Green Ocean Amazon

Tropical cloud systems are the primary drivers of the global atmospheric circulation—a huge cycle of atmospheric energy and moisture transported around the Earth, affecting both weather and climate. Tropical deep convection under contrasting very clean and polluted conditions in the Amazon and the underlying process that drives it are complex. Efforts to simulate these processes with climate models remain largely unsuccessful.

To study the coupled atmosphere-cloud-terrestrial tropical systems that drive tropical deep convection, the U.S. Department of Energy (DOE) is sponsoring an integrated field experiment in Brazil's Amazon Basin. Using a network of instrumented observation sites, the mission is to advance scientific understanding of how land-atmosphere processes affect tropical hydrology and climate, and improve the representation of these coupled processes in climate models. This experiment, Green Ocean Amazon (GOAmazon), will extend for two years, from January 2014 through December 2015.

This research activity takes place in and around the city of Manaus, Brazil. The city uses high-sulfur oil as its primary source of electricity, and is an industrial zone of 3 million people with high emissions of soot.

Coordinated through the DOE's Office of Biological and Environmental Research, Climate and Environmental Sciences Division, the following programs are providing observational resources and research funding for GOAmazon:

- Atmospheric Radiation Measurement (ARM) Climate Research Facility
- Environmental Molecular Sciences Laboratory
- Terrestrial Ecosystem Science
- Regional and Global Climate Modeling
- Earth System Modeling
- Atmospheric System Research.

The Scientific Objective

Aerosol concentrations in the atmosphere are rapidly changing with deforestation and the associated biomass burning and economic development in the Amazon region. The climatic implications for strong aerosol-cloud interactions are profound, ranging from decreasing precipitation to changes in large-scale circulations and energy transport associated with severe storms. Reduced rainfall can result in a self-reinforcing pattern of drier land surface, stronger susceptibility to fires, and even greater aerosol-induced suppression of rainfall.

GOAmazon is designed to enable the study of how aerosols, along with changes to heat and energy at the surface, influence cloud cycles under clean conditions, as well as how aerosol and cloud life cycles are influenced by pollutant outflow from a tropical megacity. These observations will provide a data set vital to improving tropical rainforest model parameters for organic aerosols, cloud and convection schemes, and vegetation components, and how these are affected by pollution.

Research Sites

Ground-based

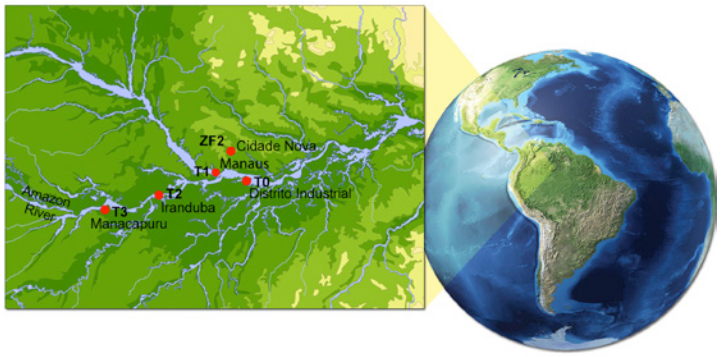
The experiment design will characterize the region in its natural state and in states perturbed by regional and global human activities. Four ground-based measurement sites are strategically located around the Manaus region:

T0, Amazonian Tall Tower Observatory, and T1, National Institute from Amazonian Research – the outskirts of Manaus are equipped with automated weather stations to gather data about basic meteorological conditions in the urban area.

T2, University of São Paulo instrumentation – located near Iranduba, between Manaus and Manacapuru, this site will host instruments to measure trace gases and aerosols.

T3, ARM Mobile Facility – the ARM Mobile Facility will obtain measurements near Manacapuru, downwind of the city of Manaus. The site is located in a pristine atmosphere where the Manaus pollution plume regularly intersects. This site will also host numerous instrument systems from other GOAmazon participants to obtain measurements of the strong hydrologic cycle of the Amazon basin. The hydrologic cycle describes the continuous movement of water, on, above, and below the surface of the Earth.

ZF2, Terrestrial Ecosystem Science measurement sites – located north of Manaus, ZF2 will host surface-flux instrumentation provided by DOE's Terrestrial Ecosystem Science program.



Airborne

Two intensive operational periods—the first from 16 February to 27 March 2014, and the second from 1 September to 10 October 2014—will be conducted to collect additional observations. The ARM Aerial Facility Gulfstream-1 (G-1) will be deployed in both phases to obtain measurements of cloud, trace gas, and aerosol properties. The German High Altitude and Long Range Research Aircraft, or HALO, is scheduled to join the G-1 during the second phase of flights to collect aerosol and cloud measurements, and trace gas.

International Collaborators

GOAmazon is an international campaign with the following key participants.

Research Funding Agencies

- Brazil – Amazonas Research Foundation (FAPEAM)
- Brazil – São Paulo Research Foundation (FAPESP)
- United States – Department of Energy (DOE)
- United States – National Science Foundation (NSF)

Universities and Research Institutions

- Department of Science and Aerospace Technology
- Federal University of Amazonas
- Max Planck – Institute for Chemistry
- National Institute for Research in the Amazon
- National Institute for Space Research
- University of São Paulo
- University of the State of Amazonas

Other Collaborating Entities

- Cloud Processes of the Main Precipitation Systems in Brazil: A Contribution to Cloud-Resolving Modeling and to the Global Precipitation Measurement Large-Scale Biosphere Atmosphere Experiment
- Science Mobility Program

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