POPEYE

Profiling at Oliktok Point to Enhance YOPP Experiments

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Areas of contribution

Polar atmospheric processes
Modelling and forecasting
Observations
Sea ice processes
Data archiving

Summary

POPEYE involves enhanced profiling of the atmosphere at Oliktok Point, Alaska during the second YOPP Special Observing Period (7/1/18-9/30/18). Included in this activity is an increase in the number of radiosondes launched (4x daily), and profiling of the lowest 1000 m of the atmosphere using tethered balloons and unmanned aircraft systems (UAS). These activities will collect information on the vertical structure of thermodynamic properties, winds, and aerosol properties.
Here, we provide an intensive observation period (IOP) at the already-deployed the ARM mobile facility (AMF-3) currently deployed to Oliktok Point, Alaska as a contribution to YOPP. The approved IOP “Profiling at Oliktok Point to Enhance YOPP Experiments” (POPEYE), will include high-frequency profiling of thermodynamics, clouds and aerosols using ARM’s unmanned capabilities (DataHawks and tethered balloon system) and extra radiosondes. These activities are proposed to take place during the second of the two identified YOPP Special Observing Periods, which will involve expanded measurements across the region. The late summer timing of this Special Observing Period will witness extensive melting of Arctic sea ice as it moves to a seasonal minimum extent. Specifically, at Oliktok Point, this period will likely produce a variety of boundary layer states. This includes the potential for stable boundary layers developed offshore during the early portion of the observing period when near-shore sea ice is likely to still be present. Later, this period will feature extensive open water between the shore and sea ice, contributing to the development of convective boundary layers over the land surface and associated shallow convective cloud structures. Generally, clouds observed during this period will likely include both liquid and mixed-phase clouds. From an aerosol perspective, this period will provide access to a variety of potential sources, including the ocean surface, biomass burning events in Alaska, local industrial activity, and the land surface.

We feel that this activity will directly support the advancement of several of the priority topics identified by YOPP, including:

1) Boundary layer including mixed phase clouds: The lower-atmospheric thermodynamic observations provided by the DataHawks and tethered balloon will provide one of the most detailed datasets of Arctic summer time boundary layers ever collected. The measurements themselves will provide detailed insight into the structure of the boundary layer and its evolution, and will additionally provide a means of validating retrieval algorithms from remote sensors (e.g., AERI, Raman Lidar) under a variety of meteorological and cloud cover scenes to support future model improvement and validation efforts. These lower atmospheric measurements, in conjunction with information from ARM remote sensors and TBS-deployed supercooled liquid water content (SLWC) and aerosol measurement systems, will provide detailed information of liquid-containing cloud properties and the environment that sustains them. Finally, this suite of observations will provide critically needed measurements to directly support the stated YOPP goal of pursuing an integrated modeling framework to connect cloud, boundary layer and surface energy exchange schemes through LES-based development.

2) Sea ice modelling: Measurements provided as part of POPEYE will compliment a variety of observational efforts occurring during YOPP, and will be used directly by our team to advance our ability to predict sea ice variability at timescales from 0 to 10 days. This will be completed as part of our validation effort to improve the Regional Arctic System Model currently being employed by NOAA Physical Sciences Division (RASM-ESRL), a fully-coupled, ice-ocean-atmosphere regional prediction system being used for forecasting sea ice. This model will be run in ensemble mode starting in Fall 2017.

3) Physics of coupling, including snow on sea ice: While the connection to this objective is not obvious, one of the topics listed under this YOPP objective is the development of improved schemes of moist convection associated with unstable boundary layer conditions occurring with cold-air outbreaks. The lower atmospheric profiling suggested can provide measurements of the structure of the boundary layer at a known distance from a sharp temperature contrast (e.g. the coast, or the ice-ocean interface).

5) Model validation and intercomparison: The detailed measurements provided as part of POPEYE will provide a highly-detailed dataset that can be used for evaluation of model performance. Specifically, the detailed structure and evolution of the boundary layer and lower troposphere, as well as the additional insight provided
into cloud properties are items worth investigating across a variety of model products (e.g., reanalyses, weather forecast models, coupled regional forecast models, global climate models). Additionally, the measurements collected will provide detailed constraints on the initial and boundary conditions for intercomparisons of single-column and large eddy simulation models could be constructed.

7) The Stratosphere: The increased frequency of radiosonde launches will provide an increased level of detail for stratospheric observation. This is particularly interesting in conjunction with similar increases in radiosonde launch frequency at other sites, such as those in the Integrated Arctic Systems for Observing the Atmosphere (IASOA) consortium of observatories, or over the Beaufort Sea from planned ship activities such as those to be carried out by the Japanese research vessel Mirai.

8) Chemistry, including aerosols and ozone: The aerosol measurements that will be provided by the ARM Tethered Balloon system include information on particle number concentration, size distribution, scattering, and (hopefully) composition. Profiling these properties, even at low altitudes, will provide a rare opportunity to evaluate stratification of aerosol properties in the Arctic atmosphere over an extended, nearly continuous period and in coordination with detailed boundary layer measurements.

**Timeline**

2018-07-01 - 2018-09-30

**Regional emphasis**

Northern hemisphere: Yes

Southern hemisphere: No

**Further specification**

This includes measurements at Oliktok Point, Alaska (70.5103° N, 149.8600° W).

**Key project deliverables**

Data collected by the DOE ARM instrumentation deployed at Oliktok Point, including both the enhanced measurements from UAS, balloons and radiosondes, as well as the routinely-collected measurements from the ARM Mobile Facility (AMF-3) will be available for free public download through the DOE ARM data browser.

**Data management**
The data will be hosted at the DOE ARM data archive (http://www.archive.arm.gov/armlogin/login.jsp).

Is data provided to WMO Global Telecommunication System

Yes

Real-time provision

Data will be provided as quickly as possible, with most datasets available within a few days of being obtained. The radiosondes are planned to be provided for GTS use (though not the tethered balloon and UAS measurements).