

Challenges and Opportunities of a Year in the Arctic Sea Ice



MOSAIC

Multidisciplinary drifting **O**bservatory
for the **S**tudy of **A**rctic **C**limate

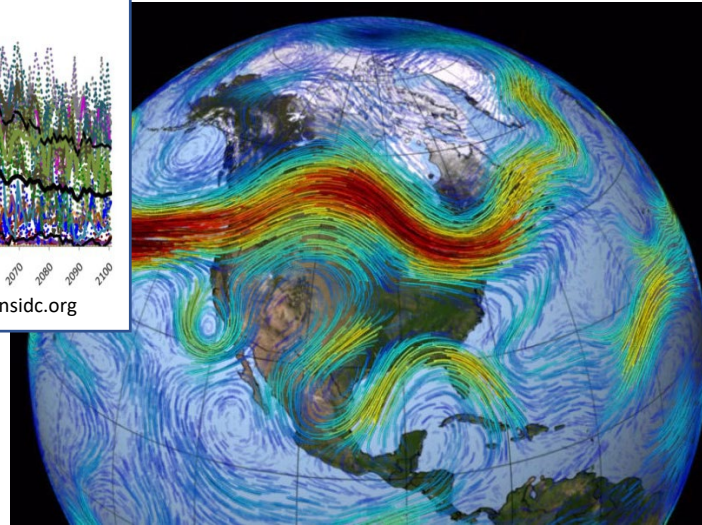
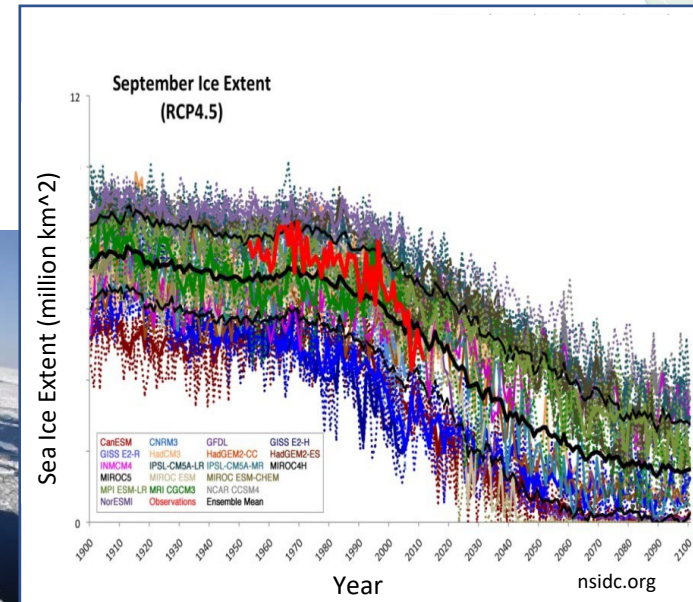
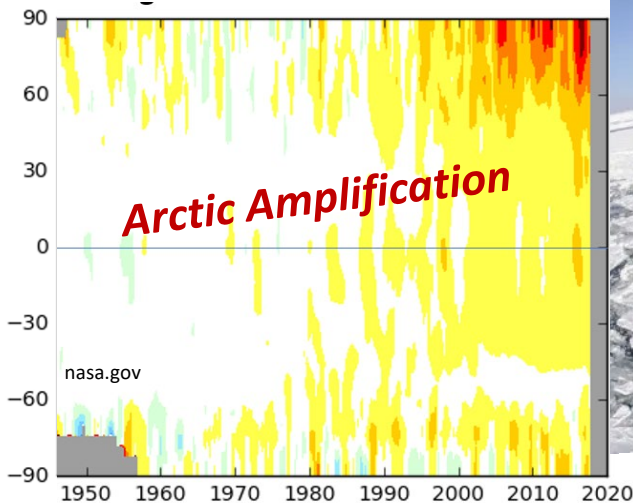
Matthew Shupe

University of Colorado / NOAA

ARM User Facility / ASR PI Meeting, 22 June 2021

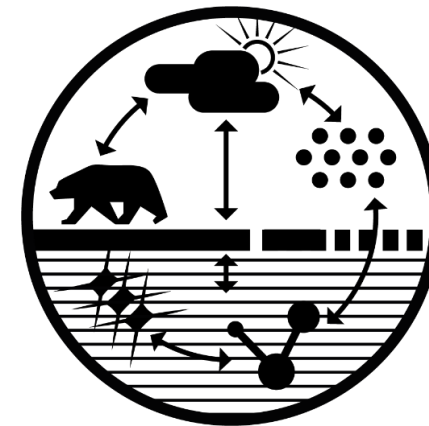
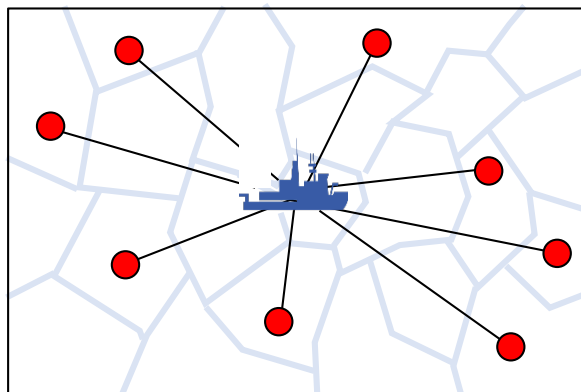
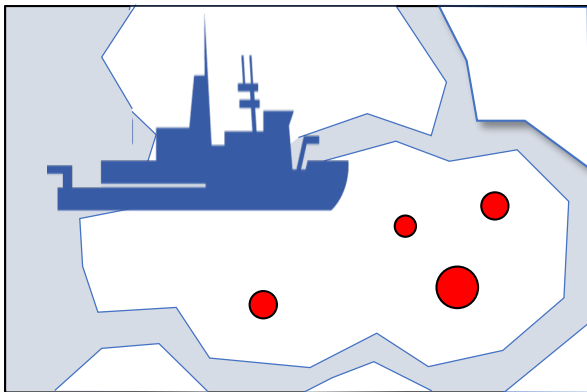
Motivations

- Rapid change... sea-ice decline, amplification
- Poor model predictive capabilities
- Emerging operational/management needs
- Questions about global linkages
- Dearth of observations



Plans for an Expedition

- International: IASC, AWI, many US agencies (12 years of planning!)
- Interdisciplinary: ATMOS-ICE-OCEAN, physical-chemical-biological
- Multiscale: Point, grid-cell, pan-Arctic
- Integration: Observations and Models
- Annual Cycle: Contiguous seasons in the ice



So how did it go?

Polarstern Icebreaker



What are the causes and consequences of an evolving and diminished Arctic sea-ice cover?

Leg 1: The Install

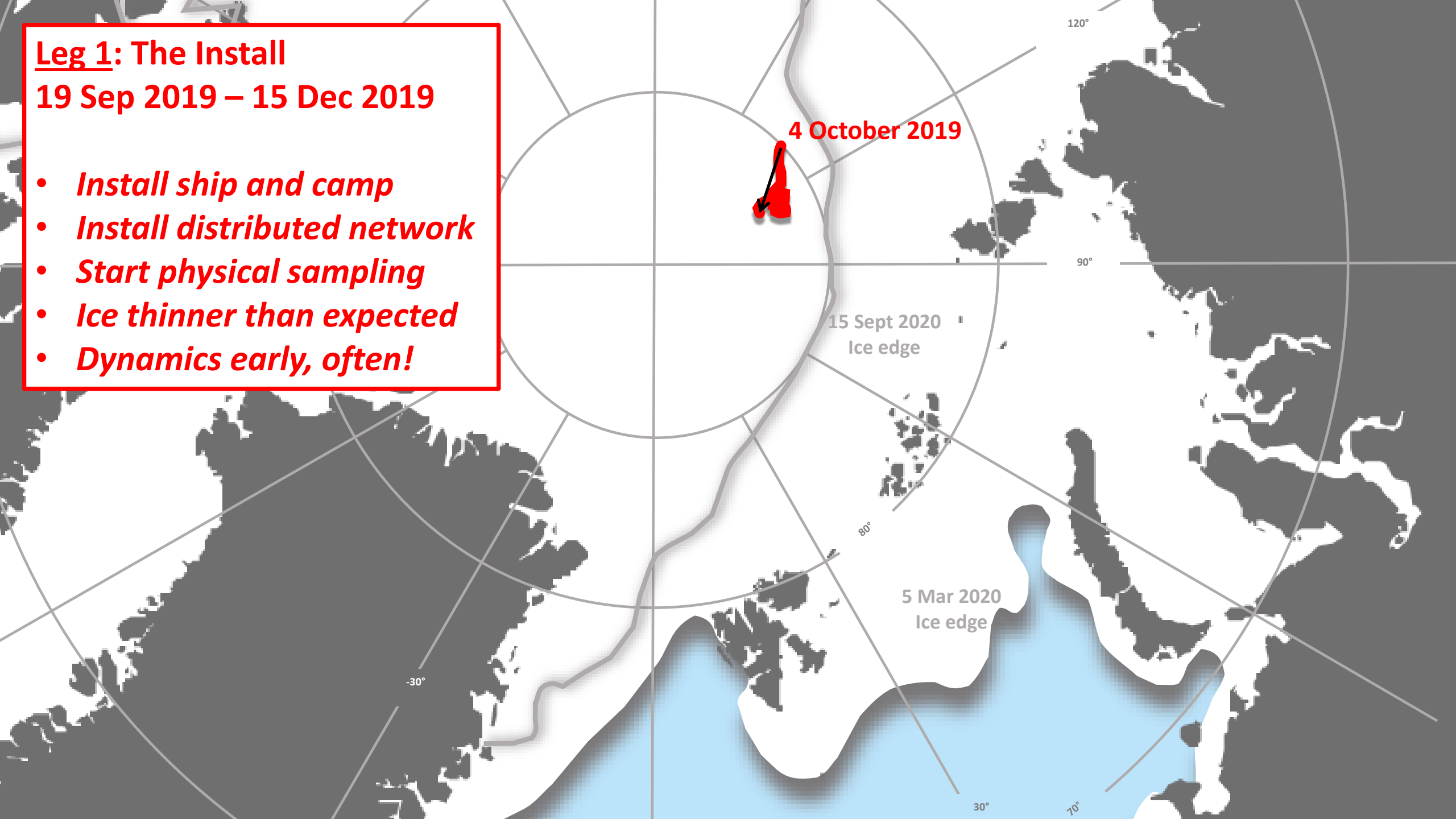
19 Sep 2019 – 15 Dec 2019

- *Install ship and camp*
- *Install distributed network*
- *Start physical sampling*
- *Ice thinner than expected*
- *Dynamics early, often!*

4 October 2019

15 Sept 2020
Ice edge

5 Mar 2020
Ice edge





Loading the AMF2 and everything else







First exploration of MOSAiC floe



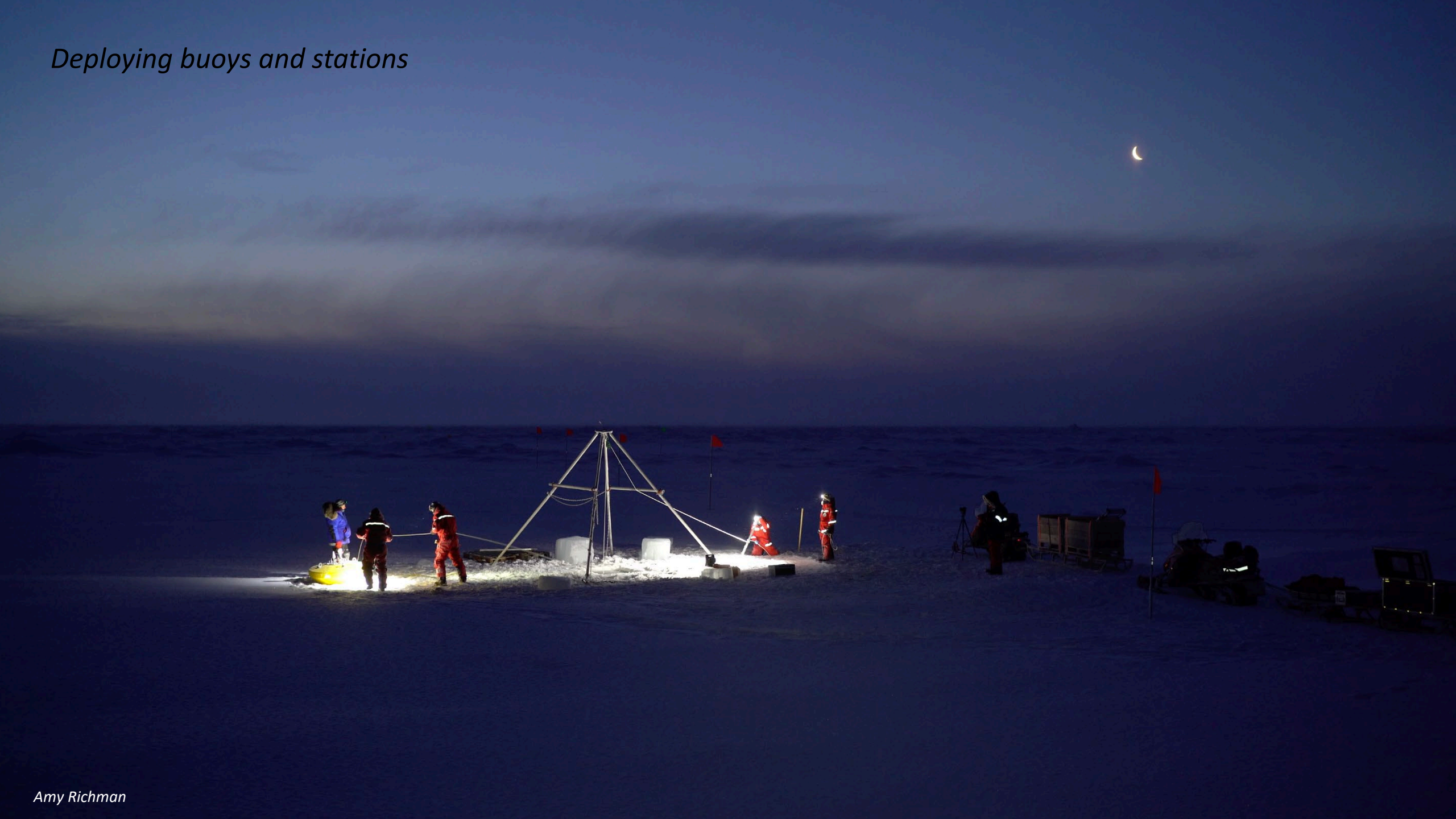
Establishing ARM's Measurements



“Cities” on the ice; Descent into winter darkness



Deploying buoys and stations



Comprehensive physical measurement and sample programs



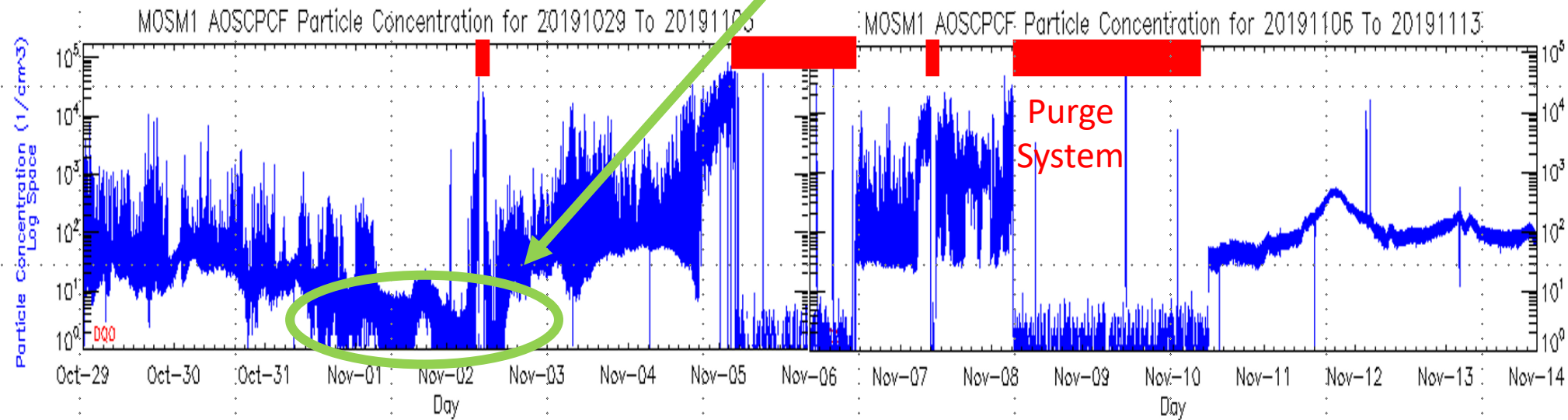
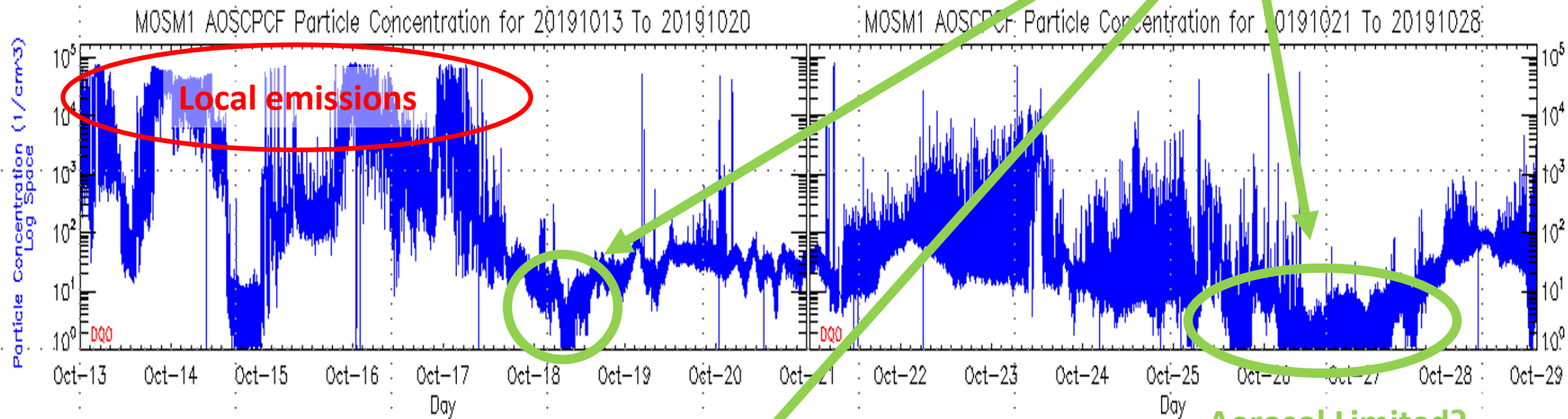
Ice dynamics.... early and often



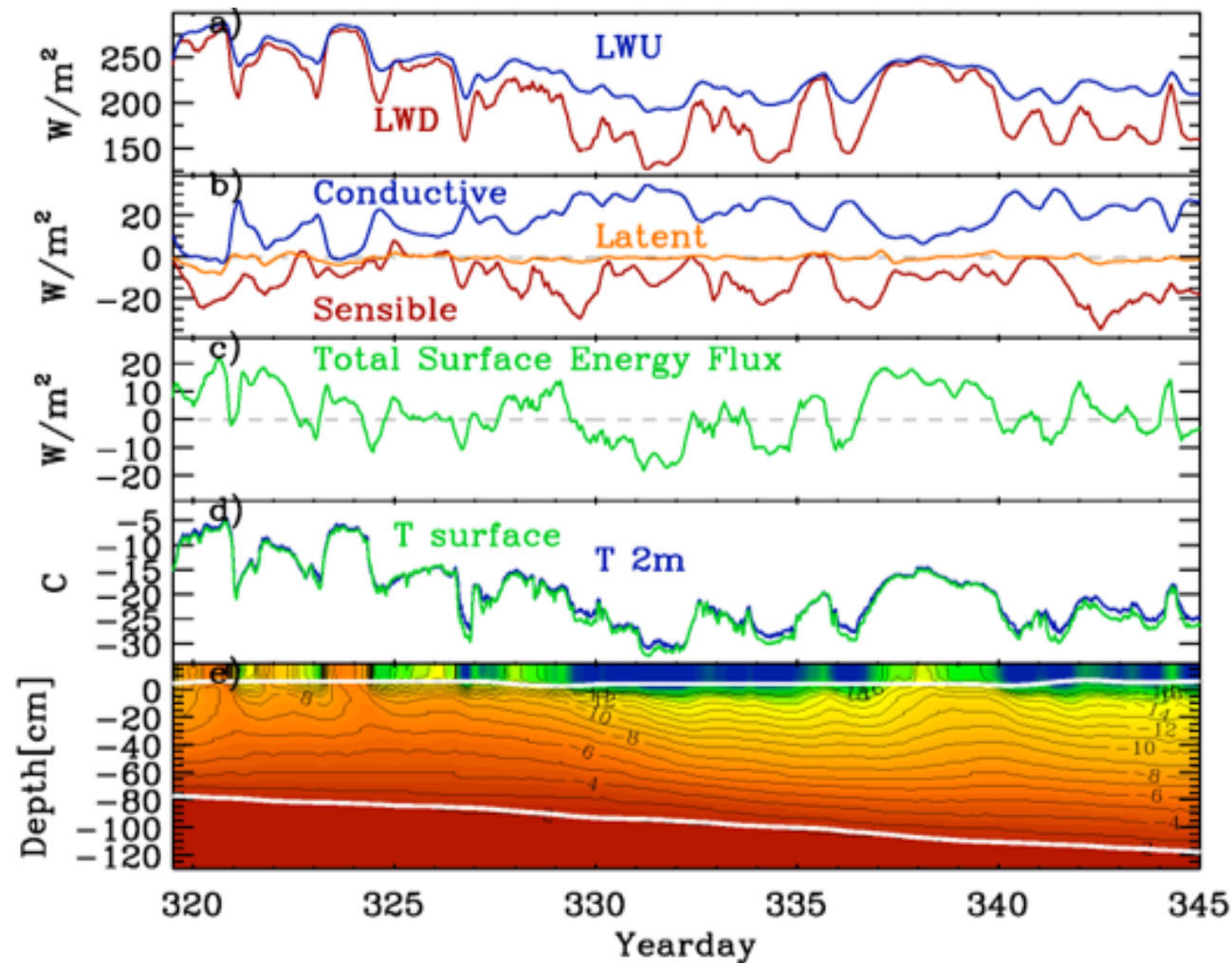
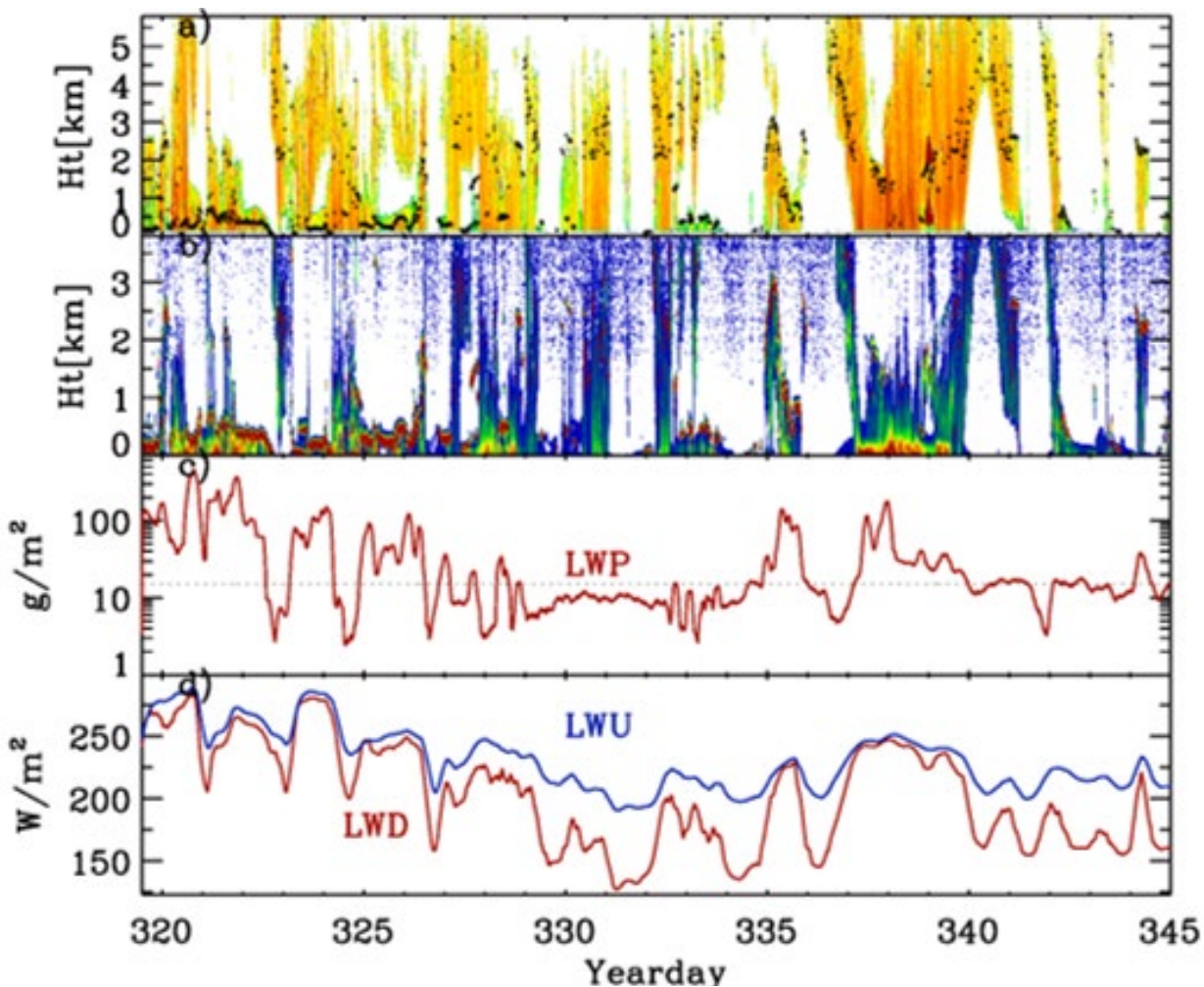


Where is the Aerosol?

Remarkably low concentrations!



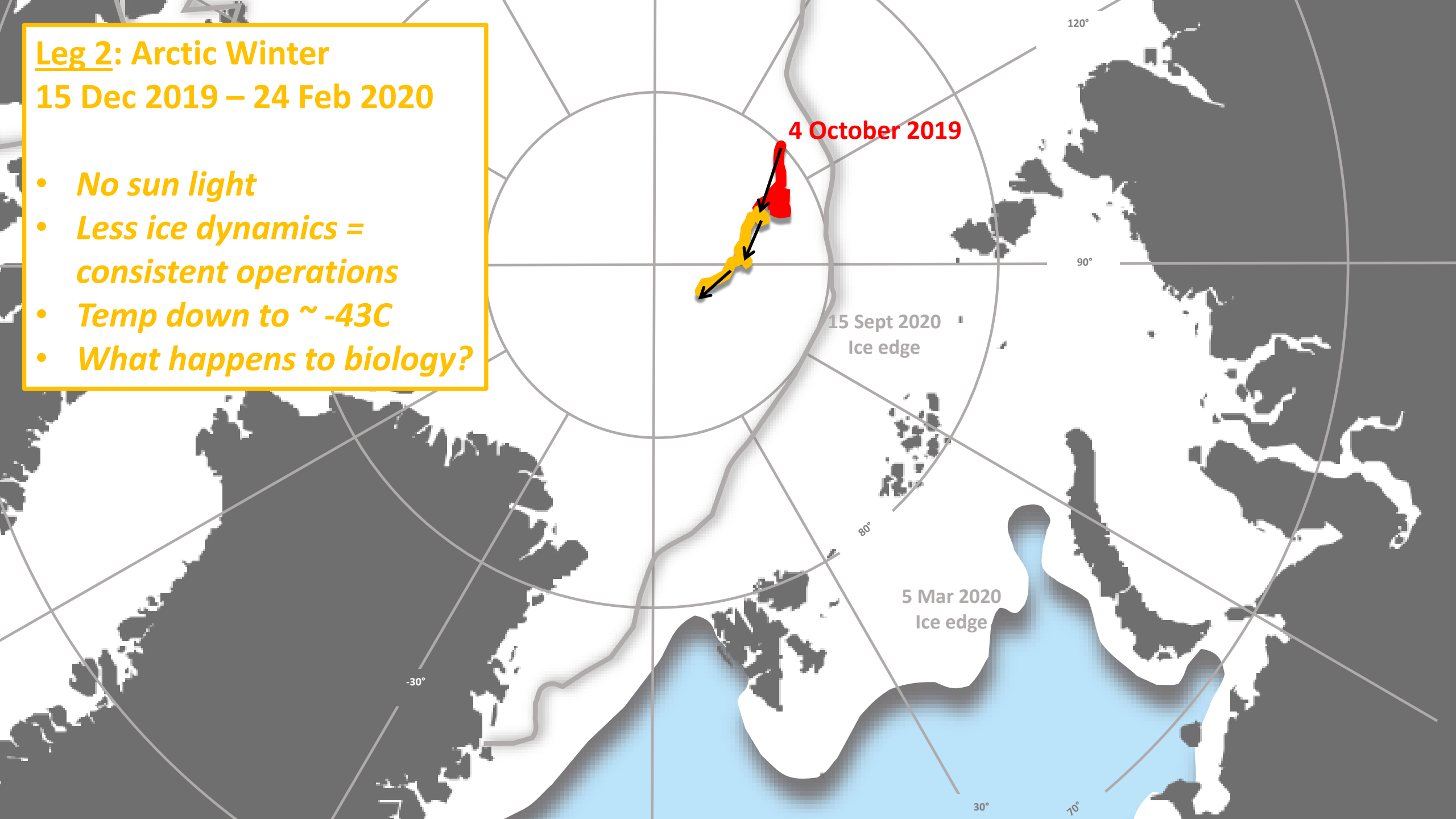
Cloud Phase, Radiation, and SEB



Leg 2: Arctic Winter

15 Dec 2019 – 24 Feb 2020

- *No sun light*
- *Less ice dynamics = consistent operations*
- *Temp down to ~ -43C*
- *What happens to biology?*



Descent into in to Night

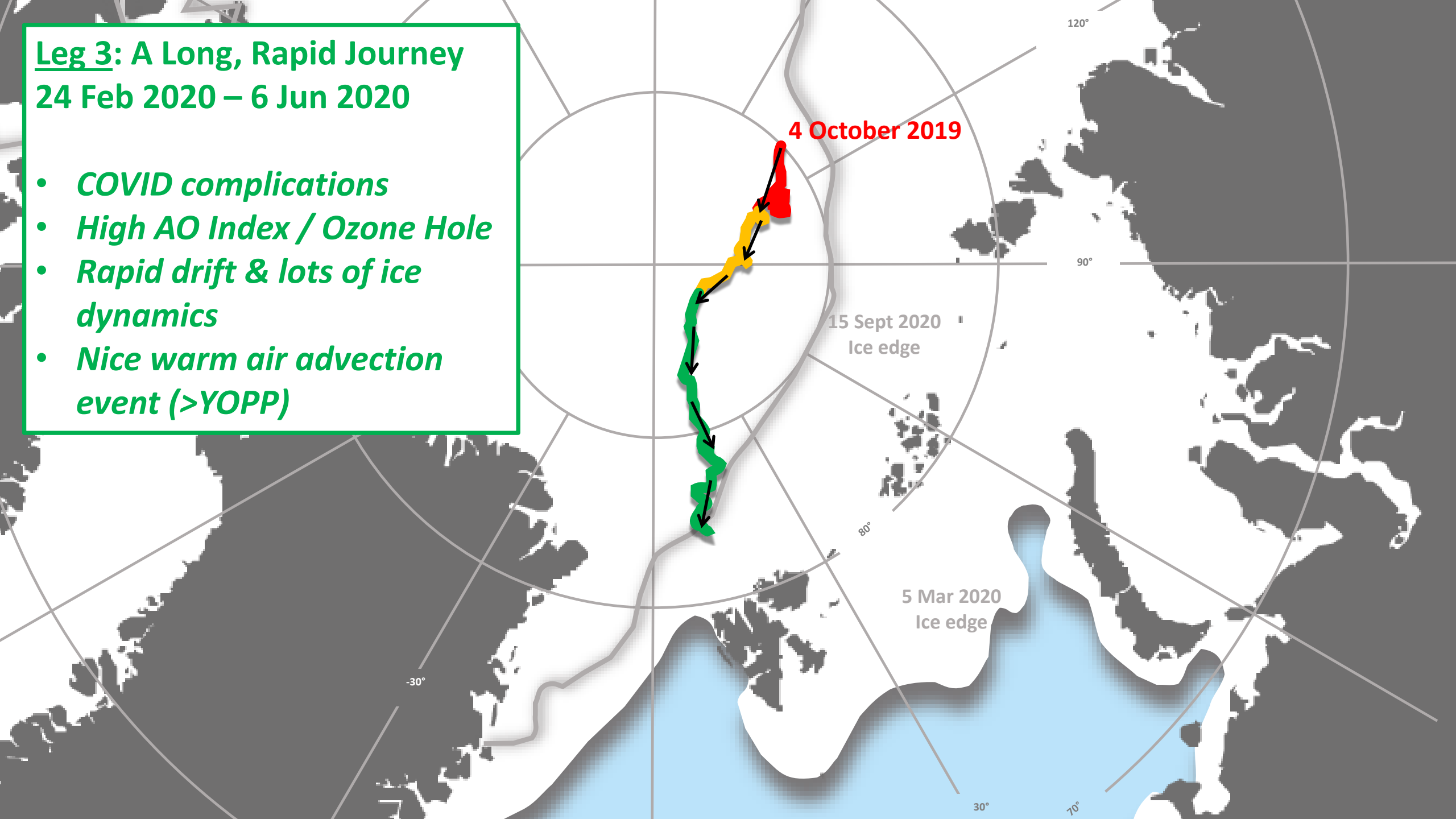


JGI Project: Exploring seasonal changes in microbial community meta-genomes and -transcriptomes

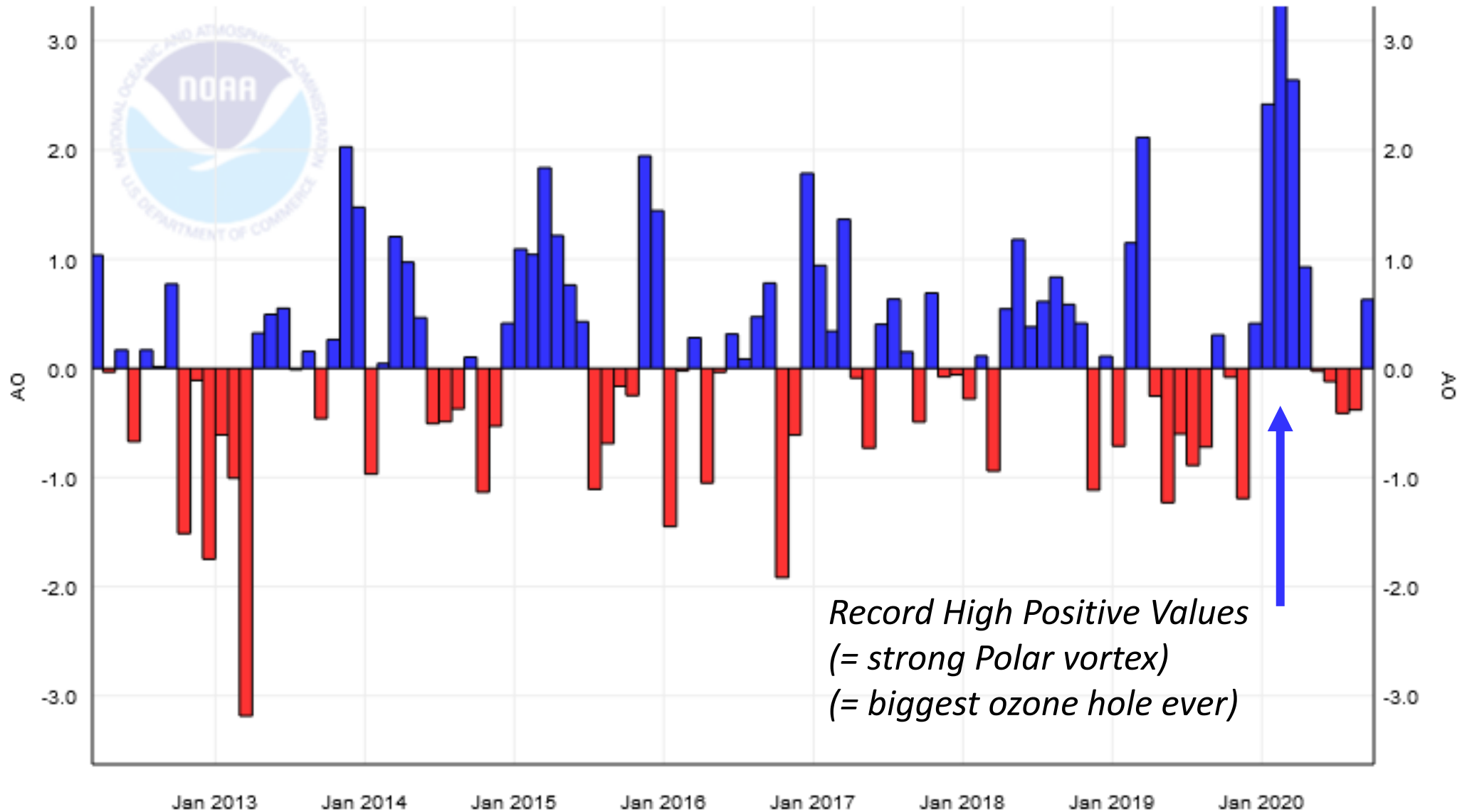


Leg 3: A Long, Rapid Journey
24 Feb 2020 – 6 Jun 2020

- *COVID complications*
- *High AO Index / Ozone Hole*
- *Rapid drift & lots of ice dynamics*
- *Nice warm air advection event (>YOPP)*



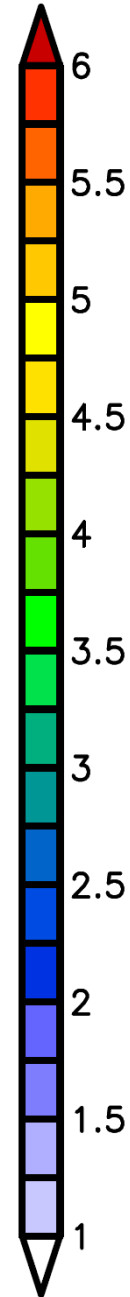
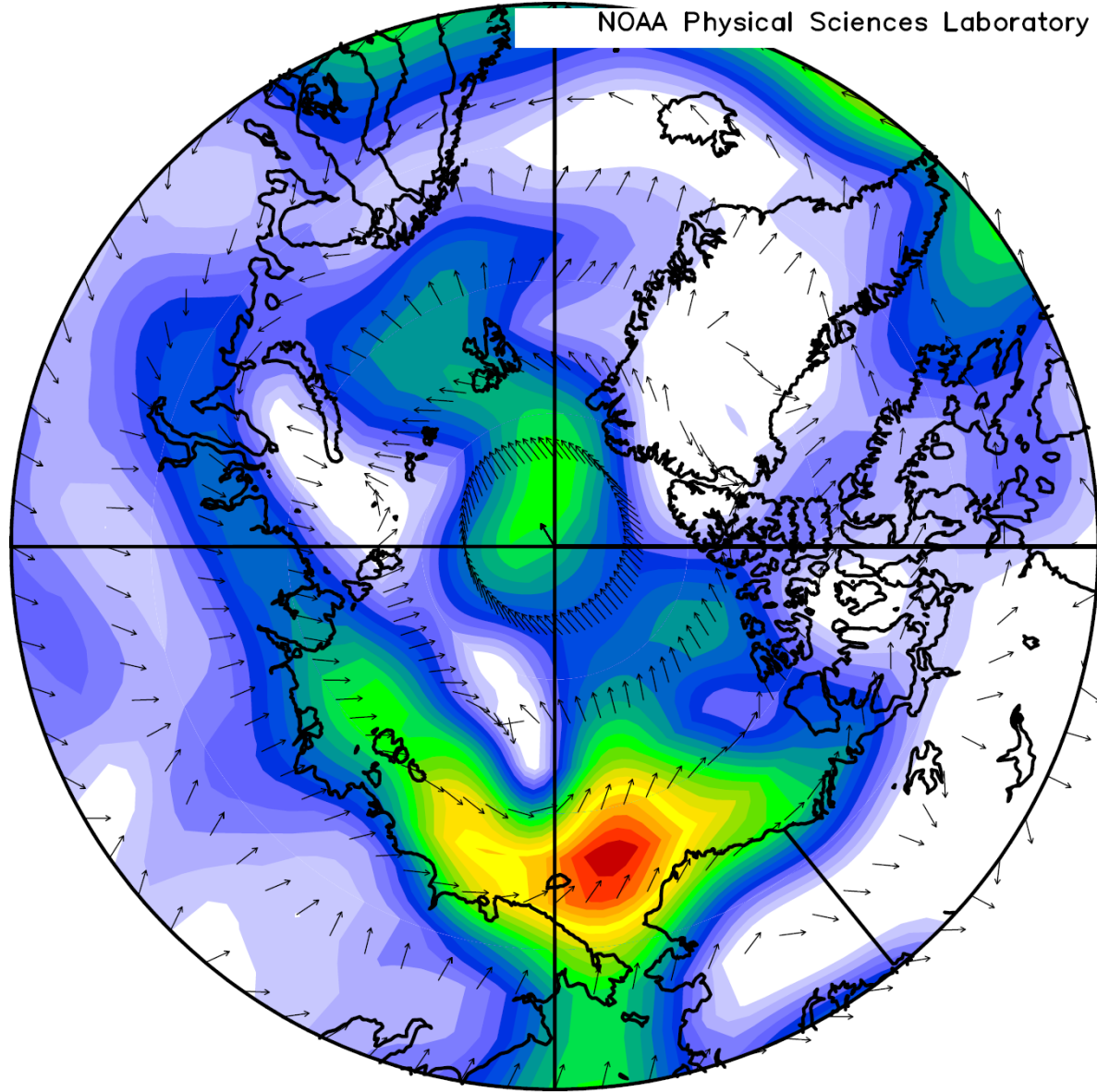
Arctic Oscillation (AO)



NCEP/NCAR Reanalysis
1000mb Vector Wind (m/s) Composite Anomaly 1981–2010 climo

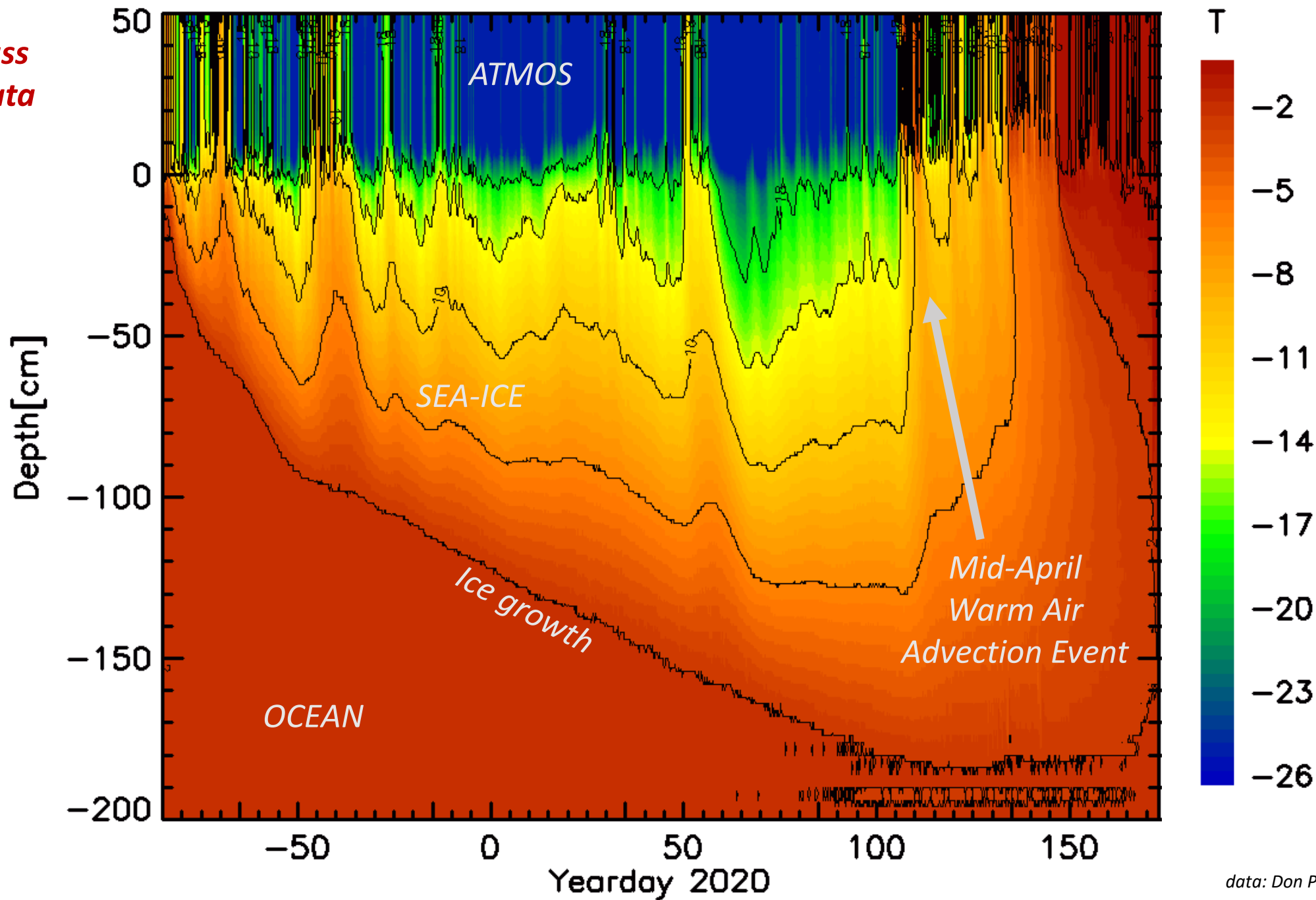
NOAA Physical Sciences Laboratory

*Pushed by
Anomalous Winds*



Jan to Mar: 2020

*Seasonal Ice Mass
Balance buoy data*



Major ice shear zone kept things on edge



Frequent adaptation of strategy

ARM Equipment

