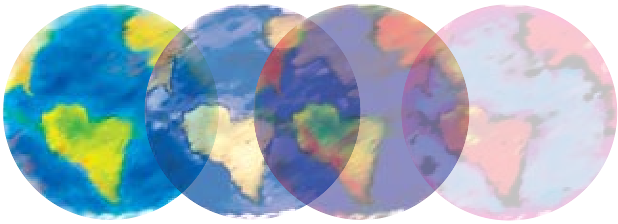

AEROCLIMA – DIRECT AND INDIRECT EFFECTS OF ATMOSPHERIC AEROSOL PARTICLES ON CLIMATE IN AMAZONIA AND PANTANAL

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SCIENCE QUESTIONS AND OBJECTIVES

The Aeroclima project is working on unveiling the role of atmospheric aerosol particles in the Amazonian climate, and is part of the LBA Experiment (The Large Scale Atmosphere-Biosphere Experiment in Amazonia). Aerosols are very small particles (1-1000 nanometers) that are the largest uncertainties in global climate change. This project will study the chemistry, physical properties, radiative forcing, capability to become a cloud condensation nucleus among other properties, and will also include the critical aerosol properties in regional and global climate models. Aeroclima will enhance the knowledge on the direct and indirect effects of aerosols on climate for the Amazonia and Pantanal regions. We plan to reduce uncertainties on aerosol direct and indirect radiative forcing trough an approach with detailed aerosol and radiation measurements in several sites, coupled with a modeling component with a regional and global climate models approach. Remote sensing of aerosol and clouds will also help to provide the large scale distribution and characterization. Key aerosol properties such as aerosol size distribution, mass, composition, light scattering and absorption, CCN activity, will be measured for at least one year in three aerosol and trace gas atmospheric monitoring stations. Intensive campaigns will use aerosol mass spectrometers and advanced instrumentation to better characterize aerosol properties. We will also have aerosol vertical profile up to 12 Km, measured with Raman Lidar measurements as well as 7 Nasa/Aeronet sun photometers and radiometers in continuous operation. Airborne measurements using an instrumented aircraft (Inpe Bandeirante) will explore the large scale aerosol

Figure 1. Tower of the LBA Experiment in Manaus were the FAPESP Aeroclima project is doing long term trace gas and aerosol measurements

properties and distribution over Amazonia and Pantanal. The large scale will be observed with the use of satellite remote sensing using Modis and Calipso sensors. The modeling component will use CATT-Brams and WRF-Chem to study the regional aerosol radiative forcing. Large Eddy Simulations models will be used to study aerosol-cloud interactions. We also plan to incorporate in the Brazilian Global Climate Model under development at Inpe the aerosol parameterization developed in this project. Aeroclima will contribute to the objectives of the FAPESP Research Programme on Global Climate Change (FRPGCC) by expanding the scientific base related to Climate Change, with the observation of key components integrating the Earth System and its interfaces, and specifically in the following highlighted FRPGCC areas: (a) consequences of Global Climate Change over ecosystem functioning, biodiversity, and water, carbon, nitrogen cycles; and (b) atmospheric radiation balance, aerosols, trace gases and land-use change.

CURRENT RESULTS AND PERSPECTIVES

Two long term aerosol and trace gases measurement sites were installed, close to Manaus and Porto Velho. The site in Manaus is located in a very clean and pristine area, with the lowest possible aerosol and trace gas concentrations in any continental area in the world. The site in Porto Velho is being operated in an area with heavy land use changes, representing areas in Amazonia where anthropogenic contributions are already changing significantly the atmospheric properties. We observed very pronounced changes in the radiation balance and cloud droplet nucleation at these sites. Cloud properties in pristine areas have very different microphysical properties from polluted areas in Amazonia, and this have important impacts in precipitation suppression, surface temperature and the hydrological cycle. The Amazonian vegetation interacts strongly with the atmosphere, with emission of aerosols and trace gases that control cloud droplet formation and evolution. We also observed that the vegetation have important role in maintaining the pristine atmospheric composition in Amazonia, with a strong role in regulating oxidant concentrations in Amazonia. Most of the aerosol particles in clean conditions are actually produced from secondary reaction in the atmosphere, modulated by solar radiation. *Figure 2* shows the distribution of aerosol direct radiative forcing over the whole Amazonia, obtained using remote sensing techniques. A large spatial (as well as temporal) variability can be observed, and the magnitude of the effect (up to -30 watts/m²) have significant effects on ecosystem functioning. This deficit in radiation affects photosynthesis in large areas of Amazonia. It also increase the diffuse radiation flux, increasing carbon uptake by the forest by up to 30% compared with pristine conditions.

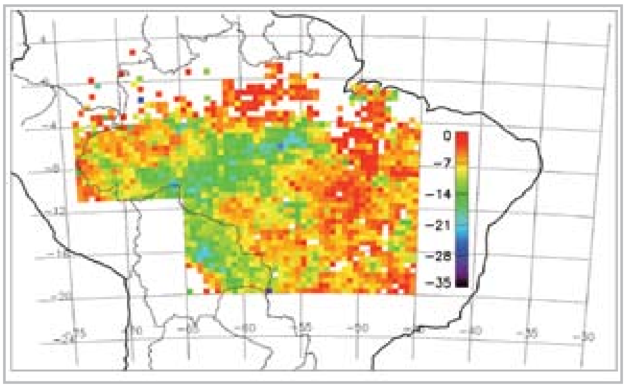

Figure 2. Aerosol radiative forcing at the surface resulting from biomass burning in large areas of Amazonia. A large radiation deficit at the surface of up to -28 watts/m² were observed over large areas in Amazonas, with important effects on the ecosystem functioning

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