Inaugural Campaigns for ARM Research using Unmanned Systems (ICARUS): An update on ongoing flight activities in Alaska

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ISARRA 2018, 9-12 July, 2018, Boulder, CO USA

Introduction to ICARUS

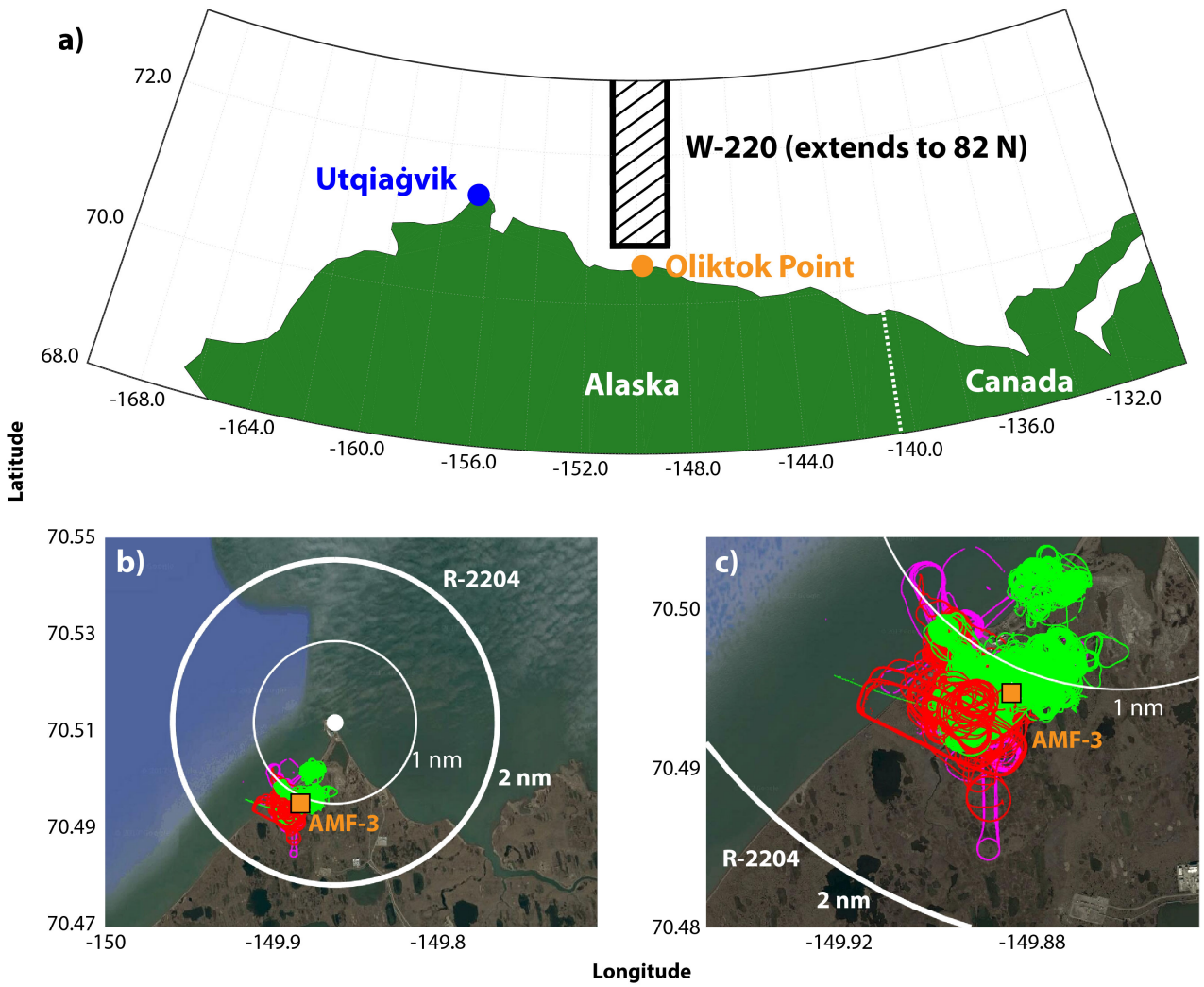
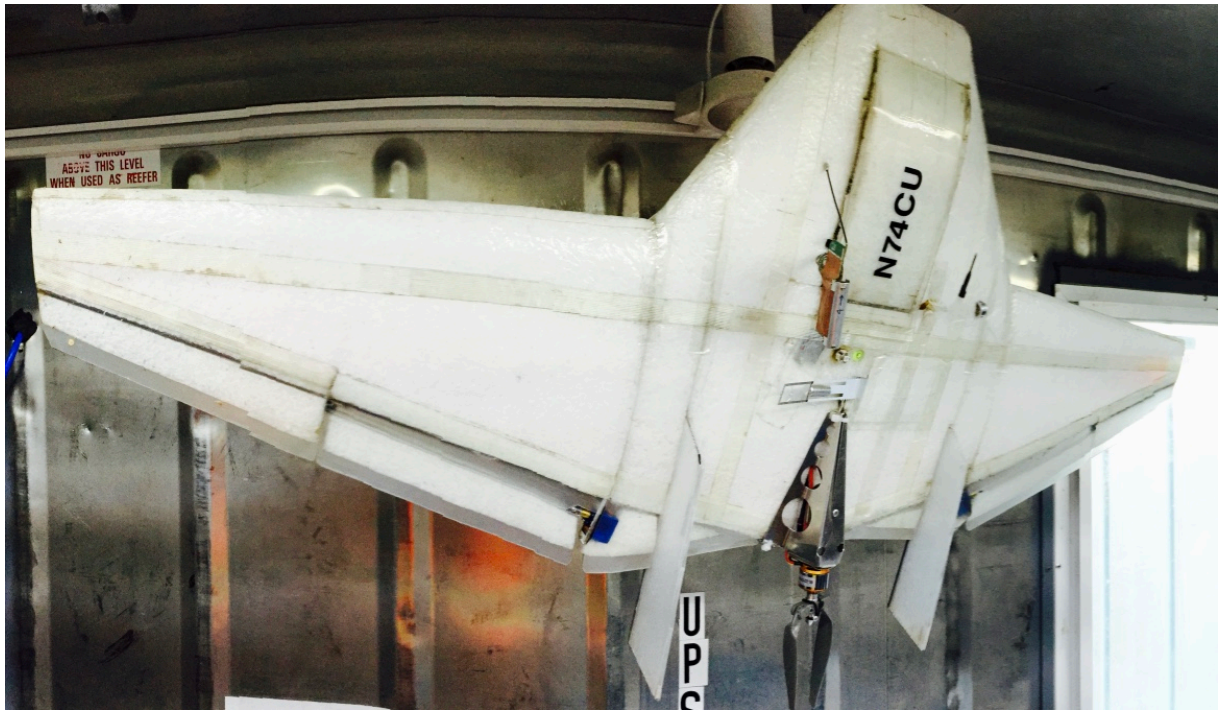


TABLE 1. An overview of flight campaigns for COALA, ERASMUS, and ICARUS. Colors match those used in the map in Fig. 1.

Campaign	Dates	Operator	Platforms	No. of flights (UAS/TBS)	No. of flight hours (UAS/TBS)
COALA	6 –20 Oct 2014	CU, DOE ARM	DH1, TBS	29/3	6.5/5
ERASMUS	2–16 Aug 2015	CU	DH2	206/0	41/0
	2–16 Apr 2016	CU	DH2, Pilatus		
	9–22 Oct 2016	CU	DH2		
ICARUS	22–28 Oct 2015	DOE ARM	TBS	130/55	77.8/198
	3–20 Apr 2016	DOE ARM	TBS		
	5–11 Jun 2016	DOE ARM	DH2, TBS		
	26 Jun–27 Jul 2016	DOE ARM	DH2, TBS		
	25–26 Sep 2016	DOE ARM	TBS		
	9–22 Oct 2016	DOE ARM	TBS		
	15–17 Nov 2016	DOE ARM	TBS		
	2–9 Apr 2017	DOE ARM	TBS		
	14–28 May 2017	DOE ARM	DH2, TBS		
	1–15 Aug 2017	DOE ARM	DH2, TBS		
	12–24 Oct 2017	DOE ARM	TBS		

Platforms and Instruments



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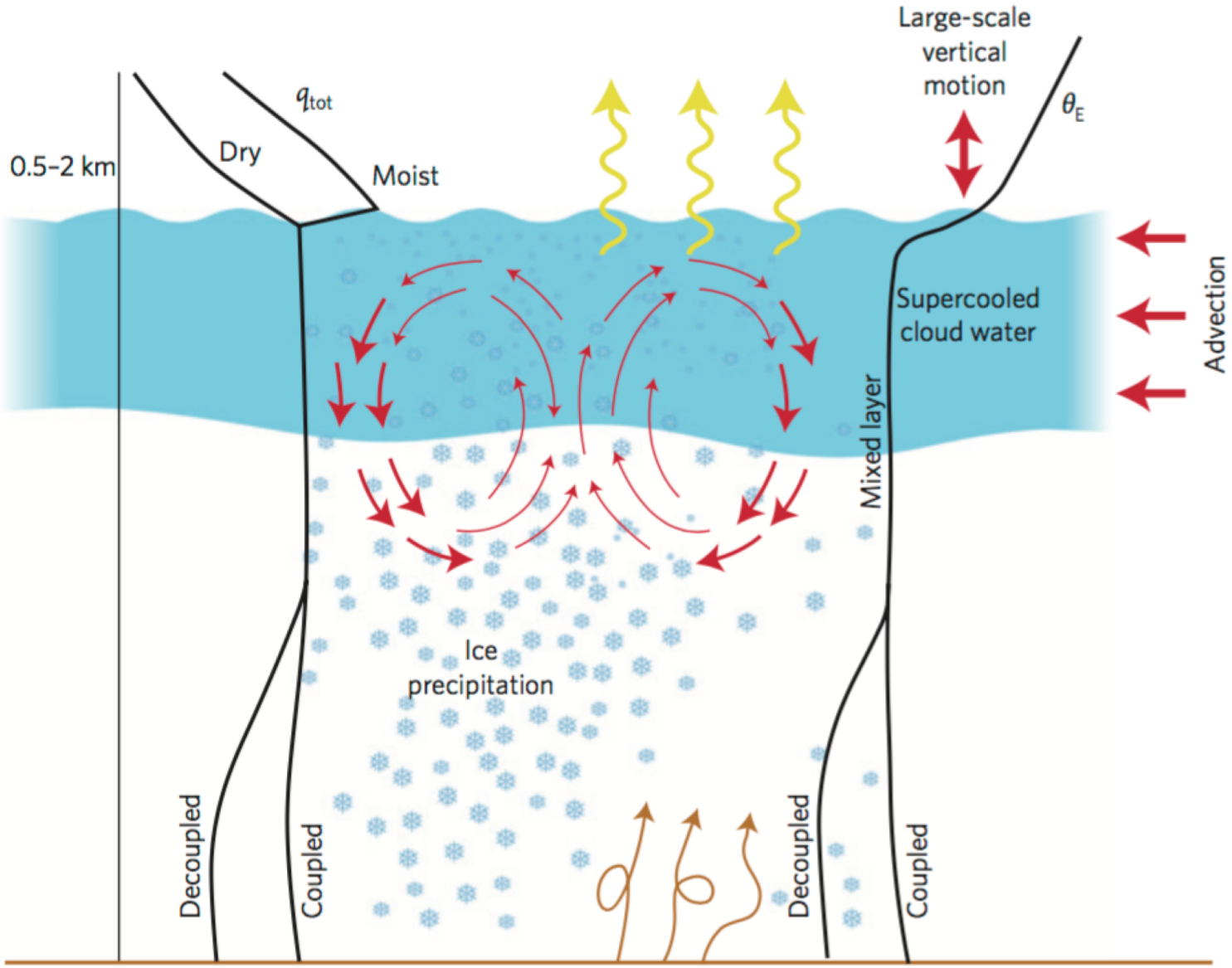
Scientific Targets



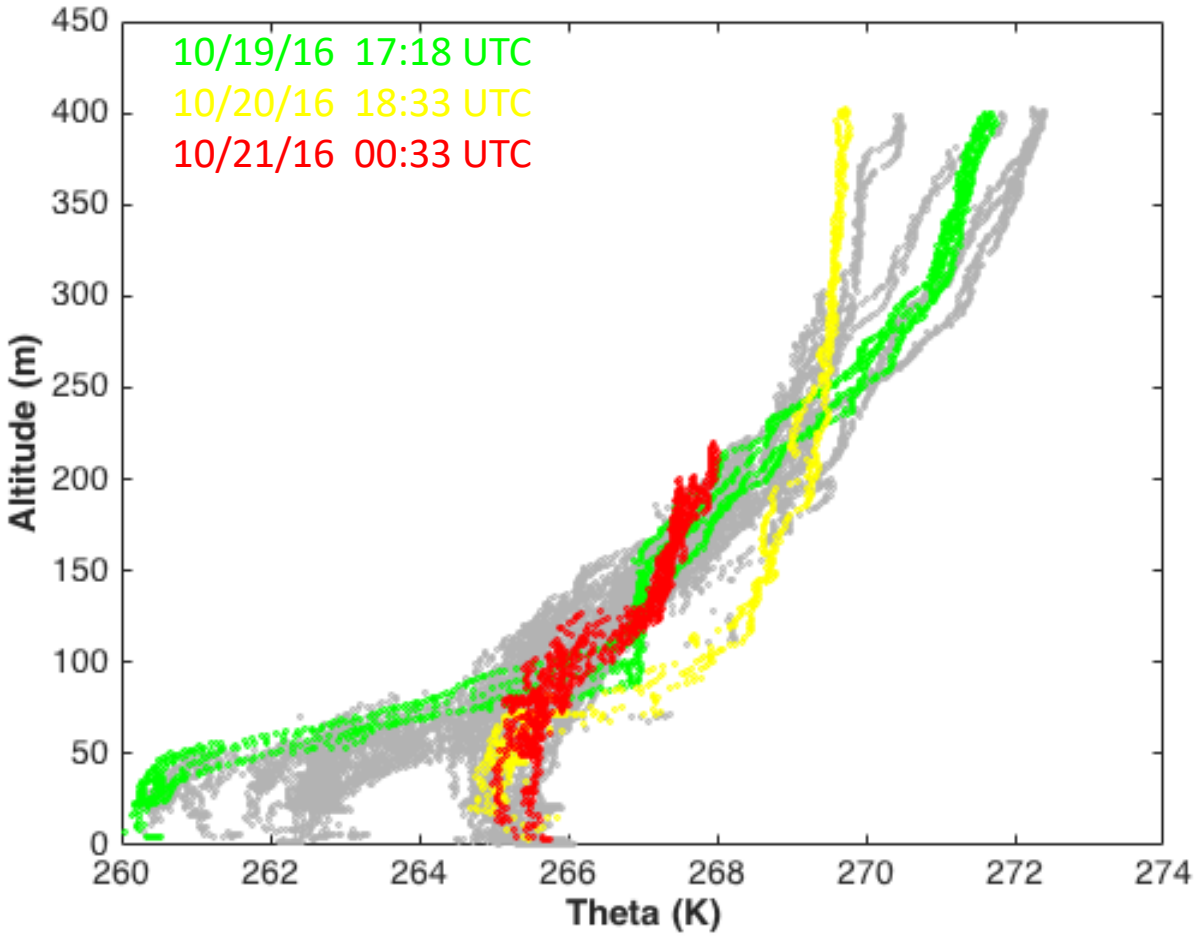
Radiative Cooling
- Drives buoyant production of turbulence
- Forces direct condensation within inversion layer
- Requires minimum amount of cloud liquid water

Microphysics
- Liquid forms in updrafts and sometimes within the inversion layer
- Ice nucleates in cloud
- Rapid ice growth promotes sedimentation from cloud

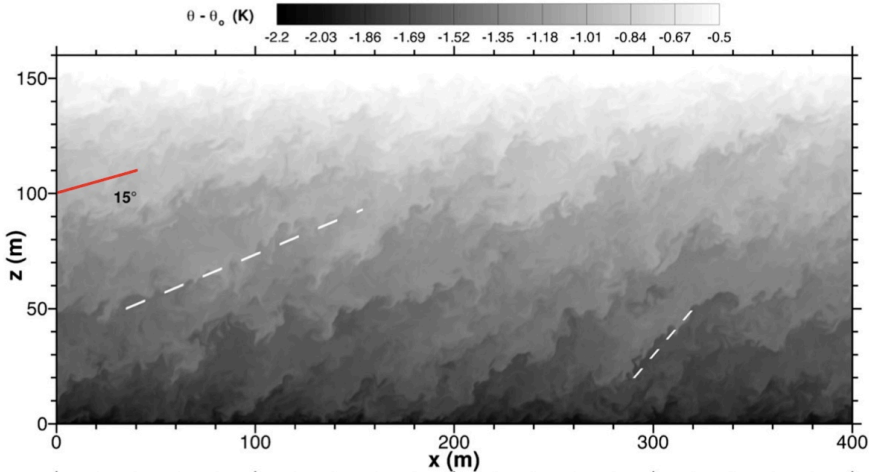
Dynamics
- Cloud-forced turbulent mixed layer with strong narrow downdrafts, weak broad updrafts, and q_{tot} and θ_E nearly constant with height
- Small-scale, weak turbulence in cloudy inversion layer
- Large-scale advection of water vapour important

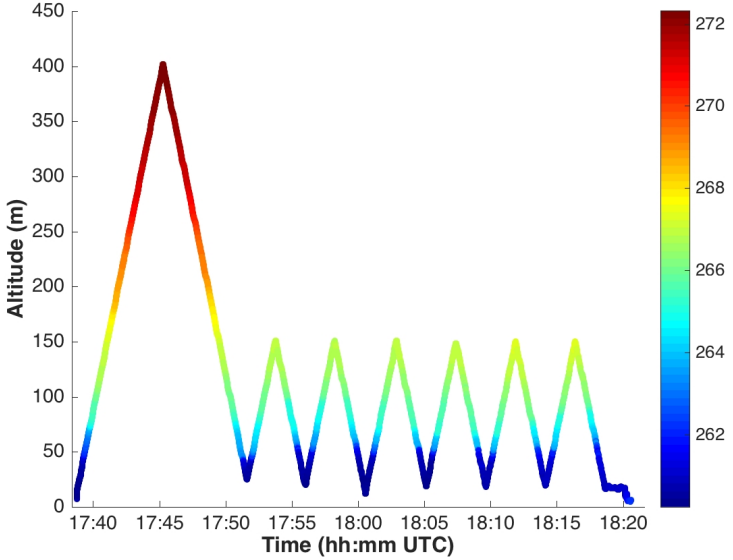
Surface Layer
- Turbulence and q contributions can be weak or strong
- Sink of atmospheric moisture due to ice precipitation
- Surface type (ocean, ice, land) influences interaction with cloud

Science Topics: Thermodynamic State

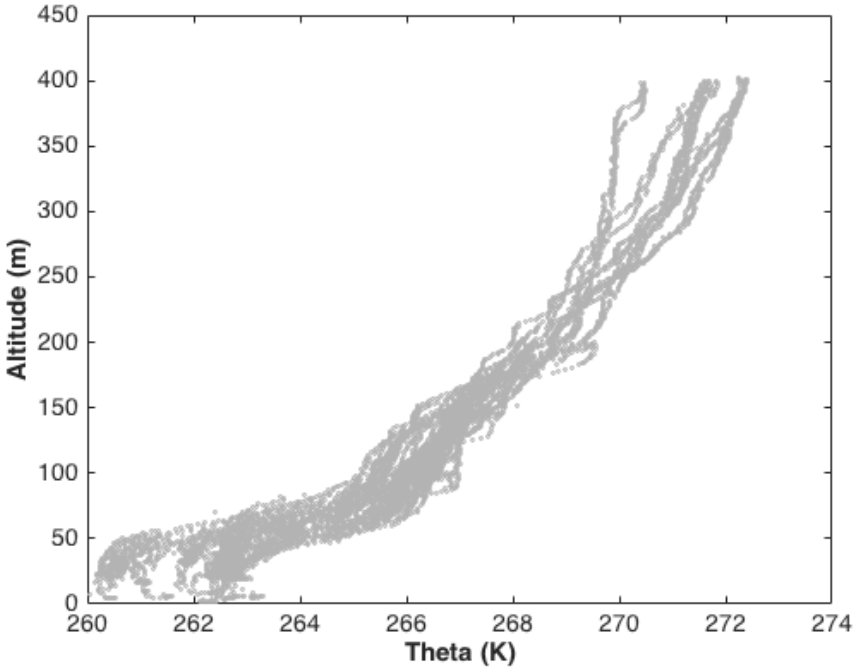


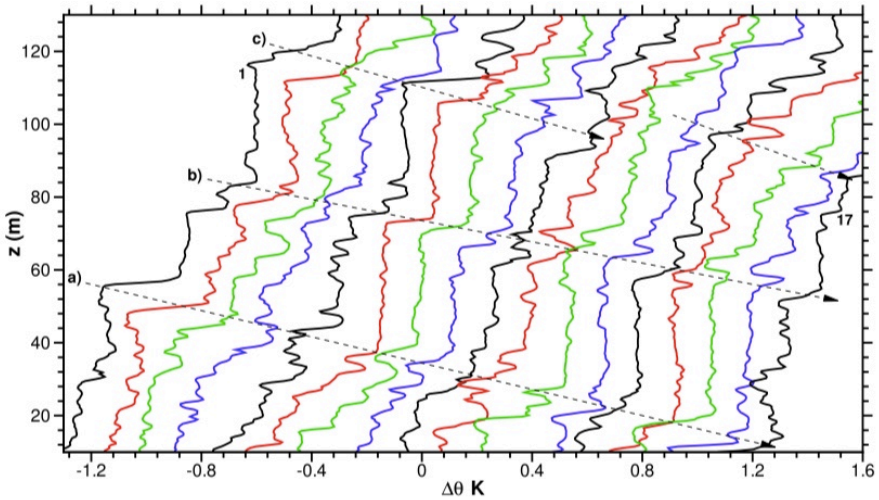
Science Topics: Stable Boundary Layers

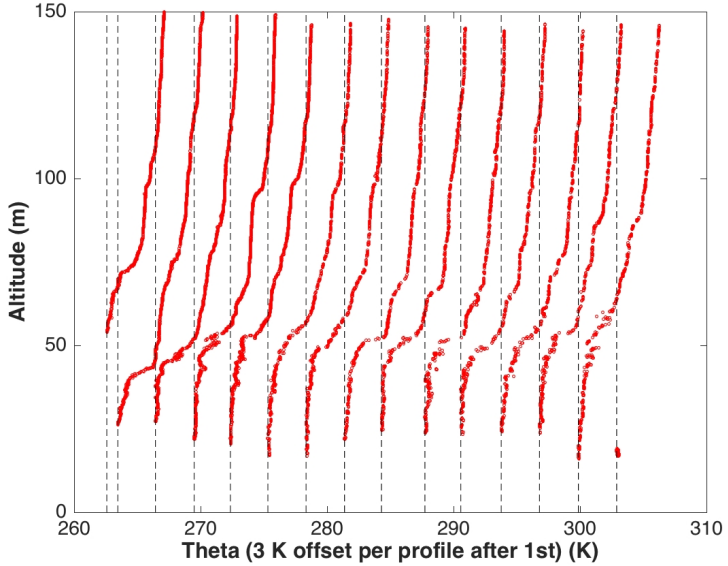




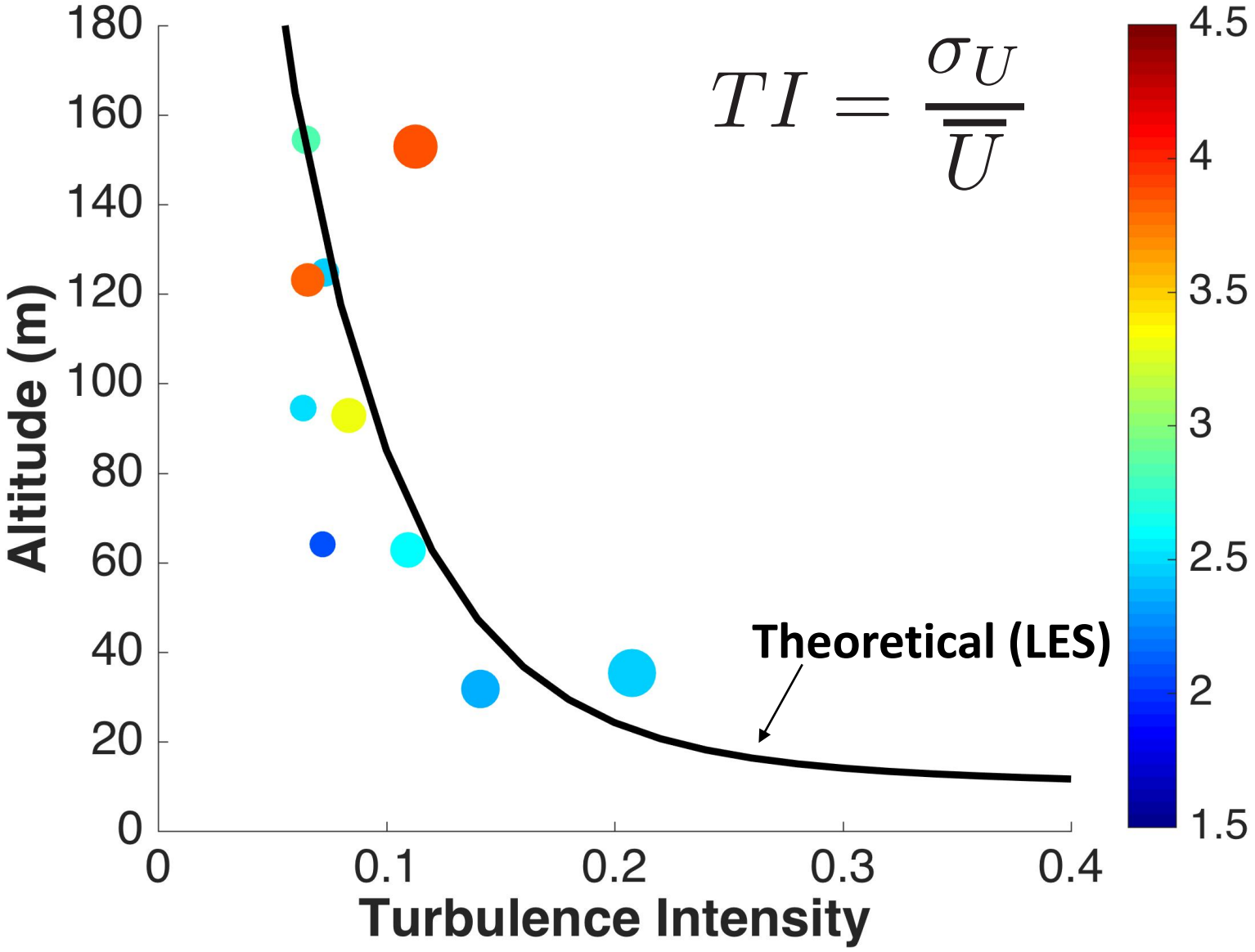
(Sullivan et al., 2016)

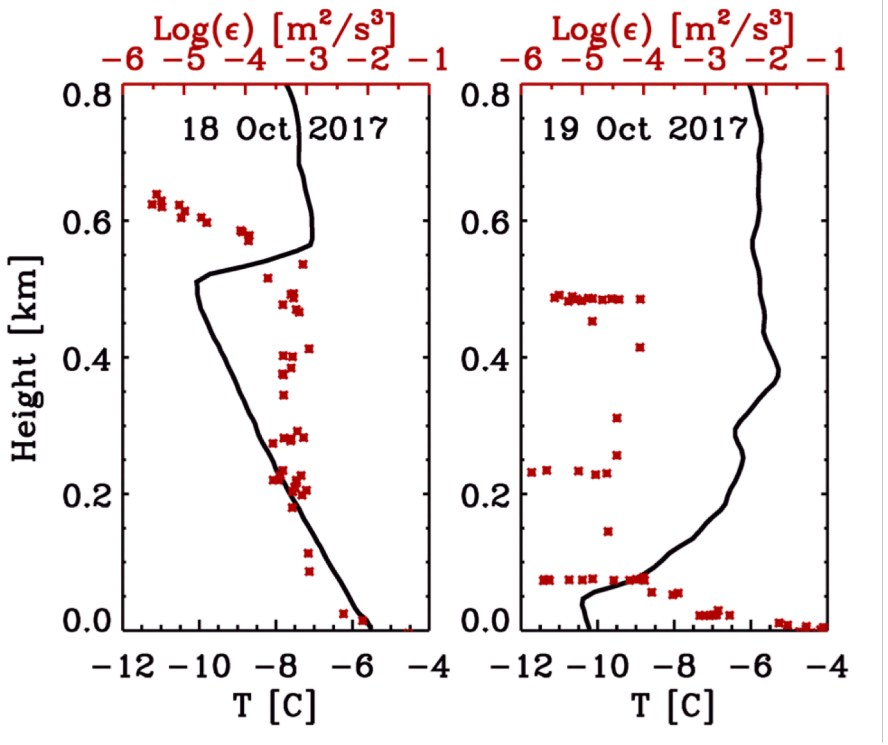


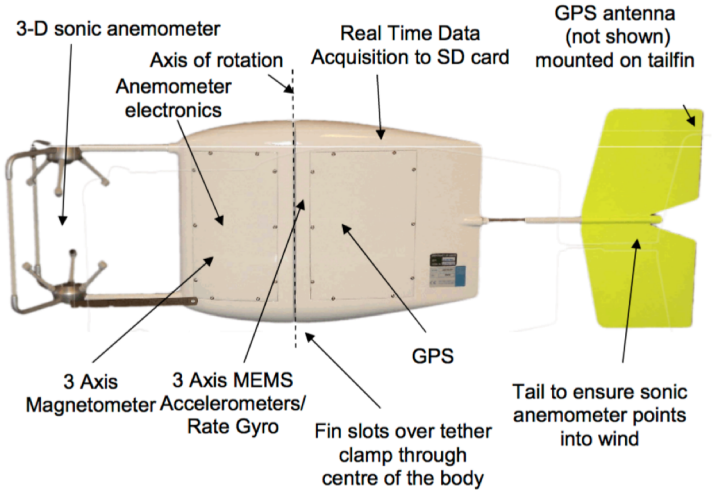




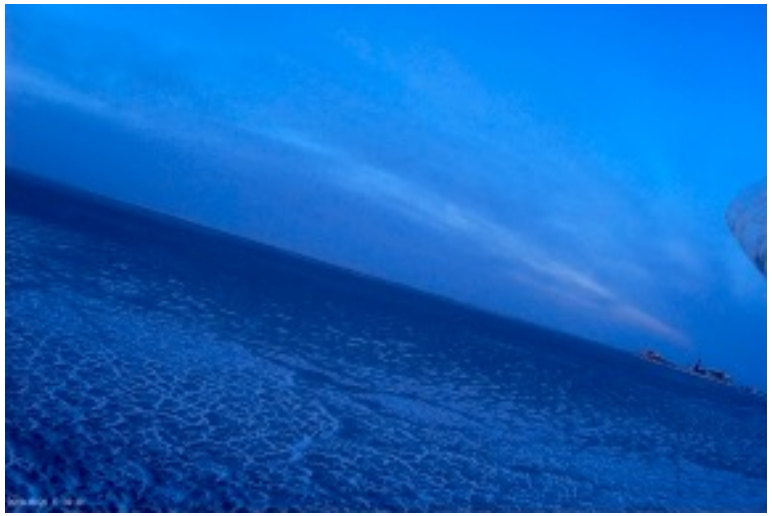
Science Topics: Turbulence Intensity

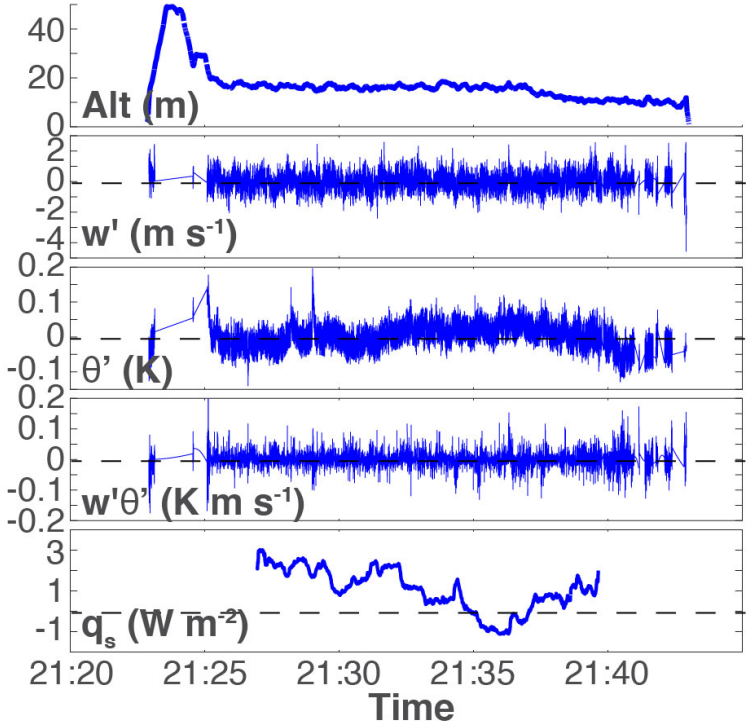


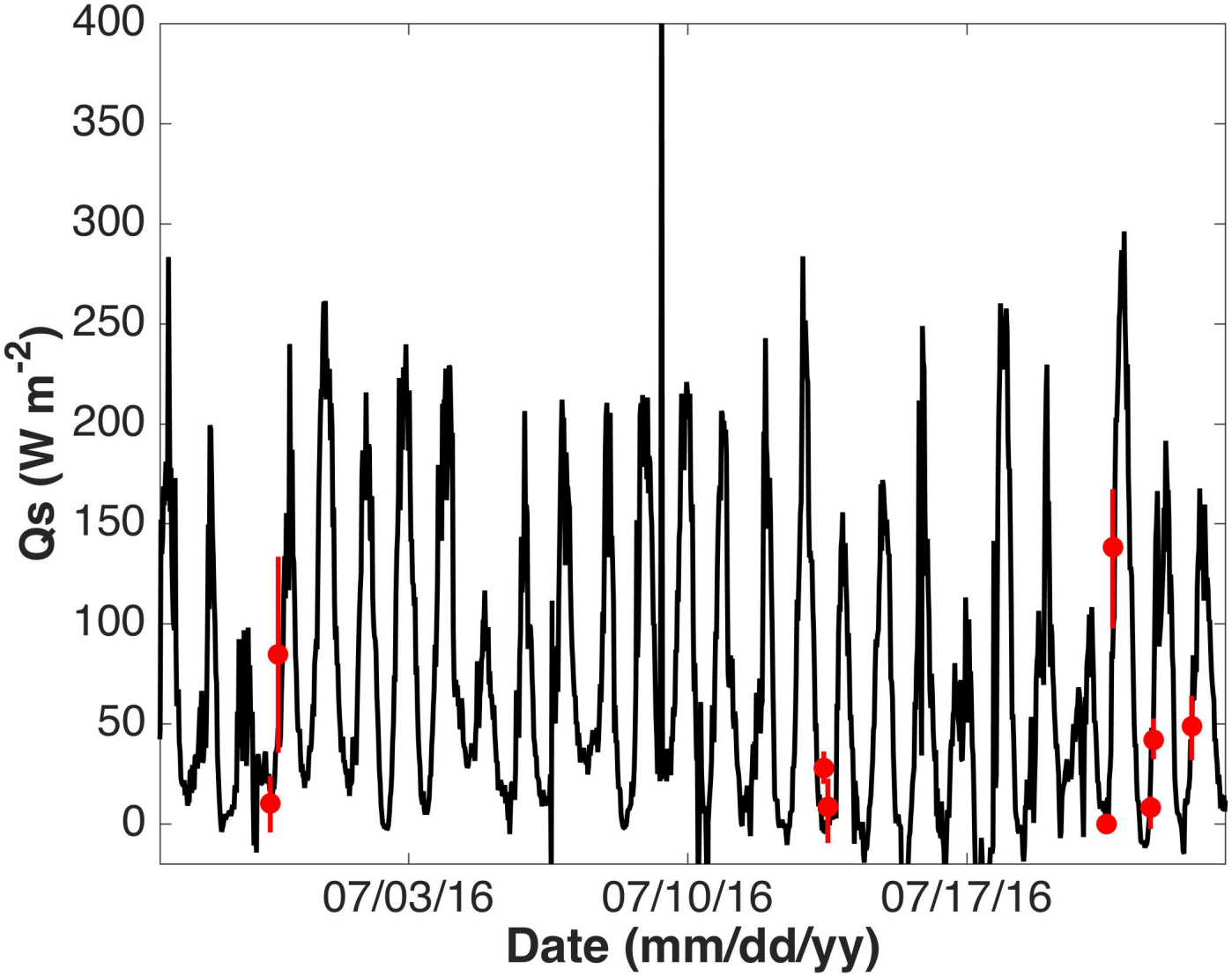




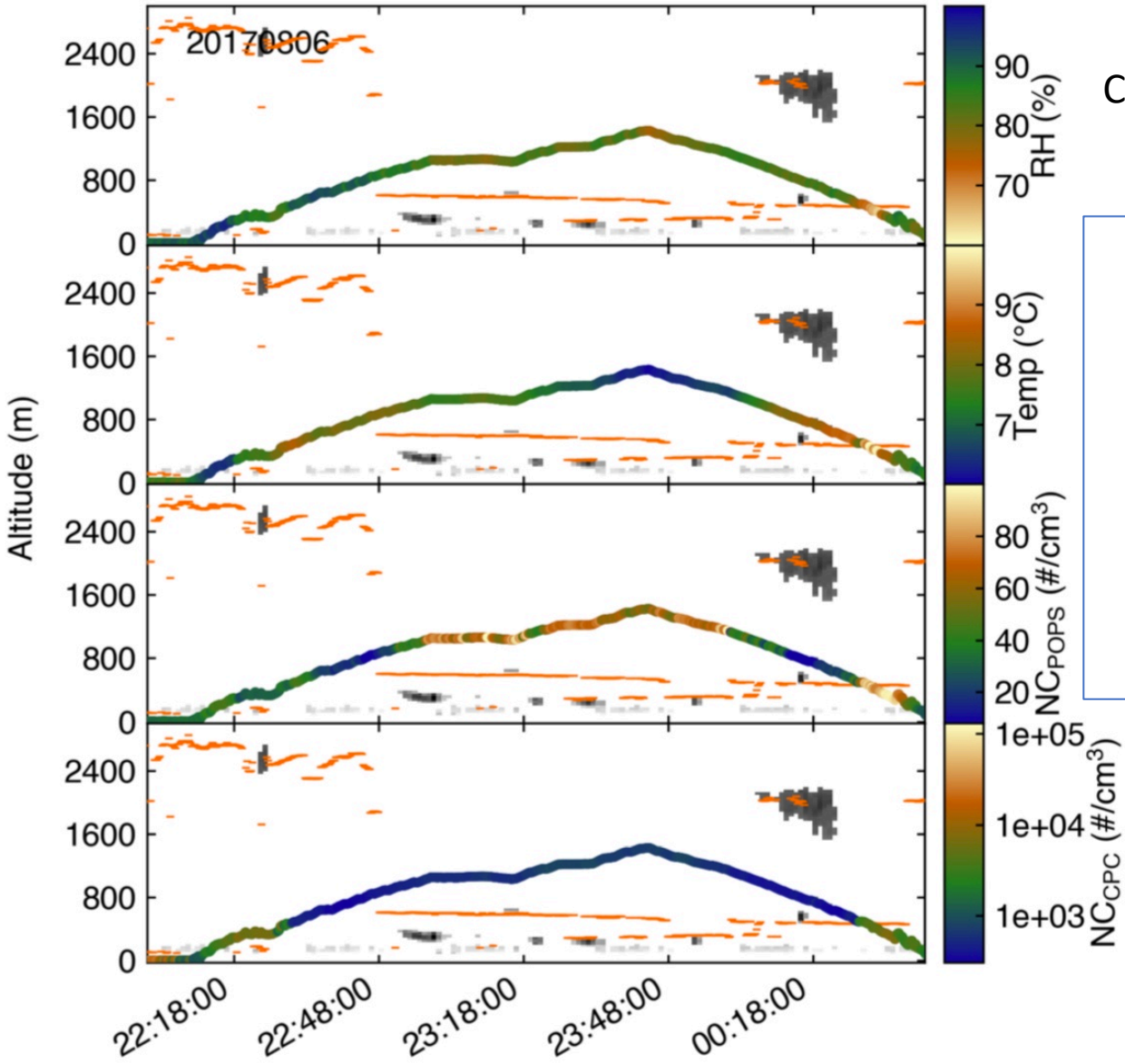
Science Topics: Surface Fluxes





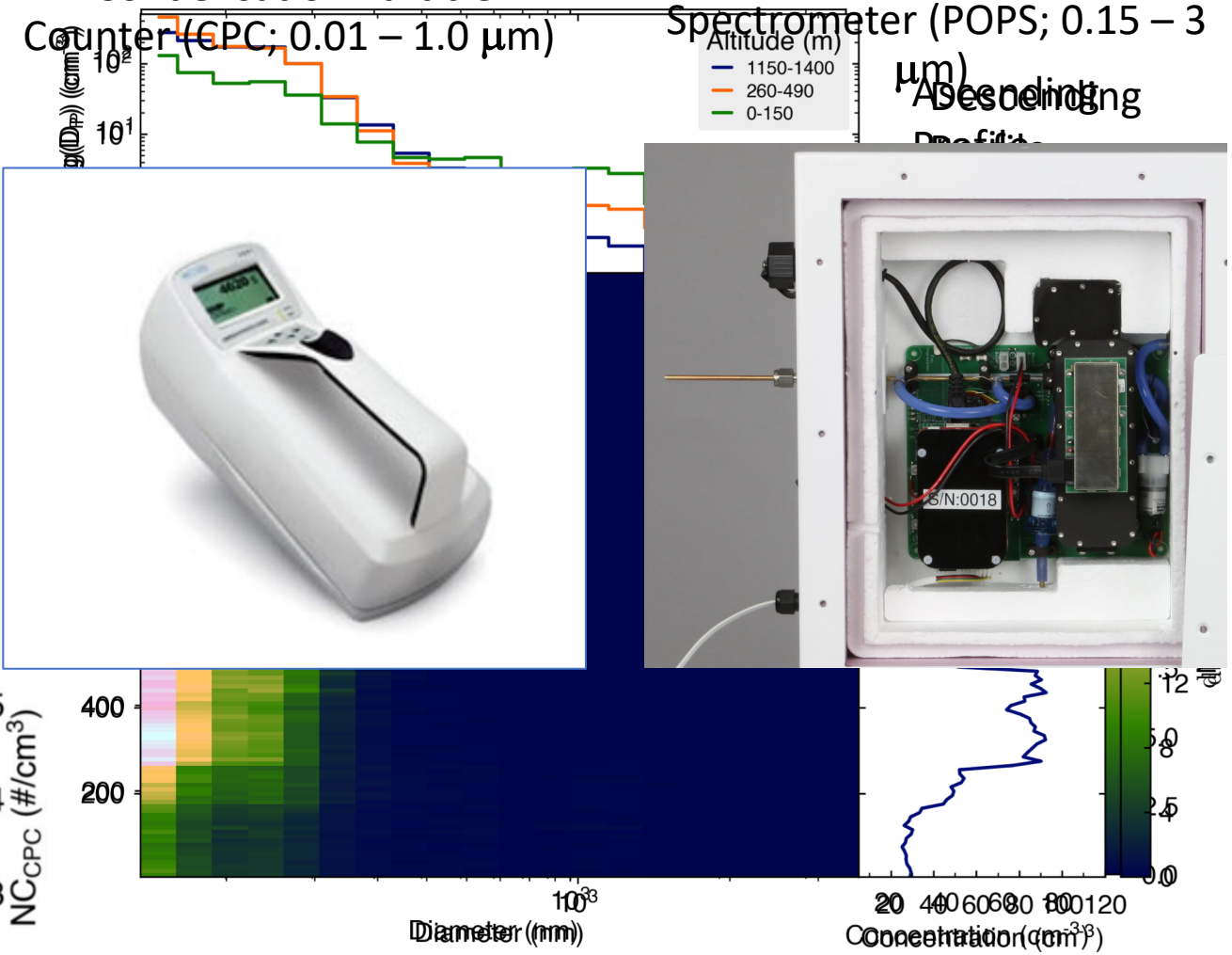


Science Topics: Aerosol-Cloud Interactions



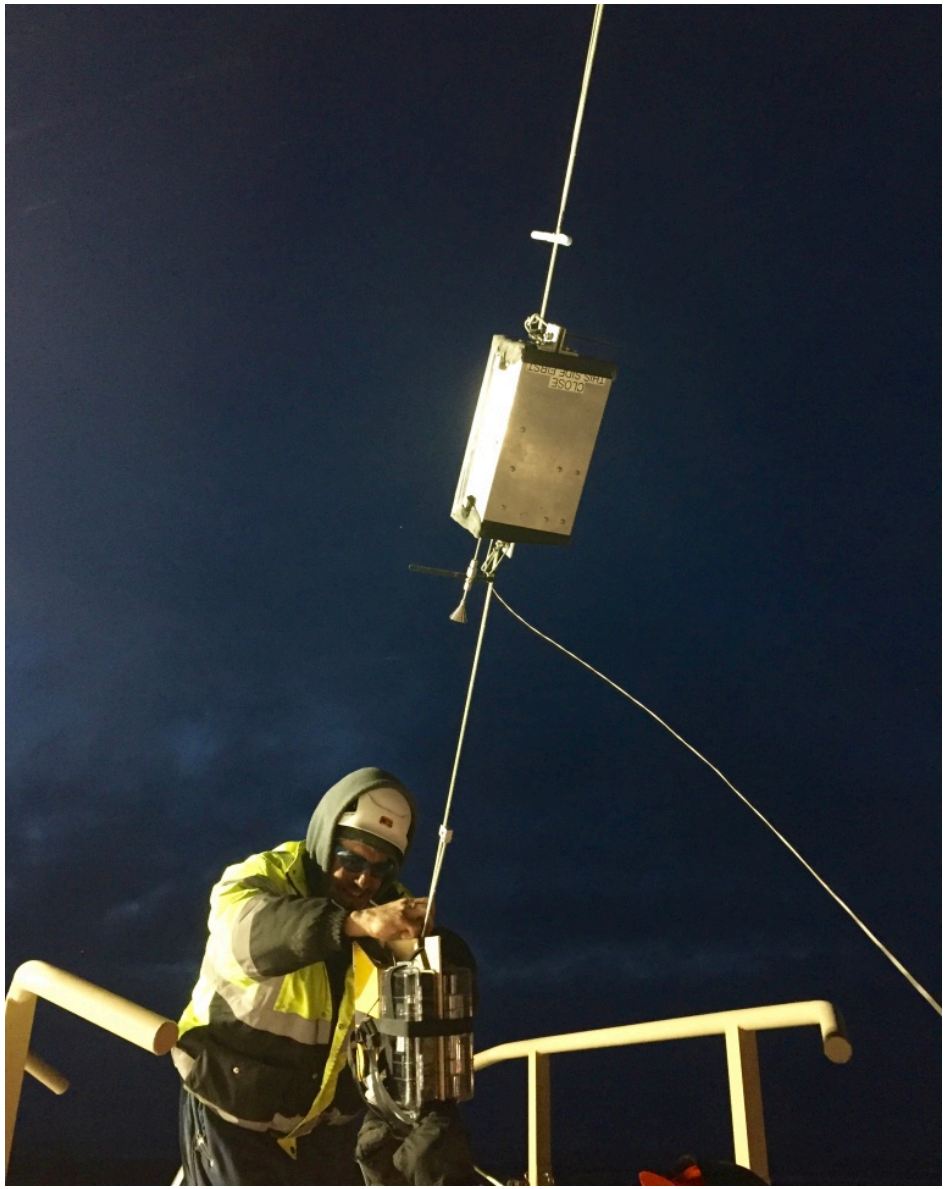
Condensation Particle Counter (CPC; 0.01 – 1.0 μm)

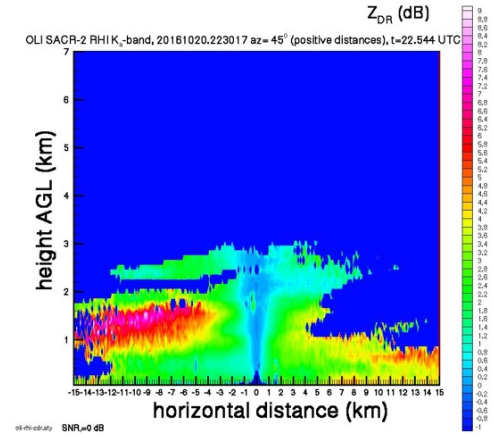
Printed Optical Particle Spectrometer (POPS; 0.15 – 3 μm)

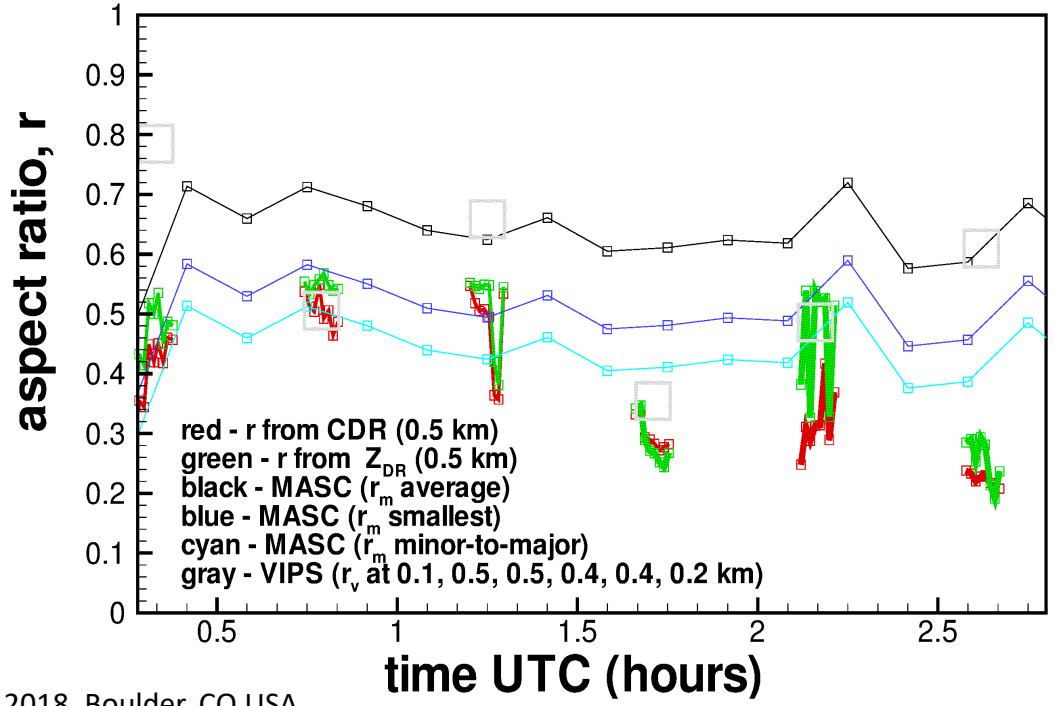


Science Topics: Ice Crystal Shapes

Matrosov et al. (2017)







Community Resource

arm.gov

Polarprediction: YOPP Arctic Science Workshop 2019 – Abstract Submission | ARM Research Facility

CAMPAIGN PROCESS

ARM accepts proposals for two types of field campaigns:

- Small Campaigns – These campaigns cost ARM less than $300k and may include deployment of guest instruments at ARM observatories, use of instruments for offsite deployments, or special operations, such as enhanced radiosonde or special scanning strategies.
- Annual Facility Call Campaigns – These campaigns typically exceed $300k cost to ARM and include a large fixed-location atmospheric observatory campaign, and/or deployment of ARM mobile facilities (AMF) and/or the ARM aerial facilities (AAF).

Before proposing a field campaign, principal investigators should read the expectations for principal investigators and review the ARM field campaign guidelines to ensure they understand all responsibilities and determine if their campaign fits the parameters defined by ARM. The field campaign guidelines also describe the proposal review process and timeline. Proposals are reviewed quarterly to annually depending on the size of the proposed campaign.

SEARCH CAMPAIGNS

Search...

READ – Review instructions carefully.

SUBMIT – Fill out and submit the pre-proposal form.

WAIT – Please be patient while the IMB reviews proposals.

RESPOND – A full proposal or science plan may be requested.

CONDUCT – Execute the campaign as proposed/approved.

CLOSE OUT – Submit any data and a final report.

PROPOSING A CAMPAIGN

To propose a campaign, principal investigators must first submit a pre-proposal. Read the field campaign pre-proposal instructions for detailed information on how to fill out and submit the pre-proposal form.

The initial review of pre-proposals and responses to the principal investigators (PIs) will normally be communicated within four weeks of submission and may include requests for clarifying information, an abbreviated or a full proposal, and/or information regarding the review timeline.

PROPOSAL DEADLINES | PROPOSE A CAMPAIGN

EXECUTING A CAMPAIGN

Before a campaign begins, the PI must submit an abstract, suitable for posting on the ARM website. Based on the scope the field campaign, a science plan may also be required. The PI should work closely with the appropriate site manager regarding

ACKNOWLEDGING ARM

The Atmospheric Radiation Measurement (ARM) user facility should be acknowledged in publications as the origin of field studies or data used in the research.

Investigators who receive ARM support (e.g., logistical support for guest instrument deployments or ARM mentor support) should also properly acknowledge the Office of Biological and Environmental Research (BER) and ARM.

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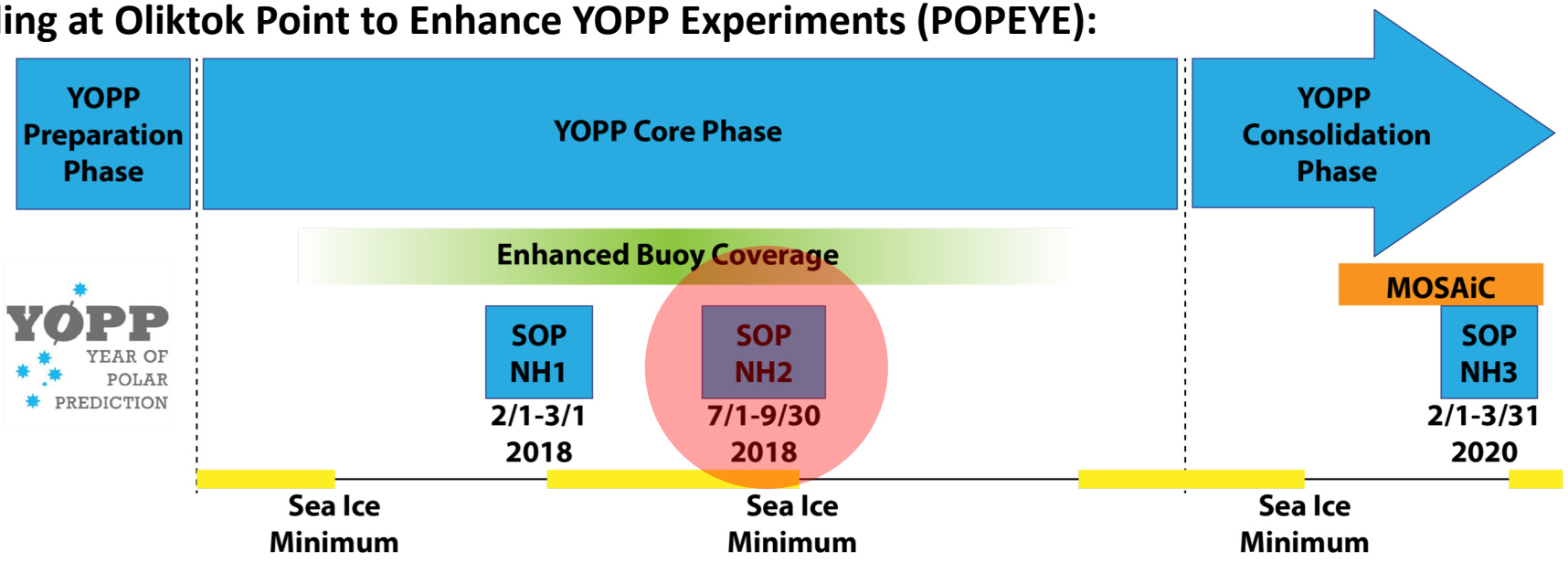
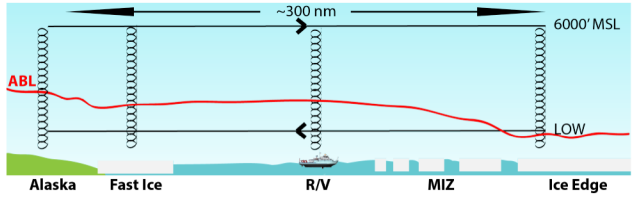
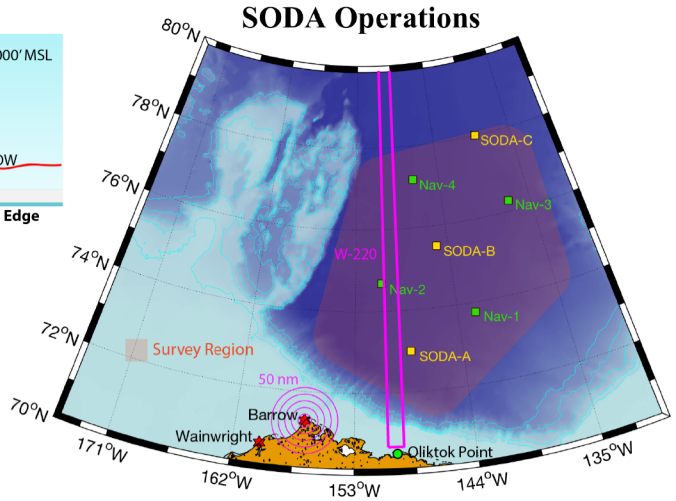
Looking Ahead

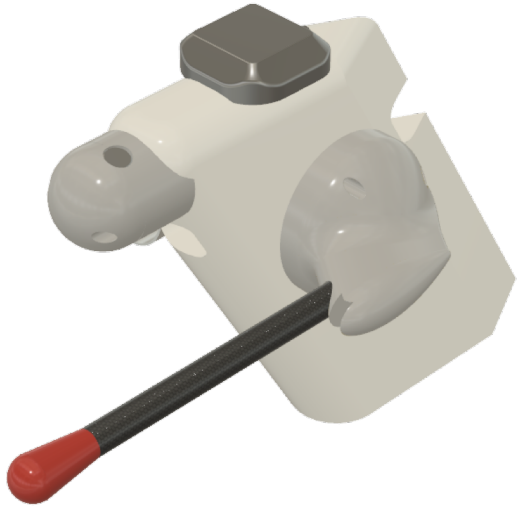
Profiling at Oliktok Point to Enhance YOPP Experiments (POPEYE):



Stratified Ocean Dynamics of the Arctic (SODA):







Summary and Acknowledgments

Summary:

- UAS have been deployed to northern Alaska (Oliktok Point) to provide new perspectives to help us answer fundamental questions about the physics of the Arctic atmosphere.
- The ARM Climate Research Facility has developed an operational UAS observing capability through a variety of campaigns, including the combined engineering and research campaign ICARUS.
- Over a series of deployments, measurements were obtained of lower atmospheric thermodynamic state, turbulence, turbulent fluxes, aerosols and precipitation.
- These measurements are now beginning to be used to evaluate model physics across several numerical models.
- The ARM UAS capability can now be requested for scientific deployment by the community through a proposal process.

Acknowledgments:

References:

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