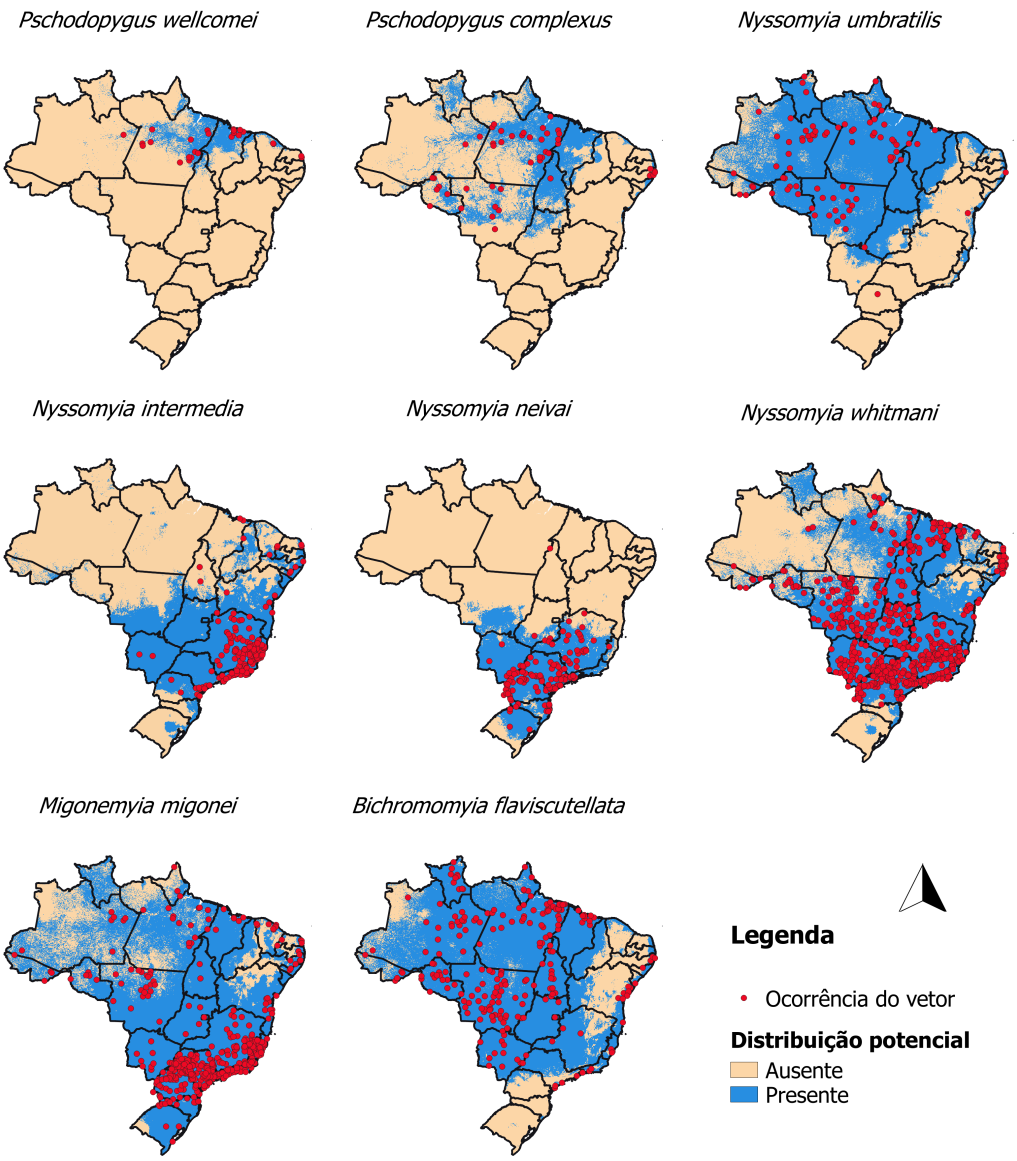


Figure 35. Potential distribution of American Cutaneous Leishmaniasis vectors in Brazil, according to ecological niche models based on climate, vegetation and elevation.

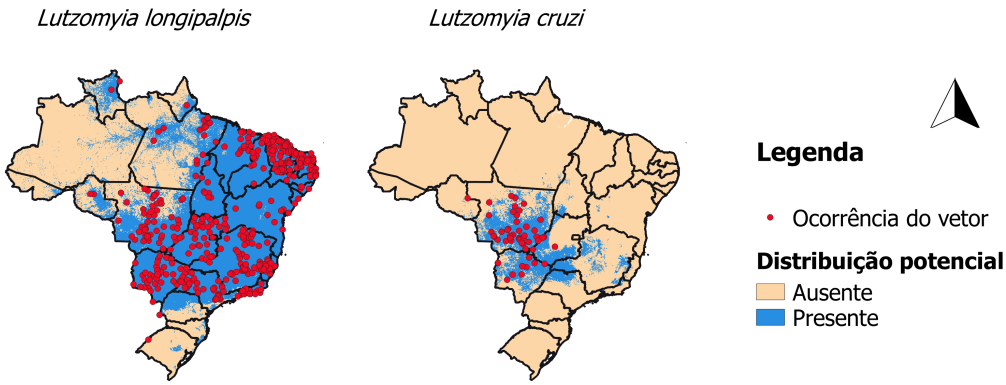


Figure 36. Potential distribution of American Visceral Leishmaniasis vectors in Brazil, according to ecological niche models based on climate, vegetation and elevation.

The potential distribution areas of the vectors in these current scenarios were overlaid with the potential distribution areas of the respective human diseases, ACL (Figure 35) and AVL (Figure 36). Of the 3451 Brazilian municipalities with human cases of ACL, only 922 have information

about the occurrence of their vectors. This divergence demonstrates the lack of vector information in the outbreaks of disease transmission. About 93% of the potential distribution area of ACL was overlapped by the potential distribution of its vectors (Figure 35). The remaining 7% indicate gaps in the knowledge of the vectors, especially in the Northeast and North regions (Figure 35). For AVL, about 68% of the potential distribution of the disease was overlapped by the potential distribution of *L. longipalpis* and *L. cruzi*, with the remaining 32% indicative of gaps in the occurrence of these vectors in the North and South regions (Figure 36). These shortcomings may represent a lack of field studies or insufficient published data.

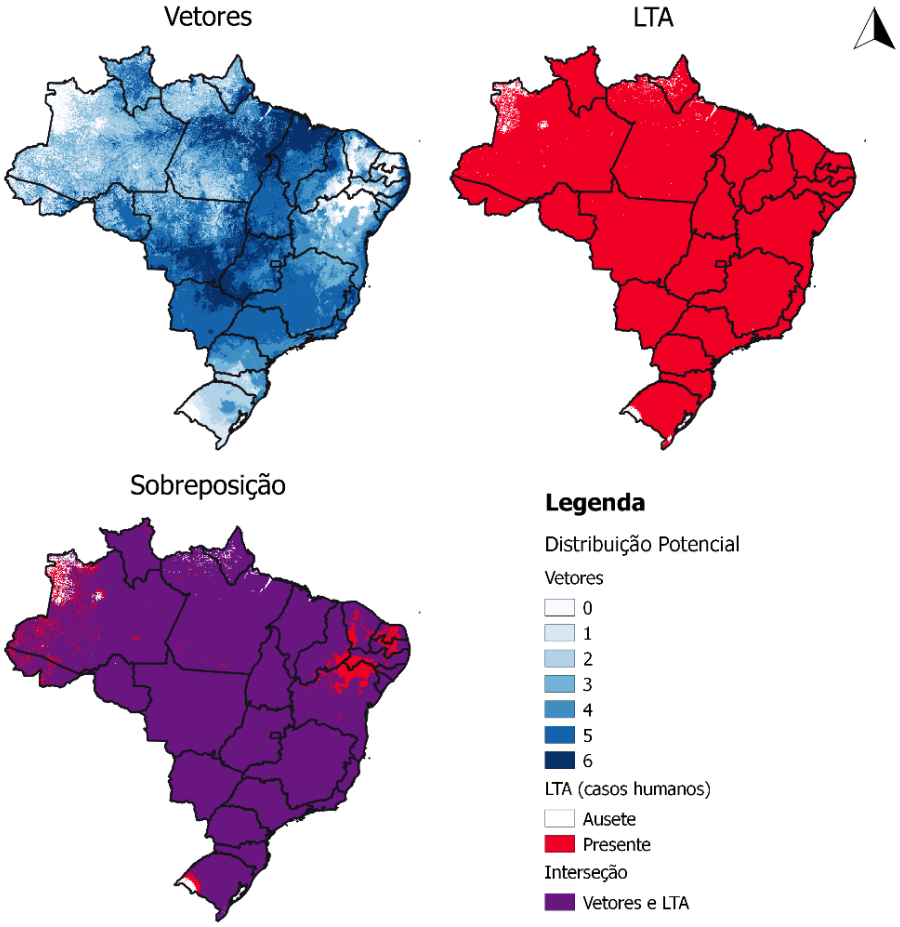


Figure 37. Overlap between potential distribution areas of the American Cutaneous Leishmaniasis vectors and human disease in Brazil, according to ecological niche models based on climate, vegetation and elevation.

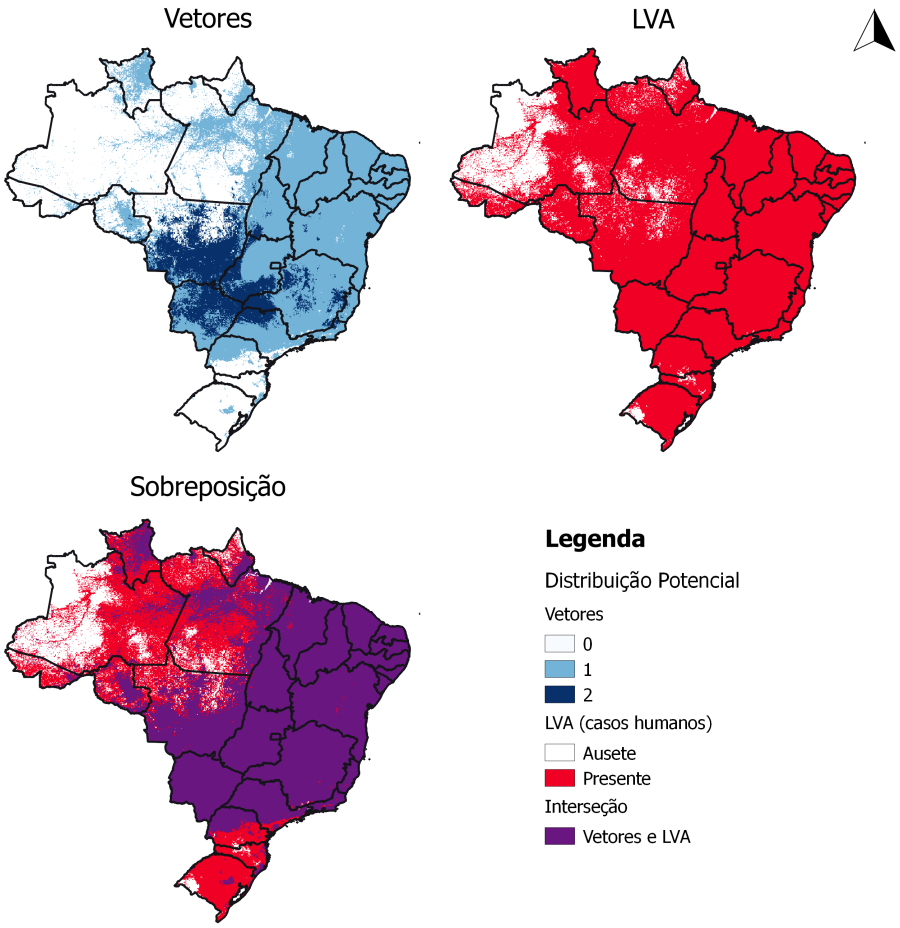


Figure 38. Overlap between areas of potential distribution of American Visceral Leishmaniasis vectors and human disease in Brazil, according to ecological niche models based on climate, vegetation and elevation.

In the state of Rio de Janeiro, human AVL was recorded in 23 of the 92 municipalities, with 2 municipalities with canine LV records since 2007, but without human cases (Mangaratiba and Maricá). The ecological niche model showed the potential distribution of *L. longipalpis* in 51 municipalities (Figure 39). Twenty-one vulnerable municipalities were identified, four of which were receptive, three were non-receptive, and 14 without entomological investigations (Figure 40). Approximately 60% of the municipalities do not have information about the phlebotomine fauna, which demonstrates the clear need for field studies.

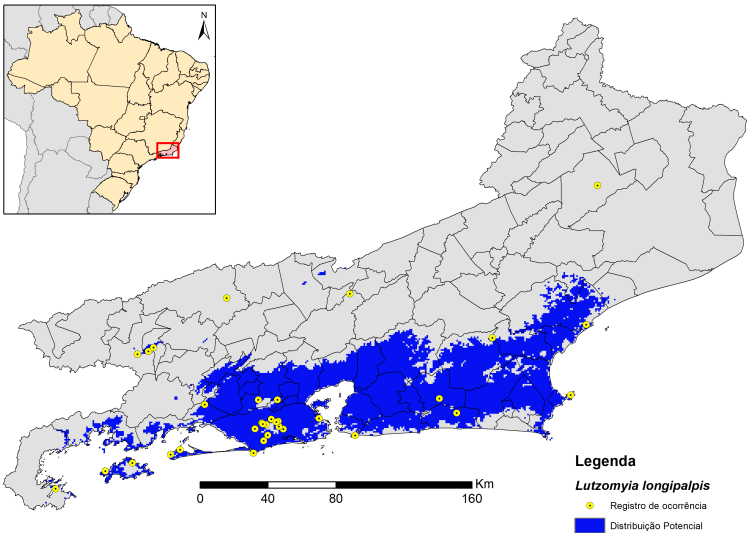


Figure 39. Records of occurrence and potential distribution of *Lutzomyia longipalpis* in the State of Rio de Janeiro.

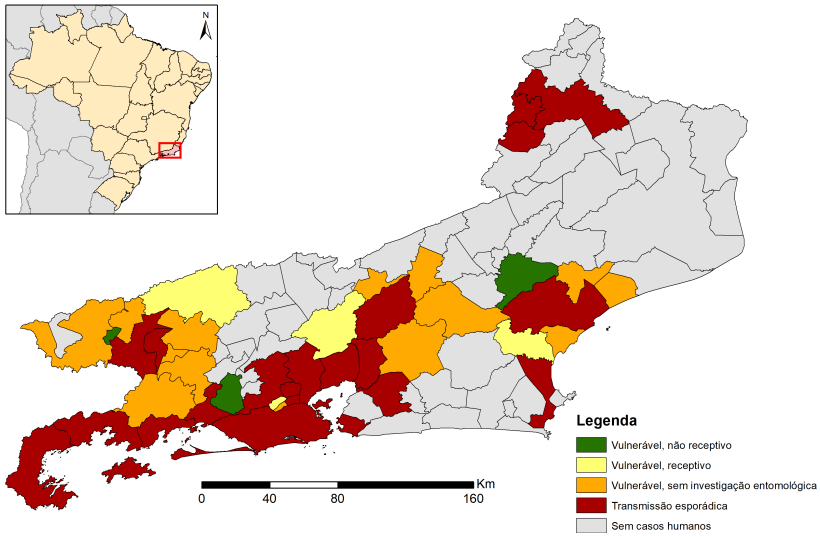


Figure 40. Classification of municipalities of the State of Rio de Janeiro according to the transmission of American Visceral Leishmaniasis. Green: vulnerable, non receptive; yellow: vulnerable, receptive; orange: vulnerable, without entomological investigation; red: sporadic transmission; grey: no human cases.

Areas of potential occurrence of *L. cruzi*, secondary vector of AVL, were identified in the Center-West Region of Brazil and neighbouring countries, especially Bolivia. Most of this area of climate and favourable habitats is located in the Brazilian states of Mato Grosso do Sul and Mato Grosso, where most of the known species records occur (Figure 41). Four known records of the vector fell outside the area predicted by the models: one in Bolivia (El Carmen) and three in the state of Mato Grosso (New Canaã do Norte, Colíder and Rondolândia) (arrows in Figure 42). Suitable areas without known occurrence of the vector are located in the Bolivian departments Santa Cruz and El Beni; south of the state of Goiás in Brazil, as well as in the north of Mato Grosso do Sul and in areas bordering the states of São Paulo and Minas Gerais (circles in Figure 42).

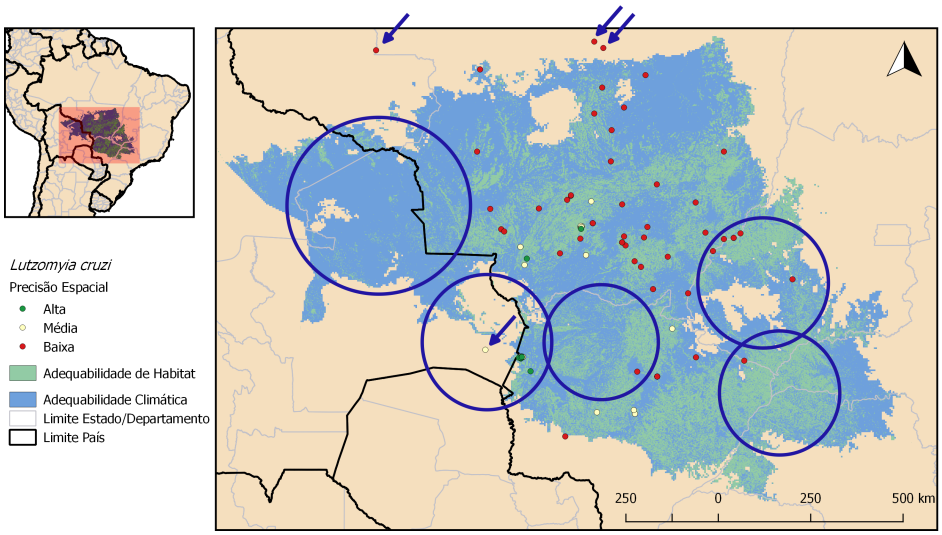


Figure 41. Potential distribution of *Lutzomyia cruzi* according to niche models and known presence records. Circles represent areas of environmental suitability that require further field studies to assess the occurrence of vectors. Arrows indicate records that were not predicted by the models.

The distribution of *L. whitmani*, the main vector of ACL in Brazil, was evaluated in association with the deforestation areas of the Legal Amazon. Of the 775 municipalities in the Legal Amazon, *L. whitmani* was detected in 216, associated with human cases of ACL. Areas of overlap between human cases of ACL and occurrence of *L. whitmani* associated to deforestation regions were identified in the states of Pará, Mato Grosso, Rondônia, Acre and Maranhão (Figure 42). Although having extensive deforested areas, the states Amazonas and Roraima did not present a significant correlation between human cases and vector occurrence, mainly due to the low frequency of the vector.

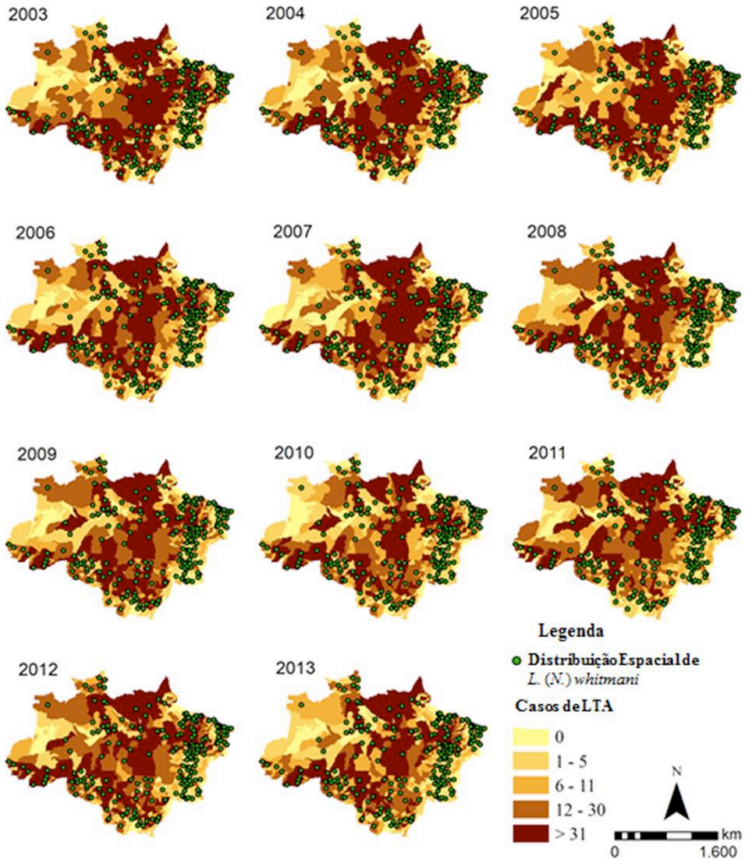


Figure 42: Temporal space profile of human cases of American Cutaneous Leishmaniasis in the Legal Amazon in association with spatial distribution of *Lutzomyia whitmani*, from 2003 to 2013. Map developed by the "Núcleo de Geoprocessamento LIS/ICICT/FIOCRUZ".

In order to know the geographical distribution and the amount of flooding and flash floods events in the past two years (2016/2017), a search on official websites on the number and location of occurrence of these events was performed in Minas Gerais (Figure 43). Next, large, medium and small municipalities were selected, which presented more relevant information about the selected events in the last two years, to integrate the research (the next stage of interviews depends on the interviewee's memory) (Figure 13).

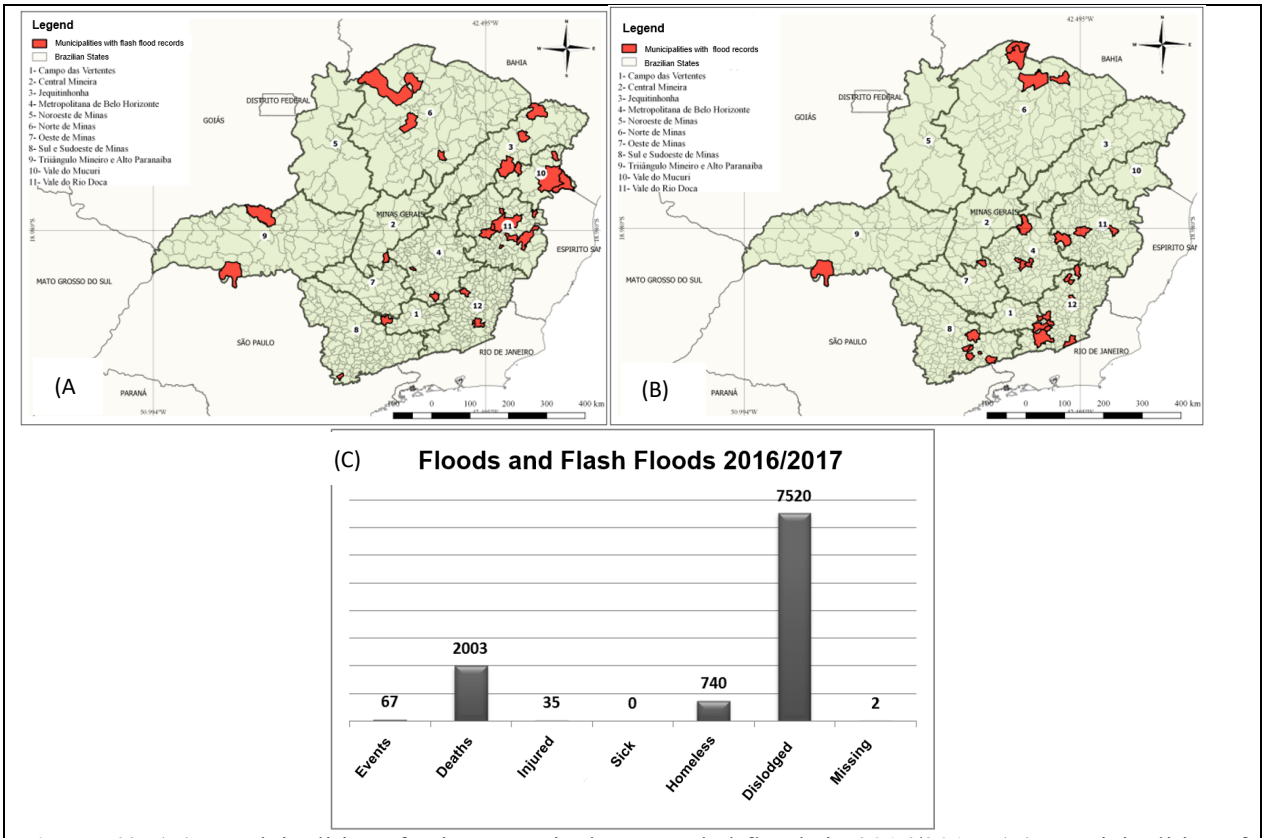


Figure 43. (A) Municipalities of Minas Gerais that recorded floods in 2016/2017; (B) Municipalities of Minas Gerais that registered flash floods in 2016/2017; (C) Flood and flash flood records in Minas Gerais in the years 2016/2017. Source: Integrated Disaster Information System – S2ID, 2018.

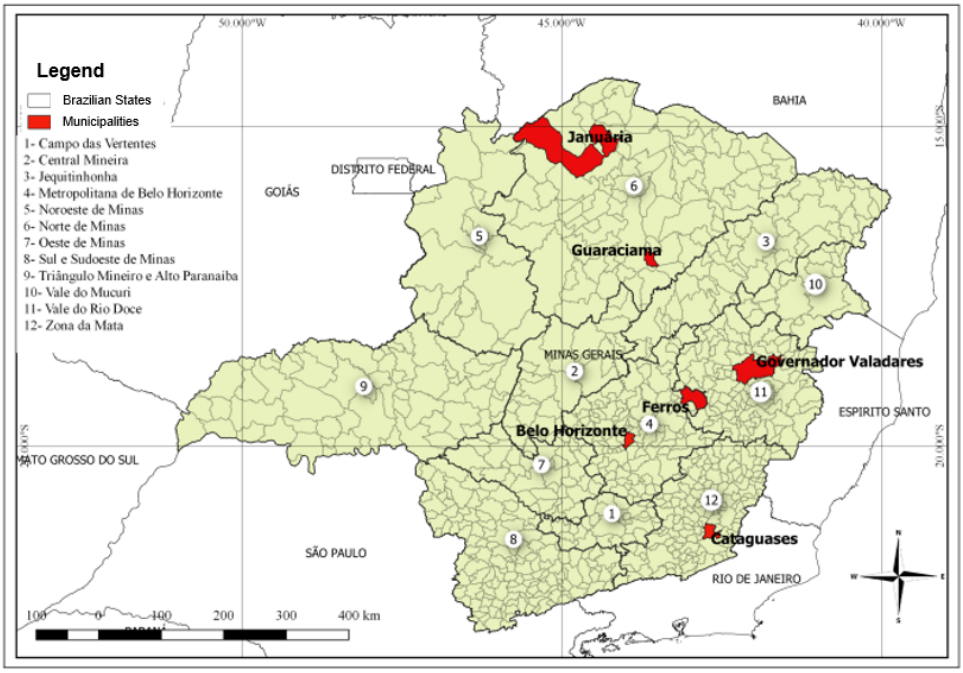


Figure 44. Municipalities selected to study the flow of health information in floods and flash floods.

Initially, the interview script was elaborated and applied to a pilot municipality (Sabará) in order to allow the adjustments necessary for the subsequent interviews. After this step, the interviews were conducted with professionals from the Civil Defense, Health Surveillance and Fire Department. The municipalities of Cataguases, Ferros and Guaraciama do not have a unit of the fire department in the municipality; was necessary the displacement to other municipalities in order to guarantee that the units of the fire

department responsible for these localities were interviewed, then (Leopoldina, Itabira and Montes Claros respectively). The interviews conducted in the city of Belo Horizonte will be held in June 2019 due to the need to submit the project to the Ethics Committee of the city of Belo Horizonte. Ferros, for its proximity to the state capital, will be visited at the same week of the interviews in Belo Horizonte.

Table 1. Schedule of interviews.

Municipality	Schedule			
	2018		2019	
	Nov.	Dec.	Jan.	Feb.
Sabará (Pilot)	x			
Governador Valadares		X		
Itabira			X	
Guaraciama			**X**	
Montes Claros			X	
Cataguases			X	
Leopoldina			X	
Januária				X
Belo Horizonte		Still to be defined		
Ferros		Still to be defined		

For the second year, the project related to the drought and health index raised the main variables related to vulnerability in the semi-arid region, considering the scientific literature. The studied area, treated as a pilot, approached 65 municipalities in the states of Pernambuco, Piauí and Bahia. Twenty-two variables covering socio-demographic (income, urbanization, vulnerable groups), epidemiological (infectious diseases, hospitalizations, mortality and hospital beds), water use (potability, sanitation, type of use) and environment (demographic density, vegetation cover, drought index) aspects were compiled. Factor analysis showed that the first five factors explained 85.99% of the variance, and these have been retained. The configuration of the variables in each factor allowed to classify them in the following dimensions: i) social health infrastructure (factor 1); (ii) demographics and infectious diseases (factor 2); iii) environmental health (factor 3); iv) socioenvironmental dengue (factor 4); and v) water availability and health (factor 5).

The matrix rotated with the five retained factors is shown in Table 2. In substantive terms, the first factor is related to variables V1 to V6 representing the social dimension of the health infrastructure. Note that this factor is strongly and positively related to variables V1 (hospital beds), V4 (rural vs. urban ratio), V5 (income) and V6 (sanitation), but strongly and negatively related to variables V2 (malnutrition) and V3 (probability of dying before the age of 40). The second factor consists of the variables V7 to V11 and configures the demography and infectious diseases dimension. It is positively related to the variables V7 (visceral leishmaniasis), V8 (skin infections) and V10 (infant population), while negatively associated with V9 (elderly population) and V11 (female heads of household). The third factor refers to variables V12 to V16 and concerns the environmental aspect of health. All variables showed a positive association with factor 3 (V12 - asthma, V13 - mental disorders, V14 - infant mortality, and V16 - water consumption), except for V15 (forest cover). The fourth factor comprises variables V17 to V19 related to the socioenvironmental aspects of dengue. All the variables that compose it are positively related (V17 - dengue, V18 - demographic density, V19 – droughts). Finally, factor 5 connects variables V20 to V22 designating water availability and health (V21 - basic care, V22 - quality and supply of water), in which only V20 (hepatitis) is negatively associated.

Table 2. Rotated varimax matrix showing the loads of each variable used by extracted factor and its commonalities.

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Commonalities
V1 (hospital beds)	0,53874	-0,04145	0,01248	-0,12236	-0,01013	0,307
V2 (undernutrition)	-0,64774	0,04608	0,31335	0,02798	0,13701	0,539
V3 (probability of dying before the age of 40)	-0,65512	0,1539	0,0209	-0,29756	-0,18104	0,575
V4 (rural x urban ratio)	0,69611	-0,18518	0,06469	-0,34891	-0,02113	0,645
V5 (income)	0,55171	0,06282	-0,51859	-0,42134	0,17425	0,785
V6 (sanitation)	0,64679	-0,24293	-0,25143	0,12861	0,18599	0,592

V7 (visceral leishmaniasis)	-0,38277	0,45997	0,21145	-0,01965	0,14988	0,426
V8 (skin infections)	-0,18914	0,4937	0,32795	0,20103	-0,21567	0,474
V9 (elderly population)	0,04177	-0,85757	-0,0901	0,02986	-0,00164	0,746
V10 (infant population)	-0,13334	0,8179	-0,31281	-0,01668	0,05345	0,788
V11 (female heads of household with no education)	0,06206	-0,56892	-0,21012	0,30695	0,25531	0,531
V12 (asthma)	-0,26729	-0,02018	0,51826	0,41728	0,15749	0,539
V13 (mental disorders)	-0,13957	0,34719	0,6575	0,05522	-0,04543	0,577
V14 (infant mortality)	-0,13438	0,30063	0,32882	-0,05571	0,15767	0,245
V15 (forest cover)	-0,12638	0,05934	-0,54295	0,00643	-0,03843	0,316
V16 (per capita water consumption)	-0,16662	0,01665	0,37709	-0,11149	-0,10703	0,194
V17 (dengue)	-0,11092	0,21544	0,3039	0,46107	-0,03942	0,365
V18 (demographic density)	0,25566	-0,24809	-0,00268	0,67303	0,24874	0,642
V19 (drought)	-0,11888	-0,074	-0,14818	0,47617	-0,17475	0,299
V20 (hepatitis)	-0,14548	0,03473	0,1712	0,06529	-0,52046	0,327
V21 (basic care cover)	-0,37008	0,36779	-0,11245	-0,20802	0,3894	0,480
V22 (supply/demand and quality of water)	-0,0877	-0,0248	0,29678	0,11446	0,55434	0,417

The construction of the Vulnerability Index of Drought and Health (VIDH) was based on the results obtained in the factorial analysis. The loads obtained in each factor were considered to assemble the regression equations and generate the values of the indices. For comparison, the generated indices were standardized to values ranging from 0 to 1, where 0 indicates less vulnerability and 1 greater vulnerability. The factor loads allowed the discrete identification of five aspects of human health vulnerability to drought from the spatial variation of the indices generated. These factors include the dimensions observed in the factorial analysis, such as health and socioeconomic infrastructure (factor 1), demography and infectious diseases (factor 2), environment and health (factor 3), socioenvironmental and dengue (factor 4) and water availability and health (factor 5) shown in Figure 45. It is worth remembering that these dimensions do not represent precise categories; only show the key indicators or variables that define each of the five retained factors and thus the five indices of health vulnerability to drought. The factors of health infrastructure (factor 1), demography and health (factor 2) and water availability (factor 5) are more prevalent in the municipalities of Piauí, while the environmental and health aspects (factor 3) and socioenvironmental and dengue (factor 4) were also distributed, with greater emphasis, in the municipalities of Pernambuco. Figure 46 shows the distribution of VIDH values according to the five factors extracted in the factorial analysis.

Figure 46 shows the behaviour of the factors for the municipalities that recurrently appeared in the highest categories of vulnerability according to the maps of Figure 45. Petrolina and Juazeiro, for example, presented medium loads for practically all factors. In Petrolina, factors 2 (demography and infectious diseases) and 3 (environment and health) can be considered as the most relevant to explain human health. For Juazeiro, factors 2 (demography and infectious diseases) and 5 (water availability and health) were preponderant. In general, Piauí was the one with the highest number of municipalities in higher categories of vulnerability (Figure 47), being also the ones that represented the highest and lowest scores among the factors. In Figure 46, it can be seen that the municipalities of Massapê do Piauí and Queimada Nova showed similar profiles, with factor 1 (health and socioeconomic infrastructure) and 4 (socioenvironmental and dengue) being the most important. In Francisco Macedo, factors 3 (environment and health) and 5 (water availability and health) were fundamental to increase the vulnerability of human health to drought.

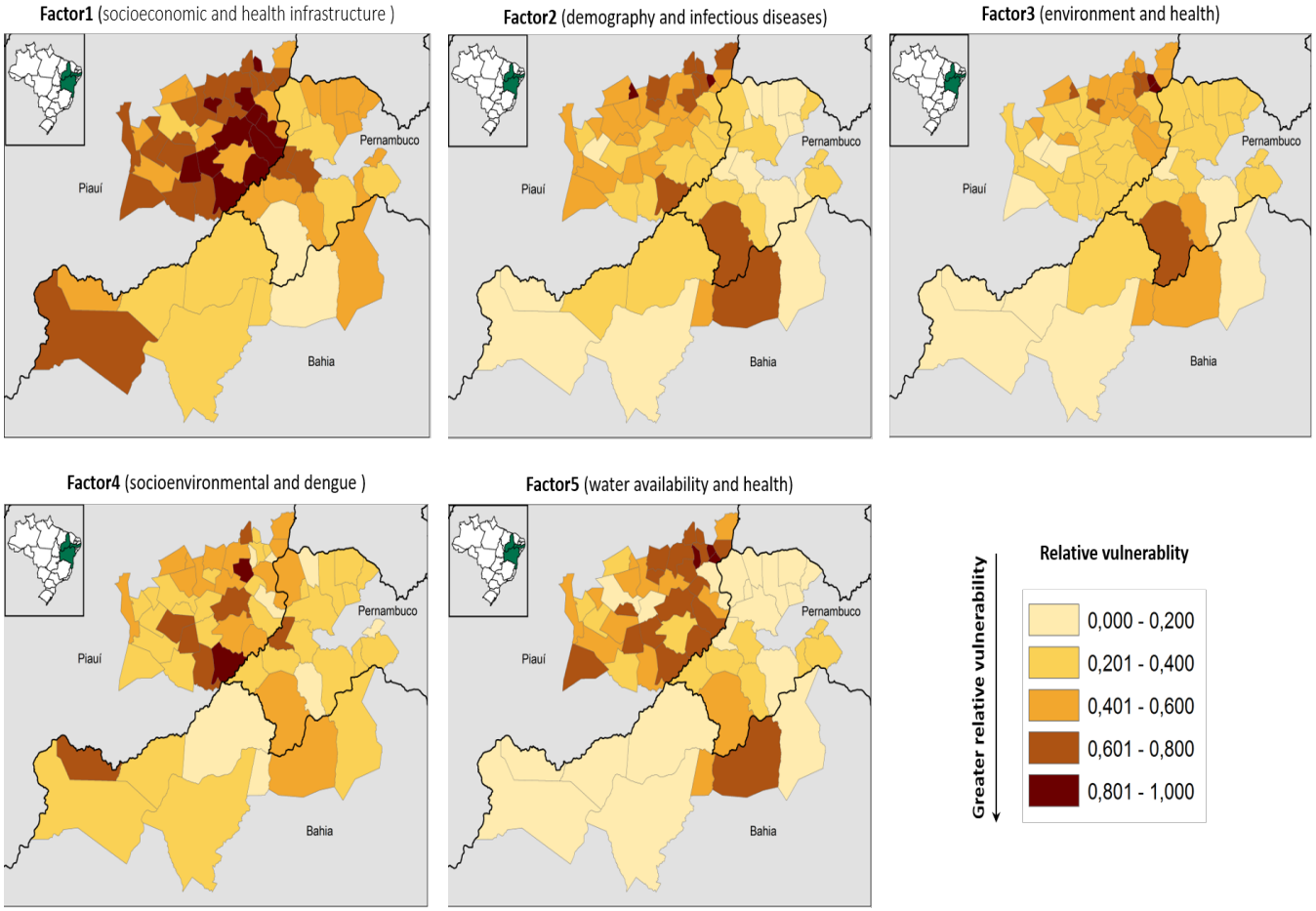


Figure 45. Distribution of the values of the indices formed by the regression of factors 1 to 5 for the 65 municipalities studied in the states of Piauí, Pernambuco and Bahia.

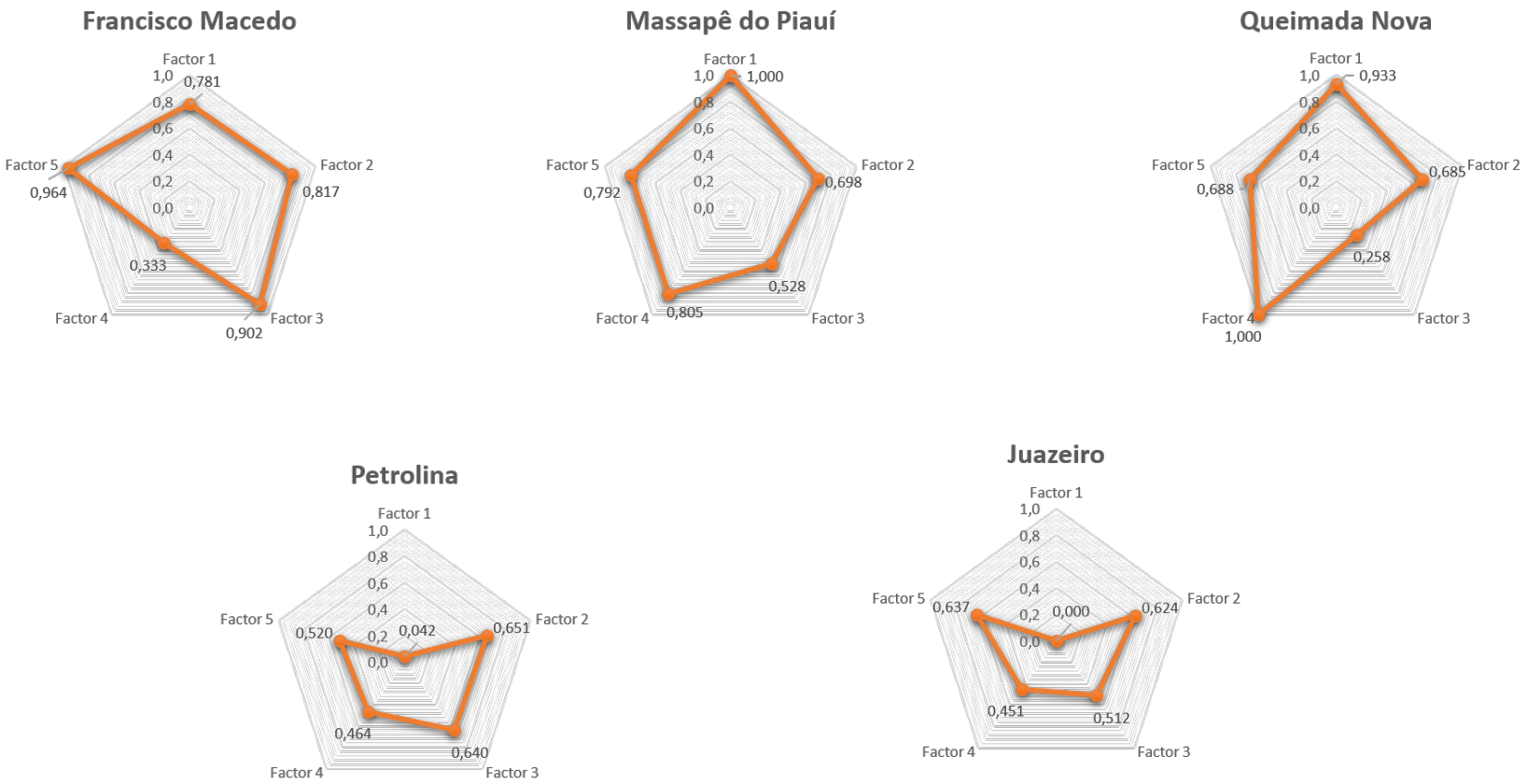


Figure 46. Radar charts showing the values obtained in the five factors extracted in the factorial analysis for some of the municipalities that recurrently appeared in the highest categories of vulnerability.

5.7 Economy and impacts in key sectors

The objective of the subcomponent remains the same:

"To provide policymakers and society in general with quantitative results of rating studies of the economic costs associated with impacts of climate change, to subsidize a more systematic way, the design of sectorial and global public policies aimed at reducing climate vulnerability."

We have focused on the development of integrated modelling approaches to generate quantitative results associated with the impacts of climate change. We continued to focus on two areas that received more attention in year 1: (i) dealing with uncertainty in agriculture productivity models and the implications for economy-wide impacts; and (ii) exploring the effects of climate on demographic variables, mainly fertility rates and, now, health.

We have also started the development of specific projects within the INCT Climate Change Project, complementing the funding received. In this context, the following projects funded by Fapesp should be mentioned: (i) "Urbanização e Mudanças Climáticas: Análises de Impacto na Região Metropolitana de São Paulo" (Doctorate, 2018/08833-5, granted); (ii) "Agricultural and Agro-Industrial Sustainability in Chile: Modeling the Impacts of Climate Change and Natural Disasters in an Integrated Framework" (CONICYT - Regular Research Project, 2018/08337-8, granted); (iii) "Fertility and Inequality: Evidence from Brazil " (Fellowship Abroad, 2018/06782-4, granted); (iv) "Uma Análise Espacial de Impacto da Acessibilidade à Água na Produção Agropecuária do Semiárido Brasileiro" (Scientific Initiation, 2018/11799-3, granted); (v) "The Economics of Low Carbon Markets – 2018" (Scientific Event Organization, 2018/17781-9, granted); (vi) "Assessing the Climate and Weather Effects in Brazil using Panel Data" (Fellowship Abroad, 2018/02081-1, granted).

We have also succeeded in receiving additional funding from Instituto Escolhas for master and Ph.D. students: (i) "O impacto da crise hídrica no sistema público de saúde da Região Metropolitana de São Paulo", Tales Rozenfeld (Ariaster Chimeli); (ii) "Transição florestal e instituições: evidências dos últimos 50 anos no estado de São Paulo", Keyi Ando Ussami (Ariaster Chimeli); (iii) "Choque China: efeitos sobre saúde e meio ambiente no Brasil", Victor Simões Dornelas (Ariaster Chimeli); and (iv) "Mudanças Climáticas e Secas no Brasil: Uma Análise Espacial Integrada a partir de Modelos IEGC e Monitoramento Climático no Semi-Árido Brasileiro", Bruno Proença Pacheco Pimenta (Eduardo A. Haddad). And there is a member of the group with a CNPq scholarship from Rede Clima: "Modelagem Integrada de Sistemas Econômicos e Hidrológicos com Base nas Unidades de Planejamento Hidrográfico do Brasil", Ademir Antônio Moreira Rocha (Eduardo A. Haddad).

In December 2018, we have organized a workshop in Chile together with colleagues from Universidad Adolfo ibañez, in Viña del Mar, on "International Workshop on General Equilibrium Modeling: Applications for the Chilean Economy". The workshop was the first event of a project cofounded by Fapesp and Conicyt. The project is linked to our INCT MC Phase 2 and proposes to replicate some of the INCT-MC Phase 2 features in the Chilean case. Given the focus of the call, we plan to adapt one of its sub-components ("food security") and one of its transversal themes ("economy and impacts on key sectors") to Chilean agroindustry. During the three-year period of the project, we plan to address issues related to the topic Environmental Sustainability vs. Food Production.

Following-up on the INCT-MC meeting hosted at FEAUSP, on November 30, 2018, when we foresaw potential for interactions with the "Natural Disasters" subcomponent on issues related to urban mobility, we had a meeting hosted by CEMADEN on February 26, 2019. We have agreed to

collaborate on a study using the Uber database and also, on the study on drought in the Brazilian semiarid.

Plans for the third year include further approximation with researchers from the subcomponent "Water Security", to develop joint projects. Moreover, the FAPESP granted scholarship abroad for Paula Pereira Pereda, to develop the project "Assessing the Climate and Weather Effects in Brazil using Panel Data" at Yale University, has provided additional incentives to integration with other areas of the INCT, mainly related to health and agriculture. Finally, a recent FIPE's project with Uber is about to grant us access to the Uber Movement database stimulating the integration with the subcomponent "Natural Disasters". The signature of the protocol between NEREUS and Uber to have access to the data is in its final stage. In addition to researchers at USP, researchers at CEMADEN will have access to the data to write a collaborative paper on the effects of climate on urban mobility and the associated economic costs.

The regionalization method has been tested and implemented in different countries (Figure E.12). The work was developed in collaboration with USP, CEMADEN, IPEA, and INPE.

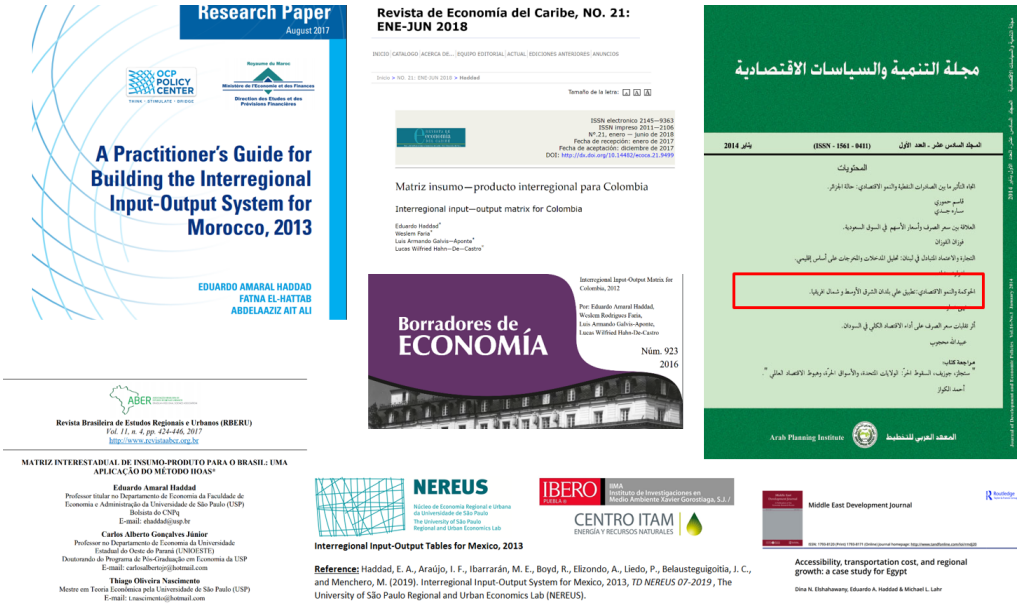


Figure 47 Applications of the regionalization method for different countries developed by the research team (Brazil, Morocco, Mexico, Colombia, Greece).

Team members

In year 2, the following members were included:

- ✓ Ariaster Baumgratz Chimeli, USP
- ✓ Danilo Igliori, USP
- ✓ Paula Pereda, USP

They are all faculty at the Department of Economics at FEAUSP working with different aspects of climate change.

Prof. Chimeli works with Environmental Economics and his research is closely related to different aspects of the project. Danilo Igliori is an Urban Economist and he has interest in modeling land use in urban areas. Paula Pereda has interests in assessing different impacts of climate using econometric models; her research on climate and health is particularly important for the project.

5.8 Modelling the earth system and production of future climate scenarios to study Vulnerability, Impacts and Adaptation

During this period, BESM2.5 piControl and Abrupt4xCO2 runs completed 1,000+ years of integration, revealing the eventual reduction, and then restablishment of the Atlantic Meridional Overturning Circulation (AMOC). Figure 49 shows the time series for both experiments, depicting the stability of the model outputs for sea surface temperature, global mean, and the abrupt changes of salinity in the region of deep water formation over the North Atlantic (North Atlantic Deep Water – NADW). The main results of these experiments are presented in a manuscript, being prepared).a.1.2 CMIP6 scenarios with the new version of BESM (version 2.9) are being computed. BESM 2.9 has already been integrated for 100 years under pre-industrial CO2 atmospheric concentrations and the results presented at CMIP6 Model Diagnosis Workshop in Barcelona, Spain in March 2019.The negative sum of monthly precipitation anomalies, both of observation and climate change scenario computed by BESM is presented in Nobre et al (2019) as a pressing evidence of the importance of adaptation measures to be taken to confront with climate conditions, present and future. Also, in the period of this report, the Brazilian Earth System Model, coupled ocean-atmosphere-cryosphere-biosphere (BESM-OA2.9) has reached its version 2.9, which includes the coupling of the most recent version of INPE's CPTEC global atmospheric model, BAM1.0, to NOAA/GFDL ocean global model MOM5 via the Flexible Modular System (FMS).

The Eta model code has been modified by removing all common blocks and replaced by module calls. This new version of the model enables easier coupling of new physics processes; (b) The restart functionality of the model is revisited in order to operate with the FMS coupler. This will enable the coupling with the MOM5 ocean model; (c) The previous GFDL radiation scheme was replaced by the RRTMG radiation scheme; The RRTMG scheme is further coupled with the convection scheme (Figure 50). (d) The previous NOAH-MP land-surface scheme is replaced by the NOAH-MP scheme (Figure 50). (e) The dynamical vegetation scheme is being coupled into the Eta model code. (f) Reclassification of the new European Space Agency vegetation map into the INLAND scheme vegetation types and into the NOAH-MP vegetation classes. The Eta model version to be applied to generate the climate change projections, with the new SSPs is shown in Figure 50. It is clear the large reduction in the surface incoming shortwave radiation. The replacement of the land-surface from NOAH to NOAH-MP scheme still requires some fine-tuning of the land-surface properties. Precipitation evaluation against observations (GPCP) shows larger underestimate, especially over the Amazon region.

The Regional Earth System Model (RESM), based on the Eta Regional Climate Model, is being developed in parallel with the BESM. The Eta has the restart functionality of the model revised in order to operate with the FMS coupler as used by BESM. Other physics processes, such as radiation, land-surface, and dynamic vegetation, have been coupled and updated in the Eta RCM (Figure 51). The modifications follow the new coding structure of the model.

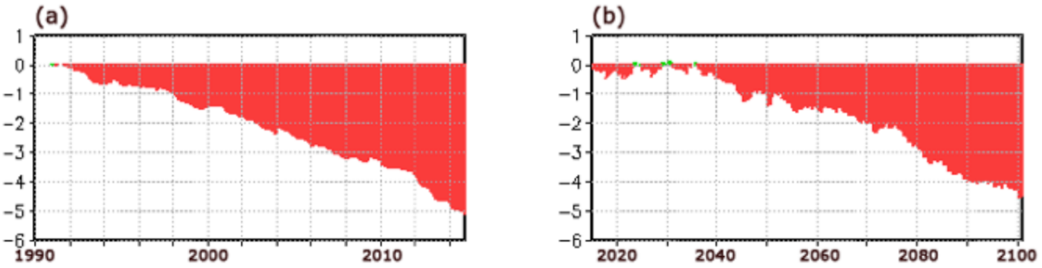


Figure 48 – Summation of monthly anomalies of mean precipitation for the Northeast Brazil from January 1991; (a) observations for the period January 1991 to December 2015; and (b) simulated by the BESM2.5 model for future atmospheric CO2 concentration for the RCP 4.5 scenario between 2005 and 2100. Unit: 1000 liters/m^2. Source: Nobre et al (2019, in press)

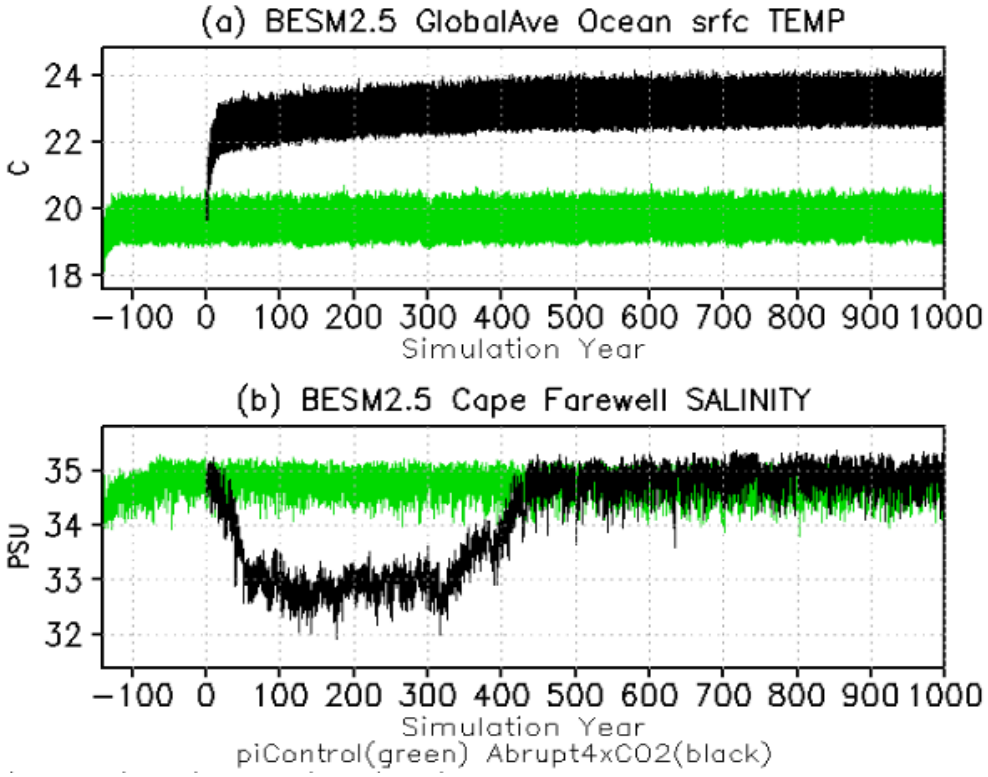


Figure 49 – 1147 years (piControl) and 1000 year (Abrupt 4xCO2) BESM2.5 experiments showing (a) global mean ocean surface temperature and (b) Cape Farewell (Greenland) salinity time series. Source: Nobre et al (2019, in press)

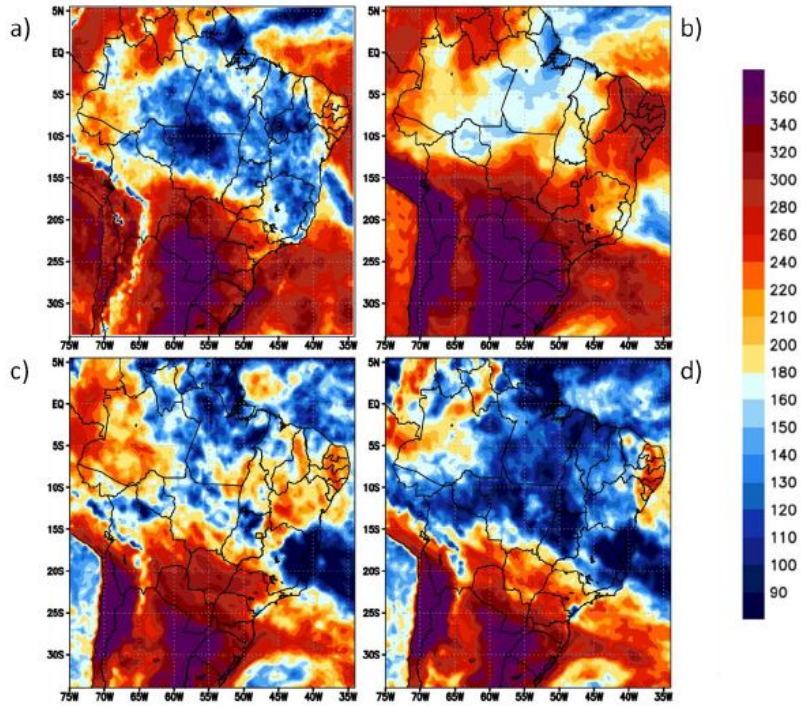


Figure 50 – Incoming shortwave radiation at the surface (W/m²): estimated by GL model (a), simulated by the Eta-GFDL (b) simulated by the Eta-RRTMG, and simulated by Eta-RRTMGwith coupling with convection . Values are averaged between 01/12/2018 and 05/12/2018.

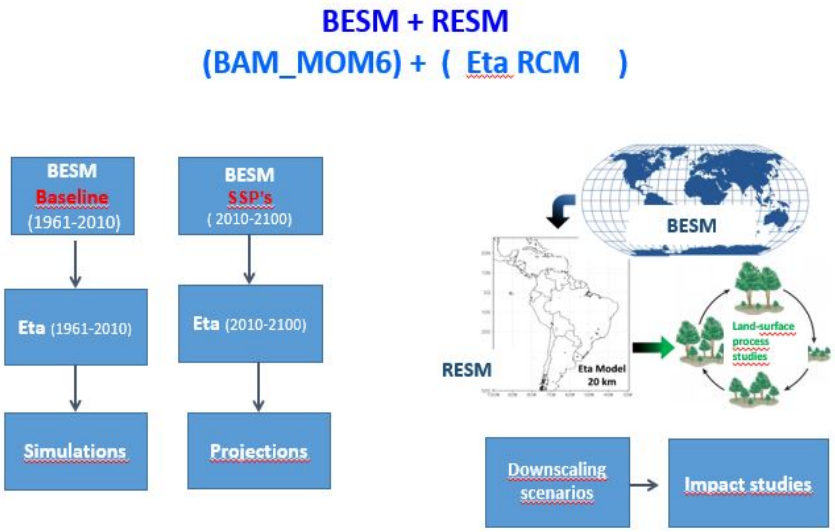


Figure 51 Model strategy for the BESM and RESM runs for this component for future clomate change projections.

Figure 51 – Precipitation (mm/day) simulated in January by (a) Eta-NOAH; (b) Eta-NOAH-MP; (c) GPCP; and simulated in July Eta-NOAH; (g) Eta-NOAH-MP; (f) GPCP

5.9 Communication, dissemination of knowledge and education for sustainability.

The evaluation of the political efficacy of scientific communication and education regarding climate change, in this transversal theme, has involved studies with different approaches, from cultural studies, cultural pedagogy, discourse analysis, social studies of the sciences, anthropology, history and philosophy of science, and has shown the need to complicate the attention given to

television programs, news, interviews, documentaries, works of art, presentations at events, arenas of debates, negotiation tables, daily conversations, etc. This is because the climatic problem is also a problem of words, images and sounds, of tiredness and impotence of the narratives. What has implied since the analysis of which words, images and sounds are selected to be presented and noted, the evaluation of the narrative, discursive and sensorial functions of the various materials, the problematization of the modes of composition and configuration of the media and messages and the perceptions which are generated from climate change, science, environment, sustainability, human and future.

The work developed by this transversal theme in this direction, in this period, indicates that bets that seek to persuade and convince the public can result in a simplification of a supposedly didactic nature that prevent an effective dialogue on human activities and the future of the planet. Among other problems, what is shown and presented to convince and persuade the public often falls to words, images and sounds in which the human appears separated, above and outside nature, marked by denunciations and judgments, abstractions and generalizations, in which the human being is placed as a villain or saviour. This anthropocentric perspective predominates in the communication of science based on the same ontological and epistemological assumptions that have generated the climate crisis. In the context of the dissemination of social technologies, for example, it is perceived that the gender dimension has been neglected and that such neglect ratifies productivity logics that are reflected in policies, texts and debates that exclude the role of caring, women. In this paper, we present the results of the strong and problematic presence of dualisms, already widely identified in environmental communication (life-death, creation-destruction, freedom-slavery, global-local, science and traditional knowledge, etc.), indicates the need for new assessments dealing with related singularities to climate change communication.

Since scientific discourse is the basis of climate change argumentation, the bets on persuasion and public persuasion end up generating perceptions of climate-related sciences that transform possibilities into certainties, probabilities into determinations, and call into question the relationship between science, truth, and power. Unlike the bets of persuasion and persuasion, this cross-cutting theme has articulated dissemination and research in the quest to generate new ways of thinking and experiencing communication in which it is not a question of communicating a given, inert, ready, finished world, but of entering into communication with worlds in motion, uncertain and changeable. The articulations between climate scholars, scholars of the humanities and artists have opened up new possibilities for thinking about human dimensions and possibilities not anthropocentric of generating new ways of sensitizing to climate change, particularly in the so-called multispecies studies, post-human studies, epistemologies, post-structuralist philosophy, among others, which call for more experimentation and research related to communication, education and climate change.

Creating collectively images that generate new sensibilities and escape of the environmental catastrophic perspectives of the mass media. It is one of the aim of the Transversal Theme of Communication. Figure 52 shows an image resulting from workshop with embroiderers, with the background as the time series of projections of global warming.

Figure 52. Perception of global warming by embroiderers

Activities

- General meetings of the team of researchers on the cross-cutting theme Communication;
- Implementation of FAPESP TT3 scholarship to conduct interviews with researchers of all subcomponents and crosscutting themes of INCT for the production of journalistic material (news, interviews, reports, etc.) for ClimaCom magazines, ComCiência and the future INCT website. Dr. Mario Mendiondo, from the sub-component "Water Resources", and Dr. Paulo Artaxo from the Subcomponent "Ecosystems" have already been interviewed.
- Launch of three dossiers of ClimaCom Magazine - "Dialogues of the Anthropocene" (Aug 2018); "Inter / Transdisciplinarity" (Dec 2018) and "Mycelial Fabulations" (Apr 2019) with articles, essays, reviews, signed column and artistic and cultural productions. Book launch: DIAS, S .; WIEDEMANN, S .; AMORIM, A. C. (Org.) Deleuze and Cosmopolitical Connections and Radical Ecologies and New Earth and ... Campinas: ALB, 2019.
- Encouragement to the researchers of the other sub-components and crosscutting themes to be published in the section Signed Column of the journal. It has been already published an article by Dr. José Marengo.
- Continuum Preparation of the national report on communication and climate change, which will be finalized in August 2019 in the format of the book: "Endless Conversations: Scientific Communication and Climate Change and..". The book will deal with themes such as negationism, public participation, human dimensions, the common world, etc. from the perspective of human sciences, philosophy and the arts.
- Dissemination of the public poll "Climate change in Bariloche: a survey of public perception" by networks and local media as part of the project of the student Laura García Ovied, named "Public perception of climate change" gives a Master's Degree in Science, Technology and Innovation from UNRN directed by Prof. Dr. Sandra Murriello.
- Elaboration and presentation of projects to get other funding (look up item related to other projects).
- Production of articles, abstracts, extended abstracts, presentations of works in events from the researches done individually or in groups.
-

Due to the involvement with other activities and the impossibility of participating in the actions of the transversal theme of communication of INCT Global Climate Change, the following researchers left: Profa. Dr. Denise Nacif Pimenta, Prof. Dr. Paulo Teles (IA / Unicamp), Profa. Dr. Raquel Wiggers (UFAM) and entered the researcher Prof. Dr. Wenceslao Machado de Oliveira Júnior (FE / Unicamp) and Francis Lacerda (Instituto de Pesquisa Agronômica de Pernambuco/ IPA-Recife/PE). Being today the group of researchers of the Transversal Theme "Communication" thus constituted.

5.10 Coordination

The two coordinators Jose Marengo and Tercio Ambrizzi have meet during year 2 in several occasions, some of these meetings took place USP, and other during other meetings and conferences where we both were there. The coordinators have presented the INCT MC Phase 2 in various national and international events relevant to global change, among them two public audiences in the *Camara dos Deputados* and the *Senado* of Brazil in June 2019.

For the administrative issues, CEMADEN hired Ms. Josiane Rosa, who is working part-time dedicated to this project. Ms Rosa helps the coordination with the procedures to indicate *bolsas* to CNPq, CAPES and FAPESP, with payments, meetings organization and air travel arrangements for participant scientists to meetings among INCT MC Phase 2 participants. Due to the delay in the decision of the approval of the project since 2014, Dr. Marcos Foliador from Way Carbon, the private organization that would work with us, left Brazil and moved to Italy and left the project and so we have no longer collaboration with Way Carbon.

6 Integration among components of the project in Year 2

As previously described in the sub components and cross-cutting themes, there is convincing evidence that our climate is changing, and that emissions of greenhouse gases from human activities are partly responsible for these changes and decisions in different sectors of society. The economy will need to take into account and manage the risks associated with climate change. It is also known that climate change is also a source of uncertainty for decision makers, due to the limitations of our scientific knowledge about the dynamics of the Earth system and how the climate will respond to anthropogenic forces at different scales. At the same time, there are trends and evidence of global environmental changes exceeding the limits of the planet, with increased risk for society to advances in the science of climate change models and allow us to be sure to present and future modifications.

So the challenge of the INCT MC Phase 2 will be to provide an integration of all six components and three cross-cutting themes through dialogue and workshops, for a better understanding of the impacts and benefits arising from current climate variability, and help to think of ways to reduce the uncertainty surrounding the consequences of future climate change scenarios.

The new observations and projections of climate models and future scenarios of climate change should be placed in the context of these established thresholds and integrated assessment of adaptation options and pathways.

This task of coordination can help decision makers to recognize and assess the risks arising from a change in climate, making the best use of available information on climate change, its impacts and appropriate adaptive responses as a project of true integration. In the initial proposal we planned various workshops (total of six), which will lead to the preparation of documents and reports that to guide the upcoming workshops. Due to budget constraints we decided to have 5 workshops starting on 2019 until 2023.

So far, in year 2 various workshops took place among individual components and collaboration between two or more sub components to adjust to the reality of a budget cut, and in some cases to redefine the specific objectives, with some new people coming and other leaving the project due to retirement, changing institution or to inability to wait for almost 3 years since the time of submission to the time of the formal approval.

Lastly, Prof. Jailson Andrade from the UFBA came with the initiative of having Meetings of Coordinators of INCTs, to discuss synergies, collaboration and also problems related to logistics

and procedures with the funding agencies. The first meeting took place in October 2018 in Brasilia. These meetings will take place once a year.

7 Plans for Year 3 of the project

7.1 Food security

Product 1: Elaborate a typology of agricultural establishments for Mata Atlântica, Cerrado and Amazônia biomes, that discriminates the main single, integrated and diversified production systems;

Product 2: Analyze the relationship between the main types of agricultural establishments (Product 1) and the stage of soil preservation;

Product 3: Analyze the impacts of the adoption of integrated and / or diversified systems (Product 1) on the total value of production and yield of the agricultural activity;

Product 4 (optional, depending on the availability of time) - Analyze the climatic resilience of the types of producers (Product 1), ie the sensitivity of production to climatic variations;

7.2 Water security

Developing hidrometeorological scenarios under Climate Change conditions, considering potential reforestation (proposed by INPE and UFRJ partners)

Implementing TT4 Fapesp grant to apply hydrological routing and assessment of streamflows´ impacts.

Host the 2019 Joint INCTMC2 - CAPES SASW&SC Modules (under alliance of Graduate Programs of UFPE, UFCG and EESC-USP): “Modeling Under Uncertainty” (August, 2019), “Climate Change and Uncertainties” (Sept, 2019), “SWATPlus Modelling Under Climate Change” (Sept, 2019), “Economy and Social Nexus” (Sept., 2019), "Civil Protection to Water Hazards” (Oct., 2019), “Socio-Hydrology Follow Up” (Dec., 2019); final program to be available at: www.eesc.usp.br/ppgshs

Attendance at 27 IUGG General Assembly, Montréal, Canada (July, 2019), presenting four contributions: A Multiobjective Optimization Approach for Flood Risk Management based on Composite Indicators (No. IUGG19-4439), Multiobjective Optimization of Hardware and Software Combined Infrastructures for Natural Systems Monitoring in Brazil (IUGG19-4326), Put the lab in your pocket: a smart, low-cost, mobile phone based system for a real-time pre-screening water quality measurements (IUGG19-4862), Enterprise Knowledge Development (EKD) oriented by techniques of modelling Network of Business Processes (NBP) for hydrological system (IUGG19-4811); Joint Session Convener JH04 - MOXXI: Innovation and Multidisciplinary to Observe Earth Processes (IAHS, IAMAS) - **http://iugg2019montreal.com/jh.html**

Attendance at XXIII Braz Symp of Water Resources, Foz de Iguacu-PR, presenting 10 oral and poster contributions, https://eventos.abrh.org.br/xxiiisbrh/

Joint ANA-USP Organization of Workshop on Water Security National Plan Under Climate Change, October 2019 (Sao Carlos-SP, to be available at: www.eesc.usp.br/ppgshs

Stronger engagement and promotion of special activities to attract early-careers scientists at all levels (undergraduate, master, doctorate and postdocs) in future INCT-MC2 meetings, also open to

other subcomponents looking forward to boosting interdisciplinary progress in this and others INCT-MC2's subcomponents,

starting invitation to more INCT-MC2's water security researchers to participate in running courses on water security (i.e. with webinars, talks, MOOCs etc), according to item 10.2.5.5 (Original Proposal), through the existing course of "SHS5934 – Applied Solutions for Water Security", open to all fields, researchers and levels of knowledge of groups participating in the INCTMC2; this Water Security Course, offered in 2017 and in 2018 (https://uspdigital.usp.br/janus/componente/catalogoDisciplinasInicial.jsf?action=3&sgldis=SHS5934), will be newly offered in 2019/2020, with inputs from INCTMC2 researchers open to share their knowledge at graduate programs of USP, INPE, CEMADEN and EMBRAPA,

Promotion of INCTMC2-Water Security into international networks acknowledging water security under global changes, i.e. IAHS/Group of Measurements and Observations in the XXIst Century and IAHS/Panta Rhei Group (2013-2022)

the Virtual Interactive Library, planned in the original proposal, is being progressively converted into a more feasible framework, based on participatory citizen science approach, through the new Socio-Hydrological Observatory for Water Security-SHOWS, to better achieve objectives and goals of Water Security subcomponent (pages 34-72 of INCTMC2 proposal), especially to fit better indices at the scale of 5,560 Brazilian municipalities aligned with ANA's Atlas of Agua & Esgotos (atlasesgotos.ana.gov.br/), Brazilian System of Sanitary Information (SNIS, app4.cidades.gov.br/serieHistorica/), the Brazilian Association of Sanitary Engineering ranking (http://abes-dn.org.br/pdf/Ranking2019.pdf) and wit Siqueira et al (2018) runoff database repository, as boundary conditions for inner-scale hydrological modelling of other INCTMC2 groups;

INCTMC2's water security outreach will communicate new reflections and opportunities of sociohydrological observatories for a society under change in open debates for the wide public during the XXIII Brazilian Symposium of Water Resources, Foz det Iguacu, PR, with linkage to tailored debate on "Water Connect-Agua Conecta" (www.abrhidro.org.br; https://eventos.abrh.org.br/xxiiisbrh/)

Although of the SHOWS framework has started with an understanding of risk perception and enigma of peoples' memory through social-hydrology(FAPESP Grant 2018/03473-0, UK Academies Call), also offering dialogues among EESC-USP's, IAG-USP's and CEMADEN's researchers,http://www1.eesc.usp.br/ppgshs/files/WATERS2019workshopannouncementfinal.pdf) there is a strong need of further development with new grant support, follow up and linkage with the PNSH 2019-2035 in the field of water security, sociohydrology and climate change, especially at demonstrative pilot projects with state agencies like APAC (Pernambuco; www.apac.pe.gov.br), FUNCEME (Ceará; www.funceme.br), CETESB (Sao Paulo; https://cetesb.sp.gov.br/), and the Sao Paulo Center for Education and Research on Disasters (Sao Paulo, CEPED/SP; www.usp.br/ceped/), among others.

7.3 Energy security

Enhancement of the main models that are being developed by the COPPE team

- Improving solar technologies cost representation
- Calibration of historical emissions for 2010 and 2015 in the models
- Inclusion of an air quality link in the BLUES model
- Enhancement of demand aspects representation in the model. Focus on demand side management and transport demand
- Start the full implementation of the TEA model
- Better representation of the water system in the BLUES model

- Improvement of the BLUES and COFFEE land use sector representation
- Inclusion of an approach to better deal with bunker fuels for navigation
- Better representation of other Latin-American countries in the global model (COFFEE), such as Argentina, Colombia and Ecuador

Other researches:

- Start to development of a biomass value chain optimization model
- Evaluate solutions focus on non-conventional carbon capture and storage
- Analyze the potential of biofuels to supply fuel demand for international maritime transport
- Conclude the development of a Brazilian refining activity model representation
- Conclude the development of an electric dispatch operation model.

Improvement of the main models being developed and / or used by the teams LABREN / INPE and UNIFESP / IM:

- Adaptation of the BRASIL-SR radiation transfer model for data entry of the new GOES-R geostationary satellite.
- Development of new parameterizations for the optical depth of aerosols
- Implementation and testing of a new effective methodology for calculating effective cloud cover.
- Continuous processing of satellite images and calculation of incident solar radiation throughout Brazil.
- Implementation of a robust interpolation method to generate uninterrupted time series of solar irradiation from the data produced by the BRASIL-SR model.
- Implementation of the mesoscale model WRF-solar and adjust of parameterization for various climatic regions of Brazil.
- Development of an integrated solar radiation forecast model.
-

Applications and field research carried out by INPE / UNIFESP / UNIFEI teams:

- Continuous maintenance and data collection of the SONDA network for solar and wind data.
- Soil temperature collection to validate thermal performance model in urban areas.
- Configuration and start of data collection from spectroradiometers installed in Cachoeira Paulista and São Paulo to support studies of efficiency of solar panels.
- Collect wind and solar energy data in hydroelectric dams to study the behaviour of the planetary boundary layer and its impact on the local atmospheric environment.

Data analysis:

- Implementation and application of the WEAP model for the environmental data available for the São Francisco river basin in order to study the water-food-energy Nexus in this region.
- Statistical analysis of lake breeze data and cloud cover on lakes of hydroelectric dams
- Analysis of solar and wind energy data from the SONDA network and available earth stations to study complementarities and possible solar-wind-hydro hybrid energy generation
- Vectorization of cloud data from satellite imagery for the implementation of short-term solar energy forecasts.

7.4 Natural disasters, impacts on physical infrastructure in urban areas and urban development

The next steps to be developed during the year 3 of the subcomponent are detailed below. Some of these initiatives are new, as compared to the objectives presented in 2014 when the project was submitted. Some of these activities will be developed with other components of the project,

- Continue the detailed analysis of extreme precipitation and streamflow in pilot municipalities that lead to natural disasters: Itajaí Açu River in the South region, and São Francisco River in the Northeast. For drought events, we will assess severity, duration and frequency of droughts, and its impacts on the water availability and ecosystems, in particular for the Amazon forest (together with the component of ecosystems)
- Determine frequency, intensity and duration of land heatwaves and their impacts on human health and marine heatwaves in the western South Atlantic and their impact on marine ecosystem, which in turn can affect fisheries and food security (together with the food security component)
- Create a risk indicator that addresses the physical-environmental (susceptibility), socio-economic, and demographic dimensions of vulnerability, which subsidize the proposition of adaptation measures at the local level. The knowledge produced by FioCruz's research group will be considered, since they have expertise in understanding the population vulnerability to climate change and the action pathways for transforming cities, in order to take action that help Brazilian cities to be resilient considering climate change risk (together with the component of health).
-Drought characterization and impact assessments for the whole domain of the study area, defined previously during the year 1 of the project
-Create a complete historical disaster database, from 1970 to 2016 period, for the critical municipalities considered in the scope of the project, in DesInventar System. This database will be useful to subsidize, an economic analysis of negative effects over the population.
- Interaction with the team of the ECONOMY AND IMPACTS IN KEY SECTORs project, for advances in the integration of studies / products of droughts (generated in CEMADEN) with economic models.

7.5 Impacts on Brazilian ecosystems in view of changes in land use and biodiversity.

At the third year, the Ecosystems component will continue the long term measurements of trace gases, aerosols and clouds at the ATTO tower, as well as to continue the modeling efforts to better understand what control the critical processes associated with environmental changes in the Amazon basin and cerrado biomas. We will also continue with the quantification of greenhouse emissions, now with the support of the MapBiomas Alert platform, that is integrating many essential information on a single platform

Biomass estimates for the Amazon biome, which comprises almost half of the country (4,196,943 km2), were based primarily on the forest inventory from the RadamBrasil project and IBGE previous vegetation map. RadamBrasil covered nine plant physiognomies, which account for approximately 90% of the Amazon biome. The biomass stock of other 20 plant physiognomies in the biome (not covered by the RadamBrasil inventory) was estimated based on values found in the scientific literature. The figure summarizes the processes 208 used to generate regional biomass estimates in the Amazon biome. RadamBrasil plots had their basal area and biomass calculated. Inverse distance weighting (IDW) interpolation was then performed to generate a continuous surface of basal area for the entire Amazon biome.

In terms of field measurements, we will do the field experiment of the CAFE-Brazil experimento in April-May 2020. In the CAFE-Brazil (Chemistry and Aerosols Field Experiment in Amazonia - Brazil) experiment, we will use the German HALO (High Altitude Long Range Observatory) G5 plane, that is capable to fly up to 14 Km in the tropics, to measure trace gases, aerosols and clouds

in the upper Amazonian atmosphere. This is a cooperation with the Max Planck Institute, in Mainz, Germany, and will investigate convective transport of particles and trace gases in teh wet season in Amazonia.

7.6 Health and climate change

1. To explore the results of the climate suitability scenarios for the studied vectors individually and their associations with the distribution of the respective human diseases: AVL and ACL;
2. To evaluate the relationship between the occurrence of vectors and changes in land use in the country;
3. To estimate the municipal vulnerability to the occurrence of leishmaniasis in Brazil in climate change scenarios.
4. Lecture: Title: Health surveillance and natural disasters: actors and roles (Rhavena Barbosa dos Santos);Week of quality, biosafety and environment of the René Rachou Institute, Date: June 13, 2019, 9am.
5. To Finish data collection:Interviews held in the municipalities of Ferros and Belo Horizonte in June 2019. Results analysis. Analysis of interviews transcribed in the months of June, July and August.
6. Submission of two articles until September 2019 ("the role of health surveillance in the disaster", and "the vulnerability index related to drought and health in the Semiarid region")
7. Conference: VIII Brazilian Congress of Human and Social Sciences in Health Date: September 26-30, 2019, João Pessoa, Paraíba.

7.7 Economy and impacts in key sectors

Plans for the third year include further approximation with researchers from the subcomponent "Water Security", to develop joint projects. Moreover, the Fapesp granted scholarship abroad for Paula Pereira Pereda, to develop the project "Assessing the Climate and Weather Effects in Brazil using Panel Data" at Yale University, has provided additional incentives to integration with other areas of the INCT, mainly related to health and agriculture. Finally, a recent FIPE's project with Uber is about to grant us access to the Uber Movement database stimulating the integration with the subcomponent "Natural Disasters". The signature of the protocol between NEREUS and Uber to have access to the data is in its final stage. In addition to researchers at USP, researchers at CEMADEN will have access to the data to write a collaborative paper on the effects of climate on urban mobility and the associated economic costs.

7.8 Modelling the earth system and production of future climate scenarios to study Vulnerability, Impacts and Adaptation

For the Year 3 of the project it is planned the generation suite of the CMIP6 scenarios protocol, including the piControl, Historical, Abrupt4xCO2, and ScenarioMIP, encompassing the period of 1985-2100, after a 600 years coupled spinup run.

1. Coupled Eta based model with MOM5 ocean model (RESM – Eta Model);
2. Coupled Radiation-Convection scheme in the RESM (Eta Model)
3. Coupled Lightning-precipitation and NOx production schemes in the RESM (Eta Model)
4. Coupled dynamic vegetation + Carbon cycle in the RESM (Eta Model)
5. Generation of projections using new model version and new SSP's emission scenarios.

7.9 Communication, dissemination of knowledge and education for sustainability.

The TT3 FAPESP Fellow will hold interviews with researchers at INCT Climate Change - Phase 2 and will produce journalistic materials for dissemination of scientific practices for the ClimaCom,

Comciência and INCT websites. The materials can be produced in different formats, from news, interviews, reports, to podcasts, videos, among others. Parallel to the production will be made readings and collaborative analyzes of the problems that involve the communication and the climatic changes. The idea is that the problems to be worked are born of the relationship between the researchers of this INCT, the production of the materials and the bibliographies proposed. Through these relationships we intend to explore and broaden our understanding of the effectiveness and effectiveness of climate change communication. We assume that a dialogue with the philosophy of science and the social studies of the sciences, especially with the works of Bruno Latour and Isabelle Stengers, will be fruitful for this project.

We will start the cycle of seminars "SYMBIOSES - sciences, philosophies, arts and climate change" at Labjor-Unicamp to address topics such as Adaptation, Uncertainty, Vulnerability, Modeling, Risk, Forests, Contingency ... "with the participation of two guests from the various sub -components and cross-cutting themes of this INCT. The seminars will be aimed at public university students and teachers and students of the state and municipal teaching networks of Campinas and region.

Three new ClimaCom dossiers will be launched with articles, essays, journalistic materials and artistic productions. The participation of the researchers of the various components of INCT in the journal will be stimulated with the production of texts, interviews, participation in news, etc.

As a result of the meetings held to encourage the creation of sub-projects of researchers of the transversal theme of communication together with other INCT researchers we have some proposals that will be developed in the next project year:

- The Profa. Dr. Simone Pallone from Labjor-Unicamp will coordinate the production of a series of radio programs (podcasts) to be done with the nine INCT groups (sub-components and cross-cutting themes).
- The Prof. Dr. Gabriel Cid de Garcia will record an episode of the series 'Education and Culture', from the Podcast School of Education of UFRJ, with INCT researchers.
- The Profa. Dr. Susana Dias (Labjor-Unicamp) and Prof. Dr. Antonio Carlos Amorim (FE-Unicamp) will hold the workshops "Sensitive Forest: Images, Writings and Climate Change" in the EDUCA SP PROGRAM of the Secretary of Education of the State of São Paulo with students from the state of São Paulo.
- Prof. Dr. Leandro Belinaso will organize a digital book which contends five interviews with renown environmental educators . Face the climatic changes is necessary; thus environmental education that thematizes and problematizes the ways of our culturally and historically relationships between other human beings as human-non-human beings, takel a political relevance and an uncontested currentness. In addition of interviews, the book will give a wide list of literary, film and music references that will contribute to reflection on the socio-environmental relationships that takes part of us, opening space to think of modes of existence that confront problematic climatic changes.

We also highlight the proposal of a PhD project by Bruno Stramandinoli Moreno entitled "Climate Change and Production of Work Subjectivity in the contemporary world", which will be submitted to FAPESP under the guidance of Prof. Dr. Carlos Martins. The project articulates PPG-DHT - UNESP, LABJOR - UNICAMP and CEMADEN. And the doctorate project by Tatiana Plens de Oliveira entitled “Catastrophe learning: communication, education and climate change”, which will be submitted to FAPESP under the guidance of Prof. Dr. Wenceslao Machado de Oliveira Jr.. The project articulates FE-Unicamp and LABJOR - UNICAMP.

The defense of the master's thesis "Public perception of climate change". Master in Science, Technology and Innovation scholarship - SECTYP Secretariat of Research, International and Postgraduate, National University of Cuyo - research by Laura García Oviedo. Supervisor: Sandra Murriello of the National University of Río Negro, Argentina.

The organization of COPUCI 2019 - Congress of Public Communication of Science (COPUCI) - "Think and make public communication of science and technology", October 2-4, 2019, in Cordoba-Argentina, by Profa. Dr. Elisabeth Vidal.

The celebration of two agreements, one between Labjor-Unicamp and the National University of Río Negro, Bariloche, by Profas. Dras. Simone Pallone, Susana Dias and Sandra Murriello and the other between Labjor-Unicamp and the National University of Córdoba, by Profas. Dras. Susana Dias and Elisabeth Vidal, which aim to promote greater articulation and involvement with the INCT project.

The production publications (for congresses, articles, books, chapters) by the researchers of this transversal theme. The following work has already been approved:
DIAS, S. O. "Floresta sensível: entrar em comunicação com um mundo todo vivo e vigorizar uma anarquia ecológica". Revista Linha Mestra. Campinas, 2019.
DIAS, S. O.; AMORIM, A. C. R. de; SPEGLICH, E. Cosmic becoming: new sensibilities for to think the human in catastrophes times. 12th Annual Deleuze & Guattari Studies Conference. July, 1-5, 2019.
DIAS, S. O.; AMORIM, A. C. R. de; OLIVEIRA, R. S. de M. The "Elemental" Potency of Climate to Think Communication in the Anthropocene. 4S 2019 New Orleans. Elements: Thinking our Present Elementally. Coord. Courtney Addison, Victoria University of Wellington Timothy Neale, Deakin University Thao Phan, University of Melbourne, Australia. September, 4-7, 2019.

8 Events organized by the INCT MC Phase 2 and its components with interaction among sub components of the project in Year 2

1) Skype meeting with Subcomponent Water Security to discuss a project application to the Belmont Forum funding scheme. Participants: Bruno Carvalho (Health), Eduardo Mendiondo (Water Security), Alexandre Delbem (USP). 18 Apr 2019.
2) Meeting with Subcomponent Water Security to discuss a project application to the Belmont Forum funding scheme. Participants: Elizabeth Rangel (Health), Bruno Carvalho (Health), Eduardo Mendiondo (Water Security), Marcio Giacomoni (Univ. of Texas San Antonio). USP São Carlos, SP, 02 May 2019.
3) INCT-MC2 project Follow-up meeting. Participant from the Health sub-component: Elizabeth Rangel., USP, São Paulo, SP, 30/11/ 2018
4) Annual meeting of the FAPESP Climate Change Program. Participants from the Health sub-component: Elizabeth Rangel, Bruno Carvalho. FAPESP, São Paulo, SP, 20-21 Feb 2019.
5) Water-Health Resilience Workshop, CAPES School of Advanced Studies of Water & Societies under Change. Participants from the Health sub-component: Elizabeth Rangel, Bruno Carvalho. USP São Carlos, SP, 02-03 May 2019.
6) MOVER – Mobilization for Organization and Feasibility of Resilient Urban Spaces, held on August 21-24, 2018, Sao Jose dos Campos, SP
7) Reunião de Coordenação dos INCTs, CNPq, 24 de outubro de 2018, 09:00h-17:00h, Brasília, DF,
8) 14/05/2019 - General researchers' meeting of the Cross Cutting Theme of Communication at LABJOR / UNICAMP - collective definition of a work agenda for 2019. 1) launching new ClimaCom dossier; 2) open calls of ClimaCom; 3) report on the cross-cutting theme communication; 4) a proposal for Communication and Climate Change Seminars that bring together researchers from the humanities and exact and natural sciences at Labjor-Unicamp with the participation of all the components of INCT.
9) 08/04/2019 - General researchers' meeting of the Cross Cutting Theme of Communication at LABJOR / UNICAMP - 1) ongoing group initiatives related to the project 2) new members.
10) 25/03/2019 - General researchers' meeting of the Cross Cutting Theme of Communication at LABJOR / UNICAMP - 1) progress of the proposal of a national report of communication and

climate change and redefinition in book format 2) next dossiers of ClimaCom magazine

11) 20 e 21/02/2019 - Participation in the Annual Meeting of the FAPESP Program for Research on Global Climate Change 2019 - Fapesp - SP

12) 15/02/2019 - General researchers' meeting of the Cross Cutting Theme of Communication at LABJOR / UNICAMP - 1) planning of the semester (meetings, readings, etc.) - 2) TT Fapesp scholarship proposals) 3) sub-projects that can be developed by each cross-sectional researcher using resources Fapesp + CNPq

13) 17/08/2019 - General researchers' meeting of the Cross Cutting Theme of Communication at LABJOR / UNICAMP - 1) launch of the dossier of the journal ClimaCom "Dialogues of the Anthropocene"; 2) definition of the next ClimateCom dossiers.

14) 26 September 2018: Internal meeting for the development of the BESM-GEF global climate model, among both BESM and GEF developers at CPTEC.

15) Meetings with the State of Sao Paulo Secretariat of Environment to support the development of the Ecological-Economic Zoning of the State.

16) 2018 International Talk on "Paradoxes of Interactions in Social Hydrology Through Humanitarian Engineering", co-supported by FAPESP UK Academies, by Univ of Chester and EESC/USP, http://www1.eesc.usp.br/ppgshs/files/Talk-UnivChester-USP01August2018-Namrata.pdf

17) 2018 CEMADEN Série de Debates "Ciência, Riscos e Desastres" Paradoxes of Water Security Peoples' Memory as a Tool for Adaptation in a Changing Society", co-supported by FAPESP UK Academies, Univ of Chester, UK (August, 2018), https://www.cemaden.gov.br/percepcao-de-riscos-de-desastres-foi-o-tema-abordado-por-pesquisadora-do-reino-unido-no-cemaden/

18) 2018 Graduate Course of Biogeochemical Fluxes of River Basins Under Changes, co-supported by CAPES/PROEX, by EMBRAPA and EESC-USP, http://www1.eesc.usp.br/ppgshs/noticias/6 (September 2018)

19) 2018 Graduate Course of SWAT Model Applied to Water Security under Climage Change, co-supported by CAPES/PROEX, by Texas A&M Univ, USA, Climatempo, UFRPE, Potsdam Univ, Germany, UFMS and EESC-USP http://www1.eesc.usp.br/ppgshs//files/CursoSWAT-EESC-USP-2018x.pdf (October, 2018

20) 018 USP Lecture THE BLUE GOLD UNDER CHANGE: INTERNATIONAL EXPERIENCES ON THE SECURITY OF THE WATER-FOOD ENERGY NEXUS http://www1.eesc.usp.br/ppgshs//files/LectureThebluegoldunderchange.pdf

21) 2018 Workshop on Water-Health-Resilience, co-supported by FAPESP SPRINT/UWarwick http://www1.eesc.usp.br/ppgshs//files/WorkshopUWarwick-USP-Nov2018.pdf (Nov, 2018)

22) WATERS 2019 - International workshop on knowledge exchange of Socio-hydrological vulnerability and patterns of public risk perception of water security, co-supported by FAPESP UK Academies & CAPES PROEX, Univ of Chester (UK), EESC-USP, IAG/USP, University of Nottingham Ningbo, Ningbo, China, East Carolina University, USA, Uppsala University, Sweden, University of Bonn, Germany, Atlas Copco IAS UK Limited, UK

23) 2019 Joint Training Course on Urban Flood Risk and Insurance to Paraguay Ministry of Public Works, USP

24) 2019 School of Advanced Studies on Water & Society Under Change, supported by CAPES EAE Program, TU Vienna, UFPE, UFCG & EESC/USP, Module 1: Hydro-Social Dynamics, http://www1.eesc.usp.br/ppgshs//files/Hydro-social-dynamics-announcement.pdf

25) 2019 School of Advanced Studies on Water & Society Under Change, supported by CAPES EAE Program, Univ of Oxford (UK), UFPE, UFCG FIOCRUZ, UTSA (USA) & EESC/USP, Module 2: Challenges in Sanitation Processes, http://www1.eesc.usp.br/ppgshs//files/Challenges-of-Sanitation-Processes-announcement.pdf

26) 2019 "Water-Intelligence-Innovation Framework" hosted by ABRHidro (Braz Water Res Association),, promoting open science, with a vivid network of researchers, stakeholders and citizens with mapping and opportunities for startups on water security, https://pt-br.facebook.com/pg/ABRHidro/posts/

27) Bhattacharya-Mis, N, Mendiondo, E M, Fava, M C, Sarmento-Buarque, A C, Restrepo-Estrada, C E, Caballero-Campos, P F, Mohor, G (2019) The synergistic model: A comprehensive way to understand the real cost of disaster, In: 2019 European Geophysical Union Meeting, Session NH9.4, Abstract Number: EGU2019-NH9.4. X3.66 (poster)

28) Costa, C. F. G.; Camargo, P. B. de; Reis, L. C.; Piccolo, M. C.; Figueiredo, R. de O. Matéria orgânica particulada na bacia do rio Jaguari sob diferentes usos da terra. In: SIMPÓSIO CIENTÍFICO DOS PÓS-GRADUANDOS NO CENA, 11., 2018, Piracicaba. Ensino, pesquisa e extensão: integração, funcionalidade e aplicabilidade: [Piracicaba, SP: CENA/USP, 2018.

29) Figueiredo, R. de O.; Simioli, M. M.; Cruz, P. P. N. da; Green, T. R. Stream water quality monitoring as a tool to evaluate a payment for environmental service in Extrema (Minas Gerais), Brazil. In: LATIN AMERICA AND CARIBBEAN ECOSYSTEM SERVICES PARTNERSHIP CONFERENCE, 2., 2018, Campinas. Campinas: Ecosystem Services Partnership (ESP), 2018.

30) Guzmán, D, Mendiondo, E, Mohor, G S (2019) A Hydrological Risk Transfer Assessment under Changing Conditions in Brazilian Watersheds Context, In: 2019 European Geophysical Union Meeting, Session NH9.9, Abstract Number: EGU2019-11434 (Pico Session)

31) Mendiondo, E M, Guzmán, D, Mohor, G., Taffarello, D (2018) How does a willingness-to-adapt insurance cope with risks on aging infrastructure and climate services?, In: 2018 American Geophysical Union Fall Meeting, Session: Connecting Earth Sciences and Risk Financing and Transfer: Case Studies on Integration and Application of Earth Observations in the Insurance Sectors[SWIRLScience & Society], Abstract No: 272306, Final Paper Number: PA22A-08, Oral Presentation.

32) Mendiondo, E M, H C Mendes, N Bhattacharya-Mis, I Giuntoli, M C Fava, F S Arguello[1], A C Sarmento Buarque (2018) Understanding Urban Risk Perception & Enigma of Peoples' Memory through Social-Hydrology Observatories of Water Security Under Global Changes, Session: H54C Hydrology, Society and Environmental Change: Human-Water Interactions Across Scales II, Final Paper Number: H54C-05, Oral Presentation.

33) Reis, L. C.; Piccolo, M. C.; Domingues, G.; Costa, C. F. G.; Figueiredo, R. de O.; Camargo, P. B. de Evolução de parâmetros qualitativos nos corpos hídricos em áreas de restauração, Extrema - MG. In: SIMPÓSIO CIENTÍFICO DOS PÓS-GRADUANDOS NO CENA, 11., 2018, Piracicaba. Ensino, pesquisa e extensão: integração, funcionalidade e aplicabilidade: Piracicaba, SP: CENA/USP, 2018.

34) The Scientific and Managament Board of the INCTMC2 has met in August/2018 and February/2019 (FAPESP Annual Meeting), with representatives of the Water Security subcomponent. Internally, in April/2019 and May/2019, EESC-USP, IAG-USP, UFPE, UFC and FioCruz representatives have met in Sao Carlos to discuss about approved budget and scholarships and long term goals. Some crosscutting events organized and/or attended by INCTMC2 Water Security researchers are listed as follows.

35) 2018 American Geophysical Union Fall Meeting, Washington DC, USA, https://agu.confex.com/agu/fm18/meetingapp.cgi/Paper/425610 , https://agu.confex.com/agu/fm18/meetingapp.cgi/Paper/426925

36) 2019 FAPESP Annual Meeting on Global Climate Change Program: Current Issues and Perspectives, http://www.fapesp.br/12560 (Fev, 2019)

37) 2019 European Geophysical Union Meeting, Vienna, Austria, https://meetingorganizer.copernicus.org/EGU2019/EGU2019-12401-1.pdf

38) 2019 Ciclo UrbanSus: Sustentabilidade Urbana e Gestão de Bacias Hidrográficas e Sustentabilidade, co-supported by CAPES, at IEA/USP, Sao Paulo, https://www.youtube.com/watch?v=kcws47UaeyQ&feature=share

39) Apr/2019: Presentation of the front-line socioeconomics team for Year 3 of the project

40) May/2019: Methodological discussion of economics and geoprocessing integration.

41) Jun/ 2019: Meeting with NEXUS. Structuring the Database and Information Systems; analysis of the Land Use and Agricultural Production Database; analyze climate variability and characterize current and future droughts; analyze water availability through the Hydrological-

Climatic Model coupling; design and apply Nexus Modeling methodology; propose strategies of Adaptive Management and environmental recovery for the São Francisco River Extended Basin; analysis of the Data Base and Information of the Social and Economic Dynamics and propose strategies of Adaptive Management and environmental recovery for the St Francis River Basin.

Public hearings

Talk in the Annual Meeting of the Brazilian Academy of Sciences Title: *Climate change and biodiversity: Challenges for Brazil*, Rio de Janeiro, May 15th 2019.

Public hearing in the Committee for Environment of the Brazilian Senate. Title: *Mudanças climáticas e biodiversidade: desafios e oportunidades para o Brasil*, Brasília, May 31th 2019

Public hearing in the Committee for Environment of the Brazilian Chamber of RepresentativesTitle: *Uso da terra no Brasil: desafios e oportunidades de mitigação e adaptação às mudanças climáticas*, Brasília, June 5th 2019.

9 Participation in scientific events relevant to the INCT MC Phase 2 with accepted abstracts or presentations

1) Marengo JA (2019) Desastres Naturais, Vulnerabilidade e Adaptação no Brasil: INCT para Mudanças Climáticas Fase 2, SEMINÁRIO MEDIDAS DE MITIGAÇÃO E ADAPTAÇÃO ÀS MUDANÇAS CLIMÁTICAS CÂMARA DOS DEPUTADOS, COMISSÃO DE MEIO AMBIENTE E DESENVOLVIMENTO SUSTENTÁVEL 05/06/2019, Brasilia DF
2) Marengo JA (2018) Present and future climate in Amazonia and its impacts, Workshop The Scientific, Social, and Economic Dimensions of Development in the Amazon, Washington DC, USA, September 24 2018.
3) Rangel EF, Lainson R, Afonso MMS, Shaw JJ (2018) Eco-epidemiology of American visceral leishmaniasis with particular reference to Brazil. In: Rangel EF, Shaw JJ (orgs.) Brazilian Sand Flies. Biology, Taxonomy, Medical Importance and Control. Cham: Springer Nature. p. 381-416.
4) Afonso MMS, Carvalho BM, Dias CMG, Rangel EF. Distribuição espacial da leishmaniose visceral e avaliação da vulnerabilidade municipal como ferramenta da vigilância entomológica no estado do Rio de Janeiro, Brasil. In: 54º Congresso da Sociedade Brasileira de Medicina Tropical. Recife (PE), Setembro 2018.
5) Carvalho BM, Afonso MMS, da Costa SM, Vasconcelos dos Santos T, Rangel EF. Distribuição potencial dos principais vetores de Leishmaniose Tegumentar Americana no Brasil e sua relação com as áreas de transmissão da doença. In: 54º Congresso da Sociedade Brasileira de Medicina Tropical. Recife (PE), Setembro 2018.
6) Carvalho BM, Oliveira AG, Galati EAB, Rangel EF, Oliveira EF. Nicho ecológico e distribuição potencial de *Lutzomyia cruzi* na América do Sul. In: 54º Congresso da Sociedade Brasileira de Medicina Tropical. Recife (PE), Setembro 2018.
7) Costa SM, Cordeiro JLP, Rangel EF. Adequação ambiental para *Lutzomyia (Nyssomyia) whitmani* (Diptera: Psychodidae: Phlebotominae) e a ocorrência da Leishmaniose Tegumentar Americana (LTA) no Brasil. In: 54º Congresso da Sociedade Brasileira de Medicina Tropical. Recife (PE), Setembro 2018.
8) AMORIM, A. C. R.; GUIDO, L. F. E.; CHAVES, S.N. Mesa Redonda 'Artes da vida e vidas com arte no Ensino de Biologia', VII Encontro Nacional de Ensino de Biologia. 2018. (Congresso, Apresentação de Trabalho).
9) DIAS, S. O. Colóquio Deleuze Guattari (Universidade Autonoma de Quito-Equador). “Selva sensible: entrar en comunicación con un mundo todo vivo y vigorizar una anarquia ecológica". 2019. (Apresentação de Trabalho/Comunicação).
10) DIAS, S. Seminário “Modos de viver sustentáveis”. Floresta sensível.. Sesc Sorocaba.

2018. (Palestra e oficina).
11) DIAS, S. O.. Um laboratório-sensível entre nuvens, árvores e pedras. 2018. (Apresentação de Trabalho/Conferência ou palestra).
12) DIAS, S. O.. 11th Deleuze and Guattari Studies International Conference. Of the imminence of common causes: stop judjing, make exist!. 2018. (Apresentação de Trabalho/Comunicação).
13) DIAS, S. O.. Floresta sensível: da dignificação do papel como matéria viva. 2018. (Apresentação de Trabalho/Conferência ou palestra).
14) GARCIA, G. C. de. XVII Encontro da Associação Nacional de Pós-Graduação em Filosofia - ANPOF. Vitória, Espírito Santo, outubro 2019 - apresentação de trabalho como membro do GT Filosofia Contemporânea de Expressão Francesa.
15) GARCIA, G. C. de. Mesa redonda no evento Pint of Science Brasil. Arte e ciência, tudo junto e misturado, maio de 2019.
16) GOMES, I. M.; MEDEIROS, P. M. . Reimagining sustainability: communication and media research in a changing world. 2018. (Apresentação de Trabalho/Comunicação).
17) GOMES, I. M.; FLORES, N. . Posicionamentos discursivos do Ocupe Estelita em produções de vídeo: o 'eu' contra o 'outro?. 2018. (Apresentação de Trabalho/Congresso).
18) OLIVEIRA, T. P. Instaurações da terra ou de uma escrita por vir. (08/11/2018), II Colóquio Variações Deleuzianas: Educação e Pensamento e Política e Fabulação e..., Universidade Federal do Pará, Belém, Brasil. (Apresentação de trabalho).
19) OLIVEIRA JUNIOR, W. M. Seminário “Modos de viver sustentáveis”. Cultura e natureza urbanas. Sesc Sorocaba. 2018. (Palestra).
20) TADDEI, R.. Duke University Scholars Program Seminar. Título: The Haunted Nature of Geoengineering: engaging with the atmosphere. Outubro 2018.
21) TADDEI, R.. Seminário Negotiating Environmental Knowledges - Institute for Science, Innovation and Society, Oxford University. Título: Performative knowledge in/is the multiverse: ethnographic speculations. Dezembro 2018.
22) WUNDER, Alik. Colóquio Deleuze Guattari (Universidade Autonoma de Quito-Equador). Superfícies de encontro com o povo indígena Kariri Xocó: imagens e o devir-planta. 2019. (Apresentação de Trabalho/Comunicação).
23) GARCIA, G. C. de. Matinê Pedagogias da Imagem - Itinerância UFRJ da Mostra Ecofalante de Cinema Sócio-Ambiental, agosto de 2018. Exibição de seis (6) filmes em sessões semanais, com presença de pesquisadores para debate com o público.
24) GARCIA, G. C. de. Sessões mensais do projeto de extensão Pedagogias da Imagem - cineclube da Faculdade de Educação da UFRJ, com exibição de filmes seguida de palestra e debate com pesquisadores.
25) GARCIA, G. C. de. Encontro sobre arte, educação e mudanças climáticas. Junho de 2019.
26) FERREIRA, Marcia Serra; CHAVES, S.N.; GASTAL, M.L.G.; AMORIM, A. C. R. VII Encontro Nacional de Ensino de Biologia (ENEBIO)/ I Encontro Regional de Ensino de Biologia da Região Norte (EREBIO/NORTE), 2018. (Congresso, Organização de evento)
27) AMORIM, A. C. R.; GALLO, Silvio Donizetti de Oliveira; OLIVEIRA JÚNIOR, Wenceslao Machado de; DIAS, S. O.; WUNDER, A.; MARQUES, D.; LEITE, C.D.P; MONTEIRO, A.; TEBET, G. 11th Deleuze and Guattari Studies International Conference, 2018. (Congresso, Organização de evento).
28) GALLO, Solange Leda; NECKEL, N. R. M.; FLORES, G. G. B.; CASTELLANOS PFEIFFER, C. R.; LAGAZZI, S.; ZOPPI, Mónica; DALTOE, A. co-organização do IV SEDISC (Seminário Discurso, Cultura, Mídia), 2018. (Congresso, Organização de evento).
29) DIAS, S. O.; AMORIM, A. C. R. de; SPEGLICH, E. Cosmic becoming: new sensibilities for to think the human in catastrophes times. 12th Annual Deleuze & Guattari Studies Conference. July, 1-5, 2019.
30) DIAS, S. O.; AMORIM, A. C. R. de; OLIVEIRA, R. S. de M. The "Elemental" Potency of Climate to Think Communication in the Anthropocene. 4S 2019 New Orleans. Elements: Thinking our Present Elementally. Coord. Courtney Addison, Victoria University of Wellington Timothy Neale, Deakin University Thao Phan, University of Melbourne, Australia. September, 4-7, 2019.

31) Campos, D.A., Chou, S.C., 2019: Efeito radiativo das nuvens em cenários de mudanças climáticas sobre o Brasil. Abstract in VI Workshop em Modelagem Numérica de Tempo e Clima em Mesoescala utilizando o Modelo Eta: Aspectos Físicos e Numéricos. 25-29 March 2019, Cachoeira Paulista, SP. Brazil.
32) Lyra, A.A., Chou, S.C. 2019: Projeções de mudanças climáticas. Abstract in VI Workshop em Modelagem Numérica de Tempo e Clima em Mesoescala utilizando o Modelo Eta: Aspectos Físicos e Numéricos. 25-29 March 2019, Cachoeira Paulista, SP. Brazil.
33) Rodriguez, D.A., et al., 2019: Aplicações da modelagem hidrometeorológica em estudos de recursos hídricos. Abstract in VI Workshop em Modelagem Numérica de Tempo e Clima em Mesoescala utilizando o Modelo Eta: Aspectos Físicos e Numéricos. 25-29 March 2019, Cachoeira Paulista, SP. Brazil.
34) Mayta, Victor C., George N. Kiladis, Juliana Dias, Pedro Leite da Silva Dias, Tercio Ambrizzi. Convectively Coupled Kelvin Waves over Tropical South America region, In: EMS Annual Meeting: European Conference for Applied Meteorology and Climatology 2018. 3–7 September 2018. Budapest, Hungary. 2018 https://www.ems2018.eu/workshops/
35) Helber Gomes, Tercio Ambrizzi. Life cycle assessment of easterly wave disturbances on tropical south Atlantic and their impact over northeast Brazil. In: EMS Annual Meeting: European Conference for Applied Meteorology and Climatology 2018. 3–7 September 2018. Budapest, Hungary. 2018 https://www.ems2018.eu/workshops
36) Ciclo (Im)permanências: vulnerabilidade, Centro de Filosofia e Ciências Humanas da UFRJ - campus Praia Vermelha), 19/06/2019, de 10h às 17h,
37) Da SILVA, F.T.F.; SZKLO, A.; SCHAEFFER, R. - Biochar Reverse Mining in Brazil: Coupling Land Reclamation to a Negative Emissions Technol. Available in proceedings: 11th IAMC meeting in Seville, Spain, 2018.
38) Angelkorte, G. B.; Koberle, A.; Szklo, A.; Schaeffer, R.- Organic Agriculture, Climate Mitigation and Human Health: A Tradeoff Analysis for Brazil. Available in proceedings: 11th IAMC meeting in Seville, Spain, 2018.
39) Casseres, E. M. M. D.; Rochedo, P.; Freitas, M.; Carvalho, F.; Cunha, B.; Callegari, C.; Régis R.; Lucena, A.; Szklo, A.; Schaeffer, R. - Understanding the role of international shipping in high mitigation scenarios. Available in proceedings: 11th IAMC meeting in Seville, Spain, 2018.
40) Cunha, B.; Gurgel, A.; Garaffa, R.; Rochedo, P.; Lucena, A.; Szklo, A.; Schaeffer, R. - Biochar Reverse Mining in Brazil: Coupling Land Reclamation to a Negative Emissions Technology. Available in proceedings: 11th IAMC meeting in Seville, Spain, 2018.
41) Garaffa, R.; Gurgel, A.; Cunha, B.; Lucena, A.; Szklo, A.; Schaeffer, R. - Climate finance and investment allocation in a CGE model. Available in proceedings: 11th IAMC meeting in Seville, Spain, 2018.
42) Vasquez, E.; Orosco, R. T.; Rochedo, P.; Szklo, A.; Schaeffer, R. - Water Implications by mitigation scenarios for the Brazilian energy sector. Available in proceedings: 11th IAMC meeting in Seville, Spain, 2018.
43) Ferreira, F.L.S. fatores associados ao desempenho térmico e energético de superfície urbanas., XV ENCAC, João Pessoa, 2019, http://www.ct.ufpb.br/labcon/contents/menu/artigos-em-anais-de-congresso.
44) Pinto, L. I. C. ; Lima, F. J. L.; Martins, F. R.; Pereira, E. B. (2019) Sensitivity tests for different WRF model cumulus parameterizations to improve wind estimates.. In: Paulo Jayme Pereira Abdala. (Org.). Energia solar e eólica 2. 1ed.Ponta Grossa: Antonella Carvalho de Oliveira, 2019, v. 2, p. 290-302. doi: 10.22533/at.ed.67419220122.
45) Pereira, E. B. ; Martins, F. M. ; Costa, R. S. ; Gonçalves, A. R. . Brazilian Photovoltaic Potential. In: ISES EuroSun 2018 Conference 12th International Conference on Solar Energy for Buildings and Industry, 2018, Rapperswil. Proceedings of EuroSun 2018, 2018. p. 1. doi: 10.18086/eurosun2018.09.11
46) Luiz, E. W. ; Martins, F. R. ; Gonçalves, A. R.; Costa, R. S.; Souza, J. G. ; Lima, F. J. L; PES, M. P. ; Pereira, E. B . Monthly Solar Irradiance Variability in Brazilian Climate Zones. In: ISES EuroSun 2018 Conference - 12th International Conference on Solar Energy for

Buildings and Industry, 2018, Rapperswil. Proceedings of EuroSun 2018. Freiburg: International Solar Energy Society, 2018. p. 1. doi: 10.18086/eurosun2018.09.09

47) Lima, F. J. L. ; Martins, F. R ; Costa, R. S. ; ; Gonçalves, A. R.; Santos,A. P.; Pereira, E. B. The Spatial and Temporal Patterns of the Surface Solar Irradiation in Northeastern Region of Brazil. In: ISES EuroSun 2018 Conference - 12th International Conference on Solar Energy for Buildings and Industry, 2018, Rapperswil. Proceedings of EuroSun 2018. Freiburg: International Solar Energy Society, 2018. p. 1. doi: http://dx.doi.org/10.18086/eurosun2018.09.02

48) Torres, B. E. B.R., Martins, F. R., Lima, F. J. L., Costa, R. S., Gonçalves, A. R.;, Pereira, E. B. Comparative study of solar irradiance databases on the surface of the national territory. In: Proceedings of the XIX Brazilian Symposium on Remote Sensing, 2019, Santos. Electronic records.Campinas, GALOÁ, 2019. Available in: <https://proceedings.science/sbsr-2019/papers/estudo-comparativo-das-bases-de-dados-de-irradiancia-solar--na-superficie-para-o-terrirtorio-nacional>. Acesso em: 01 jun. 2019.

49) Goncalves, A. R; Casagrande, M. S. G.; Costa, R. S.; Martins, F. R.; Lima, F. J. L.; Pereira, E. B. Assessing Complementarity of Wind and Solar Resources for Hybrid Projects in Northeastern Brazil. Proceedings of 6º International Congress of Energy Meteorology, Copenhagen, 2019.

50) Casagrande, M. S. G.; Goncalves, A. R; Martins, F. R.; Costa, R. S.; Pereira, E. B. Improvements in the estimation of the solar energy resource in tropical regions from satellite data - A statistical approach. Proceedings of 6º International Congress of Energy Meteorology, Copenhagen, 2019

51) Academic Seminar, Forestry and Environmental School, Yale University (September 2018): "Climate Change and Migration in Brazil", Paula C. Pereda

52) Eastern Economic Association, New York (February 2019): "The impact of Climate Change on Internal Migration in Brazil", Paula C. Pereda

53) Academic Seminar, Forestry and Environmental School, Yale University (April 2019): "Consequences of Air pollution in Sao Paulo: Evidence for Health", Paula C. Pereda

54) Academic Seminar “Drought Shocks and Student Performance in Brazilian Rural Schools”, FEAUSP, 09/08/2018., José Féres

55) NEREUS at FEAUSP hosts a weekly seminar, on Mondays, during the academic year. In 2018-2019, there were different presentations on topics related to the INCT-MC. The full program with the names of the presenters and titles of the presentations can be accessed at (http://www.usp.br/nereus/?p=3989)

56) PUGLIERO, V. S.; ZANETTI, M. R.; ASSAD, E. D. Diagnóstico ambiental: quantificação do passivo em app hídrica nos municípios da caatinga na bacia do São Francisco. In: II SIMPÓSIO DA BACIA HIDROGRÁFICA DO RIO SÃO FRANCISCO, 2018, Aracaju.

57) PUGLIERO, V. S. ; ALMEIDA, M. B. ; ZANETTI, M. R. ; ASSAD, E. D. . Emissões evitadas de GEE na expansão da soja no Brasil de 2010 a 2016. In: XIV MOSTRA DE ESTAGIÁRIOS E BOLSISTAS DA EMBRAPA INFORMÁTICA AGROPECUÁRIA, 2018, Campinas.

58) ZANETTI, M. R. ; PUGLIERO, V. S. ; ASSAD, E. . Espacialização do passivo em APP hídrica dos municípios da caatinga na Bacia do Rio São Francisco. 2018. In: XIV MOSTRA DE ESTAGIÁRIOS E BOLSISTAS DA EMBRAPA INFORMÁTICA AGROPECUÁRIA, 2018, Campinas.

59) ZANETTI, M. R. ; PUGLIERO, V. S. ; ALMEIDA, M. B. ; ASSAD, E. D. . Cálculo de tamanho de amostra para análise de acurácia em mapeamentos temáticos. In: XIV MOSTRA DE ESTAGIÁRIOS E BOLSISTAS DA EMBRAPA INFORMÁTICA AGROPECUÁRIA, 2018, Campinas.

60) ALMEIDA, M. B.; PUGLIERO, V. S.; ZANETTI, M. R.; BOLFE, E. L.; ASSAD, E. D.. Espacialização de áreas aptas para a citricultura no recôncavo da Bahia. In: XIX SIMPÓSIO BRASILEIRO DE SENSORIAMENTO REMOTO, 2019, Santos.

61) Artaxo, P., Amazon forest's importance in regulating atmospheric chemistry. Workshop of the TropOZ NERC project. Bangor, 22-25 January 2018.

62) Artaxo, P., Cleaning megacities in Latin America. Invited lecture at the 7th International

Workshop advances in cleaner production, Barranquilla, Colombia, 21-22 June 2018.
63) Jann Schrod, Daniel Weber, Erik S. Thomson, Jorge Saturno, Christopher Pöhlker, Paulo Artaxo, Valerie Clouard, Jean-Marie Saurel, Hans-Christen Hansson, Joachim Curtius, and Heinz Bingemer. Long-term observations from a small globally operating INP network. INUIT Final Conference and Second Atmospheric Ice Nucleation Conference. 26 February - 1 March 2018, Odenwald, Germany.
64) Shilling, J., Pekour, M., Fortner, E., Artaxo, P., deSa, S., Hubbe, J., Longo, K., Machado, L., Martin, S., Springston, S., Tomlinson, J., and Wang, J. Particle-phase Chemical Composition Measurements Onboard the G-1 Research Aircraft During the GoAmazon 2014/5 Campaign. 2018 ARM/ASR Joint User Facility and Principal Investigator Meeting, March 19-23, 2018, Sheraton Tysons Hotel, Leesburg, VA, USA.
65) Yang Wang, Florian Ditas, Sophie Mayne, Mira Pöhlker, Luciana Rizzo, Meinrat Andreae, Paulo Artaxo, Scot Martin, Christopher Pöhlker, Ulrich Pöschl, Courtney Schumacher, Jian Wang. Sub-micrometer aerosol size distribution under natural conditions in the Amazon basin. 2018 ARM/ASR Joint User Facility and Principal Investigator Meeting, March 19-23, 2018, Sheraton Tysons Hotel, Leesburg, VA, USA.
66) L. V. Rizzo, G. Cirino, H. Barbosa, J. Brito, S. Carbone, R. Souza, S. Martin, P. Artaxo, Changes on aerosol properties along the transport of the Manaus city plume in Amazonia – results from the GoAmazon 2014/15 ground based observations. 2018 ARM/ASR Joint User Facility and Principal Investigator Meeting, March 19-23, 2018, Sheraton Tysons Hotel, Leesburg, VA, USA
67) M. Frame, P. P. Correia, G. Prakash, B. Krishna, L. V. Rizzo, A. Felipe, W. Barbosa, R. Martineli, H. Museti, K. Ferraz, P. Artaxo. Enabling integrated research through monitoring of biodiversity and climate measurements in the Amazon Basin. 2018 ARM/ASR Joint User Facility and Principal Investigator Meeting, March 19-23, 2018, Sheraton Tysons Hotel, Leesburg, VA, USA
68) R. Zaveri, J. Wang, J. Schiling, S. Martin, P. Artaxo, L. Machado, K. Longo, E. Fortner, M. Pekour, J. Tomiinson, Fan Mei, Duli Chand, J. Hubbe, S. Springston. Modeling evolution of aerosol size distribution in the Manaus urban plume during the GoAmazon Campaign. J. Schling, M. Pekour, E. Fortner, P. Artaxo, Suzane Sá, J. Hubbe, K. Longo, L. Machado, S. Martin, S. Springston, J. Tomiinson, J. Wang. Particle-phase chemical composition measurements onboard the G-1 research aircraft during the GoAmazon 2014/15 campaign. 2018 ARM/ASR Joint User Facility and Principal Investigator Meeting, March 19-23, 2018, Sheraton Tysons Hotel, Leesburg, VA, USA
69) Pedro Pizzigatti Correia, M. Frame, G. Prakash, S. Allard, B. Krishna, R. Albrecht, A. Filipe, W. Barbosa, R. Oliveira, S. Garcia, P. Artaxo. Workshop on data science – management techniques, analysis and voisualization of scientific data from the GoAmazon campaign. 2018 ARM/ASR Joint User Facility and Principal Investigator Meeting, March 19-23, 2018, Sheraton Tysons Hotel, Leesburg, VA, USA.
70) Matthew Fraund, Don Pham, Daniel Bonanno, Tristan Harder, Daniel Veghte, Joel Brito, Suzane de Sá, Smara Carbone, Swarup China, Christopher Pöhlker, Bingbing Wang, Paulo Artaxo, Meinrat O. Andreae, Scot Martin, Jian Wang, Alexander Laskin, Daniel Knopf, Mary Gilles, Ryan Moffet. Aerosol elemental and modelucar mixing state measurements via multimodal X-ray and electron microscopy. 2018 ARM/ASR Joint User Facility and Principal Investigator Meeting, March 19-23, 2018, Sheraton Tysons Hotel, Leesburg, VA, USA.
71) Paulo Artaxo, Scot Martin, Meinrat O. Andreae, Christopher Pöhlker, Henrique Barbosa, Luciana Rizzo, Suzane de Sá, Samara Carbone, Jian Wang, Luiz A. Machado. GoAmazon2014/15 Experiment: Overview of main findings on the interaction of natural biogenic emissions with urban pollution from Manaus. EGU European Geosciences Union General Assembly 2018, Vienna. 8-13 April 2018.
72) Robbie Ramsay, Eiko Nemitz, Chiara di Marco, Matthew Heal, Matthias Sörgel, Meinrat Andreae, Paulo Artaxo, Alessandro Araujo, Marta Sá. Biosphere / atmosphere exchange of trace gases and water soluble aerosol chemical compounds above tropical rainforest. EGU European Geosciences Union General Assembly 2018, Vienna. 8-13 April 2018.
73) Jann Schrod, P. Artaxo et al. A globally operating network for INP sampling. Abstract

EGU2018-1730. EGU European Geosciences Union General Assembly 2018, Vienna. 8-13 April 2018.
74) Sebastian Donner, Steffen Dörner, Paulo Artaxo, Steffen Beirle, Christian Gurk, Mark Lamneck, Matthias Sörgel, David Walter, and Thomas Wagner. MAX-DOAS measurements and profile retrievals of tropospheric trace gases at the Amazonian Tall Tower Observatory (ATTO) in the Brazilian rain forest. EGU European Geosciences Union General Assembly 2018, Vienna. 8-13 April 2018.
75) Nga Lee Ng, Wing-Yin Tuet, Nilmara de Oliveira Alves, Shierly Fok, Dong Gao, Paulo Artaxo, Pérola Vasconcellos, Julie A. Champion and Rodney Weber. Oxidative Potential and Cellular Oxidant Production from Biomass Burning Aerosol. Abstract #529808. 2018 Spring Meeting and 14th Global Congress on Process Safety, Orlando World Center Marriott, April 22-26, 2018.
76) Jann Schrod, Daniel Weber, Erik S. Thomson, Jorge Saturno, Christopher Pöhlker, Paulo Artoxo, Valerie Clouard, Jean-Marie Saurel, Hans-Christen Hansson, Joachim Curtius, and Heinz Bingemer. Long-term observations from a small globally operating INP network . INUIT Final Conference and Second Atmospheric Ice Nucleation Conference. Odenwald, Germany, February 26 – March 1, 2018.
77) Artaxo, P., Cambio Climático global. Vision 2018 Conference, Barranquilla, 2-5 Maio de 2018.
78) Artaxo, P., Environmental research in Amazonia. Royal Academy of Engineering, Workshop on Frontiers of Development, 15-19 julho de 2018, Rio de Janeiro, 2018.
79) Artaxo, P., A Ciência das mudanças climáticas e seus impactos no Brasil. 70ª reunião anual da SBPC, Universidade federal de Alagoas, Maceió, Brasil, 22 a 28 de julho de 2018.
80) Artaxo, P., O desenvolvimento sustentável e seus objetivos. 70ª reunião anual da SBPC, Universidade federal de Alagoas, Maceió, Brasil, 22 a 28 de julho de 2018.
81) Artaxo, P., The impacts of global climate change in Amazonia. Simposio FAPESP-Wilson Center, Washington, DC, 25 de Setembro de 2018.
82) Paulo Artaxo, A ciência das mudanças climáticas e seus impactos no Brasil. 70a. reunião annual da SBPC, 22 a 28 de julho de 2018, Maceió, Brasil.
83) Paulo Artaxo, Os objetivos do desenvolvimento sustentável. 70a. reunião annual da SBPC, 22 a 28 de julho de 2018, Maceió, Brasil.
84) Fernando G. Morais, Eduardo Landulfo, Paulo Artaxo, Joel Schafer and Rafael Palácios, Scattering and Absorption Properties of Aerosols in Amazonia Using Remote Sensing (AERONET and AURA) and in situ Measurements. 10th International Aerosol Conference (IAC) St. Louis, Missouri, September 2-7, 2018.
85) FLORIAN DITAS, Christopher Pöhlker, Henrique Barbosa, Joel Brito, Samara Carbone, Xuguang Chi, Bruna A. Holanda, Isabella Hrabe de Angelis, Tobias Könemann, Jing Ming, Mira L. Pöhlker, Maria Prass, Daniel Moran-Zuloaga, Marta Sá, Jorge Saturno, Hang Su, Jian Wang, David Walter, Stefan Wolff, Alessandro Araujo, Paulo Artaxo, Ulrich Pöschl, Meinrat O. Andreae. Observation of Nucleation Size Particles in the Amazon. 10th International Aerosol Conference (IAC) St. Louis, Missouri, September 2-7, 2018.
86) FLORIAN DITAS, Christopher Pöhlker, Henrique Barbosa, Joel Brito, Samara Carbone, Xuguang Chi, Bruna A. Holanda, Isabella Hrabe de Angelis, Tobias Könemann, Jing Ming, Mira L. Pöhlker, Maria Prass, Daniel Moran-Zuloaga, Marta Sá, Jorge Saturno, Hang Su, Jian Wang, David Walter, Stefan Wolff, Alessandro Araujo, Paulo Artaxo, Ulrich Pöschl, Meinrat O. Andreae. Aerosol Self-Cleansing by Dry Deposition in the Amazon Dry Season. 10th International Aerosol Conference (IAC) St. Louis, Missouri, September 2-7, 2018.
87) MARCO AURÉLIO FRANCO, Luciana Rizzo, Paulo Artaxo. Evaluation and Comparison of Aerosol Properties at Two Background Sites in the Central Amazon Rainforest. 10th International Aerosol Conference (IAC) St. Louis, Missouri, September 2-7, 2018.
88) Wing-Yin Tuet, Nilmara de Oliveira Alves, Shierly Fok, Dong Gao, Paulo Artaxo, Perola Vasconcellos, Julie Champion, Rodney J. Weber, NGA LEE NG. Oxidative Potential and Cellular Oxidant Production from Biomass Burning Aerosol. 10th International Aerosol Conference (IAC) St. Louis, Missouri, September 2-7, 2018.

89) DJACINTO MONTEIRO DOS SANTOS, Luciana Rizzo, Patrick Schlag, Samara Carbone, Paulo Artaxo. Primary Sources and Secondary Formation of Organic Aerosols in Diadema, São Paulo, Brazil. 10th International Aerosol Conference (IAC) St. Louis, Missouri, September 2-7, 2018.

90) RAYNER SANTOS, Paulo Artaxo. The Sahara Desert Dust Contribution in the Central Amazonia Determined with in situ Measurements in the ATTO Tower and in the ZF2 Reserve and Remote Sensing Use. 10th International Aerosol Conference (IAC) St. Louis, Missouri, September 2-7, 2018.

91) Robbie Ramsay, Chiara Di Marco, Mathew Heal, Matthias Sörgel, Meinrat O. Andreae, Paulo Artaxo, Alex Araujo, Marta Sá, EIKO NEMITZ. Concentrations and Fluxes of Water Soluble Inorganic Aerosol Components above Tropical Rainforest. 10th International Aerosol Conference (IAC) St. Louis, Missouri, September 2-7, 2018.

92) MARIA PRASS, Florian Ditas, Isabella Hrabe de Angelis, Bruna A. Holanda, Oliver Lauer, Ovid Krüger, Bettina Weber, Paulo Artaxo, Eckhard Thines, Bernhard M. Fuchs, Meinrat O. Andreae, Ulrich Pöschl, Christopher Pöhlker. Molecular Genetic Staining Techniques for Bioaerosol Analysis in the Amazon Rainforest. 10th International Aerosol Conference (IAC) St. Louis, Missouri, September 2-7, 2018.

93) PAULO ARTAXO, Scot T. Martin, Meinrat O. Andreae, Christopher Pöhlker, Henrique Barbosa, Luciana Rizzo, Luciana Rizzo, Samara Carbone, Christiane Schulz, Johannes Schneider, U Production of Secondary Organic Aerosol from the Interaction Between the Urban Pollution from Manaus and Natural Biogenic VOCs. 10th International Aerosol Conference (IAC) St. Louis, Missouri, September 2-7, 2018.

94) BRUNA A. HOLANDA, Christopher Pöhlker, Henrique Barbosa, Joel Brito, Samara Carbone, Yafang Cheng, Florian Ditas, Jeannine Ditas, Thomas Klimach, Christoph Knote, Luiz Machado, Jing Ming, Daniel Moran-Zuloaga, Mira L. Pöhlker, Maria Prass, Jorge Saturno, Hang Su, David Walter, Qiaoqiao Wang, Paulo Artaxo, Ulrich Pöschl, Meinrat O. Andreae, Properties and Mixing State of Refractory Black Carbon over the Amazon Basin. 10th International Aerosol Conference (IAC) St. Louis, Missouri, September 2-7, 2018.

95) SAMARA CARBONE, Guilherme Santa Cecília, Luciana Rizzo, Joel Brito, Nga Lee Ng, Lu Xu, Jorge Saturno, Bruna A. Holanda, Florian Ditas, Christopher Pöhlker, Meinrat O. Andreae, Paulo Artaxo, Fine Particulate Mass Scattering Efficiency and Refractive Index in the Central Amazonian Basin (ATTO station). 10th International Aerosol Conference (IAC) St. Louis, Missouri, September 2-7, 2018.

96) Matteo Reggente, Robin Modini, Giulia Ruggeri, SATOSHI TAKAHAMA, Andrew Weakley, Alexandra Boris, Ann Dillner, Provat Saha, Andrew Grieshop, Christoph Hueglin, Christopher Pöhlker, Meinrat O. Andreae, Samara Carbone, Paulo Artaxo. Prediction of Atmospheric Organic Aerosol Concentrations From Carbonyl Absorption in the Mid-Infrared. 10th International Aerosol Conference (IAC) St. Louis, Missouri, September 2-7, 2018.

97) Artaxo, P., The LBA (Large-Scale Biosphere-Atmosphere Program) and ATTO (Amazon Tall Tower Observatory) Science plans. Grandes projetos de colaboração internacional da ciência brasileira. Simpósio da Academia Brasileira de Ciências, Rio de Janeiro, 12-13 setembro de 2018.

98) Artaxo, P., Mitigation, monitoring and adaptation of climate change. International Atomic Energy Agency Scientific Forum Nuclear Technology for Climate. IAEA, Viena International Center, Austria, 18-19 September 2018.

99) Artaxo, P., The global cycle of methane and its effects on the radiation balance and ecosystems. São Paulo School of Advanced Methane Science, Ilhabela, 16-26 Outubro de 2018.

100) Artaxo, P., Meio ambiente amazônico em transição. I Seminário de Pesquisa "AMAZÔNIAS CONTEMPORÂNEAS: CONFLITOS E PERSPECTIVAS". Instituto de Geografia da Universidade de São Paulo, 22-23 de Outubro de 2018.

101) Artaxo, P. Estratégias energéticas e mudanças climáticas. Simpósio a Era da Bioenergia, Ciência: Tecnologia e Sustentabilidade, Instituto de Biociencias, UNICAMP, 26-27 de Novembro de 2018.

102) Artaxo, P., The complex functioning of the Amazonian ecosystem and recent changes due to anthropogenic and climate pressures. Symposium Frontiers of Science FAPESP/Max Planck,

Maksoud Plaza Hotel, São Paulo, November 27-28, 2018.

103) Glauber Cirino; Henrique Barbosa; Simone N. Rodrigues da Silva; Paulo Artaxo, Propriedades químicas da pluma urbana de Manaus no contexto do experimento GoAmazon 2014/15. XX CBMET Congresso Brasileiro de Meteorologia, Maceió, Brasil, 27-30 de Novembro de 2018.

104) 1100) Artaxo, Paulo, Henrique M Barbosa, Luciana Varanda Rizzo, Samara Carbone, Joel Brito, Meinrat O Andreae, Scot T Martin. The Central Amazonia Atmosphere Perturbed by Urban Pollution From Manaus. Abstract B53J-2194, AGU Fall Meeting, December 10-14, 2018, Washington, D.C., Estados Unidos.

105) 1101) Pedro Luiz Pizzigatti Corrêa, Giri Prakash, Mike Thomas Frame, Bhargavi Krishna, Luciana Varanda Rizzo, Ricardo Martinelli Oliveira, Wesley Lourenço Barbosa, André Filipe de Moraes Batista, Paulo Artaxo, Solange Nice Alves-de-Souza and Katia Maria P. M. B. Ferraz. Big Data Analytics to Enable Integrated Research of Biodiversity and Climate Datasets in the Amazon Basin. Abstract H51O-1496. AGU Fall Meeting, December 10-14, 2018, Washington, D.C., Estados Unidos.

106) Jiwen Fan, Daniel Rosenfeld, Yuwei Zhang, Scott E Giangrande, Zhanqing Li, Luiz Machado, Scot T Martin, Yan Yang, Jian Wang, Paulo Artaxo, Henrique M Barbosa, Ramon C. Braga, Jennifer M Comstock, Zhe Feng, Wenhua Gao, Helber Barros Gomes, Fan Mei, Christopher Pöhlker, Mira L. Pöhlker, Ulrich Poeschl and Rodrigo A. F. de Souza. Substantial Convection and Precipitation Enhancements by Ultrafine Aerosol Particles Abstract A21E-07. AGU Fall Meeting, December 10-14, 2018, Washington, D.C., Estados Unidos.

107) Janaina Mayara Pinto Nascimento, Megan Bela, Sameh Adib Abou Rafee, Angel Liduvino Vara Vela, Luciana Varanda Rizzo, Rita Ynoue, Samara Carbone, Edmilson D Freitas, Michael Trainer and Paulo Artaxo. Optical properties of aerosols over the Amazon rainforest in the GoAmazon 2014/15 experiment using the WRF-Chem model. Abstract A31F-06. AGU Fall Meeting, December 10-14, 2018, Washington, D.C., Estados Unidos.

108) Rebecca Caravan, Tom Bannan, Frank Winiberg, Md Anwar H Khan, Aric Rousso, Ahren Jasper, Stephen Klippenstein, Stephen D Worrall, Asan Bacak, Paulo Artaxo, Joel Ferreira de Brito, Stanley Sander, James D Allan, Hugh Coe, David L. Osborn, Nils Hansen, Dudley E Shallcross, Craig Allen Taatjes and Carl Percival. The potential role of Criegee Intermediate + ROOH reactions on secondary organic aerosol formation. Abstract AGU A51C-05. AGU Fall Meeting, December 10-14, 2018, Washington, D.C., Estados Unidos.

109) Janaina Mayara Pinto Nascimento, Megan Bela, Sameh Adib Abou Rafee, Angel Liduvino Vara Vela, Luciana Varanda Rizzo, Rita Ynoue, Samara Carbone, Edmilson D Freitas, Michael Trainer and Paulo Artaxo. Manaus Urban Plume Influence on Aerosol Optical Properties. AIR International Workshop on Air Quality Forecasting Research, November 7-9, 2018, Boulder, Colorado, Estados Unidos.

110) Paulo Artaxo, Luciana V. Rizzo, Samara Carbone, Henrique M. J. Barbosa, Marco A. M. Franco, Christopher Pöhlker, Mira Pöhlker, Bruna Holanda, Florian Ditas, Maria Prass, Uli Pöschl, and Meinrat Andreae. Long term measurements of physical and chemical properties of biogenic atmospheric aerosols at the ATTO tower, Central Amazonia. EGU2019-561. Viena, Austria, 7-12 Abril 2019.

111) Florian Ditas and the ATTO team. Observation of nucleation size particles in the Amazon. EGU2019-12665. Viena, Austria, 7-12 Abril 2019.

112) Ben Langford, Emily House, Paulo Artaxo, Michael Barkley, Joel Brito, Brian Davison, Nick Hewitt, Rob MacKenzie, Eloise Marais, Mike Newland, Andrew Rickard, Marvin Shaw, Amy Valach, Ana Maria Yañez-Serrano, and Eiko Nemitz. Seasonality of isoprene oxidation chemistry in the remote Amazon is mediated by anthropogenic pollution. EGU2019-15012, AS3.33/BG1.20. Viena, Austria, 7-12 Abril 2019.

113) Qiaoqiao Wang, Jorge Saturno, Xuguang Chi, David Walter, Jost V. Lavric, Daniel Moran-Zuloaga, Florian Ditas, Christopher Pöhlker, Joel Brito, Samara Carbone, Paulo Artaxo, and Meinrat O. Andreae. Long range transport of Saharan mineral dust to the Amazon Basin. EGU2019-6465. Viena, Austria, 7-12 Abril 2019.

114) Marco Aurélio Franco, Paulo Artaxo, Samara Carbone, Luciana Rizzo, Henrique Barbosa,

Fernando Morais, Christopher Pöhlker, Bruna Holanda, Florian Ditas, and Meinrat O. Andreae. Aerosol physical properties at different heights of the ATTO tower in the central Amazon rainforest. A.364, EGU2019-14774. Viena, Austria, 7-12 Abril 2019.
115) Stefan A. Wolff, Anywhere Tsokankunku, Christopher Pöhler, David Walter, Jost Lavric, Florian Ditas, Jonathan Williams, Nora Zannoni, Achim Edtbauer, Eva Y. Pfannerstill, Akima Ringsdorf, Laurens Ganzeveld, Meinrat O. Andreae, Paulo Artaxo, Luciana Rizzo, Alessandro Araújo, Marta Sá, Rodrigo Souza, Ivonne Trebs, and Matthias Sörgel. Analyses of relevant processes determining surface O3 concentrations (2013-2017) in the Central Amazon rainforest at the ATTO site. A.370, EGU2019-11029. Viena, Austria, 7-12 Abril 2019.
116) Efstratios Bourtsoukidis, Thomas Behrendt, Ana Maria Yañez-Serrano, Heidi Hellén, Efstathios Diamantopoulos, Elisa Catão, Kirsti Ashworth, Andrea Pozzer, Carlos Alberto Quesada, Demetrius Lira Martins, Marta Sá, Alessandro Araújo, Joel Brito, Paulo Artaxo, Jürgen Kesselmeier, Jos Lelieveld, and Jonathan Williams. Strong sesquiterpene emissions from Amazonian soils as product of microbial activity. A.371, EGU2019-13388. Viena, Austria, 7-12 Abril 2019.
117) Joel Brito, Marco Aurelio de Menezes Franco, André Burguer, Samara Carbone, Fabio Jorge, Fernando Morais, Luciana V. Rizzo, Rafael Stern, Henrique Barbosa, and Paulo Artaxo. Western Amazonia aerosol and VOC measurements: Overview of 2018 intensive campaign and associated measurements. A.379, EGU2019-13948. Viena, Austria, 7-12 Abril 2019.
118) Bruna Holanda and the ATTO team. Aerosol physical properties over the Amazon basin. A.378, EGU2019-15907. Viena, Austria, 7-12 Abril 2019.
119) Bruna Holanda, M. Pöhlker, O. Krüger, T. Klimach, L. Kremper, F. Ditas, J. Saturno, D. Walter, Q. Wang, Y. Cheng, H. Su, J. Ditas, N. Ma, I. Lieberwirth, G. Glaßer, L. Machado, M. Wendisch, D. Sauer, J. Schneider, P. Artaxo, J. Williams, H. Fischer, J. Lelieveld, U. Pöschl, M. O. Andreae, C. Pöhlker. Black carbon particles in biomass burning plumes. 12th International Conference on Carbonaceous Particles in the Atmosphere (ICCPA), Viena, Austria, 5 April 2019.
120) Artaxo, P., Climate change and sustainable developmemnnt goals. Reunião Magna 2019 da Academia Brasileira de Ciências. Museu do Amanhã, Rio de Janeiro, 14-16 de maio de 2019.
121) Artaxo, P., Urban air pollution and climate change. Klimapolis workshop, IAG-USP, São Paulo, 21-24 de Maio de 2019.
122) Artaxo, P., Mudanças climáticas, governança e direito internacional. 24 Congresso Brasileiro de Direito Ambiental, São Paulo, 25 a 29 de Maio de 2019.
123) O. Lauer, D. Rosenfeld, R. Braga, Y. Zhu, Y. Zheng, E. Hashimshoni, F. Ditas, M. O. Andreae, P. Artaxo, H. M. J. Barbosa, J. Brito, S. Carbone, A. Efraim, B. Holanda, M. A. Pinsky, C. Pöhlker, A. P. Khain, T. Klimach, O. Krüger, B. Nillius, M. Praß, J. Shpund, D. Walter, S. Wolff, U. Pöschl,. M. L. Pöhlker and the ATTO and MPIC Multiphase team. Detection of secondary droplet activation and differentiation of microphysical zones in deep convective cumulus clouds over the Amazon rainforest using satellite imaging. 8th COAA International Conference on Atmosphere, Ocean, and Climate Change (ICAOCC), Nanjing, China, July 10-12, 2019.
124) Artaxo, P., Why we are discussing geoengineering? International Symposium on Climate Geoengineering, Academia Brasileira de Ciências, Rio de Janeiro, 10-11 junho de 2019.
125) Rahul Zaveri, Paulo Artaxo et al., Growth of Urban Ultrafine Aerosols and Their Impact on Shallow Clouds and Precipitation in the Amazon Rainforest. DoE ASR Science Team Meeting. Bethesda North Marriott Hotel and Conference Center in Rockville, Maryland, USA, June 10 to 13, 2019.
126) Arthur Dias Freitas, Ednaldo Carvalho Guimarães, Luciana Varanda Rizzo, Paulo Artaxo, Samara Carbone. IDENTIFICAÇÃO DE PICOS NA CONCENTRAÇÃO DE MP1 NA BACIA CENTRAL DA AMAZÔNIA DURANTE A ESTAÇÃO CHUVOSA DE 2015 (ATTO). Paper numero 160496. XVII ENEEAMB e V Forum Latino Americano de Engenharia e Sustentabilidade, João Pessoa, Paraiba, 22-26 de Julho de 2019.
127) Artaxo, P;. Cambio climático global: bases cientificas y su impacto en nuestra Sociedad global. IV Congresso internacional de calidad ambiental, Barraquilla, 1-4 de março de 2019.
128) Artaxo, P., The impacts of climate change on our planet Earth. FAPESP-UNICAMP,

Cardiff Workshop on Environment and Development: Shared 21st Century Sustainability Challenges, UNICAMP, Campinas, 15-19 July 2019.
129) CHAGAS, V.B.P., BEVACQUA, A.G., CHAFFE, P.L.B., 2018: Propagação de Secas Meteorológicas para Secas Hidrológicas no Sul do Brasil. In: I Encontro Nacional de Desastres, 2018, Porto Alegre. I Encontro Nacional de Desastres.
130) DAVID, P.C., CHAFFE, P.L.B., 2018: Análise da estrutura das cheias da bacia do Itajaí. In: I Encontro Nacional de Desastres, 2018, Porto Alegre. I Encontro Nacional de Desastres.
131) GOERL, R.F., TASCA, F.A., SPECKHANN, G.A., CHAFFE, P.L.B., 2018: Análise da evolução populacional em áreas propensas a inundação: estudo de caso de Santa Catarina. In: I Encontro Nacional de Desastres, 2018, Porto Alegre. I Encontro Nacional de Desastres.
132) INNOCENTE, C., MONTEIRO, L.R., CORSEUIL, C.W., KOBIYAMA, M., CHAFFE, P.L.B., 2018: Um estudo sobre a definição da duração crítica da chuva de projeto na bacia da UFSC, Florianópolis - SC. In: I Encontro Nacional de Desastres, 2018, Porto Alegre. I Encontro Nacional de Desastres.
133) OLIVEIRA, D.Y., BARTIKO, D.; CHAFFE, P.L.B., 2018: Incerteza na análise de frequência de vazões máximas anuais utilizando modelos estacionário e não estacionário aplicados à região sul do Brasil. In: I Encontro Nacional de Desastres, 2018, Porto Alegre. I Encontro Nacional de Desastres.
134) PEREIMA, M.F.R., BORGES, P. A., CHAFFE, P.L.B., 2018: Correção de viés da precipitação de modelos de clima do CMIP5 na bacia do rio Itajaí. In: I Encontra Nacional de Desastres, 2018, Porto Alegre. I Encontra Nacional de Desastres.
135) SAKSCHEWSKI, B., van BLOH, W., DRUKE, M., SORENSSON, A., RUSCICA, R., LANGERWISCH, F., BILLING, M., OLIVEIRA, R.S., HIROTA, M., SCHAPHOFF, S., THONICKE, K., 2019: Variable rooting strategies stabilize biome productivity. In: EGU General Assembly, 2019, Vienna. Proceeding of the EGU General Assembly.
136) VERBESSELT, J., UMLAUF, N., REICHE, J., ANDERSON, L., HIROTA, M., VREUGDENHIL, M., DORIGO, W., HEROLD, M., 2019: Towards monitoring tropical forest recovery capacity using dense time series of Sentinel-1 and 2. In: 2019 Living Planet Symposium, Milan. Proceedings of the 2019 Living Planet Symposium.
137) BARATA, M.M.L; CONFALONIERI,U.; MARINHO,D.; COSTA NETO,C.; LUIGI,G.; OLIVEIRA,F.; SILVA,H.V.; VOMMARO,F.M., 2018: Mapping Municipal Population Vulnerability to Climate Change and Stakeholder Engagement Process – case study: the State of Rio de Janeiro, Brazil. On: Cities and Climate Change Science Conference, March 5-7, 2018, Edmonton, Canada.
138) BARATA, M.M.L., 2018: Climate Change Adaptation Strategy for the City of Rio de Janeiro, Brazil. In: Research Priorities and Multisectoral Collaborations Needed to Support the Most Vulnerable People. On Cities, Cities and Climate Change Science Conference, March 5-7, 2018, Edmonton, Canada
139) Jun/ 2019: Meeting with NEXUS. Structuring the Database and Information Systems; analysis of the Land Use and Agricultural Production Database; analyze climate variability and characterize current and future droughts; analyze water availability through the Hydrological-Climatic Model coupling; design and apply Nexus Modeling methodology; propose strategies of Adaptive Management and environmental recovery for the São Francisco River Extended Basin; analysis of the Data Base and Information of the Social and Economic Dynamics and propose strategies of Adaptive Management and environmental recovery for the St Francis River Basin.

10 List of publications

The papers published within the Year 2 of the INCT-MC Phase 2 included in the publication list reflects the activities of the subgroups that have different funding sources, as well as a continuous interdisciplinary work over the last years. Some of them were published with new data (collected from funds from this project this year) others contain scientific material from 2-3 years ago, that were compiled within the framework of this INCT but that started at the INCT MC Phase 1 lead by Carlos Nobre and that ended in 2017. As the new data are being collect over the duration of this

INCT, the published papers will reflect more the activities of this project over the next years.

1) Marengo JA Jr, Souza C, Thonicke K, Burton C, Halladay K, Betts RA, Alves LM and Soares WR (2018) Changes in Climate and Land Use Over the Amazon Region: Current and Future Variability and Trends. Front. Earth Sci. 6:228. doi: 10.3389/feart.2018.0022
2) Young Af, JA Marengoa, JOM Coelho, GB Scofield, CC Silva, C Prieto (2019) The role of nature-based solutions in disaster risk reduction: The decisionmaker's perspectives on urban resilience in São Paulo state, International Journal of Disaster Risk Reduction 39 (2019) 101219
3) ESPINOZA, JHAN CARLO; RONCHAIL, JOSYANE; MARENGO, JOSÉ ANTONIO; SEGURA, HANS Contrasting North-South changes in Amazon wet-day and dry-day frequency and related atmospheric features (1981-2017). CLIMATE DYNAMICS. , v.45, p.1421 - , 2018.
4) Lapola, David M.; PINHO, PATRICIA; QUESADA, CARLOS A.; STRASSBURG, BERNARDO B. N.; RAMMIG, ANJA; KRUIJT, BART; BROWN, FOSTER; OMETTO, JEAN P. H. B.; PREMEBIDA, ADRIANO; MARENGO, JOSÉ A.; VERGARA, WALTER; Nobre, Carlos A. (2018) Limiting the high impacts of Amazon forest dieback with no-regrets science and policy action. PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA. , v.100, p.201721770 - , 2018.
5) Costa SM, Cordeiro JLP, Rangel EF (2018) Environmental suitability for *Lutzomyia (Nyssomyia) whitmani* (Diptera: Psychodidae: Phlebotominae) and the occurrence of American Cutaneous Leishmaniasis in Brazil. Parasites & Vectors 11: 155.
6) Oliveira EF, Galati EAB, Oliveira AG, Rangel EF, Carvalho BM (2018) Ecological niche modelling and predicted geographic distribution of *Lutzomyia cruzi*, vector of *Leishmania infantum* in South America. PLoS Neglected Tropical Diseases 12(7): e0006684.
7) Costa SM, Magalhães MAFM, Rangel EF (2018) Spatial distribution of the *Lutzomyia (Nyssomyia) whitmani* (Diptera: Psychodidade: Phlebotominae) and American Cutaneous Leishmaniasis (ACL), in view of environmental changes in the states of the legal Amazon, Brazil. In: Folquitto (org.) Alicerces da Saúde Pública no Brasil 2. Ponta Grossa: Atena. p. 132-145.
8) Rangel EF, Lainson R, Carvalho BM, Costa SM, Shaw JJ (2018) Sand fly vectors of American cutaneous leishmaniasis in Brazil. In: Rangel EF, Shaw JJ (orgs.) Brazilian Sand Flies. Biology, Taxonomy, Medical Importance and Control. Cham: Springer Nature. p. 341-380.
9) DIAS, R. B.; SMITH, A. Making in Brazil: can we make it work for social inclusion? Journal of Peer Production, v. 12, 2018.
10) GUIMARÃES, L. B.; ESTEVINHO, L. ; RAMOS, M. B.. Environmental education in television narratives: a Brazilian case study. Environmental Education Research, p. 1-11, 2019.
11) MEDEIROS, P. M. ; GOMES, I. M. DE A. M.. O papel do dualismo no discurso ambiental: uma análise a partir de filmes documentários sobre a questão agrícola. MATRIZES (ONLINE), v. 12, p. 277-296, 2018.
12) MONTEIRO, M. S. A. Ethnography and interdisciplinary work: experiences from the US and Brazil. Tapuya: Latin American Science, Technology and Society, v. 1, p. 153-169, 2018.
13) DIAS, S.; WIEDEMANN, S.; AMORIM, A. C. (Org.) Conexões Deleuze e Cosmopolíticas e Ecologias Radicais e Nova Terra e… Campinas: ALB-ClimaCom, 2019.
14) Chapters of books
15) LESSA, E.; AMORIM, A. C. R. Comunicação, Ciência e Divulgação dos conflitos socioambientais no Brasil In: Ciências, culturas e tecnologias: divulgações plurais.1 ed.Rio de Janeiro : Bonecker, 2019, v.1, p. 161-184.
16) DIAS, S.; OLIVEIRA, T.; WUNDER, M.; AGUIAR, N. Da vida por um fio ao mundo como um infinito tecer(-se). In: DIAS, S.; WIEDEMANN, S.; AMORIM, A. C. (Org.) Conexões Deleuze e Cosmopolíticas e Ecologias Radicais e Nova Terra e… Campinas: ALB-ClimaCom, pp. 241-254, 2019.
17) DIAS, S.; RODRIGUES, C.; PESTANA, F. Entre limites abre-se um mar: fazer escuta para novos possíveis na política de comunicação das mudanças climáticas. In: KANASHIRO, M.; MANICA, D. (Org.). Ciências, culturas e tecnologias: divulgações plurais. Rio de Janeiro: Bonecker, 2019.
18) DIAS SOBRINHO, J.; DIAS, R. B.; SERAFIM, M. P. Universidade, ciência, tecnologia,

degradação do ecossistema e crise civilizacional. In: BENTO, J. O.; MOREIRA, W. W.; LOUREIRO, A. C. C.; BAGUINHO BENTO, H. C.; BOTELHO, R. G.; MARINHO, T. C.. (Org.). Cuidar da Casa Comum: da Natureza, da Vida, da Humanidade. Oportunidades e Responsabilidades do Desporto e da Educação Física. 1ed.Belo Horizonte: Casa da Educação Física, 2018, pp. 29-38.

19) VASCONCELLOS, B. M. ; DIAS, R. B. ; FRAGA, Lais . Tecendo conexões entre feminismo e alternativas sociotécnicas. In: HENRIQUES, F. C.; ADDOR, F.; MALINA, A.; ALVEAR, C. A. S.. (Org.). Tecnologia para o desenvolvimento social: Diálogos Nides-UFRJ. Marília: Lutas Anticapital, 2018, pp. 271-301.

20) GARCIA, G. C.; OLIVEIRA, R. Anatomias de um crime: o que aquelas linhas demarcavam? In: DIAS, S.; WIEDEMANN, S.; AMORIM, A. C. (Org.) Conexões Deleuze e Cosmopolíticas e Ecologias Radicais e Nova Terra e… Campinas: ALB-ClimaCom, pp. 345-358, 2019.

21) GARCÍA, D.; MENEGAZ, A.; MURRIELLO, A. "Practica hortícolas y saberes en diálogo: de los agrotóxicos a la agroecología". In: Hacia la sostenibilidad en América Latina: prácticas, investigación y reflexiones desde la divulgación de la ciencia. RedPop, 2019. (no prelo).

22) GUIMARÃES, L. B.; SILVA, G.; TORREZAN, G. Escritas labirínticas. In: DIAS, S.; WIEDEMANN, S.; AMORIM, A. C. (Org.) Conexões Deleuze e Cosmopolíticas e Ecologias Radicais e Nova Terra e… Campinas: ALB-ClimaCom, pp. 223-240, 2019.

23) RODRIGUES, C.; MARTINS, C. J.; MELO, S. Fragilidade, força de vida – Um relato impossível. In: DIAS, S.; WIEDEMANN, S.; AMORIM, A. C. (Org.) Conexões Deleuze e Cosmopolíticas e Ecologias Radicais e Nova Terra e… Campinas: ALB-ClimaCom, pp. 269-278, 2019.

24) SILVEIRA, E.; GUIMARÃES, L. B. Gambiarras inventivas de ambientes. In: Paula Corrêa Henning; Andresa Mutz; Virgínia Tavares Vieira. (Org.). Educações ambientais possíveis: ecos de Michel Foucault para pensar o presente. 1ed.Curitiba: Appris, 2018, v. 1, p. 129-137.

25) GUIMARÃES, L. B. Euclides da Cunha e a escultura de um grito na Amazônia. In: Valdo Barcelos. (Org.). Intérpretes do Brasil: ontem e hoje. 1ed.Santa Maria: Caxias, 2018, v. 1, p. 163-175.

26) GONÇALVES, M; MORAES, B.; SPEGLICH, E.; MONTEIRO, M. Imediações de uma língua aberrante: experimentando paisagens possíveis para uma Nova Terra. In: DIAS, S.; WIEDEMANN, S.; AMORIM, A. C. (Org.) Conexões Deleuze e Cosmopolíticas e Ecologias Radicais e Nova Terra e… Campinas: ALB-ClimaCom, pp. 279-294, 2019.

27) GOMES, I. M.; FLORES, N. . A divulgação científica nas mãos do pesquisador. In: Cristiane Porto, Kaio Eduardo Oliveira, Flávia Rosa. (Org.). Produção e Difusão de Ciência na Cibercultura - Narrativas em Múltiplos Olhares. 1ed.Ilhéus-BA: Editus, 2018, v. 1, p. 107-116.

28) GOMES, I. M.; SANTOS, M.O.S. ; GURGEL, I. G. D. ; GURGEL, A. M. ; REBELO NETO, A. J. ; MELO, P. S. . Jornalismo ambiental e o discurso da mídia pernambucana sobre Suape. In: Mariana Olívia Santana dos Santos; Aline do Monte Gurgel; Idê Gomes Dantas Gurgel. (Org.). Conflitos e injustiças na instalação de refinarias: os caminhos sinuosos de Suape, Pernambuco.. 1ed.Recife-PE: EDUFPE - Editora Universitária da UFPE, 2018, v. 1, p. 112-124.

29) GOMES, I. M.; SANTOS, M.O.S. ; GURGEL, I. G. D. ; AUGUSTO, L.G.S. ; RIBEIRO, T. S. ; SILVA, J. M. . Ciberativismo, saúde e ambiente: movimentos sociais no Brasil e na Espanha. In: Mariana Olívia Santana dos Santos; Aline do Monte Gurgel; Idê Gomes Dantas Gurgel. (Org.). Conflitos e injustiças na instalação de refinarias: os caminhos sinuosos de Suape, Pernambuco. 1ed.Recife-Pernambuco: EDUFPE, 2018, v. 1, p. 181-234.

30) OLIVEIRA JÚNIOR, W. et al. Corpos-pesquisas cavam o terreno: intensidades do comum. In: DIAS, S.; WIEDEMANN, S.; AMORIM, A. C. (Org.) Conexões Deleuze e Cosmopolíticas e Ecologias Radicais e Nova Terra e… Campinas: ALB-ClimaCom, pp. 279-294, 2019.

31) PONTIN, V.; PELLEJERO, E. Outra forma de pensar juntos: notas sobre a partilha de uma experiência. In: DIAS, S.; WIEDEMANN, S.; AMORIM, A. C. (Org.) Conexões Deleuze e Cosmopolíticas e Ecologias Radicais e Nova Terra e… Campinas: ALB-ClimaCom, pp. 255-262, 2019.

32) TADDEI, Renzo R.. La construcción de las bases del diálogo interdisciplinario: especulaciones etnográficas. In: Hidalgo, Cecilia; Vienni, Bianca; Simón, Claudia. (Org.). Encrucijadas Interdisciplinarias. 1ed.Buenos Aires: Fundacción CICCUS; CLACSO, 2018, v. 1, p. 47-55.
33) AMORIM, A. C. Apresentação. In: DIAS, S.; WIEDEMANN, S.; AMORIM, A. C. (Org.) Conexões Deleuze e Cosmopolíticas e Ecologias Radicais e Nova Terra e… Campinas: ALB-ClimaCom, 2019. 367p.
34) DIAS, S. "Cenários Sensíveis – apresentação curadoria dossiê Diálogos do Antropoceno". Dossiê "Diálogos do Antropoceno". 12. ed. Campinas: ClimaCom/Labjor, 2018. v. 1. 180p.
35) MONTEIRO, M.; OLIVEIRA FILHO, A.; MIGUEL, J. (Orgs.). "Diálogos do Antropoceno". Dossiê "Diálogos do Antropoceno". 12. ed. Campinas: ClimaCom/Labjor, 2018. v. 1. 180p.
36) DIAS, Susana (resumo). "Povoamentos fúngicos". ClimaCom – Fabulações Miceliais[online], Campinas, ano. 6, n. 14. Abr. 2019 .
37) DIAS, Susana (resumo expandido). "Floresta sensível II". ClimaCom – Fabulações Miceliais [online], Campinas, ano. 6, n. 14. Abr. 2019 .
38) DIAS, Susana (resumo). "Bichário". ClimaCom – Fabulações Miceliais [online], Campinas, ano. 6, n. 14. Abr. 2019 .
39) DIAS, Susana (resumo) "Floresta água-viva". ClimaCom – Inter/Transdisciplinaridade [online], Campinas, ano. 5, n. 13. Nov. 2018 .
40) DIAS, Susana (resumo) "Floresta sensível" . ClimaCom – Inter/Transdisciplinaridade [online], Campinas, ano. 5, n. 13. Nov. 2018 .
41) DIAS, Susana (resumo) "Doações despropositadas". ClimaCom – Inter/Transdisciplinaridade [online], Campinas, ano. 5, n. 13. Nov. 2018 . Available from: http://climacom.mudancasclimaticas.net.br/?p=10432
42) Organization of the dossiers of ClimaCom Journal/Magazine
43) MONTEIRO, M.; OLIVEIRA FILHO, A.; MIGUEL, J. (Orgs.). Dossiê "Diálogos do Antropoceno". 12. ed. Campinas: ClimaCom/Labjor, 2018. v. 1. 180p.
44) DIAS, S. O. Dossiê "Diálogos do Antropoceno". Seções Artes, Laboratório-Ateliê e Coluna Assinada. Dossiê "Diálogos do Antropoceno". 12. ed. Campinas: ClimaCom/Labjor, 2018. v. 1. 180p.
45) DIAS, S. O.; OLIVEIRA, T. P. Dossiê Diálogos do Antropoceno - Revista ClimaCom, ano 05, n. 12, Ago/2018, Campinas, SP, Brasil, 2018. (Editoração).
46) CANTARINO, C.; DIAS, S. O.; OLIVEIRA, T. P. Dossiê Inter/Transdisciplinaridade – Revista ClimaCom. Ano 05, n. 13, Dez/2018, Campinas, SP, Brasil, 2018. (Editoração).
47) OLIVEIRA, T. P.; ELIZEU, T.; DIAS, S. O. Dossiê Fabulações Miceliais – Revista ClimaCom. Ano 06, n. 14, Abr/2019, Campinas, SP, Brasil, 2019. (Editoração).
48) Capistrano, V., R. Tedeschi, J. Silva, P. Nobre, O. Neto, F. Rodrigues, F. Casagrande, M. Baptista, S. Figueroa, M. Cardoso, and C. A. Nobre, 2019: Climate sensitivity of the Brazilian Earth System Model, version 2.5. *Geosci. Model Dev.*, Accepted for publication.
49) Nobre, P., M. Baptista Jr, M. J. Bottino, P. Kubota, A. L. Marquez, H. Cachanhuk, S. N. Figueroa, and E. Giarolla, 2019a: Brazilian Earth System Model - BESM-OA2.9 Developments towards CMIP6. CMIP6 Model Analysis Workshop, Barcelona, Spain, WCRP, Poster https://www.dropbox.com/s/cmv5rpoecz2lkqk/20190321aBESMCMIP6ModelAnalysisWorkshop.pptx?dl=0
50) Nobre P, E. B. Pereira, F. F. Lacerda, M. Bursztyn, E. A. Haddad, and D. Ley, 2019b: Solar Smart Grid as a Path to Economic Inclusion and Adaptation to Climate Change in the Brazilian Semiarid Northeast. *Int. J. Clim. Change Strateg. Manag.*, in press.
51) Capistrano, V., R. Tedeschi, J. Silva, P. Nobre, O. Neto, F. Rodrigues, F. Casagrande, M. Baptista, S. Figueroa, M. Cardoso, and C. A. Nobre, 2019: Climate sensitivity of the Brazilian Earth System Model, version 2.5. *Geosci. Model Dev.*, Under review.
52) Nobre, P., M. Baptista Jr, M. J. Bottino, P. Kubota, A. L. Marquez, H. Cachanhuk, S. N. Figueroa, and E. Giarolla, 2019a: Brazilian Earth System Model - BESM-OA2.9 Developments towards CMIP6. CMIP6 Model Analysis Workshop, Barcelona, Spain, WCRP, Poster

https://www.dropbox.com/s/cmv5rpoecz2lkqk/20190321a_BESM_CMIP6_ModelAnalysisWorkshop.pptx?dl=0.
53) Veiga, S. F., P. Nobre, E. Giarolla, V. Capistrano, M. Baptista Jr., A. L. Marquez, S. N. Figueroa, J. P. Bonatti, P. Kubota, and C. A. Nobre, 2019: The Brazilian Earth System Model ocean–atmosphere (BESM-OA) version 2.5: evaluation of its CMIP5 historical simulation. *Geosci. Model Dev.*, 12, 1613–1642, doi:10.5194/gmd-12-1613-2019.
54) GOMES, HELBER B. ; AMBRIZZI, Tércio ; PONTES DA SILVA, BRUCE F. ; HODGES, KEVIN ; SILVA DIAS, PEDRO L. ; HERDIES, DIRCEU L. ; SILVA, MARIA CRISTINA L. ; GOMES, HELIOFÁBIO B. . Climatology of easterly wave disturbances over the tropical South Atlantic. CLIMATE DYNAMICS, v. 51, p. 1-17, 2019.
55) REBOITA, M. S. ; AMBRIZZI, T ; SILVA, B. A. ; PINHEIRO, R. F. ; ROCHA, R. P. . The South Atlantic Subtropical Anticyclone: Present and Future Climate. FRONTIERS IN ENVIRONMENTAL SCIENCE, v. 7, p. 1-17, 2019
56) HALL, NICHOLAS M. J. ; LEROUX, STEPHANIE ; Ambrizzi, Tercio . Transient contributions to the forcing of the atmospheric annual cycle. CLIMATE DYNAMICS, v. 52, p. 6719-6733, 2019.
57) REHBEIN, AMANDA ; Ambrizzi, Tercio ; MECHOSO, CARLOS ROBERTO . Mesoscale convective systems over the Amazon basin. Part I: climatological aspects. INTERNATIONAL JOURNAL OF CLIMATOLOGY, v. 38, p. 215-229, 2018.
58) AMADOR, JORGE A. ; Ambrizzi, Tercio ; ARRITT, RAYMOND W. ; CASTRO, CHRISTOPHER L. ; CAVAZOS, TEREZA ; CEREZO-MOTA, RUTH ; FUENTES-FRANCO, RAMÓN ; GIORGI, FILIPPO ; GUILIANI, GRAZIANO ; LEE, HUIKYO ; MÉNDEZ-PÉREZ, MATÍAS ; RIVERA, ERICK R. R. . Putting into action the REGCM4.6 regional climate model for the study of climate change, variability and modeling over Central America and Mexico. ATMOSFERA, v. 31, p. 185-188, 2018.
59) DE OLIVEIRA, CRISTIANO PRESTRELO ; AÍMOLA, LUIS ; AMBRIZZI, Tércio ; FREITAS, ANA CAROLINA VASQUES . The Influence of the Regional Hadley and Walker Circulations on Precipitation Patterns over Africa in El Niño, La Niña, and Neutral Years. PURE AND APPLIED GEOPHYSICS, v. 175, p. 1134-1149, 2018.
60) SILVA, CARLOS BATISTA ; SILVA, MARIA ELISA SIQUEIRA ; KRUSCHE, NÍSIA ; AMBRIZZI, Tércio ; DE JESUS FERREIRA, NELSON ; DA SILVA DIAS, PEDRO LEITE . The analysis of global surface temperature wavelets from 1884 to 2014. THEORETICAL AND APPLIED CLIMATOLOGY, v. 133, p. 1-18, 2018.
61) AMBRIZZI, Tércio; Reboita, Michelle Simões ; da Rocha, Rosmeri Porfírio ; LLOPART, MARTA . The state-of-the-art and fundamental aspects of regional climate modeling in South America. Annals of the New York Academy of Sciences, v. 330, p. 1-23, 2018.
62) CHERCHI, ANNALISA ; Ambrizzi, Tercio ; BEHERA, SWADHIN ; FREITAS, ANA CAROLINA VASQUES ; MORIOKA, YUSHI ; ZHOU, TIANJUN . The Response of Subtropical Highs to Climate Change. Current Climate Change Reports, v. 1, p. 1-12, 2018
63) MAYTA, VICTOR C. ; AMBRIZZI, Tércio ; ESPINOZA, JHAN CARLO ; SILVA DIAS, PEDRO L. . The role of the Madden-Julian oscillation on the Amazon Basin intraseasonal rainfall variability. INTERNATIONAL JOURNAL OF CLIMATOLOGY, v. 39, p. 1-18, 2018.
64) REHBEIN, AMANDA ; DUTRA, LÍVIA MÁRCIA MOSSO ; Ambrizzi, Tercio ; da Rocha, Rosmeri Porfírio ; Reboita, Michelle Simões ; DA SILVA, GYRLENE APARECIDA MENDES ; GOZZO, LUIZ FELIPPE ; TOMAZIELLO, ANA CAROLINA NÓBILE ; CAMPOS, JOSÉ LEANDRO PEREIRA SILVEIRA ; MAYTA, VICTOR RAUL CHAVEZ ; CRESPO, NATÁLIA MACHADO ; BUENO, PAOLA GIMENES ; ALIAGA NESTARES, VANNIA JAQUELINE ; MACHADO, LAÍS TABOSA ; DE JESUS, EDUARDO MARCOS ; PAMPUCH, LUANA ALBERTANI ; CUSTÓDIO, MARIA DE SOUZA ; CARPENEDO, CAMILA BERTOLETTI . Severe Weather Events over Southeastern Brazil during the 2016 Dry Season. Advances in Meteorology, v. 2018, p. 1-15, 2018.
65) Chapter, in press: Menezes JA, Santos, RB, Vomaro F, Confalonieri, UEC, Barata, MML, Margonari, C. Extreme weather events under a changing climate: impacts on health in the Brazilian context. In Extreme weather events and human health, Rais Akhtar Eds. 2019.

66) Velloso, M.F.A., Martins, F.R. & Pereira, E.B. (2019) Case study for hybrid power generation combining hydro- and photovoltaic energy resources in the Brazilian semiarid region. Clean Techn. Environ. Policy. https://doi.org/10.1007/s10098-019-01685-1.
67) Nobre, P.; Pereira, E.B.; Lacerda, F.F.; Bursztyn, M.; Faddad, E. A. and Ley, D. (2019) Solar smart grid as a path to economic inclusion and adaptation to climate change in the Brazilian Semiarid Northeast (in press) doi: 10.1108/IJCCSM-09-2018-0067
68) Lima F. J. L.; F. R. Martins; R. S. C.; A. R. Gonçalves; A. P. P. Santos e E. B. Pereira - The seasonal variability and trends for the surface solar irradiation in northeastern region of Brazil. Submitted to Sustainable Energy Technologies and Assessments (2019)
69) Mahecha, R. E. G.; Lucena, A.; Szklo, A.; Ferreira, P.; Vaz, I. Optimization model for evaluating on-site renewable technologies with storage in zero/nearly zero energy buildings. Energy and Buildings. https://doi.org/10.1016/j.enbuild.2018.04.027.
70) Portugal-Pereira, J.; Ferreira, P.; Cunha, J.; Szklo, A.; Schaeffer, R.; Araújo, M. (2018) Better late than never, but never late is better: Risk assessment of nuclear power construction projects. Energy Policy. https://doi.org/10.1016/j.enpol.2018.05.041.
71) Rochedo, P. R. R.; Soares-Filho, B.; Schaeffer, R.; Viola, E.; Szklo, A.; Lucena, A. F. P.; Koberle, A.; Davis, J. L.; Rajão, R.; Rathmann, R. (2018) The threat of political bargaining to climate mitigation in Brazil. Nature Climate Change. https://doi.org/10.1038/s41558-018-0213-y.
72) Köberle, A. C.; Garaffa, R.; Cunha, B.; Rochedo, P.; Lucena, A. F.P.; Szklo, A.; Schaeffer, R. (2018) Are conventional energy megaprojects competitive? Suboptimal decisions related to cost overruns in Brazil. Energy Policy. https://doi.org/10.1016/j.enpol.2018.08.021.
73) Miranda, R.; Simoes, S.; Szklo, A.; Schaeffer, R. (2019) Adding detailed transmission constraints to a long-term integrated assessment model - A case study for Brazil using the TIMES model. Energy. https://doi.org/10.1016/j.energy.2018.11.036.
74) Costa, I.; Rochedo, P.; Costa, D.; Ferreira, P.; Araújo, M.; Schaeffer, R.; Szklo, A. (2019) Placing hubs in CO_2 pipelines: An application to industrial CO_2 emissions in the Iberian Peninsula. Applied Energy. https://doi.org/10.1016/j.apenergy.2018.11.050.
75) Lap, T.; Benders, R.; Köberle, A.; Van Der Hilst, F.; Nogueira, L.; Szklo, A.; Schaeffer, R.; Faaij, A. (2019) Pathways for a Brazilian biobased economy: towards optimal utilization of biomass. Biofuels Bioproducts & Biorefining. https://doi.org/10.1002/bbb.1978.
76) Köberle, A. C.; Portugal-Pereira, J.; Cunha, B.; Garaffa, R.; Lucena, A.; Szklo, A.; Schaeffer, R. (2019) Brazilian ethanol expansion subject to limitations. Nature Climate Change. https://doi.org/10.1038/s41558-019-0422-z.
77) Simioni, T.; Schaeffer, R. (2019) Georeferenced operating-efficiency solar potential maps with local weather conditions - An application to Brazil. Solar Energy. https://doi.org/10.1016/j.solener.2019.04.006.
78) Tagomori, I.; Rochedo, P.; Szklo, A. (2019) Techno-economic and georeferenced analysis of forestry residues-based Fischer-Tropsch diesel with carbon capture in Brazil. Biomass & Bioenergy. https://doi.org/10.1016/j.biombioe.2019.02.018.
79) Pinto, L. I. C. ; Lima, F. J. L.; Martins, F. R.; Pereira, E. B. (2019) Sensitivity tests for different WRF model cumulus parameterizations to improve wind estimates.. In: Paulo Jayme Pereira Abdala. (Org.). Energia solar e eólica 2. 1ed.Ponta Grossa: Antonella Carvalho de Oliveira, 2019, v. 2, p. 290-302. doi: 10.22533/at.ed.67419220122.
80) Tomasella, J et al Probabilistic flood forecasting in the Doce Basin in Brazil: Effects of the basin scale and orientation and the spatial distribution of rainfall, J Flood Risk Mgmt 12(1), doi: 10.1111/jfr3.12452
81) Lago, C A, Giacomoni, M, Olivera, F, Mendiondo, E M (2019) Application of a Disaggregation Method for the Generation of Climate Changed Intensity-Duration-Frequency Curves for Predicting Future Extreme Rainfall Impacts on Transportation Infrastructure , Matweb of Conf 271(04002), DOI: 10.1051/matecconf/201927104002
82) Fava, M C, Abe, N, Restrepo-Estrada, C E, Kimura, B, Mendiondo, E M (2019) Flood Modelling Using Synthesized Citizen Science Urban Streamflow Observations, Journal of Flood Risk Management, DOI: 10.1111/jfr3.12498

83) Macedo, M B, Mendiondo, E M (2018) Performance of bioretention experimental devices: contrasting laboratory and field scales through controlled experiments, Braz. J. Wat. Res, RBRH 23(e3), DOI: 10.1590/2318-0331.0318170038
84) de Macedo, M B, de Lago, C A, Mendiondo, E M (2019) Stormwater volume reduction and water quality improvement by bioretention: potentials and challenges for water security in a subtropical catchment, Science of the Total Environment, doi: 10.1016/j.scitotenv.2018.08.002,
85) Amaral Marques, L O, Calijuri, M C, Mendiondo, E M, Taffarello, D, de Souza-Ferreira, M, Cunha, D F G (2019), Loads of Phosphorus and Thermotolerant Coliforms in Brazilian Poor Gauged Basins: First Considerations for Integrated Water Quality Assessment, RBRH-Brazilian Journal of Water Resources, Ref. No.: RBRH-2017-0137.R1
86) Campos, A, Mendiondo, E M, (2019) Water Security in the Context of Regional Changes, **DAE** Journal, Brazil (accepted)
87) Taffarello, D, Mendiondo, E M (2019) Sustainable River Basins under Risks and Changes, Chapter 15, A Philippi Jr & M C Sobral (editors), Sustainable River Basins, Ed Manole, Sao Paulo (Port.)
88) de Souza, F, Mendiondo, E M, et al, (2019) The Socio-Hydrological Observatory for Water Security to Cope with Disasters, C Morales & H Yoshizaki (eds) Disasters II: Strategies, Ed. Manole, Sao Paulo (Portuguese)
89) Scarcioffolo, A., F.F. Perobelli and A. Chimeli (2018). "Wind power and corn: Counterfactual comparisons of investment options in Northern Ohio." Energy Economics, 74, 299-399.
90) Vale, V.A., F.S. Perobelli and A.B. Chimeli (2018). "International trade, pollution and economic structure: Evidence on CO2 emissions for the North and the South." Economic Systems Research, 30:1, 1-17.
91) Mobility in Cities: Distributional Impact Analysis of Transportation Improvement in São Paulo Metropolitan Region Regional (with Nancy Lozano-Gracia, Eduardo Germani, RenatoVieira, Shohei Nakamura, Emmanuel Skoufias and Bianca Alves), *Transport Policy*, v. 73, pp. 125-142, 2019.
92) Modelagem do uso da Terra e Efeitos de Mudanças na Produtividade Agrícola entre 2008 e 2015 (with Weslem R. Faria), *Estudos Econômicos*, v.49, n.1, p.65-103, 2019
93) Matriz Insumo-Producto Interregional para Colombia (with Luis Galvis, Weslem Faria and Lucas Hahn), *Revista de Economía del Caribe*, n. 21, pp. 1-26, 2018.
94) Solar Smart Grid as a Path to Economic Inclusion and Adaptation to Climate Change in the Brazilian Semiarid Northeast (with Paulo Nobre, Enio Pereira, Francis Lacerda, Marcel Bursztyn and Debbie Ley), forthcoming in *International Journal of Climate Change Strategies and Management*
95) O Paradigma da Abundância para o Desenvolvimento Sustentável do Nordeste Semiárido: Uma Análise *Ex-ante* do Papel da Geração Fotovoltaica Distribuída (with Paulo Nobre, Enio Pereira, Francis Lacerda, Marcel Bursztyn), forthcoming in the volume *Avaliação de Políticas Públicas no Brasil: Uma Análise do Semiárido*, edited by Daniel da Mata, Guilherme Resende e Rogério Freitas, IPEA
96) Analysis of the Northeastern Constitutional Financing Fund: A Computable General Equilibrium Application (with Thiago Oliveira Nascimento), submitted to *Regional Science Policy and Practice*
97) Climate Change and Land Use Pattern in Brazil (with Eduardo Barbosa, José Feres and Antonio Paez), forthcoming in the volume *Innovations in Urban and Regional Systems: Contributions from GIS&T, Spatial Analysis and Location Modeling*, Advances in Spatial Sciences Series, edited by Jean-Claude Thill, Springer-Verlag
98) A Bad Year? Climate Variability and the Wine Industry in Chile (with Patricio Aroca, Pilar Jano, Ademir Rocha and Bruno Pimenta), *Working Pape*Water Content in Trade: A Regional Analysis for Morocco (with Fatima Ezzahra Mengoub and Vinicius A. Vale), *Working Paper*
99) Regional Vulnerability to Climate Change under Uncertainty: The Case of the Brazilian Agriculture (with Bruno S. Souza), *Working Paper*

100) Farm size and land use efficiency in Brazilian Amazon (withr Marcelo Ferreira) submitted to *Land Use Policy*
101) Drought Shocks and Student Performance in Brazilian Rural Schools" (with Danyelle Branco), *Working Paper*
102) Saturno, J., Ditas, F., Penning de Vries, M., Holanda, B. A., Pöhlker, M. L., Carbone, S., Walter, D., Bobrowski, N., Brito, J., Chi, X., Gutmann, A., Hrabe de Angelis, I., Machado, L. A. T., Moran-Zuloaga, D., Rüdiger, J., Schneider, J., Schulz, C., Wang, Q., Wendisch, M., Artaxo, P., Wagner, T., Pöschl, U., Andreae, M. O., and Pöhlker, C.: African volcanic emissions influencing atmospheric aerosols over the Amazon rain forest, Atmos. Chem. Phys., 18, 10391-10405, https://doi.org/10.5194/acp-18-10391-2018, https://www.atmos-chem-phys.net/18/10391/2018/ , 2018.
103) Scott, C. E., S. A. Monks, D. V. Spracklen, S. R. Arnold, P. M. Forster, A. Rap, M. Äijälä, P. Artaxo, K. S. Carslaw, M. P. Chipperfield, M. Ehn, S. Gilardoni, L. Heikkinen, M. Kulmala, T. Petäjä, C. L. S. Reddington, L. V. Rizzo, E. Swietlicki, E. Vignati, C. Wilson. Impact on short-lived climate forcers increases projected warming due to deforestation. Nature Communications, Vol. 9, 157, doi:10.1038/s41467-017-02412-4, https://www.nature.com/articles/s41467-017-02412-4, 2018.
104) Jiwen Fan, Daniel Rosenfeld, Yuwei Zhang, Scott E. Giangrande, Zhanqing Li, Luiz A. T. Machado, Scot T. Martin, Yan Yang, Jian Wang, Paulo Artaxo, Henrique M. J. Barbosa, Ramon C. Braga, Jennifer M. Comstock, Zhe Feng, Wenhua Gao, Helber B. Gomes, Fan Mei, Christopher Pöhlker, Mira L. Pöhlker, Ulrich Pöschl, Rodrigo A. F. de Souza. Substantial Convection and Precipitation Enhancements by Ultrafine Aerosol Particles. Science, Vol. 359, Issue 6374, pp 411-418, http://science.sciencemag.org/content/359/6374/411, DOI: 10.1126/science.aan8461, 2018.
105) Rahman. A. A., P. Artaxo. A. Asrat, A. Parker. Developing countries must lead on solar geoengineering research. Nature, Vol. 556, Issue 7699, Pg. 22-24, https://www.nature.com/articles/d41586-018-03917-8 , 2018.
106) Yingjun L., R. Seco, S. Kim, A. Guenther, A. H. Goldstein, F. N. Keutsch, S. R. Springston, T. B. Watson, P. Artaxo, R. A. F. Souza, K. A. McKinney, and S. T. Martin. Isoprene photo-oxidation products quantify the effect of pollution on hydroxyl radicals over Amazonia. Sciences Advances, Vol. 4, No. 4, eaar2547, DOI: 10.1126/sciadv.aar2547, http://advances.sciencemag.org/content/4/4/eaar2547.full, 2018.
107) Efstratios Bourtsoukidis, Thomas Behrendt, Ana Yañez-Serrano, Heidi Hellén, Efstathios Diamantopoulos, Elisa Catão, Kirsti Ashworth, Andrea Pozzer, Carlos Quesada, Demetrius Martins, Marta Sá, Alessandro Araujo, Joel Brito, Paulo Artaxo, Jürgen Kesselmeier, Jos Lelieveld, Jonathan Williams. Strong sesquiterpene emissions from Amazonian soils. Nature Communications, 9, 2226, https://www.nature.com/articles/s41467-018-04658-y DOI: 10.1038/s41467-018-04658-y. 2018.
108) Joel Brito, Samara Carbone, Djacinto A. Monteiro dos Santos, Pamela Dominutti, Nilmara de Oliveira Alves, Luciana V. Rizzo and Paulo Artaxo. Disentangling vehicular emission impact on urban air pollution using ethanol as a tracer. Scientific Reports, Scientific Reports, 8:10679, DOI:10.1038/s41598-018-29138-7. https://www.nature.com/articles/s41598-018-29138-7. 2018.
109) Swarup China, Susannah M. Burrows, Bingbing Wang, Tristan H. Harder, Johannes Weis, Meryem Tanarhte, Luciana V. Rizzo, Joel Brito, Glauber G. Cirino, Po-Lun Ma, John Cliff, Paulo Artaxo, Mary K. Gilles & Alexander Laskin. Fungal spores as a source of sodium salt particles in the Amazon basin. Nature Communications, vol. 9, Article number: 4793, https://www.nature.com/articles/s41467-018-07066-4 , https://doi.org/10.1038/s41467-018-07066-4, 2018.
110) Saarikoski, S., Teinilä, K., Timonen, H., Aurela, M., Laaksovirta, T., Reyes, F., Vásques, Y., Oyola, P., Artaxo, P., Pennanen, A. S., Junttila, S., Linnainmaa, M., Salonen, R. O. & Hillamo, R. (2017): Particulate matter characteristics, dynamics, and sources in an underground mine, Aerosol Science and Technology, Vol 52, Vol. 1, Pg. 114-122, DOI: 10.1080/02786826.2017.1384788.http://www.tandfonline.com/doi/full/10.1080/02786826.2017.1384788 , 2018.

111) Palm, B. B., de Sá, S. S., Day, D. A., Campuzano-Jost, P., Hu, W., Seco, R., Sjostedt, S. J., Park, J.-H., Guenther, A. B., Kim, S., Brito, J., Wurm, F., Artaxo, P., Thalman, R., Wang, J., Yee, L. D., Wernis, R., Isaacman-VanWertz, G., Goldstein, A. H., Liu, Y., Springston, S. R., Souza, R., Newburn, M. K., Alexander, M. L., Martin, S. T., and Jimenez, J. L.: Secondary organic aerosol formation from ambient air in an oxidation flow reactor in central Amazonia, Atmos. Chem. Phys., Vol. 18, Pg, 467-493, https://doi.org/10.5194/acp-18-467-2018 , https://www.atmos-chem-phys.net/18/467/2018/ , 2018.

112) Rocha-Lima, A., Martins, J. V., Remer, L. A., Todd, M., Marsham, J. H., Engelstaedter, S., Ryder, C. L., Cavazos-Guerra, C., Artaxo, P., Colarco, P., and Washington, R.: A detailed characterization of the Saharan dust collected during the Fennec campaign in 2011: in situ ground-based and laboratory measurements. Atmos. Chem. Phys., 18, 1023–1043, https://doi.org/10.5194/acp-18-1023-2018. 2018.

113) Andreae, M. O., Afchine, A., Albrecht, R., Holanda, B. A., Artaxo, P., Barbosa, H. M. J., Borrmann, S., Cecchini, M. A., Costa, A., Dollner, M., Fütterer, D., Järvinen, E., Jurkat, T., Klimach, T., Konemann, T., Knote, C., Krämer, M., Krisna, T., Machado, L. A. T., Mertes, S., Minikin, A., Pöhlker, C., Pöhlker, M. L., Pöschl, U., Rosenfeld, D., Sauer, D., Schlager, H., Schnaiter, M., Schneider, J., Schulz, C., Spanu, A., Sperling, V. B., Voigt, C., Walser, A., Wang, J., Weinzierl, B., Wendisch, M., and Ziereis, H.: Aerosol characteristics and particle production in the upper troposphere over the Amazon Basin. Atmospheric Chemistry and Physics, 18, 921–961, 2018. https://doi.org/10.5194/acp-18-921-2018, https://www.atmos-chem-phys.net/18/921/2018/.

114) de Oliveira Galvao, Marcos Felipe; Alves, Nilmara de Oliveira; Ferreira, Paula Anastacia; Caumo, Sofia; Vasconcellos, Perola de Castro; Artaxo, Paulo; Hacon, Sandra de Souza; Roubicek, Deborah Arnsdorff; Batistuzzo de Medeiros, Silvia Regina. Biomass burning particles in the Brazilian Amazon region: Mutagenic effects of nitro and oxy-PAHs and assessment of health risks. Environmental Pollution, Vol 233, 960-970, 10.1016/j.envpol.2017.09.068, https://doi.org/10.1016/j.envpol.2017.09.068 , 2018.

115) Varanda Rizzo, L., Roldin, P., Brito, J., Backman, J., Swietlicki, E., Krejci, R., Tunved, P., Petäjä, T., Kulmala, M., and Artaxo, P.: Multi-year statistical and modeling analysis of submicrometer aerosol number size distributions at a rain forest site in Amazonia, Atmos. Chem. Phys., 18, 10255-10274, https://doi.org/10.5194/acp-18-10255-2018, 2018. https://www.atmos-chem-phys.net/18/10255/2018/. https://doi.org/10.5194/acp-18-10255-2018

116) Pöhlker, M. L., Ditas, F., Saturno, J., Klimach, T., Hrabě de Angelis, I., Araùjo, A., Brito, J., Carbone, S., Cheng, Y., Chi, X., Ditz, R., Gunthe, S. S., Kandler, K., Kesselmeier, J., Könemann, T., Lavrič, J. V., Martin, S. T., Mikhailov, E., Moran-Zuloaga, D., Rizzo, L. V., Rose, D., Su, H., Thalman, R., Walter, D., Wang, J., Wolff, S., Barbosa, H. M. J., Artaxo, P., Andreae, M. O., Pöschl, U., and Pöhlker, C.: Long-term observations of cloud condensation nuclei in the Amazon rain forest – Part 2: Variability and characteristic differences under near-pristine, biomass burning, and long-range transport conditions. Atmos. Chem. Phys., 18, Series 14, 10289-10331, 2018.https://doi.org/10.5194/acp-18-10289-2018.https://www.atmos-chem-phys.net/18/10289/2018/, 2018.

117) Schmale, J., Silvia Henning, Bas Henzing, Helmi Keskinen, Mikhail Paramonov, Karine Sellegri, Jurgita Ovadnevaite, Mira Pöhlker, Joel Brito, Aikaterini Bougiatioti, Nikos Kalivitis, Iasonas Stavroulas, Samara Carbone, Anne Jefferson, Minsu Park, Patrick Schlag, Adam Kristensson, Yoko Iwamoto, Pasi Aalto, Mikko Äijälä, Nicolas Bukowiecki, Stefano Decesari, Mikael Ehn, Göran Frank, Roman Fröhlich, Arnoud Frumau, Erik Herrmann, Rupert Holzinger, Gerard Kos, Markku Kulmala, Nikolaos Mihalopoulos, Athanasios Nenes, Colin O'Dowd, Tuukka Petäjä, David Picard, Laurent Poulain, André Prévôt, Erik Swietlicki, Ulrich Pöschl, Paulo Artaxo, Alfred Wiedensohler, John Ogren, Atsushi Matsuki, Seong Soo Yum, Frank Stratmann, Urs Baltensperger, and Martin Gysel. Long-term cloud condensation nuclei number concentration, particle number size distribution and chemical composition measurements at regionally representative observatories. Atmospheric Chemistry and Physics, Vol., 18, No.4, pp. 2853–2881, https://doi.org/10.5194/acp-18-2853-2018, https://www.atmos-chem-phys.net/18/2853/2018/acp-18-2853-2018.pdf. 2018.

118) Amy Hodgson, Will Morgan, Sebastian O'Shea, Stephane Bauguitte, James Allan, Eoghan Darbyshire, Michael Flynn, Dantong Liu, James Lee, Ben Johnson, Jim Haywood, Karla Longo, Paulo Artaxo, and Hugh Coe. Near-field emission profiling of Rainforest and Cerrado fires in Brazil during SAMBBA 2012. Atmospheric Chemistry and Physics, 18, 8, 5619–5638, 2018, doi: 10.5194/acp-18-5619-2018, https://www.atmos-chem-phys.net/18/5619/2018/ , 2018

119) Machado, L. A. T., Calheiros, A. J. P., Biscaro, T., Giangrande, S., Silva Dias, M. A. F., Cecchini, M. A., Albrecht, R., Andreae, M. O., Araujo, W. F., Artaxo, P., Borrmann, S., Braga, R., Burleyson, C., Eichholz, C. W., Fan, J., Feng, Z., Fisch, G. F., Jensen, M. P., Martin, S. T., Pöschl, U., Pöhlker, C., Pöhlker, M. L., Ribaud, J.-F., Rosenfeld, D., Saraiva, J. M. B., Schumacher, C., Thalman, R., Walter, D., and Wendisch, M.: Overview: Precipitation characteristics and sensitivities to environmental conditions during GoAmazon2014/5 and ACRIDICON-CHUVA, Atmos. Chem. Phys., 18, 6461-6482, https://doi.org/10.5194/acp-18-6461-2018, https://www.atmos-chem-phys.net/18/6461/2018/acp-18-6461-2018.pdf, 2018.

120) Cirino, G., Brito, J., Barbosa, H.M.J., Rizzo, L.V., Tunved, P., de Sá, S.S., Jimenez, J.L., Palm, B.B., Carbone, S., Lavric, J., Souza, R.A.F., Wolff, S., Walter, D., Tota, Jú., Oliveira, M.B.L., Martin, S.T., Artaxo, P., Observations of Manaus urban plume evolution and interaction with biogenic emissions in GoAmazon 2014/5, Atmospheric Environment Vol. 191, Pg. 513 - 524, https://doi.org/10.1016/j.atmosenv.2018.08.031, doi: 10.1016/ j.atmosenv.2018.08.031. 2018.

121) de Sá, S. S., Palm, B. B., Campuzano-Jost, P., Day, D. A., Hu, W., Isaacman-VanWertz, G., Yee, L. D., Brito, J., Carbone, S., Ribeiro, I. O., Cirino, G. G., Liu, Y., Thalman, R., Sedlacek, A., Funk, A., Schumacher, C., Shilling, J. E., Schneider, J., Artaxo, P., Goldstein, A. H., Souza, R. A. F., Wang, J., McKinney, K. A., Barbosa, H., Alexander, M. L., Jimenez, J. L., and Martin, S. T.: Urban influence on the concentration and composition of submicron particulate matter in central Amazonia, Atmos. Chem. Phys., Vol. 18, 16, 12185-12206, https://doi.org/10.5194/acp-18-12185-2018, 2018. https://doi.org/10.5194/acp-18-12185-2018, https://www.atmos-chem-phys.net/18/12185/2018/.

122) Shilling, J. E., Pekour, M. S., Fortner, E. C., Artaxo, P., de Sá, S., Hubbe, J. M., Longo, K. M., Machado, L. A. T., Martin, S. T., Springston, S. R., Tomlinson, J., and Wang, J.: Aircraft observations of the chemical composition and aging of aerosol in the Manaus urban plume during GoAmazon 2014/5, Atmos. Chem. Phys., 18, 10773-10797, https://doi.org/10.5194/acp-18-10773-2018, 2018. https://www.atmos-chem-phys.net/18/10773/2018/ .

123) Yee, L. D., Isaacman-VanWertz, G., Wernis, R. A., Meng, M., Rivera, V., Kreisberg, N. M., Hering, S. V., Bering, M. S., Glasius, M., Upshur, M. A., Gray Bé, A., Thomson, R. J., Geiger, F. M., Offenberg, J. H., Lewandowski, M., Kourtchev, I., Kalberer, M., de Sá, S., Martin, S. T., Alexander, M. L., Palm, B. B., Hu, W., Campuzano-Jost, P., Day, D. A., Jimenez, J. L., Liu, Y., McKinney, K. A., Artaxo, P., Viegas, J., Manzi, A., Oliveira, M. B., de Souza, R., Machado, L. A. T., Longo, K., and Goldstein, A. H.: Observations of sesquiterpenes and their oxidation products in central Amazonia during the wet and dry seasons, Atmos. Chem. Phys., 18, 10433-10457, https://doi.org/10.5194/acp-18-10433-2018, https://www.atmos-chem-phys.net/18/10433/2018/acp-18-10433-2018.pdf, 2018.

124) Schulz, C., Schneider, J., Amorim Holanda, B., Appel, O., Costa, A., de Sá, S. S., Dreiling, V., Fütterer, D., Jurkat-Witschas, T., Klimach, T., Knote, C., Krämer, M., Martin, S. T., Mertes, S., Pöhlker, M. L., Sauer, D., Voigt, C., Walser, A., Weinzierl, B., Ziereis, H., Zöger, M., Andreae, M. O., Artaxo, P., Machado, L. A. T., Pöschl, U., Wendisch, M., and Borrmann, S.: Aircraft-based observations of isoprene-epoxydiol-derived secondary organic aerosol (IEPOX-SOA) in the tropical upper troposphere over the Amazon region, Atmos. Chem. Phys., 18, 14979-15001, https://doi.org/10.5194/acp-18-14979-2018, https://www.atmos-chem-phys.net/18/14979/2018/ , 2018.

125) de Oliveira, B.F.A., de Carvalho, L.V.B., de Souza Mourão, D., de Cássia Oliveira da Costa Mattos, R., de Castro, H.A., Artaxo, P., Junger, W.L. and Hacon, S. (2018) Environmental Exposure Associated with Oxidative Stress Biomarkers in Children and Adolescents Residents in Brazilian Western Amazon. Journal of Environmental Protection, 9, n 4, 347-367. https://doi.org/10.4236/jep.2018.94023, http://www.scirp.org/Journal/PaperInformation.aspx?PaperID=84205 , 2018.

126) Gonçalves, Karen dos Santos; Winkler, Mirko; Benchimol-Barbosa, Paulo; de Hoogh, Kees; Artaxo, Paulo; Hacon, Sandra; Schindler, Christian; Künzli, Nino. Development of non-linear models predicting daily fine particle concentrations using aerosol optical depth retrievals and ground-based measurements at a municipality in the Brazilian Amazon region. Atmospheric Environment, Vol. 184, pg. 156 - 165, https://doi.org/10.1016/j.atmosenv.2018.03.057 , 2018

127) Moran-Zuloaga, D., Ditas, F., Walter, D., Saturno, J., Brito, J., Carbone, S., Chi, X., Hrabě de Angelis, I., Baars, H., Godoi, R. H. M., Heese, B., Holanda, B. A., Lavrič, J. V., Martin, S. T., Ming, J., Pöhlker, M. L., Ruckteschler, N., Su, H., Wang, Y., Wang, Q., Wang, Z., Weber, B., Wolff, S., Artaxo, P., Pöschl, U., Andreae, M. O., and Pöhlker, C.: Long-term study on coarse mode aerosols in the Amazon rain forest with the frequent intrusion of Saharan dust plumes, Atmos. Chem. Phys., 18, 10055-10088, https://doi.org/10.5194/acp-18-10055-2018 , https://www.atmos-chem-phys.net/18/10055/2018/acp-18-10055-2018.pdf. 2018.

128) Wimmer, D., Buenrostro Mazon, S., Manninen, H. E., Kangasluoma, J., Franchin, A., Nieminen, T., Backman, J., Wang, J., Kuang, C., Krejci, R., Brito, J., Goncalves Morais, F., Martin, S. T., Artaxo, P., Kulmala, M., Kerminen, V.-M., and Petäjä, T.: Ground-based observation of clusters and nucleation-mode particles in the Amazon, Atmos. Chem. Phys., 18, 13245-13264, https://doi.org/10.5194/acp-18-13245-2018, 2018. https://www.atmos-chem-phys.net/18/13245/2018/

129) Christopher Pöhlker, David Walter, Hauke Paulsen, Tobias Könemann, Emilio Rodríguez-Caballero, Daniel Moran-Zuloaga, Joel Brito, Samara Carbone, Céline Degrendele, Viviane R. Després, Florian Ditas, Bruna A. Holanda, Johannes W. Kaiser, Gerhard Lammel, Jošt V. Lavrič, Jing Ming, Daniel Pickersgill, Mira L. Pöhlker, Maria Praß, Nina Ruckteschler, Jorge Saturno, Matthias Sörgel, Qiaoqiao Wang, Bettina Weber, Stefan Wolff, Paulo Artaxo, Ulrich Pöschl, and Meinrat O. Andreae. Land cover and its transformation in the backward trajectory footprint region of the Amazon Tall Tower Observatory. Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-323.

130) Carly Reddington, William T. Morgan, Eoghan Darbyshire, Joel Brito, Hugh Coe, Paulo Artaxo, John Marsham, Dominick V. Spracklen. Biomass burning aerosol over the Amazon: analysis of aircraft, surface and satellite observations using a global aerosol model. Atmospheric Chemistry and Physics Discussion, Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-849.

131) Artaxo, P., Working together for Amazonia. Editorial Science Magazine, Vol. 363, Issue 6425, http://science.sciencemag.org/content/363/6425/323 doi: 10.1126/science.aaw6986, 25 January 2019.

132) Manish Shrivastava, Meinrat O. Andreae, Paulo Artaxo, Henrique M J Barbosa, Larry Berg, Joel Brito, Joseph Ching, Richard C Easter, Jiwen Fan, Jerome D Fast, Zhe Feng, Jose D Fuentes, Marianne Glasius, Allen H. Goldstein, Helber Barros Gomes, Dasa Gu, Alex B. Guenther, Shantanu H. Jathar, Saewung Kim, Ying Liu, Sijia Lou, Scot T Martin, V. Faye McNeill, Adan Medeiros, Suzane S de Sá, John E Shilling, Stephen R Springston, Rodrigo A. F. Souza, Joel A Thornton, Gabriel Isaacman-VanWertz, Lindsay D. Yee, Rita ynoue, Rahul A Zaveri, Alla Zelenyuk, Chun Zhao. Urban pollution greatly enhances formation of natural aerosols over the Amazon rainforest. Nature Communications, Vol. 10, number: 1, pg. 1046, https://doi.org/10.1038/s41467-019-08909-4, https://www.nature.com/articles/s41467-019-08909-4. 2019.

133) de Sá, S. S., Rizzo, L. V., Palm, B. B., Campuzano-Jost, P., Day, D. A., Yee, L. D., Wernis, R., Isaacman-VanWertz, G., Brito, J., Carbone, S., Liu, Y. J., Sedlacek, A., Springston, S., Goldstein, A. H., Barbosa, H. M. J., Alexander, M. L., Artaxo, P., Jimenez, J. L., and Martin, S. T.: Contributions of biomass-burning, urban, and biogenic emissions to the concentrations and light-absorbing properties of particulate matter in central Amazonia during the dry season, Atmos. Chem. Phys., Vol. 19, No. 12, Pg. 7973-8001, https://doi.org/10.5194/acp-19-7973-2019, https://www.atmos-chem-phys.net/19/7973/2019/ , 2019.

134) Malavelle, F. F., Haywood, J. M., Mercado, L. M., Folberth, G. A., Bellouin, N., Sitch, S., and Artaxo, P.: Studying the impact of biomass burning aerosol radiative and climate effects on the Amazon rainforest productivity with an Earth system model, Atmos. Chem. Phys., 19, 1301-

1326, https://doi.org/10.5194/acp-19-1301-2019, https://www.atmos-chem-phys.net/19/1301/2019/, 2019.
135) Morgan, W. T., Allan, J. D., Bauguitte, S., Darbyshire, E., Flynn, M. J., Lee, J., Liu, D., Johnson, B., Haywood, J., Longo, K. M., Artaxo, P. E., and Coe, H. Transformation and aging of biomass burning carbonaceous aerosol over tropical South America from aircraft in-situ measurements during SAMBBA. Atmospheric Chemistry and Physics Discussions, https://doi.org/10.5194/acp-2019-157, https://www.atmos-chem-phys-discuss.net/acp-2019-157/acp-2019-157.pdf, Feb 2019.
136) Carbone, Samara, Timonen, Hilkka J., Rostedt, Antti, Happonen, Matti, Rönkkö, Topi, Keskinen, Jorma, Ristimaki, Jyrki, Korpi, Heikki, Artaxo, Paulo, Canagaratna, Manjula, Worsnop, Douglas, Canonaco, Francesco, Prévôt, Andre S. H., Hillamo, Risto, Saarikoski, Sanna. Distinguishing fuel and lubricating oil combustion products in diesel engine exhaust particles. Aerosol Science and Technology, Vol. 17, doi: 10.1080/02786826.2019.1584389. https://doi.org/10.1080/02786826.2019.1584389, 2019.
137) Darbyshire, E., Morgan, W. T., Allan, J. D., Liu, D., Flynn, M. J., Dorsey, J. R., O'Shea, S. J., Lowe, D., Szpek, K., Marenco, F., Johnson, B. T., Bauguitte, S., Haywood, J. M., Brito, J. F., Artaxo, P., Longo, K. M., and Coe, H.: The vertical distribution of biomass burning pollution over tropical South America from aircraft in situ measurements during SAMBBA, Atmos. Chem. Phys., Vol. 19, No. 9, 5771-5790, https://doi.org/10.5194/acp-19-5771-2019, https://www.atmos-chem-phys.net/19/5771/2019/, 2019.
138) Glicker, H. S., Lawler, M. J., Ortega, J., de Sá, S. S., Martin, S. T., Artaxo, P., Vega Bustillos, O., de Souza, R., Tota, J., Carlton, A., and Smith, J. N. Chemical composition of ultrafine aerosol particles in central Amazonia during the wet season. Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2019-299, https://www.atmos-chem-phys-discuss.net/acp-2019-299/ , 2019.
139) Tuet, Wing; Liu, Fobang; Alves, Nilmara; Fok, Shierly; Artaxo, Paulo; Vasconcellos, Perola; Champion, Julie; Ng, Nga Lee. Chemical oxidative potential and cellular oxidative stress from biomass burning aerosol. Environmental Science & Technology Letters, Vol. 6, 126-132, https://pubs.acs.org/doi/pdf/10.1021/acs.estlett.9b00060, DOI: 10.1021/acs.estlett.9b00060, 2019.
140) Paulo Artaxo e Délcio Rodrigues. As Bases Científicas das Mudanças Climáticas.Capitulo 1, pages 43-58. Livro Litigância climática no Brasil, editado por Joana Setzer, Kamyla Cunha, Amália Botter Fabbri. Editora Thomson Reuters - Revista dos Tribunais, 500 pages. ISBN 9788553214037, 2019.
141) Rahul A. Zaveri, Jian Wang, Jiwen Fan, Yuwei Zhang, John E. Shilling, Alla Zelenyuk, Fan Mei, Mikhail Pekour, Jason Tomlinson, John M. Hubbe, Manish Shrivastava, Edward Fortner, Stephen R. Springston, Karla M. Longo, Courtney Schumacher, Saewung Kim, Luiz A. T. Machado, Paulo Artaxo, and Scot T. Martin. Rapid growth of urban nanoparticles and their impact on warm clouds and precipitation in the Amazon rainforest. Submitted to PNAS, 28 Feb 2019.
142) Fan Mei, Jennifer Comstock, Jian Wang, Mikhail Pekour, John Shilling, Johannes Schneider, Charles Long, Manfred Wendisch, Luiz Machado, Beat Schmid, Trismono Krisna, Andreas Giez, Bernadett Weinzierl, Martin Zoeger, Christiane Schulz, Mira L. Pöhlker, Hans Schlager, Micael A. Cecchini, Meinrat O. Andreae, Scot T. Martin, Suzane, S. de Sá, Jason Tomlinson, John Hubbe, Stephen Springston, Ulrich Pöschl, Paulo Artaxo, Christopher Pöhlker, and Thomas Klimach. Comparison of Aircraft Measurements during GoAmazon2014/5 and ACRIDICON-CHUVA. Submitted to Atmospheric Measurement Techniques (AMT), manuscript number amt-2018-154, 2019.
143) Tong, Haijie; Zhang, Yun; Filippi, Alexander ; Wang, Ting; Li, Chenpei, Liu, Fobang; Kourtchev, Ivan ; Wang, Kai; Keskinen, Helmi-Marja; Levula, Janne T. ; Arangio, Andrea M.; Shen, Fangxia; Ditas, Florian; Martin, Scot; Artaxo, Paulo; Godoi, Ricardo; Yamamoto, Carlos; de Souza, Rodrigo; Huang, Ru-Jin, Berkemeier, Thomas; Wang , Yueshe; Su, Hang; Cheng, Yafang; Pope, Francis; Fu, Pingqing; Yao, Maosheng, Poehlker, Christopher; Petäjä, Tuukka; Kulmala, Markku; Andreae, Meinrat O.; Shiraiwa, Manabu; Pöschl, Ulrich; Hoffmann, Thorsten; Kalberer, Markus. Radical Formation by Fine Particulate Matter Associated with Highly Oxygenated

Molecules. Environmental Science & Technology. Manuscript ID ES-2019-03272t. Submitted in May 31, 2019.
144) Nina Löbs, Cybelli G. G. Barbosa, Sebastian Brill, David Walter, Florian Ditas, Marta de Oliveira Sá, Alessandro C. de Araújo, Leonardo R. de Oliveira, Ricardo H. M. Godoi, Stefan Wolff, Meike Piepenbring, Jürgen Kesselmeier, Paulo Artaxo, Meinrat O. Andreae, Ulrich Pöschl, Christopher Pöhlker, and Bettina Weber. Aerosol measurement methods to study spore emissions from fungi and cryptogamic covers in the Amazon. Submetido à publicação em Atmospheric Measurement Techniques (AMT), amt-2019-238. Junho de 2019.
145) Richard Pope, Steve Arnold, Martyn Chipperfield, Carly Reddington, Edward Butt, Tim Keslake, Wuhu Feng, Barry Latter, Brian Kerridge, Richard Siddans, Luciana Rizzo, Paulo Artaxo, Mehliyar Sadiq, Amos Tai. Substantial increases in Eastern Amazon and Cerrado biomass burning-sourced tropospheric ozone. Submitted for publication in Geophysical research Letters 9GRL, paper 2019GL084143, June 2019.
146) Lindsay D. Yee, Gabriel Isaacman-VanWertz, Rebecca A. Wernis, Nathan M. Kreisberg, Mads S. Bering, Marianne Glasius, Matthieu Riva, Jason D. Surratt, Suzane de Sá, Scot T. Martin, M. Lizabeth Alexander, Brett. B. Palm, Weiwei Hu, Pedro Campuzano-Jost, Douglas A. Day, Jose L. Jimenez, Yingjun Liu, Karena A. McKinney, Pawel K. Misztal, Paulo Artaxo, Juarez Viegas, Antonio Manzi, Rodrigo de Souza, Eric E. Edgerton, Karsten Baumann, Susanne V. Hering, and Allen H. Goldstein. Observed anthropogenic influence on isoprene oxidation in the Southeastern U.S. and Central Amazon. Submitted for publication in Atmospheric Chemistry and Physics, June 2019
147) BARTIKO, D., OLIVEIRA, D.Y., BONUMÁ, N.B., CHAFFE, P.L.B., 2019: Spatial and Seasonal Patterns of Flood Change Across Brazil. **Hydrological Sciences Journal-Journal Des Sciences Hydrologiques,** 64.
148) BORGES, P.A., BERNHOFER, C., RODRIGUES, R.R., 2018: Extreme rainfall indices in Distrito Federal, Brazil: Trends and links with El Niño southern oscillation and Madden-Julian oscillation. **International Journal of Climatology**, 38, 4550-4567.
149) BORGES, P.A., CHAFFE, P.L.B., 2019: Towards a comprehensive characterization of evidence in synthesis assessments: the climate change impacts on the Brazilian water resources. **Climatic Change**, 153, 1-21.
150) BOY, N.; Influência das Variáveis Meteorológicas nos óbitos por Doenças Cardiovasculares no Município do Rio de Janeiro. 2018. Dissertação. Mestrado em Mestrado em Saúde Pública e Meio Ambiente - Escola Nacional de Saúde Pública, Fundação Oswaldo Cruz, FIOCRUZ, Brasil.
151) BRIGHENTI, T.M., BONUMÁ, N.B., GRISON, F., MOTA, A.A., KOBIYAMA, M., CHAFFE, P.L.B., 2019: Two calibration methods for modeling streamflow and suspended sediment with the swat model. **Ecological Engineering**, 127, 103-113.
152) CIEMER, C., BOERS, N., HIROTA, M., KURTHS, J., MULLER-HANSEN, F., OLIVEIRA, R. S., WINKELMANN, R., 2019: Higher resilience to climatic disturbances in tropical vegetation exposed to more variable rainfall. **Nature Geoscience**, 12, 174–179.
153) CHAGAS, V.B.P., CHAFFE, P.L.B., 2018: The Role of Land Cover in the Propagation of Rainfall into Streamflow Trends. **Water Resources Research**, 54, 5986-6004.
154) CUNHA, ANA PAULA MARTINS DO AMARAL; MARCHEZINI, VICTOR ; LINDOSO, DIEGO PEREIRA ; SAITO, SILVIA MIDORI ; ALVALÁ, REGINA CÉLIA DOS SANTOS., 2019: The challenges of Consolidation of a Drought-Related Disaster Risk Warning System to Brazil. **Sustainability in debate**, v. 10, p. 43-76.
155) CUNHA, A. P. M. A.; TOMASELLA, J.; RIBEIRO-NETO, G. ; BROWN, M. ; GARCIA, S. R.; BRITO, S.B.; CARVALHO, M. A.. 2018: Changes in the spatial-temporal patterns of droughts in the Brazilian Northeast. **Atmospheric Science Letters**, v. 19, p. e855.
156) DAVID, P.C., OLIVEIRA, D.Y., GRISON, F., KOBIYAMA, M., CHAFFE, P.L.B., 2019: Systematic increase in model complexity helps to identify dominant streamflow mechanisms in two small forested basins. **Hydrological Sciences Journal-Journal Des Sciences Hydrologiques**, 64.

157) FLORES, B.M., STAAL, A., JAKOVAC, C., HIROTA, M., HOLMGREN, M., OLIVEIRA, R.S., 2019: Soil erosion as a resilience drain in disturbed tropical forests. **Plant and Soil**, 1-15.
158) IBGE - Instituto Brasileiro de Geografia e Estatística. População em Áreas de Risco no Brasil. Rio de Janeiro: IBGE, 90 p. 2018. ISBN 978-85-240-4468-7
159) MARENGO, J. A.; CUNHA, A. P.; SOARES, W. R.; TORRES, R. R.; ALVES, L. M.; BRITO, S. S. B.; CUARTAS, L. A.; LEAL, K.; RIBEIRO NETO; G.; ALVALÁ, R. C. S. ALVALÁ, MAGALHÃES, A. R., 2019: Increase Risk of Drought in the Semiarid Lands of Northeast Brazil Due to Regional Warming above 4 °C. In: Carlos A. Nobre: Jose A. Marengo; Wagner R. Soares, (Eds.). **Climate Change Risks in Brazil**. 1ed.: Springer International Publishing, 2019, v. , p. 181-200.
160) OLIVEIRA, D.Y., CHAFFE, P.L.B., SA, J.H.M., 2018: Extending the applicability of the Generalized Likelihood function for zero-inflated data series. **Water Resources Research**, 54, 2494-2506.
161) RODRIGUES, R.R., SUBRAMANIAN, A., ZANNA, L., BERNER, J., 2019: ENSO bimodality and extremes. **Geophysical Research Letters**, doi:2019GL082270-x.
162) ROSSI, A.; CANAVESSI, V.; SEGONI, S.; NERY, T. D.; CATANI, F.; CASAGLI, N., 2019: Landslides in the Mountain Region of Rio de Janeiro: A Proposal for the Semi-Automated Definition of Multiple Rainfall Thresholds. **Geosciences**, 9, 203; doi:10.3390/geosciences9050203.
163) SOUZA, K.I.S., CHAFFE, P.L.B., PINTO, C.R.S.C., NOGUEIRA, T.M.P., 2019: Proteção ambiental de nascentes e afloramentos de água subterrânea no Brasil: histórico e lacunas técnicas atuais. **Águas Subterrâneas**, 33, 76-86
164) VOMMARO, F. C., 2018: Mapa da vulnerabilidade da população às mudanças do clima, em municípios do Maranhão 2018. Dissertação. Mestrado em Saúde Pública e Meio Ambiente - Escola Nacional de Saúde Pública, Fundação Oswaldo Cruz, FIOCRUZ, Brasil.
165) MARTINS, S. C. ; ASSAD, E. D. ; PAVÃO, E. M. ; LOPES ASSAD, M.L. . Inverting the carbon footprint in Brazilian agriculture: an estimate of the effects of the ABC plan. REVISTA CIÊNCIA, TECNOLOGIA & AMBIENTE (ONLINE), v. 7, p. 4352, 2018.
166) ASSAD, E. D.; LOPES ASSAD, M.L. . O aquecimento global e a agricultura. SCIENTIFIC AMERICAN BRASIL, v. 122, p. 14-19, 2018.
167) REZENDE, C.L. ; SCARANO, F.R. ; ASSAD, E.D. ; JOLY, C.A. ; METZGER, J.P. ; STRASSBURG, B.B.N. ; TABARELLI, M. ; FONSECA, G.A. ; MITTERMEIER, R.A. . From hotspot to hopespot: An opportunity for the Brazilian Atlantic Forest. Perspectives in Ecology and Conservation , v. 16, p. 2008-2014, 2018. https://www.sciencedirect.com/science/article/pii/S2530064418301317
168) REZENDE, CAMILA LINHARES ; FRAGA, JOANA STINGEL ; SESSA, JULIANA CABRAL ; DE SOUZA, GUSTAVO VINAGRE PINTO ; Assad, Eduardo Delgado ; SCARANO, FABIO RUBIO . Land use policy as a driver for climate change adaptation: A case in the domain of the Brazilian Atlantic forest. LAND USE POLICY , v. 72, p. 563-569, 2018.
169) ZANETTI, M. R. ; PUGLIERO, V. S. ; ALMEIDA, M. B. ; ASSAD, E. D. . Cálculo de tamanho de amostra para análise de acurácia em mapeamentos temáticos. In: XIV MOSTRA DE ESTAGIÁRIOS E BOLSISTAS DA EMBRAPA INFORMÁTICA AGROPECUÁRIA, 2018, Campinas.
170) ALMEIDA, M. B.; PUGLIERO, V. S.; ZANETTI, M. R.; BOLFE, E. L.; ASSAD, E. D.. Espacialização de áreas aptas para a citricultura no recôncavo da Bahia. In: XIX SIMPÓSIO BRASILEIRO DE SENSORIAMENTO REMOTO, 2019, Santos.

11 Fellowships (bolsas) granted by FAPESP and other funding agencies in Year 2 (including students)

1. Título – Divulgação jornalística do INCT Mudanças climáticas – 2ª fase
Bolsista - Allison Eduardo da Silva Almeida
Orientadores – Antonio Carlos Amorim e Susana Oliveira Dias (Unicamp)

Tipo de bolsa: Bolsa TT3 / Duração – 1 ano / Dedicação - 40 horas / Valor mensal – R$ 1.136,40

2. Title: A second year of fellowship, extending it until 30 April 2020 was submitted.
Bolsista: Manoel Batista da Silva Jr.,
Orientador: Paulo Nobre
Tipo de bolsa: FAPESP fellowship for technical training, for the period May 1st, 2018 to April 30th, 2019.

Titulo: Coupling MOM5 ocean model to the Eta Framework model.
Bolsista: Luís Thiago Lucci Correa Paolicchi
Orientador: Sin Chan Chou
Tipo de bolsa: CNPq DTI-A fellowship, from March 2018 until February 2020.

3. Title: On the climate variability and impacts on major Brazilian Biomes
Bolsista: André Lyra,
Orientador: Sin Chan Chou
Tipo de bolsa:FAPESP pos-doc fellow.. Period: 01/09/2017 and 31/08/2019. A request for extension is being prepared.

4. Title: Impacts of different deforestation scenarios on the projections of climate change over the Plata river basin
Bolsista: Isabel Pilotto,
Orientador: Sin Chan Chou
Tipo de bolsa:FAPESP pos-doc fellow on the. Period: 01/08/2018 a 31/07/2020

5. FAPESP 2018/03473-0, UK Academies, Understanding Peoples' Memories and Risk Perception Using Social Hydrology, Prof. Dr Namrata Bhattacharya-Mis, Univ of Chester, UK, in the period of July/2018-June/2019

6. CAPES 2018/2019 School of Advanced Studies on Water & Society under Change (EESC-USP, UFPE & UFCG), Visiting Professor G Bloeschl, Tech Univ of Vienna, Austria, in April 2019

7. CAPES 2018/2019 School of Advanced Studies on Water & Society under Change (EESC-USP, UFPE & UFCG), Visiting Professor N Hankins, Univ of Oxford, United Kingdom, in April/May 2019

8. PROEX/PPGSHS 2018/2019 Prof Dr M Giacomoni, Univ Texas San Antonio, United States of America, in May 2019

9. Paula Carvalho Pereda
"Assessing the climate and weather effects in Brazil using panel data"
Scholarships abroad – Research

10. Michael Tulio Ramos de França
"Fertility and Inequality"
Scholarships abroad - Research Internship - Doctorate
Columbia University in the City of New York (United States)
Eduardo Amaral Haddad

11. François Claude Prado Boris
"A spatial impact analysis of water accessibility on farming in the Brazilian semiarid"
Scholarships in Brazil - Scientific Initiation
Eduardo Amaral Haddad

12. Karina Simone Sass
"Urbanization and climate change: impact evaluation in the Metropolitan Region of São Paulo"Scholarships in Brazil - Doctorate
Eduardo Amaral Haddad

13. Inácio Fernandes de Araújo Junior
"Agricultural and agro-industrial sustainability in Chile: modeling the impacts of climate change and natural disasters in an integrated framework"
Scholarships in Brazil - Technical Training Program - Technical Training
Eduardo Amaral Haddad

14. Ms. Gabriela dos Santos Eusébio, beneficiary of the project / subproject 465501/2014-l - INCT para Mudanças Climáticas (INCT-MC) in the modality of Post-Doctoral Internship of the University State of Campinas, has been linked to the Institutos Nacionais de Ciência e Tecnologia (INCT) since April 2019 receiving from the Coordination of Improvement of Higher Level Personnel (CAPES), CNPJ 00.889.834/0001-08, a scholarship which consists of monthly payments according to the statement of payments available in the detail of the benefit process, which ends in March 2020.

15. MASTER – CAPES
PROCESS NUMBER: 88887.137543/2017-00
TITLE: A variação da posição dos jatos subtropical e polar e sua relação com eventos extremos de precipitação e ventos no sul do Brasil
NAME: João Lucas Eberl Simon
PERIOD: 01/03/2017-28/02/2019

16. MASTER – CAPES
PROCESS NUMBER: 88887.318111/2019-00
TITLE: Downscaling de Modelos Climáticos na Bacia do Rio Itajaí e eventos extremos
NAME: Maria Fernanda Rodrigues Pereima
PERIOD: 01/03/2019-28/02/2021

17. MASTER
TITLE: Estudo da Vulnerabilidade Socioambiental e de Saúde aos Impactos das Mudanças do Clima - em Municípios do Maranhão
NAME: Felipe de Carvalho Vommaro Marincola
PERIOD: 01/03/2016 -28/02/2018

18. MASTER - CAPES
TITLE: Influência das Variáveis Meteorológicas nos óbitos por Doenças Cardiovasculares no Município do Rio de Janeiro.
NAME: Natan Boy
PERIOD: 01/03/2016 -28/02/2018

Students

1. Bruno Moreira de Carvalho, PhD. Postdoctoral fellowship (CAPES), Jun 2018 to May 2019.
2. Margarete Martins Afonso dos Santos, PhD. Postdoctoral fellowship (CAPES), Mar 2018 to Feb 2019.
3. Simone Miranda da Costa, PhD. Research collaborator.

4. Shannon McIntyre, M.Sc. Doctorate student (Medical Entomology – London School of Hygiene and Tropical Medicine).
5. Francisco Agustinho Neto, Doctoral Student developing Antarctic Ice modeling studies with BESM. Advisor: Paulo Nobre.
6. Diego de Andrade Campos, Doctoral Student. Coupling Radiation-Convection in the Eta Model. Advisor: Sin Chan Chou
7. CNPq PIBIC - M M Simioli - PUC Campinas -
8. FAPESP Talita - V U de Camargo Jesus -
9. CNPq - PhD Candidate - L G Lopes- CCST/INPE
10. Master of Sci. Candidate - A. C. Marques - PEC/COPPE/UFRJ -
11. FAPESP PhD(BEPE), M de Macedo, Monash University, Australia
12. FAPESP Young Scientist (IC), M de Souza Bittar, EESC-USP
13. FAPESP Master of Science (MS), M Gomes Jr, EESC-USP
14. CAPES, MS, B Souza, EESC-USP
15. CAPES, MS, T. Oliveira, EESC-USP
16. CNPq, MS, C H Fialho, EESC-USP
17. CNPq, MS, T. Oliveira, EESC-USP
18. CAPES, PhD Candidate, F A A de Souza EESC-USP
19. CNPq, PhD Candidate, A Campos, EESC-USP
20. CAPES, PhD Candidate, G Chiquito, EESC-USP
21. José Davi de Moura, Doctoral Student. .Coupling lightning with precipitation in the Eta Model. Advisor: Sin Chan Chou
22. Júlia Alves Menezes, PhD. Postdoctoral fellowship (CNPQ), Fev 2018 to Jan 2019.
23. Rhavena Barbosa dos Santos, M.Sc. Doctoral fellowship (FAPEMIG), Feb 2018 to Jan 2019.
24. Pedro Regoto, Meteorologist. Technical support (ABRASCO), March 2019.

12 Other activities

1) ALMEIDA, A. Entrevista com pesquisador Mario Mendiondo, líder do grupo relacionado a recursos hídricos do INCT – Mudanças climáticas 2a. Fase. ClimaCom, jun. 2019.
2) ALMEIDA, A. Entrevista com pesquisador Paulo Artaxo, líder do grupo relacionado a estudos ecossistêmicos do INCT – Mudanças climáticas 2a. Fase. ClimaCom, jun. 2019.
3) DIAS, Susana; OLIVEIRA, Tatiana Plens; SCARTEZINI, Carolina. "Povoamentos fúngicos". ClimaCom – Fabulações Miceliais[online], Campinas, ano. 6, n. 14. Abr. 2019 .
4) DIAS, Susana; OLIVEIRA, Tatiana Plens; SCARTEZINI, Carolina. "Bichário". ClimaCom – Fabulações Miceliais [online], Campinas, ano. 6, n. 14. Abr. 2019 .
5) DIAS, Susana (Org.) "Floresta água-viva". ClimaCom – Inter/Transdisciplinaridade [online], Campinas, ano. 5, n. 13. Nov. 2018 .
6) SILVA, Glauco; MACELLARI, Vaneza; PLENS, Tatiana; DIAS, Susana (Org.) Doações despropositadas (Instalação artística). ClimaCom – Inter/Transdisciplinaridade [online], Campinas, ano. 5, n. 13. Nov. 2018 . Available from: http://climacom.mudancasclimaticas.net.br/?p=10432
7) MARQUES, D.; WUNDER, A.; WUNDER, M.; OLIVEIRA, T. P.; MELO, S.; FERRER, C. G.; IWAKAMI, V. H. S. Parece que foi ontem. Julho/2018, Universidade Estadual de Campinas, Unicamp, Campinas, Brasil. (Organização de exposição fotográfica). http://climacom.mudancasclimaticas.net.br/?p=9684
8) 2019 Water Academy Day Invited Lecture: "Amazon Region as a Water Producer for a Society under Climate Change", by Dr. Carlos Nobre, IEA (in Port.), https://www.youtube.com/watch?v=0MDnXQQTn4&feature=share
9) 2019 CAPES School of Advanced Studies on Water & Society Under Change Invited Lecture: "Opportunities with Socio-Hydrology for a Society Under Change", Prof. G Bloeschl, TU Vienna, Austria, https://www.youtube.com/watch?v=TuYUZqTerCQ&feature=share
10) 2019 Joint Seminar "Improving Urban Storm and Sanitary Water Systems Health and Resilience through Low Impact Development", by Prof. M Giacomoni, UTSA, USA

https://www.youtube.com/watch?v=YmSlgN3z0VI&feature=share
11) 2019 CAPES SASW&SC Invited Lecture: "The Clean Water Challenge: How do We Ensure a Sustainable Supply - Prof. Nick Hankins, Univ. of Oxford, United Kingdom, https://www.youtube.com/watch?v=rs3kCoZkzWQ&feature=share
12) 2019 Joint "Workshop on Water-Health-Resilience", Dr E Rangel, Dr. B Carvalho, FIOCRUZ, https://www.youtube.com/watch?v=PRAJXguke4&feature=share
13) Figueiredo, R (2018) "IMPACTO DAS MUDANÇAS CLIMÁTICAS SOBRE A HIDROBIOGEOQUÍMICA DE DUAS PEQUENAS BACIAS CONTRIBUINTES DO SISTEMA CANTAREIRA EM ÁREA ATENDIDA POR PROGRAMA DE PAGAMENTO POR SERVIÇOS AMBIENTAIS" - PROCESSO FAPESP 2016/02890-1, (Set./2016-Set/2018), Final Report
14) Rodrigues, D. 2019. Baselines scenarios for South America integrated for 10 years: Baseline scenarios were integrated during 10 years with Eta/Noah model, considering both actual land use and land cover conditions and potential reforestation. Internal Report. INPE/UFRJ.

13 FAPESP Projects associated to the INC MC Phase 2

1) DIAS, S.; AMORIM, A. C.. "Sensitive Forest: Images, Writings and Climate Change". Workshops approved by EDUCA SP PROGRAM of the Secretary of Education of the State of São Paulo. with students from the state of São Paulo. 60 students are expected and R$500,00 of financial support are expected for each student.
2) GARCIA, G. Cid de. Pedagogias da imagem - contemplado com duas (2) bolsas para estudantes de graduação do Programa Institucional de Bolsas de Iniciação Artística e Cultural - PIBIAC/PR-1/UFRJ.
3) GARCIA, G. Cid de. Podcast Faculdade de Educação da UFRJ - projeto aprovado e periodicamente renovado nos editais RUA (Registro Único de Ações de Extensão), PR-5/UFRJ.
4) 2017-2020 - "For a new ecology of emissions and disseminations: how can communication modulate the human´s most intense potency of existing in face of climate changes?" Productivity scholarship - CNPq - research by Susana Oliveira Dias at Labjor-Unicamp.
5) 2019-2020 - "Science communication of INCT Climate Change - 2nd phase". Technical Training Scholarship - Fapesp TT3 - research by Allison Eduardo da Silva Almeida. Supervisors: Susana Oliveira Dias and Antonio Carlos Rodrigues de Amorim of the Labjor-FE-Unicamp.
6) 2018-2019 - "Public perception of climate change". Master in Science, Technology and Innovation scholarship - SECTYP Secretaría de Investigación, Internacionales y Posgrado, Universidad Nacional de Cuyo - research by Laura García Oviedo. Supervisor: Sandra Murriello of the Universidad Nacional de Río Negro, Argentina.
7) FAPESP CEPID/CeMEAI-Phase 2 "Centre of Applied Maths for Industry" (2018-2023) has started strong synergisms with INCTMC2 Water Security subcomponent; however, a common agenda of activities are needed for the period 2019/2020 on INCTMC2-CeMEAI win-win partnerships on cutting-edge solutions of water security under climate change with high impacts in crosscutting issues of the nexus "water-energy-food-biodiversity-health", especially to promote new climate-resilient startups and jobs (www.cemeai.icmc.usp.br);
8) FAPESP Young Scientist, Dr. Andrea Young, 2018-2012, Resilience in cities

14. Collaboration with other INCTs and Research networks

This INCT MC Phase 2 works very closely with the Rede Clima, the Brazilian Panel on Climate Change PBMC, and the INCLINE program at USP. We are already interacting or plan to interact with these INCTs in the future, due to common interests and collaboration:

Process 465680/2014-3
Instituto Nacional de Ciência e Tecnologia da Criosfera
Coordinator: Jefferson Cardia Simões
UFRGS - Universidade Federal do Rio Grande do Sul

Process: 465319/2014-9
Instituto Nacional de Ciência e Tecnologia do Bioetanol
Coordinator: Marcos Silveira Buckeridge
USP - Universidade de São Paulo

Porocess: 465583/2014-8
Instituto Geotécnico de Reabilitação do Sistema Encosta- Planície e Desastres Naturais
Coordinator: Willy Alvarenga Lacerda
UFRJ - Universidade Federal do Rio de Janeiro

15 Financial report: Use of the RT and BC

Use of the RT:

	Valor cada Componente	**Valor Gasto**	**Descrição**	**SALDO**
COORDENAÇÃO	R$ 17.280,46			R$ 17.280,46
DESASTRE NATURAIS	R$ 25.994,92			R$ 25.994,92
ECONOMIA	R$ 25.994,92			R$ 25.994,92
SEGURANÇA ALIMENTAR	R$ 25.994,92			R$ 25.994,92
ENERGIA	R$ 25.994,92			R$ 25.994,92
COMUNICAÇÃO	R$ 25.994,92			R$ 25.994,92
ECOSSISTEMA	R$ 25.994,92			R$ 25.994,92
HIDROLOGIA	R$ 18.569,22			R$ 18.569,22
SAÚDE				
MODELAGEM	R$ 25.994,92			R$ 25.994,92

Use of the BC: Year 2018-2019

PI	**BC individual para PIs**	**Valor Gasto**	**Descrição**	**Saldo**
JOSÉ ANTÔNIO MARENGO ORSINI	R$ 16.932,00	R$ 9.243,65	-Pagamento de 3 diarias para José A. Marengo Orsini,participar do CSSP 2018, Workshop Ano da Ciencia Brasil-Reino Unido, , a ser realizado na Sede do Met Office em Exeter, Reino Unido. R$ 4.445,76 -Pagamento de diárias para José A. Marengo Orsini participar de reunião com o Vice Coordenador do projeto para elaboração do relatório do ano II INCT. R$ 570,00 -Pagamento de 4 diárias para o Coordenador do projeto José A. Marengo	R$ 7.688,35

			Orsini para participar da "First Meeting of the Steering Committee of the Alliance of Alliances for Research and Education on Water and Disasters", no Institute for Disaster Management and Reconstruction (IDMR) da Sichuan University - The Hong Kong Polytechnic University, em Chengdu/China, R$4.227,89	
REGINA CÉLIA ALVALÁ	R$ 36.000,00	R$ 8.228,58	-INVOICE-Wiley Pagamento de Publicação Article Title: Changes in the spatial-temporal patterns of droughts in the Brazilian Northeas R$ 6.803,58 -Pagamento de diárias para pesquisadores visitante participar do Workshop Mobilização para ordenação e viabilização de espaços urnbanos Resilientes; 1 diaria com pernoite Coronel Helena S.Reis R$ 380,00\ 2 diarias para Angela Cruz Guirão R$ 760,00 1 diaria sem pernoite para Sara Regina de Amorim R$ 285,00	R$ 27.771,42
EDUARDO AMARAL HADADD	R$36.000,00	R$ 14.299,12	-Pagamento de passagem para Eduardo Amaral Hadadd participar do Evento 65 th annual north american meetings em San Antonio TX/E.U.A. R$ 3.868,85. -Pagamento de Inscrição Evento 65 th annual north american meetings. R$ 1.440,45. -Pagamento de 4 diarias para Eduardo Amaral Hadadd participar do Evento 65 th annual north american meetings em San Antonio TX/E.U.A. R$ 6.367,20. -Pagamento de 2 diarias para Eduardo A. Hadadd para	R$ 21.700,88

			participar XVI ENABER Encontro Nacional da Associação Brasileira de Estudos Regionais e Urbanos Caruaru –PE.R$ 760,00 -Pagamento de passagem para Eduardo A. Hadadd para Caruaru –PE, para participar do ENABER 2018. R$ 1.362,62. -Pagamento de inscrição para Eduardo A. Hadadd participar do XVI ENABER Encontro Nacional da Associação Brasileira de Estudos Regionais e Urbanos Caruaru –PE. R$ 500,00.	
EDUARDO D. ASSAD	R$36.000,00	R$3.456,22	-Pagamento de 3 diarias para duas bolsista Participarem do XIX Simpósio Brasileiro de Sensoriamento Remoto realizado de 14 a 17 de abril de 2019 em Santos- SP. Marilia R. Zanetti R$ 765,00Vanessa S. PuglieroR$ 765,00 -Pagamento de passagem para duas bolsista participarem do XIX Simpósio Brasileiro de Sensoriamento Remoto realizado de 14 a 17 de abril de 2019 em Santos- SP. Marilia R. Zanetti R$ 123,11 Vanessa S. PuglieroR$ 123,11 -Pagamento de inscrição das Bolsista para apresentação no XIX Simpósio Brasileiro de Sensoriamento Remoto realizado de 14 a 17 de abril de 2019 em Santos- SP. Marilia R. Zanetti R$ 530,00 Vanessa S. PuglieroR$ 1.150,00	R$ 32.543,78
ENIO B. PEREIRA	R$ 34.200,00	R$ 14.615,71	-Pagamento de inscrição para a bolsista Madeleine S. G. Casagrande para participar da 6TH INTERNATIONAL CONFERENCE ENERGY & METEOROLOGY (ICEM 2019).R$ 2.199,59	R$ 19.584,29

			-Pagamento de passagem para a bolsista Madeleine S. G. Casagrande para participar da 6TH INTERNATIONAL CONFERENCE ENERGY & METEOROLOGY (ICEM 2019) Copenhage/Dinamarca R$ 4.041,84 -Pagamento de seguro saúde para a bolsista Madeleine S. G. Casagrande para participar da 6TH INTERNATIONAL CONFERENCE ENERGY & METEOROLOGY (ICEM 2019)Copenhage/Dinamarca R$ 187,63. -Pagamento de 5 diarias para a bolsista Madeleine S. G. Casagrande para participar da 6TH INTERNATIONAL CONFERENCE ENERGY & METEOROLOGY (ICEM 2019) Copenhage/Dinamarca R$ 8.186,65.	
ANTONIO C RODRIGUES AMORIM	R$ 36.000,00	R$3.975,96	-Diagramação de Revista – Climacom "Dossiê "Ecologias Radicais". R$ 1.500,00 -Pagamento de 3 diarias para a pesquisadora Susana O. Dias para participar 1 coloquio internacional Devenir Animal : la Filosofia de Gilles Deleuze y Felix Guattari , junto a Universidade Central do , em Quito.R$ 2.475,96	R$ 32.024,04
EDUARDO MENDIONDO	R$ 34.335,00	R$17.107,57	-Pagamento de 5 diarias para Eduardo Mendiondo participar como palestrante American Geophysical Union Fall Meeting em Washington –DC. R$ 7.66140. -Pagamento de passagem para Eduardo Mendiondo participar como palestrante American Geophysical	R$ 17.227,43

			Union Fall Meeting em Washington–DC.R$ 3.926,27. -Pagamento de publicação Invoice HESS-PUC-2018-443"Copernicus.org – Meetings & Open Access Publications. R$ 4.759,90 Pagamento de 2 diarias para Eduardo Mendiondo para trabalho de campo em bacias hidrográficas do Sistema Cantareira (Joanópolis-SP).R$ 760,00	
PAULO NOBRE	R$ 36.000,00	R$ 19.754,93	-Pagamento de 7 Diarias para Paulo Nobre participar no workshop cientifico CMIP6 MODEL ANALYSIS EM Barcelona/Espanha. R$ 8.723,40- -Pagamento de passagem para Paulo Nobre participar do workshop cientifico CMIP6 MODEL ANALYSIS EM Barcelona/ Espanha.R$ 3.232,13. -Pagamento para publicação INVOICE 6653593 – "Esmerald Publishing" Solar Smart Grid as a Path to Economic Inclusion and Adaptation to Climate Change in the Brazilian Semiarid Northeast' R$ 7.799,40	R$ 16.245,07

16 Acquisitions

For the energy security component, two spectroradiometers were purchased and are already in operation at INPE's facilities in São José dos Campos. The first data collected are being used in the studies of characterization of the solar spectrum of the region and its influence on the performance of photovoltaic panels with several technologies.

We also acquired a backup storage system for measured data and the results of models used in INCT studies. The purchase of the workstations is being carried out during this period and will be used mainly in the development of the models and the analysis of the data collected.

Annexes

Banner that describes the INCT MC Phase 2

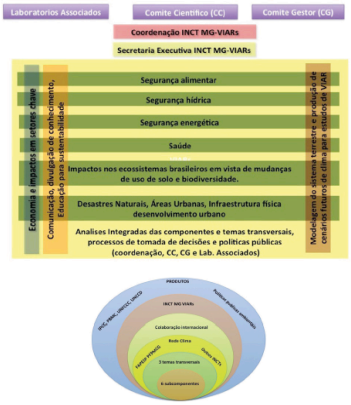
O Instituto Nacional de
Ciência e Tecnologia para Mudanças Climáticas (INCT MC Fase 2)

INCT MC2
INCT para Mudanças Climáticas · Fase 2

visa implementar e desenvolver uma rede abrangente de pesquisa interdisciplinar sobre mudanças globais e sustentabilidade.

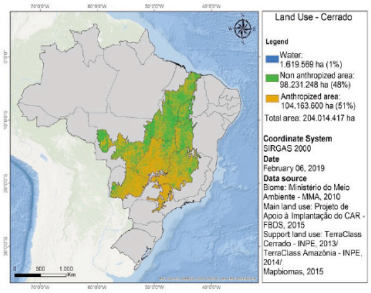
Está estruturado em seis linhas temáticas ou subcomponentes (barras horizontais na figura) conectadas através de três temas integrativos ou temas transversais (barras verticais na figura).

O INCT MC Fase 2 trabalha em estreita colaboração com outras redes de pesquisas nacionais e internacionais relacionadas ao tema.



Linhas temáticas:

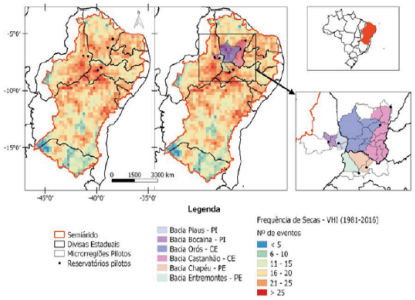
- Segurança Alimentar



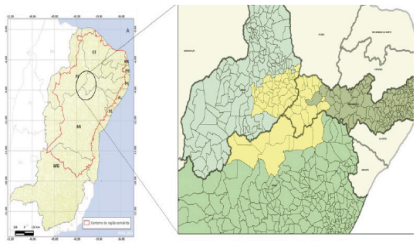
Mapeamento de áreas antrópicas e não antrópicas no Cerrado

- Economia e impactos em setores-chave
- Desastres naturais, impactos na infraestrutura física em áreas urbanas e desenvolvimento urbano

Frequência de eventos de seca e seleção de açudes e microrregiões pilotos



- Segurança energética
- Saúde

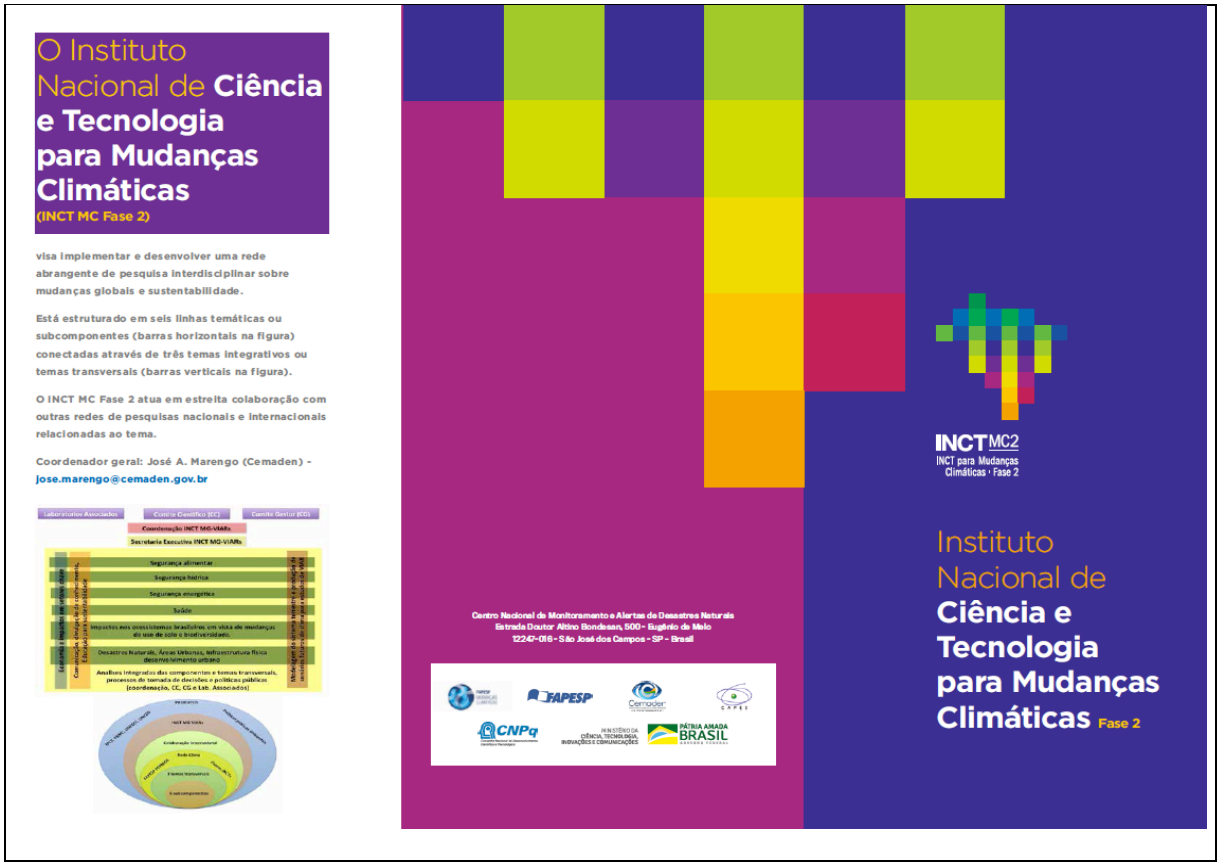


Estudos sobre seca e saúde na bacia do rio São Francisco

- Impactos nos ecossistemas brasileiros
- Comunicação, disseminação de conhecimento e educação para sustentabilidade

FAPESP MUDANÇAS CLIMÁTICAS · FAPESP · Cemaden · CAPES · CNPq · MINISTÉRIO DA CIÊNCIA, TECNOLOGIA, INOVAÇÕES E COMUNICAÇÕES · PÁTRIA AMADA BRASIL GOVERNO FEDERAL

Folder that describes the INCT MC Phase 2



O Instituto Nacional de **Ciência e Tecnologia para Mudanças Climáticas**
(INCT MC Fase 2)

visa implementar e desenvolver uma rede abrangente de pesquisa interdisciplinar sobre mudanças globais e sustentabilidade.

Está estruturado em seis linhas temáticas ou subcomponentes (barras horizontais na figura) conectadas através de três temas integrativos ou temas transversais (barras verticais na figura).

O INCT MC Fase 2 atua em estreita colaboração com outras redes de pesquisas nacionais e internacionais relacionadas ao tema.

Coordenador geral: José A. Marengo (Cemaden) - jose.marengo@cemaden.gov.br

Centro Nacional de Monitoramento e Alertas de Desastres Naturais
Estrada Doutor Altino Bondesan, 500 - Eugênio de Melo
12247-016 - São José dos Campos - SP - Brasil

INCT MC2
INCT para Mudanças Climáticas - Fase 2

Instituto Nacional de **Ciência e Tecnologia para Mudanças Climáticas** Fase 2

INCT PARA MUDANÇAS CLIMÁTICAS FASE 2

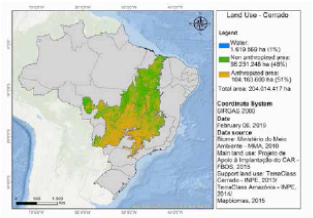
Linhas temáticas:

• Segurança Alimentar

O Cerrado é responsável por mais de 70% da agricultura brasileira e 50% da pecuária.

Foram avaliados os sistemas de produção que são adotados na região e temos uma projeção de produção futura e desmatamento estimado até 2050.

Nesse meio tempo, 14 milhões de toneladas de soja foram perdidas este ano, devido à falta de chuva e calor intenso. O valor da perda na safra 2018/2019 é de 4,5 bilhões de dólares.



Mapeamento de áreas antrópicas e não antrópicas no Cerrado

• Economia e impactos em setores-chave

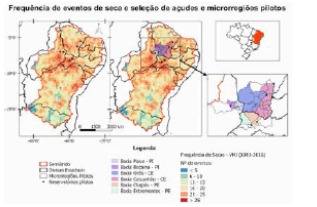
A agricultura tende a ser a mais diretamente afetada pelas mudanças climáticas no Brasil, mas o impacto desse efeito para outros setores produtivos (alimentos processados, por exemplo) também tende a ocorrer até 2100.

Impactos econômicos da mudança climática na agricultura brasileira: impactos diretos: US$ 174 bilhões (cenário menos pessimista) e US$ 1 trilhão (cenário mais pessimista). Centro Oeste: cinco vezes mais vulnerável que a média do país em ambos os cenários.

• Desastres naturais, impactos na infraestrutura física em áreas urbanas e desenvolvimento urbano

Estudos para a região Nordeste do Brasil apontam recorrência de secas, no período de 1981 a 2016, com as maiores frequências observadas na região semiárida central (mais de 20 eventos no período). Estão em curso estudos focando os impactos das secas na agricultura de sequeiro e nos reservatórios hídricos (para abastecimento público e irrigação).

As recorrentes secas têm afetado durante séculos as atividades agropecuárias no semiárido, bem como os reservatórios hídricos criados para regularizar o abastecimento público.



• Segurança Energética

Revisão das projeções de crescimento das fontes de energia solar e eólica na matriz elétrica brasileira.

Desenvolvimento do modelo de previsão da expansão do parque eólico, com base em uma adaptação do ambiente de modelagem LuccME e do modelo de uso e cobertura da terra.

Apesar do crescimento da energia solar e eólica na próxima década, é necessário determinar a necessidade e as alternativas ao balanceamento de carga nos horários de pico. O aumento na geração de energia termoelétrica pode trazer perdas e comprometer as metas de emissões de GEE.

• Saúde

Seca e saúde no semiárido do Nordeste do Brasil: Projeto-piloto com 65 municípios da região do rio São Francisco, para entender os impactos da seca na saúde e propor estratégias de adaptação.

• Modelagem do Sistema Terrestre

Experimentos com o modelo global BESM 2.5 geraram 1.000 anos de simulações para o presente e considerando uma concentração de CO2 quatro vezes maior, no supercomputador CRAY EX6 do INPE/CPTEC para gerar cenários futuros de clima. Modelo regional Eta - ESM: atualização e elaboração de mapas de uso e cobertura da terra para uso no downscaling de mudanças climáticas urbanas e estudo dos impactos no cerrado brasileiro. Estas atividades apoiam o desenvolvimento da vegetação dinâmica e os componentes do clima urbano.

• Segurança Hídrica

A estiagem em 2013/2014 no Sudeste resultou em perdas econômicas de R$ 12 a 21 bilhões no setor hidrelétrico e de R$ 2,6 a 4,1 bilhões pela perda de serviços ecossistêmicos. Estudos deste INCT incorporam novas mudanças nas previsões hidrológicas com assimilação das etapas clássicas de modelagem hidrológica, calibração, validação e exploração de cenários. No país há experiência para aplicações de modelagem hidrológica e seus acoplamentos no Nordeste, na Amazônia, na bacia do Paraná e no Sudeste.

• Impactos nos ecossistemas brasileiros

Desenvolvimento e atualização de estimativas e incertezas de emissões e remoções de gases de efeito estufa associadas à cobertura da terra e mudanças no uso da terra para a Amazônia, Cerrado, Caatinga e Mata Atlântica.

A torre ATTO de 325 metros de altura na Amazônia Central será usada para gases traços, aerossóis e outros, medindo continuamente ao longo dos 5 anos deste projeto

• Comunicação, disseminação de conhecimento e educação para sustentabilidade

A comunicação-educação em ciência aparece habitualmente como uma possibilidade de maior participação social, identificando a falta de acesso ao conhecimento científico por parte da população como o problema das políticas educacionais e de inclusão social.

O acesso à informação não garante por si só a participação efetiva das pessoas, mas sim a construção de produtos e processos com o envolvimento ativo do público.

Presentations of the INCT MC Phase 2 Coordination Meeting of December 2018, FEA USP, Sao Paulo

INCT MC2
INCT para Mudanças Climáticas - Fase 2

Agenda de Reunião Presencial

Líderes e Membros do Comitê Científico do INCT-MC fase II

30/11/2018

PROGRAMAÇÃO		
08:30-09:00	**Café de boas-vindas**	
09:00 -09:15	**Abertura**	Introdução (Coordenador do Projeto José A. Marengo)
09:15-11:00	**Apresentação**	Relatório de cada componente (apresentação das atividades, cada líder ou representante resumirá em **10 minutos cada**, (e as observações serão apontadas somente pelo Coordenador).
11:00 -12:00	**Discussões**	Problemas, limitações (apresentação de todos ,). Marengo lidera)
12:00-12:30	**Financeiro**	Aspectos, Observações (Josiane Rosa)
12:30-14:00	**Almoço**	
14:00-15:00	**Atividades Futuras**	Artigos conjuntos, Conferência e Planos para o ano de 2019.
15:00-16:00	**Apresentação**	Sumário da reunião e outros assuntos
16:00-16:30	**Fala de Encerramento**	

Subcomponente economia e impactos nos setores chaves

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INCT Mudanças Climáticas Fase II - Segurança Energética

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INCT para Mudanças Climáticas - Fase 2

Ministério da Saúde
FIOCRUZ
Fundação Oswaldo Cruz

INCT MC2 Subcomponente Saúde

Coordenação:
Ulisses Confalonieri (Centro de Pesquisas René Rachou, FIOCRUZ)
Elizabeth Rangel (Instituto Oswaldo Cruz, FIOCRUZ)

INPE

Instituto Nacional de Pesquisas Espaciais - INPE

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INCT para Mudanças Climáticas - Fase 2

INCT 2 – MUDANÇAS CLIMÁTICAS

SUBCOMPONENTE MODELAGEM

Modelagem do sistema terrestre e produção de cenários futuros de clima para estudos de IVAR

Paulo Nobre coordenador	Modelagem Global Modelo Brasileiro do Sistema Terrestre (BESM)
Chou Sin Chan	Modelagem Regional Modelo Regional do Sistema Terrestre (RESM)

INCT MC2
INCT para Mudanças Climáticas - Fase 2

INCT Mudanças Climáticas (INCT-MC)

Coordenador: *Jose A. Marengo Orsini*

Sub – componente Segurança Alimentar

Coordenador: *Eduardo Delgado Assad*

Instituições participantes: Embrapa | Unicamp | UFV | ITAL | UFG

Apresentação: J.Zullo Jr, R.R.V.Gonçalves - Unicamp

INCT- Mudanças Climáticas Fase 2

Componente:
Impactos nos ecossistemas brasileiros em vista de mudanças de uso de solo e biodiversidade

UFSC FIOCRUZ

INCT – MUDANÇAS CLIMÁTICAS
INCT FASE II

Sub componente: Desastres naturais, áreas urbanas, infraestrutura física, desenvolvimento urbano

Chamada 2014, Processo 465501/2014-1
Coordenador: José A. Marengo - Cemaden/MCTIC

Reunião do Comitê Científico do INCT MC Fase 2
São Paulo, SP, 30 de novembro de 2018

Cemaden

MINISTÉRIO DA CIÊNCIA, TECNOLOGIA, INOVAÇÕES E COMUNICAÇÕES

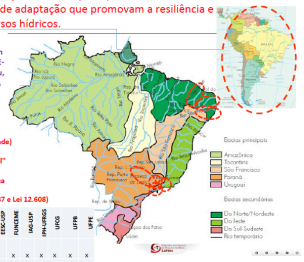
INCT-MC-II: Componente de Segurança Hídrica

Participantes: UFPE, USP (EESC, IAG), CEMADEN, INPE, FUNCEME, UFCG, UFPB, UFRGS,

Objetivo Geral: Analisar indicadores de segurança hídrica em principais bacias brasileiras associados às mudanças climáticas para propor estratégias de adaptação que promovam a resiliência e sustentabilidade de setores usuários de recursos hídricos.

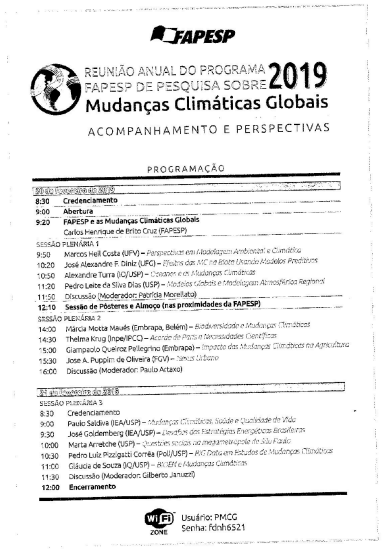
Modelagem de bacias de América do Sul (continental) com estudos de caso em diferentes escalas, com ênfase em: NE-Brasileiro (Bacias do Capibaribe, Pajeú, Uma, Piranhas-Açu, Jaguaribe, Paraíba, São Francisco), SE-Brasileiro (Bacias do Mogi-Guaçu, Paraíba do Sul, Tietê, Jaguari, Sistema Cantareira, Monjolinho, Aricanduva, Tietê-Jacaré); Indicadores socio-econômicos do NE e SE brasileiro.

RESULTADOS ESPERADOS:
- Fortalecimento de bases de informações (clima-água-sociedade)
- Rede cooperativa de pesquisa e extensão entre IESs
- Novas estratégias de adaptação "clima-água-resiliência social"
- Subsídios para as políticas de adaptação
- Criação de novas disciplinas e seminários de segurança hídrica
- Formação de recursos humanos e apoio a PPPs
- Subsídios à legislação vigente (Lei 9.433, Lei 11.445, Lei 12.187 e Lei 12.608)



Atividades	CEMADEN	INPE	EMBRAPA	EESC-USP	FUNCEME	IAG-USP	IPH-UFRGS	UFCG	UFPB	UFPE
Identificação de bacias hidrográficas estratégicas (oferta, demanda e setores usuários)	x	x	x	x	x	x	x	x	x	
Calibração/validação hidrológica para diferentes escalas e sob diferentes demandas e biomas	x	x	x	x	x	x	x			x
Simulação de modelos (clima-hidrologia) em cenários de longo prazo e não-estacionários	x	x	x	x		x	x			x
Novos indicadores e estratégias de adaptação e de transferência de riscos hidrológicos			x	x		x				
Estratégias para melhoria da comunicação entre pesquisadores e usuários em geral			x	x			x			x

Other meetings among components or where the INCT MC Phase 2 was presented or organized by the INCT



FAPESP

REUNIÃO ANUAL DO PROGRAMA FAPESP DE PESQUISA SOBRE 2019
Mudanças Climáticas Globais

ACOMPANHAMENTO E PERSPECTIVAS

PROGRAMAÇÃO

21 de novembro de 2018

8:30 Credenciamento
9:00 Abertura
9:20 FAPESP e as Mudanças Climáticas Globais
Carlos Henrique de Brito Cruz (FAPESP)

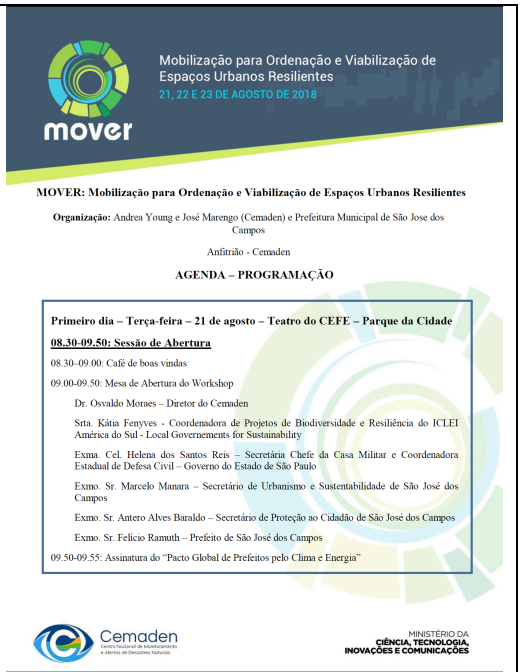
SESSÃO PLENÁRIA 1
9:50 Marcos Heil Costa (UFV) – Perspectivas em Modelagem Ambiental e Climática
10:20 José Alexandre F. Diniz (UFG) – Efeitos das Mudanças Climáticas Globais nos Modelos Preditivos
10:50 Alexandre Turra (IO/USP) – Oceano e as Mudanças Climáticas
11:20 Pedro Leite da Silva Dias (USP) – Modelos Globais e Modelagem Atmosférica Regional
11:50 Discussão (Moderador: Fapesp a definir)
12:10 Sessão de Pôsteres e Almoço (nas proximidades da FAPESP)

SESSÃO PLENÁRIA 2
14:00 Márcia Motta Maués (Embrapa, Belém) – Biodiversidade e Mudanças Climáticas
14:30 Thelma Krug (Inpe/IPCC) – Acordo de Paris e Necessidades Científicas
15:00 Giampaolo Queiroz Pellegrino (Embrapa) – Impacto das Mudanças Climáticas na Agricultura
15:30 José A. Puppim de Oliveira (FGV) – Cidades Globais
16:00 Discussão (Moderador: Paulo Artaxo)

22 de novembro de 2018

SESSÃO PLENÁRIA 3
8:30 Credenciamento
9:00 Paulo Saldiva (IEA/USP) – Mudanças Climáticas, Saúde e Qualidade de Vida
9:30 José Goldemberg (IEA/USP) – Lições das Estratégias Energéticas Brasileiras
10:00 Marta Arretche (USP) – Quantum social: os megaprocessos no Século XXI
10:30 Pedro Luiz Pizzigatti Corrêa (PoliUSP) – PhD Defesa em Estudos de Mudanças Climáticas
11:00 Cláudia de Souza (IO/USP) – Riscos e Mudanças Climáticas
11:30 Discussão (Moderador: Gilberto Januzzi)
12:00 Encerramento

WiFi ZONE Usuário: PMCG
Senha: fdnh6521



mover

Mobilização para Ordenação e Viabilização de Espaços Urbanos Resilientes
21, 22 E 23 DE AGOSTO DE 2018

MOVER: Mobilização para Ordenação e Viabilização de Espaços Urbanos Resilientes

Organização: Andrea Young e José Marengo (Cemaden) e Prefeitura Municipal de São Jose dos Campos

Anfitrião - Cemaden

AGENDA – PROGRAMAÇÃO

Primeiro dia – Terça-feira – 21 de agosto – Teatro do CEFE – Parque da Cidade

08.30-09.50: Sessão de Abertura

08.30–09.00: Café de boas vindas

09.00-09.50: Mesa de Abertura do Workshop

Dr. Osvaldo Moraes – Diretor do Cemaden

Srta. Kátia Fenyves - Coordenadora de Projetos de Biodiversidade e Resiliência do ICLEI América do Sul - Local Governements for Sustainability

Exma. Cel. Helena dos Santos Reis – Secretária Chefe da Casa Militar e Coordenadora Estadual de Defesa Civil – Governo do Estado de São Paulo

Exmo. Sr. Marcelo Manara – Secretário de Urbanismo e Sustentabilidade de São José dos Campos

Exmo. Sr. Antero Alves Baraldo – Secretário de Proteção ao Cidadão de São José dos Campos

Exmo. Sr. Felício Ramuth – Prefeito de São José dos Campos

09.50-09.55: Assinatura do "Pacto Global de Prefeitos pelo Clima e Energia"

Cemaden
Centro Nacional de Monitoramento e Alertas de Desastres Naturais

MINISTÉRIO DA CIÊNCIA, TECNOLOGIA, INOVAÇÕES E COMUNICAÇÕES

As dimensões científicas, sociais e econômicas do desenvolvimento da Amazônia 1

INPA LBA FASE 2 Wilson Center FAPESP

As dimensões científicas, sociais e econômicas do desenvolvimento da Amazônia

Prof. Paulo Artaxo – Instituto de Física da USP, Paulo Sotero, Woodrow Wilson International Center for Scholars, EUA, Prof. Carlos Eduardo Lins e Silva, FAPESP

Programa Final

Agenda do workshop on Amazonian Science

Wilson Center, Washington DC, September 24, 2018 |

9:00 Opening – Brito Cruz, FAPESP scientific director, Wilson Center Director, Ernie Muniz.

9:15 – Thomas Lovejoy (George Mason University) – Biodiversity, tipping points and sustainable development in Amazonia

10:00 – Paulo Artaxo (USP) – The close links between the Amazonian forest biology and climate

10:45 – Douglas Morton (NASA Goddard) – Remote sensing of Amazonia deforestation.

11:15 – Celso von Randow (INPE) – Ecosystem and physiological control of carbon balance in Amazonia

12:00 – Lunch

14:00 – Rita Mesquita (INPA) – The role of research institutions in Amazonia in fostering development in the region.

14:45 – José Marengo (CEMADEM) – Present and future climate in Amazonia and its impacts.

15:30 – Paulo Moutinho (IPAM): How to achieve zero deforestation in Amazonia.

16:15 - Gustavo Fonseca - Banco Mundial – The economic incentives to halt deforestation in Amazonia.

17:00 – Closing remarks (Paulo Sotero and Paulo Artaxo).

Convite para Curso Internacional:

'SWAT Aplicado à Segurança Hídrica sob Mudanças Climáticas'

Escola de Engenharia de São Carlos/USP, São Carlos, 9-11 de outubro de 2018

Prof. R. Srinivasan, Texas A&M Univ – SWAT worldwide reference

Convite: entre dias 9 e 11 de outubro de 2018 para **Curso 'SWAT (Soil & Water Assessment Tool) Aplicado à Segurança Hídrica sob Mudanças Climáticas'**, como parte do ciclo oficial de palestras internacionais 2018 International Water Lectures, com apoio CAPES/PROEX do Programa de Pós-Graduação em Engenharia Hidráulica e Saneamento (PPGSHS) da Escola de Engenharia de São Carlos (EESC), Universidade de São Paulo (USP), e **associado a iniciativas interdisciplinares vigentes**: (1) a Subcomponente de Segurança Hídrica do Instituto Nacional de Ciência e Tecnologia em Mudanças Climáticas-Fase 2 (INCTMC2) coordenado pelo CEMADEN/MCTIC, (2) o Subprojeto de Recursos Hídricos e Mudanças Climáticas do Interdisciplinary Climate Investation Centre (INCLINE), (3) o Centro de Ciências Matemáticas Aplicadas à Industrica (CEPID/CeMEAI) e IAHS-Panta Rhei + IAHS-MOXXI

Instituições Convidadas: Este Curso é co-ministrado pelo Prof. Raghavan "Srini" Srinivasan (Foto) da Texas A&M University, EUA, e oferece créditos aos alunos matriculados em cursos de pós-graduação via código SHS5813 das disciplinas oferecidas pelo PPGSHS. Diferente das edições realizadas em 2012, o Curso atual oferece um novo Programa* com: (a) várias aplicações de SWAT em bacias brasileiras, (b) palestrantes convidados de instituições público-privadas, dentre elas: a empresa Climatempo, o Depto de Eng. Civil da UFPE, a Faculdade de Engenharias, Arquitetura e Urbanismo e Geografia – FAENG/UFMS, e o Institute of Earth and Environmental Science, University of Potsdam, Alemanha, e (c) workshops de novas fronteiras científicas e de oportunidades para jovens pesquisadores. O curso será ministrado em Inglês e Português.

Inscrições: Podem se inscrever profissionais de quaisquer formações, e/ou estágios de pós-graduação, inclindo pós-doutorados, enviando seu pedido de inscrição **por email** à Comissão Organizadora (emm@sc.usp.br), **anexando** uma (1) Carta de Recomendação de Referente Nacional ou Internacional que explique (i) o perfil do(a) interessado(a) no Curso e responda (ii) na mesma Carta à pergunta: **"Como as aplicações atuais/futuras com SWAT do(a) participante recomendado(a) para este Curso têm/terão aderência às iniciativas interdisciplinares INCTMC2, INCLINE e CEPID/CeMEAI?"**

Programa Preliminar* horários do Curso: 9:00-12:00 e 14:00-17:00h

Dia 09-10-2018, Recepção e Abertura: Prof E M Mendiondo, EESC-USP. Palestra inaugural: "SWAT Overview: past, present and future", Prof. R. Srinivasan, Texas A&M Univ; Aulas de Curso; Aplicações: "Economic indicators of hydrologic drought insurance under water demand and climate change scenarios in a Brazilian context", Eng., Me. G S Mohor, University of Potsdam, Alemanha; Workshop

Dia 10-10-2018: Aulas de Curso; Aplicações (1) "Assessing uncertainties in surface water security: An empirical multimodel approach", Profa. D. Rodrigues, FAENG/UFMS; (2) "Modeling freshwater quality scenarios with ecosystem-based adaptation in the Cantareira system, Brazil", Dra D. Taffarello, EESC/USP; Workshop

Dia 11-10-2018. Aulas de Curso; Aplicações: "Hydrological modeling and scenarios of land use and climate changes in a representative basin, Northeastern Brazilian", Profa C. W. L. de Andrade, UAST/UFRPE; "Effects of spatial and temporal weather data resolutions on streamflow modeling of a semi-arid basin, Northeast Brazil", Dra. Danielle Bressiani, CLIMATEMPO; Conclusões e Recomendações; Encerramento

Comissão Organizadora: E M Mendiondo (emm@sc.usp.br) e D Taffarello, EESC/USP (taffarellod@gmail.com)

Promoção: IAHS-Measurements & Observations in the XXIst Century & IAHS-Panta Rhei/Everything Flows


Matinê Pedagogias da Imagem, cineclube da Faculdade de Educação da UFRJ, convida para o
Ciclo
(Im)permanências:
Vulnerabilidade
Diálogos entre artes, humanidades e mudanças climáticas
Dia 19/06
9h às 18h
Auditório Manoel Maurício - CFCH
UFRJ
Praia Vermelha
9h
Filme: Espólio da Terra (Land Grabbing - Áustria, 2015, 91'), de Kurt Langbein
10h40 - Mesa I
Paulo Nobre (INPE)
Susana Dias (Labjor/Unicamp)
Walmeri Ribeiro (Artes/UFF)
14h
Filme: Água Mole Pedra Dura (Brasil, 2017, 68'), de James Robert Lloyd & Flavia Angelico
15h20 - Mesa II
Diana Marinho (Fiocruz)
Sarah Almeida (CAp/UFRJ)
Cinthia Mendonça (Artes/UERJ)
Realização
Apoio
climacom
ecofalante


SBHSF
II SIMPÓSIO DA BACIA HIDROGRÁFICA DO RIO SÃO FRANCISCO
Desafios da Ciência para um novo velho Chico
EU ♥ VELHO CHICO
CNPq
CAPES
Cemaden
RedeClima
ESPACIALIZAÇÃO DE ÁREAS APTAS PARA A CITRICULTURA NO RECÔNCAVO DA BAHIA
Autores:
Mariela Brito de Almeida, Vanessa Silva Pugliero, Marilia Ribeiro Zanetti, Edson Luis Bolfe e Eduardo Delgado Assad


INPA
LBA
FASE 2
Wilson Center
FAPESP
INCT MC2
Present and future climate in Amazonia and its impacts
Dr. José A. Marengo
Research Director
CEMADEN
(jose.marengo@cemaden.gov.br)
Workshop The Scientific, Social, and Economic Dimensions of Development in the Amazon, Washington DC, USA, September 24 2018


Cemaden
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA, INOVAÇÕES E COMUNICAÇÕES
PÁTRIA AMADA BRASIL GOVERNO FEDERAL
INCT MC2
Desastres Naturais, Vulnerabilidade e Adaptação no Brasil: INCT para Mudanças Climáticas Fase 2
Jose A. Marengo
Coordenador Geral de Pesquisa e Desenvolvimento
CEMADEN
jose.marengo@cemaden.gov.br
SEMINÁRIO
MEDIDAS DE MITIGAÇÃO E ADAPTAÇÃO ÀS MUDANÇAS CLIMÁTICAS
CÂMARA DOS DEPUTADOS, COMISSÃO DE MEIO AMBIENTE E DESENVOLVIMENTO SUSTENTÁVEL
05/06/2019, Brasília DF.

Reunião de Coordenação dos INCTs
Brasília, DF, CNPq,
24 de outubro de 2018, 09:00h-17:00h

Proposta de Pauta:

A governança dos INCT e a sua inserção institucional. A situação da primeira fase continua na segunda fase;

As bolsas alocadas pelo CNPq e pela CAPES são de grande relevância. Entretanto o CNPq suspendeu a implementação de Bolsas PDJ e a CAPES só permite duas por ano;

O financiamento dos INCTs, é feito pelo CNPq, CAPES e as FAPs. A situação dos repasses é critica e com relação as FAPs muitas não repassaram recursos, outras nem assinaram os convênios;

Participação de outros Ministérios e Empresas Públicas e Privadas: Iteração e financiamento com os INCTs

O alinhamento dos INCTs com a Estratégia Nacional de C,T&I, ENCTI 2016-2022;

Day 1 (1st April, 2019)	Speakers	Topic
8:00 - 8:30	Dr Tercio Ambrizzi, Coordinator of INCLINE and Professor at IAG/USP, also Vice-Coordinator of Brazilian Institute of Science and Technology on Climate Change-2 (INCTMC2)	
8:30 -8:45	Eduardo M Mendiondo (USP, University of Sao Paulo), Namrata Bhattacharya Mis (University of Chester)	Introduction to the WATERS workshop
8:45 – 9:30	Dr Faith Chan (China) +11 hours from Brazilian time	Rethink the flood risk management strategies in Chinese coastal megacities – the cases of Hong Kong and Ningbo
9:30 -9:45	Coffee Break	
9:45 – 10:25	Dr Daniel Green (UK) +4 hours from Brazilian time	An evaluation of the city-scale accessibility of emergency responders operating during flood events
10:30 – 12:00	Practical discussion session and group work	**PARTICIPANTS ARE REQUIRED TO HAVE LAPTOPS WITH QGIS INSTALLED**
12:00 – 13:30	Lunch break	
13:30 – 14:10	Dr Andrew Miles (UK) +4 hours from Brazilian time	Open Source GIS & Open Data for Improving Understanding of Risk & Vulnerability
14: 10 – 15:00	Dr Burrell Montz (USA) -1 hours from Brazilian time	Matthew, Florence and Michael: Repeat Losses, Perceptions and Vulnerability
15:00 -15:40	Practical discussion session and group work	Living with risk: Water concerns
15:40 – 16:00	Coffee break	
16:00-17:00	Practical discussion session and group work	

#WATERS2019

Audience and Priority: the International Water Lectures organization invites an open audience ranging from academics to stakeholders, decision-makers and private companies. However, students from PPGSHS have priority if we reach the number of places available. For those who cannot attend the workshop, it is possible to watch the live streaming at https://www.youtube.com/channel/UCNMbbL413ivyku2_ymUcbrQ/live **Fees and Credits:** No fee will be charged to participants. Students attending the Workshop will have partial credits recognized if officially enrolled in the cycle of 2018 PPGSHS International Water Lectures – SHS5936. **Registration:** PPGSHS-EESC/USP, Av. Trabalhador Saocarlense, 400, CEP 13566-590, Sao Carlos-SP, Tel: (16)33739552, Email: ppgshs@sc.usp.br. **Website:** www.eesc.usp.br/ppgshs. Because of limited number of places, we strongly recommend earlier registration. **Disclosure Statement:** these International Water Lectures are in compliance with the CAPES Engineering I Strategic Document, the 2013-2016 CAPES Engineering I Evaluation Report, as well the PPGSHS Action Plan 2017-2020.

Dam and weather: what does the measurements tell us

Arcilan T. Assireu

[1] *Instituto de Recursos Naturais – Universidade Federal de Itajubá*
arcilan@unifei.edu.br

Nacqua
Núcleo de Estudos Avançados e Interdisciplinares em Recursos Hídricos

Simpósio internacional
"Crise hídrica: desafios e soluções"

07 e 10 de abril de 2019
Universidade Federal de São João del-Rei – UFSJ
Campus CSA – São João del-Rei (MG)
https://crisehidrica.com

Soil water dynamics in Forest environments and the role of deep roots

Javier Tomasella
CEMADEN
Lavras, May 2019

Emissões evitadas de GEE na expansão da soja no Brasil de 2010 a 2016

Vanessa Pugliero
13/11/2018

Systemic Resilience to Climate Shocks: Impacts of a Drought in Central Chile

International Workshop on General Equilibrium Modeling, Universidad Adolfo Ibañez
Viña del Mar, December 3-4, 2018

Eduardo Haddad Bruno Pimenta Karina Sass Denise Li

Trade in Natural Resources in the Interregional Input-Output System for Chile

International Workshop on General Equilibrium Modeling, Universidad Adolfo Ibañez Viña del Mar, December 3-4, 2018

Eduardo Haddad Keyi Ussami Raphael Fernandes

A Bad Year? Climate Variability and the Wine Industry in Chile

International Workshop on General Equilibrium Modeling, Universidad Adolfo Ibañez Viña del Mar, December 4-5, 2018

Eduardo Haddad Patricio Aroca Ademir Rocha Bruno Pimenta

AGENDA REUNIÃO NEXUS

DIA 04 E 05 DE JUNHO

LOCAL: SALA DE REUNIÃO DEHA E AUDITÓRIO POSDEHA

DIA 04/06 | SALA DE REUNIÃO DEHA

8:30 Chegada

9:00 Boas Vindas e Apresentação da Agenda de Trabalho

9:30 Seção Técnica 1A: Estruturar a Base de Dados e Sistemas de Informações

- Apresentação Base de Dados Hidrometeorológico da UNB: *Dirceu Reis*
- Apresentação Base de Dados de Satélite da EMBRAPA: *Eduardo Assad*
- Apresentação Base de Dados de Modelos de Mudança Climática da UFC/FUNCEME: *Francisco Vasconcelos Júnior*
- Apresentação Bases de dados BESF da UFCG: *Iana Rufino*

10:10 Seção Técnica 1B: Análise da Base de Dados de Uso do Solo e Produção Agrícola

- Identificar a produção agrícola: *Eduardo Assad e Stoécio Malta*
- Identificação das demandas hídrica e energética dos municípios da BESF: *Gabriela Reis e Tais Maria*
- Avaliar quali-quantitativamente a dinâmica do uso da terra na BESF com a utilização de técnicas de sensoriamento remoto EMBRAPA: *Eduardo Assad*
- Quantificando e analisando mudanças do uso do solo na BESF: *Higor Costa*

11:00 Seção Técnica 2: Analisar a variabilidade do clima e caracterizar secas do presente e futuro

- Analisar as séries temporais de precipitação, vazão e temperatura para identificar os modos de variação (alta e baixa frequência) e detectar mudanças: *Larissa Zaira e Renan Rocha*
- Analisar secas meteorológicas e hidrológicas utilizando índices como SPI, SPIE e SRI – Século XX: *Luiz Júnior*
- Abordagem cumulativa do monitor de secas brasileiro e análise de impactos como métricas de vulnerabilidade às secas: *Yáscara Brito*
- Analisar o desempenho dos modelos do CMIP5 na representação do clima do Século XX: *Cleiton Silveira*
- Analisar os cenários projetados para o século XXI dos modelos de mudança climática do CMIP5: *Cleiton Silveira*

Reunião Anual do Programa FAPESP de Pesquisa sobre Mudanças Climáticas Data: 20 e 21 de fevereiro 2019
Local: Fapesp - Rua Pio XI, 1500 - Alto da Lapa
São Paulo-SP

INCT MC-Phase 2

National Institute of Science and Technology for Climate Change-Phase 2

FAPESP Grant 2014/50848-9

J.A. Marengo (CEMADEN; jose.marengo@cemaden.gov.br) PI, T. Ambrizzi (IAG-USP) co-PI, P. Nobre (CPTEC INPE), P. Artaxo(IF-USP), E. Mendiondo (EESC-USP), E. B. Pereira (CCST-INPE), E. Haddad (FEA-USP), E. Assad (EMBRAPA), R. Schaeffer & A. Szklo (COPPE-UFRJ), U. Confalonieri & E. Rangel (UFMG e FIOCRUZ), E. Martins (FUNCEME), S. Montenegro (UFPE), R. Alvala (CEMADEN), R. Rodrigues (UFSC), A. Amorim & S. Dias (UNICAMP), J. Feres (IPEA), M. Barata (FIOCRUZ), M. Bustamante (UNB)

Overview

The INCT for Climate Change Phase 2 (INCT MC Phase 2) aims to implement and develop a comprehensive network of interdisciplinary research on global change and sustainability, and is based on the cooperation between about 30 research groups from all regions of Brazil and 4 international research groups, involving in its entirety over approximately 350 researchers, and establishing itself as one of the largest networks of global change research developed in Brazil. It **has six thematic lines or subcomponents** (Horizontal bars in Fig 1) connected **via three integrative themes or cross cutting themes** (vertical in Fig 1). INCT MC Phase 2 works closely with other networks and national and international research related to issues of global change and sustainability (Fig 2).

Fig 1. Structure of the INCT MC Phase 2

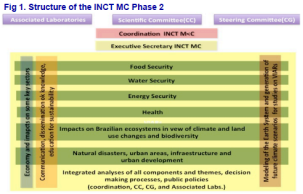


Fig 2. Scope of the INCT MC Phase 2 at the national and international level

Main objectives.

-To implement and develop a comprehensive network of interdisciplinary research on global environmental change and sustainability and develop actions aimed at assessing adaptation to environmental changes and the transformation to sustainability,
-To provide an overview of issues related to sustainability and environmental-social-corporate responsibility, in order to facilitate the participation or even the implementation of activities in different areas of management of public and private institutions and their relationships with stakeholders.
-To maintain excellence in activities in Science & Technology & Innovation as the structural axis of sustainable environmental development, with an integrator and innovative character.
-To develop a research agenda in global change to identify and understand the current impacts of climate variability on natural and human systems in Brazil;
-To enhance and expand the scope of studies on global change and their impacts on important sectors to the economy of Brazil.
-To sensitize the public perception of science and technology in relation to global change and impacts on society.
-To contribute prominently in the research and development of the National Plan on Climate Change and the National Adaptation Plan to Combat Drought and Desertification, in partnership with federal, state and international research programs on global change and to provide scientific contributions for the IPCC AR6, special reports of the Brazil.

Main results from some components in year 1 (May 2017-Dec 2018)

Food Security

This component obtain the environmental diagnosis in 187 municipalities fully inserted in Caatinga and São Francisco River basin using geoprocessing tools (Fig.3). It was mapped 24.333.158 hectares, nearly 40% of the area of the municipalities in the basin. For this it was analyzed primary and secondary spatial data. The primary data used GIS and Remote Sensing, resulting in land use and hydrographic mapping. From these two mapping it was possible to extract the permanent protection areas, following the forest code standards. Crossing the land use mapping with the permanent protection areas (1.281.512 ha) it was obtained 36% the environmental debt along the river. The environmental diagnosis is the first step to plain the water, energy and food security. The crossing of spatial data using GIS provided important conclusions about the transformation of land and how it could affect the sustainability in Brazilian semiarid, furthermore, the municipal scale level facilitates the adoption of public policies.

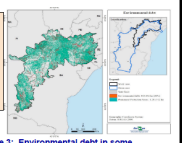


Figure 3: Environmental debt in some municipalities of Caatinga inside the Basin of São Francisco

Water Security

This component assessed ecosystem-based Adaptation (EbA) as using services on which human well-being depends to help people adapt to the impacts of climate change. Aiming at strengthening ecosystem resilience and reducing ecosystem and people's vulnerability, EbA has been encouraged worldwide as an option for climate change. Payments for Ecosystem Services (PES) are incentives offered to farmers and landowners to provide an ecological service and are currently proposed as a method for EbA and water resources sustainability on a global scale. In Brazil, we found 16 ongoing Water-PES in the Brazilian Atlantic Forest. Thus, we discuss how PES projects could be more effective by implementing hydrological monitoring based on ecohydrological concepts. Special attention has been given to explaining how the recent Impact-Vulnerability-Adaptation idea could be integrated into Water-PES.

Energy Security

This project began with a review on the growth projections of the solar and wind energy sources in the Brazilian electricity matrix. In this phase, the researchers started the development of the prediction model for the wind park expansion based on an adaptation of the LuccME modeling environment and the land use and land cover model. The importance of this study lies in the fact that despite the prospect growth of solar and wind energy share reaching 26% of Brazilian electricity matrix in the next decade, more studies are needed to ascertain the need and alternatives to load balancing at peak times once that the increase in thermoelectric power generation can bring losses to the emissions targets and impact on the cost of energy for society.

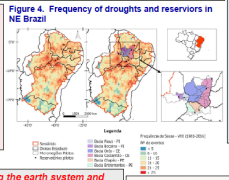
Economy and impacts in key sectors

Agriculture tends to be the most directly affected by climate change in Brazil, but the impact of this effect to other productive sectors (processed foods, for example) also tends to occur by 2100.
Economic Impacts of Climate Change in Brazilian agriculture (US $):
▶Direct Impacts: $174 billion(RCP 2.6) & 1 trillion(RCP 8.5)
▶Indirect Impacts: $596 billion(RCP 2.6) & 2.5 trillion(RCP 8.5)
▶West-Central:Five times more vulnerable than the country average in both scenarios.

Natural disasters, impacts on physical infrastructure in urban areas and urban development

Figure 4 presents the new delimitation of Northeast Brazil, based on recurrence of droughts and the hydrological basins of the reservoirs criteria. It is observed a high frequency of drought occurrence (more than 20 events between 1981 and 2016), mainly in the central semiarid region. In this area, 6 reservoirs for public supply were selected, whose drainage basins coincide with the regions characterized by high frequency of drought events.

Figure 4. Frequency of droughts and reservoirs in NE Brazil



Health

Drought and health in the Semiarid NEB: Pilot project with 65 municipalities in the São Francisco river region, to understand impacts of drought in health and to propose adaptation strategies (Figure 5).

Communication, dissemination of knowledge and education for sustainability

Science communication-education habitually appears as a possibility of a greater social participation, identifying the lack of access to scientific knowledge by a part of the population as the problem of the educational politics and of social inclusion. As a result of the innovative activities and of research developed by the team of this Cross Cutting Theme, what is perceived is that the access to information does not ensure by itself the effective participation of people, but rather the construction of products and process with the active involvement of the public, that is, with a mutual implication of people as well as of things, beings, concepts, words, images and sounds.

Modeling the earth system and production of future climate scenarios to study Vulnerability, Impacts and Adaptation

This component aims to develop a global and a regional Brazilian Earth System Model (BESM). Both levels of modeling will be extensively tested to operate well globally with emphasis over the continent. Models will be tested for the various processes relevant for the study of climate variability and change. Projections of future climate generated from different global earth system models, inclusive the BESM will be downscaled by the RESM (Regional Environmental System, Model) .

Impacts on Brazilian ecosystems in view of changes in land use and biodiversity

This component develops and updates estimates and uncertainties of anthropogenic emissions by sources and removals by sinks of greenhouse gases associated with land cover and land use change for the Amazon, Cerrado, Caatinga and Mata Atlântica (including secondary vegetation growth and in managed areas).
The ATTO 325 meters tall tower in Central Amazonia. Top of the tower as well as profiles for trace gases and aerosols will be measured continuously over 5 years of this project (Figure 6)

Figure 6. ATTO Tower in Amazonia

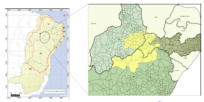


Figure 5. Drought and health in the São Francisco river basin

Scientific prduction (pending)

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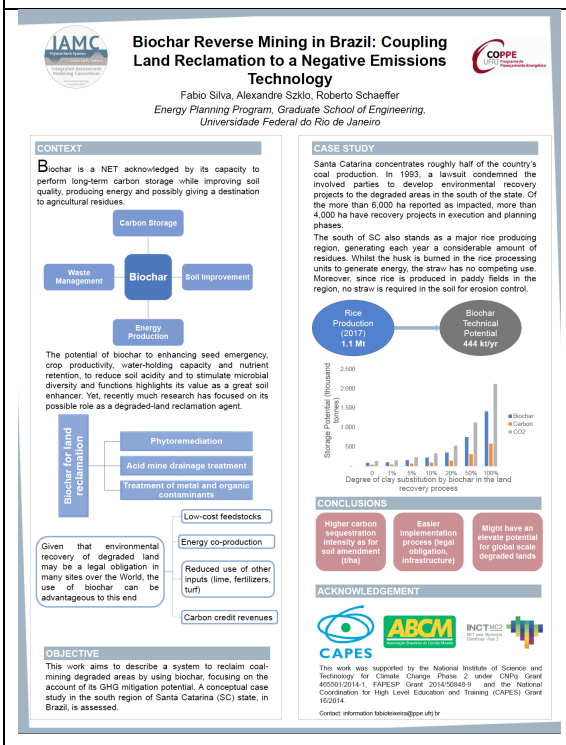
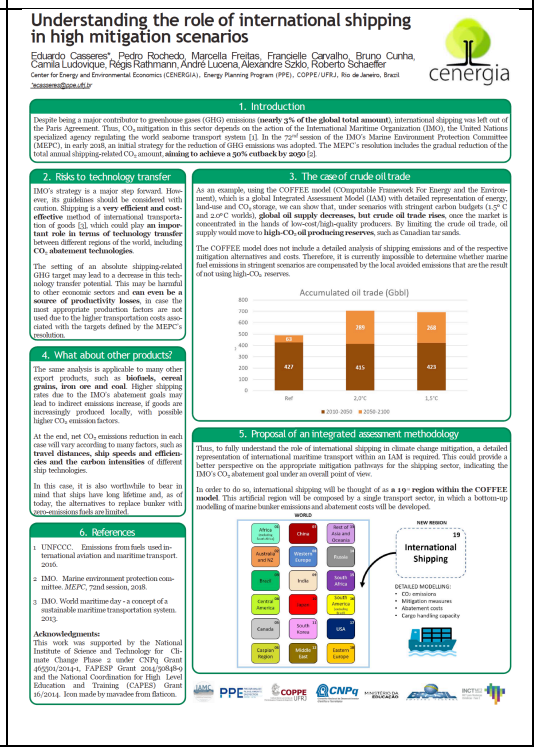
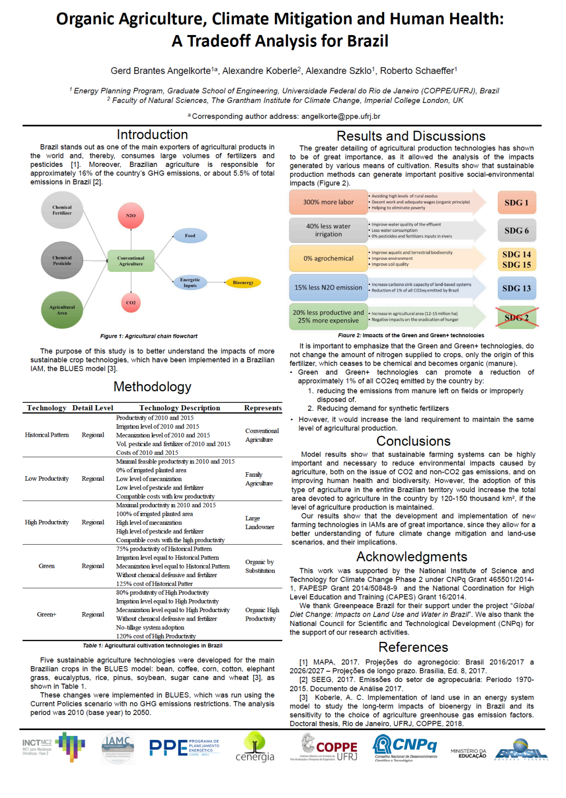
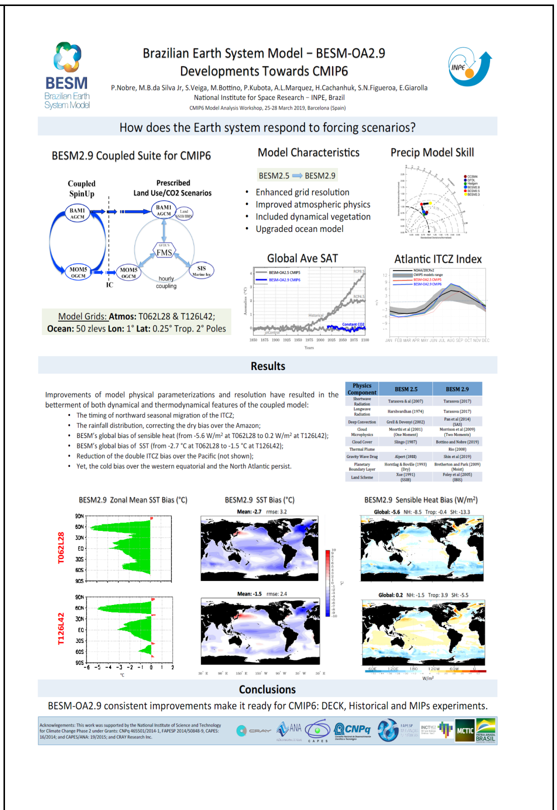
Posters presented at scientific events






Organic Agriculture, Climate Mitigation and Human Health: A Tradeoff Analysis for Brazil
Gerd Brantes Angelkorte, Alexandre Koberle, Alexandre Szklo, Roberto Schaeffer
Introduction
Results and Discussions
Methodology
Conclusions
Acknowledgements
References


Brazilian Earth System Model – BESM-OA2.9
Developments Towards CMIP6
How does the Earth system respond to forcing scenarios?
BESM2.9 Coupled Suite for CMIP6
Model Characteristics
Precip Model Skill
Global Ave SAT
Atlantic ITCZ Index
Results
Conclusions
BESM-OA2.9 consistent improvements make it ready for CMIP6: DECK, Historical and MIPs experiments.


EGU2019-NH9.4, X3.66
The synergistic model: A comprehensive way to understand the real cost of disasters
Background
Methodology
Conceptualization
Applications of specific modules
Acknowledgements and Main References

Some papers and other publications derived from the project, funded by or relevant to the objectives of the INCT MC Phase 2

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Maize yield under a changing climate in the Brazilian Northeast: Impacts and adaptation

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ABSTRACT

This paper assessed the potential impacts of climate change on maize productivity in the Brazilian Northeast. To achieve this objective, bias-corrected regional downscaled scenarios from three global models for the representative emission pathways, RCP4.5 and RCP8.5, for the periods 1980–2005, 2007–2040, 2041–2070, and 2071–2099 were used as input data for a crop productivity model. Because increased temperatures are likely to shorten the crop cycle length, thus reducing productivity, we investigated the lengthening of the growing cycle as an adaptation strategy. To cope with the reduction of rainfall projected by future climate scenarios, we analyzed the potential impact of irrigation on productivity. The results showed that climate change effects would be mostly negative for maize rainfed agriculture, particularly for the worst-case scenario (RCP8.5, 2071–2099), in which losses were expected to reach more than 60%. However, productivity losses were limited to a maximum of 30% for all RCP4.5 scenarios and before 2070 for the RCP8.5 scenario. The use of maize cultivars with a longer crop cycle for rainfed agriculture was likely to increase the average productivity in all scenarios, although it came at the expense of increasing the risk of crop failure. Regarding the use of irrigation, there was an improvement in productivity for both the short- and long-cycle cultivars, although longer crop cycle cultivars had a decisive advantage, with a drop in yield of less than 20% for all RCP4.5 scenarios and for the RCP8.5 scenario until 2070 compared to the present climate. We estimated the total production and the increase in water demand based on the existing and projected irrigated areas in the region and concluded that it is possible to avoid significant losses in total maize production in the region for all scenarios, with the exception of the 2071–2099 RCP8.5 scenario. However, sustaining such levels of production requires a significant increase in water consumption (up to 140%).

1. Introduction

According to the fifth IPCC report (IPCC, 2014), the projected increases in atmospheric CO_2 concentration and temperature, changes in rainfall patterns and water availability, and the intensification of climate extremes are likely to affect the economy, environment and societal sectors. Regarding crop yield, those changes might result in a wide variety of impacts (Asseng et al., 2013; Porter et al., 2014; Trnka et al., 2014), with productivity increasing in many regions and declining in others (Challinor et al., 2014; IPCC, 2014; Wheeler and von Braun, 2013). It is expected that climate changes will affect the sustainability of agricultural systems in many regions, and the populations who depend on local food production will be most vulnerable (Wheeler and von Braun, 2013; Müller et al., 2011; Asante and Mensah, 2015). In this context, food security will face significant challenges, particularly in semiarid environments, and cropping technologies will be essential to sustaining production levels for an increasing population in the stressed environment due to global warming.

In the context of climate change, the northeast region of Brazil is considered to be one of the most vulnerable regions in the country (Marengo et al., 2016; Simões et al., 2010) due to its high population exposure, high poverty rates, and low adaptive capacity. The inner region of northeast Brazil is largely semiarid, characterized by relatively low and high variability in space and time of the rainfall, combined with high evaporation rates. The region is affected by periodic droughts with severe socioeconomic impacts on the local population and substantial impacts on the public expenditure on mitigation actions. Recent studies (Brito et al., 2017; Marengo et al., 2017) suggest that there has been an intensification of both the duration and fre-

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Mudanças climáticas, impactos e políticas públicas para reduzir impactos

Por: Jose A. Marengo[1]

A realidade

O ano de 2018 foi o 4º ano mais quente da história, e a temperatura média global ultrapassou 1°C em relação à era pré-industrial, e foi 0,83°C mais alta do que a média entre 1951 e 1980, de acordo com cinco bases de dados globais independentes de agências de clima dos Estados Unidos e do Reino Unido. 2018 foi o quarto ano mais quente da história, desde o início das medições, em 1880, perdendo apenas para 2016, 2015 e 2017. Segundo estudos científicos reportados nos relatórios do Painel Intergovernamental de Mudanças climáticas IPCC (2012, 2013, 2014, 2018) e Magrin *et al* (2014), o aquecimento global se deve, ao menos parcialmente, às emissões de gás carbônico e outros gases do efeito estufa na atmosfera. Estas concentrações subiram para um novo recorde de 406,7 partes por milhão (ppm) em 2018, de 404,1 em 2017, alimentadas em grande parte pela queima humana de combustíveis fósseis e pelas queimadas da biomassa consequência do desmatamento.

Com a criação do IPCC em 1988, a ciência climática progrediu geometricamente e confirmou a hipótese de que as alterações climáticas estão de fato acontecendo com forte influência de ações antrópicas. As mudanças climáticas provocadas pela ação humana são a causa mais provável das inundações e secas severas, aquecimento anormal dos oceanos e ondas de calor extremas observadas em várias partes do mundo. Ainda que o aquecimento global seja um processo natural, uma intensificação do aquecimento observada nos últimos 50 anos tenha uma contribuição significativa das atividades humanas. Porém, é interessante de considerar que o aquecimento global é um processo natural, e que já existiram no passado períodos com aquecimento intenso e elevação na concentração de dióxido de carbono, devido a processos naturais exclusivamente e sem intervenção humana. Porém, nas décadas recentes as atividades humanas têm contribuído significativamente para intensificar este processo natural de aquecimento.

O relatório do IPCC (2018) também indica que, para limitarmos o aumento de temperatura a 1,5°C, deveríamos reduzir as emissões globais em 45% até 2030 em relação a 2010. Aponta, ainda, a importância de se limitar o aquecimento global

CAPÍTULO 13

SPATIAL DISTRIBUTION OF THE *LUTZOMYIA (NYSSOMYIA) WHITMANI* (DIPTERA: PSYCHODIDADE: PHLEBOTOMINAE) AND AMERICAN CUTANEOUS LEISHMANIASIS (ACL), IN VIEW OF ENVIRONMENTAL CHANGES IN THE STATES OF THE LEGAL AMAZON, BRAZIL

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ABSTRACT: Legal Amazon is an especially interesting region, due to the accelerated process of occupation and consequent deforestation it has undergone in the last decades. Furthermore, the region possesses a biologic diversity of the potential vectors, parasites and reservoirs. In these areas, *L. whitmani* is the main vector of ACL, can transmit *L. (V.) braziliensis, L. (V.) shawi* and *L. (V.) guyanensis*. This study aims to analyze the spatial distribution of *L. whitmani* and the dynamics of expansion and settlement of ACL in association with deforestation in the states of the Legal Amazon region, between 2003 and 2013. These data were compiled in a Geographic Information System (GIS), using the software ArcGis. From 2003 to 2013, 175,728 cases of ACL. The disease occurred with more frequency on male individuals. The *L. whitmani* was found in 216 municipalities out of the 775 of the Legal Amazon region. The analysis showed the areas where cases of ACL with the presence of the vector were concentrated, and where they coincided with deforested areas. This was the case in the states of PA, MT, RO, AC and MA. The years of 2002/2003 and 2003/2004 carried the largest number of recorded cases of ACL. The variation in the number of cases of ACL in association with the presence of *L. whitmani* is constant. However, this research showed that the growth in this number of cases is more drastic in areas with environmental changes due to deforestation. These results can contribute to the planning of vigilance and control initiatives, and can serve as a subsidy to define priorities and carry out decision-making processes in the states and municipalities analyzed.

KEYWORDS: Environmental change, Deforestation, *Lutzomyia whitmani*, American cutaneous leishmaniasis

RESUMO: A Amazônia Legal é uma região especialmente interessante, devido ao acelerado processo de ocupação e consequente desmatamento sofrido nas últimas décadas. Além disso, a região possui uma diversidade biológica dos potenciais vetores, parasitas e reservatórios. Nessas áreas, *L. whitmani* é o principal vetor de LCA, podendo transmitir *L. (V.)*

Eco-Epidemiology of American Visceral Leishmaniasis with Particular Reference to Brazil

Elizabeth F. Rangel, Ralph Lainson, Margarete M. S. Afonso, and Jeffrey J. Shaw

Early History: Studies in the States of Sergipe, Pará and Ceará

After the first description of the sand fly *Lutzomyia longipalpis* Lutz and Neiva, 1912, in an indeterminate locality in Brazil, interest in this insect remained largely entomological until the mid-1930s. In 1934, however, Henrique Penna used the viscerotome to examine liver samples from persons who were suspected to have died from yellow fever in various rural localities in Brazil (Penna, 1934). In fact, 41 of these deaths were due to visceral leishmaniasis. His results suggested the major foci of the disease to be in the northeastern states, particularly in Ceará. Carlos Chagas, at that time the director of the Instituto Oswaldo Cruz in Rio de Janeiro, sent his son, Evandro Chagas, to investigate the epidemiology. His first study was made in Sergipe where, in addition to giving the first clinical description of a living case of American visceral leishmaniasis (AVL) in Brazil, he made the important observation that the most frequent blood-sucking insect in and around the patient's house was the phlebotomine sand fly *Lu. longipalpis* (Chagas 1936).

Evandro Chagas was appointed head of a commission set up in 1936 to continue his studies, and in view of the higher prevalence of AVL in the Northeast, it was there that he wished to work. Perversely, the only state governor who offered the

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Changes in Climate and Land Use Over the Amazon Region: Current and Future Variability and Trends

Jose A. Marengo[1], Carlos A. Souza Jr.[2], Kirsten Thonicke[3], Chantelle Burton[4], Kate Halladay[4], Richard A. Betts[5], Lincoln M. Alves[4,6] and Wagner R. Soares[7]

[1] CEMADEN-National Center for Monitoring and Early Warning of Natural Disasters, São José dos Campos, Brazil, [2] IMAZON-Amazonia Man and Environment Institute, Belém, Brazil, [3] Potsdam Institute for Climate Impact Research, Potsdam, Germany, [4] Met Office Hadley Centre, Exeter, United Kingdom, [5] CCST/INPE, Earth System Science Center, National Institute for Space Research, São José dos Campos, Brazil, [6] College of Life and Environmental Sciences, University of Exeter, United Kingdom, [7] Environmental Engineering Department, Institute of Climate Studies, UFES-Federal University of Espírito Santo, Vitória, Brazil

This paper shows recent progress in our understanding of climate variability and trends in the Amazon region, and how these interact with land use change. The review includes an overview of up-to-date information on climate and hydrological variability, and on warming trends in Amazonia, which reached 0.6–0.7°C over the last 40 years, with 2016 as the warmest year since at least 1950 (0.9°C + 0.3°C). We focus on local and remote drivers of climate variability and change. We review the impacts of these drivers on the length of dry season, the role of the forest in climate and carbon cycles, the resilience of the forest, the risk of fires and biomass burning, and the potential "die back" of the Amazon forests if surpassing a "tipping point". The role of the Amazon in moisture recycling and transport is also investigated, and a review of model development for climate change projections in the region is included. In sum, future sustainability of the Amazonian forests and its many services requires management strategies that consider the likelihood of multi-year droughts superimposed on a continued warming trend. Science has assembled enough knowledge to underline the global and regional importance of an intact Amazon region that can support policymaking and to keep this sensitive ecosystem functioning. This major challenge requires substantial resources and strategic cross-national planning, and a unique blend of expertise and capacities established in Amazon countries and from international collaboration. This also highlights the role of deforestation control in support of policy for mitigation options as established in the Paris Agreement of 2015.

Keywords: Amazonia, El Niño, climate variability, deforestation, tipping point, moisture transport, rainfall, climate modelling

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INTRODUCTION

In this paper we review some aspects of climate variability and change in the Amazon region in light of new developments. We focus on climate drivers of variability and change, including natural climate variability and land-use changes, their impacts on the length of dry season, the role of the forest on climate and carbon cycles, the resilience of the forest, and the risk of fires. In

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Stormwater volume reduction and water quality improvement by bioretention: Potentials and challenges for water security in a subtropical catchment

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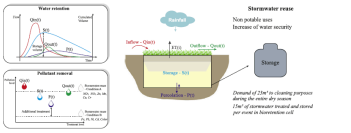
HIGHLIGHTS

- Bioretention presents a good runoff reduction capacity (mean efficiency of 70%).
- The results suggest that groundwater replenishment occurs mainly after the event.
- Stormwater reuse directly from the bioretention can be compromised by its quality.

GRAPHICAL ABSTRACT



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ABSTRACT

Climate change scenarios tend to intensify extreme rainfall events and drought in Brazil threatening urban water security. Low Impact Development (LID) practices are decentralized alternatives for flood mitigation and prevention. Recently, their potential has increasingly been studied in terms of stormwater harvesting. However, there is still a lack of knowledge about their potentialities in subtropical climate regions. Therefore, this study evaluated the behavior of a bioretention cell in a Brazilian city, during the dry period, which is critical in terms of pollutant accumulation and water availability. In addition to the runoff reduction and pollutant removal efficiency, this paper analyzed the potential for water reuse in terms of the stored volume and water quality guidelines. The results obtained show an average runoff retention efficiency of 70%. Considering only the water availability aspects, the potential stored runoff could be reused for non-potable purposes, reducing the water demand in the catchment by at least half during the dry season. On the other hand, the bioretention presented two different conditions for pollutant removal: Condition A – the concentration values are within the recommended limits for water reuse. The parameters found in this condition were NO_3, NO_2, Zn, Mn, Cu, Cr; Condition B – the pollutant concentrations are above the guideline limits for water reuse and cannot be directly used for different purposes. The parameters found in this condition were Fe, Pb, Ni, Cd and color. Considering water reuse, an additional treatment is required for parameters in this second condition. Further studies should evaluate the design aspects that can allow collection of LIDs effluent, additional treatment if necessary, and reuse in the catchment.

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Geoscientific Model Development
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The Brazilian Earth System Model ocean–atmosphere (BESM-OA) version 2.5: evaluation of its CMIP5 historical simulation

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Abstract. The performance of the coupled ocean–atmosphere component of the Brazilian Earth System Model version 2.5 (BESM-OA2.5) was evaluated in simulating the historical period 1850–2005. After a climate model validation procedure in which the main atmospheric and oceanic variabilities were evaluated against observed and reanalysis datasets, the evaluation specifically focused on the mean climate state and the most important large-scale climate variability patterns simulated in the historical run, which was forced by the observed greenhouse gas concentration. The most significant upgrades in the model's components are also briefly presented here. BESM-OA2.5 could reproduce the most important large-scale variabilities, particularly over the Atlantic Ocean (e.g., the North Atlantic Oscillation, the Atlantic Meridional Mode, and the Atlantic Meridional Overturning Circulation), and the extratropical modes that occur in both hemispheres. The model's ability to simulate such large-scale variabilities supports its usefulness for seasonal climate prediction and in climate change studies.

1 Introduction

Climate models, which have recently been expanded into Earth system models via inclusion of biogeochemical cycles, are key tools for investigating climate phenomena that significantly influence human societies (e.g., von Storch, 2010; Flato, 2011). Since 2008, the Brazilian climate community has been engaged in setting up the Brazilian Earth System Model (BESM; Nobre et al., 2013; Giarolla et al., 2015). This major scientific task has been carried out by Brazilian scientific institutions and highlights the critical need to produce reliable future climate projections and to understand their potential impact, particularly over South America. The primary objective of this effort was to assemble the scientific expertise capable of developing and maintaining a state-of-the-art Earth system model. Such an achievement would represent a significant step forward in establishing a scientific tool that can be used in different types of research activities. The importance of such an undertaking lies in the need to understand the physics of the Earth system to produce and lend credibility to studies that explore the impacts of climate change on different areas of great importance, such as food and water security, tropical ecosystems, and natural disasters. One of the fundamental aims of the BESM project is to participate in the Coupled Model Intercomparison Project's sixth phase (CMIP6; Maehl et al., 2014).

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The role of nature-based solutions in disaster risk reduction: The decision maker's perspectives on urban resilience in São Paulo state

Andrea Ferraz Young[a,*], José Antonio Marengo[a], Juliano Oliveira Martins Coelho[a], Graziela Balda Scofield[a], Camila Cristina de Oliveira Silva[b], Carla Correa Prieto[a]

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ABSTRACT

This paper presents the co-learning process outcomes based on Ecosystem-based Adaptation (EbA) and Nature-based Solutions (NbS) for Disaster Risk Reduction (DRR). EbA principles are directly associated with resilience improvement that depends on NbS for change of patterns and actions. Basically, we expected to explore how urban systems can be improved avoiding environmental degradation (i.e. waste ecosystem services and their benefits). Therefore, distinct scenarios were proposed with specific objectives: (1) identification of barriers and challenges; (2) identification of opportunities for NbS implementation. Throughout a workshop, we had chance to discuss knowledge gaps and potential emerging research such as: (1) synergies between DRR and EbA; (2) a long-term perspective of ecosystem management; (3) dynamic of DRR and the natural processes involved considering the complexity of NbS. We conclude that existing measures are limited in their ecological focus regarding to DRR and benefits they address. For this reason, a more comprehensive approach to support NbS and its systematic mainstreaming is required.

1. Introduction

This paper presents the results from co-learning process based on Ecosystem-based Adaptation (EbA) and Nature-based Solutions (NbS) for Disaster Risk Reduction (DRR). We applied knowledge maps as one of the main tools to identify current practices in São Paulo state. In addition, we explore some techniques of representation and suggest a roadmap with some directions to build a proposal of development based on nature that we called Nature-based Development (NbD).

We discussed the operationalization of DRR by improving knowledge on how ecosystem-based approaches can be considered in decision making process through the Workshop Mobilization for Organization and Feasibility of Resilient Urban Spaces (MOVER), held on August 21–24, 2018, organized by Brazilian National Center of Monitoring and Early Warning of Natural Disasters (Cemaden) and the municipality of São Jose dos Campos, in Sao Paulo, Brazil.

We focused on the necessity of an integrated program of actions in urban areas based on the potential linkages between DRR and NbS. The aim was to encourage a discussion on urban resilience to address contemporary disaster risk management. We emphasized not only aspects on how to achieve the DRR but also how to incorporate the ecosystems services in decision making.

It is recognized that over the last decade, hydrometeorological extremes have become more frequent and intense in Brazil [1,2], with records of significant socioeconomic impacts and losses of human lives in Brazil [3], leading to the need of strengthening of disaster risk management at local levels.

In 2010, the number of people affected by natural disasters in Brazil was about 96 million in contrast to recently period, when approximately 123 million were affected by direct or indirect damages. During the last decade, more than half a million people have been made homeless by landslides and floods mainly. An expressive part of affected people is in the Southeast region, which accounts approximately 66% of the total disasters occurred in the country [3]. In terms of cost, events such as landslide in Rio de Janeiro (e.g. mountain range in 2011) totaled approximately US $ 2 billion with at least 780 million for rebuilding [4].

Concerning this critical situation around the world, highlighting developing countries, the Sendai Framework for Disaster Risk Reduction (SFDRR) emphasized the urgency of national plans implementation to effectively protect the population [5].

The importance of improved understanding on DRR in all its

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Parasites & Vectors

RESEARCH Open Access

Environmental suitability for *Lutzomyia (Nyssomyia) whitmani* (Diptera: Psychodidae: Phlebotominae) and the occurrence of American cutaneous leishmaniasis in Brazil

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Abstract

Background: Leishmaniasis represents an important public health problem in Brazil. The continuous process of urbanization and expansion of human activities in forest areas impacts natural habitats, modifying the ecology of some species of *Leishmania*, as well as its vectors and reservoirs and, consequently, changes the epidemiological pattern that contributes to the expansion of American cutaneous leishmaniasis in Brazil. Here, we discuss *Lutzomyia (Nyssomyia) whitmani*, the main vector of ACL, transmitting two dermotropic *Leishmania* species including *Leishmania (Viannia) braziliensis* and *Leishmania (V.) shawi*.

Methods: We used the maximum entropy niche modelling approach (MaxEnt) to evaluate the environmental suitability of *L. (N.) whitmani* and the transmission of ACL in Brazil, in addition to designing models for a future scenario of climate change. MaxEnt was used under the "auto-features" mode and the default settings, with 100-fold repetition (bootstrap). The logistic output was used with higher values in the habitat suitability map, representing more favourable conditions for the occurrence of *L. (N.) whitmani* and human cases of ACL.

Results: Two models were developed: the *Lutzomyia (N.) whitmani* model (LWM) and the American cutaneous leishmaniasis model (ACLM). LWM identified the species "preferential habitat" included regions with moderate annual precipitation (AP) between 1000–1600 mm, intermediate vegetation density (NDVI) values, mean temperature of the coldest quarter (MTCQ), between 15–21 °C, and annual mean temperature (AMT), between 19–24 °C. ACLM indicates that ACL is strongly associated with areas of intermediate density vegetation, areas with AP between 800–1200 mm, MTCQ above 16 °C and AMT below 23 °C.

Conclusions: The models generated for *L. (N.) whitmani* and ACL indicated a satisfactory predictive capacity. Future projections of LWM indicate an expansion of climatic suitability for *L. (N.) whitmani* for the northern and southern regions of Brazil. Future projections of ACL indicate the ongoing process of disease expansion in the face of the predicted climatic changes and reinforce the broad geographical expanse of this disease in Brazil. The models were able to identify that a continuous process of environmental degradation favours the establishment of *L. (N.) whitmani* and the occurrence of ACL by a strong association of the vector(s) and ACL to areas of intermediate vegetation cover density.

Keywords: Climate change, Ecological niche modelling, *Lutzomyia (N.) whitmani*, Cutaneous leishmaniasis

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PERSPECTIVE

PNAS PNAS PNAS

Limiting the high impacts of Amazon forest dieback with no-regrets science and policy action

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Large uncertainties still dominate the hypothesis of an abrupt large-scale shift of the Amazon forest caused by climate change [Amazonian forest dieback (AFD)] even though observational evidence shows the forest and regional climate changing. Here, we assess whether mitigation or adaptation action should be taken now, later, or not at all in light of such uncertainties. No action/later action would result in major social impacts that may influence migration to large Amazonian cities through a causal chain of climate change and forest degradation leading to lower river-water levels that affect transportation, food security, and health. Net-present value socioeconomic damage over a 30-year period after AFD is estimated between US dollar (USD) $957 billion ($\times 10^9$) and $3,589 billion (compared with Gross Brazilian Amazon Product of USD $150 billion per year), arising primarily from changes in the provision of ecosystem services. Costs of acting now would be one to two orders of magnitude lower than economic damages. However, while AFD mitigation alternatives—e.g., curbing deforestation—are attainable (USD $64 billion), their efficacy in achieving a forest resilience that prevents AFD is uncertain. Concurrently, a proposed set of 20 adaptation measures is also attainable (USD $122 billion) and could bring benefits even if AFD never occurs. An interdisciplinary research agenda to fill lingering knowledge gaps and constrain the risk of AFD should focus on developing sound experimental and modeling evidence regarding its likelihood, integrated with socioeconomic assessments to anticipate its impacts and evaluate the feasibility and efficacy of mitigation/adaptation options.

ecosystem services | agriculture | hydroelectricity generation | migration | adaptation

The Amazon forest dieback hypothesis (1–3) attracted attention not only in the scientific literature but also in the public media. This is because it projects a basin-wide climate-driven transition of the region's rainforests toward a drought-prone vegetation with lower biomass, a rain-green forest, savannah, or even degraded vegetation without present-day analogs. Although a few arguments support the notion that such an Amazon dieback may be improbable (4), it is premature to rule it out. While the impacts that such a large-scale forest loss would have on the carbon and water cycles and the global climate system are relatively well-studied (1–3, 5, 6), the socioeconomic impacts that could result from Amazonian forest dieback still remain superficially assessed (but see ref. 7). Nor has the matter been approached from a formal risk-analysis perspective (8), in which both the likelihood of an event as well as the potential impacts that it can cause are addressed (*SI Appendix*, Fig. S1). As such, we still lack a scientific debate that can support policy

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Author contributions: D.M.L. and P.P. designed research; D.M.L., P.P., C.A.Q., and B.B.N.S. performed research; D.M.L. and B.B.N.S. analyzed data; and D.M.L., P.P., C.A.Q., B.B.N.S., A.R., B.K., F.B., J.P.H.B.O., A.P., J.A.M., W.V., and C.A.N. wrote the paper.

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Communication

Tools for Communicating Agricultural Drought over the Brazilian Semiarid Using the Soil Moisture Index

Marcelo Zeri [1,*], Regina Célia S. Alvalá [1], Rogério Carneiro [1], Gisleine Cunha-Zeri [2], José Maria Costa [1], Luciana Rossato Spatafora [3], Domingos Urbano [1], Mercè Vall-Llossera [3] and José Marengo [1]

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Abstract: Soil moisture over the Brazilian semiarid region is presented in different visualizations that highlight spatial, temporal and short-term agricultural risk. The analysis used the Soil Moisture Index (SMI), which is based on a normalization of soil moisture by field capacity and wilting point. The index was used to characterize the actual soil moisture conditions into categories from severe drought to very wet. In addition, the temporal evolution of SMI was implemented to visualize recent trends in short-term drought and response to rainfall events at daily time steps, as new data are available. Finally, a visualization of drought risk was developed by considering a critical value of SMI (assumed as 0.4), below which water stress is expected to be triggered in plants. A novel index based on continuous exposure to critical SMI was developed to help bring awareness of real time risk of water stress over the region: the Index of Stress in Agriculture (ISA). The index was tested during a drought over the region and successfully identified locations under water stress for periods of three days or more. The monitoring tools presented here help to describe the real time conditions of drought over the region using daily observations. The information from those tools support decisions on agricultural management such as planting dates, triggering of irrigation, or harvesting.

Keywords: soil moisture; soil moisture index; drought; semiarid; relative extractable water; available water fraction

1. Introduction

Soil moisture (SM) plays an important role in the water, carbon and energy cycles. The amount of moisture in soil is an important variable to understand the coupling of the surface and the atmosphere. Assimilation of soil moisture into land surface models has resulted in increased understanding of processes controlling the energy exchange at the land–atmosphere interface. The spatial distribution and temporal evolution of SM is of central importance to different societal sectors and activities, such as weather forecasting, management of water reservoirs, food security, watershed management, development of climate models, drought monitoring, land slide prediction, flood forecasting and others [1–9]. Of particular importance is the use of SM to monitor drought conditions over forest and agricultural sites, either using soil moisture only or in combination with other parameters, such as

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Contrasting North–South changes in Amazon wet-day and dry-day frequency and related atmospheric features (1981–2017)

Jhan Carlo Espinoza[1] · Josyane Ronchail[2] · José Antonio Marengo[3] · Hans Segura[4]

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Abstract
This study provides an updated analysis of the evolution of seasonal rainfall intensity in the Amazon basin, considering the 1981–2017 period and based on HOP (interpolated HYBAM observed precipitation) and CHIRPS (The Climate Hazards Group Infrared Precipitation with Stations) rainfall data sets. Dry and wet day frequencies as well as extreme percentiles are used in this analysis, producing the same results. Dry-day frequency (DDF) significantly increases in the Southern Amazon ($p < 0.01$), particularly during September–November (SON) in the Bolivian Amazon, central Peruvian Amazon and far southern Brazilian Amazon. Consistently, total rainfall in the southern Amazon during SON also shows a significant diminution ($p < 0.05$), estimated at 18%. The increase in SON DDF in the southern Amazon is related to a warming of the northern tropical Atlantic Ocean and a weakening of water vapour flux from the tropical Atlantic Ocean. The increase in DDF in the southern Amazon is related to enhanced wind subsidence (ascendance) over the 10°S–20°S (5°S–5°N) region and to a deficit (excess) of specific humidity at 1000–300 hPa south of 10°S (north of the 5°S), which suggest a reduction of deep convection over southern Amazonia. Subsidence over the southern Amazon shows a significant trend ($p < 0.01$), which can explain the significant increase in DDF. Wet-day frequency (WDF) significantly increases in the northern Amazon, particularly during the March–May (MAM) period ($p < 0.01$), producing an estimated rainfall increase during MAM of 17% ($p < 0.01$) between 1981 and 2017. Significant changes in both WDF and rainfall in northern Amazon have been detected in 1998 ($p < 0.01$). After 1998, the increase in MAM WDF and rainfall is explained by enhanced moisture flux from the tropical North Atlantic Ocean and an increase in deep convection over the northern and northwestern Amazon. These evolutions in DDF and WDF and in the tropical atmosphere occur simultaneously with an increase in sea surface temperature in the northern Atlantic Ocean, particularly after the mid-1990s. These results provide new insight into rainfall variability and climatic features related to increasing dry season length in southern Amazonia. Severe recent droughts may be associated with the increase in DDF in the South. In addition, the increase in MAM rainfall intensity in northern Amazon after 1998 may be associated with several historical floods that occurred after this date.

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1 Introduction

The Amazon basin is considered one of the rainiest regions of the world and hosts the largest tropical forest of the planet (Salati and Vose 1984; Davidson et al. 2012 and references quoted therein). The last two decades have featured some "once-in-a-century" extreme climate events, which are summarized in Table 1 (based on Marengo and Espinoza 2016, updated to 2017).

Interannual rainfall variability in the Amazon basin, including extreme rainfall events, has been attributed to variations in sea surface temperatures (SST) in both the tropical Pacific and Atlantic oceans (e.g. Marengo 1992; Ronchail et al. 2002; Yoon and Zeng 2010; Marengo and Espinoza 2016; Builes-Jaramillo et al. 2017; Aragão et al.

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- Introduction -

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Drought monitoring and impacts assessment in Brazil: The CEMADEN experience

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First author: Ana Paula Martins do Amaral Cunha, Researcher of CEMADEN

Brazil has been affected by intense drought events during the recent decades: Northeast Brazil (NEB) in 2010- 2018; Southeastern Brazil in 2014-15; Amazonia in 2005, 2010 and 2016, among the most important. The drought that has been affecting NEB for the past 6 years[1,2,3,4] has led to discussions about demands for improvements in drought policy and resilience to drought, - as well as management at the federal and state levels in the region of the drought - as a socio-economic environmental problem. Although drought is a recurrent phenomenon in NEB, it is perceived that risk and vulnerability are still high, particularly in its semiarid rural areas. There is a need for actions in which the scientific and the decision makers communities can work together on drought issues, focusing on reducing vulnerability.

Drought impacts are crucial for many social and economic activities in Brazil and on demand from the President's Cabinet regularly requested information about its impacts to support and provide guidance for emergency mitigation measures. In Brazil the National Center for Monitoring and Early Warning of Natural Disasters (CEMADEN), a R&D Institution linked to the Minister of Science and Technology, routinely deliver this information at federal level. For instance, since more than 70% of energy supply come from hydroelectric power plants we weekly present scenarios of the reservoir levels of the main basins where the plants are located. We also regularly deliver information about the reservoirs used to water supply. Since the 2014/2015 drought in the Brazil southeast we monitor the biggest reservoirs used in the metropolitan regions of São Paulo and Rio de Janeiro. Drought also impacts South and Midwest of Brazil, which are the main agricultural producing regions, and we develop models to forecast its impacts in the crops production.

Specifically, regarding the impact of agricultural droughts in municipalities in the NEB, CEMADEN provides, on a municipality base, remote-sensing-based drought indices besides other hydrometeorological data that allows the identification of the most critical areas affected by the drought. CEMADEN performs the evaluation of the phenological cycle of the main agricultural crops of the region (maize and beans) using a remote sensing-based index with a spatial resolution of 250 meters. Such initiative aims to meet the requirements established in the Presidential Decree No 8,472 for the Agricultural Yield Guarantee Programme (Garantia Safra Program, GS) of the Ministry of Agricultural Development (MDA). The GS Program aims to guarantee a minimum allowance to sub-sistence agriculture farmers when affected by drought or rainfall in excess.

To perform the drought monitoring and impact assessment, CEMADEN has developed and used drought indicators that combine surface observation-based drought index (Precipitation anomalies, Standardized precipitation index – SPI, Potential evapotranspira-tion and soil moisture) and remote sensing-based index (Vegetation Health Index -VHI, 4 km and Vegetation Supply Water Index - VSWI, 250 m). Recently, CEMADEN also developed the Integrated Drought Index (IIS) which combine the SPI and VSWI anomalies. The SPI is calculated considering the scales of 3, 6 and 12 months, while VSWI anomalies are calculated on the monthly scale. The ISS is calculated on the monthly scale and computed at the municipal level in the entire country (Figure 1).

In support of drought analysis, a network of soil moisture sensors was established from 2014 to 2015 by CEMADEN, in order to monitor soil water in NEB. Soil moisture is currently being monitored at 595 locations, in depths ranging from 10 to 40 cm[5]. This in-formation is used to support the development of tools and numerical models to characterize and quantify the risks associated with drought conditions. Regarding crop yield scenarios, the model AquaCrop[6] has been used for crop yield forecasting in the Brazilian semiarid using a combination of meteorological observations and seasonal climate forecasts as input data[7]. Future developments aim at coupling sub-seasonal forecasts of weather variables to the model and generate scenarios of yields for shorter time scales.

Concluding Remarks

Beyond that, CEMADEN implemented, in 2014, a monitoring network for the upstream basins of the Cantareira reservoirs, the main water supply system of the Metropolitan Region of São Paulo State, Brazil. Due to the continuity of rainfall below the historical aver-age in the Southeast region, CEMADEN has been developing and updating a monitoring and prediction system (Figure 1) for the Cantareira system, and also for Três Marias, Emborcação, Furnas Mascarenhas[8], all reservoirs located in southeastern Brazilian and, more recently, for Serra da Mesa reservoir, a hydroelectric power generation system located in Central Brazil . For the reservoirs lo-cated in the semiarid, CEMADEN has been developing similar monitoring system and simulation of the water balance. The informa-tion is available in bulletins since January 2015 for Cantareira Water Supply System, September 2015 for the NEB and February 2017

Clean Technologies and Environmental Policy
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REVIEW

Case study for hybrid power generation combining hydro- and photovoltaic energy resources in the Brazilian semiarid region

Maria Francisca Azeredo Velloso[1,2] · Fernando Ramos Martins[3] · Enio Bueno Pereira[1]

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Abstract

Hydropower is currently the primary energy resource to service the Brazilian electricity sector. However, the dry seasons in the Brazilian semiarid region have become longer due to climate variability, and they have affected the operation of hydro-power plants during the last decade. Brazil has a growing energy demand, and energy mix diversification is essential to meet the power capacity required to support sustainable development. Investments in photovoltaic power plants are already a robust strategy to foster a new cycle of socioeconomic development based on a low-carbon economy. Hybrid power generation using hydro- and solar energy resources can be an alternative source due to the seasonal complementarity between them in the Brazilian semiarid region. During the dry periods, the photovoltaic power plant can replace hydropower generation. The present study aimed to evaluate the contribution of a solar photovoltaic plant to increase power generation in the Sobradinho hydropower plant operating in the São Francisco River, the most important water resource in the Brazilian semiarid region. The results showed that the PV power plant contributes to saving water for other multiple usages and avoids emissions of greenhouse gases by thermal power plants in long periods of intense drought. According to the simulation results for the 2013–2015 period, the PV plant would add around 8350 GWh to the actual power generated in Sobradinho using an area smaller than 0.5% of its water reservoir surface. In addition, hybrid power generation would avoid emissions around 27.10^6 t CO_2 released into the atmosphere by thermal power plants using fossil fuels during 3 years.

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ESTUDO COMPARATIVO DAS BASES DE DADOS DE IRRADIÂNCIA SOLAR NA SUPERFÍCIE PARA O TERRIRTÓRIO NACIONAL

Bruno Eduardo B.R. Torres[1] Fernando R. Martins[1,2], Francisco José L. de Lima[1,2], Rodrigo S. Costa[2], André R. Gonçalves[2], Enio B. Pereira[2]

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RESUMO

O Brasil, por ser um país localizadona região intertropical, possui grande disponibilidade de energia solar durante todo ano.A disponibilidade de dados sobre o recurso solar na superfície e as incertezas associadas são fatores essenciais para incentivar novos investimentos em sistemas de geração de energia solar. Dessa forma, o presente estudo, buscou identificar pontos fortes e fracos nas diversas bases de dados disponíveis para o território brasileiro. O estudo compara valores de irradiância Global, Direta e Difusa em Brasília(DF), Petrolina(BA) e São Martinho da Serra (RS) fornecidas em 3 bases de dados solares distintas.Aplicou-se metodologias estatísticasconsolidadas na literatura para avaliar a confiabilidade das bases de dados comparando-as com dados observados em estações automáticas da rede SONDA.Os resultados mostraram diferenças significativas entre as bases de dados de irradiância nos locais de estudo.

Palavras-chave *—– Irradiância solar na superfície, Base de dados, Energia solar, Sensoriamento remoto.*

ABSTRACT

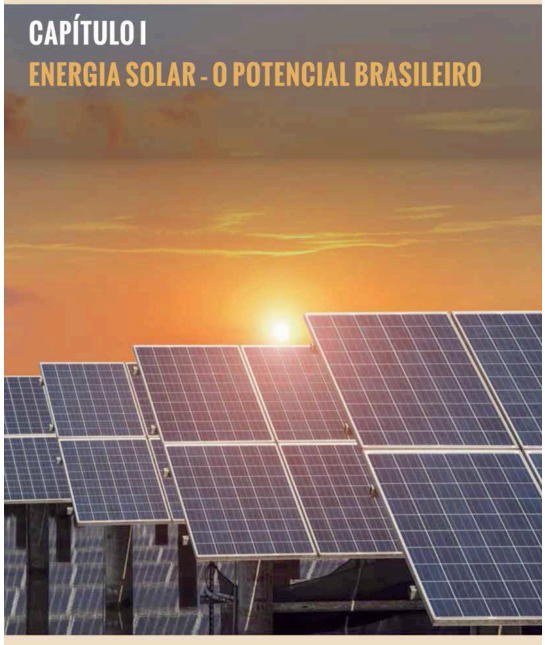
Brazil has great solar potential throughout the year due to its location in the intertropical region. The assessment of solar energy resource on the surface and the associated uncertainties are essential factors to boost new investments in solar power systems.Thus, the present study aimed at identifing strengths and weaknesses in the several databases available for the Brazil. The study compared the solar irradiance values – Global, Beam and Diffuse – provided by 3 solar databases for the location of 3 SONDA measurement sites: Brasília (DF), Petrolina (BA) and São Martinho da Serra (RS). Several statistical indexes were calculated based on the scientific literature to evaluate and compare the reliability of the databases. The results showed significant differences between solar irradiance data available in each database and the field observations in all 3 locations

Key words *— Solar irradiance, database, Remote sensing, Solar energy.*

1. INTRODUÇÃO

O Brasildestaca-se por possuir uma matriz energética bastante renovável. A geração de eletricidade sustenta-se principalmente nas fontes hidráulicas. Esta, por sua vez, mesmo sendo considerada renovável e limpa, baseia-se em grandes empreendimentos, os quais implicam em inúmeros problemas socioambientais. A energia nuclear, devido aos riscos associados a utilização e ao descarte de dejetos radioativos, não se mostra como uma alternativa. A queima de combustíveis fósseis atende a uma grande parte do setor de transporte e responde a 40% da energia usada no setor agropecuário o que contribui para o aumento da emissão de gases do efeito estufa [1]. Analisando as fontes renováveis, observamos que nos últimos anos houve um grande investimento na energia eólica como resultado das políticas governamentais como o PROINFA, implementada em 2002. Porém, apesar do grande potencial eólico no Brasil, verificou-se que grande parte do território nacional, não apresenta um regime de vento adequado para a geração de eletricidade [2]. Em contrapartida, o Brasil, por ser um país localizado na sua maior parte na região intertropical, possui grande potencial solar durante todo ano [3]. A irradiação solar diária no país varia entre 1500 kWh/m^2/ano até aproximadamente 2200 kWh/m^2/ano [4] . A utilização da energia solar pode trazer benefícios em longo prazo para o país, viabilizando o desenvolvimento de regiões remotas onde o custo da eletrificação pela rede convencional é demasiadamente alto com relação retorno financeiro do investimento. Além da importância no planejamento energético atual, a irradiação solar desempenha papel importante em diversas áreas da atividade humana. Dessa forma, o desenvolvimento de um estudo comparativo de bases de dados de irradiância solar na superfície do território brasileiro apresenta notória importância no desenvolvimento de atividades econômicas em diversos setores como agropecuária, construção civil e industrial [3], além das áreas de meteorologia e climatologia. Outro aspecto importante relativo ao avanço em estudos de bases de dados de energia solar está diretamente ligada a segurança energética nacional. Com o intuito de estabelecer medidas efetivas para afastar da sociedade o risco da falta de energia ou para diminuir a instabilidade da falta de acesso às fontes

*Por Enio Bueno Pereira e Fernando Ramos Martins**



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The threat of political bargaining to climate mitigation in Brazil

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In exchange for political support, the Brazilian government is signalling landholders to increase deforestation, putting the country's contribution to the Paris Agreement at risk[1]. The President of Brazil has signed provisionary acts and decrees lowering environmental licensing requirements, suspending the ratification of indigenous lands, reducing the size of protected areas and facilitating land grabbers to obtain the deeds of illegally deforested areas[2]. This could undermine the success of Brazil's CO_2 emission reductions through control of deforestation in the previous decade. Integrated assessment models are tools to assess progress in fulfilling global efforts to curb climate change[3,4]. Using integrated assessment models developed for Brazil, we explore 2 °C-compliant CO_2 emission scenarios estimating the effort needed in other sectors of the economy to compensate for the weakening of environmental governance, potentially resulting in higher deforestation emissions. We found that the risk of reversals of recent trends in deforestation governance could impose a burden on other sectors that would need to deploy not yet mature technologies to compensate for higher emissions from land-use change. The abandonment of deforestation control policies and the political support for predatory agricultural practices make it impossible to meet targets consistent with Brazil's contribution to a 2 °C world.

Brazil is the seventh largest greenhouse gas (GHG) emitter. Between 2005 and 2012, the country's GHG emissions were reduced by 54% (ref. [5]), mostly by cutting deforestation by 78%. However, the country's recent record on land-use policies and practices has not been bright. On the one hand, by the end of 2017 some 65% of Brazil's 5.4 million rural properties have joined the rural environmental registry, a system to monitor compliance with environmental laws, and the country committed to reduce its annual emissions to 1.3 $GtCO_2e$ in 2025, with an indicative of 1.2 $GtCO_2e$ by 2030, in its Nationally Determined Contribution (NDC) as part of the Paris Agreement. On the other hand, since 2012, following relaxation of the Forest Code[6], there has been a reversal in the declining deforestation trend in the Brazilian Amazon, and deforestation has levelled out at high rates in the Cerrado biome, which has already lost more than half of its original vegetation[7]. Since May 2016, Brazil's presidency has deepened this negative reversal by attempting to deconstruct several successful environmental policies[2].

At the core of the current government's coalition is the powerful rural/mining caucus, which holds some 40% of the seats in Congress[8]. To avoid responding to corruption accusations, the President has proposed legislative projects and signed provisionary acts and decrees that have lowered environmental licensing requirements[9], suspended the ratification of indigenous lands[10], reduced the size of protected areas in the Amazon[11], and facilitated land grabbers to obtain the deeds of illegally deforested areas as large as 2,500 ha per farm in the Amazon rainforest[12].

Analysis of the environmental governance in Brazil helps to explain how a political crisis can be a major driver for increasing deforestation and carbon emissions in the country. Deforestation control is the result of efficacy arising from institutional arrangements such as enforcing the rule of law and sending signals that may, directly or indirectly, incentivize economic agents to decide whether or not to illegally deforest. The institutional arrangement can also be affected by the degree of cooperation with the international regime on climate change. By analysing these forces over the last two decades, environmental governance in Brazil can be divided into three major periods (see Supplementary Information): pre-2005, a period with very poor governance and high rates of deforestation; 2005–2011, a period with improvements in environmental governance and effective results in reducing deforestation[13]; and 2012–2017, when governance suffered a gradual erosion with the large amnesty granted to past illegal deforesters in the revision of the Forest Code[6], which led to a reversal of the deforestation reduction trend in the Amazon after 2012 and, later, to an increase in deforestation during 2015–2017.

Based on these past records, we define three environmental governance scenarios—weak, intermediate and strong—as shown in Fig. 1.

Weak environmental governance

The weak environmental governance (WEG) scenario assumes the abandonment of current deforestation control policies, as well as strong political support for predatory agricultural practices. In practice, by 2025 this scenario represents the annulling of governance gains achieved since 2005. This represents the worst-case scenario and should be understood as a complete deconstruction of environmental governance in Brazil, with severe impacts on deforestation rates, which could potentially return to pre-2005 levels. Such a return of deforestation rates to the peak levels of the last decade would lead to annual losses of more than 27,000 and 18,000 km^2 of the Amazon and Cerrado biomes, respectively, by 2025. Cumulative CO_2 emissions from deforestation could escalate to 23.1 $GtCO_2$ from 2010 to 2030.

Intermediate environmental governance

The intermediate environmental governance (IEG) scenario assumes the maintenance of current deforestation control policies, while,

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Georeferenced operating-efficiency solar potential maps with local weather conditions – An application to Brazil

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ABSTRACT

The operating efficiency of photovoltaic solar cells depends on local meteorological conditions, varying significantly throughout large territories. As traditional solar potential maps present only solar resources, the impact of temperature on photovoltaic solar cells efficiency losses emerges as an important issue in the analysis of solar energy potentials. We developed an approach that accounts for temperature when determining solar energy potentials in large territories, using Brazil as a case study given its continental size, amplitude of meteorological conditions and high levels of solar irradiation. Our method is based on simple mathematical models for operating efficiency and temperature, applied to six commercial photovoltaic technologies in real local conditions and for distinct mounting arrangements. Results show that the real efficiency of photovoltaic solar cells can be reduced by up to 15% in the hottest hot-spot place, with much lower efficiency reduction values observed in places with more favorable operating conditions. Results also indicate that monocrystalline and thin film solar technologies are more appropriate for warmer locations. The method here developed can be easily applied to other regions of the globe and also to other commercial technologies.

1. Introduction

The expansion of solar energy production with the deployment of solar photovoltaic technologies demands precise solar potential studies aimed at determining the best locations in the world for installing solar arrays. Traditional solar potential maps consider only solar resources. Since the actual operating efficiency of photovoltaic modules is very sensitive to temperature, this aspect must be incorporated into any analysis of solar energy potentials. Most of the countries with the best solar energy potentials are located in regions with high average temperatures. Because of this fact, the relation between temperature and solar energy efficiency becomes a critical issue for energy planning purposes, mainly related to policy making for electric power infrastructure expansion studies. The real efficiency of the solar photovoltaic technologies becomes a relevant issue for selection of the places where solar energy production can be maximized, as shown in this study. Therefore, this study can be framed as an efficiency potential assessment that presents results for a warm large territory (Brazil) and can be used to propose more advanced studies using the georeferenced methodology developed here. The georeferenced methodology can be applied to real-time and forecasting of solar photovoltaic power generation for both distributed and centralized plants. This approach can also be adapted and expanded for other technologies where real operating conditions depend on meteorological conditions. The georeferenced method can also be useful for other studies when local meteorological data are not available within the same resolution for a large area.

The large availability of a natural resource in a country or region does not mean that its exploration is always high. Meteorological, technological and installation aspects, as well as economic and infrastructure factors can lead to errors on a potential analysis based exclusively in natural resources availability. Loss factors in photovoltaics observed in developed countries, located mostly in the northern hemisphere, may be significantly different from those observed in developing countries with much higher solar radiation availability and distinct meteorological conditions (García and Balenzategui, 2004; Bücher, 1997; Topic et al., 2007; Evans, 1981; Du et al., 2015; Dubey et al., 2015; Skoplaki and Palyvos, 2009, 2008; Chander et al., 2015; Jursa, 2013). This fact reinforces the need of detailed potential studies for each large region. In addition to temperature, other loss factors are significant for the analysis of solar potentials, such as spectrum, reflection, dirt, shading, humidity, installation angle, electrical connections and economic issues (Ndiaye et al., 2013; Sharma and Chandel, 2013; Hohl et al., 2008; Huld, 2010; Huld and Gracia Amillo, 2015), which are not considered in this study. Brazil is an interesting case study to evaluate the appropriateness of using traditional solar potential maps, which normally neglect loss factors. In the Brazilian case,

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ESTUDO COMPARATIVO DAS BASES DE DADOS DE IRRADIÂNCIA SOLAR NA SUPERFÍCIE PARA O TERRIRTÓRIO NACIONAL

Bruno Eduardo B.R. Torres[1] Fernando R. Martins[1,2], Francisco José L. de Lima[1,2], Rodrigo S. Costa[2], André R. Gonçalves[2], Enio B. Pereira[2]

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RESUMO

O Brasil, por ser um país localizadona região intertropical, possui grande disponibilidade de energia solar durante todo ano.A disponibilidade de dados sobre o recurso solar na superfície e as incertezas associadas são fatores essenciais para incentivar novos investimentos em sistemas de geração de energia solar. Dessa forma, o presente estudo, buscou identificar pontos fortes e fracos nas diversas bases de dados disponíveis para o território brasileiro. O estudo compara valores de irradiância Global, Direta e Difusa em Brasília(DF), Petrolina(BA) e São Martinho da Serra (RS) fornecidas em 3 bases de dados solares distintas.Aplicou-se metodologias estatisticasconsolidadas na literatura para avaliar a confiabilidade das bases de dados comparando-as com dados observados em estações automáticas da rede SONDA.Os resultados mostraram diferenças significativas entre as bases de dados de irradiância nos locais de estudo.

Palavras-chave *—– Irradiância solar na superfície, Base de dados, Energia solar, Sensoriamento remoto.*

ABSTRACT

Brazil has great solar potential throughout the year due to its location in the intertropical region. The assessment of solar energy resource on the surface and the associated uncertainties are essential factors to boost new investments in solar power systems.Thus, the present study aimed at identifing strengths and weaknesses in the several databases available for the Brazil. The study compared the solar irradiance values – Global, Beam and Diffuse – provided by 3 solar databases for the location of 3 SONDA measurement sites: Brasília (DF), Petrolina (BA) and São Martinho da Serra (RS). Several statistical indexes were calculated based on the scientific literature to evaluate and compare the reliability of the databases. The results showed significant differences between solar irradiance data available in each database and the field observations in all 3 locations

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COMPARING SOLAR IRRADIANCE DATA FROM MESOSCALE MODELS FOR BRAZILIAN TERRITORY

F. J. L. Lima, R. S. Costa, A. R. Gonçalves, E. B. Pereira, F. R. Martins

Abstract— **The main objective of this study was to evaluate the capacity of two numerical models of mesoscale in simulating the solar radiation conditions in part of the northeastern region of Brazil. For this, a case study was conducted that contemplates the whole year of 2014, in which we compared solar irradiation data collected from sensors installed in meteorological stations, the INMET and the SONDA network, with the values simulated by the BRAMS and WRF Models. The stations are in the states of Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas and part of the states of Maranhão, Piauí, Sergipe and Bahia, are 11 stations managed by INMET and 1 station managed by the SONDA network. The results indicate a high bias of the models, which can be corrected through statistical refinement, despite a high bias the models follow the tendency of the measured data. The BRAMS model had a better performance during the rainy season, while WRF model had a better performance in the dry season.**

Keywords— **Counting of Bacterial Colony, image processing, free software.**

I INTRODUÇÃO

O aproveitamento da energia a partir da radiação solar incidente na superfície da Terra é uma alternativa para complementar a matriz energética brasileira, que nos dias atuais é primariamente baseada em plantas hidroelétricas e termelétricas alimentadas com uso de combustíveis fósseis [1], [2]. A conversão de energia solar em energia elétrica ou térmica possui impactos ambientais reduzidos, quando comparado aos sistemas convencionais de geração, e emissão de poluentes nula durante a operação da planta de geração. Contudo, existem desafios ainda não solucionados, relacionados à variabilidade de oferta e dependência das condições de tempo e clima. Desta forma, no cenário atual, a energia solar, assim como outras fontes renováveis de energia, será gradativamente inserida com o intuito de complementar as atuais fontes com adoção de sistemas híbridos e de geração distribuída. As barreiras tecnológicas de geração [3] para uso da energia solar tendem a ser reduzidas ou até mesmo eliminadas com o tempo, principalmente em resposta à consolidação do mercado em termos globais, ao crescimento da demanda de energia mundial associado ao desenvolvimento socioeconômico de países emergentes, e à evolução tecnológica em armazenamento de energia.

Por ser um país localizado em sua maior parte na região intertropical, o Brasil possui grande potencial de energia solar em todo seu território. Entretanto, para que se possa otimizar o investimento de implantação dos empreendimentos solares e sua exploração eficiente, faz-se necessário o mapeamento das regiões com maior disponibilidade do recurso energético e as incertezas associadas à sua variabilidade, fatores que influenciam o potencial técnico de aproveitamento da energia solar. Mesmo com o potencial solar já reconhecido no território brasileiro [2], [4], [5], dados confiáveis sobre essa variável ainda são escassos no país. [3], [6]–[8], ao investigarem a disponibilidade e a variabilidade da irradiação solar no Brasil, enfrentaram muitas limitações em função da baixa densidade de estações radiométricas (classe 1) [2] no padrão internacional) no território brasileiro.

O conhecimento e previsão do potencial disponível de energia solar tem um papel extremamente importante no apoio ao setor energético, no planejamento de operação do sistema elétrico do País e na operação de plantas de geração solar como as fotovoltaicas (PV) e as heliotérmicas (CSP) [9]–[12]. Atualmente, a comunidade científica dispõe de uma gama de modelos numéricos de alta resolução espacial e temporal, capazes de simular os processos radiativos que ocorrem na atmosfera. As simulações numéricas com uso de modelos de previsão de tempo e clima fornecem informações valiosas para o planejamento e definição de estratégias para suporte ao crescimento da participação das fontes solar na matriz elétrica nacional. No entanto, percebe-se que é necessário conhecer as incertezas associadas aos resultados destes modelos numéricos para subsidiar a tomada de decisões no setor elétrico nacional.

A irradiância solar no Nordeste do Brasil possui algumas características peculiares, como discutido por [8]. Sua distribuição espaço-sazonal mostra que os maiores valores ocorrem durante a primavera austral e os menores valores são verificados no outono (meses de março, abril e maio), período chuvoso em grande parte da região - a exceção do leste do Nordeste, onde os menores valores foram encontrados no inverno.

Neste contexto, o presente trabalho avalia a capacidade de dois modelos numéricos de mesoescala - o BRAMS (*Brazilian Developments on the Regional Atmospheric Modeling System*) e WRF (*Weather Research and Forecasting*) - em simular o comportamento da irradiação solar global incidente na superfície no norte do Nordeste do Brasil (NEB). Os resultados aqui apresentados podem contribuir para aprimorar o conhecimento sobre a variabilidade do recurso solar na área de

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Adding detailed transmission constraints to a long-term integrated assessment model – A case study for Brazil using the TIMES model

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ABSTRACT

Onshore wind and solar-photovoltaic-based electricity are expected to drive most of the global growth in renewable energy sources capacity until 2020. This creates a challenge for properly modelling such intermittent variable resources since: (i) their availability varies spatially and temporally and (ii) thus, their integration in power systems is determined by the configuration of transmission grids. Large energy system models usually adopt simplified approaches for modelling wind and solar photovoltaic (PV) deployment and the power grid. This paper uses the recently developed TIMES-Brazil optimisation model to study the role of transmission bottlenecks in cost-effective long-term deployment of wind and solar power in the Brazilian energy system up to 2050. The model explicitly models the grid infrastructure of 29 regions in Brazil differentiated according to existing power plants, wind and solar availabilities, future RES potentials and power demand. Three different scenarios (Free Trade, Simplified Trade and Detailed Trade), with increasingly more detail in modelling electricity transmission lines, were tested. Findings show that a more detailed transmission infrastructure significantly affects capacity deployments and electricity prices. The grid connecting the North and South of Brazil was found to be the most important bottleneck affecting the deployment of solar in the country.

1. Introduction

The contribution of onshore wind- and solar-photovoltaic (PV)-based electricity are expected to drive most of the global growth in renewable energy sources (RES) capacity until 2020 [1]. This increase in wind and PV electricity is motivated not only by their cost reductions, but also by policies aiming to foster energy security, to reduce greenhouse gas (GHG) emissions and to improve air quality [2].

However, the generation potential and integration possibilities for variable intermittent RES as wind and solar depend on geographic characteristics [3–7]. Moreover, large-scale deployment of wind and solar is frequently constrained by the existing transmission and distribution grid infrastructure [5,8]. Consequently, modelling expansion pathways of such RES energy technologies can be made more accurate by considering spatial and temporal variability of the resources across the modelled energy system, as well as the existing electricity grid bottlenecks [9–12]. Challenges due to their integration are also dependent on existing power plants and their locations [13]. In Brazil, although the current hydro capacity is scattered along the country, the remaining expansion potential is predominantly located in the north of the country in an environmentally-sensitive area. The load demand in turn is mostly located in the southern part of the country. In 2017, around 70% of the Brazilian installed capacity was made up by hydropower, 7% by wind turbines and the remaining by thermal units, while solar projects were still incipient [14].

Global or national energy system models as TIMES [15], MESSAGE [16,17] or PRIMES [18] integrate the several components of the system from resource extraction, to conversion into energy carriers and to end-use consumption. Due to difficulties in obtaining the necessary data and the increased computational complexity, such models often have a simplified temporal (e.g. an average year is divided in a low number of representative time-slices) and geographical resolution (e.g. countries are represented as one aggregated region) [8,18–21]. Subsequently, electricity transmission processes are frequently modelled as only one node per country and wind and solar variability is assumed to be

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Research paper

Techno-economic and georeferenced analysis of forestry residues-based Fischer-Tropsch diesel with carbon capture in Brazil

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ABSTRACT

This study aims to identify the potential for the deployment of diesel biofuel production based on forestry residues conversion through Fischer-Tropsch synthesis in Brazil. It develops a technical and economic analysis to estimate in what extension (georeferenced analysis) and at what costs (process analysis) can this biomass-based diesel contribute to the Brazilian diesel supply, and to the reduction of greenhouse gas emissions. Findings indicate the annual techno-economic potential of 80.3 PJ (considering the use of eucalyptus and pine residues), mostly concentrated in the South, Midwest and Southeast regions of the country. Overall, 21 production hotspots were identified, allowing the deployment of 27 facilities across the country. A clear advantage of this fuel production route is the fact that the carbon capture and storage can be intrinsic to the process, leading to negative CO_2 emissions of the fuel production chain. Total mitigation potential is nearly 25 $MtCO_2$ yearly. Furthermore, while still not cost-competitive without ambitious climate and energy policies in place, the forestry residue-based diesel can contribute to the reduction of the country's dependency on imports, resulting in positive impacts on the Brazilian trade balance.

1. Introduction

The stabilization of greenhouse gases concentrations in the atmosphere requires severe transformations of the energy system [1]. Hence, it is of utmost importance the development of advanced biofuels. The thermochemical conversion of biomass into liquid biofuels through the Fischer-Tropsch (FT) synthesis stands as a promising option for the production of biofuels in such a scale capable of attending the ever-growing demand for energy [2]. Furthermore, it is expected that the production of biofuels associated with carbon capture and storage play a significant role in the reduction of carbon intensity related to liquid fuels [3–5].

The Brazilian final energy use in the transportation sector has been historically dominated by the oil industry (mainly diesel oil). However, even though diesel supply has grown, it did not keep up with the demand growth rhythm. This resulted in a market more dependent on diesel oil imports, generating negative impacts over the country's trade balance [6]. Additionally, the more stringent specifications for diesel oil in Brazil (mostly in Sulphur content) requires the expansion of severe hydrotreatment or hydrocracking capacity, which implies in yield losses in Brazilian refineries [7].

Therefore, the production of biofuels through thermochemical conversion is particularly interesting. This route produces high quality diesel: high cetane number, Sulphur free, and insignificant content of nitrogen, nickel, vanadium, asphaltenes, and aromatics [2]. Furthermore, the biomass-based FT diesel fuel produced is highly compatible with the ongoing diesel cycle engines and overall infrastructure [8]. Due to its renewable source and the singular possibility of integration with carbon capture and storage without significant additional costs [9], biomass-based FT diesel fuel stands as an opportunity for dealing with the increasing carbon intensity trend observed in the Brazilian energy system [10–13].

Throughout the literature, there are papers focused on the process simulation analysis of diverse thermochemical technological routes for the production of biofuels [2,14,15], including the Fischer-Tropsch synthesis route to produce distillates from biomass (none of which developing a detailed evaluation of the liquid products upgrading process) [9,16–18]. Van Vliet et al. [9] evaluates the production of FT diesel from a well-to-wheel perspective, estimating carbon and energy flows, and costs. NREL [18] conducts a techno-economic analysis of biofuels conversion technologies, testing two different types of gasifiers: entrained-flow and fluidized bed. Meerman et al. [16] and Meerman et al. [17] investigate the technical and economic performance of integrated gasification polygeneration facilities equipped with

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Placing hubs in CO_2 pipelines: An application to industrial CO_2 emissions in the Iberian Peninsula

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HIGHLIGHTS

- Carbon capture and storage from industrial sources has great potential to mitigate GHG emissions.
- CO_2 hubs is a strategy to optimize a carbon transportation network.
- Kernel density analysis can be used to identify areas of high CO_2 emission density.
- The Kernel analysis can be used to help to locate hubs in a pipeline network.
- The methodology was applied to the Iberian Peninsula industrial emission sources.

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ABSTRACT

Carbon capture and geological storage (CCS) is a key technology for the World deep decarbonization. However, several challenges remain, such as the optimization of the carbon transportation infrastructures. This study proposes a methodology that applies the Kernel Density function in a geographic information system software and uses as input, CO_2 emission sources data to identify emission clusters and emission high-density hotspots. The main goal of the proposed methodology is to perform a preliminary screening to identify areas of interest to install hubs when designing an optimized CO_2 pipeline network. The methodology includes an estimation of capturable CO_2 emissions and a density analysis that was based on Kernel Density function from the ArcGIS Desktop 10. The methodology was applied to the Iberian Peninsula CO_2 industrial emission sources such as refineries, coal and natural gas power plants and cement factories (case study) and the results showed that in Portugal, CO_2 industrial emissions reduction can reach up to 68% and, in Spain, up to 74% of CO_2 industrial emissions, could be avoided. These are called capturable CO_2 emissions which means that they are the portion of the total emissions that can be captured from industrial processes before they reach the atmosphere. Moreover, hubs were shown to be more viable when Portugal and Spain are considered together, therefore, carbon routes (pipeline network) in the future may consider an integrated route for the Iberian Peninsula.

1. Introduction

Carbon capture and geological storage (CCS) is an option for mitigating carbon dioxide (CO_2) emissions from fuel combustion and other chemical reactions in industrial processes, preventing the CO_2 from entering the atmosphere. The CCS chain consists of three parts: (i) capturing CO_2, (ii) transporting it, (iii) and securely storing these emissions, usually underground in geological formations [1,2], but also as a chemical product [3].

CCS is recognized worldwide as a technology capable of reducing

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Modeling and Analysis

Biofpr Biofuels Bioproducts & Biorefining

Pathways for a Brazilian biobased economy: towards optimal utilization of biomass

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Abstract: Biomass is responsible for 25% of the primary energy supply in Brazil. However, future biomass demand will be influenced by many factors. This study evaluates potential pathways for the utilization of biomass in Brazil until 2050, while considering novel biobased sectors (renewable jet fuel and biochemicals), resource competition, and greenhouse gas (GHG) emissions. Whereas other least-cost optimization models assess biobased options to meet energy and chemicals demand in Brazil to a limited extent, this study provides a detailed breakdown of biomass feedstock, including an extensive portfolio of biomass conversion technologies. A least-cost optimization model is used to assess the demand for energy and chemicals, and the competition between biomass and other climate-mitigation measures such as renewable power generation technologies, carbon capture and storage (CCS), and energy efficiency. Varied over the three scenarios, 86–96% of the sustainable biomass supply potential is used. Under more stringent mitigation targets, novel biomass conversion technologies start to play an important role: Biobased electricity production with CCS, jet fuel production from lignocellulosic biomass, and chemicals are partly produced from ethanol and bio-naphtha. The modeling framework provides a transparent view of which type of biomass can be used for which specific purpose. It is therefore an interesting tool for future research, for example to examine the dynamic interaction with

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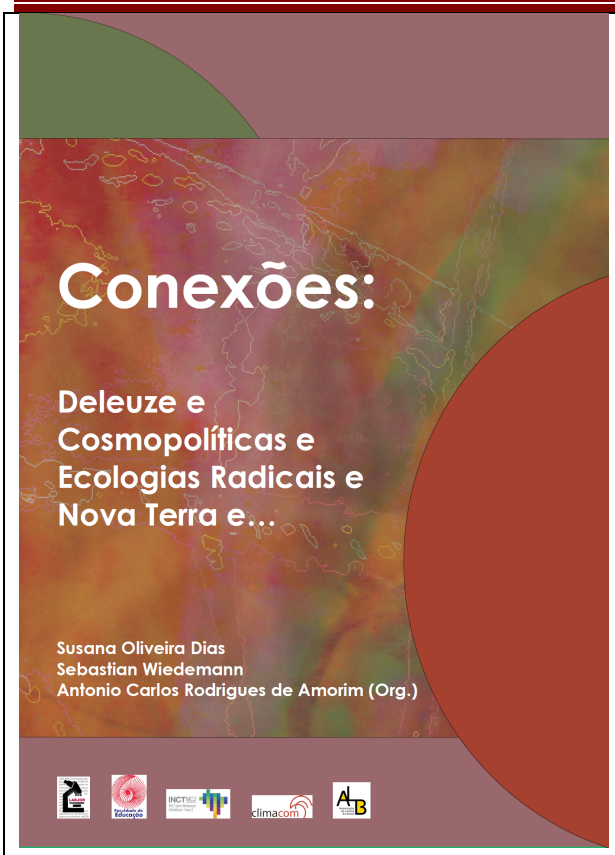

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Dossiê Inter/Transdisciplinaridade
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| EDITORIAL |

El Dossier "Interdisciplina & Transdisciplina" posee dos objetivos principales. Por un lado, busca deconstruir el concepto de interdisciplinariedad y transdisciplinariedad a partir de contribuciones que recuitan diferentes perspectivas a lo largo y ancho de América Latina y Central. Este volumen busca contribuir con la producción de conocimiento interdisciplinario y transdisciplinario a través de la reflexión sobre sus posibilidades, impactos y limitaciones.

El segundo objetivo es sumar experiencias, análisis y miradas para consolidar un ámbito de investigación denominado Estudios sobre Interdisciplina y Transdisciplina, ubicada en el campo de la Ciencia, Tecnología y Sociedad. Entender cómo el conocimiento es producido en el marco de una investigación interdisciplinaria es una de las claves para crear mejores condiciones para su desarrollo y para transformarla en objeto específico de políticas públicas. Este espacio tiene como objetivo sistemático sistematizar las investigaciones sobre los alcances del quehacer interdisciplinario y transdisciplinario en América Latina y proponer desarrollos para el fortalecimiento de estas prácticas.

Con esos objetivos, invitamos a participar de esta publicación bajo la premisa de que los autores pudieran contribuir a responder estas tres preguntas: (i) ¿Cuál es la especificidad de la interdisciplina y la transdisciplina en diferentes ámbitos del continente americano?, (ii)¿Con qué objetivo sustancial se persigue una práctica científica más interdisciplinaria y transdisciplinaria? y (iii) ¿La producción de conocimiento interdisciplinario y transdisciplinario puede incrementar el desempeño de la ciencia en términos de:

1. incorporar nuevos tipos de conocimiento?
2. construir una sociedad más democrática?
3. atender las demandas sociales?

Desde nuestra perspectiva, consideramos que esas prácticas bien pueden encarar la resolución de los problemas del Desarrollo, éste entendido en el marco de los países de América Latina. Por tanto, el presente Dossier busca estimular la reflexión partiendo de quienes han trabajado, desde casos de estudio concretos y específicos, en formatos interdisciplinarios y transdisciplinarios para dar respuestas a los problemas del Desarrollo. Queremos repensar los conflictos y dificultades que esto conlleva, estimando la experiencia desarrollada en cada contexto, periferia o interstício.

El Dossier sobre "Interdisciplina & Transdisciplina" presenta las contribuciones de varios países del continente con el anhelo de representar una constelación de experiencias diferentes pero que pueden dialogar y aprender unas de otras.

En el caso de Argentina, se presentan cuatro aportes con características diferentes. En primer lugar, se presenta un estudio sobre "La apuesta interdisciplinaria de la Universidad de Buenos Aires: el caso de los Programas Interdisciplinarios (PIUBA)". Un segundo artículo expone la experiencia de un proyecto de investigación que buscó la co-construcción de conocimiento entre diversos actores, con el título "Diálogo inter/transdisciplinario en acción: servicios climáticos para el sur de Sudamérica".

Como un tercer exponente de Argentina, en el artículo "Inquietud y contingencia: tres casos de "enredos experimentales" en la investigación ID/TD", las autoras reflexionan, como antropólogas, sobre cómo un equipo de trabajo interdisciplinario o transdisciplinario debería crear conocimiento utilizable y cuáles deberían ser los mecanismos para ello.

Por su parte, la reseña "Interdisciplina como utopía posible, deseable y necesaria", brinda una mirada desde Argentina a los desarrollos teóricos y metodológicos de la interdisciplina mexicana.

La perspectiva de Brasil queda representada bajo dos formatos. En el artículo "A Biologia na Alquimia: Correlações para uma Educação Alquímica", se desarrolla un análisis interdisciplinario de los textos e imágenes producidos por la alquimia. Por su parte, el Dossier cuenta con un ensayo "Un Papa en tiempos de urgencia", donde el autor expone las vinculaciones del Papa Francisco con los problemas sociales y ambientales de esta era. Como otra forma de mirar el fenómeno, repasamos la invitación del trabajo "Exercicios de Afogamento", que insta a la percepción más aguda del fenómeno. Por su parte, la reseña "Experiências e reflexões interdisciplinares na América do Sul: o interstício criativo" conjuga las características de las investigaciones interdisciplinarias desarrolladas en Uruguay, Brasil y Argentina.

Para el caso de Chile, se presenta "Estrategias de fomento al trabajo colaborativo en la Universidad de Chile en un contexto de privatización y mercadización del sistema de educación superior nacional". Este artículo brinda un análisis de los formatos posibles para institucionalizar la investigación colaborativa. Otro escenario de la práctica interdisciplinaria y transdisciplinaria se detalla en "Experiencia 360°: Desarrollo y discusiones de la inter y transdisciplinariedad en el contexto Latinoamericano Chileno". El texto detalla la trayectoria de una organización con la fuerte convicción de que los formatos de trabajo que cruzan fronteras, - epistemológicas, sociales, culturales - coadyuvan a la construcción de una sociedad más democrática.

En este recorrido por América, Costa Rica ofrece una experiencia de trabajo interdisciplinario con un fuerte anclaje en la conformación de comunidades como espacios para la pluralidad de miradas con el artículo titulado "Comunidades Epistémicas: Una apuesta Inter y transdisciplinaria en la Universidad Nacional, Costa Rica".

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ANO 06 - N14 - "Fabulações Miceliais" ISSN 2359-4705 CHAMADA | BUSCA E OUTRAS EDIÇÕES | ENGLISH

Dossiê Fabulações Miceliais
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| EDITORIAL |

Fabular, como fazem as micélias

Este dossiê emerge como extensão das discussões e vivências compartilhadas no projeto Interdisciplinar "Pensando com Fungos", desenvolvido pelo Laboratório de Ficção, Ciência e Cultura (LABFICC) da Universidade Estadual de Campinas (Unicamp) ao longo do ano de 2018. O LABFICC surgiu em 2016 como um coletivo que buscava pensar a diversidade num campo onde as fronteiras entre ciências, cultura e ficção insistem em se confundir. Composto em sua maioria por estudantes de pós-graduação de diversas áreas do conhecimento, o grupo se propõe a realizar atividades de pesquisa e extensão na Unicamp, com mostras de filmes, grupos de estudos, workshops e outras formas de engajamento público. O "Pensando com fungos" foi um marco importante para o grupo, pois foi nosso maior projeto até aqui e a primeira vez que nos dedicamos a uma só temática de modo sistemático, com reuniões mensais e eventos públicos no âmbito da Unicamp. O dossiê se tornou parte dos trabalhos finais do projeto, bem como a oficina de pintura com fungos e encadernação manual que aparece na seção Lab-Ateliê desse dossiê.

Pensar com fungos se tornou uma atividade de cumplicidade com as formas fúngicas de existir no mundo, que nos desloca do antropocentrismo que sufoca nossas ciências, culturas e ficções. Construir um dossiê convidando os leitores para fabular conosco (unindo pela diferença como fazem as micélias do solo) é a melhor maneira de encerrar o ciclo desse projeto. Encerramos um ciclo de trabalhos interdisciplinares com os fungos convidando a comunidade leitora da ClimaCom a colocar mais fábulas em nossa bolsa construída de fibras micelíais.

Os trabalhos de Anna Tsing e Paul Stamets nos inspiraram a tomar os fungos como companheiros para pensar e fabular e as micélias, em particular, combinam características que as tornam a companhia ideal para nossas fabulações. Em uma das muitas formas combinadas de reprodução dos fungos, está o belo ciclo de vida dos cogumelos. Cogumelos liberam esporos, esporos formam hifas e as redes de hifas construídas horizontalmente nos solos são as micélias. Contrariando o habitual da taxonomia das ciências biológicas em português, optamos pelo nome no plural e feminino. A intenção é tanto se endereçar à pluralidade das micélias evidenciada na escolha do plural latino mycelium como é também combater a universalidade do gênero masculino nas palavras plurais em português (marca indelével do antropocentrismo que fez do Homem seu herói linguístico).

As micélias, frequentemente tomadas como redes micelíais, são parte fundamental do ciclo de reprodução dos fungos e necessárias para a frutificação fúngica, que são os cogumelos. Sua existência, contudo, aponta para características que impactam as formas como pensamos a terra, os fungos, os solos, a floresta, as espécies e todo conhecimento que tenta conectá-los.

Paul Stamets (2005) nos ajuda a identificar as principais características das micélias que as tornam potentes companheiras para as fabulações, a começar pelo fato de que elas não podem ser individuadas. Micélias são uma forma de existência partilhada, que conecta a um só tempo existências múltiplas: árvores, cogumelos, microorganismos do solo, enzimas, minorrizas, o solo ele mesmo e, indiretamente, toda a vida das florestas. Micélias permitem a comunicação entre diferentes árvores e são parte fundamental da ciclagem de matéria orgânica do solo. Stamets sugere ainda que elas são uma espécie de inteligência coletiva, a "Internet da natureza", que é compartilhada e construída por várias espécies ao mesmo tempo, e, como tal, desempenha papel importante da manutenção da vida no solo e nas florestas. Como Anna Tsing (2015) ressalta, os fluxos mobilizados pela digestão micelial são, ao mesmo tempo, narrativas de degradação e criação - decomposição que configura ou torna possível novos mundos para outros organismos. Na concepção das respostas enzimáticas e químicas à decomposição da matéria, os fungos figuram como "organismos de interface entre a vida e a morte" (STAMETS, 2005, p. 1).

As micélias encontram o húmus de Donna Haraway (2016) para nos ajudar a pensar possibilidades teóricas e criativas para lidar com o antropocentrismo que marca de modo profundo o conhecimento moderno. O solo e os compostos terranos aparecem como alternativa multiespécie ao conceito de humano: "Somos húmus, nem Homo, nem anthropos; somos composto, não pós-humanos" (HARAWAY, 2016, p. 55).

É reunindo as interações várias entre fabular e as micélias que chamamos esse dossiê de Fabulações Micelíais. Fabular é criar, conectar e conversar por histórias e paisagens, considerando as múltiplas conexões entre ficções, ciências e experiências vividas, unidas enquanto narrativas sobre (e no) mundo. Essa noção de fabulação é largamente inspirada no conceito de SF de Donna Haraway, que é aberto e formulado por conexões parciais, para conceber a confusão de fronteiras entre "*science fiction, speculative fabulation, string figures, speculative feminism, science fact, so far*" (HARAWAY, 2016, p. 2) e várias outras possibilidades que não cessam em surgir. Fabular é contar histórias de naturezas diversas e intercambiantes.

Tal como sugere Anna Tsing, inspirada por Ursula K. Le Guin (1989), esse dossiê se propõe a coletar histórias. Nossa micélia fabulativa era uma bolsa vazia que agora está parcialmente preenchida. Antes de ir às fabulações que preencheram nossa bolsa de fibras micelíais, gostaríamos de trazer uma questão que marca uma diferença desse dossiê em relação aos outros da ClimaCom.

A Professora Daniela Tonelli Manica, que contribui com esse dossiê com uma resenha do filme de Donna Haraway, nos fez uma sugestão que nos pareceu muito importante. Optamos por explicitar o primeiro nome das autoras e autores nas referências de todos os trabalhos publicados. A escolha por não seguir o padrão indicado pela norma (apresentação apenas das iniciais) responde a uma crítica feminista sobre a invisibilidade e o apagamento dos

ANO 04 - N10 - "Cosmopolíticas da imagem" ISSN 2359-4705 CHAMADA | BUSCA E OUTRAS EDIÇÕES | ENGLISH

Dossiê Diálogos do Antropoceno
| ano 5, n. 12, 2018 |

| EDITORIAL |

"As contribuições desta edição estruturam diálogos entre várias abordagens e vertentes do conhecimento, as quais se conectam ao conceito do Antropoceno. Pensamos que nos é uma circunstância altruenta diante dos desafios colocados pelos fenômenos climáticos e da preminência das questões de degradação ambiental no mundo contemporâneo, onde tais diálogos e práticas interdisciplinares são cada vez mais demandados pelos governos, institutos de pesquisa, agências de fomento e pela sociedade. Assim, esta edição contribui com o debate e a criação de um diálogo plural acerca do papel da comunicação e divulgação científica no que concerne a problemática ambiental, expondo a diversidade de análises que compõem, articulando as diversas áreas das ciências (naturais, exatas, humanas), artes, filosofia e conhecimentos populares".

A trajetória evolutiva do planeta Terra, segundo o atual conhecimento científico, conta com pelo menos 4,5 bilhões de anos. Ao longo de sucessivas Eras Geológicas, o planeta passou por transformações significativas em sua biosfera. Discussões recentes, iniciadas pelas ciências do sistema terrestre, tratam da possibilidade do surgimento de uma nova era geológica marcada pela crise ambiental global desencadeada pelas atividades humanas. Surgiu com isso o termo "Antropoceno", proposto por Paul Crutzen e Eugene Stoermer (Crutzen e Stoermer, 2000) para o que eles entendem ser essa nova época, a qual teria se iniciado com a Revolução Industrial e se intensificado após a Segunda Guerra Mundial. Este processo desencadeou o crescimento populacional, a urbanização, a exploração capitalista dos recursos naturais e o desenvolvimento de tecnologias e artefatos capazes de alterar características naturais de maneira decisiva (combustíveis fósseis, bombas nucleares, intensivos agrícolas e etc.).

A esse artigo seguiram-se outros vários, que buscam definir essa nova era e definir quando teria sido o seu início. Alguns propuseram, por exemplo, que o marcador inicial seriam as grandes navegações e o contato europeu com o continente americano (Lewis e Maslin, 2015), e a discussão vem se intensificando com o passar dos anos. Há cada vez mais geólogos e geógrafos interessados no tema e cresce ainda a discussão nas outras ciências, sendo o termo cada vez mais debatido no contexto da compreensão das mudanças globais ("sociais" e "naturais"). Economistas (Brem-e Timmerman, 2015), antropólogos (Latour, 2014; Moore, 2016), filósofos (Danovski e Viveiros De Castro, 2014; Haraway, 2015) e pesquisadores atuando nas pesquisas ambientais (Palsson *et al.*, 2013; Viola e Basso, 2016) rapidamente mobilizaram o termo para pensar, para além de fenômenos atmosféricos ou registros estratigráficos (Zalasiewicz *et al.*, 2017), profundas mudanças políticas implicadas no contexto atual.

Este fenômeno inédito na história humana e na história do planeta suscita, portanto, debates em diversas áreas da ciência e na filosofia, os quais discutem como as relações humanas com o ambiente e as demais espécies podem ser repensadas criticamente. O presente dossiê "Diálogos do Antropoceno" busca, assim, contribuir, ainda que timidamente, com esse debate, trazendo à luz artigos, ensaios e intervenções artísticas que se propõem a dialogar com o tema do Antropoceno. O conceito de Antropoceno traz novos desafios ao pensamento, servindo de mote para promover debates que vão além das disciplinas científicas tradicionais e suas epistemologias. Permite também que formas inovadoras de linguagem e entendimento possam ser imaginadas, a partir de um novo entendimento da interação das ciências com o público. Ampliar a discussão e buscar refletir melhor sobre esse fenômeno e suas múltiplas implicações faz-se necessário para que ações possam ser tomadas a respeito de desafios cada vez mais urgentes, a saber: como preservar e recuperar ecossistemas; como lidar com os (cada vez mais frequentes) desastres naturais; como estimular o uso de energias renováveis; como promover ações de adaptação às mudanças climáticas; como produzir alimentos e insumos de maneira sustentável, dentre tantas outras.

Para enfrentar tais desafios, será preciso cada vez mais discutir de maneira (inter) e transdisciplinar conceitos e termos frequentemente aplicados de maneira generalizada como: "governança", "recursos", "serviços ambientais", "sustentabilidade", etc... Também se impõe ao pensamento questionar o significado de dicotomias naturalizadas tais como: "local versus global", "natureza/cultura" e a própria noção de "humanidade", bastante vaga e escassa de eficácia política na presente situação de crise planetária.

As contribuições dessa edição estruturam diálogos entre várias abordagens e vertentes do conhecimento, as quais se conectam ao conceito do Antropoceno. Pensamos que nos é uma circunstância altruenta diante dos desafios colocados pelos fenômenos climáticos e da preminência das questões de degradação ambiental no mundo contemporâneo, onde tais diálogos e práticas interdisciplinares são cada vez mais demandados pelos governos, institutos de pesquisa, agências de fomento e por coletivos os mais diversos. Assim, esta edição contribui com o debate e a criação de um diálogo plural acerca do papel da comunicação e divulgação científica no que concerne a problemática ambiental, expondo a diversidade de análises que compõem, articulando as diversas áreas das ciências (naturais, exatas, humanas), artes, filosofia e conhecimentos populares.

O desafio de superar dicotomias (como social/natural, local/global) que nos impedem de imaginar e conceituar o que está em jogo nas disputas em torno do Antropoceno é maior do que parece à primeira vista, desafiando nossa capacidade de estabelecer diálogos verdadeiramente frutíferos entre ciências do "social" e da "natureza" que permitam abarcar e refletir sobre fenômenos que extravasam tais separações (Latour, 1994). O conceito de Antropoceno serve aqui, portanto, de mote para esse processo de pesquisa e experimentação, por ser ele próprio uma expressão da insuficiência teórica das divisões tradicionais entre mundo social e natural, entre ação humana e forças da natureza (Viveiros De Castro, 1996; Descola, 2006).

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Mobility in cities: Distributional impact analysis of transportation improvements in São Paulo Metropolitan Region

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1. Introduction

Good connectivity within cities is an essential input for productivity and livability in cities, but the distributive impacts of improvements in within-city mobility are not well understood. This work aims at filling this gap by exploring the impacts of alternative infrastructure investments and mobility policies on economic growth, income distribution of households and internal distribution of economic activity.

This paper focuses on the estimation of the impacts of transportation investments/policies using a spatial computable general equilibrium (SCGE) model integrated to a travel demand model, following the methodology presented in Haddad et al. (2015). In order to enhance our understanding of the distributional impacts of transportation improvements in Brazilian cities, we simulate the impact of different types of mobility investments in the São Paulo Metropolitan Region (SPMR). To explore further the income effects of infrastructure investments, we also conduct microsimulation exercises integrated to the SCGE results.

We look at ten different scenarios, which are divided into two main categories: ranging from a series of infrastructure-related interventions on the mass-transit, and policies that create disincentives to the use of private cars. In the first group, the expansion of transportation infrastructure tends to reduce the average travel time in public transportation, representing a reduction in the generalized cost[1] of public transportation to individuals. Therefore, travelers gain an incentive to substitute away from private modes, potentially reducing congestion. The second group of interventions relates to policies that restrict car access to the city, increasing the generalized cost of individual transportation. In such cases, potential mode switch away from cars also tends to reduce congestion. The simulations results suggest potential trade-offs between efficiency and equity in the case of policies that restrict cars' access to the city. However, infrastructure-related interventions, not surprisingly, are associated with increases in GRP (Gross Regional Product) and, while their impacts on income distribution are relatively more modest, they suggest that improvements in the overall economy brought by transportation investments are not coming at the expense of lower-wage workers.

In what follows, we discuss the motivation for this study in section 2. We then discuss the main methodological aspects of the integrated modeling system in section 3, with emphasis on the microsimulation module that adds to the original work in Haddad et al. (2015). Results for the mobility scenarios derived from simulations using the integrated modeling framework are presented and discussed in section 4. Section 5 concludes.

2. Motivation and background

Cities come in different sizes and forms. However, cities that have been able to grow large and remain productive and competitive such as London, Singapore and New York, all have one thing in common: good connective infrastructure that has allowed all areas of the city to remain connected. Thus, connectivity made it possible for these cities to grow as single entities.

Connectivity is essential for the success of a city for several reasons. First, firms benefit from good links to their input and output markets. A well-connected city provides firms with a larger pool of labor and bigger markets to sell their products. Second, households also benefit from good connections in a city. They can reach more opportunities in shorter times, and have access to larger pools of goods, including housing, to choose from. When households and firms are well connected, productivity and livability can be higher (Fernald, 1999; Ghani et al., 2012; Rospabé and Selod, 2006; Gobillon et al., 2007; Gobillon and Selod, 2014; Cao and Pan, 2016).

Improvements to connectivity can be achieved in at least two ways. First, by reducing the cost of transportation per unit of distance

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[1] The term "generalized cost" refers to the weighted sum of the monetary and non-monetary costs of a journey.

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CHAMADA | BUSCA E OUTRAS EDIÇÕES | ENGLISH

Dossiê Diálogos do Antropoceno

| ano 5, n. 12, 2018 |

| EDITORIAL |

"As contribuições desta edição estruturam diálogos entre várias abordagens e vertentes do conhecimento, as quais se conectam ao conceito do Antropoceno. Pensamos que isso é uma circunstância altruaentra diante dos desafios colocados pelos fenômenos climáticos e da prevalência das questões de degradação ambiental no mundo contemporâneo, onde tais diálogos e práticas interdisciplinares são cada vez mais demandados pelos governos, institutos de pesquisa, agências de fomento e pela sociedade. Assim, esta edição contribui com o debate e a criação de um diálogo plural acerca do papel da comunicação e divulgação científica no que concerne a problemática ambiental, expondo a diversidade de análises que compõem, articulando as diversas áreas das ciências (naturais, exatas, humanas), artes, filosofia e conhecimentos populares".

A trajetória evolutiva do planeta Terra, segundo o atual conhecimento científico, conta com pelo menos 4,5 bilhões de anos. Ao longo de sucessivas Eras Geológicas, o planeta passou por transformações significativas em sua biosfera. Discussões recentes, iniciadas pelas ciências do sistema terrestre, tratam da possibilidade do surgimento de uma nova era geológica marcada pela crise ambiental global desencadeada pelas atividades humanas. Surgiu com isso o termo "Antropoceno", proposto por Paul Crutzen e Eugene Stoermer (Crutzen e Stoermer, 2000) para o que eles entenderm ser essa nova época, a qual teria se iniciado com a Revolução Industrial e se intensificado após a Segunda Guerra Mundial. Este processo desencadeou o crescimento populacional, a urbanização, a exploração capitalista dos recursos naturais e o desenvolvimento de tecnologias e artefatos capazes de alterar características naturais de maneira decisiva (combustíveis fósseis, bombas nucleares, intensivos agrícolas e etc.).

A esse artigo seguiram-se outros vários, que buscam definir essa nova era e definir quando teria sido o seu início. Alguns propuseram, por exemplo, que o marcador inicial seriam as grandes navegações e o contato europeu com o continente americano (Lewis e Maslin, 2015), e a discussão vem se intensificando com o passar dos anos. Há cada vez mais geólogos e geógrafos interessados no tema e cresce ainda a discussão nas outras ciências, sendo o termo cada vez mais debatido no contexto da compreensão das mudanças globais ("sociais" e "naturais"). Economistas (Brem e Timmermas, 2015), antropólogos (Latour, 2014; Moore, 2016), filósofos (Danovski e Viveiros De Castro, 2014; Haraway, 2015) e pesquisadores atuando nas pesquisas ambientais (Palsson *et al.*, 2013; Viola e Basso, 2016) rapidamente mobilizaram o termo para pensar, para além de fenômenos atmosféricos ou registros estratigráficos (Zalasiewicz *et al.*, 2017), profundas mudanças políticas implicadas no contexto atual.

Este fenômeno inédito na história humana e na história do planeta suscita, portanto, debates em diversas áreas da ciência e na filosofia, os quais discutem como as relações humanas com o ambiente e as demais espécies podem ser repensadas criticamente. O presente dossiê "Diálogos do Antropoceno" busca, assim, contribuir, ainda que timidamente, com esse debate, trazendo à luz artigos, ensaios e intervenções artísticas que se propõem a dialogar com o tema do Antropoceno. O conceito de Antropoceno traz novos desafios ao pensamento, servindo de mote para promover debates que vão além das disciplinas científicas tradicionais e suas epistemologias. Permite também que formas inovadoras de linguagem e entendimento possam ser imaginadas, a partir de um novo entendimento da interação das ciências com o público. Ampliar a discussão e buscar refletir melhor sobre esse fenômeno e suas múltiplas implicações faz-se necessário para que ações possam ser tomadas a respeito de desafios cada vez mais urgentes, a saber: como preservar e recuperar ecossistemas; como lidar com os (cada vez mais frequentes) desastres naturais; como estimular o uso de energias renováveis; como promover ações de adaptação às mudanças climáticas; como produzir alimentos e insumos de maneira sustentável, dentre tantas outras.

Para enfrentar tais desafios, será preciso cada vez mais discutir de maneira (inter) e transdisciplinar conceitos e temos frequentemente aplicados de maneira generalizada como: "governança", "recursos", "serviços ambientais", "sustentabilidade", etc.. Também se impõe ao pensamento questionar o significado de dicotomias naturalizadas tais como: "local versus global", "natureza/cultura" e a própria noção de "humanidade", bastante vaga e escassa de eficácia política na presente situação de crise planetária.

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Hydrology and Earth System Sciences

Toward continental hydrologic–hydrodynamic modeling in South America

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Abstract. Providing reliable estimates of streamflow and hydrological fluxes is a major challenge for water resources management over national and transnational basins in South America. Global hydrological models and land surface models are a possible solution to simulate the terrestrial water cycle at the continental scale, but issues about parameterization and limitations in representing lowland river systems can place constraints on these models to meet local needs. In an attempt to overcome such limitations, we extended a regional, fully coupled hydrologic–hydrodynamic model (MGB; *Modelo hidrológico de Grandes Bacias*) to the continental domain of South America and assessed its performance using daily river discharge, water levels from independent sources (in situ, satellite altimetry), estimates of terrestrial water storage (TWS) and evapotranspiration (ET) from remote sensing and other available global datasets. In addition, river discharge was compared with outputs from global models acquired through the eartH2Observe project (HTESSEL/CaMa-Flood, LISFLOOD and WaterGAP3), providing the first cross-scale assessment (regional/continental × global models) that makes use of spatially distributed, daily discharge data. A satisfactory representation of discharge and water levels was obtained (Nash–Sutcliffe efficiency, NSE > 0.6 in 55 % of the cases) and the continental model was able to capture patterns of seasonality and magnitude of TWS and ET, especially over the largest basins of South America. After the comparison with global models, we found that it is possible to obtain considerable improvement on daily river discharge, even by using current global forcing data, just by combining parameterization and better routing physics based on regional experience. Issues about the potential sources of errors related to both global- and continental-scale modeling are discussed, as well as future directions for improving large-scale model applications in this continent. We hope that our study provides important insights to reduce the gap between global and regional hydrological modeling communities.

1 Introduction

Reliable simulations of streamflow dynamics and related processes are vital to support water resources management regarding water security, natural hazards, navigation, agriculture and energy production. Therefore, improved predictions of the hydrological system can aid policymakers and stakeholders in making better decisions, also fostering actions to reduce risk and impacts on water resources under current and future conditions. In South America, recent important floods (e.g., Marengo et al., 2012; Heyes et al., 2013; Ovando et al., 2016) and droughts (Melo et al., 2016; Erfanian et al., 2017), together with uncertainties about the potential effects of climate change (Marengo et al., 2009), are encouraging new strategies for meeting social, economic and environmen-

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Hydrology and Earth System Sciences

Modeling freshwater quality scenarios with ecosystem-based adaptation in the headwaters of the Cantareira system, Brazil

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Abstract. Although hydrologic models provide hypothesis testing of complex dynamics occurring at catchments, freshwater quality modeling is still incipient at many subtropical headwaters. In Brazil, a few modeling studies assess freshwater nutrients, limiting policies on hydrologic ecosystem services. This paper aims to compare freshwater quality scenarios under different land-use and land-cover (LULC) change, one of them related to ecosystem-based adaptation (EbA), in Brazilian headwaters. Using the spatially semi-distributed Soil and Water Assessment Tool (SWAT) model, nitrate, total phosphorous (TP) and sediment were modeled in catchments ranging from 7.2 to 1037 km^2. These headwaters were eligible areas of the Brazilian payment for ecosystem services (PES) projects in the Cantareira water supply system, which had supplied water to 9 million people in the São Paulo metropolitan region (SPMR). We considered SWAT modeling of three LULC scenarios: (i) recent past scenario (S1), with historical LULC in 1990; (ii) current land-use scenario (S2), with LULC for the period 2010–2015 with field validation; and (iii) future land-use scenario with PES (S2 + EbA). This latter scenario proposed forest cover restoration through EbA following the river basin plan by 2035. These three LULC scenarios were tested with a selected record of rainfall and evapotranspiration observed in 2006–2014, with the occurrence of extreme droughts. To assess hydrologic services, we proposed the hydrologic service index (HSI), as a new composite metric comparing water pollution levels (WPL) for reference catchments, related to the grey water footprint (greyWF) and water yield. On the one hand, water quality simulations allowed for the regionalization of greyWF at spatial scales under LULC scenarios. According to the critical threshold, HSI identified areas as less or more sustainable catchments. On the other hand, conservation practices simulated through the S2 + EbA scenario envisaged not only additional and viable best management practices (BMP), but also preventive decision-making at the headwaters of water supply systems.

1 Introduction

Basin plans comprise the main management tool and they plan sustainable use of water resources in both spatial and temporal scales. For sustainable water allocation, river plans are based on accurate data on actual water availability per basin, taking into account water needs for humans, environmental water requirements and the basin's ability to assimilate pollution (Mekonnen et al., 2015). However, adaptive management options such as ecosystem-based adaptation (EbA; see CBD, 2010; BFN/GIZ, 2013) and the water footprint (WF) (Hoekstra and Chapagain, 2008; Hoekstra and Mekonnen, 2012) have rarely been incorporated into Brazilian basin plans. Moreover, integrated qualitative and quantitative simulations and indicators of human appropria-

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Article

SST Indexes in the Tropical South Atlantic for Forecasting Rainy Seasons in Northeast Brazil

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Abstract: May-to-July and February-to-April represent peak rainy seasons in two sub-regions of Northeast Brazil (NEB): Eastern NEB and Northern NEB respectively. In this paper, we identify key oceanic indexes in the tropical South Atlantic for driving these two rainy seasons. In Eastern NEB, the May-to-July rainfall anomalies present a positive relationship with the previous boreal winter sea surface temperature anomalies (SSTA) in the southeast tropical Atlantic (20°–10° S; 10° W–5° E). This positive relationship, which spread westward along the southern branch of the South Equatorial Current, is associated with northwesterly surface wind anomalies. A warmer sea surface temperature in the southwestern Atlantic warm pool increases the moisture flux convergence, as well as its ascending motion and, hence, the rainfall along the adjacent coastal region. For the Northern NEB, another positive relationship is observed between the February-to-April rainfall anomalies and the SSTA of the previous boreal summer in the Atlantic Niño region (3° S–3° N; 20° W–0°). The negative remote relationship noticeable between the Northern NEB rainfall and the concomitant Pacific Niño/Niña follows cold/warm events occurring during the previous boreal summer in the eastern equatorial Atlantic. The southeastern tropical Atlantic and Atlantic Niño SSTA indexes may, then, be useful to predict seasonal rainfall over the Eastern and Northern NEB, respectively, for about a 6 month leading period. The ability of both southeastern tropical Atlantic and Atlantic Niño SSTA indexes to forecast the Eastern and Northern NEB rainfall, with about a 6 month lead time, is improved when these indexes are respectively combined with the Niño3 (5° S–5° N; 150°–90° W) and the northeast subtropical Atlantic (20° N–35° N, 45° W–20° W), mainly from the 1970's climate shift.

Keywords: Brazilian Northeast; rainfall; predictability; tropical Atlantic

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Stormwater volume reduction and water quality improvement by bioretention: Potentials and challenges for water security in a subtropical catchment

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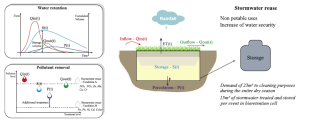
HIGHLIGHTS

- Bioretention presents a good runoff reduction capacity (mean efficiency of 70%).
- The results suggest that groundwater replenishment occurs mainly after the event.
- Stormwater reuse directly from the bioretention can be compromised by its quality.

GRAPHICAL ABSTRACT



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ABSTRACT

Climate change scenarios tend to intensify extreme rainfall events and drought in Brazil threatening urban water security. Low Impact Development (LID) practices are decentralized alternatives for flood mitigation and prevention. Recently, their potential has increasingly been studied in terms of stormwater harvesting. However, there is still a lack of knowledge about their potentialities in subtropical climate regions. Therefore, this study evaluated the behavior of a bioretention cell in a Brazilian city, during the dry period, which is critical in terms of pollutant accumulation and water availability. In addition to the runoff reduction and pollutant removal efficiency, this paper analyzed the potential for water reuse in terms of the stored volume and water quality guidelines. The results obtained show an average runoff retention efficiency of 70%. Considering only the water availability aspects, the potential stored runoff could be reused for non-potable purposes, reducing the water demand in the catchment by at least half during the dry season. On the other hand, the bioretention presented two different conditions for pollutant removal: Condition A – the concentration values are within the recommended limits for water reuse. The parameters found in this condition were NO_3, NO_2, Zn, Mn, Cu, Cr; Condition B – the pollutant concentrations are above the guideline limits for water reuse and cannot be directly used for different purposes. The parameters found in this condition were Fe, Pb, Ni, Cl and color. Considering water reuse, an additional treatment is required for parameters in this second condition. Further studies should evaluate the design aspects that can allow collection of LIDs effluent, additional treatment if necessary, and reuse in the catchment.

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Land use policy as a driver for climate change adaptation: A case in the domain of the Brazilian Atlantic forest

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State of Rio de Janeiro

ABSTRACT

Brazil has a great potential for ecosystem-based adaptation to climate change and to disaster risk reduction, leveraged by the commitment of restoring 12 million hectares until 2030. This commitment is legally backed by the Native Vegetation Protection Law (NVPL), which defines the situations in which landowners must recover native vegetation in their land. In this paper, we discuss the role of land use compliance as a driver for adaptation in the Brazilian Atlantic forest domain based on the case of the State of Rio de Janeiro. We used high resolution satellite imagery (5 m pixel) to map the state's land use and land cover, delineate Areas of Permanent Preservation and calculate the environmental debt, i.e. the areas required for restoration in order to comply to the NVPL. We also related the distribution of the environmental debt to the socioeconomic conditions of the municipalities and examined potential funding sources for economic incentives to enhance feasibility of restoration in private lands. The state has 31% of native vegetation cover, and an environmental debt of 412,876 ha, correlated to Human Development Index ($R = -0.2952$, $p = 0.0043$) and vulnerability to poverty ($R = 0.3711$, $p = 0.0003$). The north-northwestern region hosts the hotspots both for environmental debt and vulnerability to poverty, therefore it should constitute a priority target for environmental and social policies. Compliance to this large environmental debt to abide to the regulatory policy NVPL will demand incentive mechanisms. Oil royalties are a potential funding source for programs of payment for ecosystem services, as 3% of those annual revenues could pay the restoration of 39% of the state's environmental debt per year over 20 years. Thus, policy mixes that combine existing regulatory and incentive mechanisms should ensure low-cost landscape restoration in tandem with new job opportunities in a restoration chain, and might represent a significant opportunity for the State of Rio de Janeiro.

1. Introduction

Recent anthropogenic emissions of greenhouse gases are the highest in history, with severe impacts in human and natural systems all across the globe. Climate change will amplify existing risks and create new ones, unevenly distributed, and generally greater for disadvantaged people (IPCC, 2014). Despite national commitments of reducing emissions, temperature will continue to rise, leading to the depletion of ecosystem services such as food and water provision (Rogelj et al., 2016). In this scenario, carbon mitigation will continue to be relevant, but alone will not suffice to halt or circumvent ongoing climate trends. Adaptation strategies are needed to increase resilience of vulnerable socio-ecological systems (Scarano, 2017).

Ecosystem-based adaptation to climate change (EbA) is the set of adaptation measures which take into account the role of ecosystem services (ES) in reducing the vulnerability of society to climate change (Magrin et al., 2014; Vignola et al., 2009). Within this approach, adapting requires a combination of policy instruments related to nature conservation and restoration with socioeconomic policies that foster livelihood diversification and, consequently, income generation and poverty reduction (Jones et al., 2012; Magrin et al., 2014; Scarano, 2017).

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ESPACIALIZAÇÃO DE ÁREAS APTAS PARA A CITRICULTURA NO RECÔNCAVO DA BAHIA

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RESUMO

A citricultura tem sofrido variações de produção no Brasil devido a questões climáticas e como consequência tem havido queda na área colhida de laranja nos últimos anos. Este trabalho objetiva verificar as condições agroclimáticas favoráveis a expansão do cultivo do citros no Recôncavo Baiano por meio de informações de balanço hídrico, relevo favorável à mecanização agrícola, áreas com antropismo e áreas de restrição para conversão de uso do solo protegidas por legislação ambiental. Através da metodologia empregada, envolvendo sistemas de informações geográficas (SIG) e bases de dados geoespaciais, observou-se que o Recôncavo Baiano possui condições favoráveis para a expansão da cultura do citros em 173.445 hectares.

Palavras-chave — Balanço Hídrico, Expansão da Agricultura, Geoprocessamento.

ABSTRACT

The citriculture has experience production variations in the Brazilian market due to the climate and as a consequence there has been a decrease in the harvested area of orange in recent years. This paper objective to verify agroclimatic conditions favorable to the expasion of the citrus in the Recôncavo Baiano through information of water balance, relief favorable to agricultural mechanization, areas with existing anthropism and restricted areas for conversion of land use protected by environmental legislation. Through the methodology used, involving geographic information systems (GIS) and geospatial databases, it was observed that the Recôncavo Baiano has favorable conditions for the expansion of the citrus crop in 173,445 hectares.

Keywords — *Water Balance, Agricultural Expansion, Geoprocessing.*

1. INTRODUÇÃO

O Recôncavo da Bahia, denominado assim pela sua posição ao redor da baía de todos os santos, é uma região considerada muito rica devido a sua carga cultural e produção agropecuária. A agropecuária nesta região, desde o início da colonização brasileira, obteve sucesso nos diferentes ciclos. A posição geográfica favorecem o escoamento das produções agropecuárias para a capital baiana e a outros países, como Portugal e Espanha [1][2].

O primeiro ciclo econômico da agricultura do Recôncavo Baiano, a fim de expandir seu poder territorial e melhorar a economia da Coroa Portuguesa, foi o da cana-de-açúcar que se adaptou muito bem ao clima tropical e as terras férteis do Brasil. Houve assim, a implantação dos engenhos nos períodos iniciais da colonização e com o passar dos séculos vieram as usinas açucareiras, que produziam para além do açúcar, o álcool. Hoje às características ambientais que essa região tem, são advindas de um processo exploratório excessivo da terra para movimentação econômica da realeza [3].

O segundo maior ciclo da agricultura plantada na região foi a fumageira, iniciada na metade do século XVI. Os fumos de boa qualidade produzidos eram exportados para a Europa, sendo os franceses, ingleses e portugueses os que mais consumiam. Além disso, o fumo também era utilizado no processo de escambo entre Brasil e África [4]. Com o declínio econômico do ciclo do açúcar e fumo, o Recôncavo da Bahia começa a dar oportunidade de produção a outras culturas, como por exemplo a mandioca (no caso das culturas temporais) e a laranja (no caso das culturas perenes).

Para essa região desde 2003, o cultivo da laranja apresenta crescimento e se mantém em primeiro lugar entre culturas perenes nos seguintes quesitos: Quantidade Produzida (toneladas), Rendimento Médio da Produção (kg/ha) e Valor da Produção (Mil Reais) [5].

Paralelamente, o estado de São Paulo, maior produtor de citros do país, está passando por uma redução na produção devido ao aparecimento de doenças e por questões de secas. A área colhida em São Paulo reduziu 45% no ano de 1990 a 2017 e no mesmo período, no Brasil houve decréscimo de 29% [6].