ARM
CLIMATE RESEARCH FACILITY

Evaluation of Routine Atmospheric Sounding Measurements Using Unmanned Systems

The Arctic provides petroleum-rich wilderness, 4 miles of restricted air space, and an ideal area for studying clouds, aerosols, and transfer of energy from the sun to the Earth's surface. At Alaska's Oliktok Point along the Beaufort Sea, the Atmospheric Radiation Measurement (ARM) Climate Research Facility is hosting a research campaign designed to demonstrate how small, low-cost, unmanned aerial systems can be used to study and measure these clouds and aerosols in the cold and harsh Arctic atmosphere.

The campaign **Evaluation of Routine Atmospheric Sounding Measurements Using Unmanned Systems (ERASMUS)**—includes two 2-week deployments (summer 2015 and spring 2016) and will use what are called unmanned aerial systems to provide hard-to-gather data to ultimately improve climate models. With the advantages of remote operations, these systems will be instrumental in providing scientific information about atmospheric conditions—particularly properties related to clouds, aerosols, and the sun's rays—through routine measurement in challenging conditions.

Science Objective

As ice and snow in the Arctic continues to decrease, better understanding of atmospheric processes in higher latitudes becomes increasingly relevant. The goal of ERASMUS is to not only demonstrate how unmanned aerial systems can be used to continuously study the atmosphere in the Arctic,

The AMF3 instrument collection onsite includes a downwelling radiometer, total sky imager, Raman lidar, W-band ARM cloud radar, and the Ka- and W-band scanning ARM cloud radars, all instrumental in collecting data on clouds, aerosols, and the sun's rays.

but also to understand the different processes involved in a cloud's life cycle by providing measurements complimentary to those concurrently obtained by instruments stationed at the third ARM Mobile Facility (AMF3) at Oliktok Point.

ERASMUS will supply data to address the following science questions:

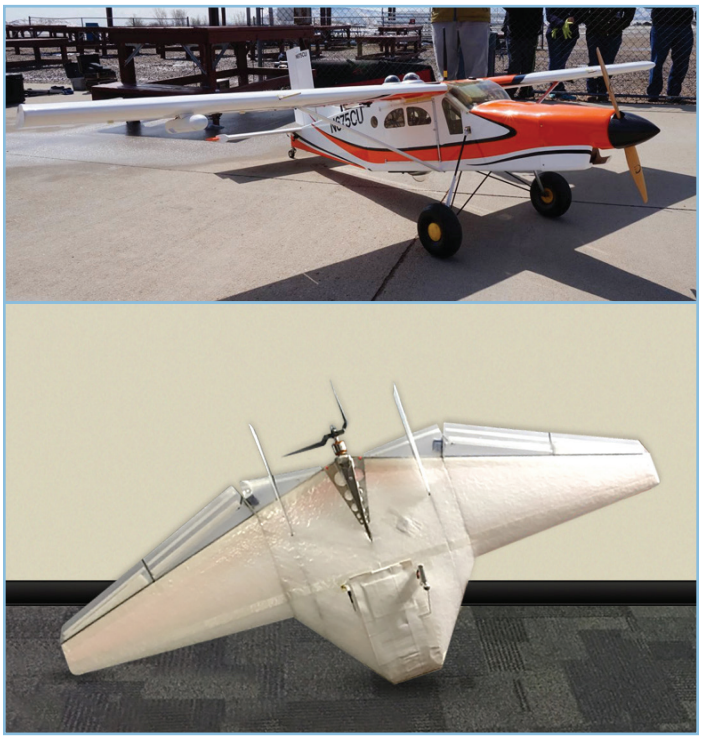
- How does temperature and humidity evolve during transitions between clear and cloudy skies?
- How do aerosol properties vary with height at high-latitude locations?
- What role does moisture play in Arctic clouds and how does their structure evolve over time?
- How well do current remote-sensing instruments perform in the Arctic environment?

Looking east from Oliktok Point at sunrise.

Research Instrumentation

This campaign will utilize two unmanned aerial systems—the DataHawk and Pilatus—as well as the ground instrumentation located at AMF3. The DataHawk, a small lightweight airplane outfitted with instruments to measure temperature, humidity, and pressure and to estimate wind speed, is just over two pounds (1 kilogram) in weight and features an almost 40-inch (1 meter) wingspan. It is primarily made of foam, making it soft, yet resilient. It is easy to transport, set up, and does not need special preparation to operate—all key characteristics when flying in such remote locations.

The Pilatus will be used to measure temperature, humidity, and pressure as well as energy in the Earth's atmosphere and aerosols from the Earth's surface up to a half-mile in altitude. It has a 10.5-foot (3.2 meter) wingspan that can carry the heavier instrumentation necessary to provide insight into clouds and their formation, as well as the impact they have on the heat transferred from the sun back to Earth.



The Pilatus (top) and DataHawk (bottom) are equipped with instruments to measure temperature, humidity, pressure, and estimate wind speed.

View of the near-shore sea ice at Oliktok Point.

Collaboration

Scientists from the Cooperative Institute for Research in Environmental Sciences (CIRES) and Aerospace Engineering department at the University of Colorado–Boulder are collaborating with others from the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), and Department of Energy (DOE) laboratories on this DOE Office of Science-funded field campaign.

This study will foster the advancement of global climate models, thereby aiding in addressing the DOE Biological and Environmental Research (BER) Climate and Environmental Sciences Division (CESD) mission to improve climate data and models for energy research.

www.arm.gov/campaigns/amf2015erasmus

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