The Atmosphere During Sea State 2015

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1) **Sea State, Oct 2 - Nov 5, 2015**
   - R/V Sikuliaq
   - Beaufort Sea/Canada Basin
2) **Objectives: Overall, atmospheric**
3) **Atmospheric observations**
   - instrumentation
   - sampling methodology
   - QC
4) **Preliminary Measurements**
   - BL characterization
   - turbulent and radiative fluxes

(1) Cooperative Institute for the Research in the Environmental Sciences, University of Colorado, Colorado, Boulder, Colorado, USA
(2) NOAA/ESRL/PSD, Boulder, Colorado, USA
(3) Naval Postgraduate School, Monterey, CA

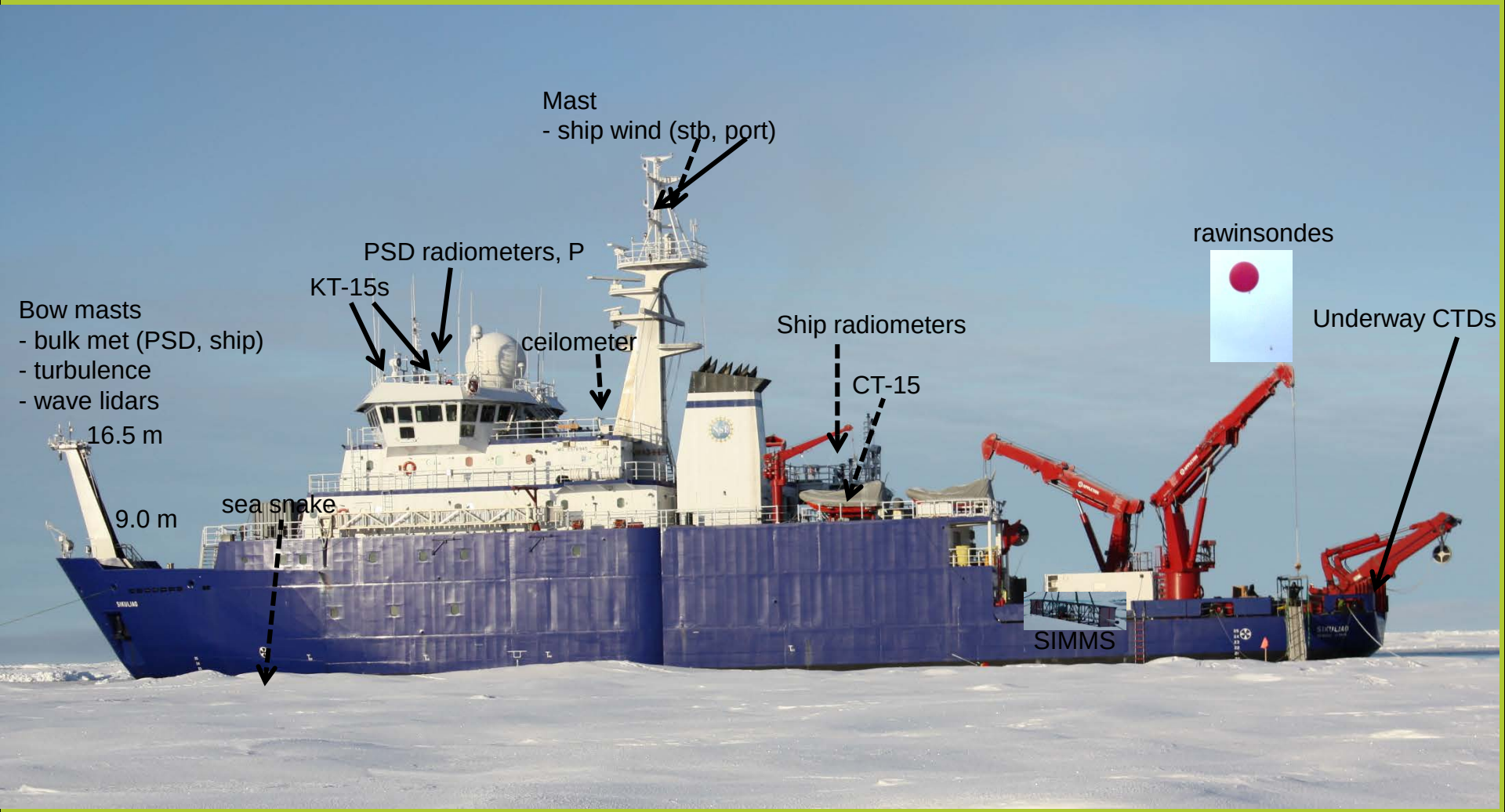
Acknowledgements: Funding provided by Office of Naval Research and NOAA.

Overall Objective: **Improve understanding of air-ice-ocean interactions, with an emphasis on the role of waves, during fall ice advance**

Atmospheric Objectives

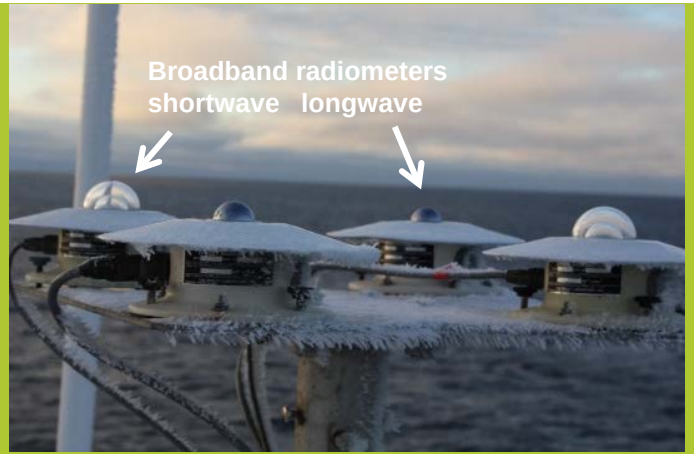
1. For various ice and wave surface conditions
    a) better understand air-wave and air-ice momentum transport,
    b) better understand surface energy fluxes
    c) improve bulk flux parameterizations
2. For conditions near an advancing ice edge (ice, edge, open water), characterize
    a) lower tropospheric stability,
    b) kinematic/thermodynamic structure,
    c) clouds, and
    d) their impacts on surface winds & fluxes
3. How the atmospheric structure and surface fluxes interact with the ice and ocean to bring about the observed changes in sea ice

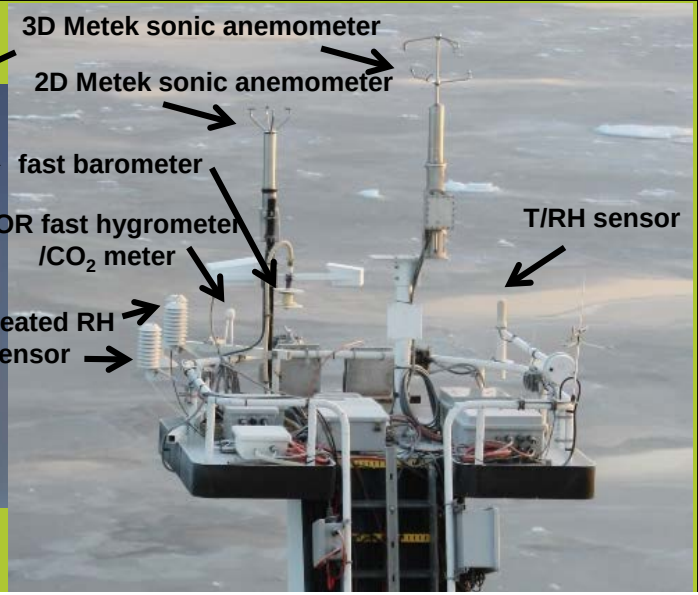
Sea State Instrument Placements



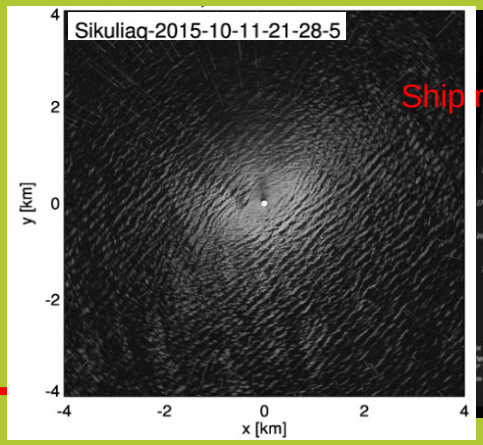
Necessary Measurements - direct

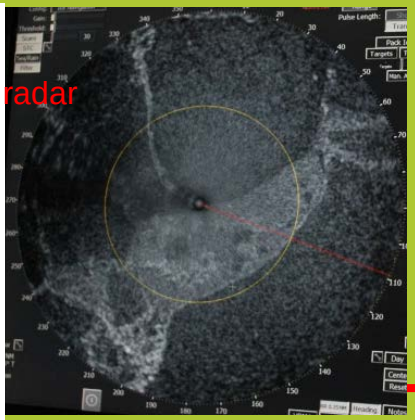
Surface fluxes – turbulent and radiative

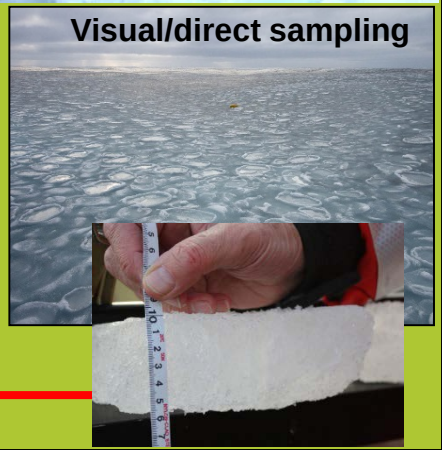




Surface Conditions - temperature; ice conc., type, thickness; wave height, wavelength

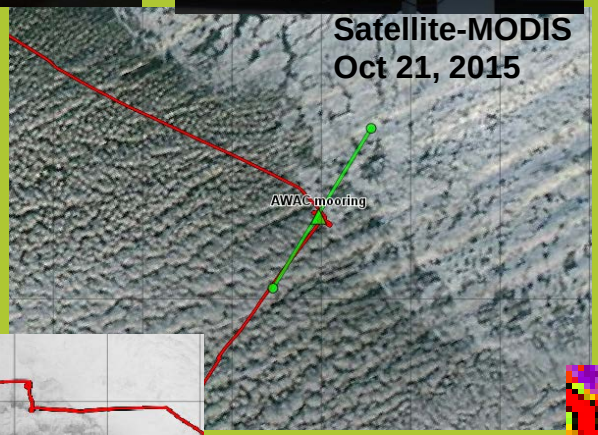


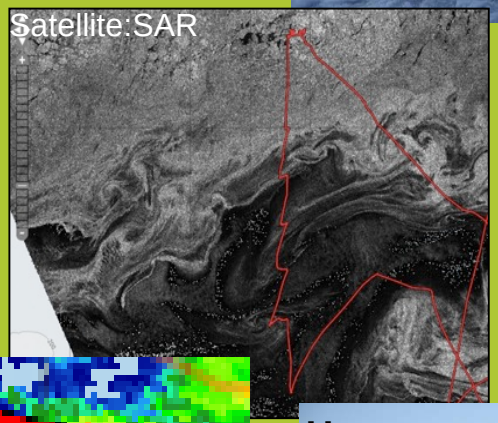


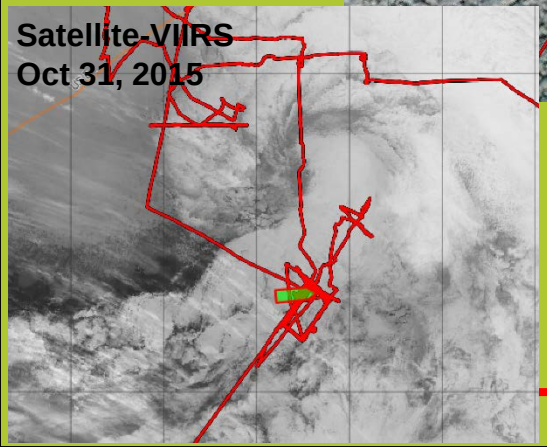


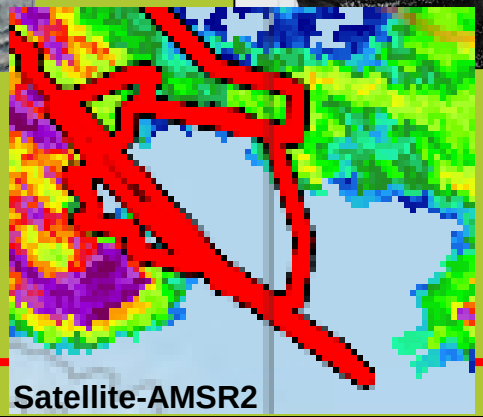
Measurements for understanding

Lower tropospheric wind, temperature, humidity, cloud profiling, photography



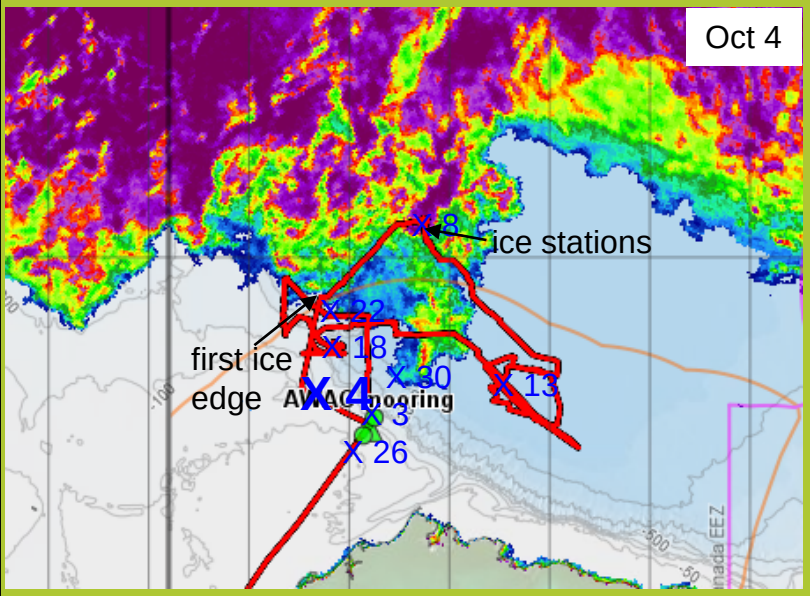


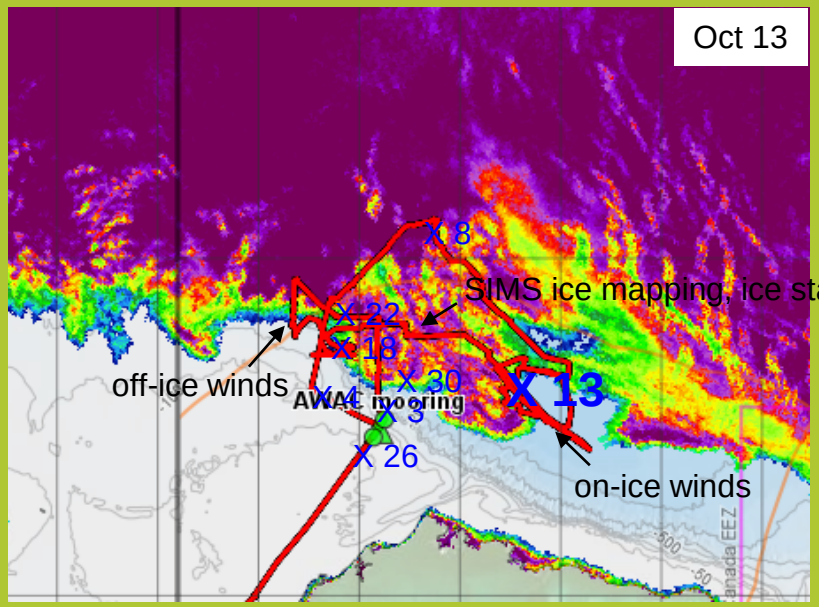


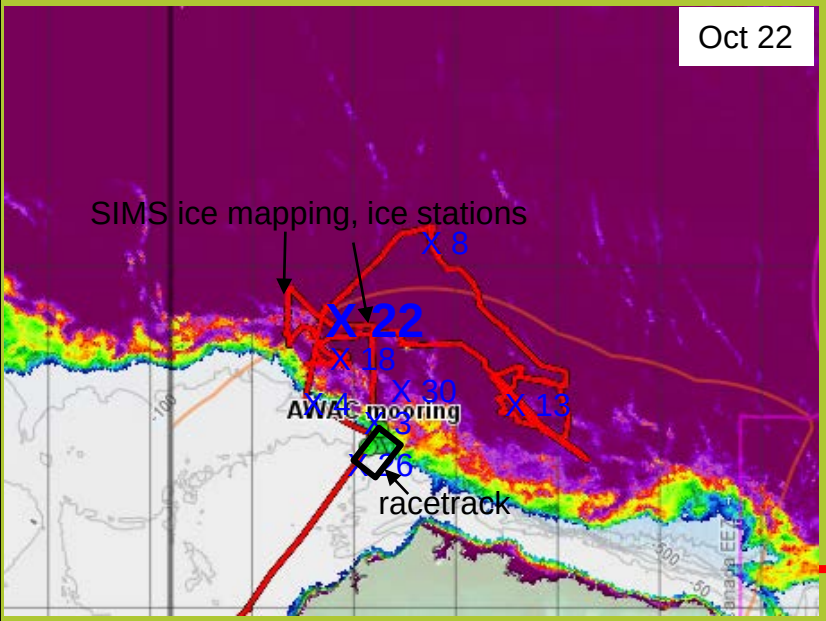


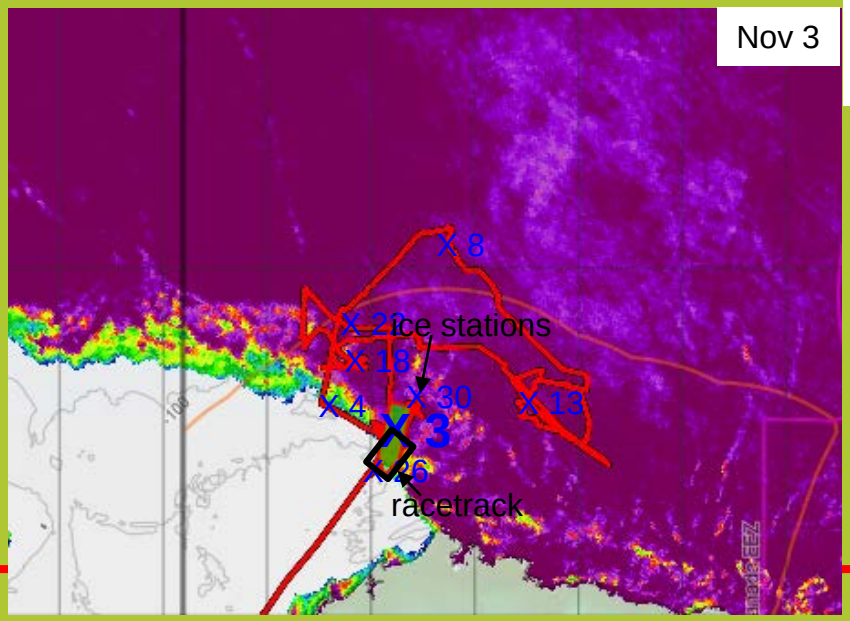
Sea State 2015 Cruise

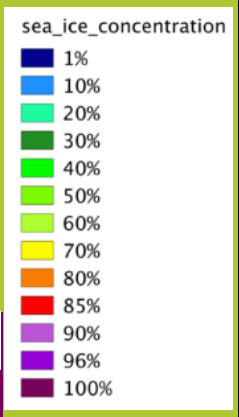
- Chukchi/Beaufort Sea freeze-up conditions; Oct 2 - Nov 5, 2015
- R/V Sikuliaq



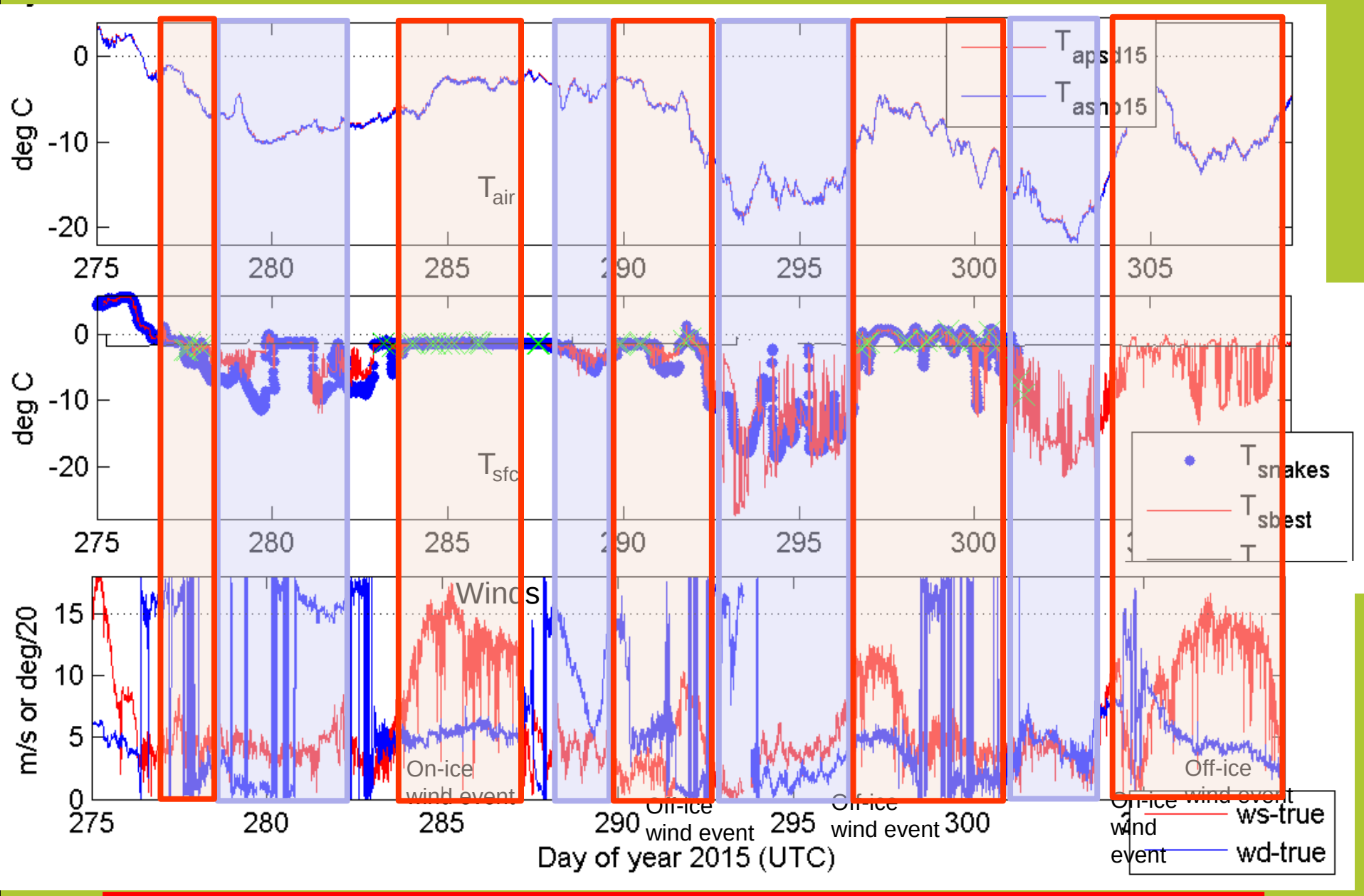








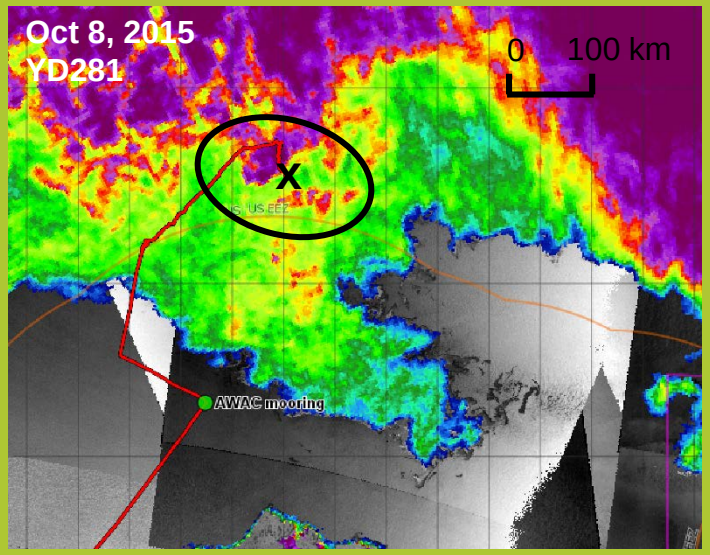
Sea State T_{air}, T_{sfc}, Winds, Oct 2 – Nov 4, 2015

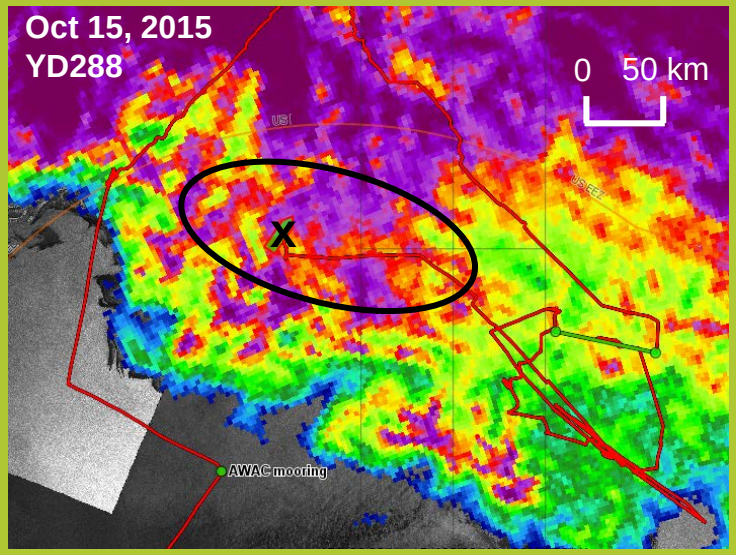


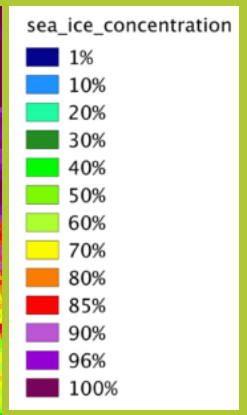
Ice Interior

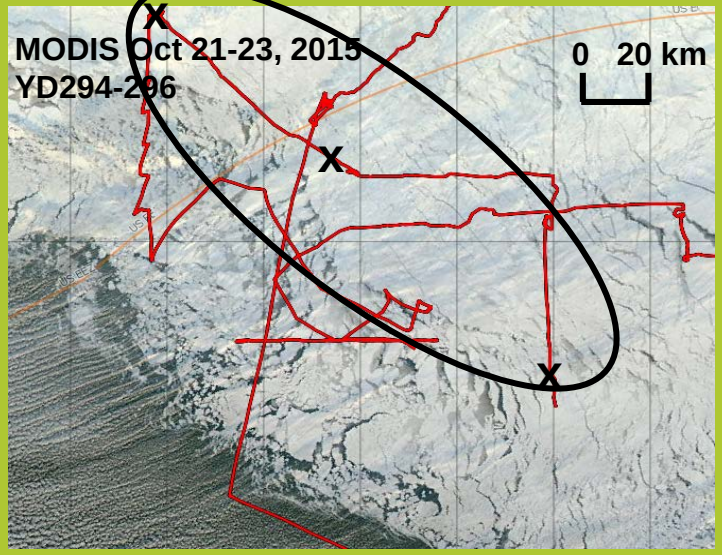
(YD278-283; 288-289; 293-297; 301-303) (Oct 5-10; 15-16; 20-24; 28-30)

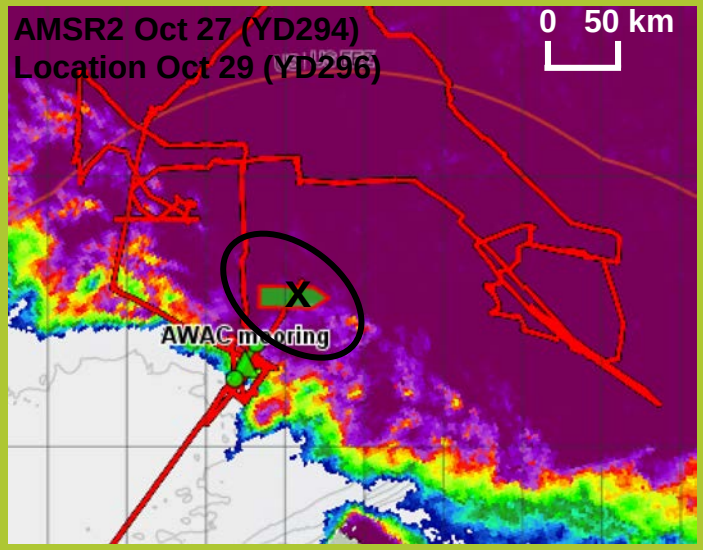
- > 70 km from nearest ice edge







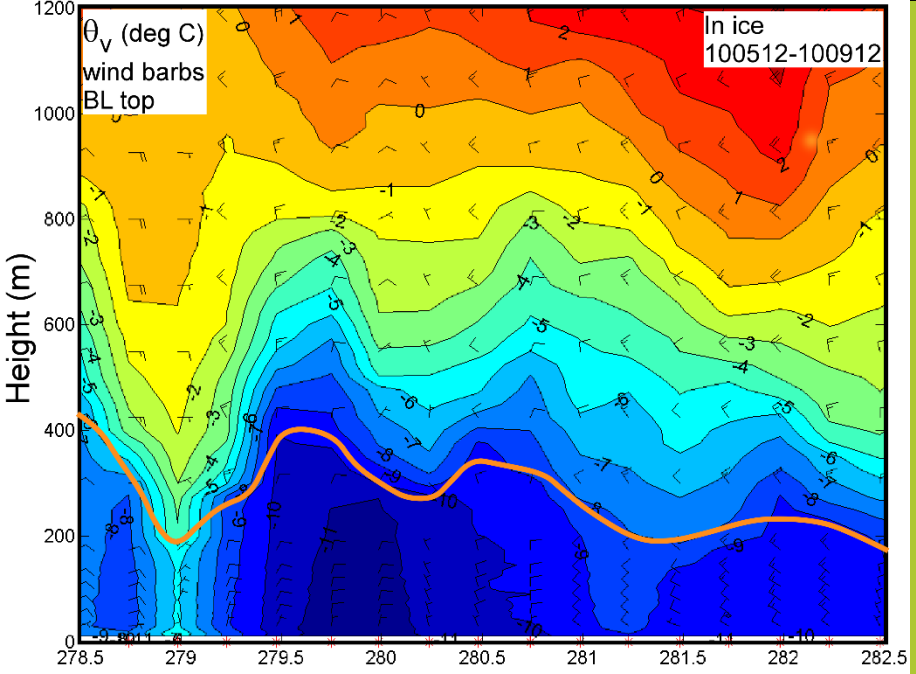


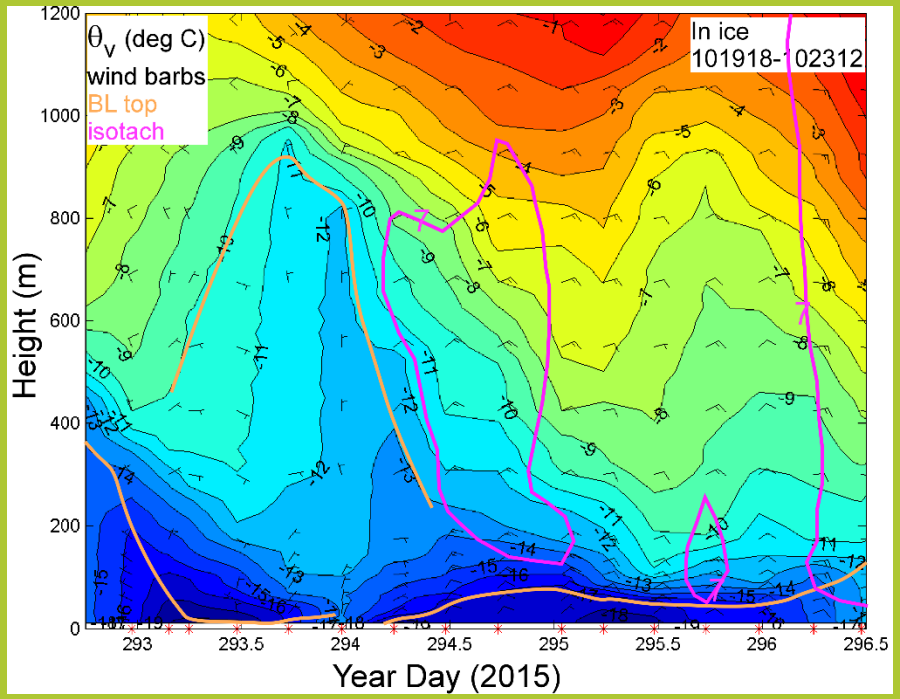


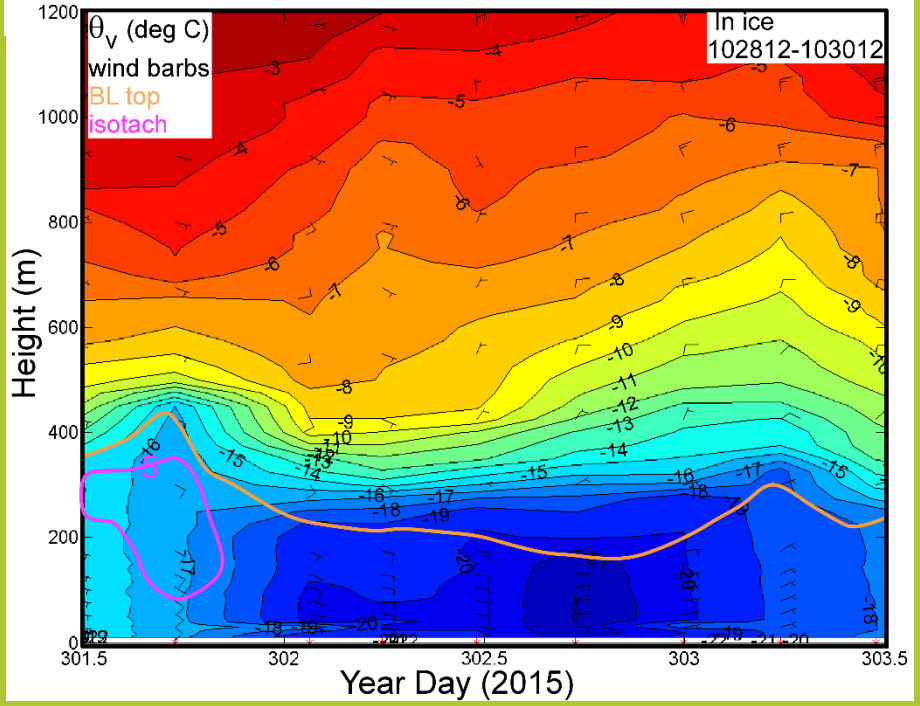
Ice Interior – Atmospheric Structure

Boundary Layer

- often well-mixed to 200-400 m
- some very shallow BL, including surface-based inversion Oct 19-23
- depth variability governed by variability of flow aloft & surface flux
- LLJs observed both above & within BL







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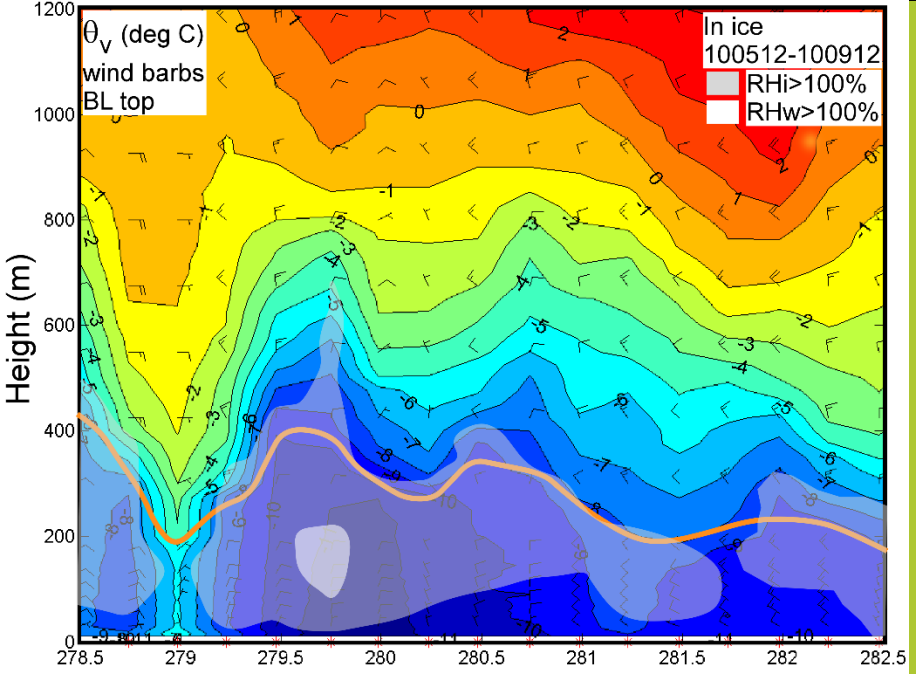
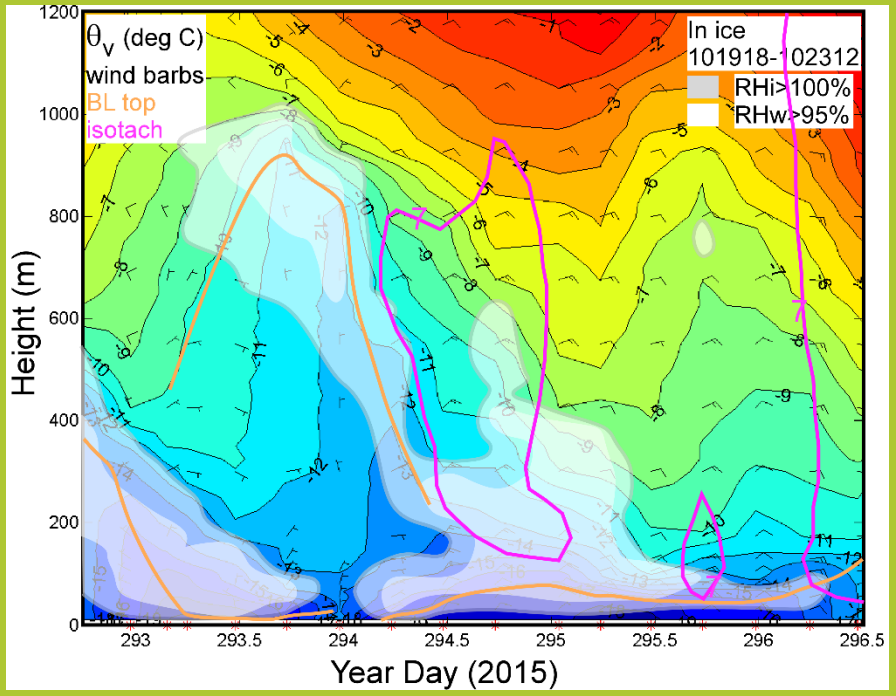
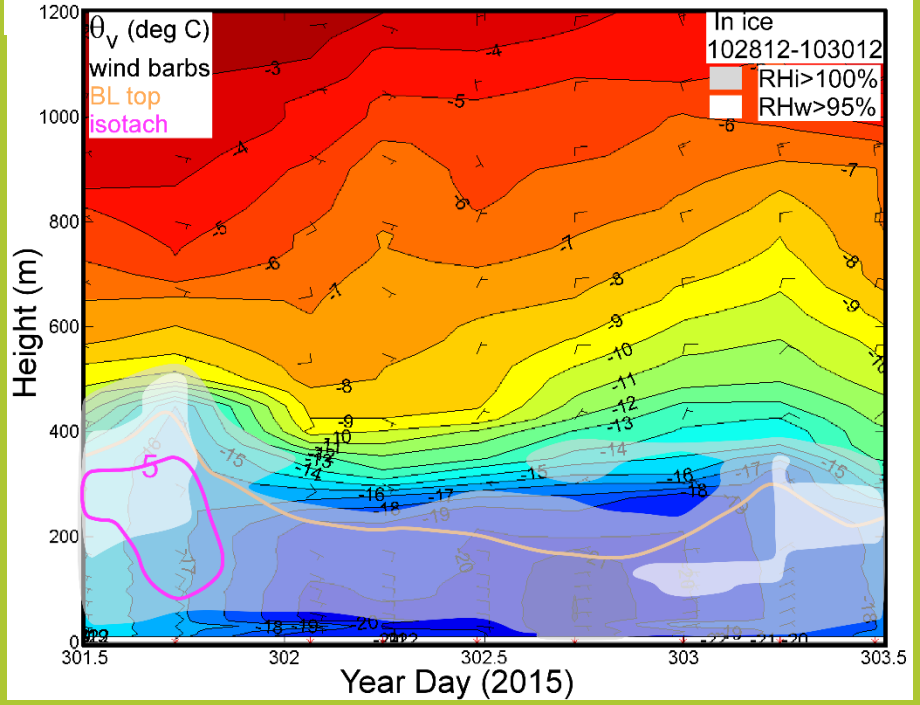
Clouds

- low, within BL
- extend to just above BL top

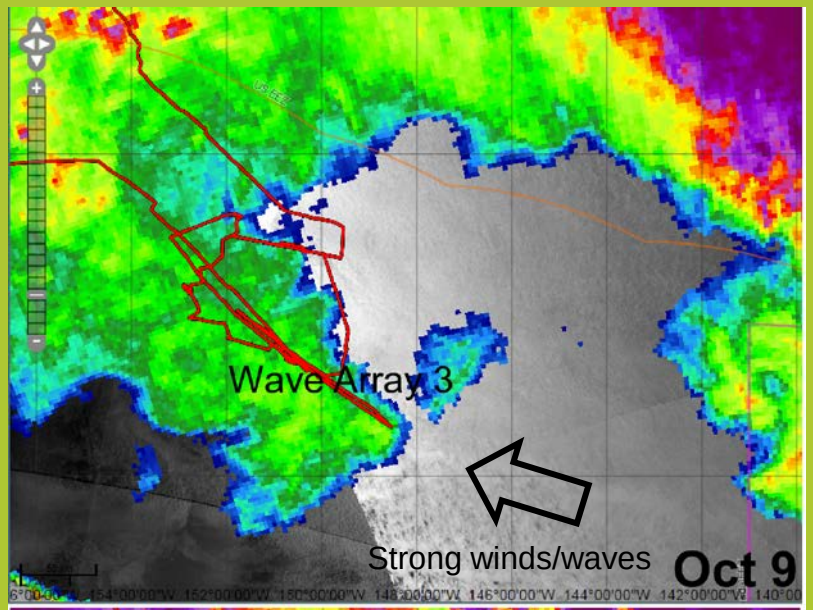


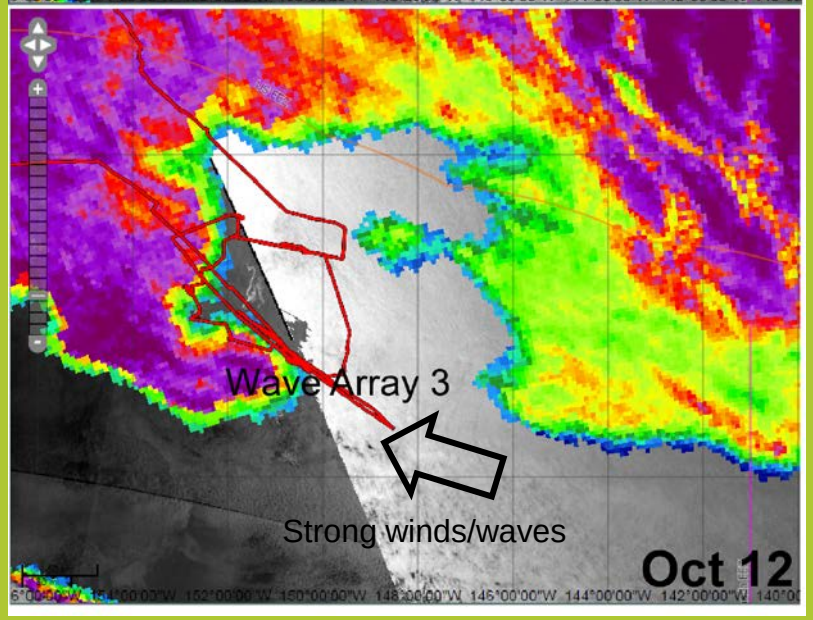




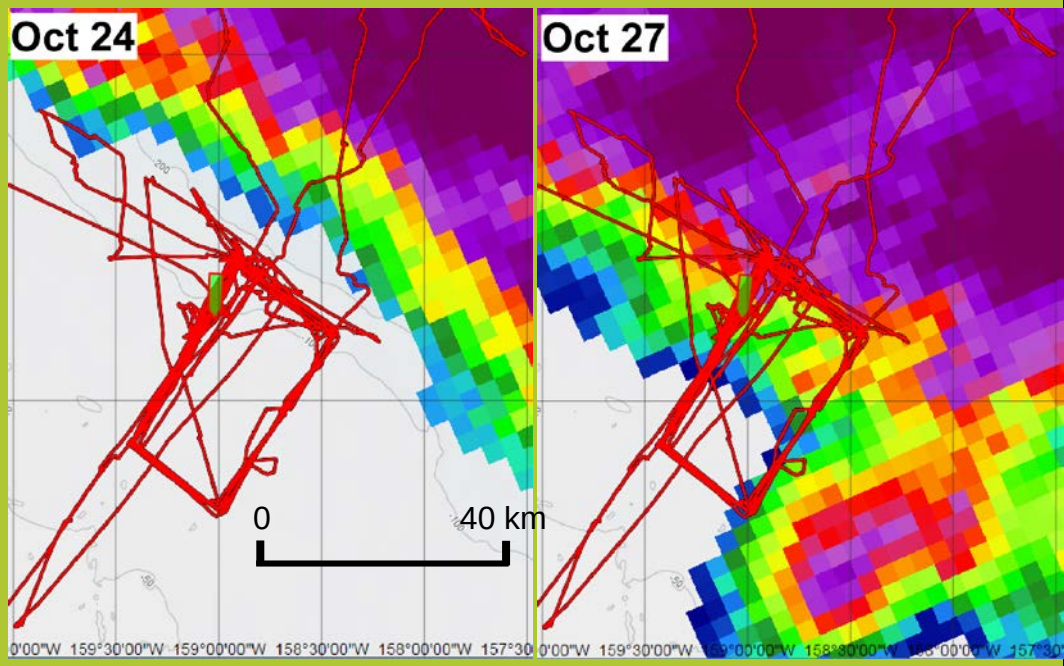
Ice Edge Periods

On-ice Wind/Wave Event

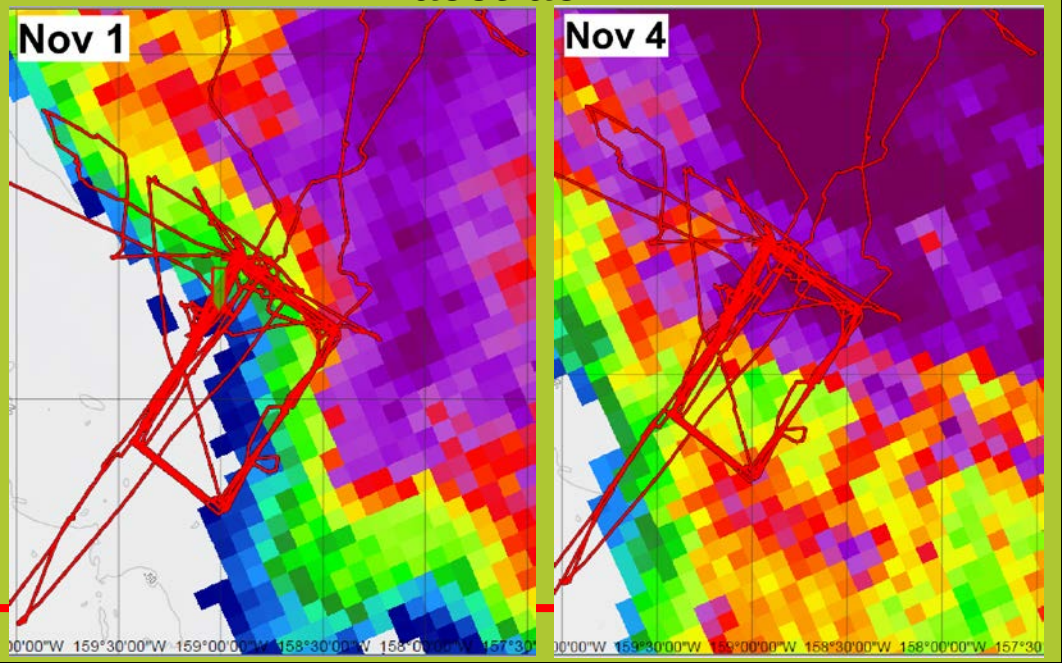




Racetrack 1



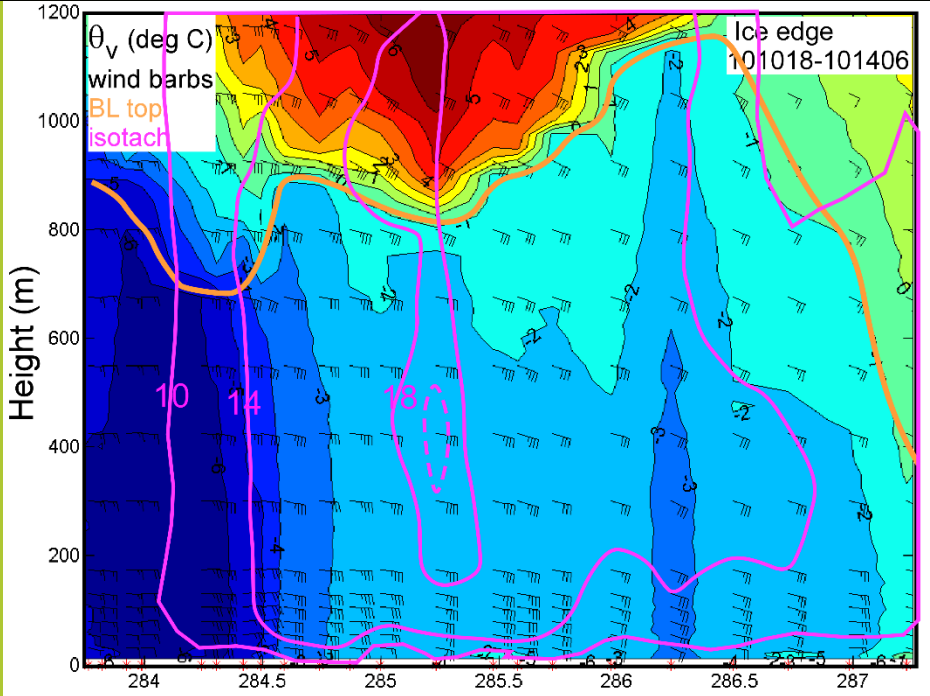
Racetrack 2

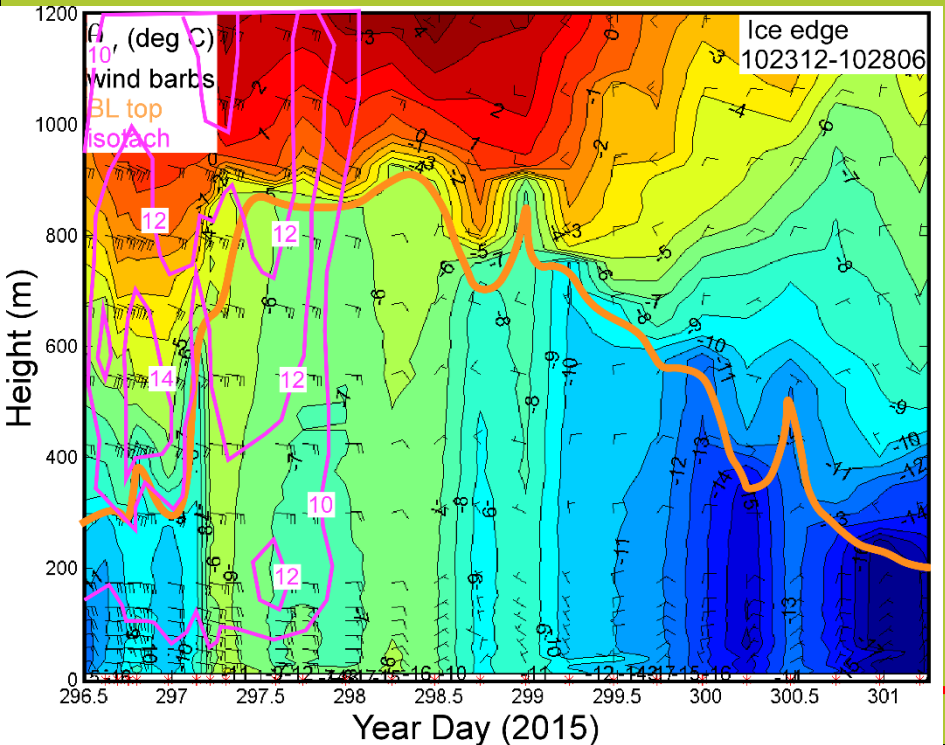


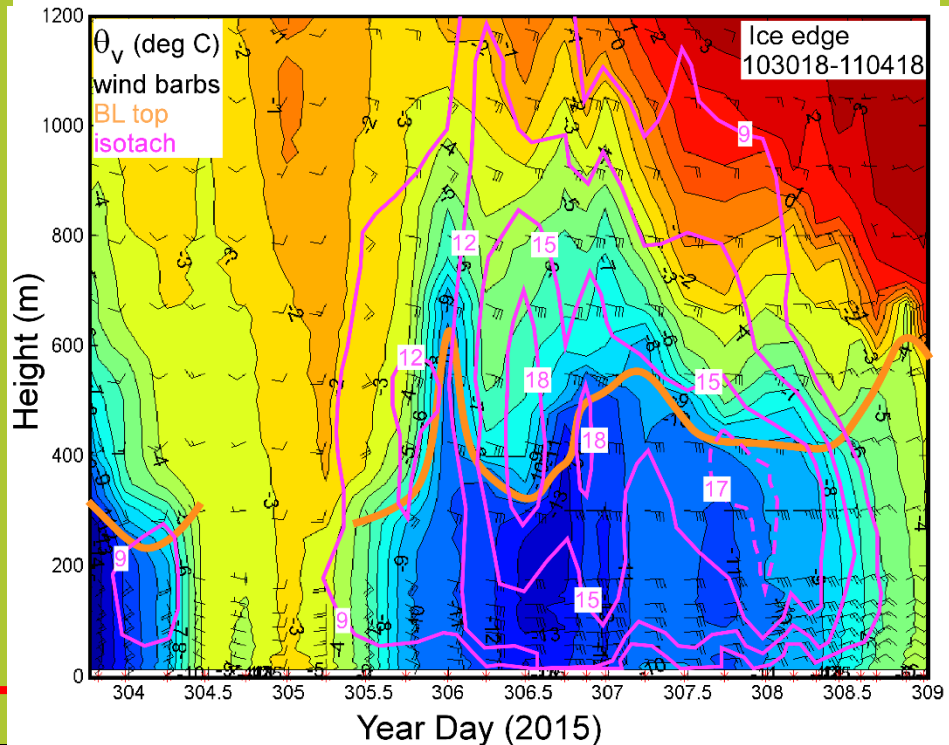
Ice Edge

Boundary Layer

- often well-mixed to 200 -1100+ m
- depth variability governed by variability of on-ice/off-ice flow & ice-relative location
- LLJs observed both above & within BL







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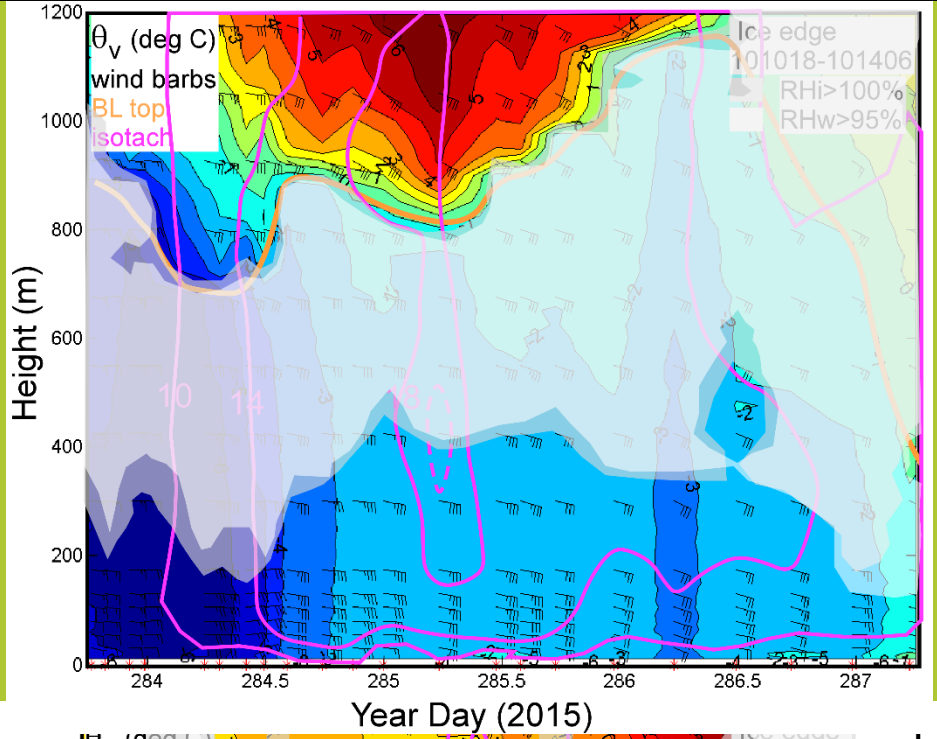
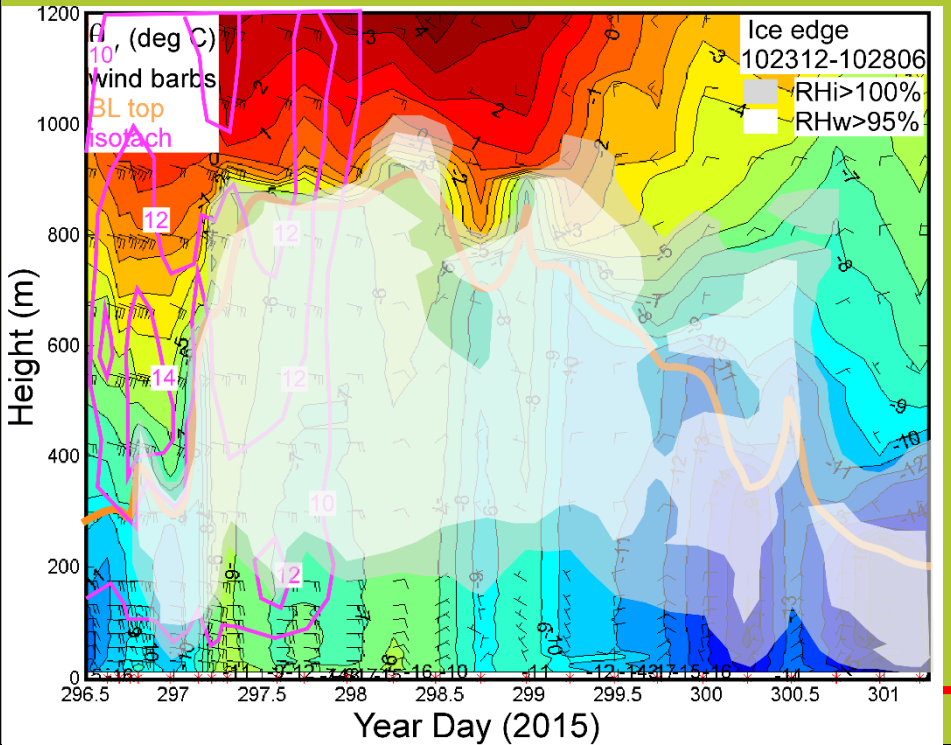
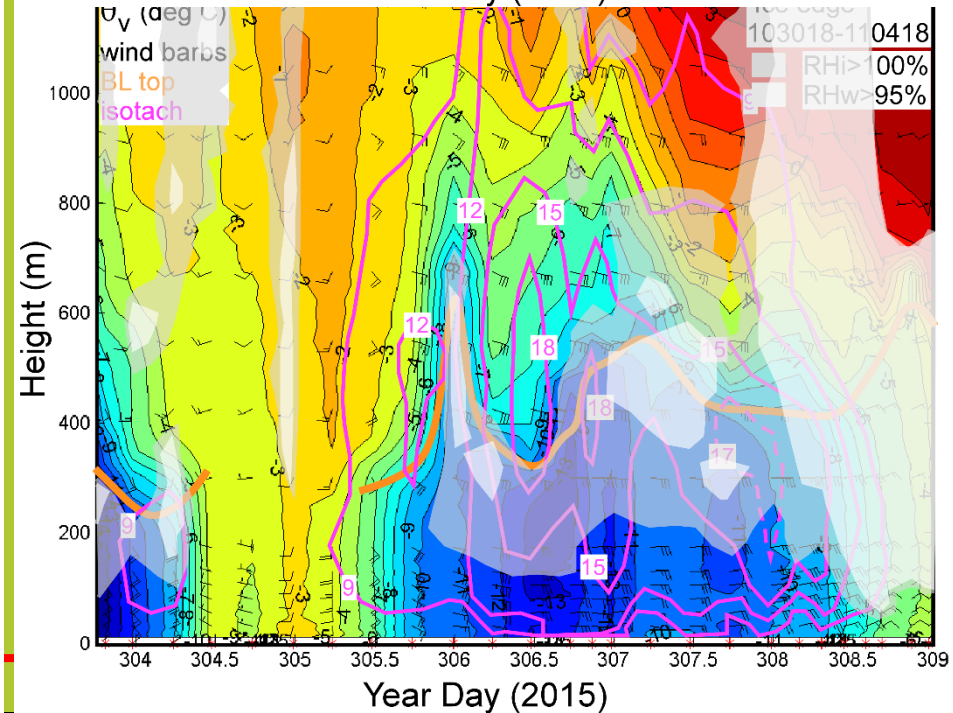






Turbulent fluxes (momentum; latent & sensible heat) – covariance, bulk parameterizations

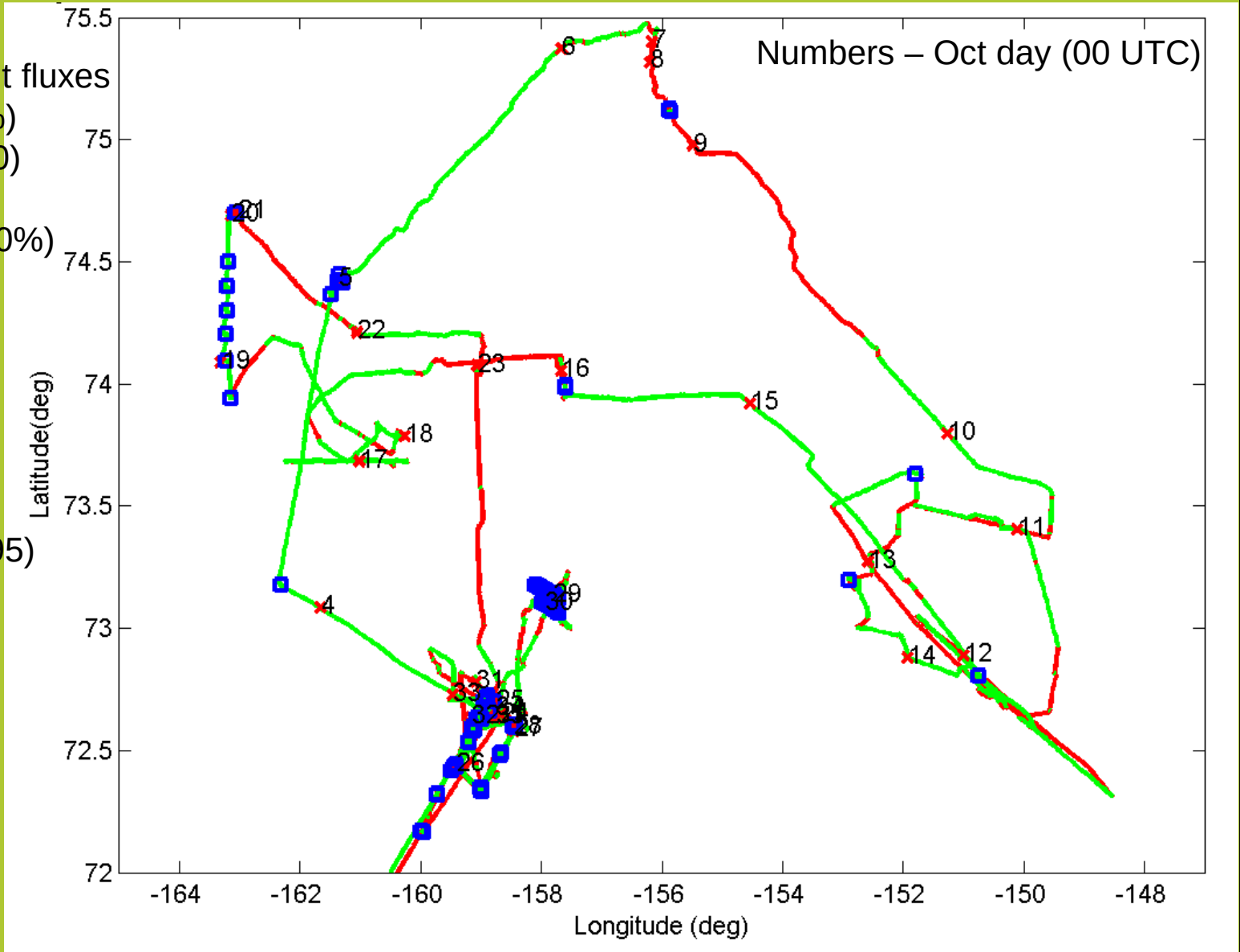
Underway turbulent fluxes

good (60%) ($|WD_{rel}| < 60$)

no good (40%)

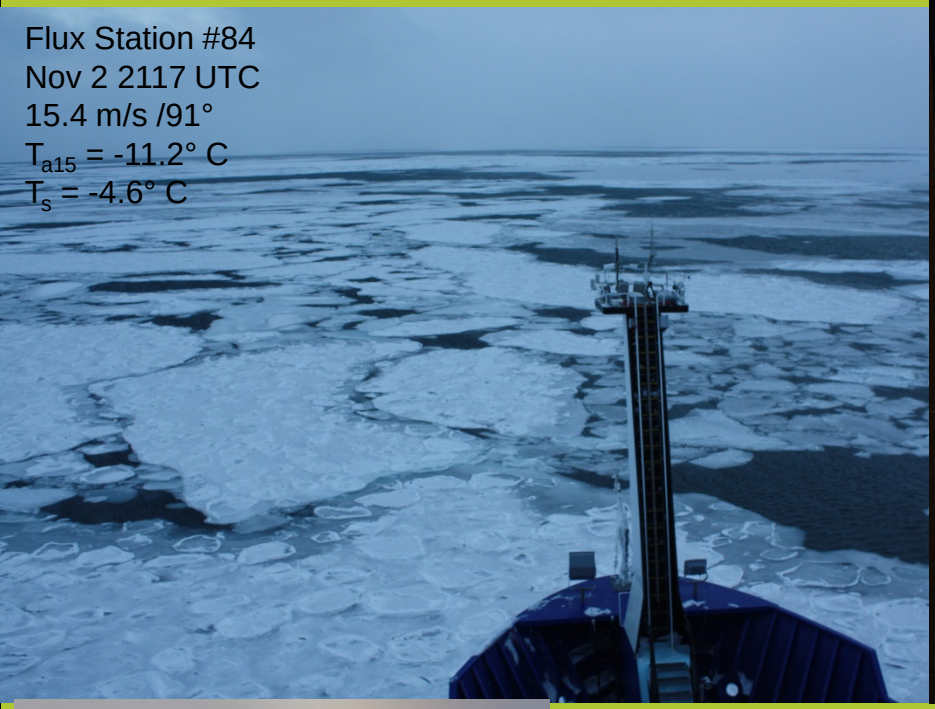
Flux stations (95)

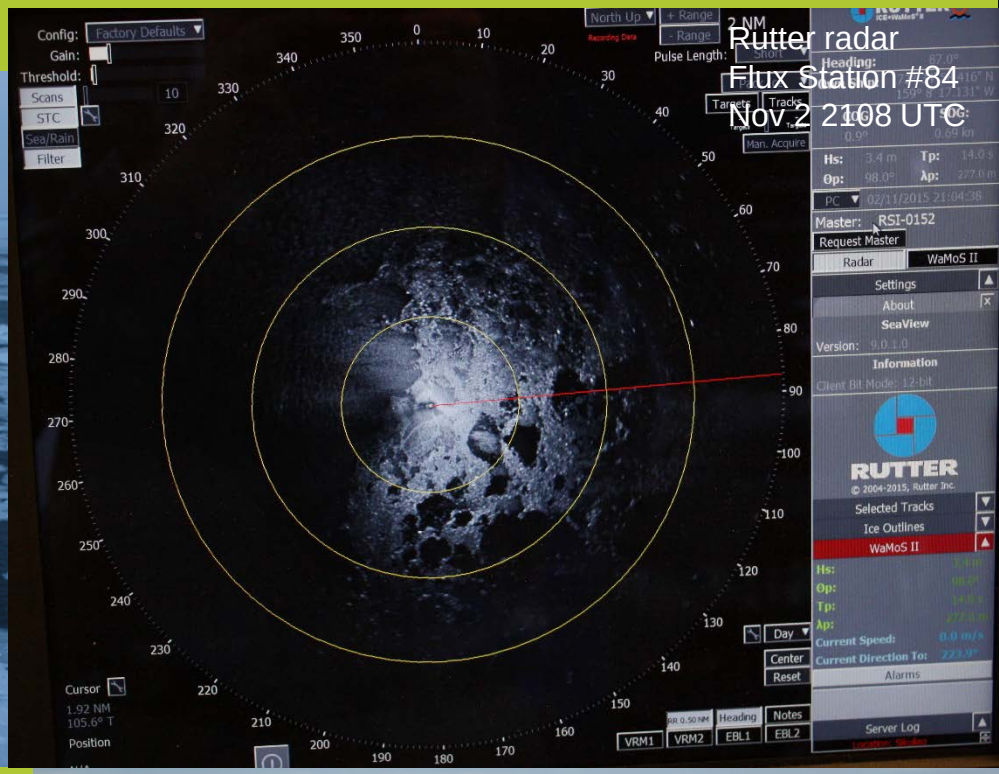
60 cont min of :
- $|WD_{rel}| < 45$
- SOG < 1 m/s



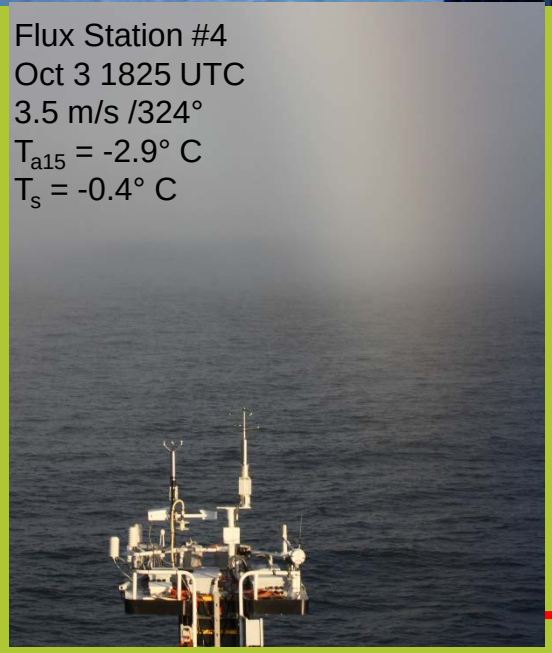
Example Flux Stations

Flux Station #84
Nov 2 2117 UTC
15.4 m/s /91°
T_{a15} = -11.2° C
T_s = -4.6° C

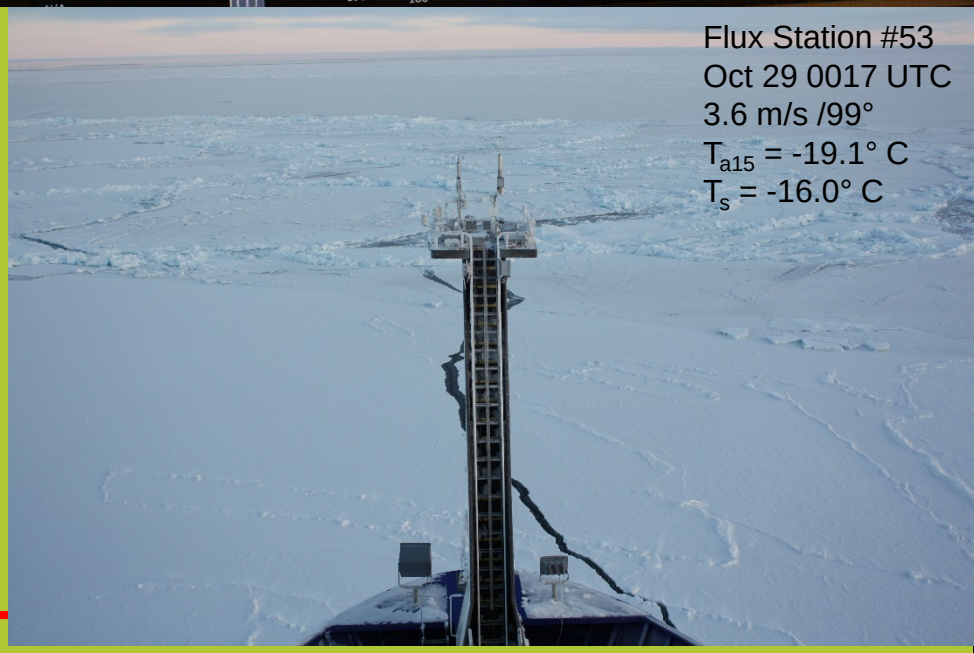




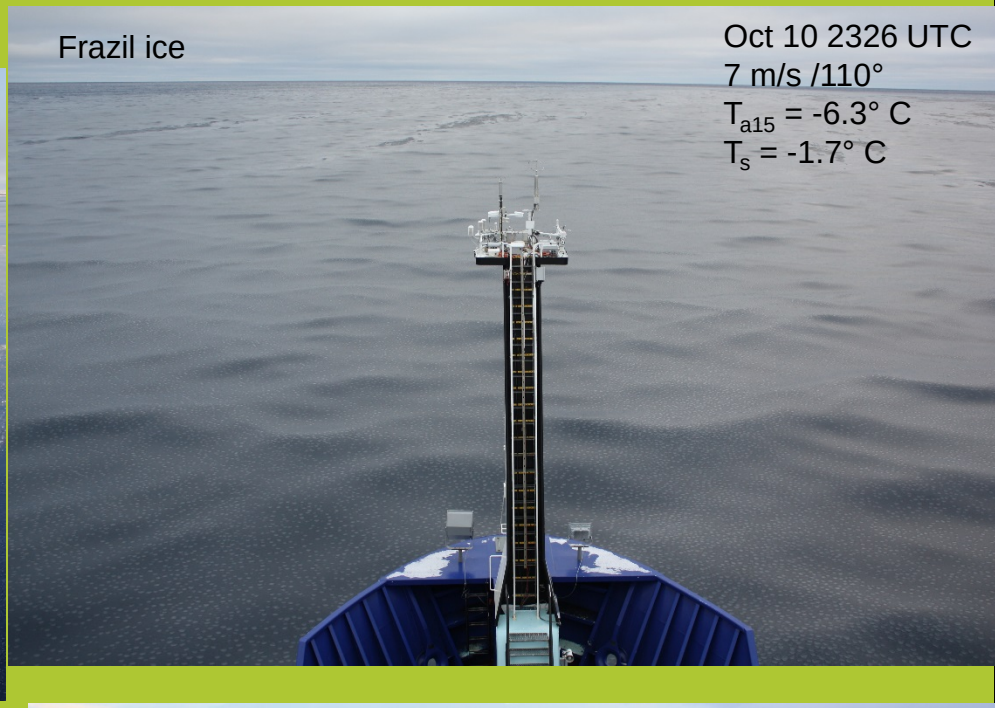
Flux Station #4
Oct 3 1825 UTC
3.5 m/s /324°
T_{a15} = -2.9° C
T_s = -0.4° C

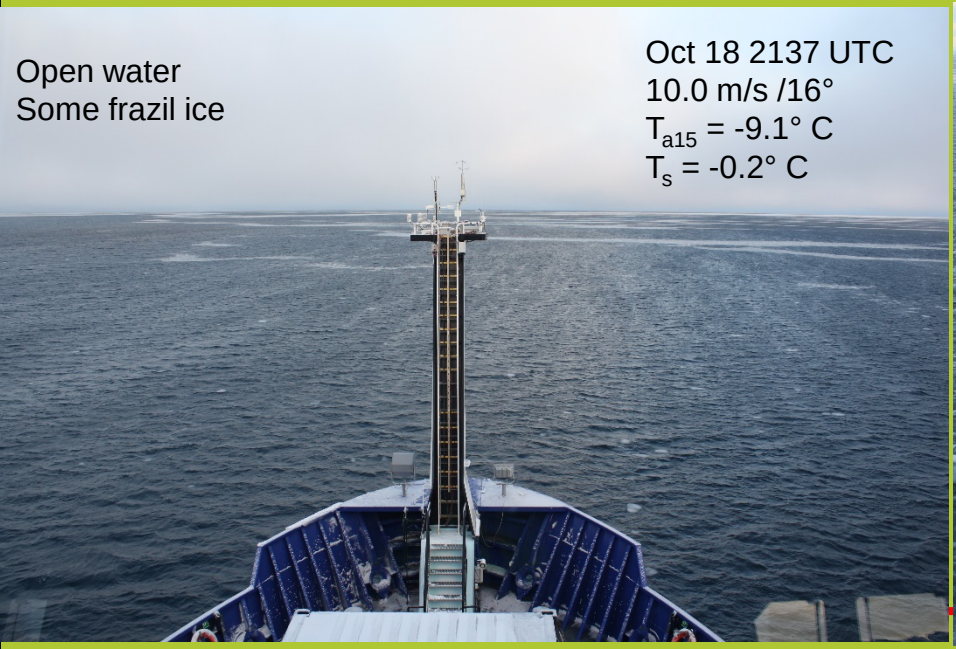


Flux Station #53
Oct 29 0017 UTC
3.6 m/s /99°
T_{a15} = -19.1° C
T_s = -16.0° C

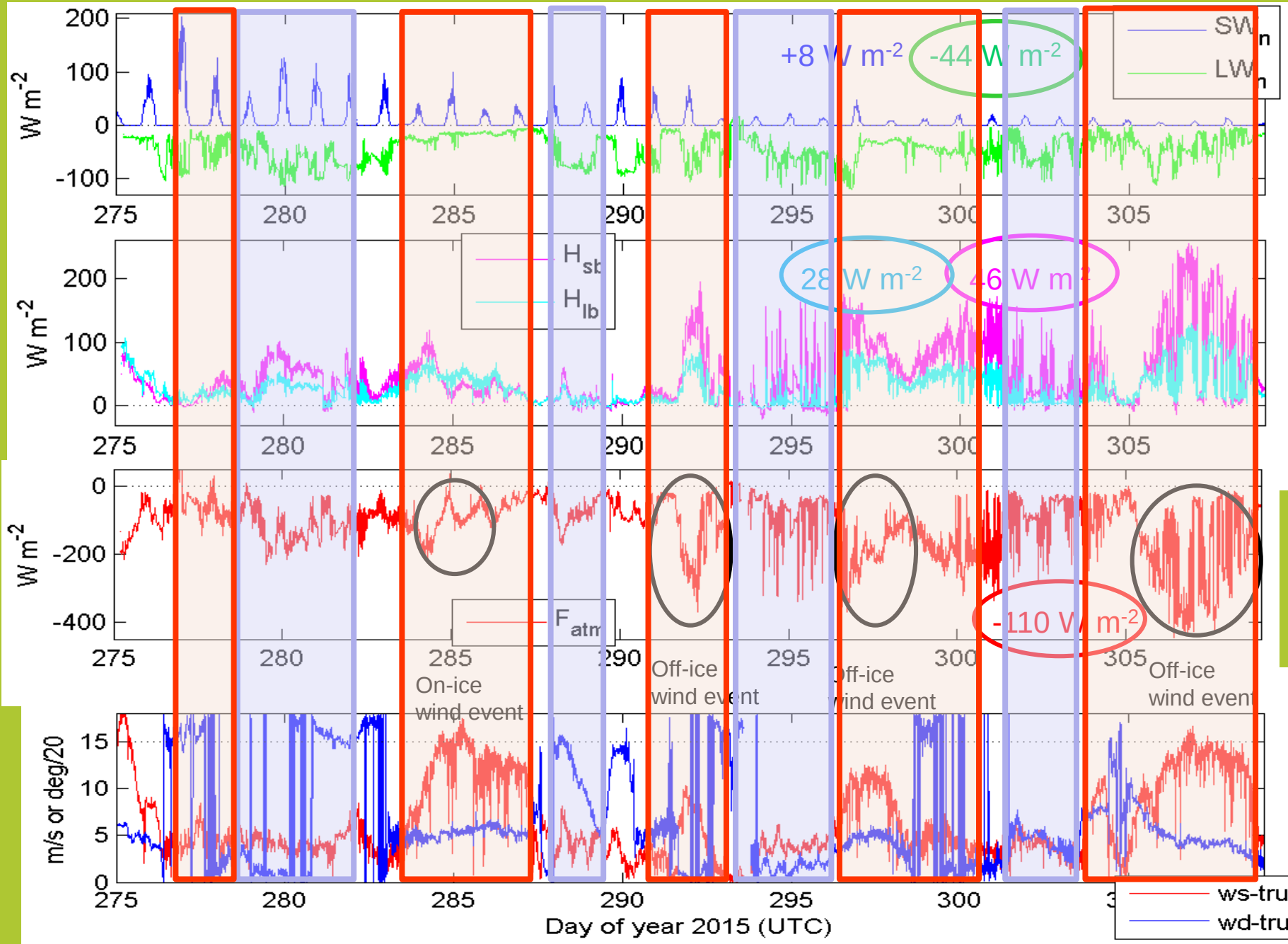


Example Good Underway Fluxes





Sea State Bulk SEB Oct 2 – Nov 4



Sea State Field Program successful in obtaining data to address most objectives

Atmospheric data

a) covariance turbulent heat/momentum fluxes for large variety of ice/water conditions (973 30-min periods; 486 hours)

- understand momentum and heat transfers when (pancake) ice present
- data for significant waves limited to one case

b) turbulent and radiative fluxes for surface energy budget calculations

- ice-relative wind direction key for flux magnitude
- match with underway CTDs to better understand system energy flow
- valuable for validation of models (atmospheric and coupled)

c) lower tropospheric kinematic/thermodynamic/cloud characterization within advancing (thin) pack ice and at ice edge

- significant differences over ice and at ice edge
- key for validation of atmospheric models and understanding of surface fluxes


The End
Slut
Ende
Fini
Martin Doble