



GLOBAL CLIMATE CHANGE MODELING: THE BRAZILIAN MODEL OF THE GLOBAL CLIMATE SYSTEM (MBSCG)

Carlos Afonso Nobre

Ministry of Science and Technology (MCT)

FAPESP Process 2009/50528-6 | Term: Apr 2011 to Mar 2015

Contact: Esplanada dos Ministérios, Bloco E, CEP 70067-900, Brasília, DF, Brazil | carlos.nobre@inpe.br

Collaborating Institutions: Brazilian Agricultural Research Corporation (Embrapa); Center for Ocean-Land-Atmosphere Interactions (Cola); Council for Scientific and Industrial Research (CSIR); Federal University of Itajubá (Unifei); Federal University of Lavras (Ufla); Federal University of Rio Grande do Sul (UFRGS); Federal University of Santa Maria (UFSM); Hadley Centre; Indian Institute of Sciences; Indian Institute of Tropical Meteorology; National Institute for Space Research (Inpe); National Institute of Amazonian Research (Inpa); Princeton University; Technical Aerospace Center (CTA); University of Brasília (UnB); São Paulo State University (Unesp); University of Amsterdam; University of Reading; University of Wageningen; University of São Paulo; Woods Hole Research Center.

SCIENCE QUESTIONS AND OBJECTIVES

Due to the high degree of non-linearity of the Earth system (e.g. moist processes, biogeochemical processes, ocean and atmosphere circulation, cryosphere dynamics and carbon cycles in marine environments), it is only possible to estimate the most probable scenarios of the Earth's climate through the creation of a model that consistently incorporates the interactions between the relevant hydro-bio-physical-chemical processes of the global climate system. The main goal of this subproject is to bring together the Brazilian scientific community to model the different components of the climate system, such as the atmosphere, the biosphere, the oceans, the cryosphere, the aerosols and the land surface processes, as well as to develop the computational methods necessary for the creation of such a complex model. The creation of the Brazilian Model of the Global Climate System (MBSCG) is an original contribution from Brazil to the international efforts to model and project global climate change, and will enhance the confidence of the scenarios on regional scales, in particular for South America.



Figure 1. Schematic Diagram of the Brazilian Model of the Global Climate System and its sub-models. The four sub-models – Atmosphere, Atmospheric chemistry, Ocean and Land – are integrated by a coupler



CURRENT RESULTS AND PERSPECTIVES

One of the most important aspects of the development of the Brazilian Model of the Global Climate System is the multinational cooperation involving leading research institutions from Brazil, the United States, India, South Africa, Argentina, Chile, and Uruguay. Senior researchers and young scientists from these nations participated in at least one of the four workshops organized by the MBSCG project, hosted in Brazil, in 2009. This interest is bringing much needed scientific expertise on topics covering all components of the global climate model under development in Brazil, from forest fire to surface hydrology, effects of river discharge on the ocean, marine biogeochemistry and ice, and advanced topics on atmospheric convection and rainfall. The development of the associated datasets needed for the model runs were discussed. Furthermore, the first scientific paper on the impacts of Amazon deforestation on climate using the coupled ocean-atmosphere global model was published. This coupled model forms the backbone of the MBSCG development, showing the interconnection between rainfall over the Amazon, the general circulation of the atmosphere and the oceans.

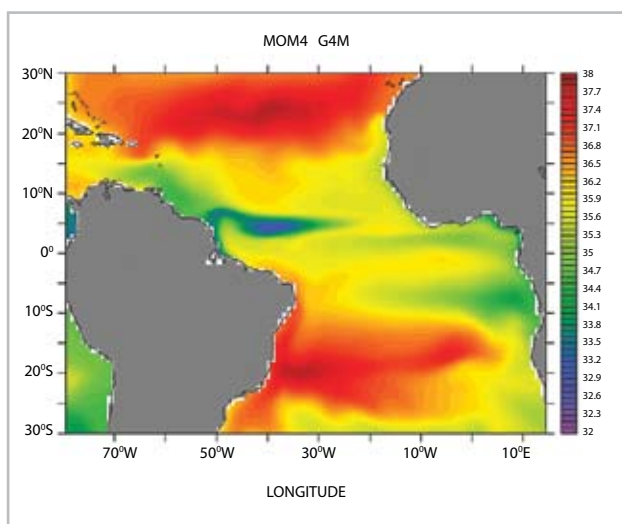


Figure 2: The modeling of river discharges on the global oceans integrates continental hydrology with ocean circulation and biogeochemistry, which in turn impact atmospheric circulation and CO₂ cycles. This figure shows the effect of the Amazon River discharge on equatorial Atlantic sea surface salinity, as simulated by the coupled ocean-atmosphere version of the MBSCG

RELATED PUBLICATIONS

- Freitas SR, Longo KM, Silva Dias MAF, Chatfield R, Silva Dias P, Artaxo P, Andreae MO, Grell G, Rodrigues LF, Fazenda A, Panetta J. 2009. The coupled aerosol and tracer transport model to the Brazilian developments on the regional Atmospheric Modeling System (CATT-BRAMS) Part 1: Model description and evaluation. *Atmospheric Chemistry and Physics (Online)*. **9**: 2843-861.
- Hoelzemann JJ, Longo KM, Fonseca RM, do Rosário NME, Elbern H, Freitas SR and Pires C. 2009. Regional representativity of Aeronet observation sites during the biomass burning season in South America determined by correlation studies with MODIS Aerosol Optical Depth. *Journal of Geophysical Research*. **114**:D13301.
- Nobre P, Malagutti M, Urbano DF, de Almeida RAF, Giarolla E. 2009. Amazon deforestation and climate change in a coupled model simulation. *Journal of Climate*. **22**: 5686-5697.
- Senna MCA, Costa MH & Pires GF. 2009. Vegetation-atmosphere-soil nutrient feedbacks in the Amazon for different deforestation scenarios. *Journal of Geophysical Research*. **114**:D04104.
- Nobre CA, Brasseur GP, Shapiro MA, Lahsen M, Brunet G, Busalacchi AJ, Hibbard K, Seitzinger S, Noone K and Ometto JP. 2010. Addressing the complexity of the Earth System. *Bulletin of the American Meteorological Society*. **91**(1): 1377-1388.

CO-PI'S AND ASSOCIATES

- Allan Spessa, Antônio Nobre, Bart Kruijt, Benedito Silva, Carlos A. Guimarães Jr., Carlos Raupp, Celso von Randow, Chou Sin Chan, Débora Roberti, Domingo Urbano, Edmo Campos, Eduardo D. Assad, George Philander, Gilvan Sampaio, H. Dolman, Henrique Barbosa, Humberto Rocha, Iracema F. A. Cavalcanti, J. Shukla, Javier Tomasella, Jefferson Simões, João Andrade de Carvalho Jr., João Paulo Delfino, Jorge Bustamante, Judith Hoelzemann, Júlio Chagas, Karla Longo, Lincoln Alves, Luiz Cândido, Luz Adriana Cuartas, Manoel Cardoso, Márcia Yamasoe, Marcos B. Sanches, Marcos Buckeridge, Marcos D. Oyama, Marcos H. Costa, Marta Malagutti, Mercedes Bustamante, Michael Coe, P. N. Vinayachandran, Paulo Kubota, Paulo Nobre, Pavel Kabat, Pedro Monteiro, Regina C. Alvalá, Richard Betts, Rita M. V. Vieira, Roberto de Almeida, Saulo Barros, Saulo Freitas, Silvio Nilo, Suryachandra Rao, Vanessa Canavesi, Walter Collischonn.