

Biogenic Aerosols – Effects on Clouds and Climate

The Biogenic Aerosols – Effects on Clouds and Climate (BAECC) field campaign was an eight-month observational effort in southern Finland to measure biogenic aerosols (tiny particles in the air) and gases released from forests to determine their effects on clouds, precipitation, and earth system processes. Sponsored by the U.S. Department of Energy’s Atmospheric Radiation Measurement (ARM) Research Facility, the campaign placed the second ARM Mobile Facility (AMF2) in a 50-year-old pine forest from February through September 2014 to obtain comprehensive measurements of cloud and aerosol properties, precipitation, solar radiation, and meteorology.

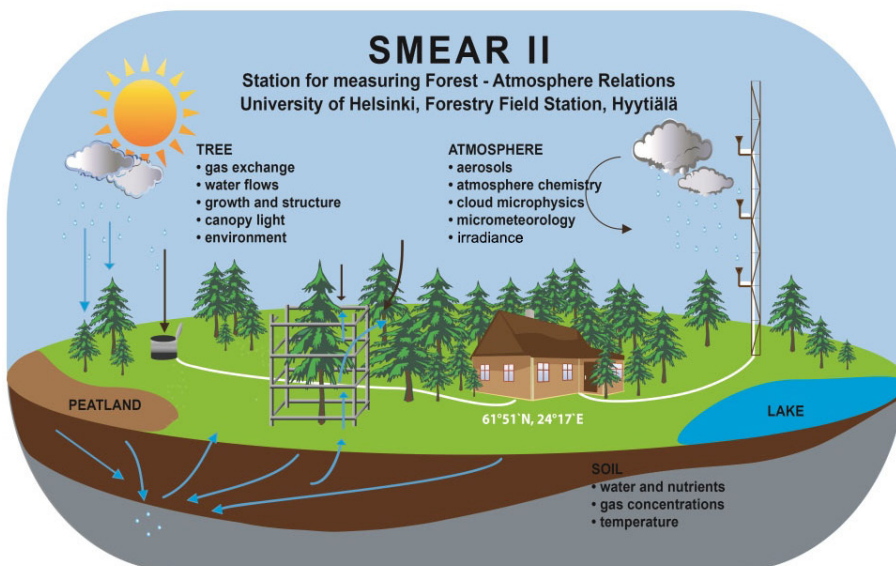
The AMF2 was located near the Station for Measuring Ecosystem-Atmosphere Relations (SMEAR) II, where the University of Helsinki has been monitoring biosphere-atmosphere interactions since 1996. Periodic flights by research aircraft, along with tower observations from other regional SMEAR stations, provided additional measurements of aerosol properties. Combined with the SMEAR II long-term record, the BAECC campaign resulted in a comprehensive data set for scientists to analyze the space and time dimensions of biogenic aerosol formation and their effects on cloud and precipitation processes. This direct link between the biosphere and atmosphere will improve model simulations of earth system processes.



Scientific Objective

Aerosols in the sky are essential to earth system processes because they can reflect light into space, cooling the atmosphere, or they can combine with other particles to create clouds that have both warming and cooling effects. Biogenic aerosols are released by the biosphere directly or are formed from biogenic volatile gases in gas-to-particle conversion. Examples include dead cells and pollen spores.

Boreal forests are among the most active areas of biogenic aerosol formation. Using data from this field study, scientists investigated these forests as a source of aerosols that form and grow to a size at which they can become cloud droplets. Understanding the impact of secondary biogenic aerosol formation on cloud properties and rainfall, and, by extension, Earth’s energy balance, was the primary goal of BAECC.



ARM Mobile Facility

Each of ARM's three mobile facilities consists of operations shelters, instrumentation, and data and communications systems for surface-based climate studies. Trained onsite operators monitor and maintain the facility to ensure that the best and most complete data set is acquired during each deployment. Data are collected 24 hours a day, seven days a week.

Measurement Capabilities

Measurement capabilities include standard meteorological instrumentation, a broadband and spectral radiometer suite, and remote sensing instruments. Additional instruments for measuring ocean meteorology, sea state, bulk aerodynamic fluxes, and ship disposition are available for shipborne deployments.

- Aerosol Observing System – nearly a dozen instruments for measuring aerosols and trace gases
- Balloon-Borne Sounding System – weather balloons launched each day at regular intervals
- Ground Radiation System – a collection of radiometers to measure visible and infrared radiation coming from the ground
- High Spectral Resolution Lidar
- Ka-Band Zenith Radar
- Marine Atmospheric Emitted Radiance Interferometer and Atmospheric Sounder Spectrometer for Infrared Spectral Technology
- Micropulse Lidar and Laser Ceilometer
- Microwave Radiometers
- Multifilter Rotating Shadowband Radiometer
- Radar Wind Profiler
- Sky Radiation System – a collection of radiometers to measure visible diffuse, global, and direct visible and infrared solar radiation
- Surface Meteorology Station
- Total Sky Imager
- W-Band Cloud Radar
- X- and Ka-Band Scanning Cloud Radar

BAECC website: www.arm.gov/research/campaigns/amf2014baecc



Modified Shipping Containers

Shipping containers serve as operations shelters, hosting a number of instruments and data systems. They also provide working space for onsite personnel and spare parts storage. Other instruments are contained in individual modules with integrated data systems.

Data and Communications System

Continuous measurements obtained by the sensors and instruments are collected by integrated data systems. These data are routinely checked for quality and transmitted to the ARM Data Center for storage and availability to the scientific community.

Using an ARM Mobile Facility

All three AMFs are available to collaborate with experiments (especially those involving aircraft) from other agencies. They can accommodate instruments in addition to, or in place of, the baseline collection. Scientific organizations interested in using an AMF are encouraged to submit proposals at the following web page: www.arm.gov/research/campaign-proposal

Sponsor

The AMFs were developed through funding from the DOE Office of Science, Office of Biological and Environmental Research. Numerous national laboratories are responsible for the science, engineering, and operation of the AMFs, which are managed by the ARM Research Facility.

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