ARM

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U.S. Department of Energy

ARM Aerial Facility

As an integral measurement capability of the Atmospheric Radiation Measurement (ARM) user facility, the ARM Aerial Facility (AAF) provides airborne measurements required to answer science questions proposed by the international research community.

Ground-based instrumentation at ARM fixed and mobile atmospheric observatories provides a unique and continuous record of the components of the atmospheric state and constituents that affect the surface radiation budget. The AAF enhances the utility and information content of long-term, ground-based measurements by providing:

- in situ measurements of aerosols, clouds, and trace gases
- sampling not possible using surface- or satellite-based techniques
- context for and extension of surface-based measurements
- measurements for testing and evaluating models.

Facilities and Resources

The AAF supports routine airborne observations and participates in field campaigns designed to contribute to the fundamental understanding of clouds, aerosols, and radiation.

To ensure that the best airborne data set can be obtained for a given campaign or routine airborne observational period, the AAF continually assesses the capabilities of its existing instruments and instruments within the airborne measurement community. New instruments are integrated into the AAF suite to fill current measurement gaps, as needed.

Working with instrument developers from national laboratories, universities, and private industry, the AAF takes an active role in new instrument development, particularly in the area of miniaturization, where existing instrumentation is merged with new technology to better fit into space- and weight-constrained airborne platforms.

Research aircraft are used to address the wide range of airborne measurement requirements associated with atmospheric science issues. As flight missions are identified, a risk evaluation is performed to ensure that the aircraft and mission meet all U.S. Department of Energy (DOE) aviation policy guidelines and safety protocols. Data obtained from the aircraft are documented, checked for quality, integrated into ARM's Data Discovery browser (***adc.arm.gov/discovery/***), and made available in a timely and consistent manner for use by the scientific community.

Traditional Aircraft

In 2019, DOE ARM purchased a Bombardier Challenger 850 regional jet to expand its scientific data capabilities. This jet will replace the retired Gulfstream-159 (G-1) research aircraft that, for three decades, helped advance atmospheric science in field campaigns across the world. The Challenger 850 is expected to be ready for its first ARM campaign in 2023.

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Pylons attached to the underside of ARM aircraft wings carry a variety of instruments that measure cloud and aerosol properties.

Uncrewed Aerial Systems

The use of uncrewed aerial systems (UAS) is becoming increasingly popular among atmospheric researchers. These systems provide revolutionary scientific information through the routine measurement of atmospheric conditions, particularly properties related to clouds, aerosols, and radiation in locations not easily accessible by manned aircraft.

Recent UAS technology advances, coupled with changes in the regulatory environment for UAS operations, increase their potential value for atmospheric and climate research. As a result, ARM is expanding its use of UAS.

The ArcticShark, a midsized UAS, is a fixed-wing vehicle with a 22-foot wingspan and a maximum gross weight of 650 pounds. The payload configuration is flexible, with multiple internal payload bays and four external hard-point wing stores. The ArcticShark can fly up to 18,000 feet above sea level for eight hours (subject to payload configuration).

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Tethered Balloon Systems

Tethered balloon systems (TBS) provide the capability of deploying a significant instrument payload of up to 50 kilograms (about 110 pounds total) on a repeated basis through the atmospheric boundary layer to elevations of approximately 1,500 meters (4,921 feet) depending on meteorological conditions and regulatory restrictions.

ARM currently operates three TBS, with a fourth system to be available in 2022. The TBS deploy a core payload of aerosol and meteorological instrumentation (***https://www.arm.gov/capabilities/instruments/tbs***). The systems are typically rotated among ARM observatories and approved field campaign locations for two-week missions several times a year.

Field Campaigns

The AAF provides aerial measurement platforms that can be used to support experiments at ARM fixed sites, in conjunction with a mobile facility, or in support of other research activities.

The AAF works with each principal investigator to develop a field campaign strategy that includes flight plans to best meet scientific requirements. The AAF then obtains approvals from civilian and military aviation authorities and other stakeholders. This includes required safety reviews and interagency coordination for joint campaigns and coordinated flights. After a campaign, AAF scientists ensure data quality and document and archive data sets.

Use of AAF resources must be requested through the ARM field campaign process. To learn more about the AAF proposal process for field campaigns, visit ***www.arm.gov/research/campaigns***. Requests to fly guest instruments to supplement the ARM instruments (or, in limited cases, to replace the ARM instruments) may be made through an annual TBS call, held near the beginning of the calendar year.

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www.arm.gov/capabilities/observatories/aaf