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AAF DataHawk Observations during ICARUS in FY16

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Motivation and Objectives

- The Inaugural Campaigns for ARM Research using Unmanned Systems, or ICARUS is an internal effort similar to the ERASMUS campaign. However, ICARUS is ARM's first foray into routine UAS and TBS (tethered balloon systems) operations with ARM instruments and measurement platforms.
- The main objectives of ICARUS are:
  - Demonstrate how low-cost UAVs can be used to routinely study the atmosphere in the Arctic.
  - Collect spatial information about the rapidly changing arctic environment in conjunction with ground-based instruments, which are part of the ARM Mobile Facility (AMF3).
  - Understand the different processes that affect the cloud life cycle.
  - Improve short-term weather models as well as help scientists understand how the climate is evolving.

AAF DataHawk Deployment in FY16

Deployment information

- Total 27 days between 06/05/2016 and 08/21/2016
- Total 74 flights
  - 61 meaningful research flights (~39 hours)
  - 38 flights are 40m circling over ECOR.
- 6 pilots/observers from PNNL and University of Alaska Fairbanks
  - Hubbell, Hubbe, Ray, Cherry, Cordle, Carroll
- Coordinated flights with TBS deployment on 6/10, 6/11.

Flight pattern examples for evaluating turbulence surface fluxes

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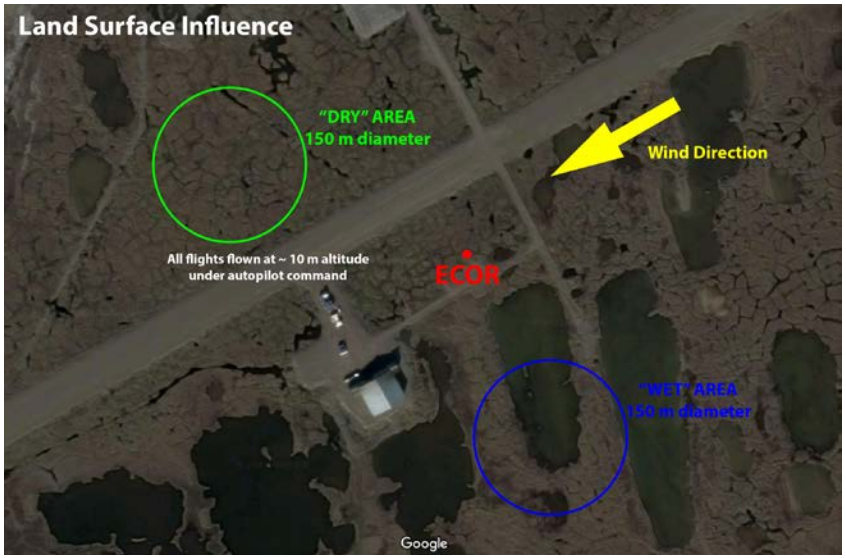
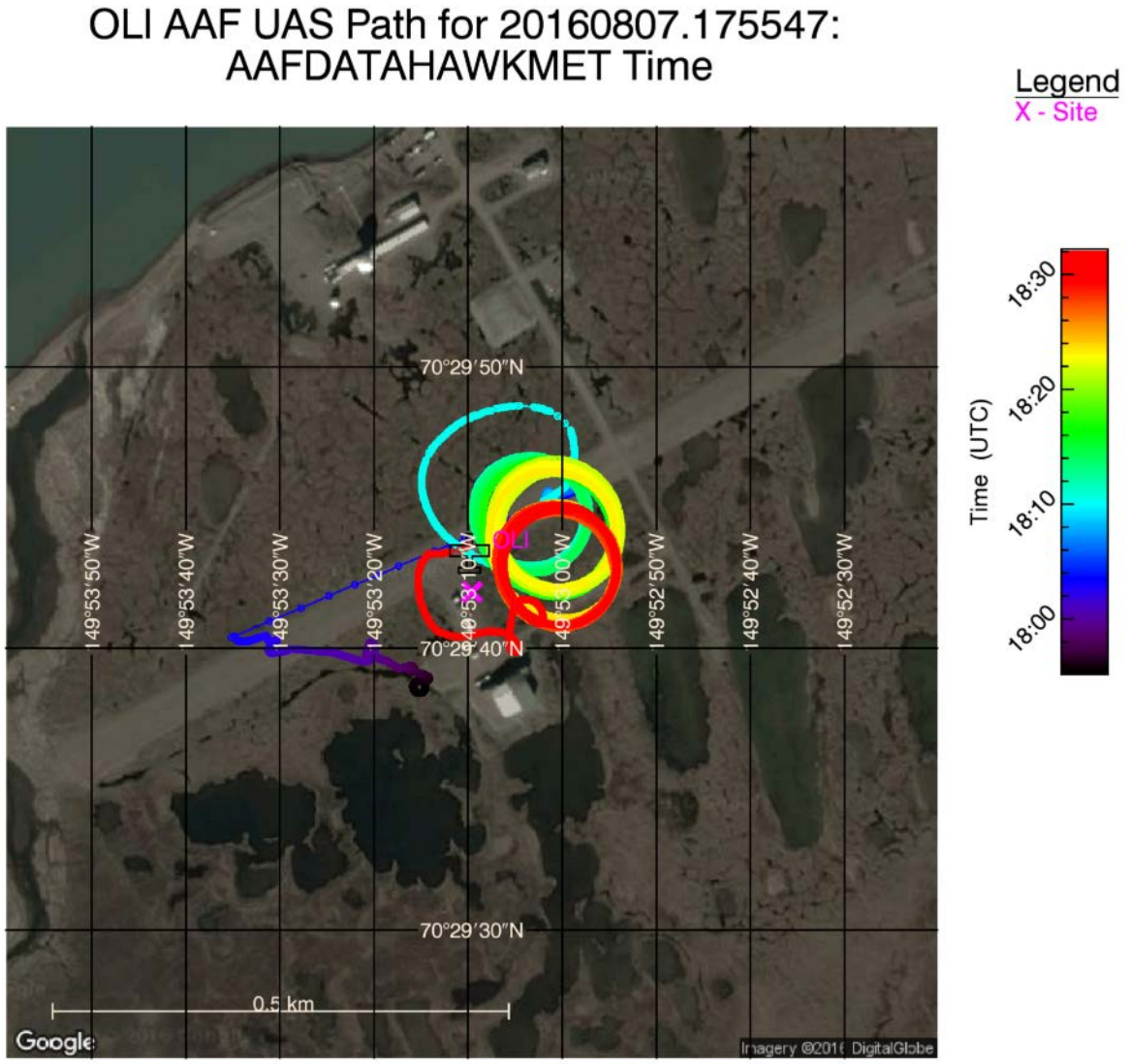


- During ICARUS 2016, we mainly focused on the “Evaluation Flight” pattern, and also flew several flights to study land surface influence and ocean surface transition.

Atmospheric state parameters quicklook plots



Total altitude profiling:

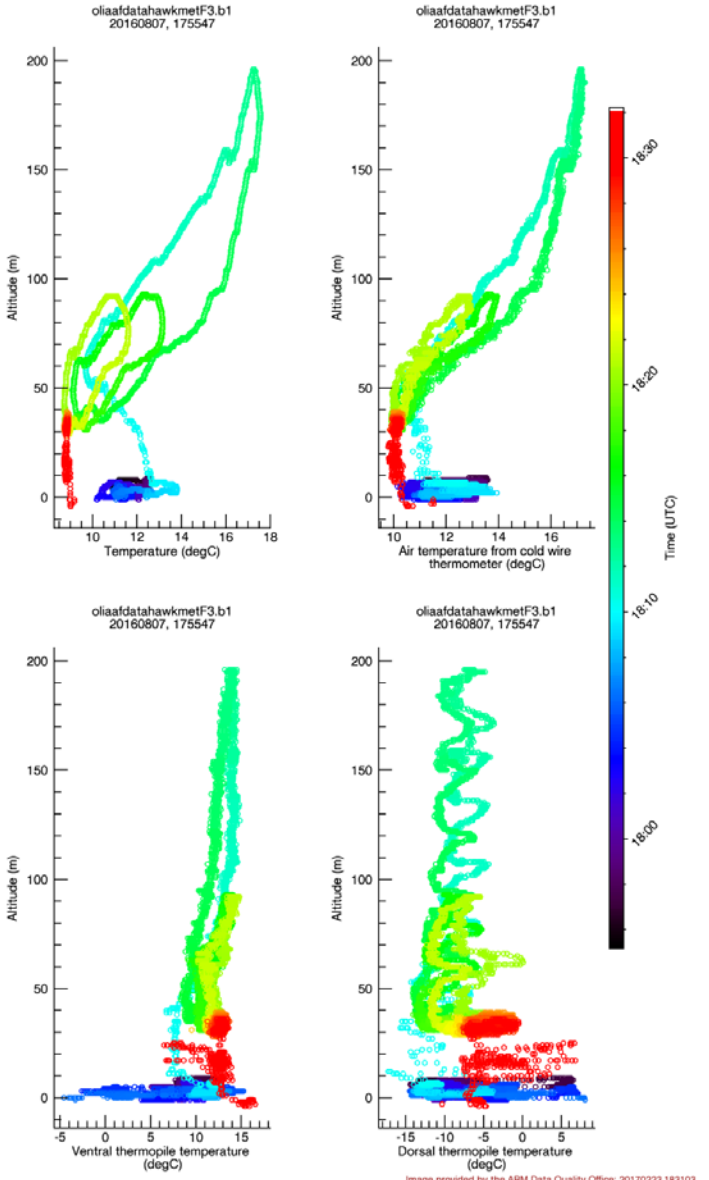
- < 200 ft: 15 flights
- > 300 ft: 4 flights
- 600 ft: 3 flights

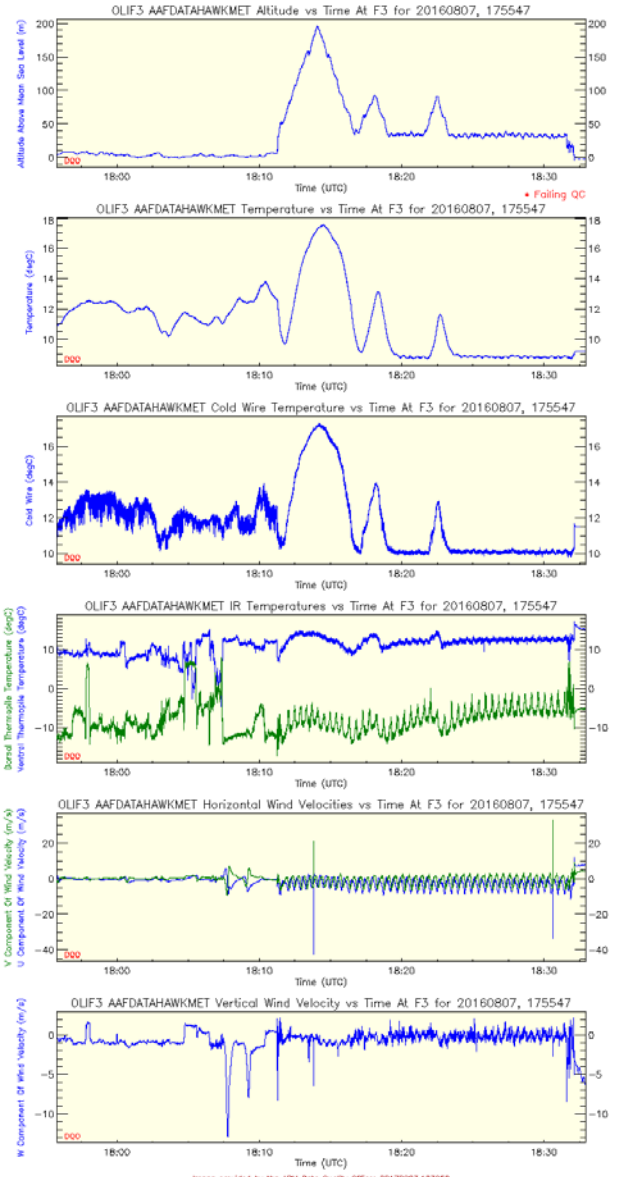
ECOR circling:

- 40 m: 38 flights
- < 200 m: 5 flights

Plots from Joshua King of ARM DQ office

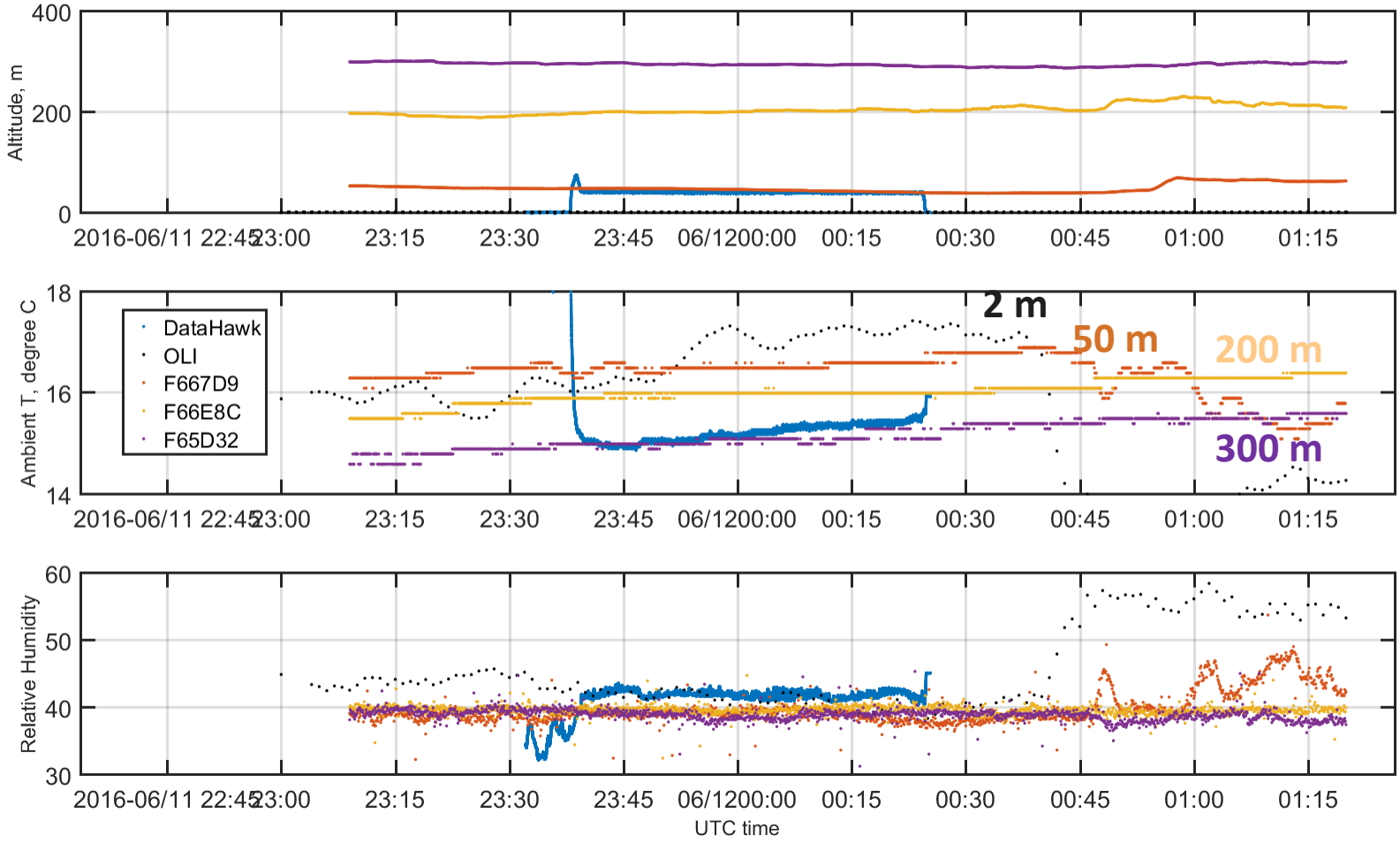
Atmospheric state parameters quicklooks



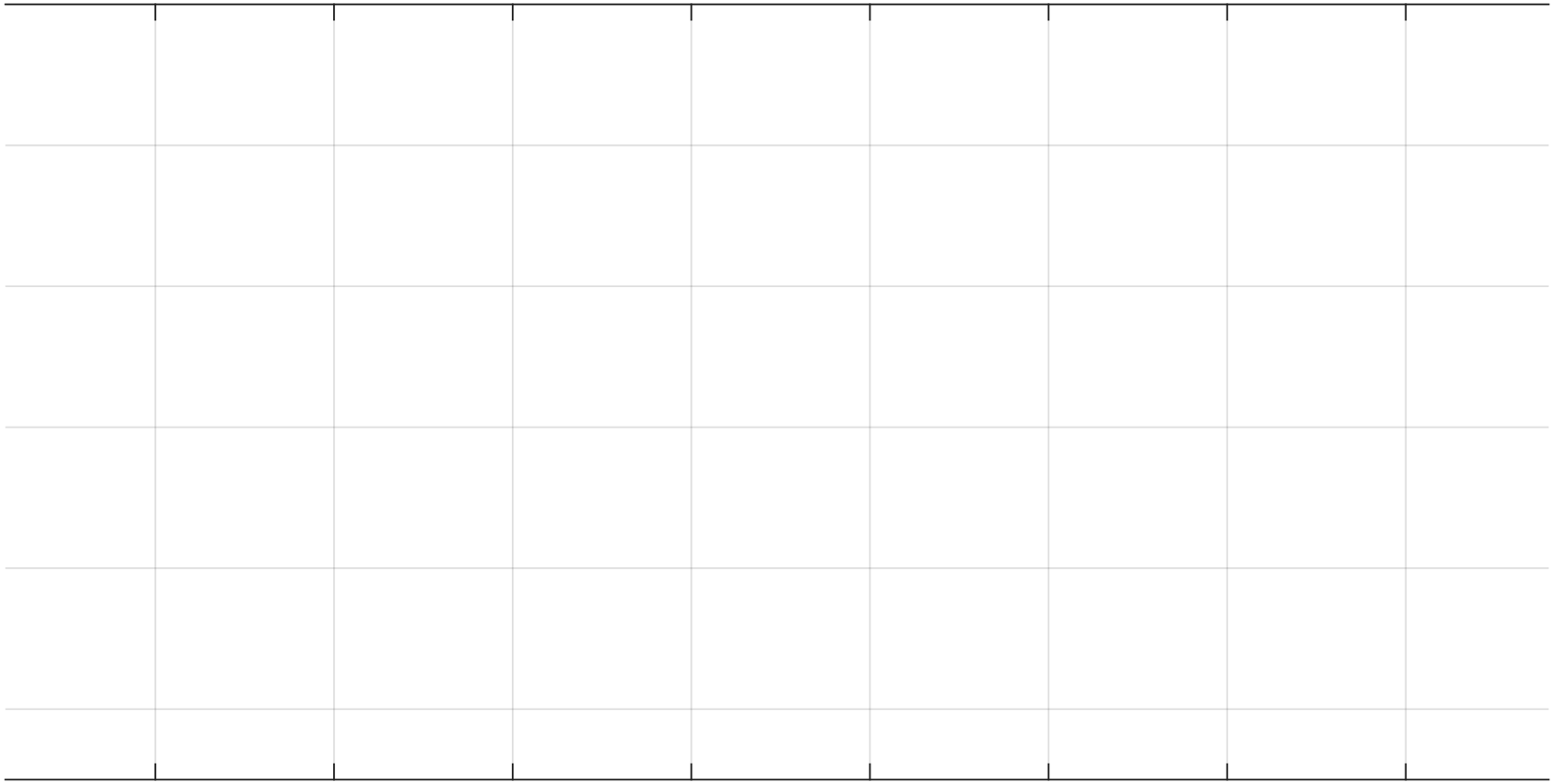


Atmospheric state parameters – DataHawk, TBS (V6) and Ground site (6/11/2016)

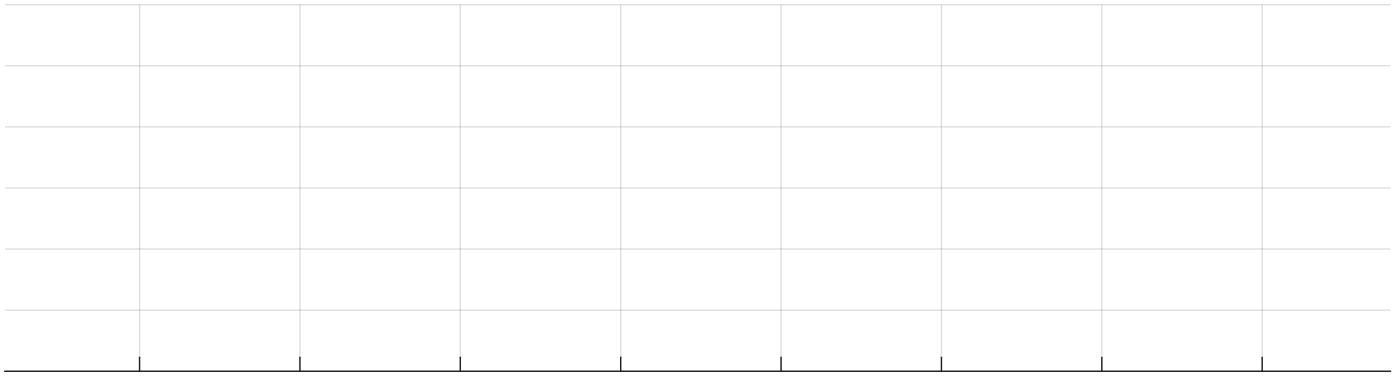
DataHawk temperature measurement is about 2 degrees off based on one comparison flight.



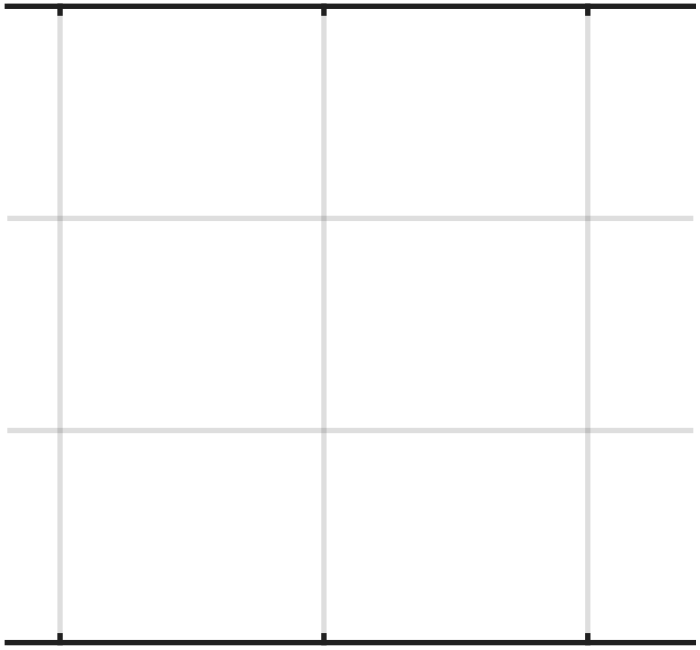
Wind comparison among ground site, TBS (V6) and DataHawk



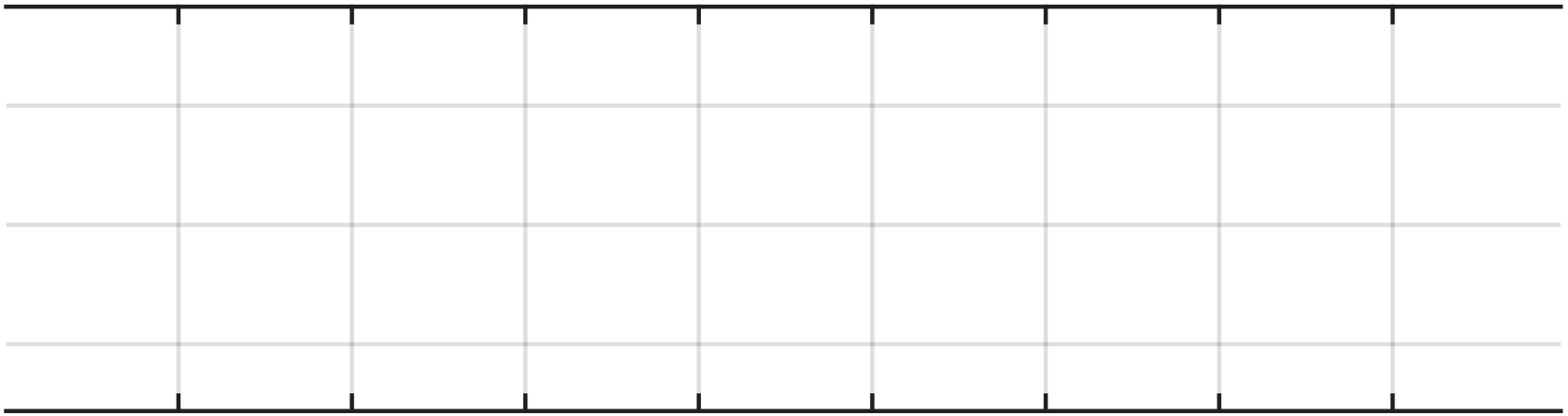
Wind comparison near ECOR



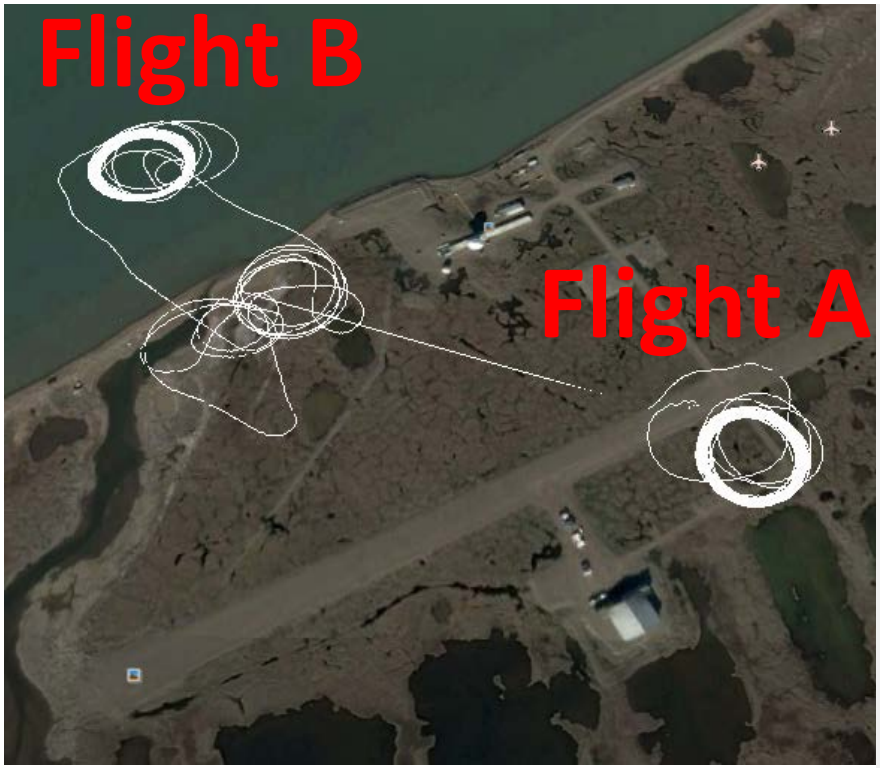
Improving wind measurement

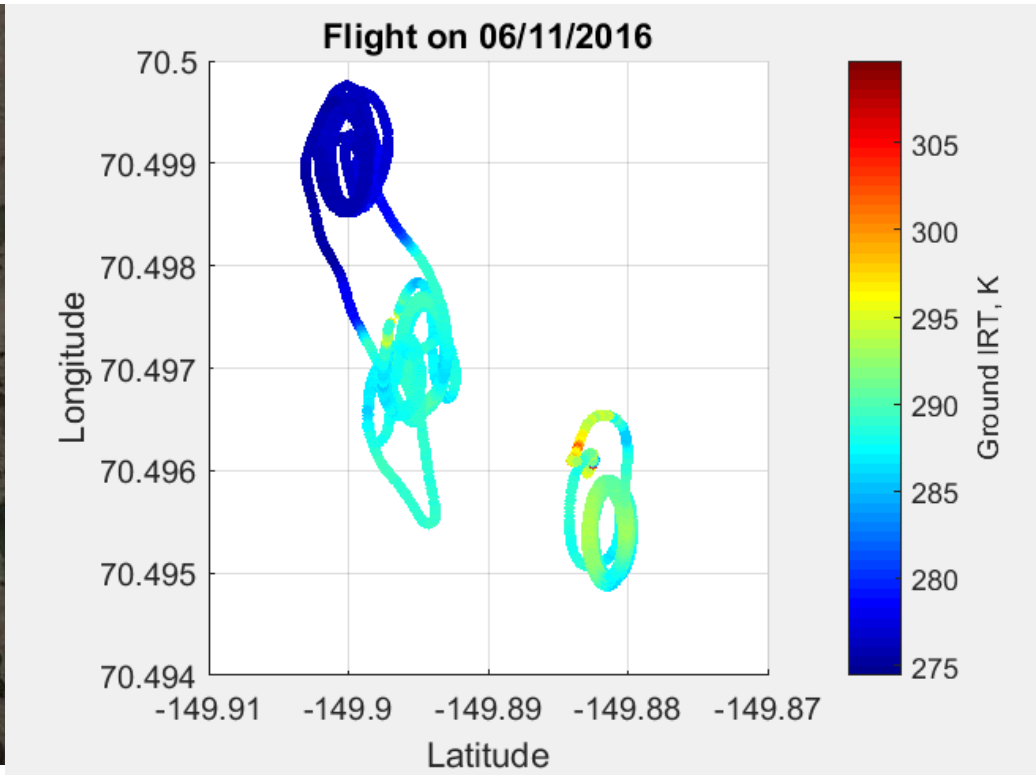


Improving wind measurement



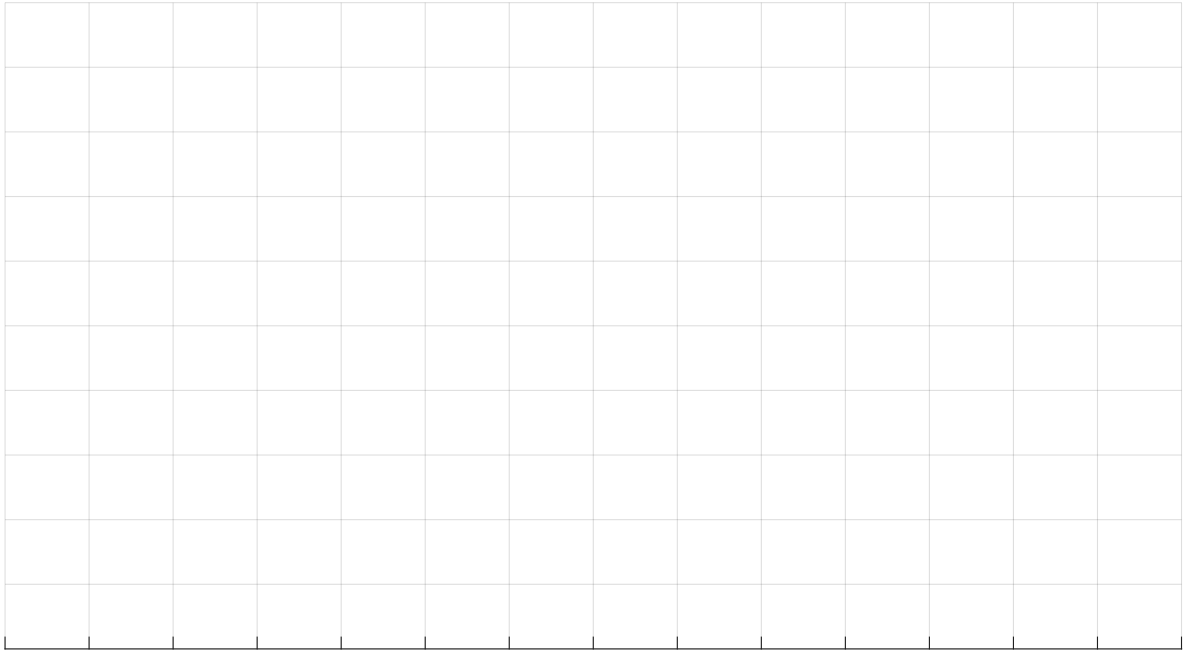
Evaluate the influence of land/ocean surface heterogeneity (6/11/2016)



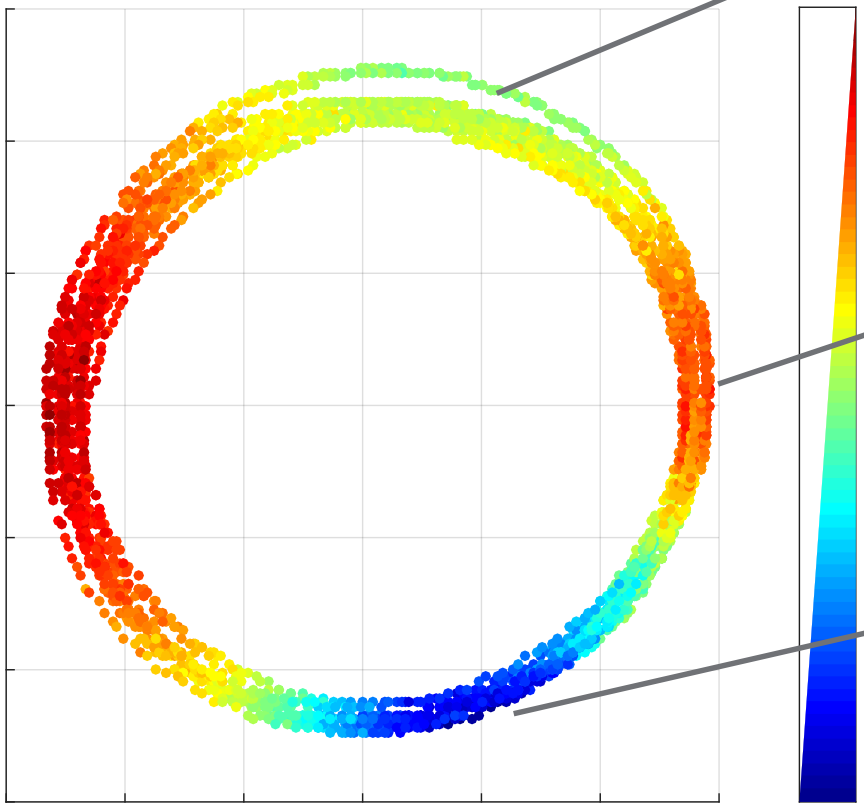


The ground temperature from the Infrared Thermometer shows different results over different land surface, which indicate the heat flux is sensitive to the land surface heterogeneity.

Infrared thermometer data at 40 m on 6/11/2016



Infrared thermometer data over land from flight A (6/11/2016)



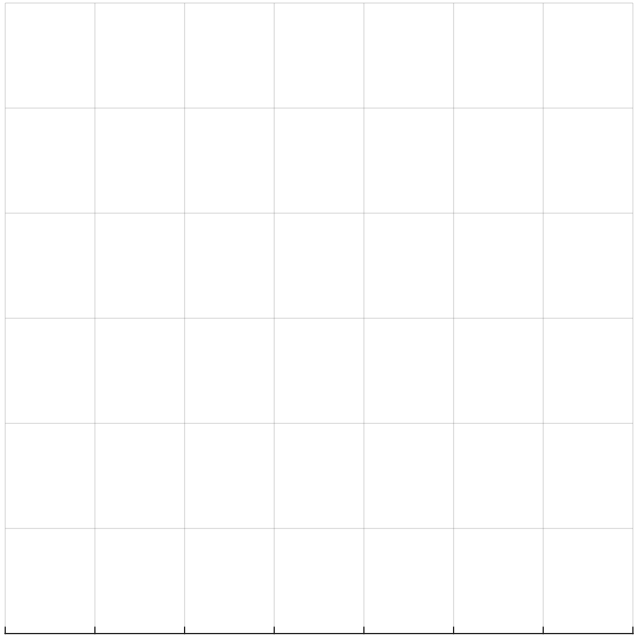
close to run way

Tundra surface

close to pond

No obvious evidence of cooling effect from wind (6/11/2016)

Infrared thermometer data over sea water (6/11/2016)



Summary and Future work

- DataHawk IRT sensors detected about 7 °C temperature difference within a 200-m distance over the tundra surface.

- Future work
  - Collaboration
    - Most suitable flight pattern for each scientific objective
    - Better sensors
    - Better calibration/correction of DataHawk temperature
    - Improve wind reconstruction in DataHawk
    - Improve TBS wind direction accuracy
  - More coordination flights with TBS operation and other observation activities.