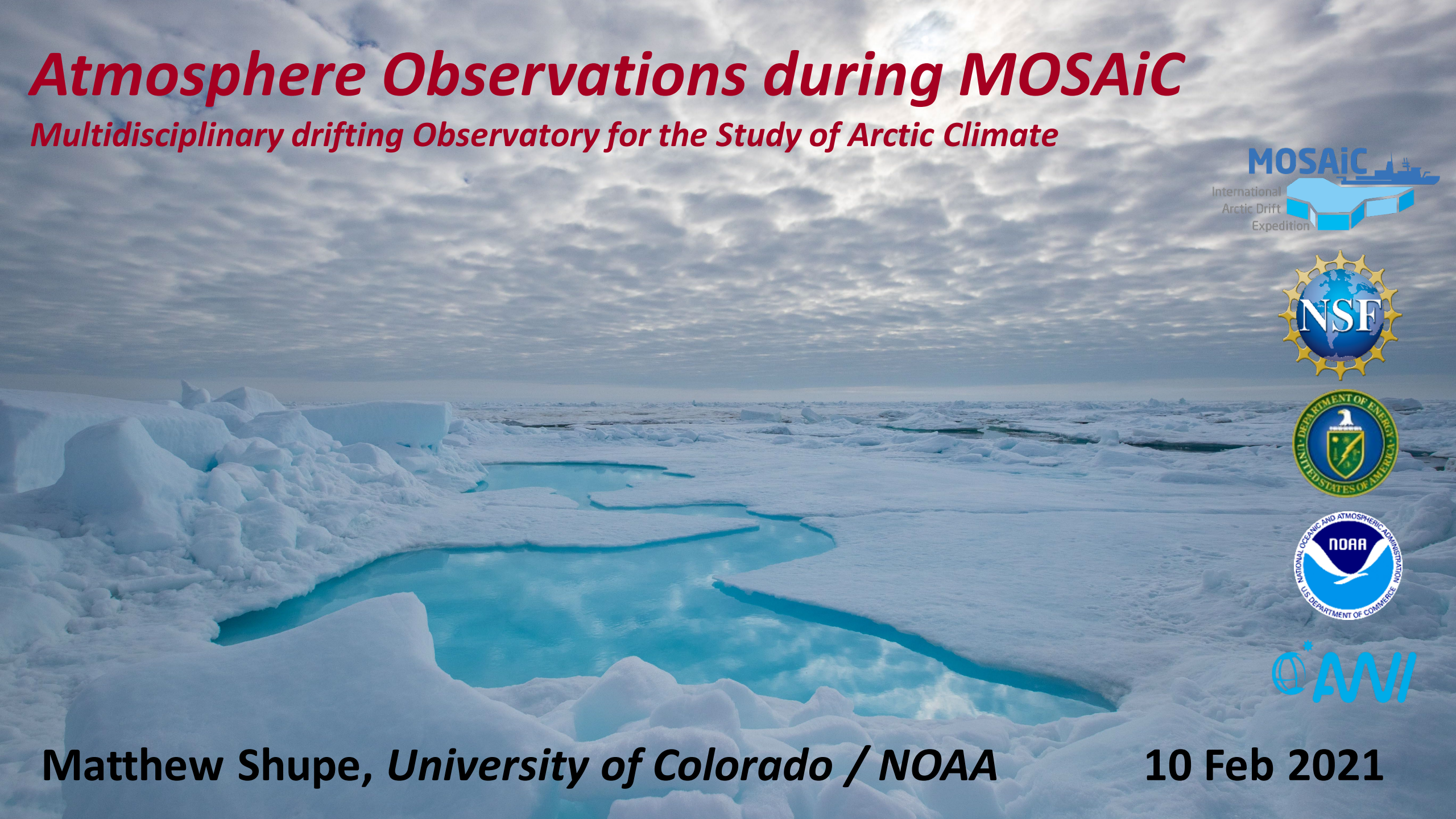
Atmosphere Observations during MOSAiC

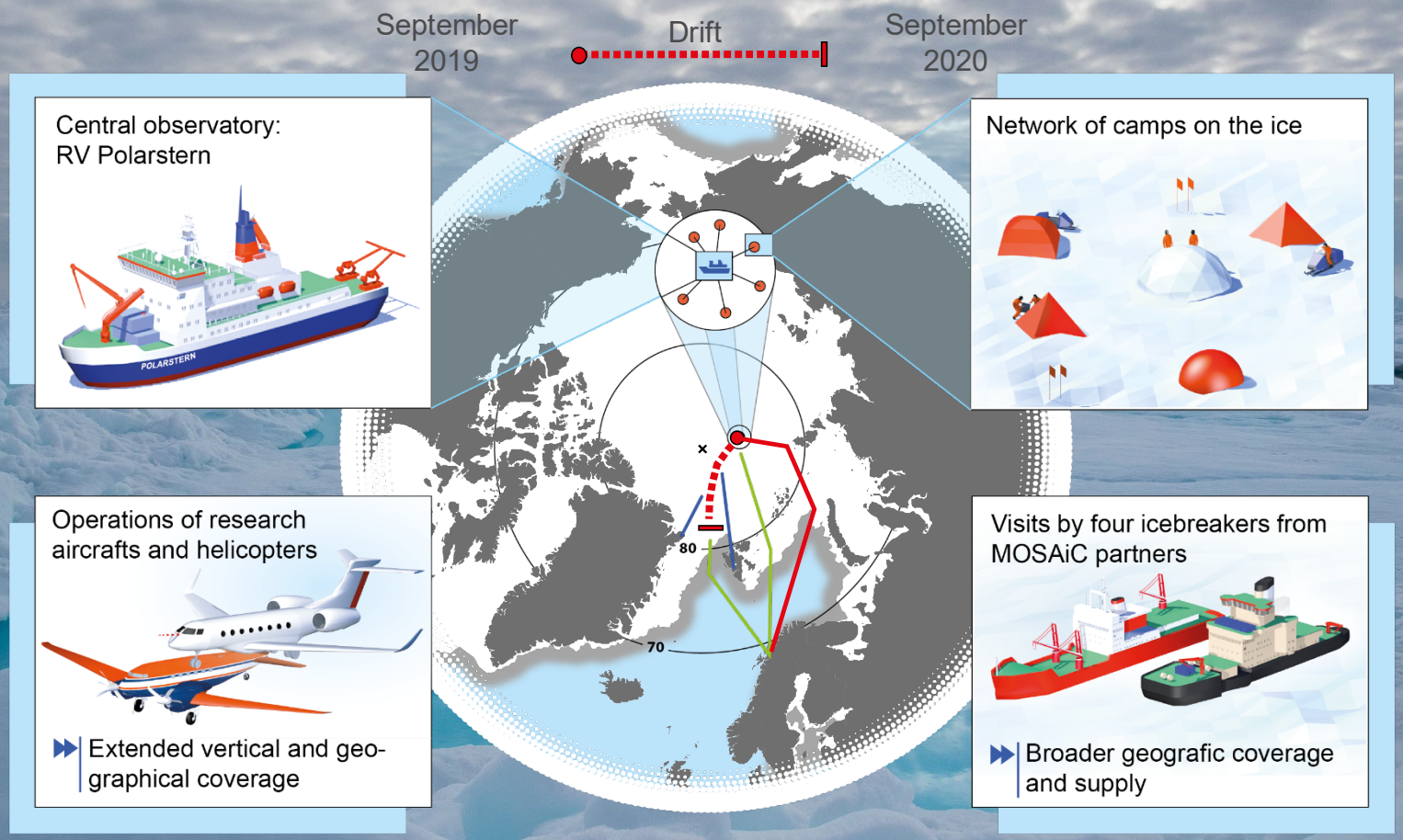
Multidisciplinary drifting Observatory for the Study of Arctic Climate

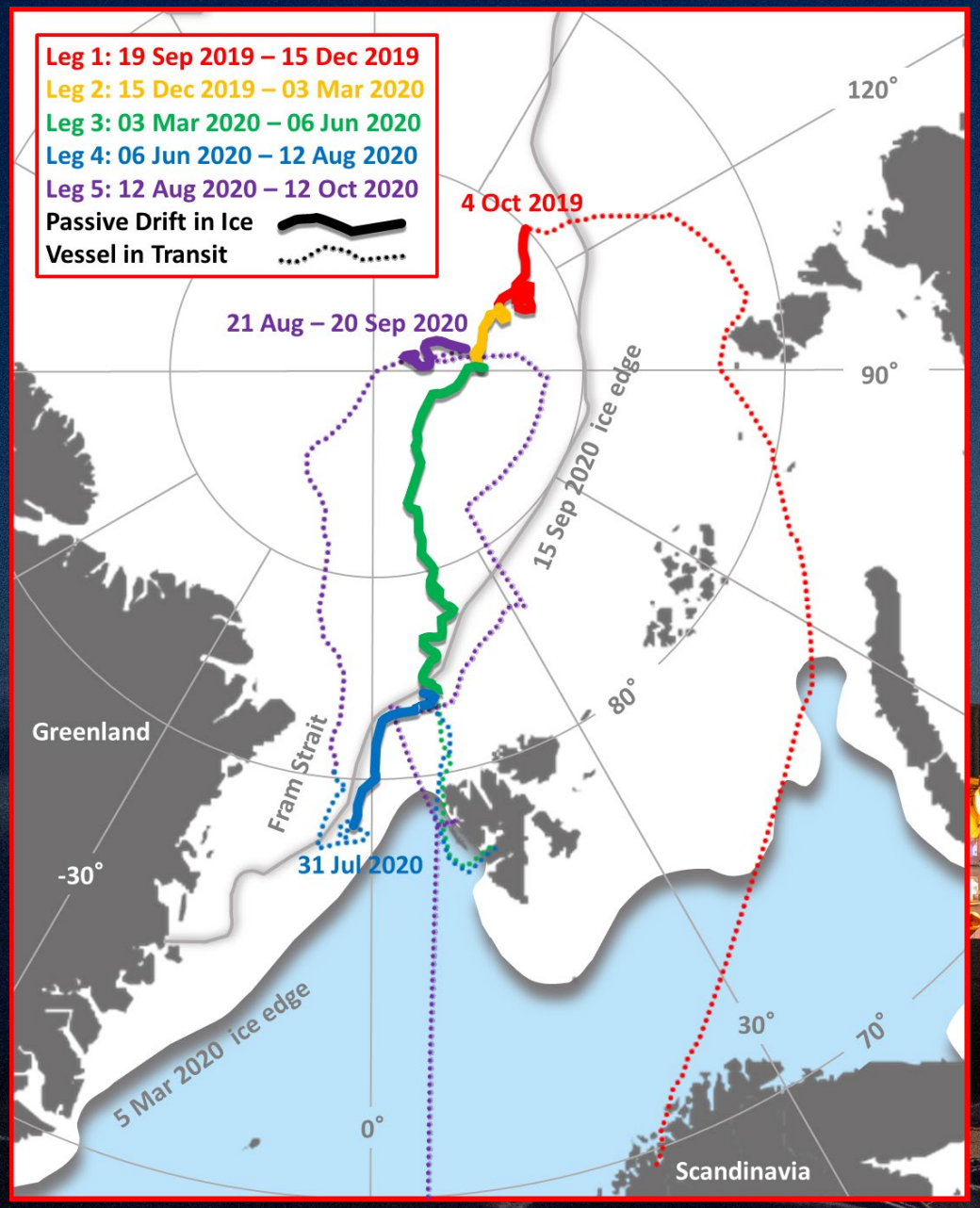


Matthew Shupe, *University of Colorado / NOAA*

10 Feb 2021

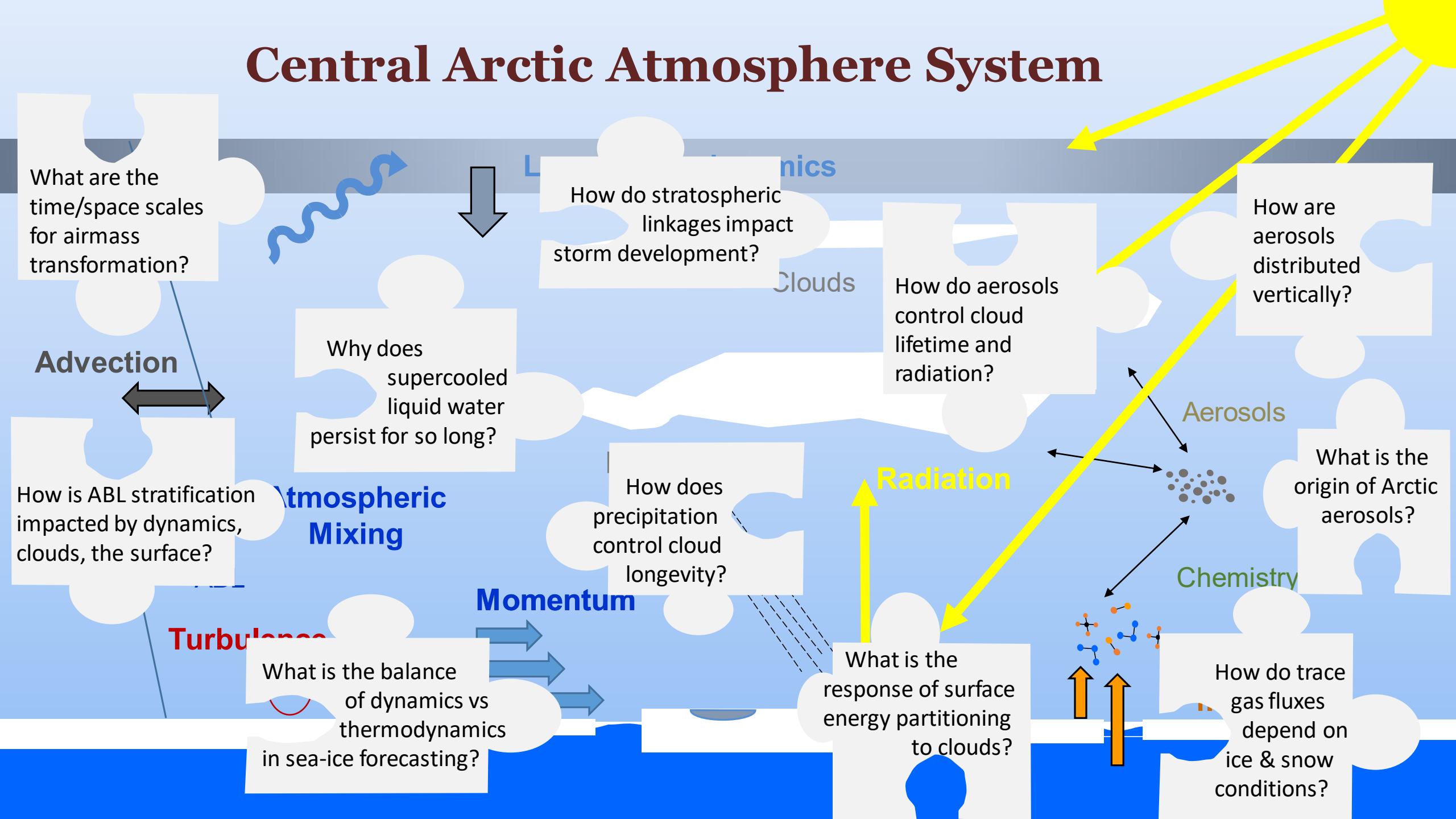
MOSAiC: The Plan



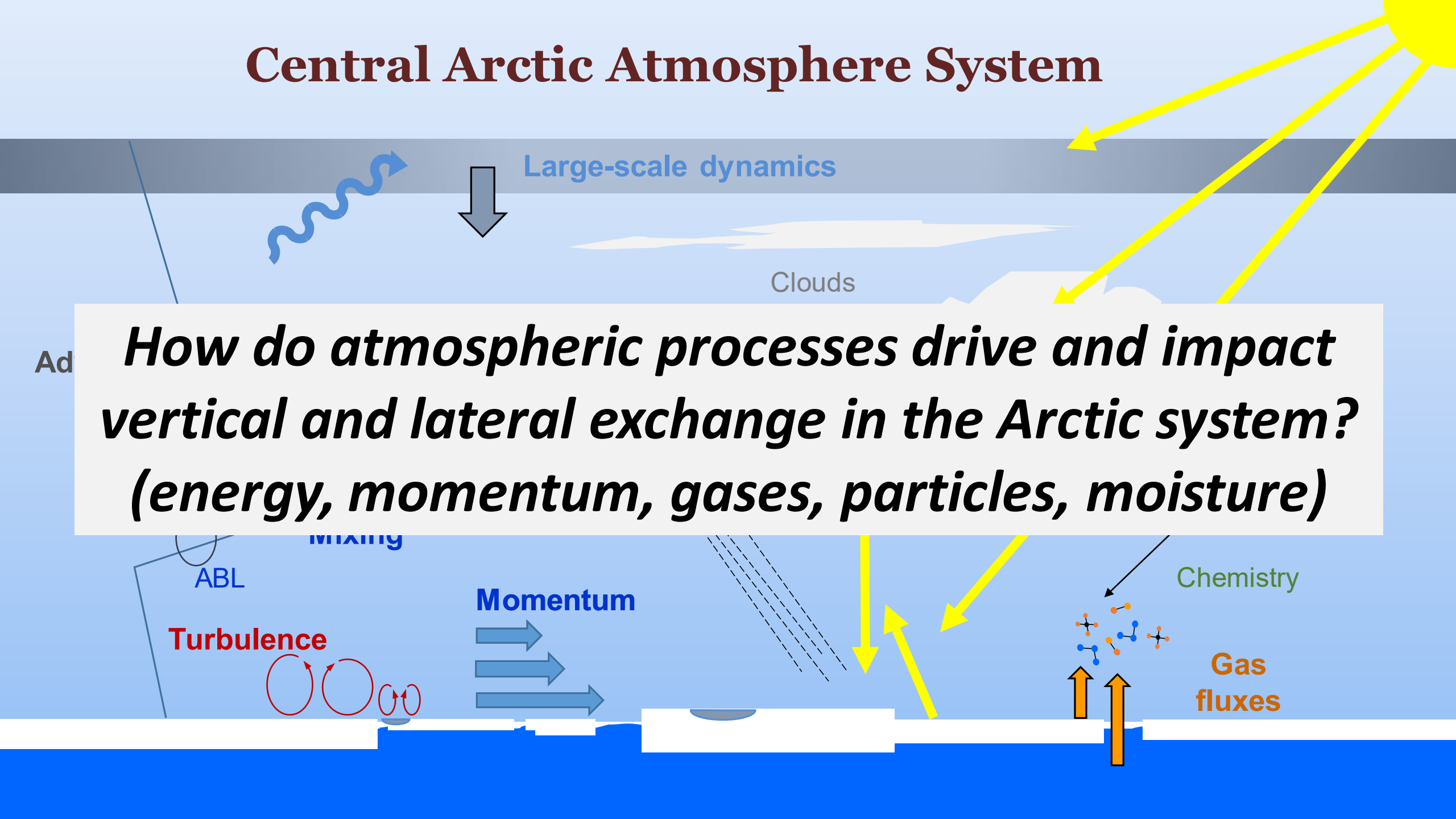


A Year in the Arctic ice

Central Arctic Atmosphere System



Central Arctic Atmosphere System

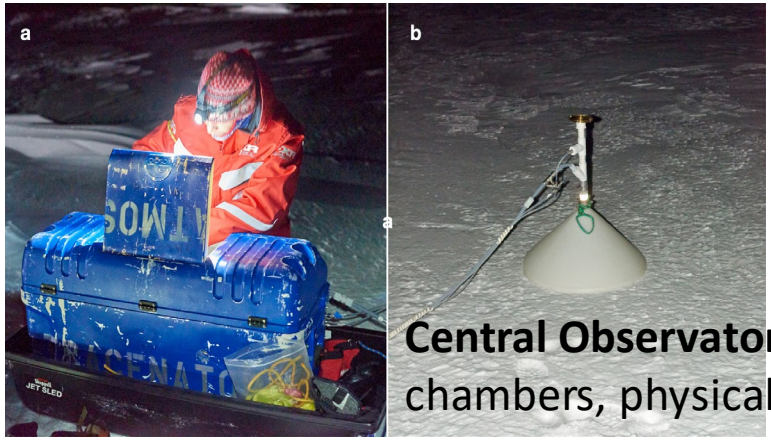


How do atmospheric processes drive and impact vertical and lateral exchange in the Arctic system? (energy, momentum, gases, particles, moisture)

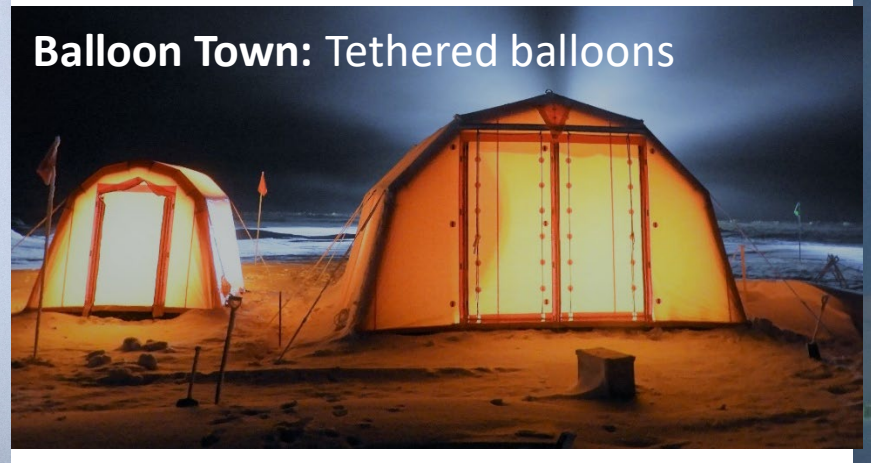
Where was ATMOS?

Polarstern:
Balloons
P-deck instruments

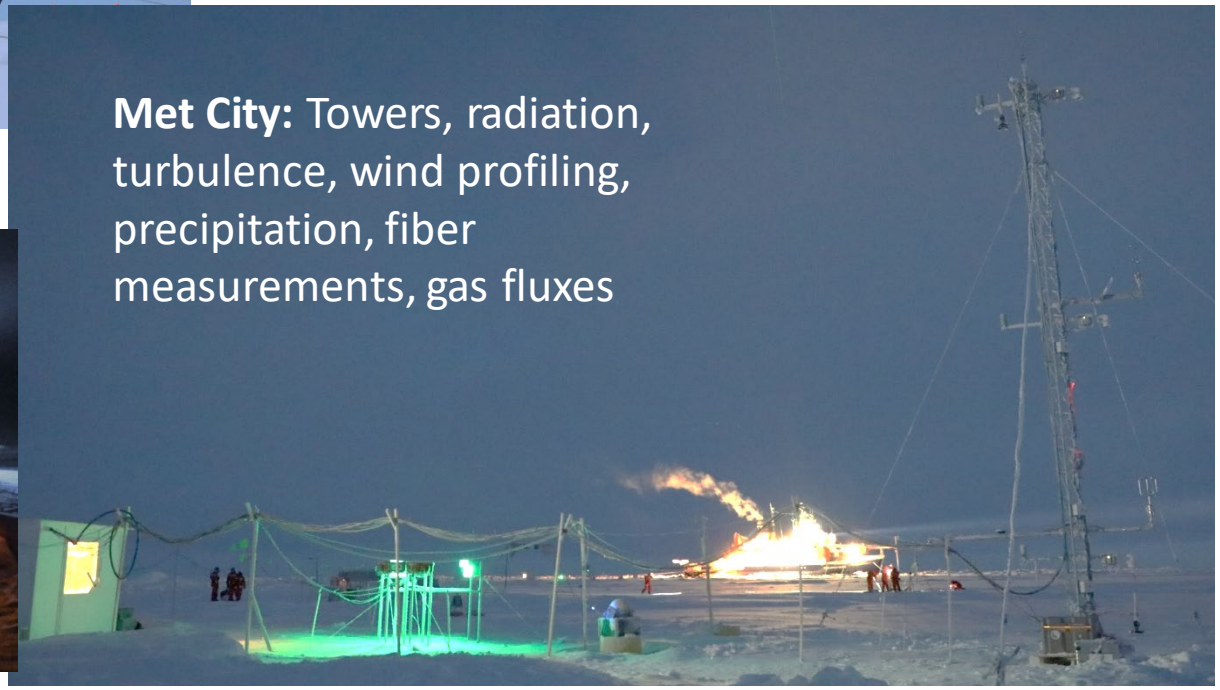
Polarstern:
8 bow containers
1 inside container
Bow crane/tower



Central Observatory: Flux chambers, physical samples

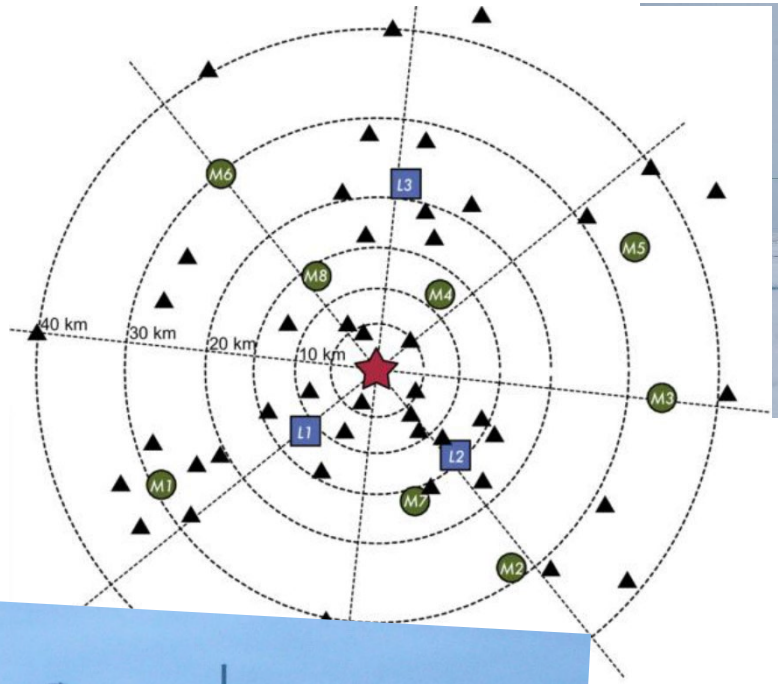


Balloon Town: Tethered balloons

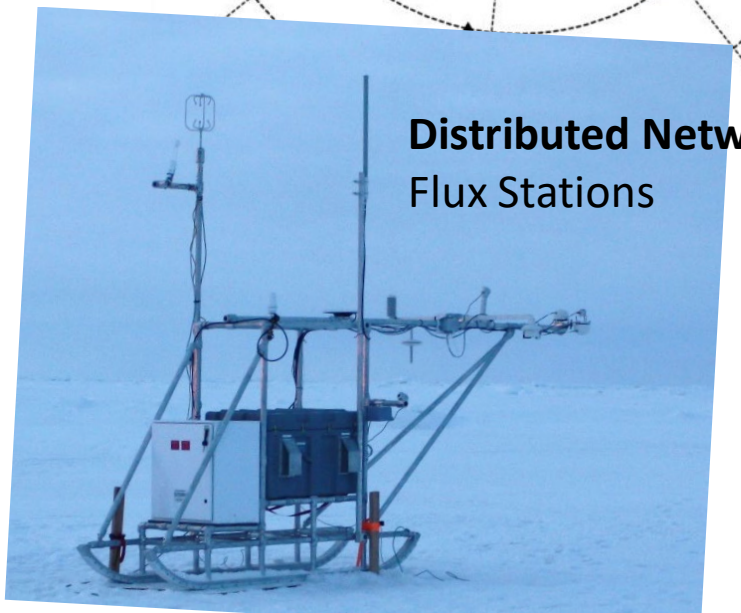


Met City: Towers, radiation, turbulence, wind profiling, precipitation, fiber measurements, gas fluxes

Where was ATMOS?



Flying all around: UAS

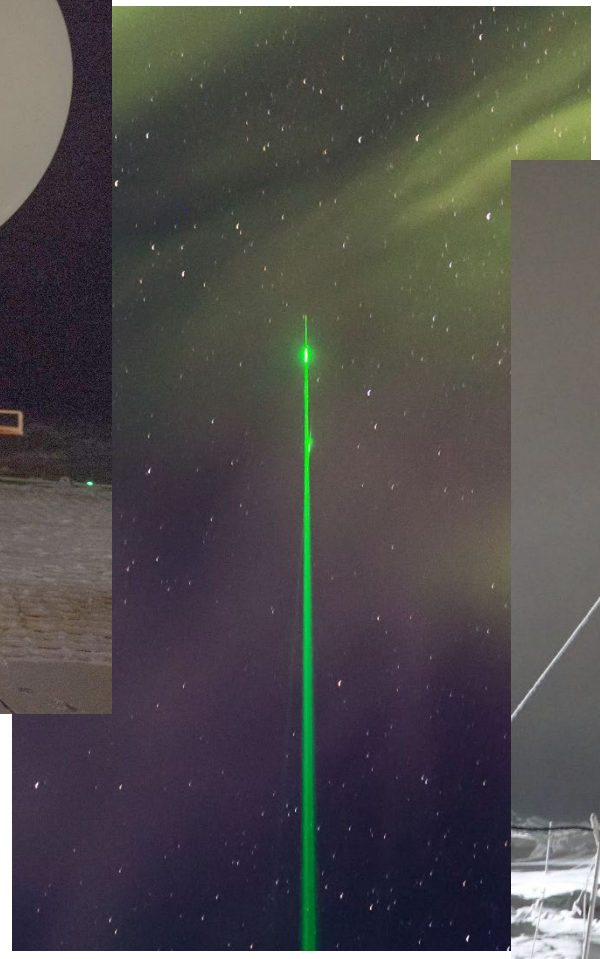


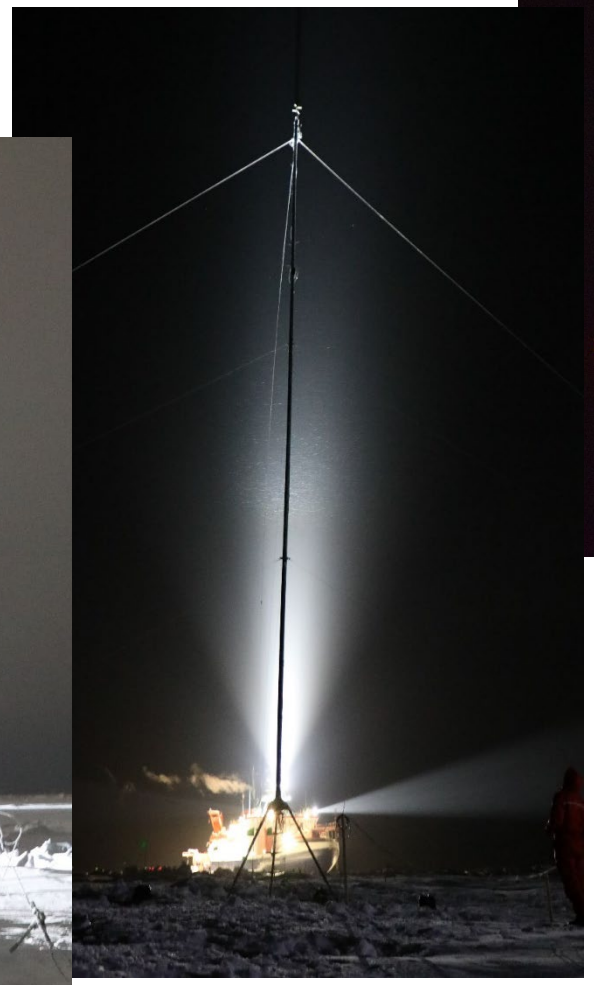
Distributed Network:
Flux Stations

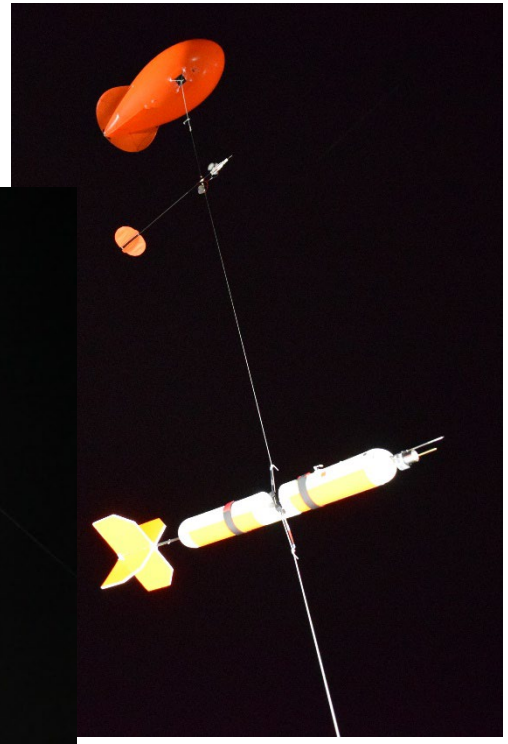
Aircraft:
Late Aug > early Sept

Profiling Atmospheric Structure

Temperature and moisture profiling

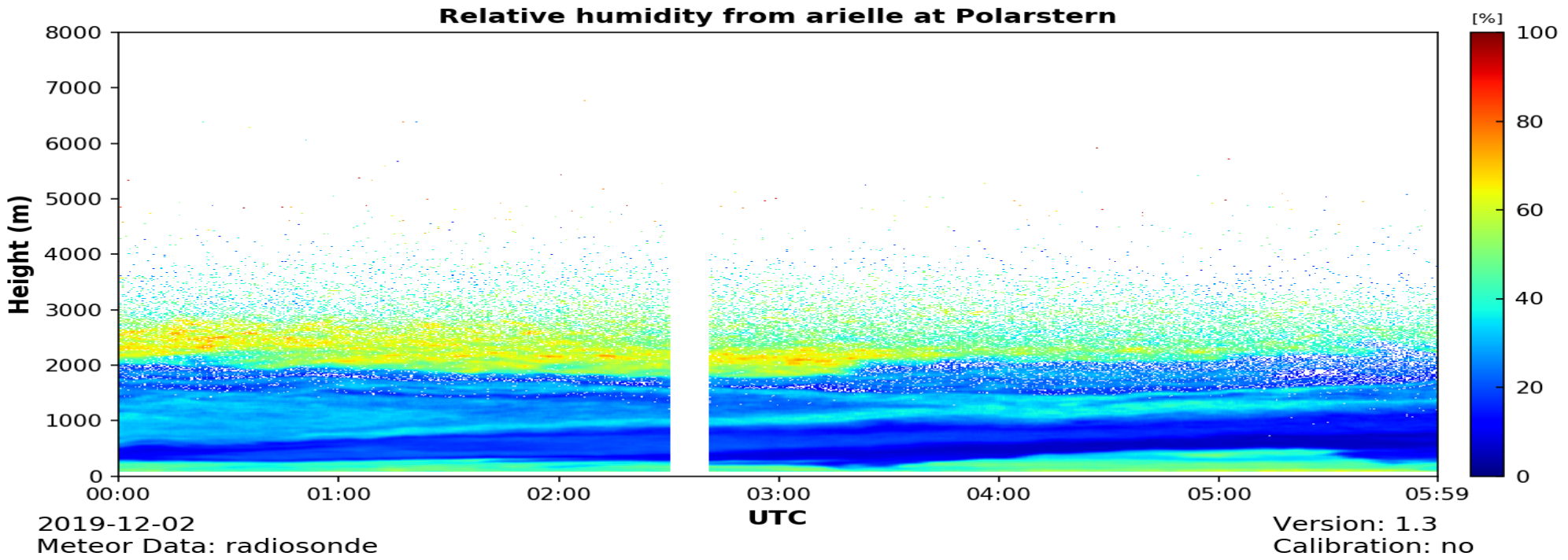




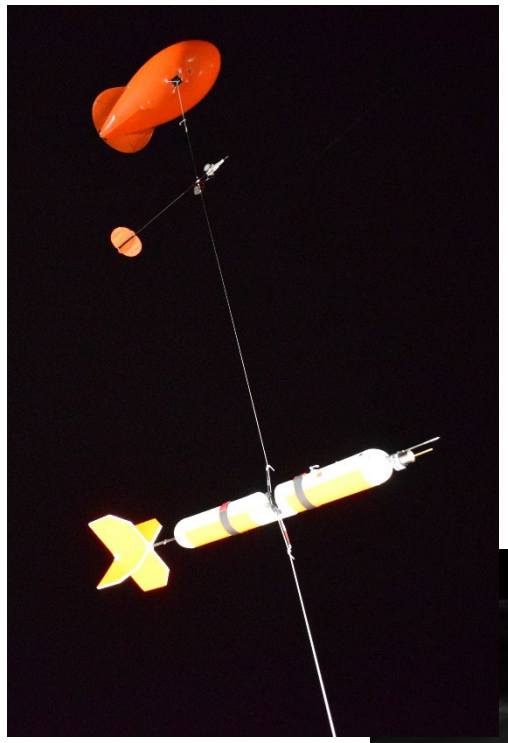


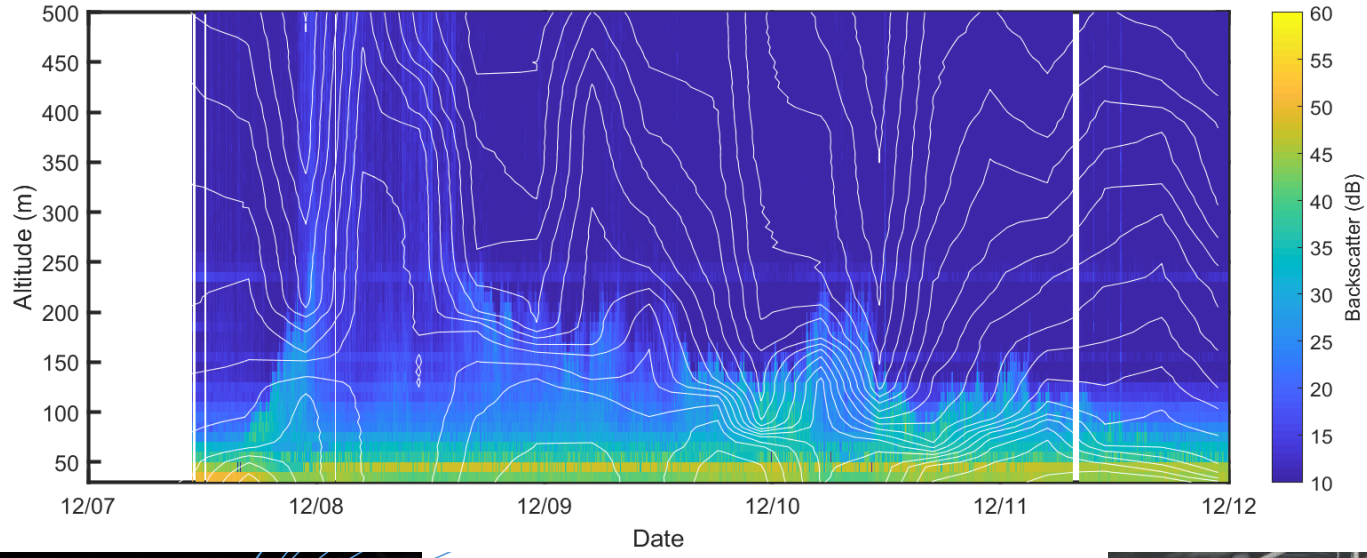
Profiling Atmospheric Structure

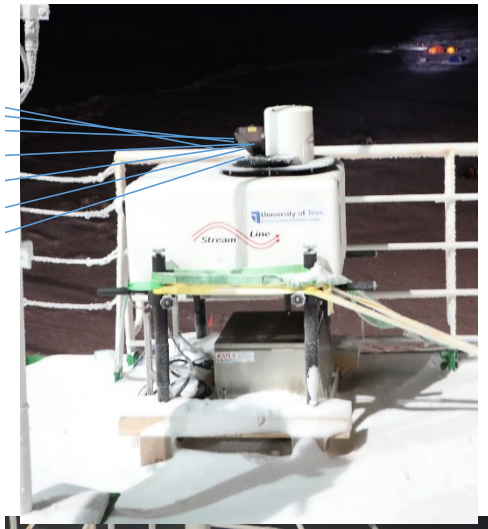
- Continuous sounding program with 4+ soundings / day >> widely used, assimilation
- First long-term, continuous humidity profiling >> insight into airmasses
- Detailed near-surface ABL observations from towers and fiber >> stratification
- 100s of hours of tethered balloon and UAS profiles >> unique insight on ABL structure, aerosols, and more

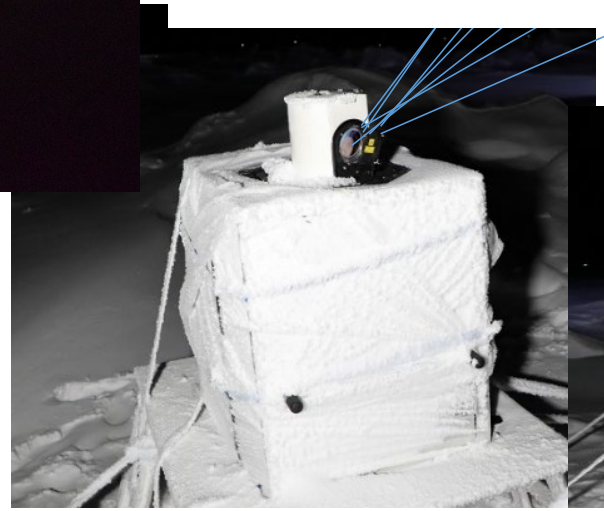


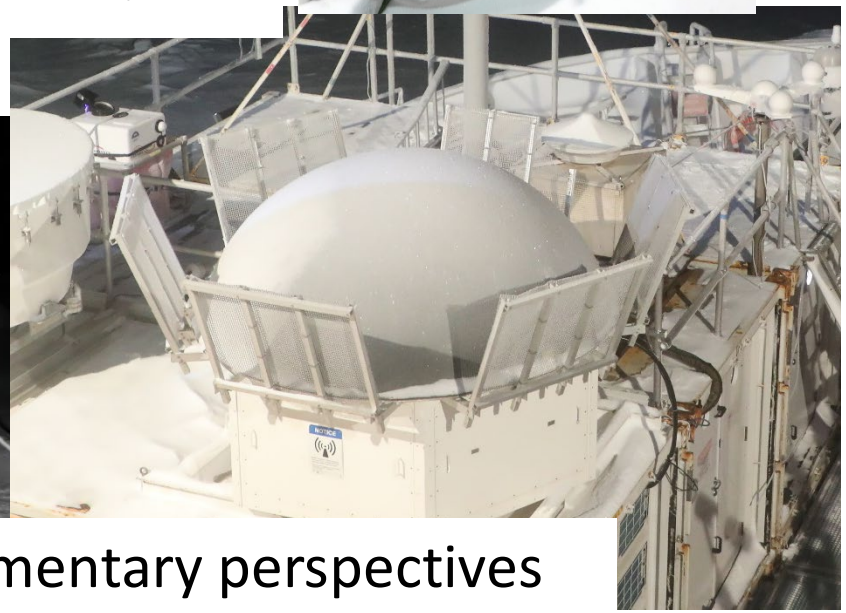
Profiling Atmospheric Dynamics









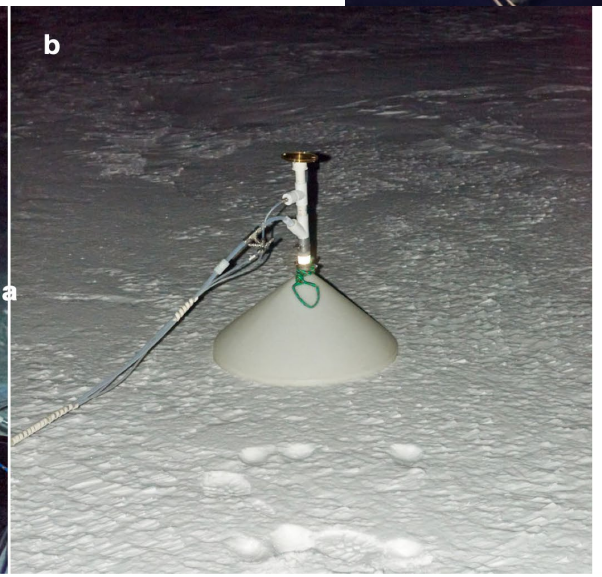


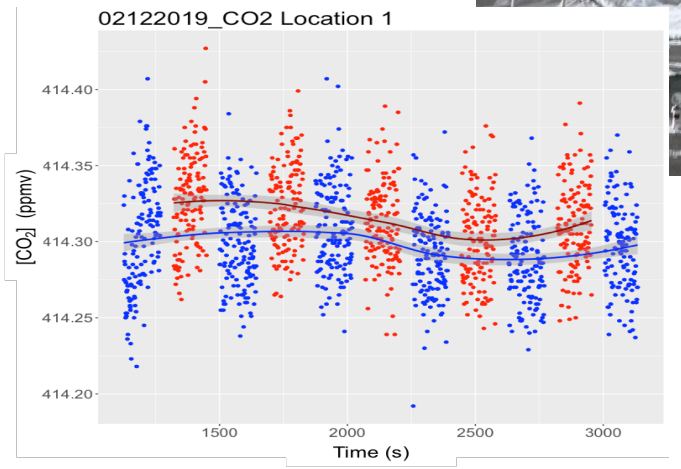
Most comprehensive wind program ever in c. Arctic; 9 complementary perspectives

Gases and Gas Exchange

Most precise gas flux measurements ever made in the Central Arctic >> enable detection of small fluxes (CO_2, CH_4, O_3, DMS)

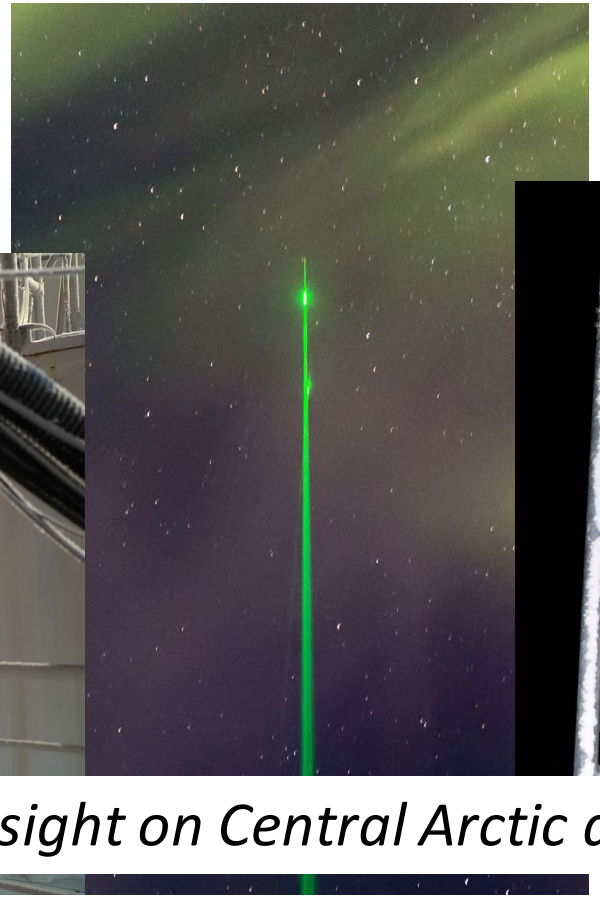
Links to BGC & ECO





Aerosols and Their Precursors

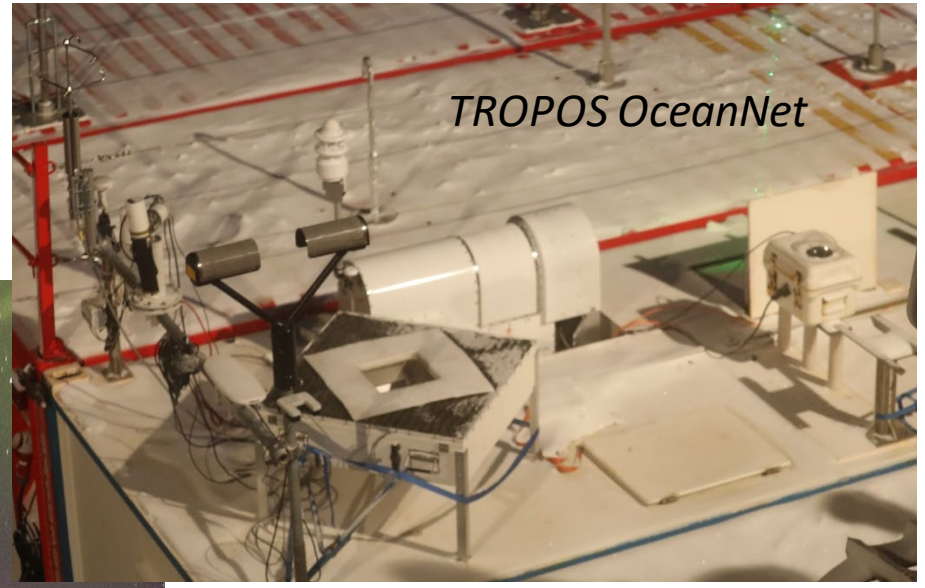
- Too many “firsts” to count
- Substantial insight into new particle formation and particle origins



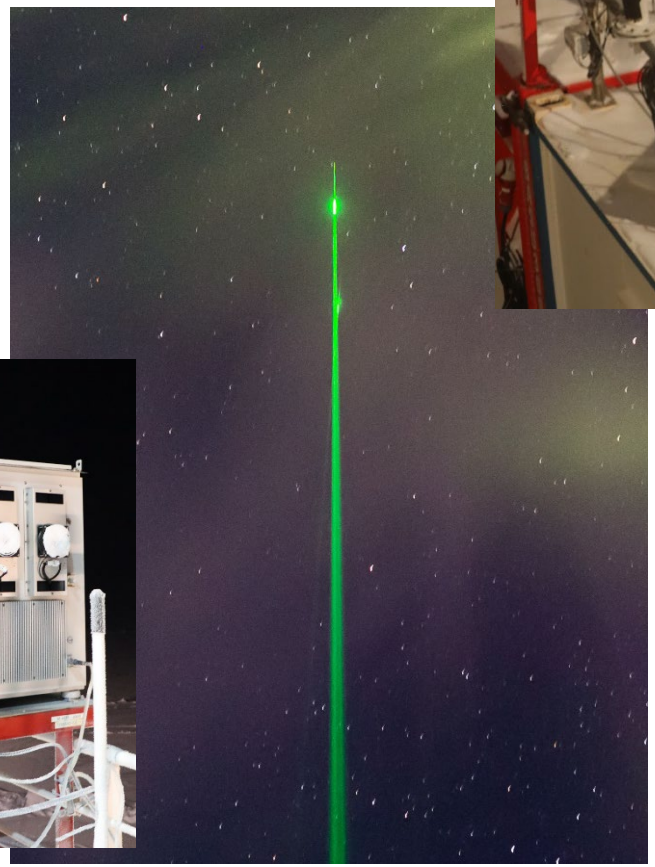
We’ve never had this type of insight on Central Arctic aerosols!

Cloud Properties and Processes

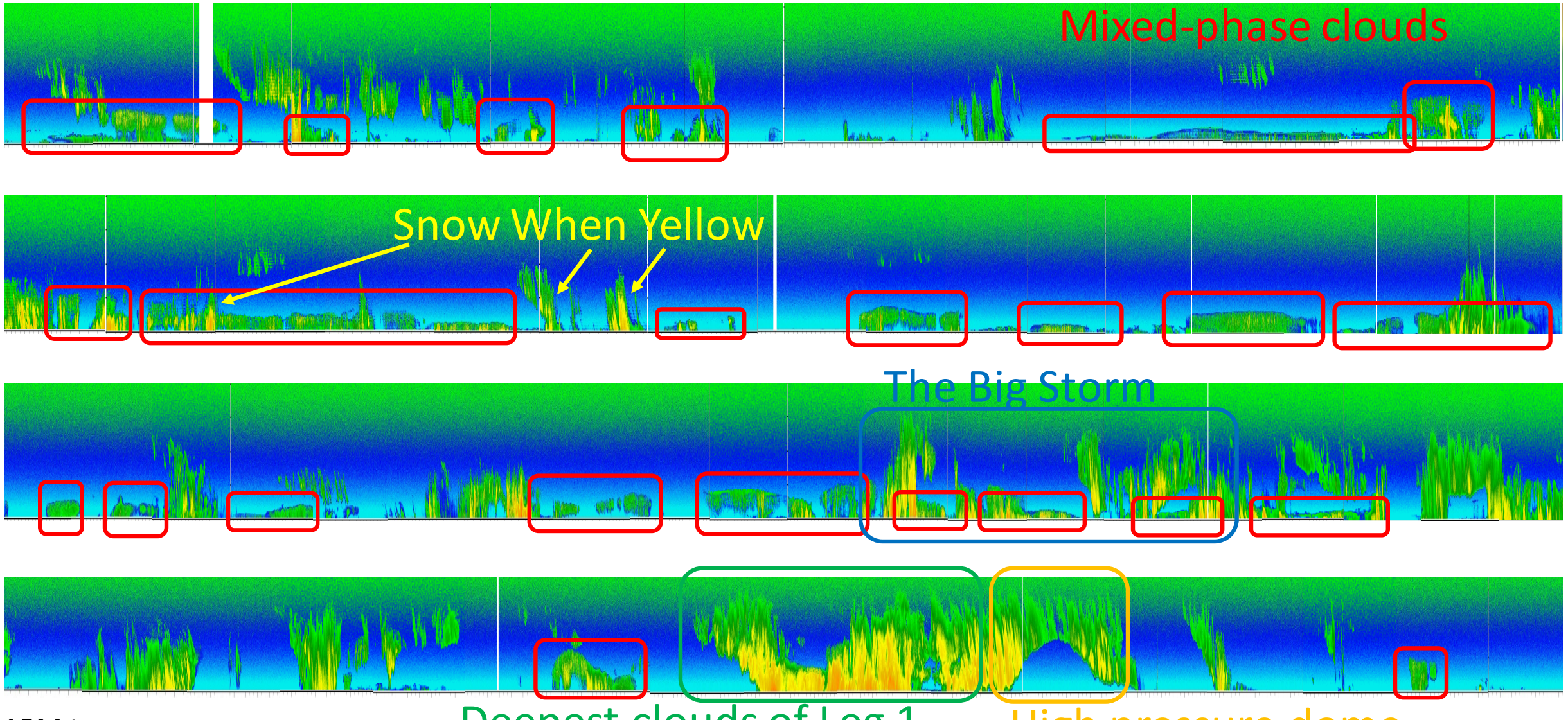
- Most extensive suite ever assembled for Arctic clouds
- Already deriving cloud products
- See clear fingerprints of strong cloud impacts
- Multiple cloud modeling projects



ARM Mobile Facility



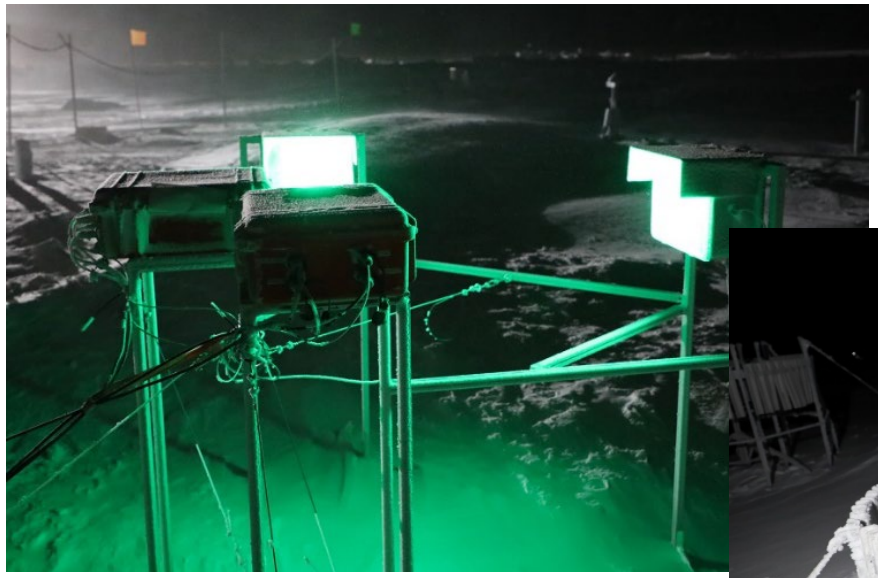
Cloud Properties and Processes



ARM team

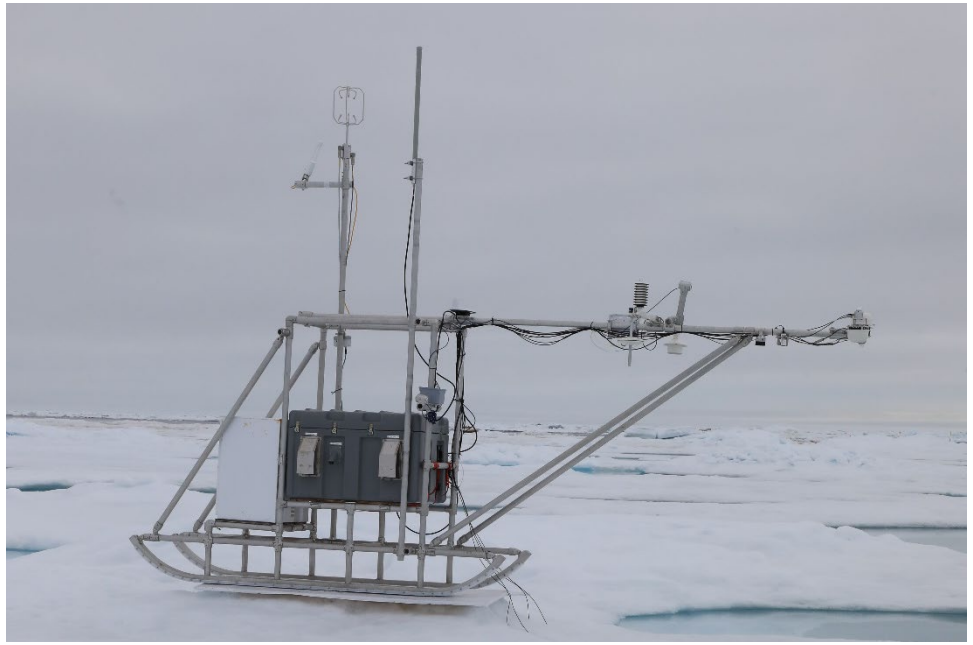
Precipitation

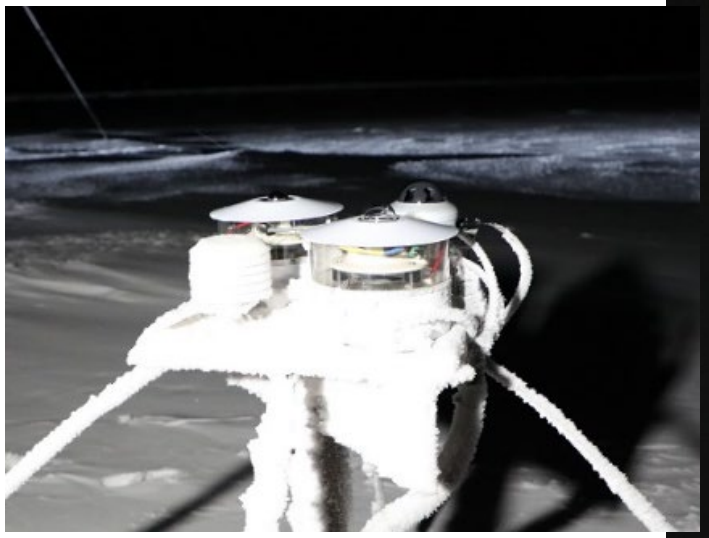
Many perspectives on snowfall offer a strong link to cloud processes and snow on ice.

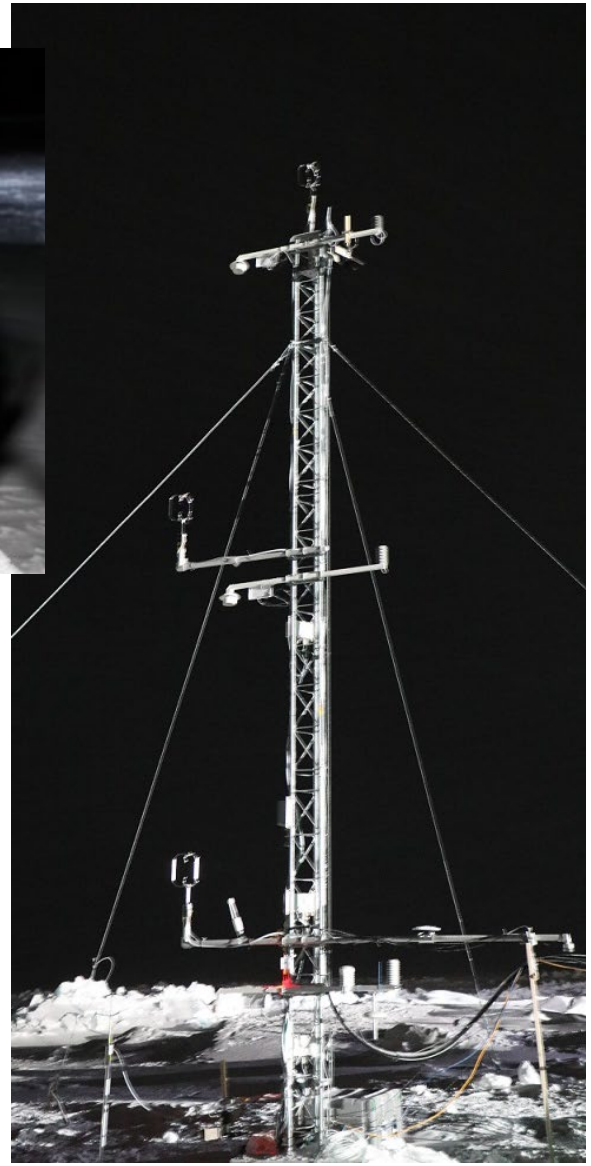


Surface Energy & Momentum Fluxes

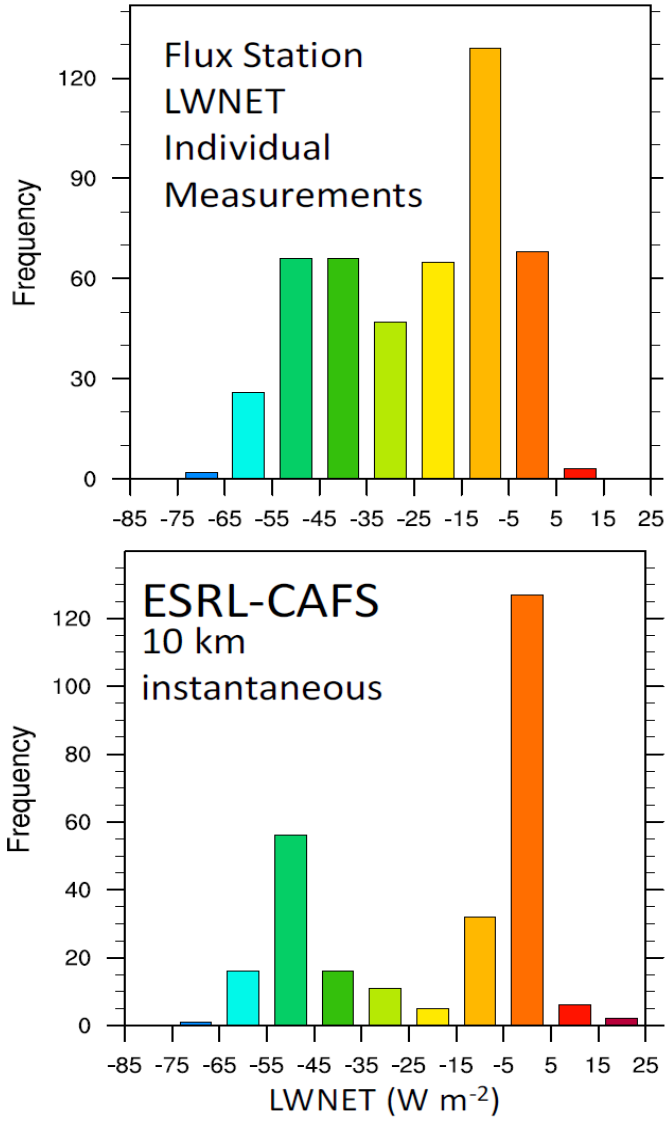
- Continuous heat /momentum transfer (even through Polarstern absence)
- New insights into cloud forcing of full energy budget over sea ice
- Linking winds to ice motion
- Data used in near-real-time model eval

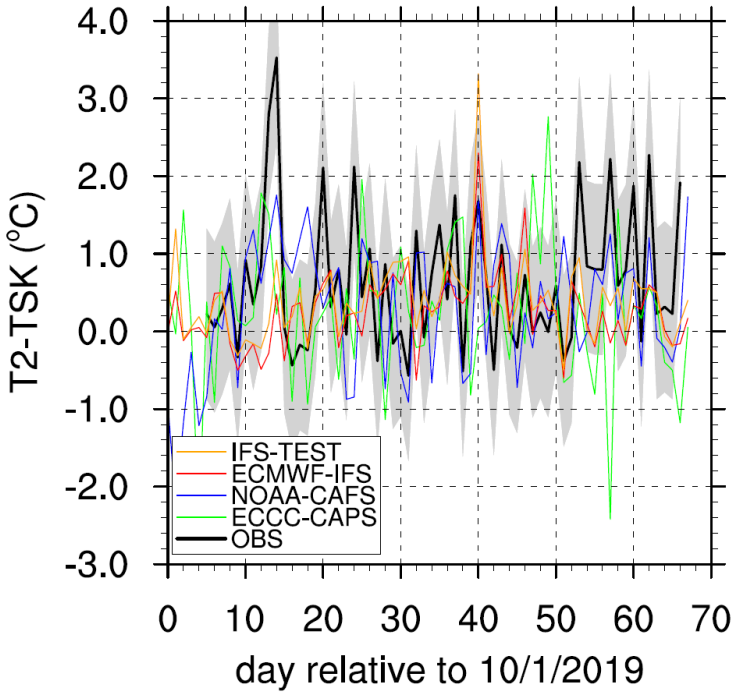




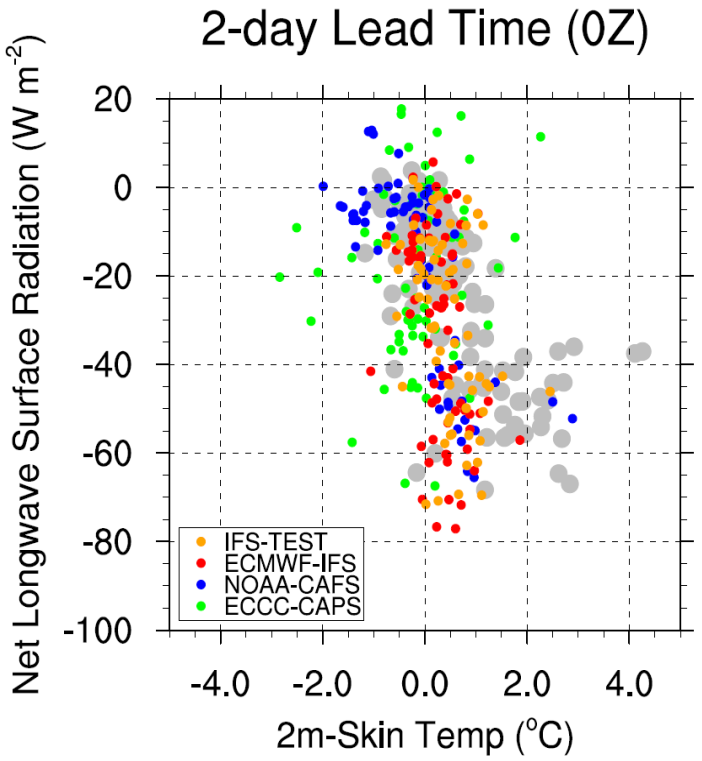


Model Evaluation





Assessment of timeseries variability
(near-surface stratification)



Examining process relations
(Net LW vs. near-surface stratification)

Research by Amy Solomon

MOSAiC
International Arctic Drift Expedition

Unique Successes

- Fantastic datasets for understanding the Arctic atmosphere + coupling
- Most comprehensive C. Arctic ATMOS measurements ever
- More than 200 instruments operated
- Captured as many as 20 distinct cyclones
- Onboard, operational measurements enabled continuity in spite of ice dynamics, ship movements, etc.
- 3 aircraft flights that can be linked via trajectories
- Near-real time model evaluation
- Development of Merged Observatory Data Files
- Data becoming available: PANGAEA, ARM, Arctic Data Center

For more info: matthew.shupe@noaa.gov