

ARM

CLIMATE RESEARCH FACILITY GOAmazon 2014 Overview

The DOE ARM Climate Research Facility

The Department Of Energy (DOE) Atmospheric Radiation Measurement (ARM) Climate Research Facility is a national scientific user facility, operated under the Office of Biological and Environmental Science's Climate and Environmental Science Division (BER/CESD). DOE's unique scientific user facilities are intended to create an open environment for advancing scientific and technical knowledge. The facilities are freely available to all who are engaging in open research, and promote the sharing of information, collaborations, and organizational efforts among scientific researchers.

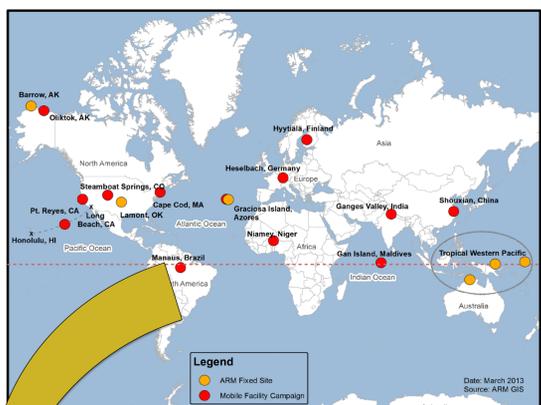


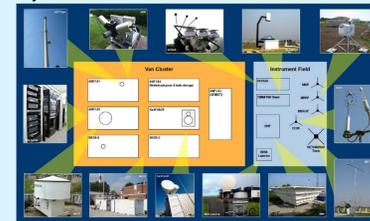
Figure 1. ARM Climate Research Facility Locations

The ARM Climate Research Facility supports instruments measuring cloud, aerosol, precipitation, and radiative properties of the atmosphere at fixed, mobile and aerial facilities with varying climate regimes around the globe, from the tropics to the arctic (Figure 1). Measurements are collected continuously at these sites, focused on enhancing the understanding of cloud and aerosol properties for representation in climate models. Field Campaigns are operated throughout the year to allow for more **intensive short term measurements** from ARM and guest instruments.

Learn more by visiting our Webpage:
<http://www.arm.gov>

ARM Mobile Facilities (AMF)

- Explore scientific questions beyond what can be addressed at fixed sites
- Similar instruments and data systems at fixed sites
- Portable and flexible designs
- Instruments include standard met instruments, broadband and spectral radiometer suite, and remote sensing instruments
- Space for guest scientist instruments



Typical AMF instrument configuration

Next AMF Location -> Amazonia region of Brazil

ARM Aerial Facilities (AAF)

AAF enhances the utility of long-term ground-based measurements by providing:



DOE G1 Aircraft

- In situ measurements of cloud properties for evaluating and improving remote sensing retrievals
- Spatial sampling not possible from the ground to provide context for and extend the ground-based measurements, for example, ice crystal habit or aerosol size distributions
- Aircraft measurements in data sets for testing and evaluating high-resolution models and model parameterizations

Observations and Modeling of the Green Ocean Amazon (GOAmazon 2014)

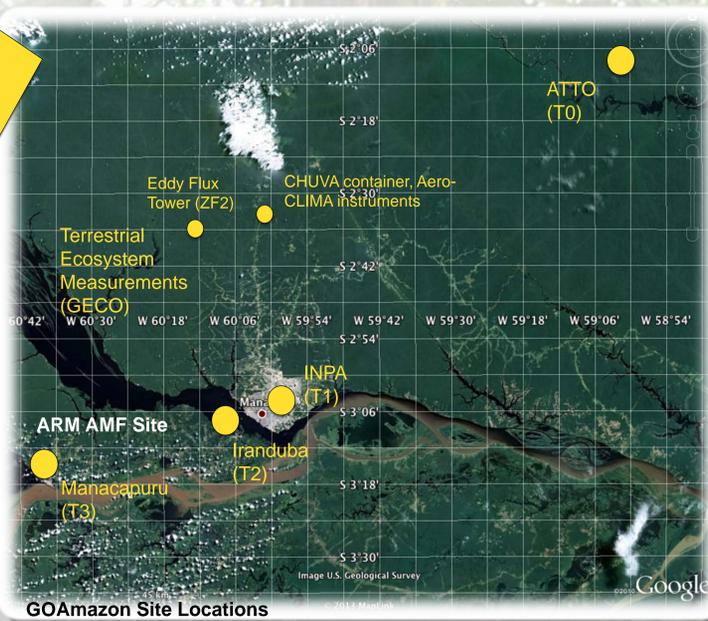
GOAmazon 2014

Focus: Atmospheric, terrestrial ecosystem, carbon cycle, and coupling questions concerning tropical systems in the Amazon



- International campaign to be conducted near Manaus Brazil, a tropical mega-city with high sulfur and soot emissions
- January through December 2014 (wet and dry season)
- Comprehensive measurements of aerosol, cloud, radiation, meteorology, ecological and ecophysiological
- Instrumented sites across area of steady easterly trade winds
 - Amazon Tall Tower Observatory (ATTO- T0)
 - National Institute for Amazonian Research (INPA- T1)
 - Iranduba (T2)
 - ARM AMF near Manacapuru (T3)
 - EMSL mass spectrometer (HR-ToF-AMS) near T3
 - Terrestrial Ecosystem Measurements (ZF2)
- AAF flights from Manaus (Feb 15 – Mar 26, wet season, Sep 1 – Oct 10, dry season)

<http://campaign.arm.gov/goamazon2014>



GOAmazon Site Locations

US Agencies and Collaborations

- DOE ARM Climate Research Facility
- DOE Terrestrial Ecosystem Science (TES) GECO
- DOE Environmental Molecular Science Laboratory (EMSL)
- DOE Regional and Global Climate Modeling (RGCM)
- DOE ASR
- Universities

Brazilian Organizations and Projects

- Fundação de Amparo à Pesquisa do Estado do Amazonas
- Fundação de Apoio à Pesquisa do Estado do São Paulo
- LBA - Large-Scale Biosphere Atmosphere Experiment, <http://lba.inpa.gov.br/lba/>
- INPA - National Institute for Research in the Amazon, <http://www.inpa.gov.br/>
- INPE - National Institute for Space Research, <http://www.inpe.br/ingles/index.php>
- CTA - Department of Science and Aerospace Technology, <http://www.cta.br/>
- UEA - University of the State of Amazonas, <http://www1.uea.edu.br/>
- USP - University of São Paulo, http://www.thefullwiki.org/University_of_Sao_Paulo, <http://web.if.usp.br/ifusp/>, <http://www.master.iag.usp.br/index.php?pi=N>
- Links to GPM-CHUVA (<http://chuvaproject.cptec.inpe.br/portal/en/index.html>)
- Ciencias Sem Fronteiras (<http://www.cienciasemfronteiras.gov.br/>)

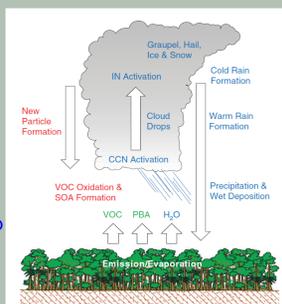


View from above

Motivation: Insufficient observational datasets to answer key scientific question

What is the effect of pollution on these cycles and their interactions:

- Cloud life cycle
- Aerosol life cycle
- Cloud-Aerosol-Precip Interactions
- Carbon cycle



Source: Pöschl, Martin, et al., "Rainforest aerosols as biogenic nuclei of clouds and precipitation in the Amazon," Science, 2010, 329, 1513-1516

Individual Group Foci

- Aerosol life cycle**
 - Interaction of Manaus pollution plume with biogenic emissions of volatile organic compounds, especially impact on aerosol formation and evolution
 - Influence of Manaus pollution plume and biomass burning on aerosol microphysical, optical, CCN, and IN properties
- Cloud life cycle**
 - Diurnal transition of convection from shallow to deep and the impact of aerosols
 - Evolution of convective intensity from severe storms in dry season to moderate storms in wet season and role of vegetation, aerosols and atmospheric conditions on wet season onset
 - Atmospheric connections between Amazonian convection and the Atlantic with relevance to global model biases in both regions
- Cloud-Aerosol Precipitation Interaction**
 - Improve understanding and treatment of aerosol effects on shallow and deep cumulus clouds, aerosol effects on precipitation, and aerosol absorption
 - Physically base/consistent estimates of aerosol-cloud interactions in General Circulation Models (GCMs) based on observations or models
- Carbon Cycle**
 - Leaf to canopy biogenic volatile organic compounds (BVOC) emissions, to improve aerosol-forest-atmospheric interaction in Earth system models (ESMs)

Measurements

- Thermo dynamic and Radiative**
 - Profiles of water vapor and aerosol extinction
 - Boundary layer height
 - Vertical velocities in deep convection
 - Boundary layer thermodynamic profiles
- Chemical and Biological**
 - Carbon dioxide and methane fluxes
 - Differentiating clean and polluted environments
 - Volatile organic carbon (VOC) and biogenic VOCs
 - High resolution aerosol composition
 - Size-resolved cloud condensation nuclei activity
- Ecosystem**
 - Leaf-to-canopy scale BVOC fluxes
 - Light quality effects on net ecosystem exchange (NEE)
 - Physiological factors controlling BVOC emissions
 - Relationships with CO₂ fluxes
- AAF (wet and dry season Intensive Operation Periods)**
 - Black carbon, VOC
 - Aerosol properties
 - Cloud properties
 - Radiation (up and down-welling broadband)



Eddy covariance system



Radiosonde launch



Microwave radiometer

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