

PolarWinds Campaign I results and plans for Campaign II

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NASA's PolarWinds and ADM Cal/Val

- Two Campaigns:
 - Campaign 1 November 2014 on UC-12B based Kangerlussuaq, Greenland
 - Campaign 2 May 2015 on DC-8 based Keflavik, Iceland
- Purposes are to conduct basic polar science investigations and to demonstrate technology readiness for ADM Cal/Val
- Critical support from NASA Headquarters (Kakar) and LaRC(Singh)
- Science and Instrument Team
 - Emmitt (SWA) , Principal Investigator
 - M. Kavaya(NASA/LaRC), Technology Lead
 - G. Koch (NASA/LaRC), Instrument Chief Engineer
 - S. Greco (SWA)
 - K.Godwin (SWA)
 - D. Bromwich (OSU)
 - K. Heins (OSU)
 - J. Cassano (CU)
 - R. Foster (U Wash)
 - M. Shapiro (NCAR)
 - D. Winker (NASA/LaRC)

PolarWinds:

Campaigns 1 &2 Science Objectives

- Validate numerical model forecasts and reanalysis characterizations of airflow in the lower atmosphere over the open oceans, land, ice sheets and transition zones of the Arctic.
- Conduct detailed investigations into the importance of dynamic features such as Arctic low level jets and organized large eddies to the transport and fluxes of heat and energy.
- Characterize and study the wind regime of the lower atmosphere over marginal ice zones in the Arctic, where ice drift and other processes are largely controlled by the low-level winds.
- Provide real measurements that can be used to validate or compare with existing remote sensing platforms. Three examples will be CALIPSO aerosol measurements , MODIS Atmospheric Motion Vectors and ASCAT Ocean Vector Winds. Additional comparisons will be made with observing systems identified by ESA and the PolarWinds Science Team.



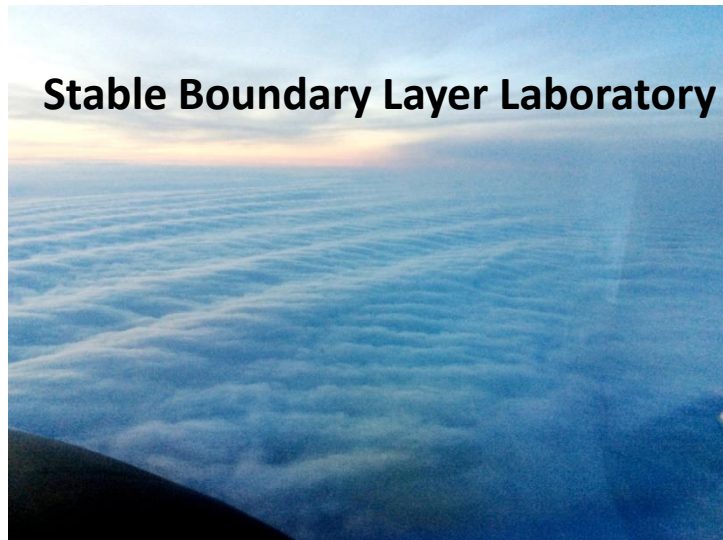
ADM/PolarWinds Campaign1 2014



2 μm
220 mJ
10 Hz
15 cm



Complex terrain
and surfaces



Stable Boundary Layer Laboratory

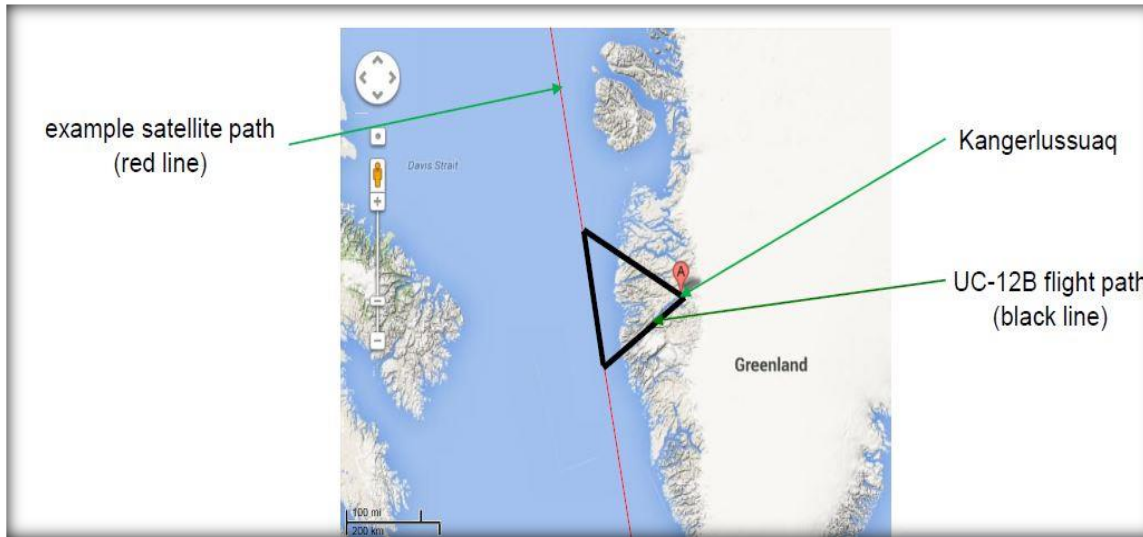


Coastal transitions

Mission Types

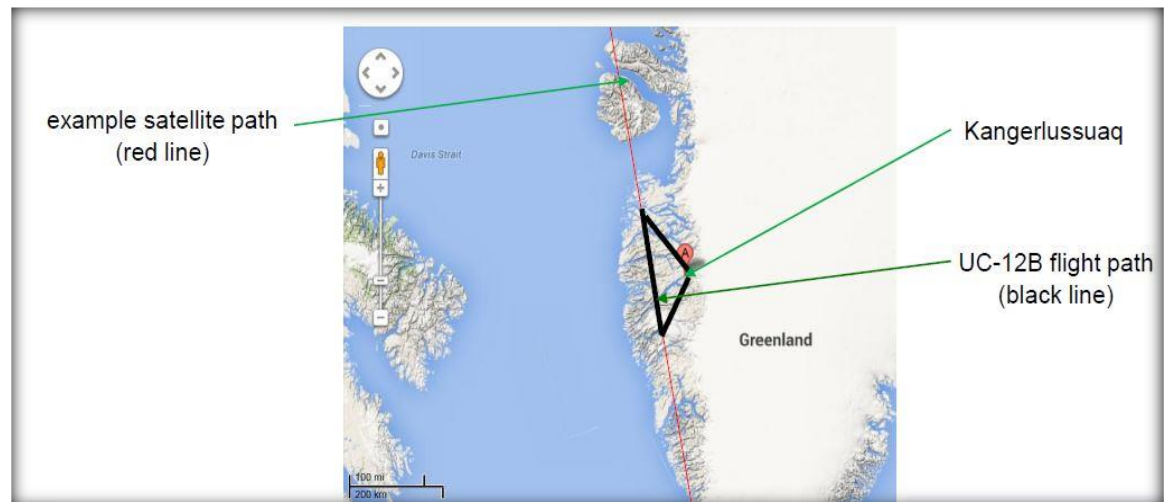
- Satellite Under Pass (SUP) missions
- Model Validation (MVAL) missions
- ADM Cal/Val (ADM_CV) missions
- OLE experiments
- Tip Jet missions
- Ice Cap Missions

Example Campaign 1 Mission Profiles

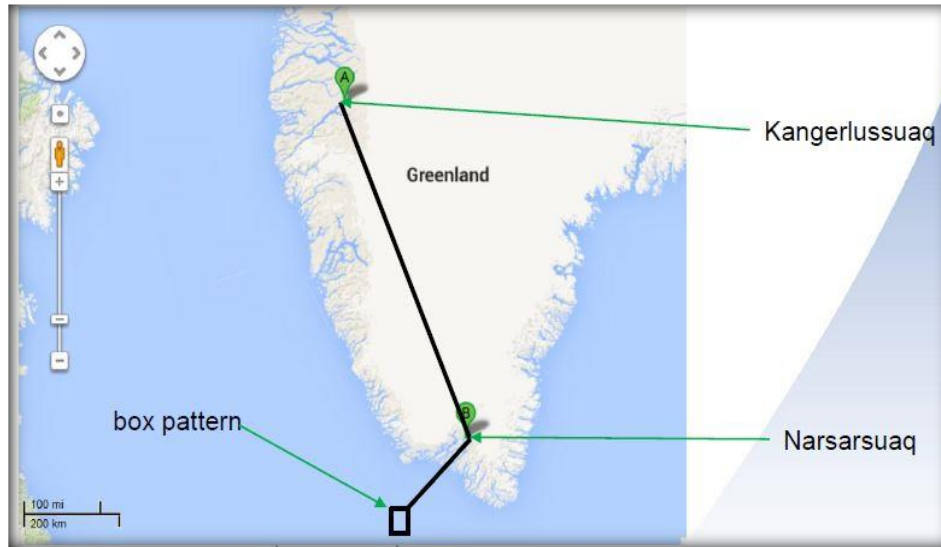


Satellite Under Pass

ADM LOS Wind Simulations

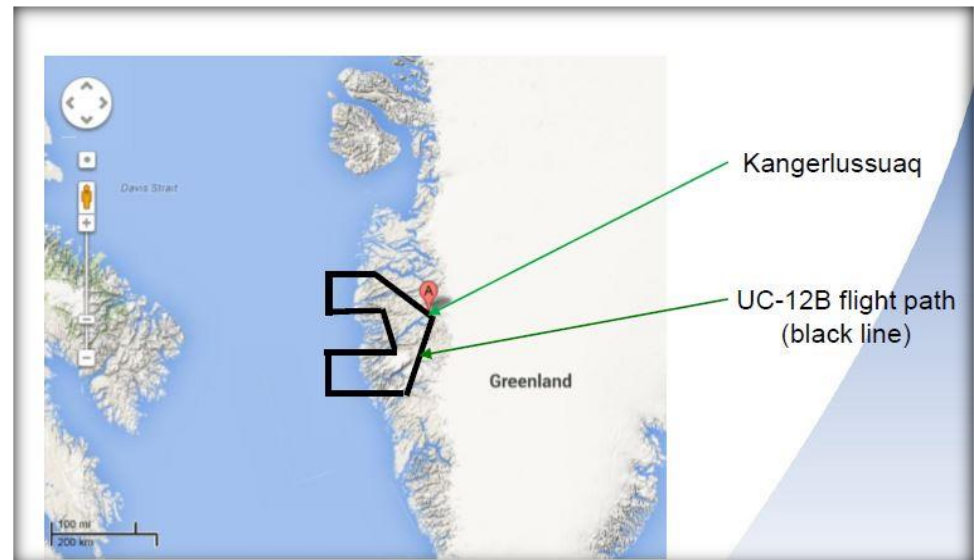


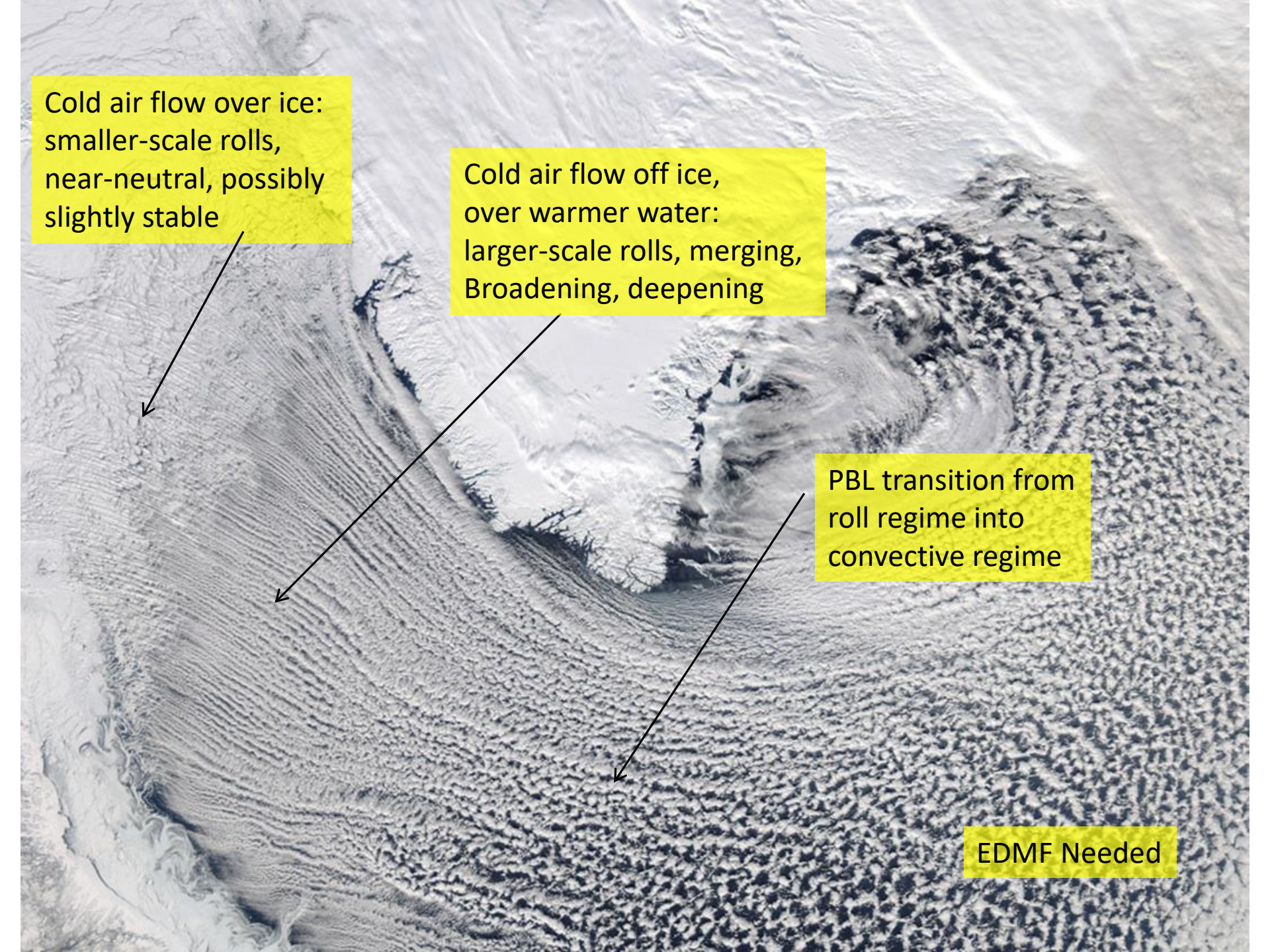
Example Campaign 1 Mission Profiles



Greenland Tip Jet Investigation

Model Validation: Land/Sea Boundary





Cold air flow over ice:
smaller-scale rolls,
near-neutral, possibly
slightly stable

This block is part of a larger image showing an aerial view of a coastal ice edge. The image is divided into several regions by arrows pointing to specific features. The top-left region shows smaller-scale rolls. The top-center region shows larger-scale rolls merging and deepening. The bottom-right region shows a transition from a roll regime to a convective regime. The bottom-right corner has a label 'EDMF Needed'.

Cold air flow off ice,
over warmer water:
larger-scale rolls, merging,
Broadening, deepening

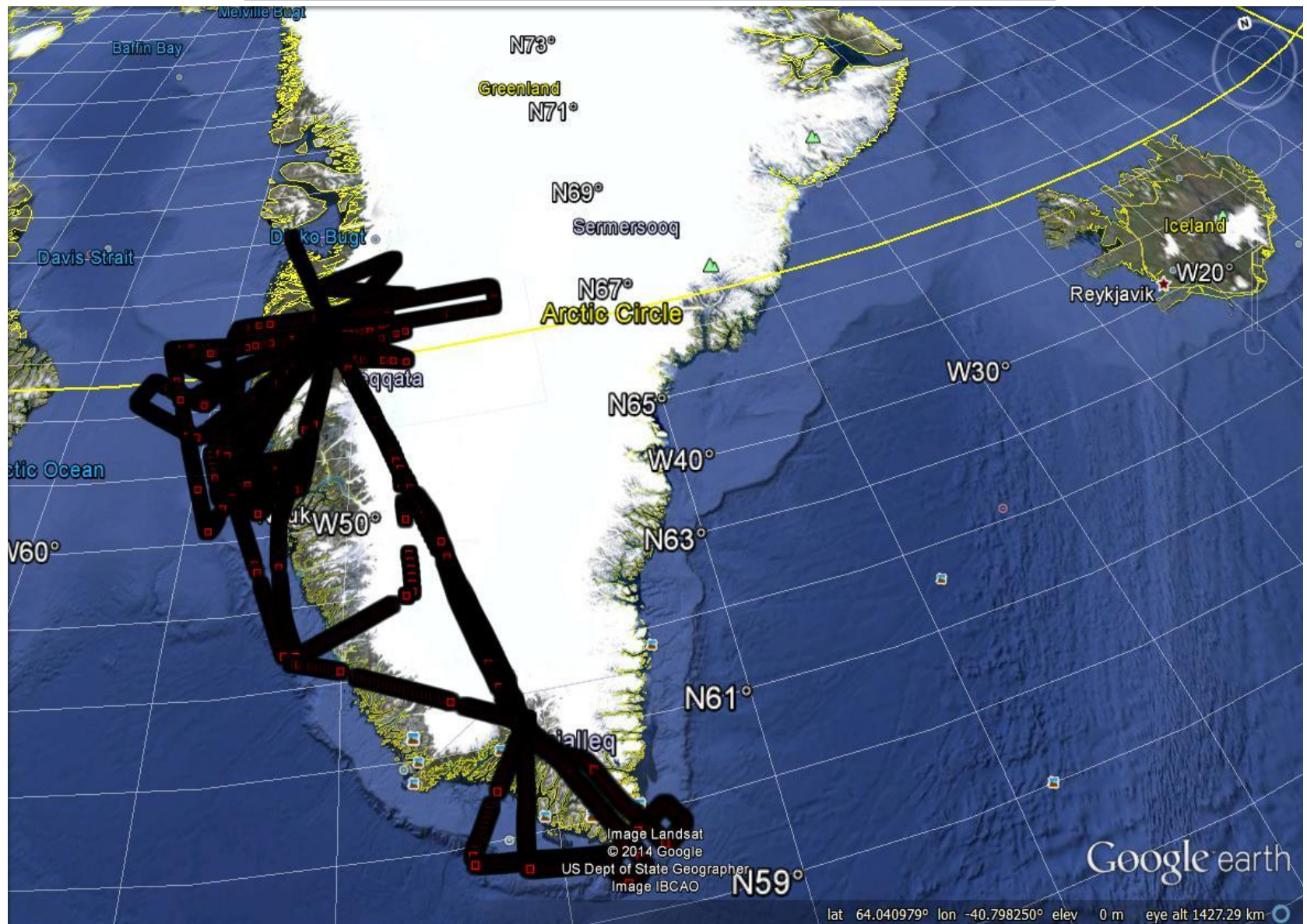
PBL transition from
roll regime into
convective regime

EDMF Needed

General Missions Summary

- 14 flights on 13 days
- ~ 45.5 science flight hours
- 22 ADM simulation segments
- 3 CALIPSO segments
- ~ 10 MODIS segments
- ~ 10 ASCAT segments
- 2 “Tip Jet” missions
- Numerous missions overflying the Ice Cap and regions of BL rolls/waves.

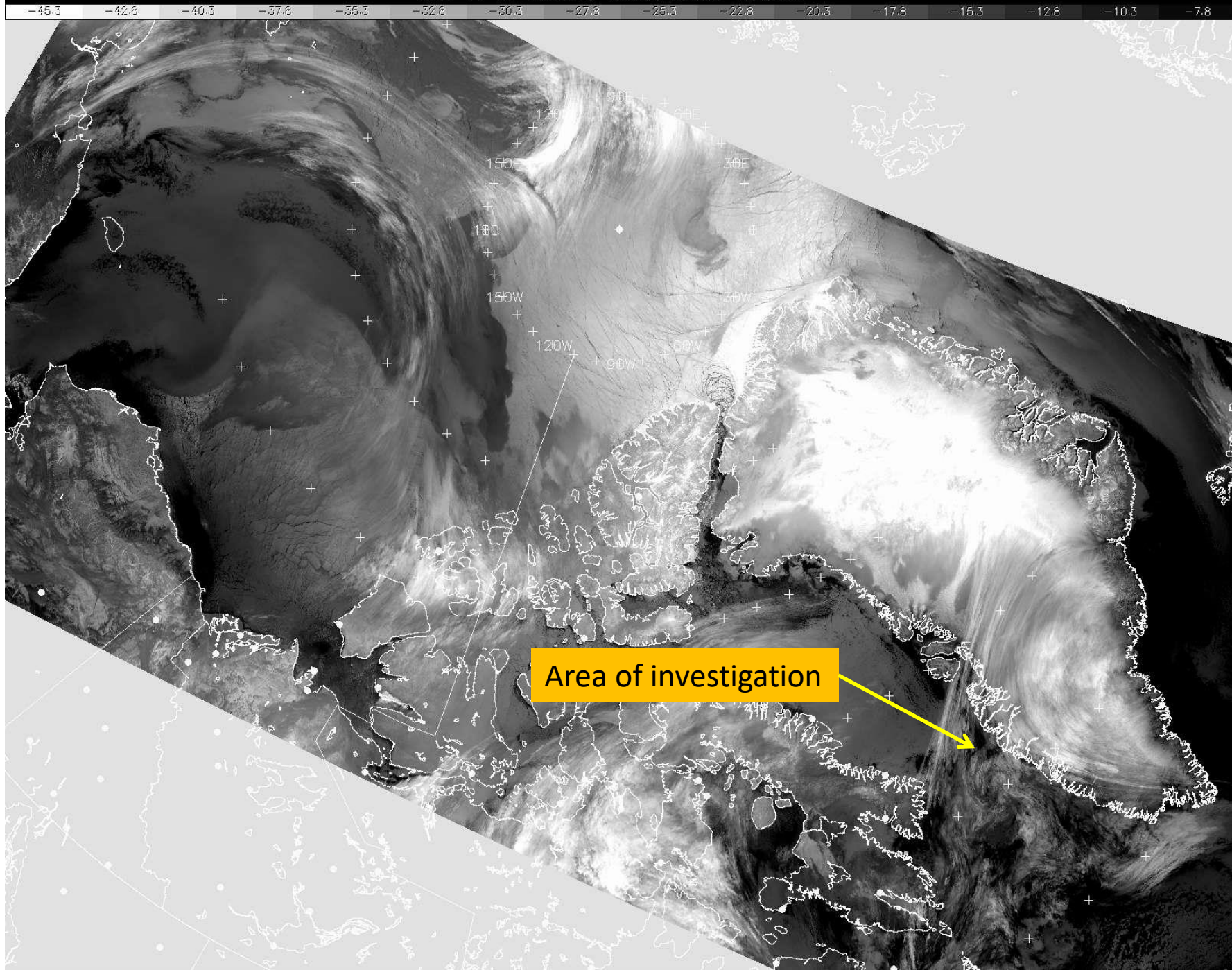
Composite of flight tracks



ADM/PolarWinds Case Study

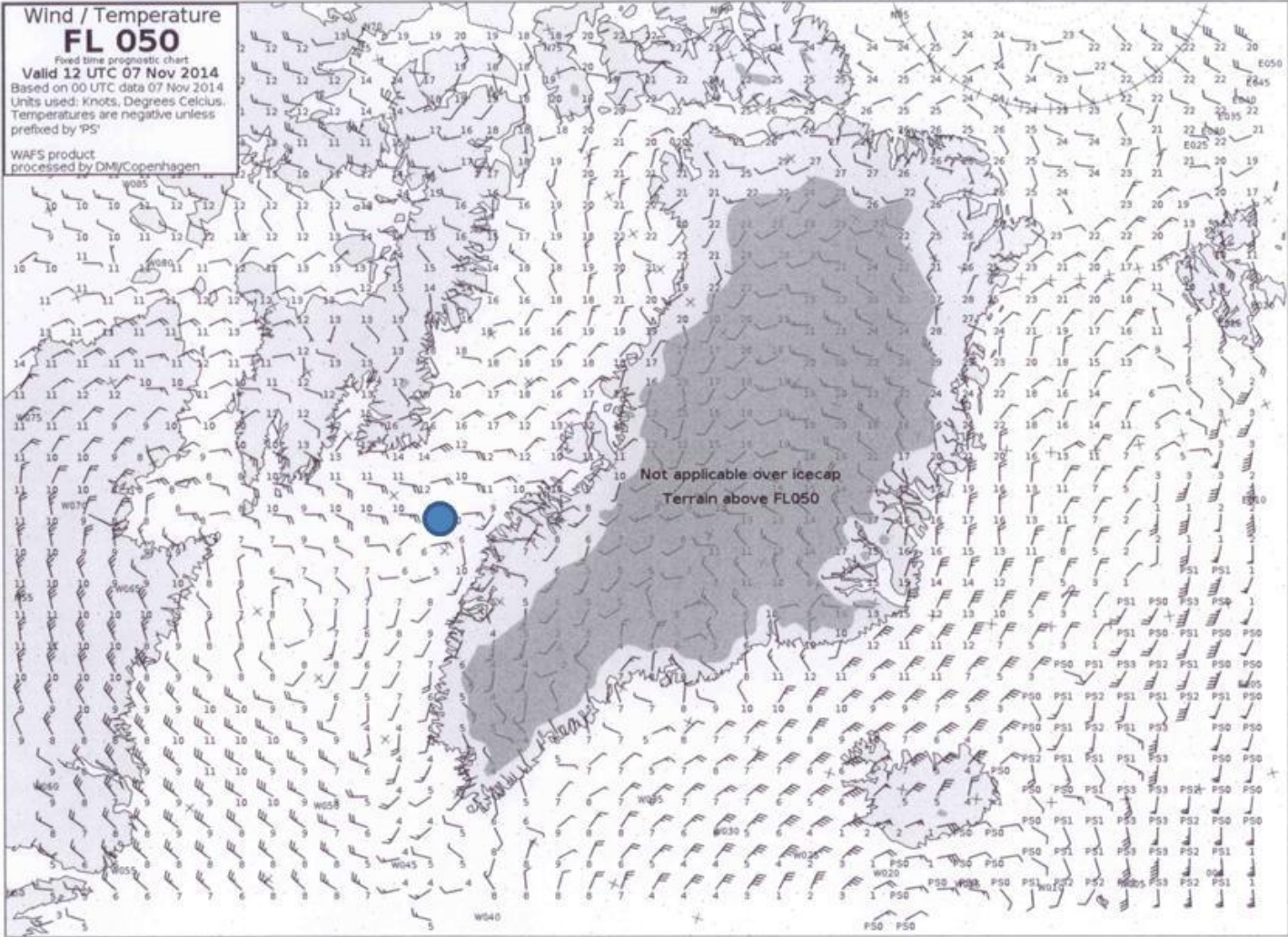
11/07/14

- Flight Objectives
 - Model validation
 - ASCAT under flight
 - MODIS under flight
 - ADM sampling simulation
- Coastal
- Complex wind patterns predicted by models
- DAWN soundings below 3000m



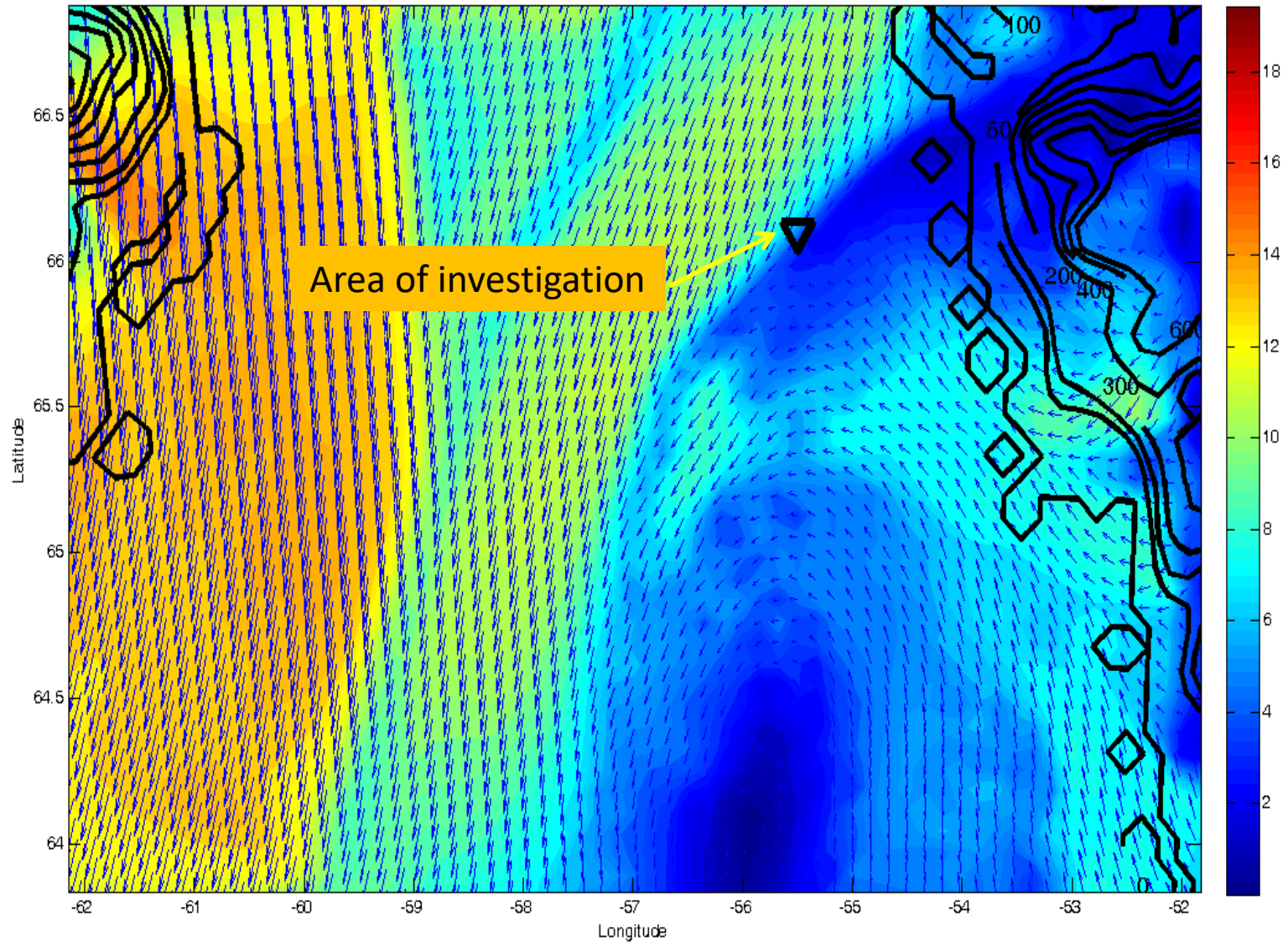
Area of investigation

Danish Meteorological Institute 12Z forecast
winds at 5000 (~1500m)

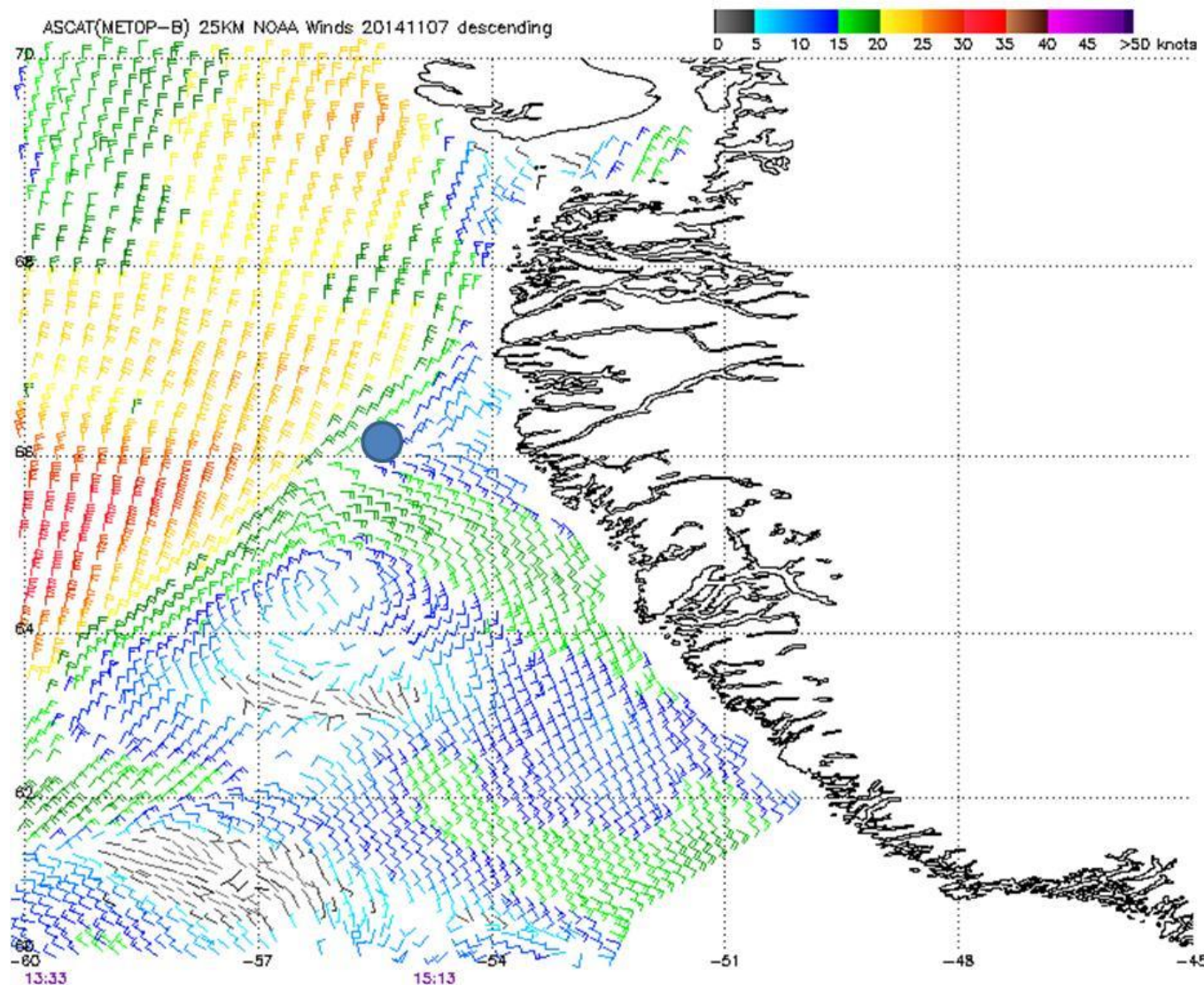


Polar WRF surface winds 11/07/14 15Z

Polar WRF Domain 1 (8km) Wind Speed and Wind Vectors (Surface)- 11/07/2014 15Z



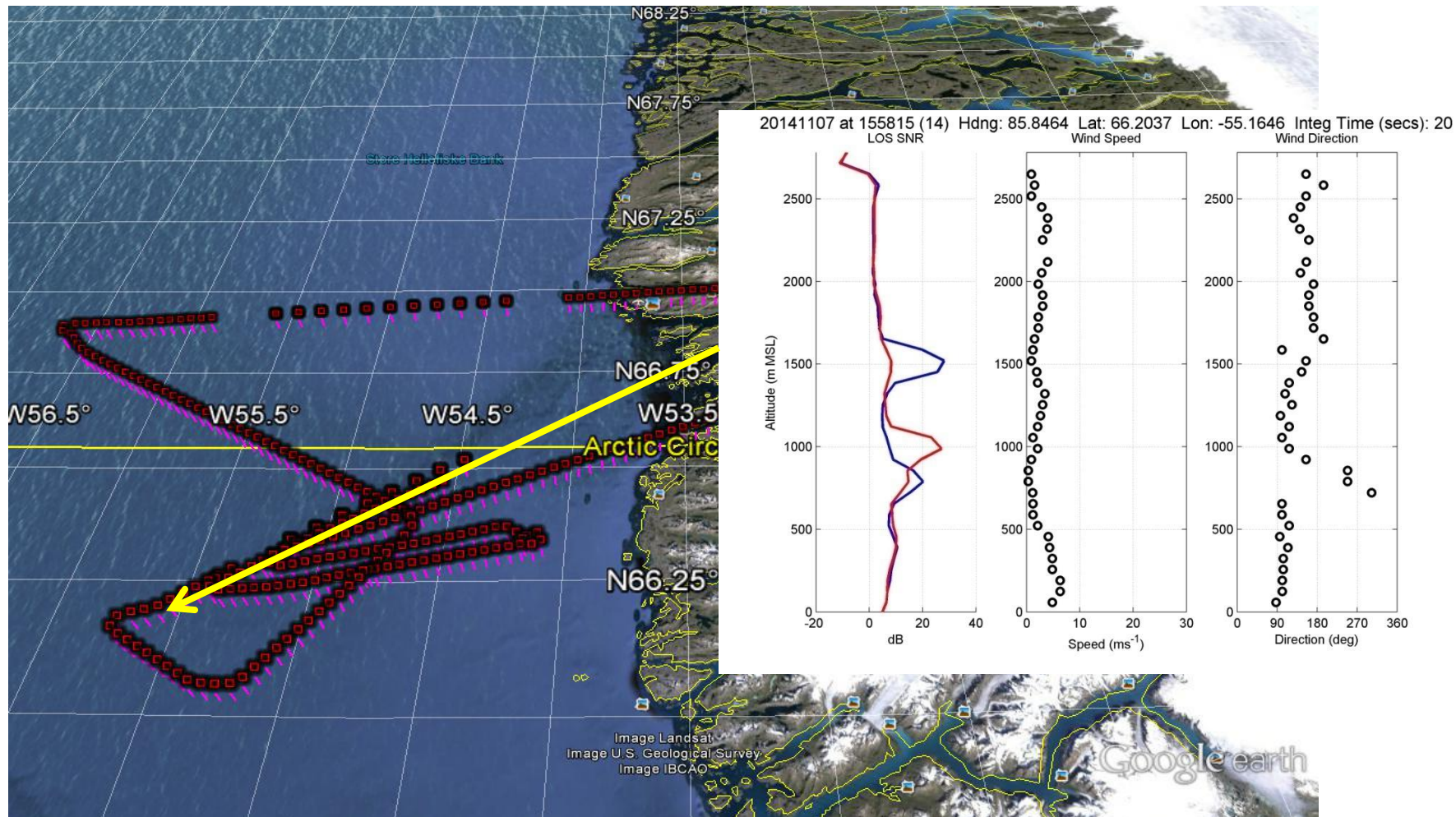
ASCAT ocean vector winds from passes at 13.33 and 15:13 GMT



Note: 1) Times are GMT 2) Times along bottom correspond to measurement at 65N
3) Data buffer is 22 hrs from 20141107 4) Black circles indicate possible contamination
NOAA/NESDIS/Office of Research and Applications

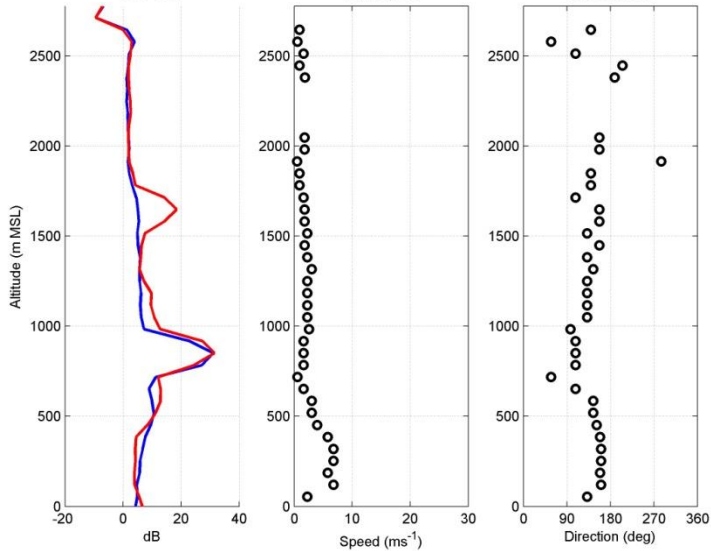
Greenland Flight 9 out of 14

11/07/14



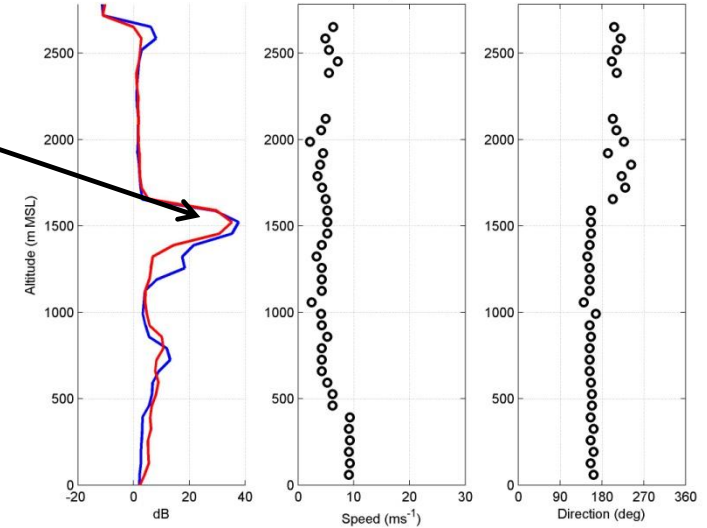
Additional sounding examples for Flight 9

20141107 at 153727 (50) Hdng: 53.0353 Lat: 66.2345 Lon: -55.3229 Integ Time (secs): 20
LOS SNR Wind Speed Wind Direction

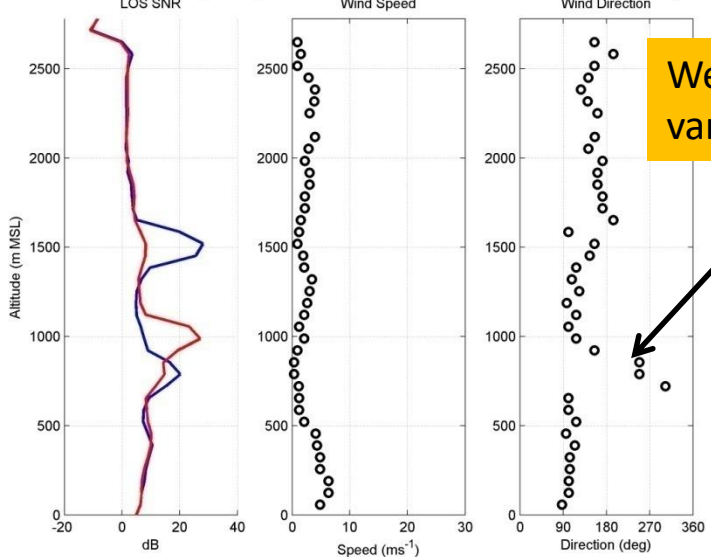


Thin clouds

20141107 at 154854 (2) Hdng: 235.5054 Lat: 66.4158 Lon: -54.5918 Integ Time (secs): 20
LOS SNR Wind Speed Wind Direction

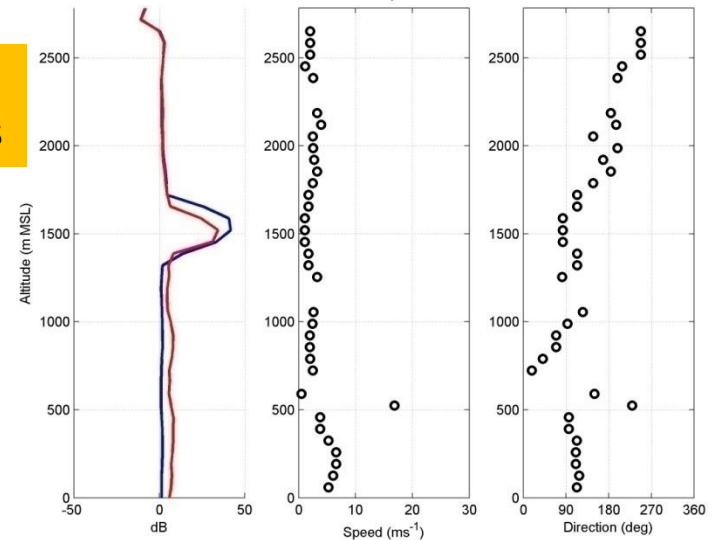


20141107 at 155815 (14) Hdng: 85.8464 Lat: 66.2037 Lon: -55.1646 Integ Time (secs): 20
LOS SNR Wind Speed Wind Direction



Weak winds w/
variable directions

20141107 at 160122 (18) Hdng: 79.3763 Lat: 66.2356 Lon: -54.799 Integ Time (secs): 20
LOS SNR Wind Speed Wind Direction



NASA's PolarWinds and ADM Cal/Val Campaign 2

- Based out of Keflavik, Iceland
- May 11 – 29, 2015
- NASA DC-8 core instrument suite
 - DAWN (Nadir port 7)
 - Yankee dropsondes (105)
 - TWiLiTE (Nadir port 5)
- Similar PolarWinds science objectives as in Campaign 1
- ADM Cal/Val activities include joint missions with DLR Falcon
 - Perform calibration flights with A2D/2um DWLs on Falcon
 - Practice under flights for ADM Cal/Val as in Campaign 1

Ceiling: 12,500m
Cruse: 225 m/s
Minimum: 180 m/s
Range: 8000 km



NASA Langley DAWN Wind Profiling Lidar on NASA DC-8

Operator Stations in Passenger Level



Laser Chillers in Passenger Level



2-micron
Pulsed
MOPA
0.25 J
10 Hz
200 ns
15 cm
Step-stare
conical scan
30-deg nadir
Dual-balanced
heterodyne
detection

Laser, Optics, and Some Electronics in Cargo Level

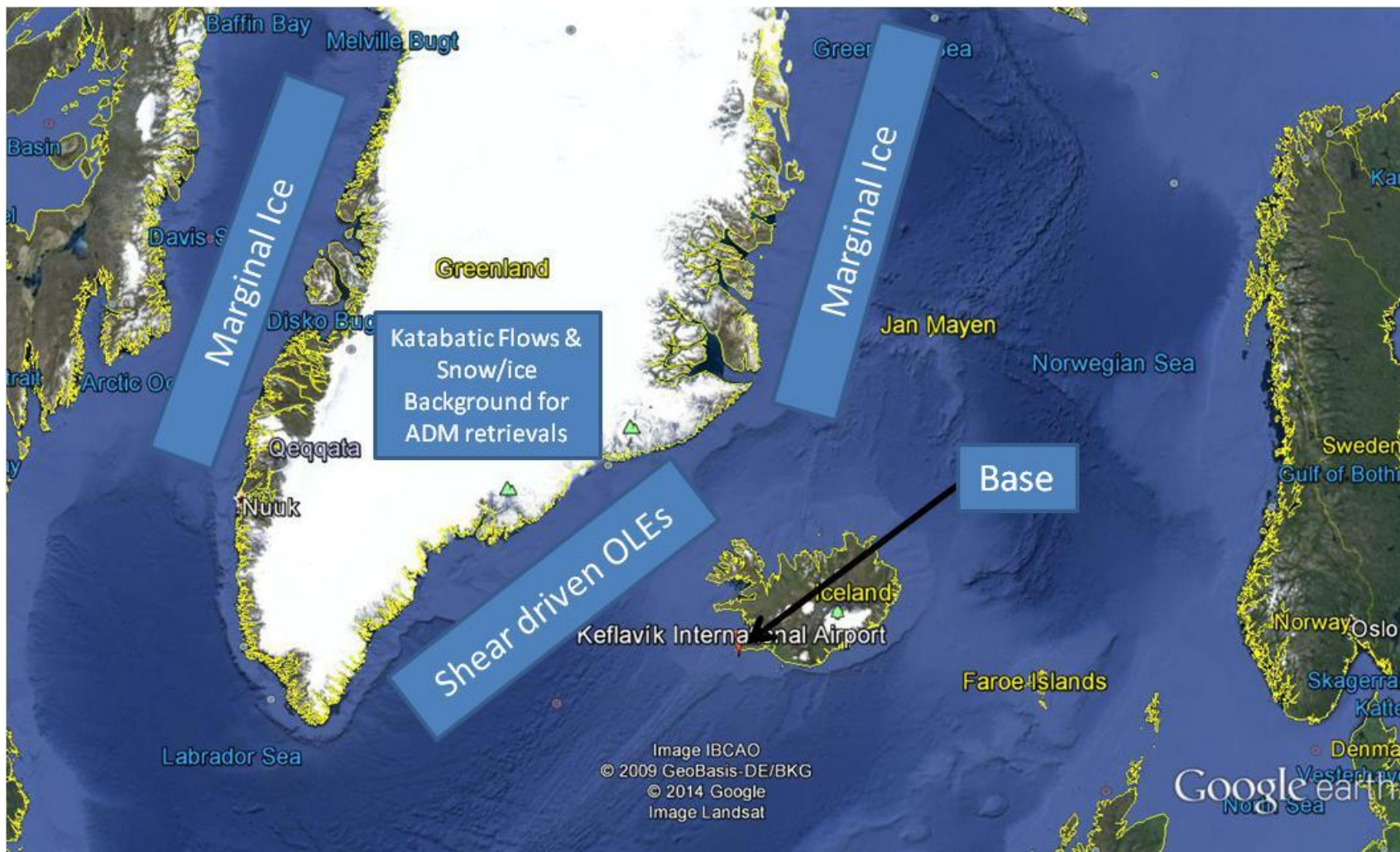


Centered Nadir Port #7 with Shutter Open



TWiLiTE on ER-2

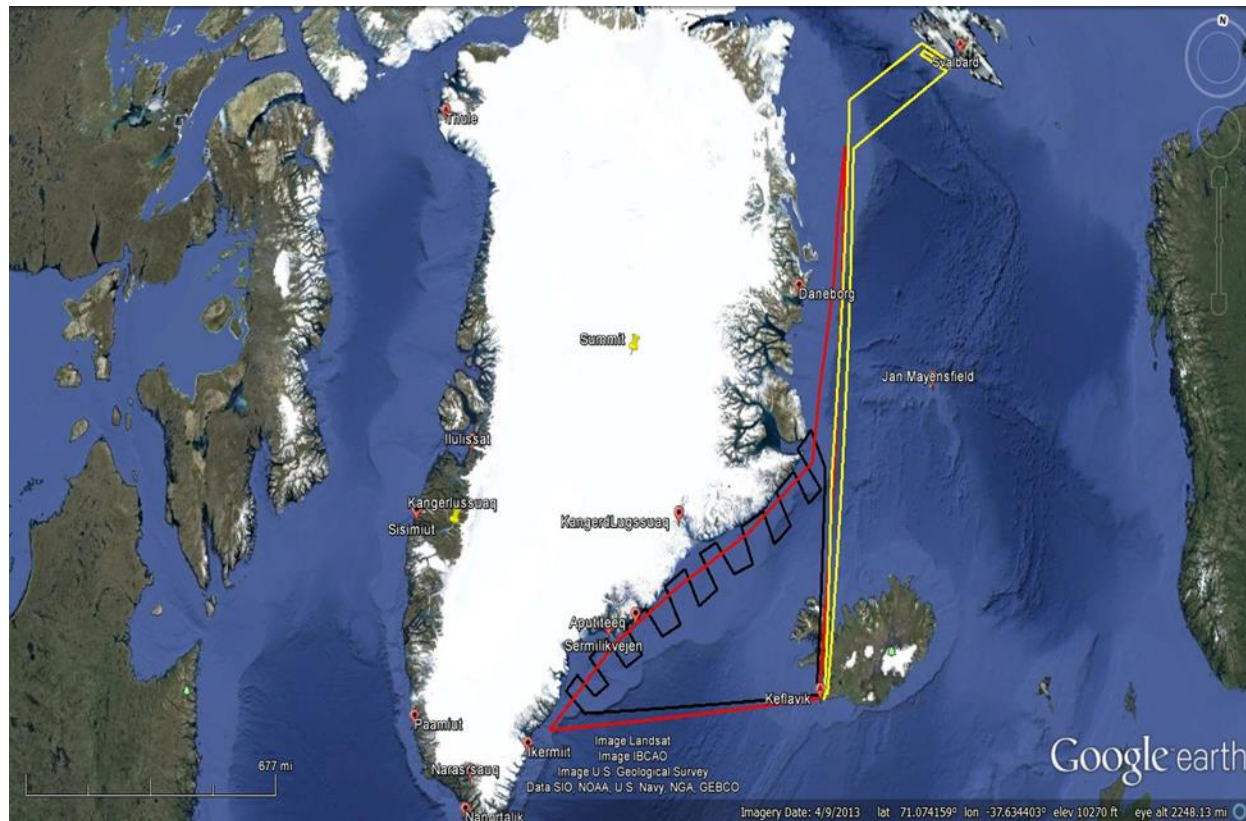




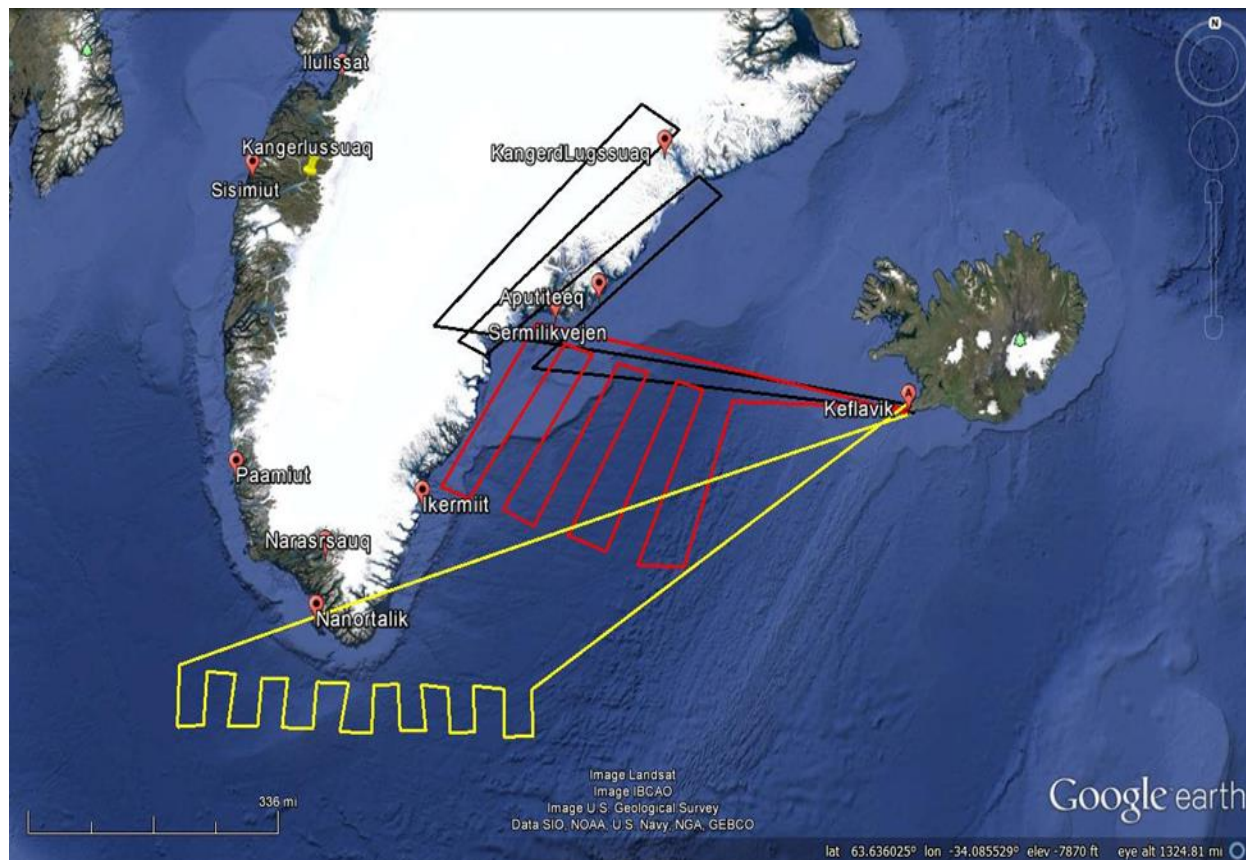
PolarWinds Campaign 2 Plans

- Conduct flights to collect wind profiles suitable for numerical model validation and development. These flight segments will be referred to as **MVAL experiments**.
- Conduct flights to collect wind data along and near the marginal ice zone off the east coast of Greenland. These flight segments will be referred to as **SEA ICE experiments**.
- Conduct flights to take wind measurements on both sides of the east coast of Greenland to measure katabatic wind flows. In addition, conduct flights to take wind measurements of possible Tip Jets (south of the southern tip) and Barrier winds (off the southeast coast of Greenland). These flight segments will be referred to as **WIND experiments**.
- Another set of potential experiments will be conducted to measure the wake flow around Iceland. These flight segments will be referred to as **ICELAND experiments**.
- Flights will also be conducted to measure the winds over the interior of Greenland with a focus on the Ice Cap and flying directly over the Summit. These flight segments will be referred to as **SUMMIT experiments**.

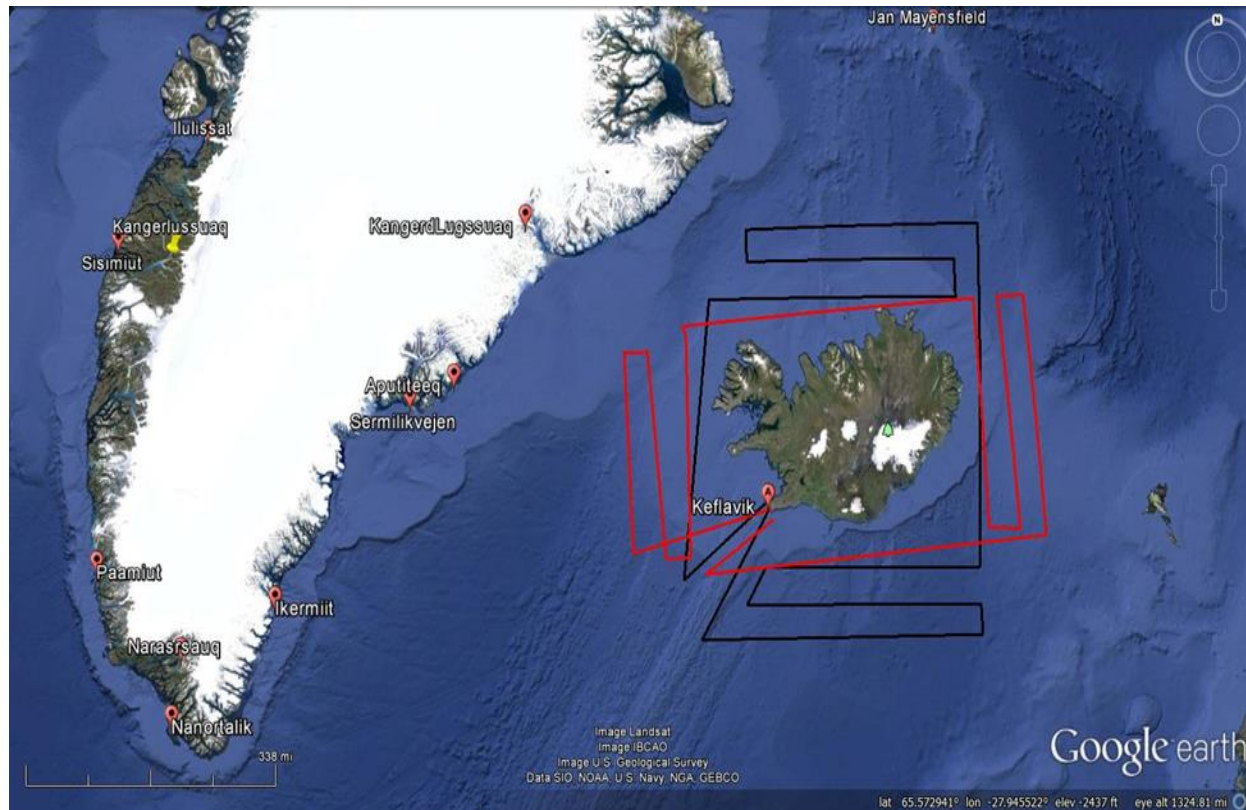
Sea Ice and coastal zones



Katabatic Flows and LLJ



Iceland Impacts on Flow



Ice Cap and Summit



Supporting Groundbased Observations

Radiosondes launched at 00Z and 12Z at the following sites:

- BGAM Ammassalik (65.6,-37.63)
- BGEM Aasiaat (68.7, -52.85)
- BGBW Narsarsuaq (61.15,-45.43)
- Summit (72.57,-38.45)
- BGSC Ittoqqortoormiit (70.48, -21.95)
- BIKF Keflavik (63.96, -22.6)
- BIEG Egilsstadir (65.28, -14.4)
- ENJA Jan Mayen (70.93,-8.66)
- ENAS Ny-Alesund (78.91, 11.93)

Ground-based commercial DWL's (Leosphere Windcube 200S) are operated at Keflavik airport and in Reykjavik by the Icelandic Met Office (IMO, contact Sybille von Löwis).

In addition the Icelandic Atmospheric Observatory (IAO, <https://www.ncas.ac.uk/index.php/en/about-iao>) situated in south-east Iceland near Vik (63°46'29.79"N 17°57'54.32"W) is equipped with a commercial DWL (HALO Photonics) operated by University Leeds (contact Barbara Brooks).

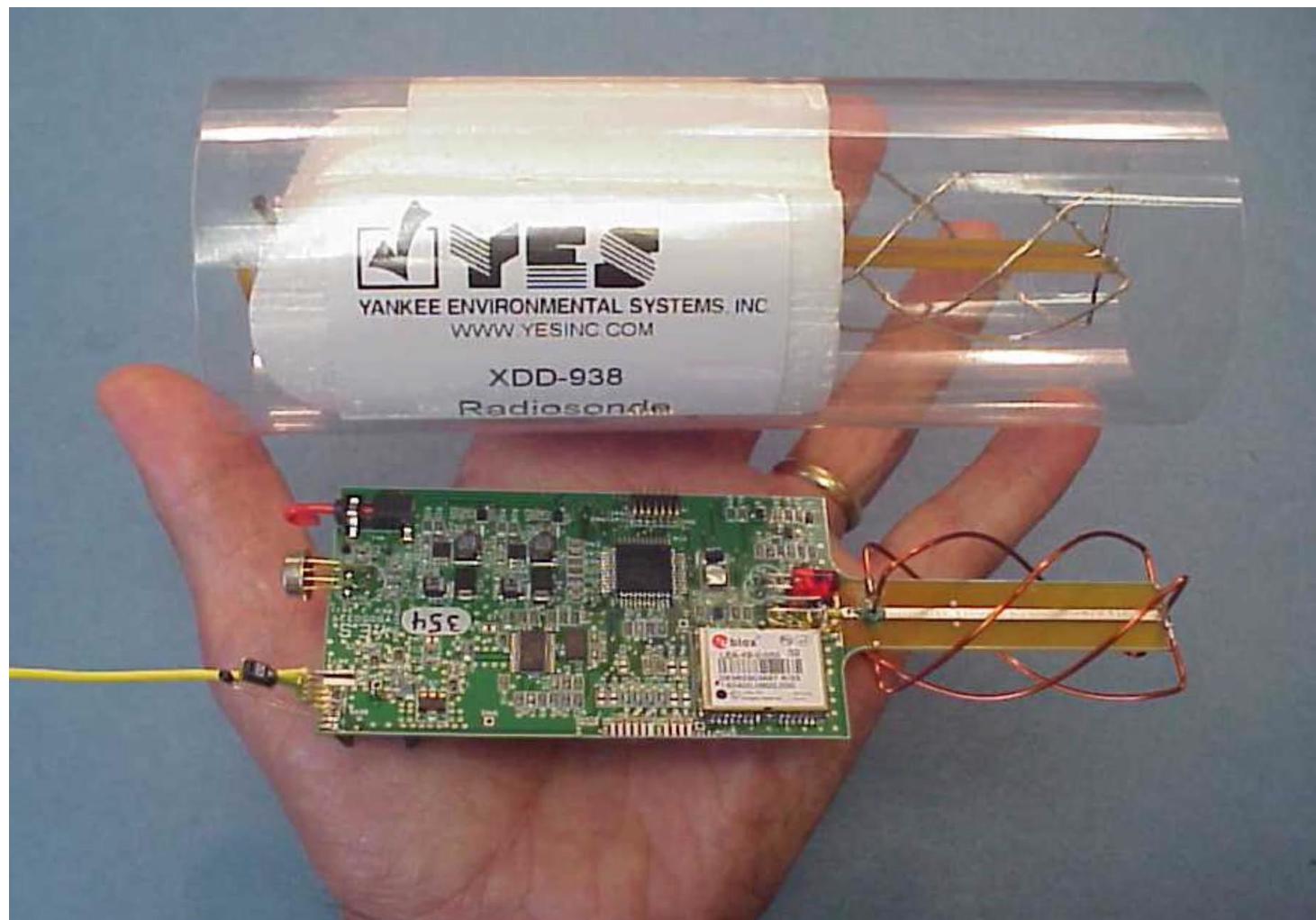
The Greenland Summit Station (72.58°N, 38.48 W, 3216 m ASL) releases 2 radiosondes per day and is equipped with an aerosol lidar from the MPL (micro-pulse lidar) network (contact Ralf Bennartz, Uni Vanderbilt, Wisconsin, Shupe et al. 2013) (<http://www.esrl.noaa.gov/gmd/obop/sum/>). Online data from an on-going campaign at summit station is available at <http://icecaps.ssec.wisc.edu/>

Acknowledgements

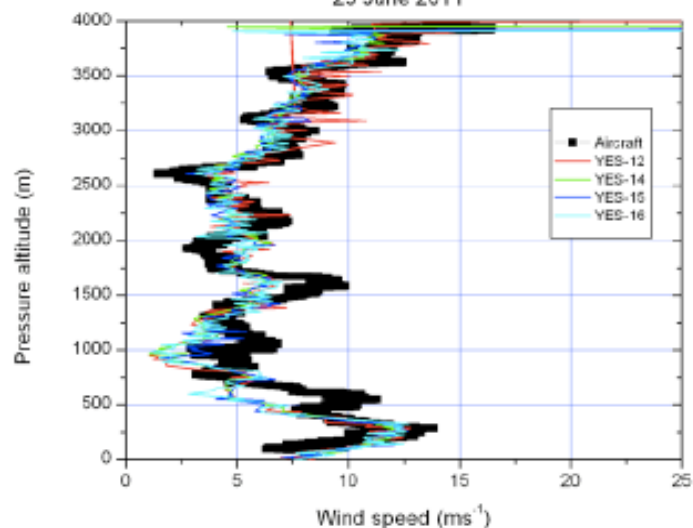
- This research is being funded by NASA.
- Credit goes to the DAWN instrument team at NASA/LaRC and the UC-12B crew that flew in challenging weather conditions during Campaign 1

CIRPAS Twin-Otter Installation

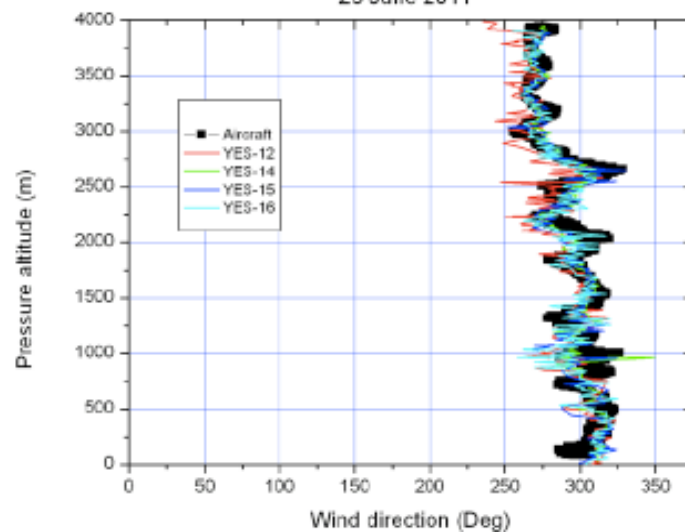




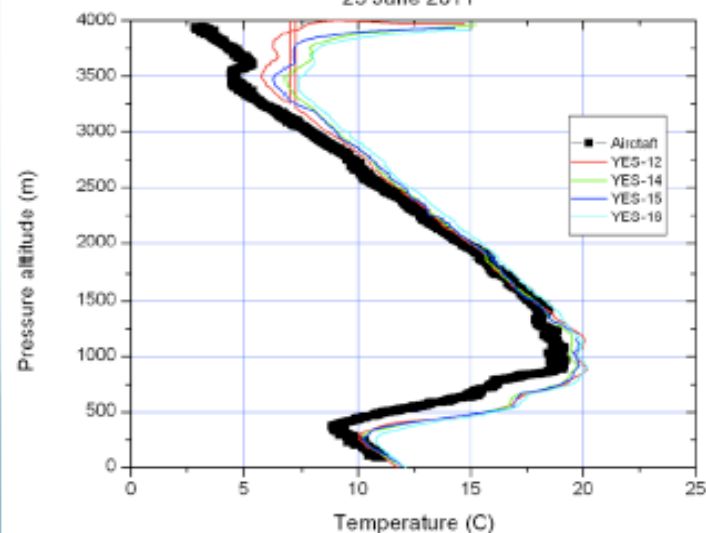
CIRPAS Twin Otter - Yankee Sonde comparison
25 June 2011



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25 June 2011



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25 June 2011



CIRPAS Twin Otter - Yankee Sonde comparison
25 June 2011

