

Trend (°C over period)



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## Tethered Balloon Operations & Modeling Efforts at ARM AMF3 Site at Oliktok Point, AK

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**Sandia National Laboratories** 

- The Atmospheric Radiation Measurement Program (ARM) was created in 1989 by the U.S. Department of Energy (DOE) to develop several highly instrumented ground stations to study cloud formation processes and their influence on radiative transfer.
- ARM focuses on obtaining continuous atmospheric measurements, supplemented by field campaigns, and providing data products that promote the advancement of climate models.
- ARM North Slope of Alaska (NSA) Science Mission is to collect high latitude atmospheric data to refine climate models as they relate to the Arctic.
- Sandia National Laboratories (SNL) manages the DOE ARM facilities in Alaska and has operated the ARM Mobile Facility #3 (AMF3) at Oliktok Point since 2013 on behalf of ARM.

2 nm

Up to 12 tethersondes are

the tether and provide a

wind speed, and wind

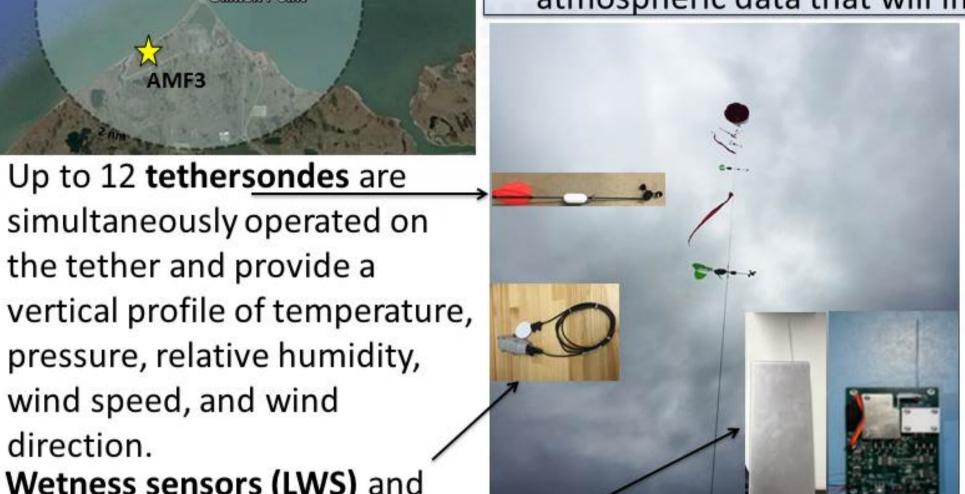
direction.

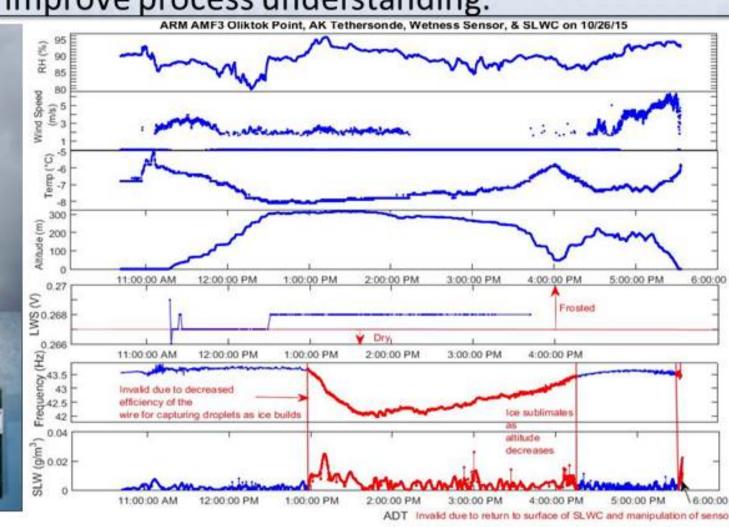
simultaneously operated on

pressure, relative humidity,

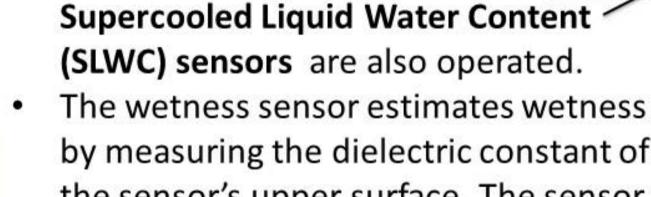
Wetness sensors (LWS) and

SNL operates R-2204 at AMF3, the only ARM site with restricted airspace. ARM is developing a tethered balloon system (TBS) capable of routine daily operation at AMF3 up to 6,000' AGL within DOE's R-2204 restricted area. The TBS operates within clouds and collects high vertical resolution atmospheric data that will improve process understanding.





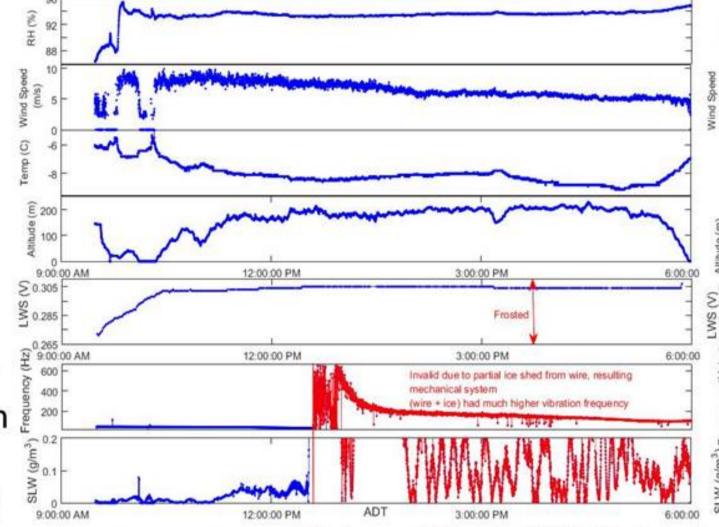


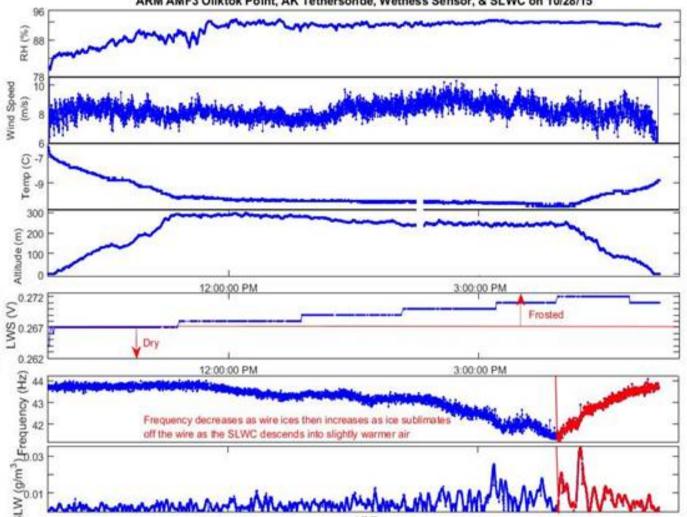


by measuring the dielectric constant of the sensor's upper surface. The sensor detects the presence of miniscule amounts of water or ice and is used in conjunction with an SLWC.

The SLWC collects supercooled liquid water droplets on a vibrating wire. The frequency change of the wire's vibration is related to SLWC. Multiple transfer functions are in development for varied wind speed, air density, and median cloud droplet diameter environments.

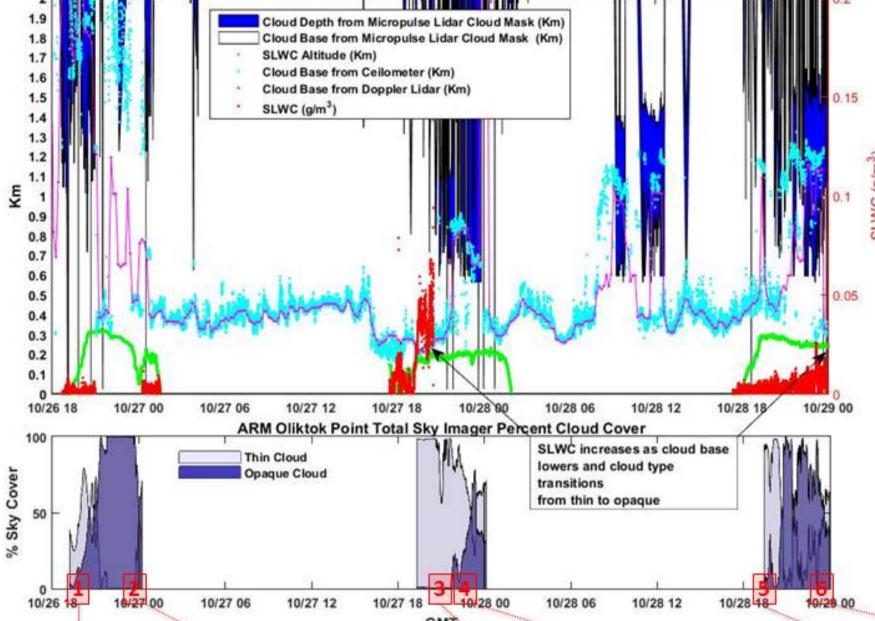
Total Sky Imager (TSI) images from AMF3:





- Higher altitude TBS flights (> 1,000' AGL 6,000' AGL) will begin at AMF3 in spring 2016.
- Multiple SLWCs and LWSs will be operated to create a vertical profile of supercooled liquid water within arctic clouds.
- A primary goal is to understand the evolution of the Arctic lower troposphere during clear to cloudy transitions.
- A variety of cloud probes may also be operated to provide in-situ measurements of cloud microphysical properties and aid in SLWC characterization.
- TBS equipment and ARM's AMF3 can be used for ARM user-supported field campaigns.
- Proposals should be submitted to www.arm.gov.
- Proposed campaigns should focus on research that addresses ARM's mission of improving the understanding and representation of clouds and aerosols in climate and earth system models

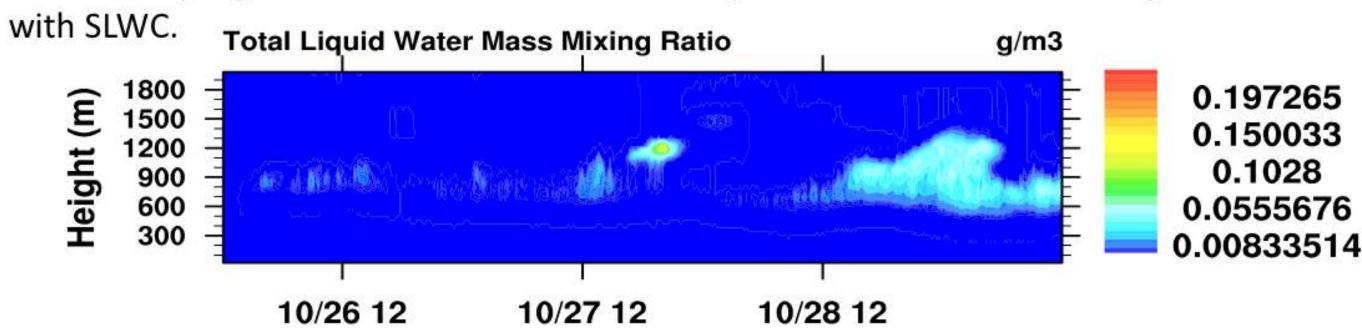
 The TBS and SLWCs are also used in an SNL Laboratory Directed Research & Development Effort to reduce uncertainty in regional climate change projections.

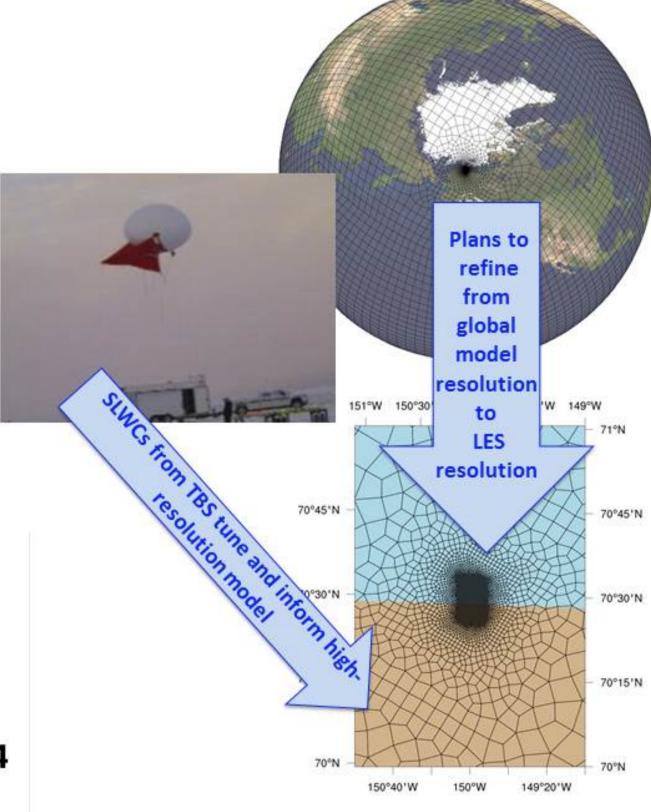




- SNL seeks to improve understanding of cloud properties using LES model
- The SLWCs flown from the TBS at Oliktok Point compared against the LES
- System for Atmospheric Modeling (SAMv6.10.8), an LES, simulated 26-29 October 2015 with  $\Delta x = 100$  m,  $\Delta z = 40$  m initialized by ARM's ECMWF reanalysis data product.
- Temperature, humidity, winds nudged to ARM's ECMWF reanalysis data product every 6 hours with prognostic ice concentration of 0.4 #/L used to tune for better agreement

Day in GMT





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