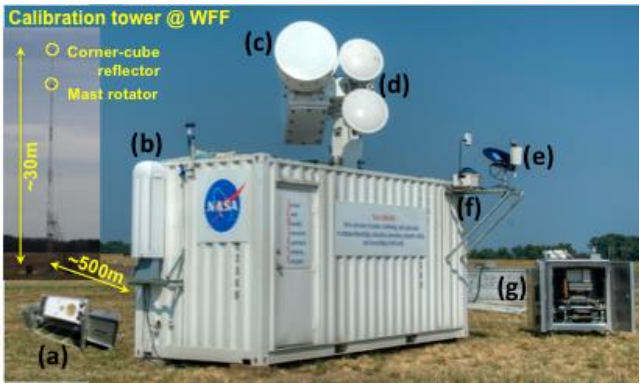
# ACHIEVE

***A**erosol-**C**loud-**H**umidity **I**nteractions **E**xploring and **V**alidating **E**nterprise*




*The ACHIEVE mobile laboratory was established in 2011.*

## Key ACHIEVE Facts

- Nominal field configuration: integrated passive and active instruments for cloud, aerosol and atmospheric state parameter measurements, serving as a supersite in "*Ground-based Formation Flight*" operations.
- Radar calibration: Using corner-cube reflectors atop a ~30 m telescoping tower with remotely controlled rotator for precise alignment with radar beam, a unified and robust statistical procedure is used for pre- & post-mission calibration of multi-frequency radars at NASA's Wallops Flight Facility (WFF).
- ACHIEVE URL: *https://smartlabs.gsfc.nasa.gov/*

## Description

Accurate retrievals of aerosol and cloud properties from spaceborne sensors have been achieved with certain degrees of confidence. One of the most difficult tasks remaining to be resolved is the interaction between aerosols and clouds, co-existing in the planetary boundary layer. Ground-based measurements of aerosol, cloud and radiation properties are critical to provide independent assessment of satellite retrievals and diagnostic/prognostic modeling studies.

ACHIEVE, extending the success of SMART-COMMIT mobile facility, is being built to provide urgently needed test-bed data with high temporal and spectral resolutions. ACHIEVE contains active remote sensing instruments of scanning 94/9.6 GHz radars (Figs. c-d), vertical-pointing 24 GHz radar (Fig. e), a ceilometer (Fig. b), and passive instruments of a scanning microwave radiometer (Fig. a), an all-sky imager (Fig. f) and an interferometer (Fig. g).

## Data Products

- Temperature, pressure and humidity profiles, boundary layer depth
- Cloud cover imagery, cloud base/top heights, cloud thermodynamic phase
- Cloud water content and effective particle size profiles, cloud optical thickness
- Doppler mean velocity
- Precipitation occurrence and rain rate

## Parameters

- Multi-frequency (94, 24 and 9.6 [in progress] GHz) radars: Range-dependent Doppler spectral width and equivalent radar reflectivity, linear depolarization ratio
- Ceilometer (910 nm lidar): Range-dependent total attenuated backscatter intensity
- Interferometer (3-20 μm): downwelling spectral intensity or sky brightness temperature
- Microwave radiometer (22-24, 36.5, and 89 GHz): spectral brightness temperature (H-/V-polarization at 89 GHz)

## Science questions to be addressed

- How do clouds respond to perturbations in aerosols, in terms of cloud condensation nuclei and ice nuclei activation?
- What is the sensitivity of the climate system to low-level cloud marco-/micro-structure in the planetary boundary layer (PBL)?
- What is the role of drizzle evaporation play in sub-cloud layer impacting the PBL moisture and energy budgets? And how quantitatively the lifecycle of drizzle can be measured?

## Principal Investigator

Si-Chee Tsay (*si-chee.tsay@nasa.gov*)
NASA Goddard Space Flight Center, Greenbelt, MD

## Team Members

Ukkyo Jeong (*ukkyo.jeong@nasa.gov*)
University of Maryland, College Park, MD

Adrian M. Loftus (*adrian.m.loftus@nasa.gov*)
University of Maryland, College Park, MD

Peter Pantina (*peter.pantina@nasa.gov*)
Science Systems and Applications, Inc., Lanham, MD

## Key References

- Tsay, et al., *AAQR*, 2016, doi:10.4209/aaqr.2016.08.0350
- Loftus, Tsay, et al., *AAQR*, 2016, doi:10.4209/aaqr.2015.011.0631