# Late Autumn Boundary Layer Observations in the Ross Sea from the PIPERS Project

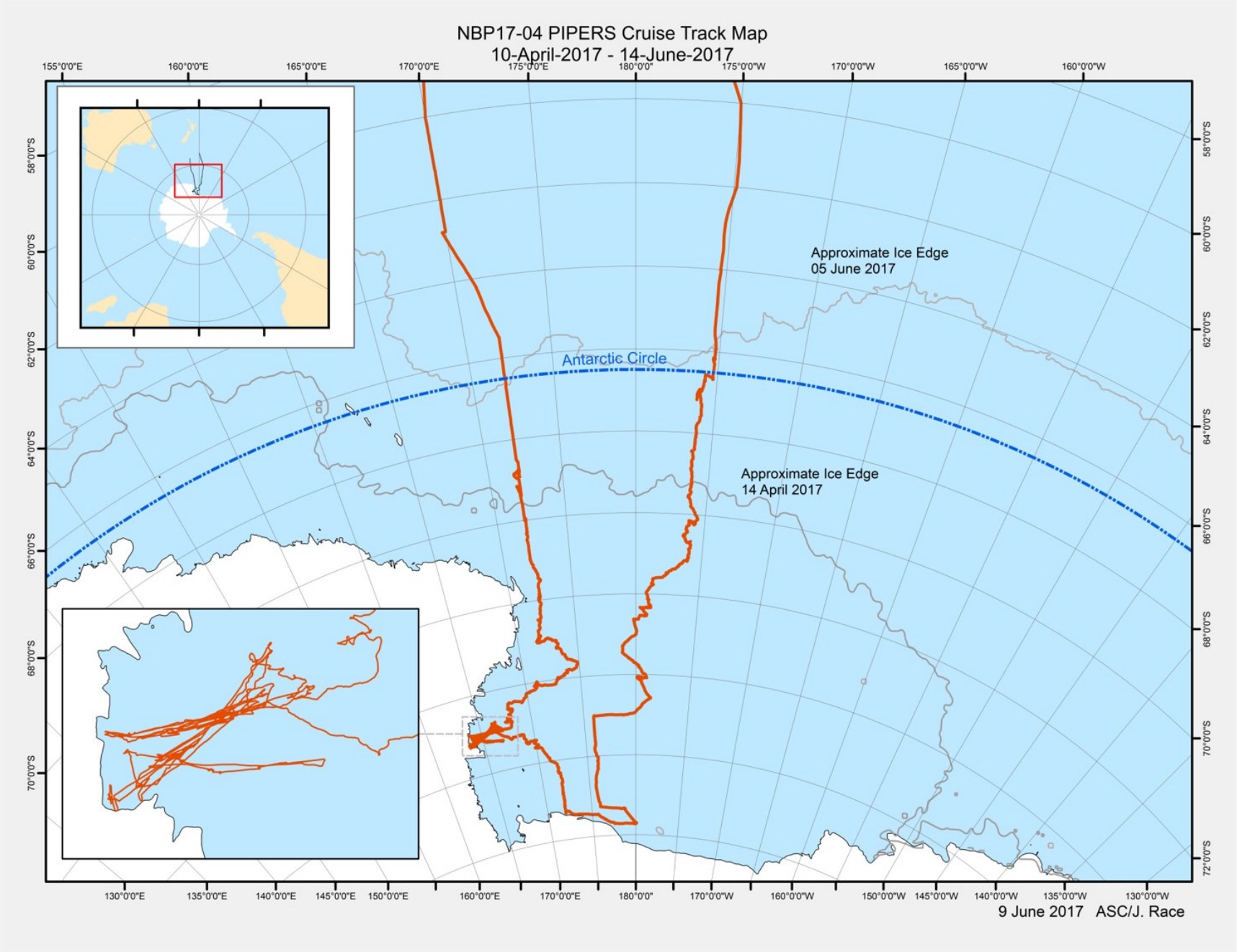

John J Cassano[1], Peter Guest[2], and Kelly Schick[1]

[1]CIRES / ATOC, University of Colorado

[2]Naval Postgraduate School

# Polynyas, Ice Production, and seasonal Evolution in the Ross Sea

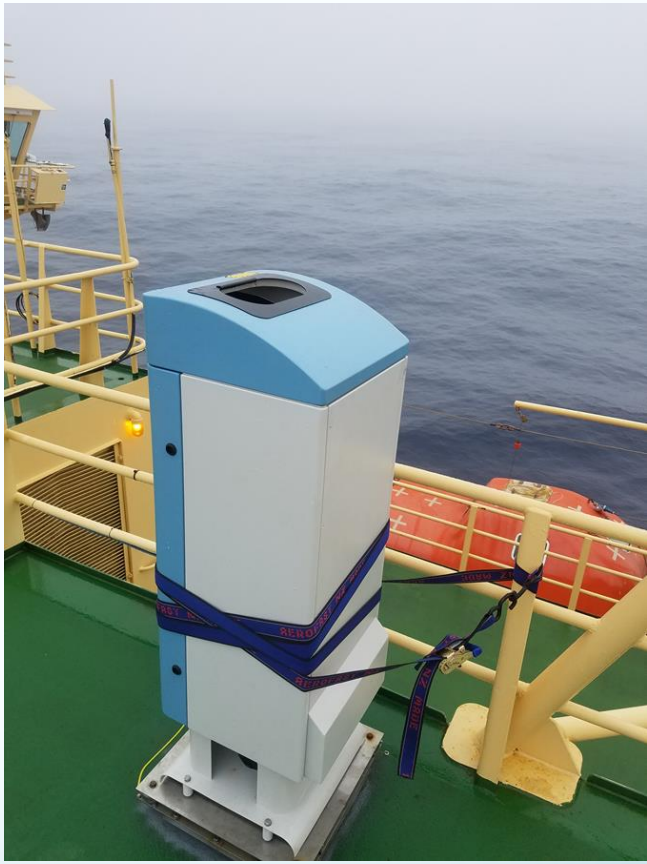
- Improve estimates of sea ice production and water mass transformation in the Ross Sea
- Observations to study:
  - Surface energy balance
  - Impact of katabatic winds on ice growth
  - Ocean property and water mass changes
  - Ice growth and thickness evolution
- Cruise: 10 April – 14 June 2017


NBP17-04 PIPERS Cruise Track Map
10-April-2017 - 14-June-2017
155°0'0"E
160°0'0"E
165°0'0"E
170°0'0"E
175°0'0"E
180°0'0"
175°0'0"W
170°0'0"W
165°0'0"W
160°0'0"W
58°0'0"S
60°0'0"S
62°0'0"S
64°0'0"S
66°0'0"S
68°0'0"S
70°0'0"S
72°0'0"S
Approximate Ice Edge
05 June 2017
Antarctic Circle
Approximate Ice Edge
14 April 2017
130°0'0"E
135°0'0"E
140°0'0"E
145°0'0"E
150°0'0"E
160°0'0"E
170°0'0"E
180°0'0"
170°0'0"W
160°0'0"W
150°0'0"W
145°0'0"W
140°0'0"W
135°0'0"W
130°0'0"W
9 June 2017 ASC/J. Race

# Instruments

- Ship-based weather station, radiometer, ceilometer
- Radiosondes
- Flux tower
- Small unmanned meteorological observer (SUMO) unmanned aerial system (UAS)

# Weather Station / Ceilometer

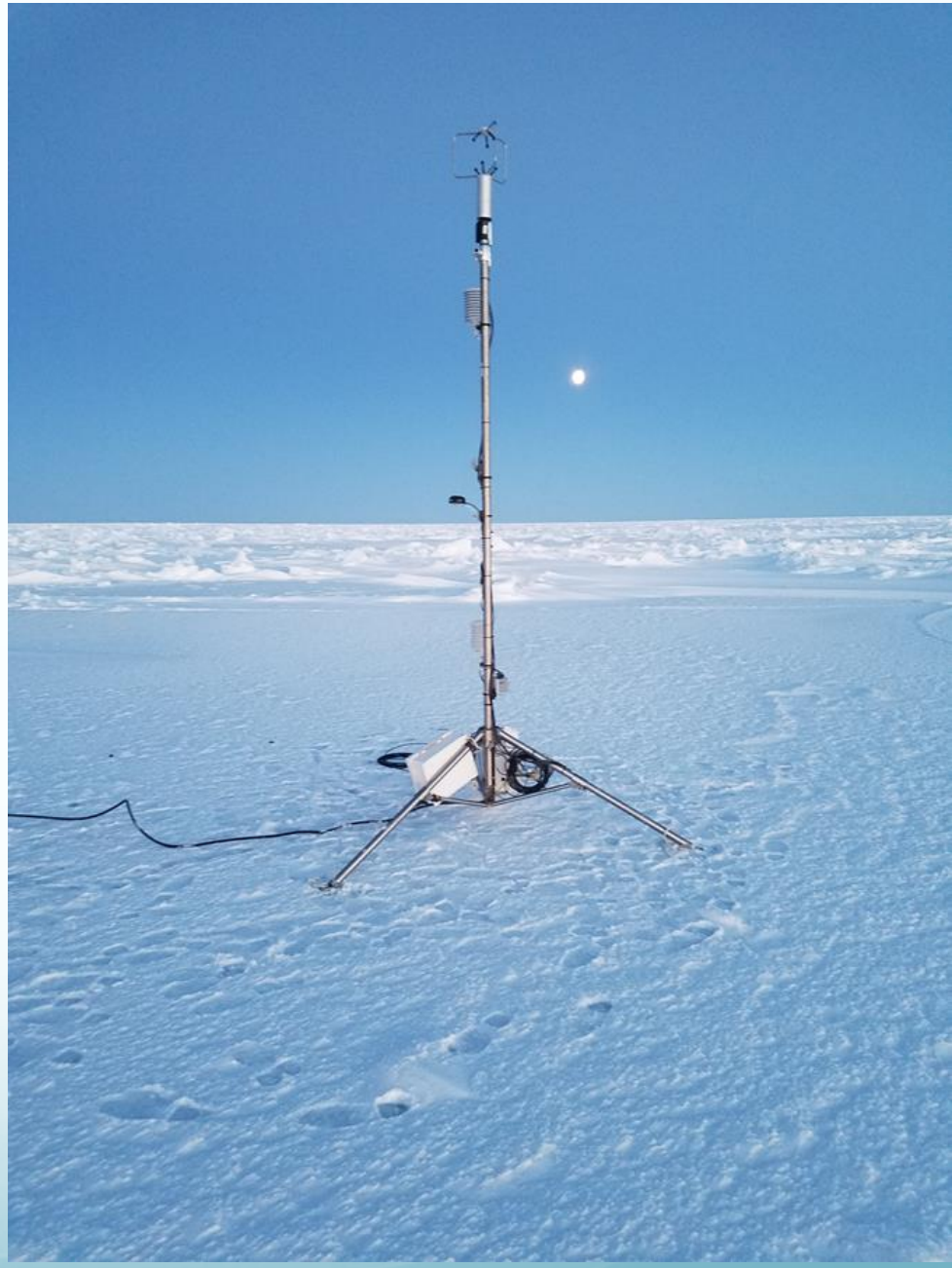


Continuous atmospheric state, radiative flux, and ceilometer observations throughout cruise

# Radiosonde


169 radiosonde launches during cruise

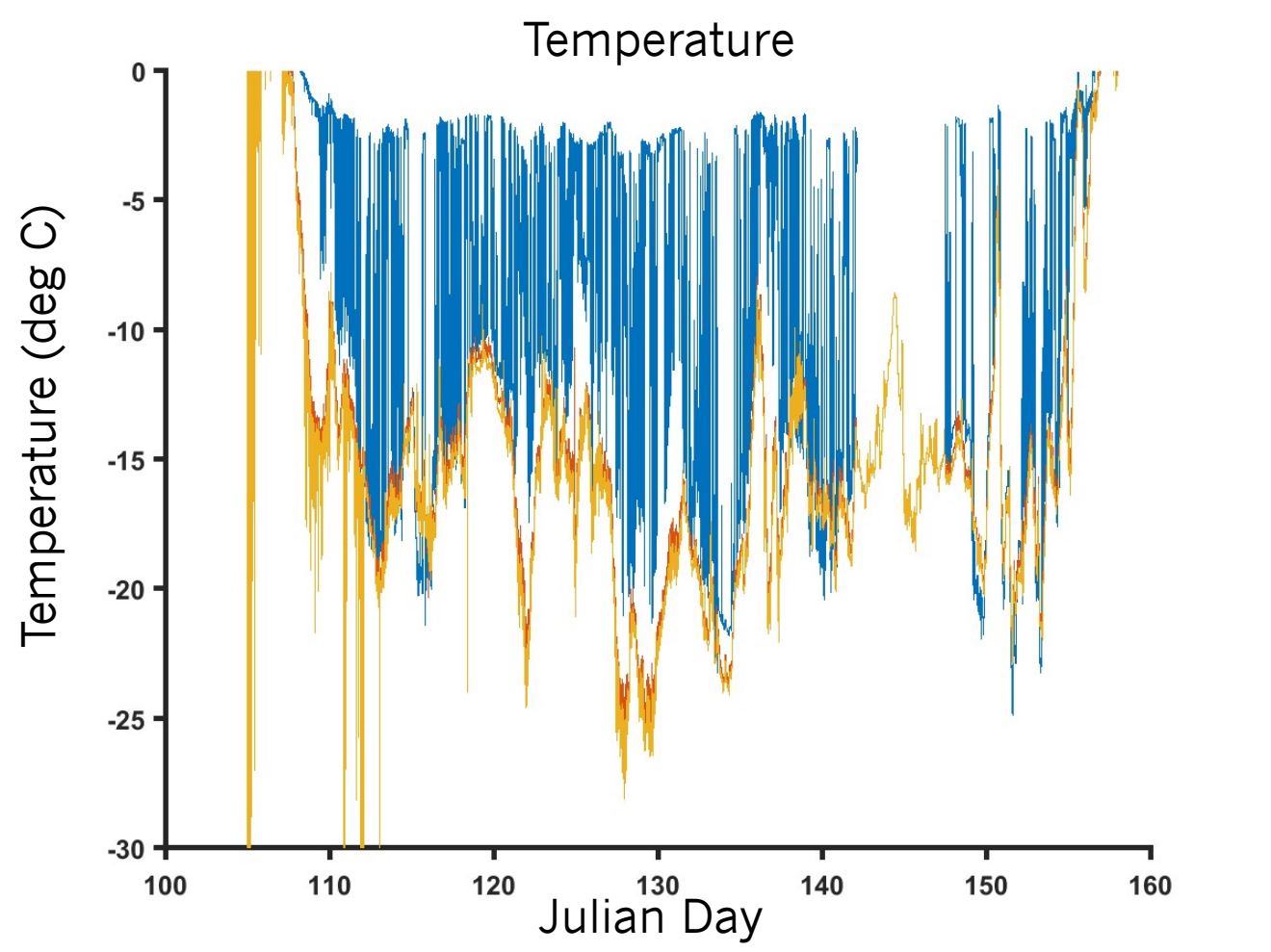
# Flux Tower

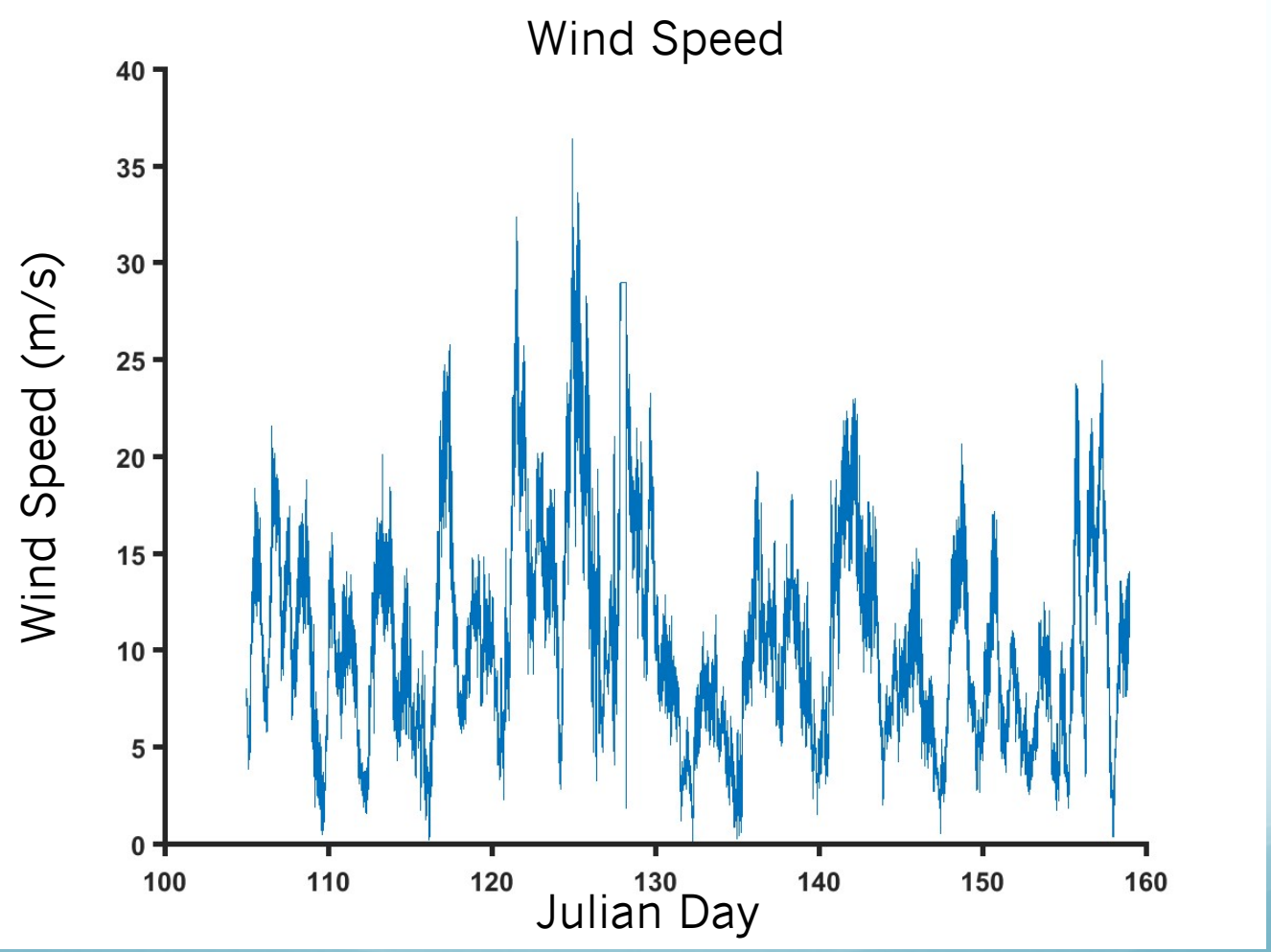
# Small Unmanned Meteorological Observer (SUMO) UAS

19 SUMO UAS profiles during cruise

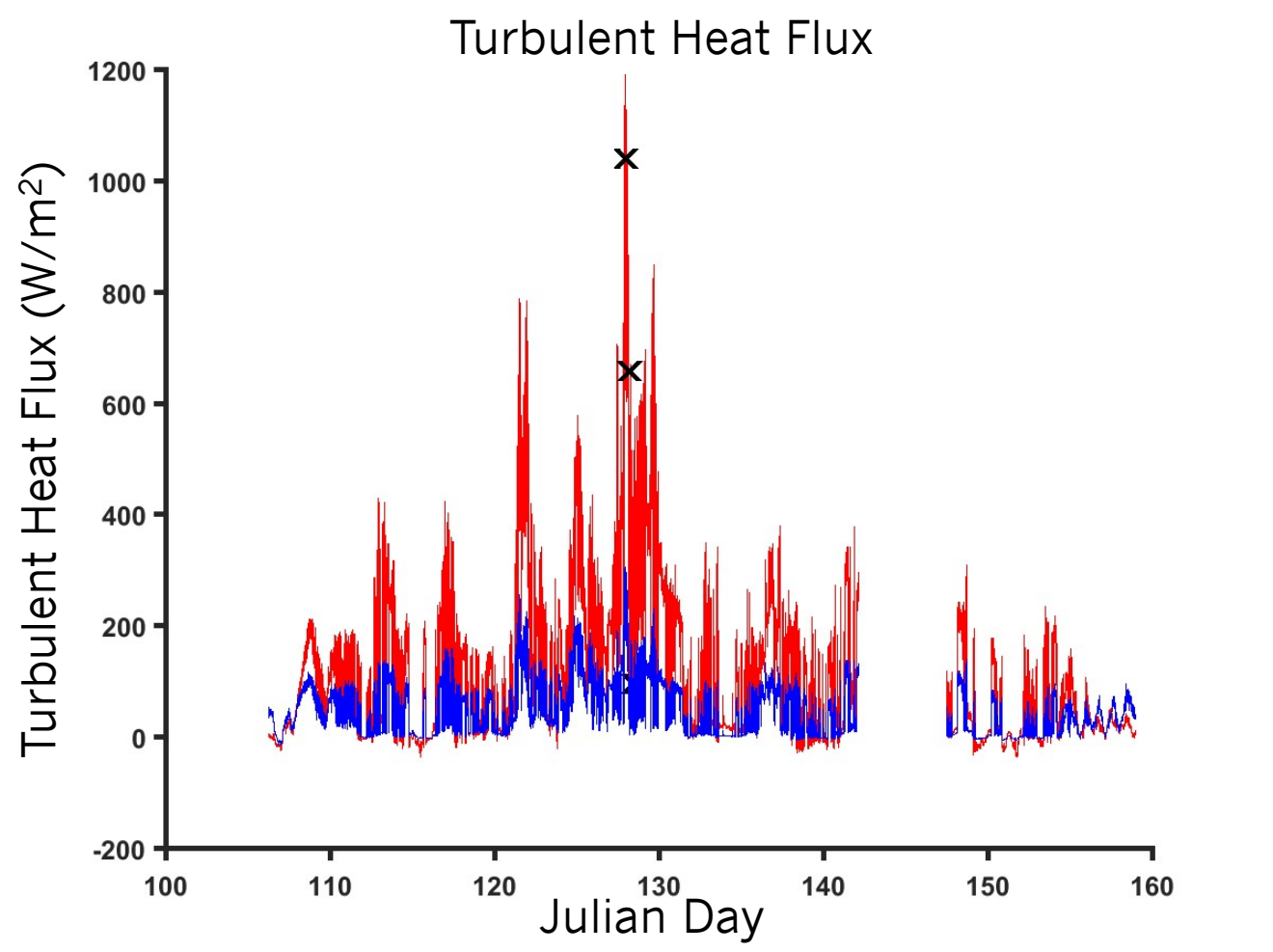
# Meteorology During the Cruise



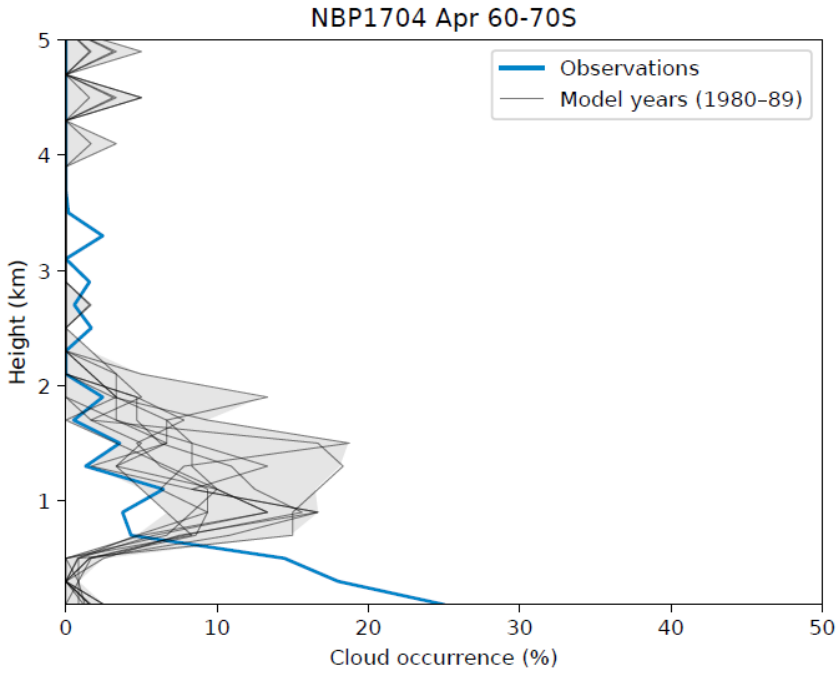
# Meteorology During the Cruise

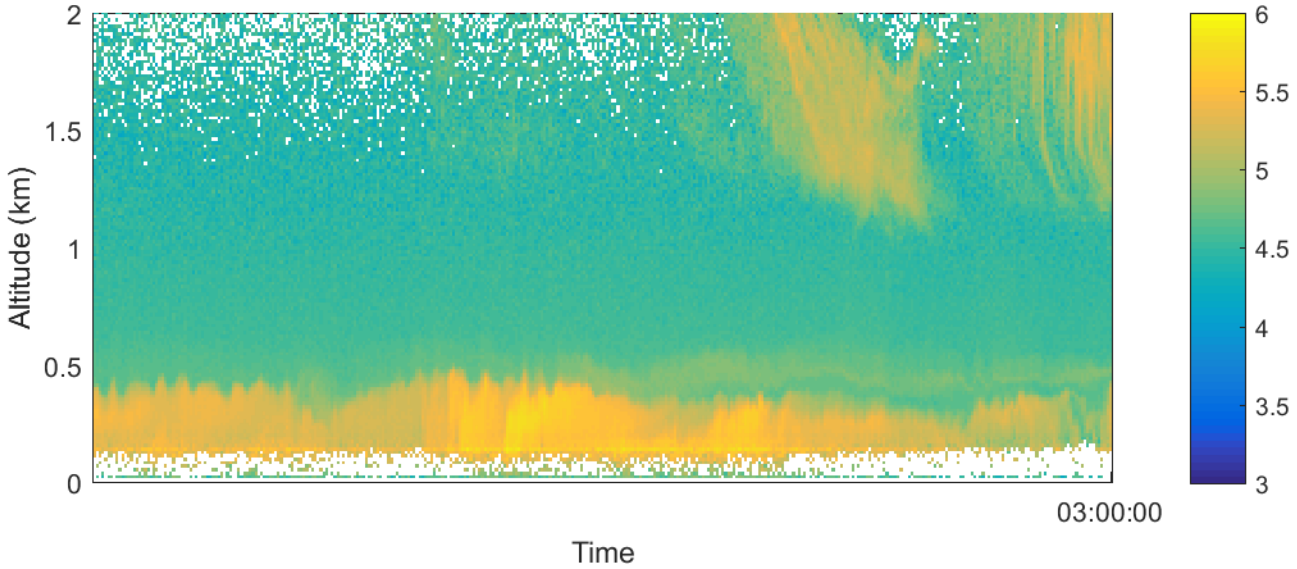


# Meteorology During the Cruise



# Cloud Observations



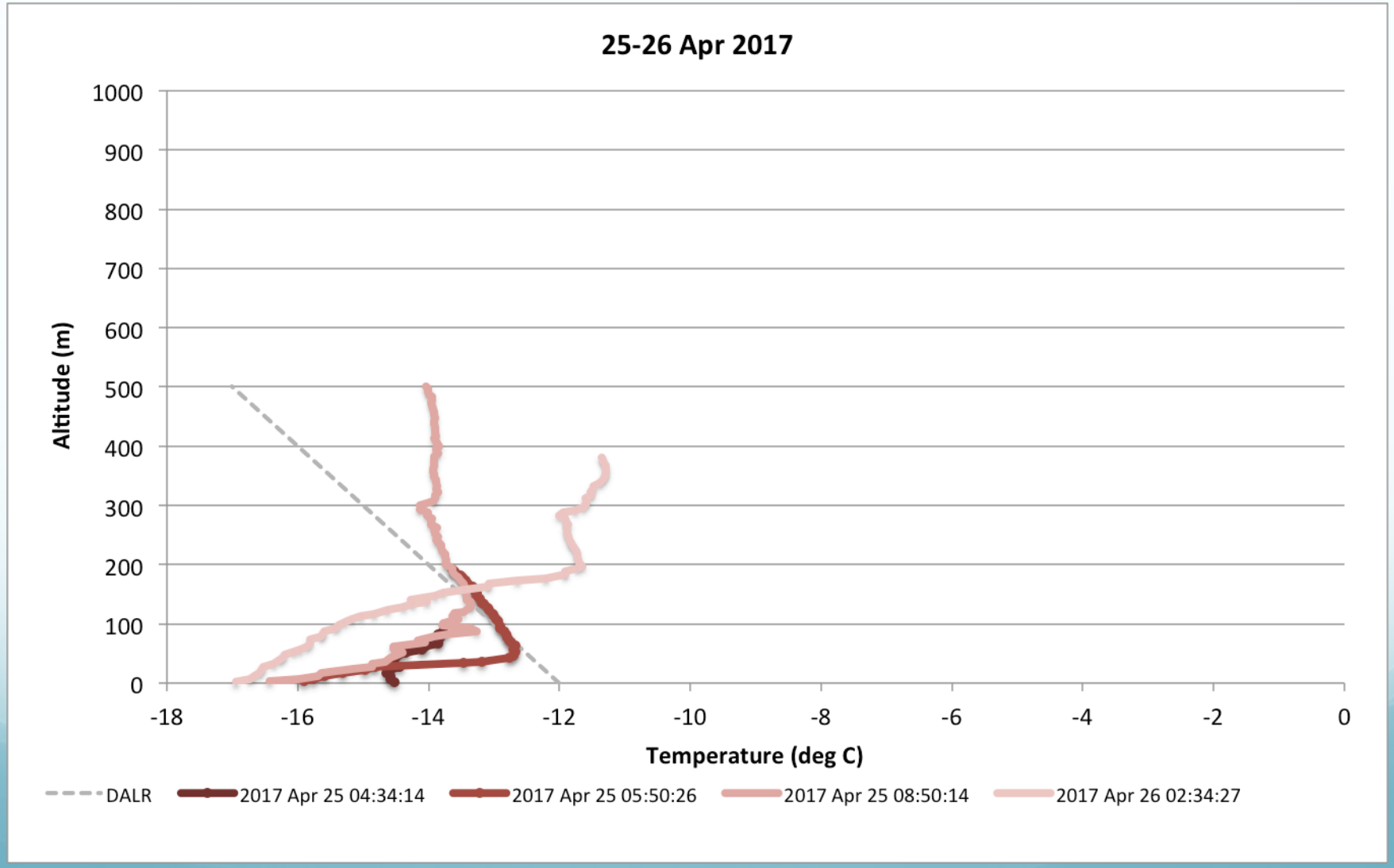




GATEWAY ANTARCTICA

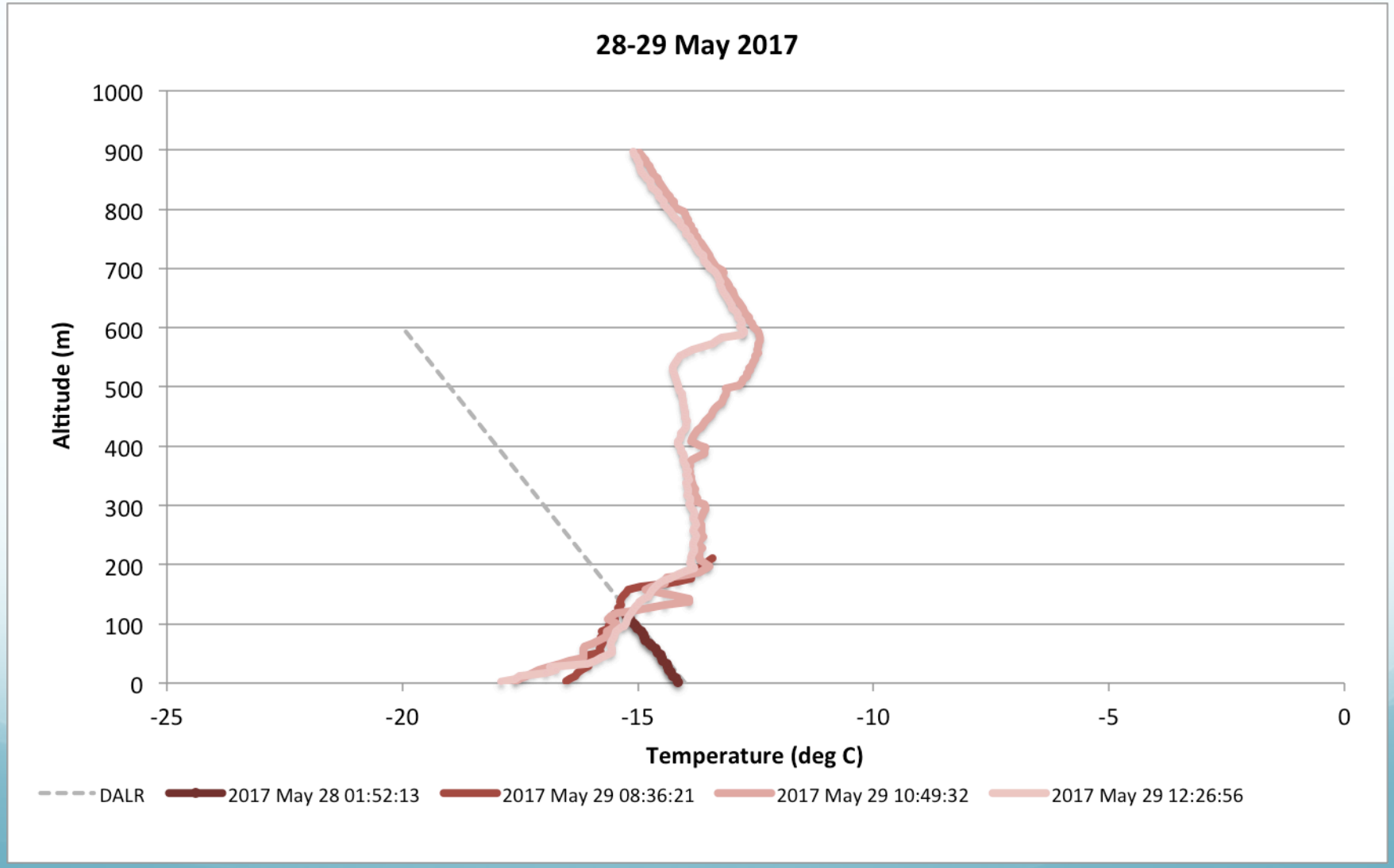
UC UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Courtesy of Adrian McDonald

# Small Unmanned Meteorological Observer (SUMO) UAS

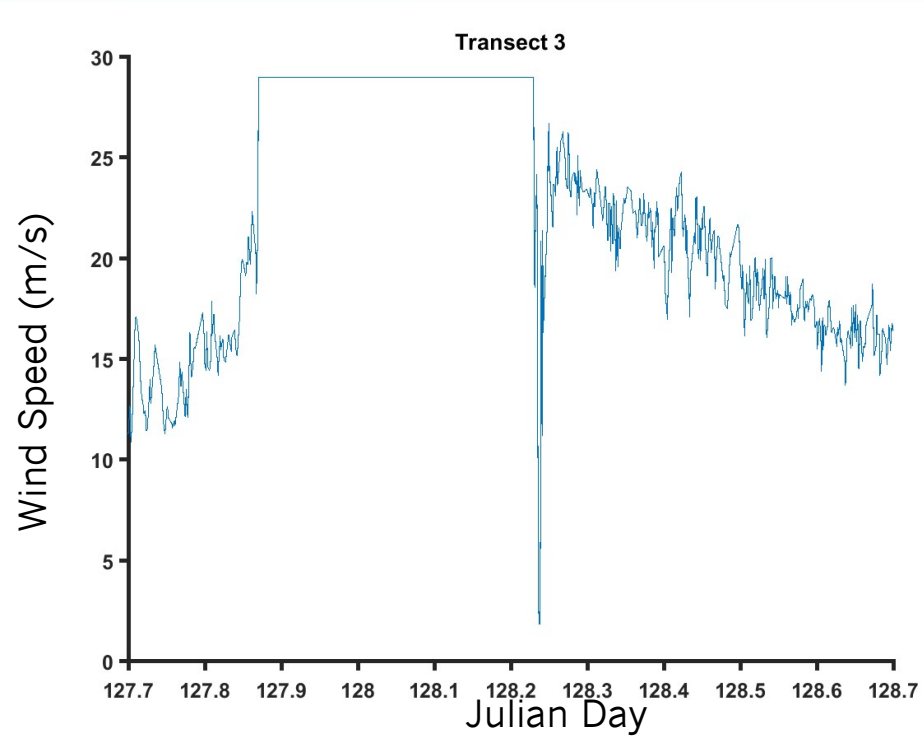


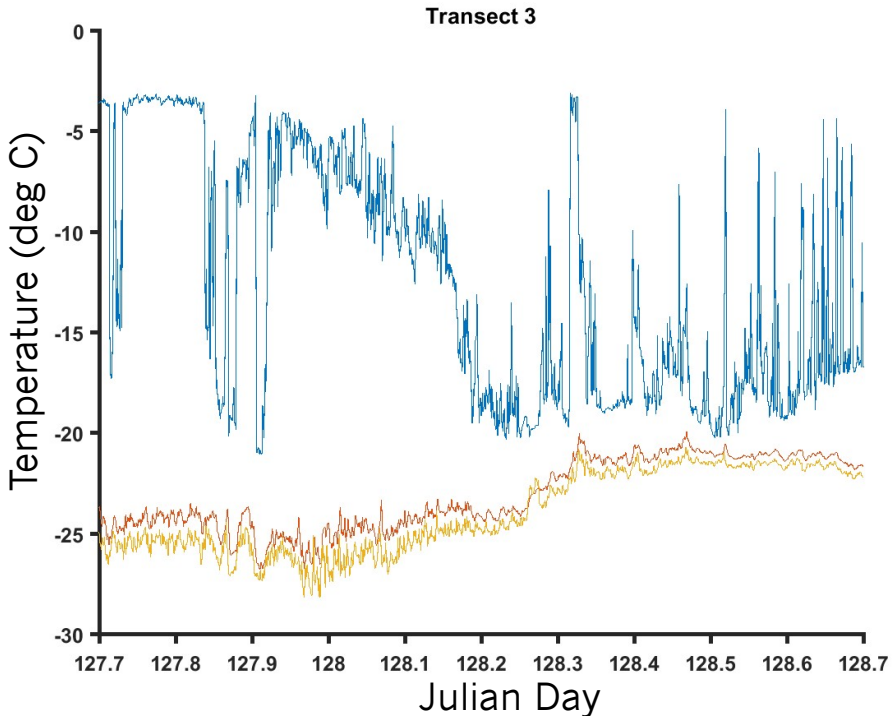
# Small Unmanned Meteorological Observer (SUMO) UAS



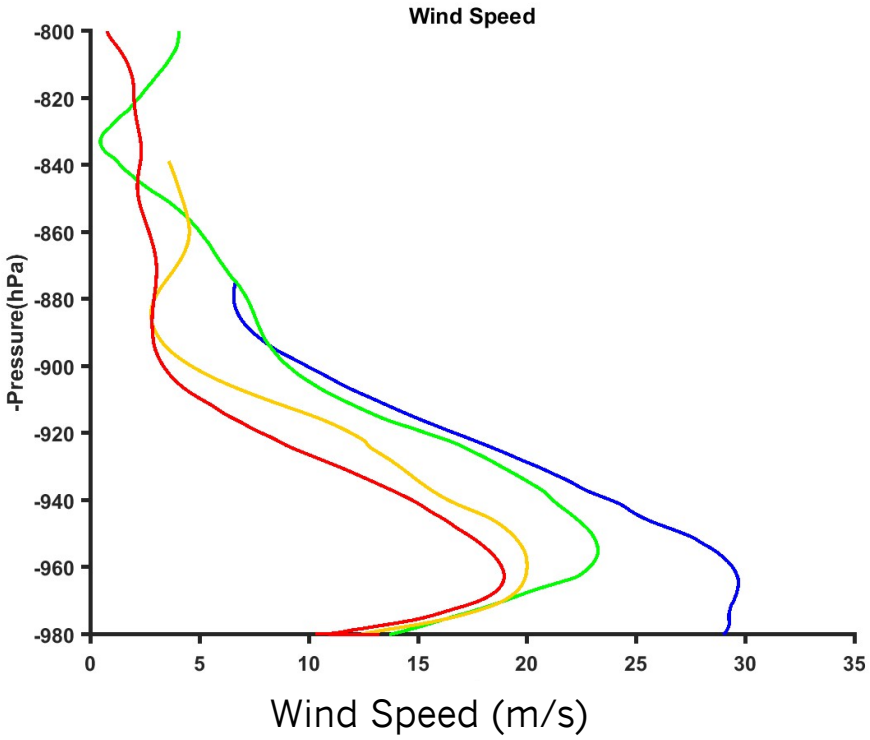
# Katabatic Winds in the Terra Nova Bay Polynya

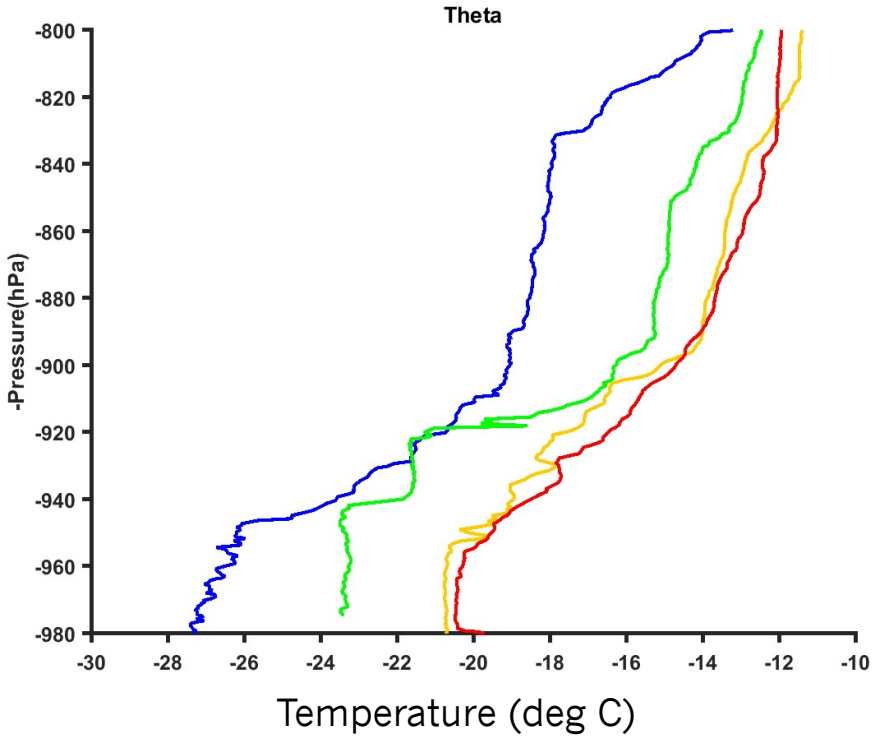
# TNB Katabatic Wind Event

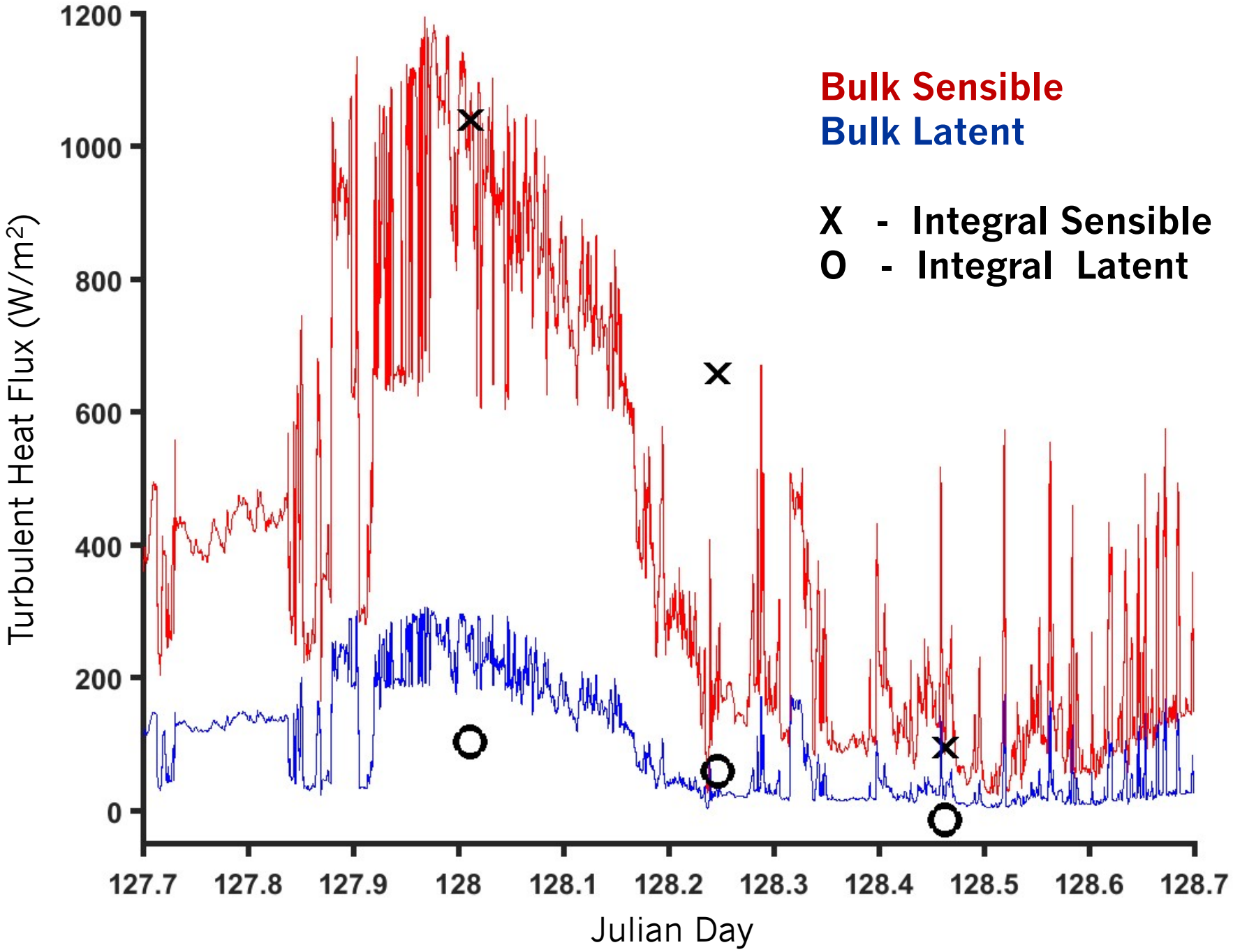


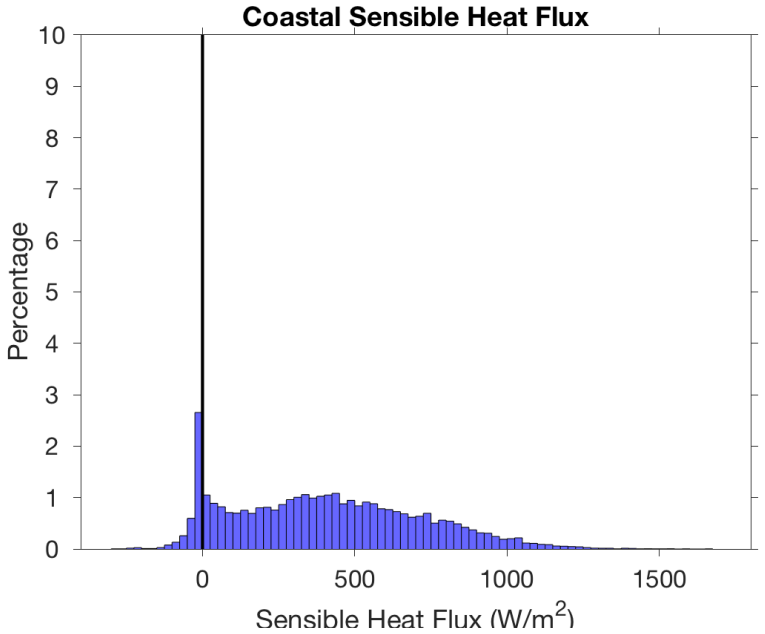
# TNB Katabatic Wind Event

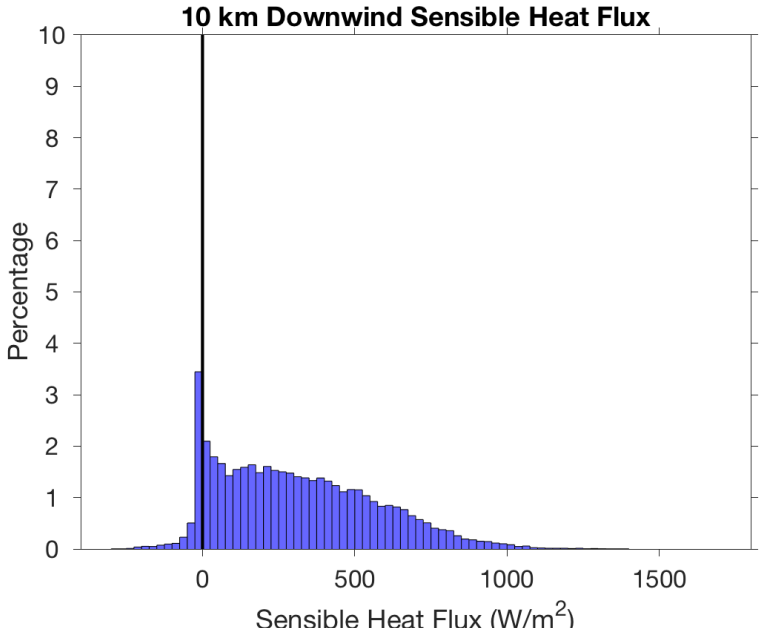


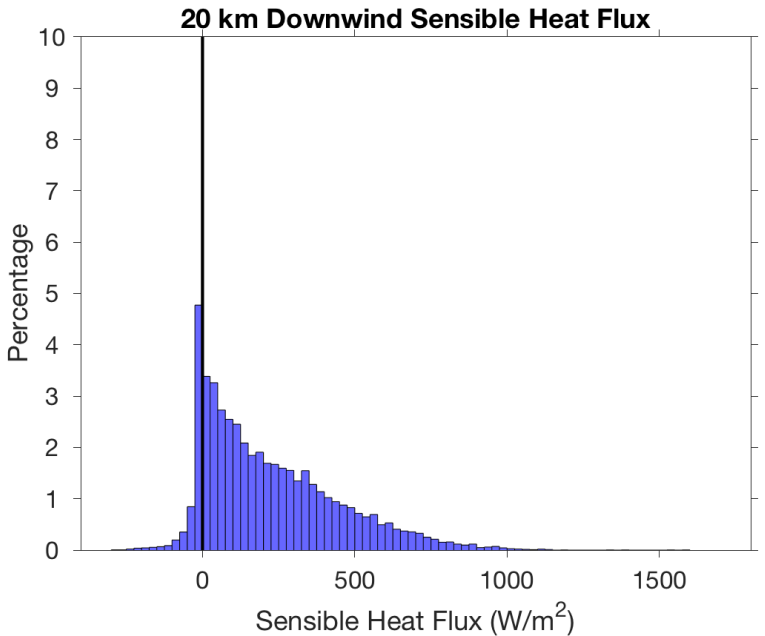



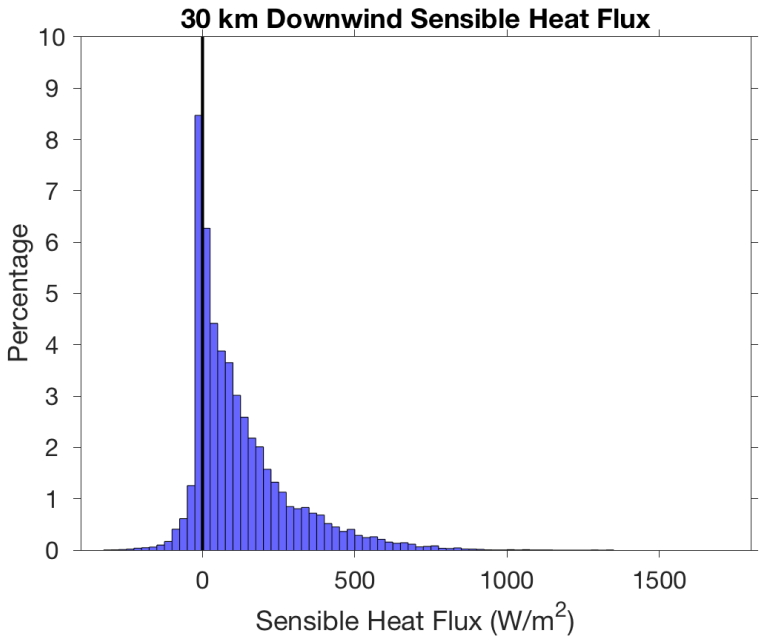

Bulk Sensible
Bulk Latent
X - Integral Sensible
O - Integral Latent
Turbulent Heat Flux (W/m²)
1200
1000
800
600
400
200
0
127.7
127.8
127.9
128
128.1
128.2
128.3
128.4
128.5
128.6
128.7
Julian Day

# Seasonal Sensible Heat Flux Estimates

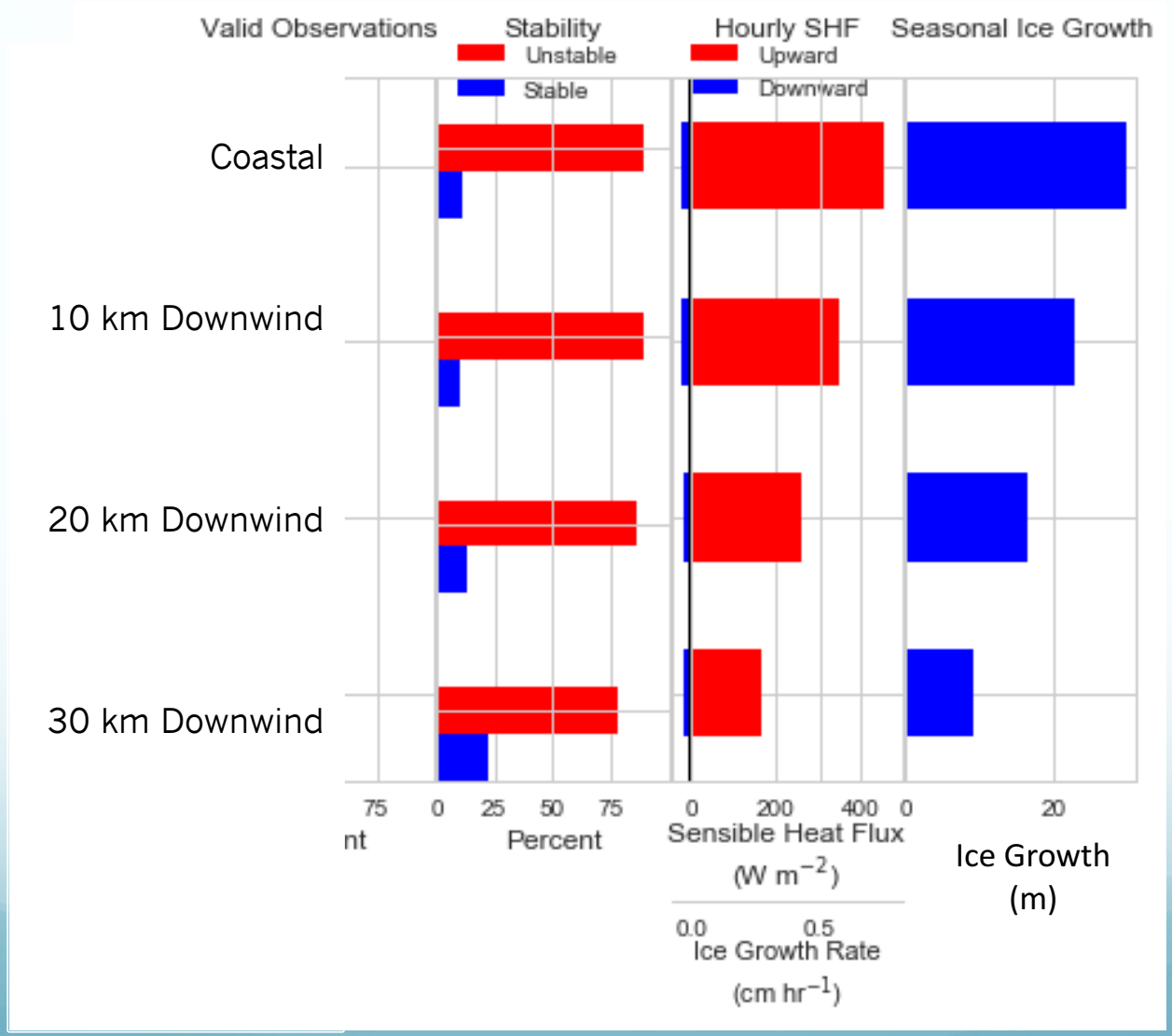


# Seasonal Sensible Heat Flux and Ice Growth Estimates



# Conclusions

- A unique meteorological data set was collected during the PIPERS cruise
  - Detailed in-situ observations of the atmospheric state and estimates of surface fluxes during the austral autumn
  - Repeat vertical profiles of boundary layer state from SUMO UAS
  - Continuous ceilometer observations of clouds (and boundary layer / aerosols)
- Katabatic wind events result in very large turbulent fluxes with a significant impact on sea ice growth
  - Schick and Cassano (in prep.) estimate average upward sensible heat fluxes of 460 to 160 W $m^{-2}$ during April to September in TNB
  - This results in 30 to 9 m of ice growth per “winter” season


Thanks to the crew of the Nathaniel B Palmer and the PIPERS science team.

Special thanks to Adrian McDonald for providing ceilometer data and Guy Williams for piloting the SUMO UAS.

http://www.utsa.edu/signl/pipers/index.html