

Two-Column Aerosol Project

Tiny particles in the sky known as “aerosols” come in many forms—dust, soot, and sea salt, for example. Depending on the type of aerosol, it can either absorb or reflect sunlight, which in turn can cause either a warming or cooling effect in the atmosphere. But to what extent? The answer to this question is critical for scientists trying to envision what Earth’s climate could be like 10, 50, and even 100 years from now.

To help find the answer, the Department of Energy’s Atmospheric Radiation Measurement (ARM) Climate Research Facility is conducting the Two-Column Aerosol Project (TCAP) at Cape Cod National Seashore. From July 2012 to June 2013, the ARM Mobile Facility—a portable observatory for measuring clouds, aerosols, and energy coming from the sun and Earth—is gathering data from a coastal bluff near the Seashore’s Highlands Center in North Truro, Mass.

In addition, instrumented research aircraft join the project for several weeks in July 2012 and again in February 2013. They will obtain measurements of clouds and aerosols in the sky over the ARM Mobile Facility site and out over the ocean.



For TCAP, instruments are measuring one “column” in the sky above the ARM Mobile Facility site in North Truro, Mass., and another “column” out over the ocean, about 155 miles off the coast.



The Seashore site was selected for measuring cloud and aerosol properties as air moves between North America and the Atlantic Ocean. Image courtesy of NASA.

Scientific Objective

Important climate processes depend on airborne particles that undergo continuous changes, not only in size—from a few nanometers to a few microns—but in composition. Despite scientific advances in understanding how aerosols evolve and affect clouds and Earth’s climate, many key knowledge gaps remain.

To close these knowledge gaps, more and better data are needed about how aerosols form, what they are made of, and how they evolve over time. Cape Cod’s unique geography—a long isolated coastal spit downwind of major metropolitan areas—makes it an ideal location to collect those data.

Measurements obtained during TCAP will allow scientists to study the effects of aerosols at a location subject to varying degrees of cloudiness, as well as clean and polluted conditions. Their analyses will be used to improve how climate models simulate the effects of aerosols on clouds and Earth’s climate.

Research Instrumentation

Ground-based – The portable ARM Mobile Facility consists of instrumentation, operations shelters, and data and communications systems for climate research. A suite of more than two dozen sophisticated instruments and radars for measuring cloud, aerosol and other atmospheric properties, as well as standard meteorological instruments and sensors, operate 24 hours a day, seven days a week. In addition, weather balloons are launched 4 times a day at regular intervals.



During the TCAP field campaign, ARM's new Mobile Aerosol Observing System will also operate at the Highlands Center during aircraft operations in July 2012 and February 2013. It includes more than two dozen specialized instruments for measuring the composition of aerosols and gas chemistry.

Airborne – Coordinated by the ARM Aerial Facility, two research aircraft based out of Barnstable, Mass., are flying in stacked formation to obtain measurements of aerosol and cloud properties in the sky.



- *Battelle Gulfstream-159*. The G-1 (foreground) is taking measurements at altitudes between 300 and 22,000 feet. For TCAP, it is equipped with more than 30 different instruments for obtaining measurements of clouds, aerosols, gases, energy, and basic atmospheric state parameters (wind, pressure, etc.).
- *NASA King Air B200*. The B200 (background) is flying above the G-1 at around 27,000 feet. It carries two downward-looking instruments for measuring the amount of light scattered or absorbed by aerosol particles at various altitudes.

Science Outreach

In collaboration with the ARM Facility, the National Seashore is complementing TCAP science with a variety of outreach activities. For example, an “Education Ranger” is working with teachers in the area to enhance their curriculum with TCAP science subjects and to provide related hands-on student activities at appropriate grade levels.

TCAP Website: <http://campaign.arm.gov/tcap>

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