ARM
CLIMATE RESEARCH FACILITY

Arctic Lower Troposphere Observed Structure (ALTOS)

From October to December 2010, a team of researchers will gather in Oliktok Point, Alaska, during the Arctic Lower Troposphere Observed Structure (ALTOS) field campaign. Sponsored by the U.S. Department of Energy's Atmospheric Radiation Measurement (ARM) Climate Research Facility, scientists will use a large tethered balloon—equipped with instruments that measure microphysics, radiation, and aerosol—to make routine ascents into the clouds above Oliktok Point. In addition to measurements taken from the surface, this will result in an unprecedented data set of cloud properties from Alaska's North Slope.

The one-month ALTOS campaign will focus on capturing data during the fall transition season, a time when sea ice begins to form and dramatic changes in the atmospheric structure and cloud properties occur. This unique data set will provide support for the future testing of Arctic cloud processes used in climate models and for testing algorithms used to retrieve these measurements.

Science Objective

Clouds in the Arctic regions have not been extensively sampled for a variety of reasons, including inadequate technology and prohibitive costs—a result of the dependence on aircraft to obtain cloud data. To reduce costs, yet still attain the desired measurements, the ALTOS science team will raise and lower a heavily instrumented tethered balloon system at regular intervals in the lower 2 kilometers of the atmosphere at Oliktok Point.

Data obtained during the ALTOS campaign will provide a statistically significant set of observed in situ cloud properties for validating retrieval algorithms and help scientists reduce the uncertainty in the radiative forcing and heating rates on hourly time scales. The data will also help researchers gain a better understanding of the driving processes that control climate changes and determine the state of the Arctic climate system.

At Oliktok Point, Alaska, the U.S. Air Force Long Range Radar Station—also known as Dew Line Station—is situated at the edge of the Arctic Ocean. Operations for the ALTOS campaign will take place just south of the station, near the aircraft hangar. (Photo courtesy of Aeromap U.S.)

Collaborators

Science Team: The Pennsylvania State University, Stratton Park Engineering Company, Inc., Scripps Institution of Oceanography, and University of Alaska Fairbanks

Logistics: Sandia National Laboratories and Los Alamos National Laboratory

Instrumentation and Operations

The sampling strategy for ALTOS includes measurements made using a heavily instrumented tethered balloon, complemented with measurements from additional instrumentation on the ground. Three different sampling scenarios with the tethered balloon are anticipated to achieve the science goals:

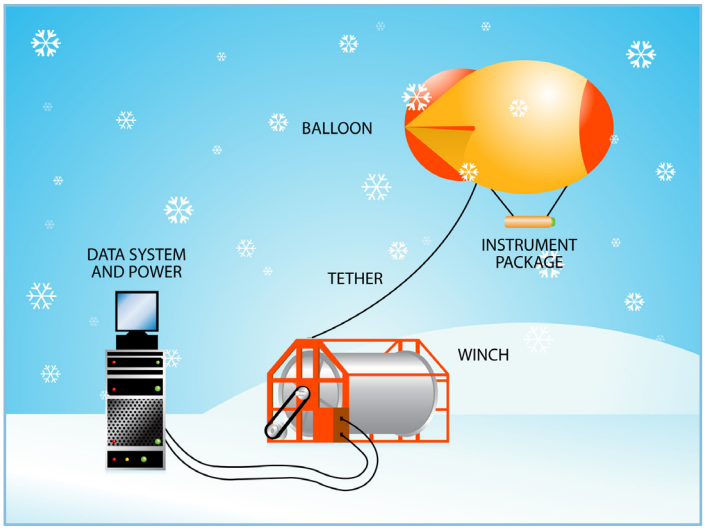
- Lower tropospheric profiling—continuous profiling through the maximum extent of the tether
- Cloud layer profiling—rapid ascents and descents through a single cloud layer
- Constant altitude flights—document the horizontal structure below, in, and above the liquid cloud layer.

Tethered balloon. A 43-cubic meter balloon containing the following instrument payload will record data at the instrument package and also transmit to the ground using a standard 5.8-gigahertz spread spectrum radio link:

- lightweight cloud particle imager
- cloud forward scattering probe
- cloud condensation nuclei counter chamber
- basic meteorology package: temperature, pressure, humidity, GPS position, wind speed, and direction
- shortwave radiometer.

Surface instrumentation. Measurements from the following instruments on the ground will be used to constrain the profiles obtained by the tethered balloon system:

- 95-gigahertz cloud radar
- micropulse lidar
- ceilometer
- microwave radiometer
- longwave and shortwave radiometer package
- meteorological tower.



Operations

When low-level clouds are present, ALTOS instruments will operate continuously for stretches of several hours as weather and personnel considerations permit. Daily operations will use several insulated shelters for the ground instruments, balloon operations, and office space, plus a truck for the radar. An existing hangar at Oliktok Point will serve as shelter for the balloon in the event of high winds.

Balloon operations at Oliktok Point will use restricted airspace, designated and activated by the Federal Aviation Administration. Penn State will provide forecasts for decisions on when to activate restricted air space.

Operations for ALTOS at Oliktok Point are being conducted with support from the 611th Civil Engineer Squadron/ CEAO at Elmendorf Air Force Base in Anchorage, and ARCTEC, Alaska Radar Division. Accommodations are being provided by the U.S. Air Force and an arrangement with the onsite Italian energy company, Eni.

http://campaign.arm.gov/altos/

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DOE/SC-ARM-10-026

U.S. DEPARTMENT OF ENERGY | Office of Science

The ARM Climate Research Facility is funded through the U.S. Department of Energy's Office of Science. Additional information is available on the ARM website at www.arm.gov.