



AIRBORNE DOPPLER WIND LIDAR MISSIONS IN THE ARCTIC: LOW LEVEL OBSERVATIONS AND COMPARISON WITH MODELS AND OTHER OBSERVING PLATFORMS



S. Greco¹, G.D. Emmitt¹, M. Kavaya² and K. Hines³

¹ – Simpson Weather Associates, Charlottesville, VA, USA; ² – NASA LaRC, Langley, VA; USA ³ – PMG/BPRC, Ohio State Univ., OH, USA

Introduction

During Oct-Nov 2014 and May 2015, NASA sponsored two airborne campaigns designed to fly the Doppler Aerosol WiNd (DAWN) lidar to take wind measurements of the Arctic atmosphere, specifically over and off the coasts of Greenland:

- Campaign I was based in Kangerlussuaq, Greenland and flew DAWN on board the NASA King Air UC-12B
- Campaign II was based in Keflavik, Iceland and utilized the NASA DC-8 aircraft to fly DAWN and Dropsondes over the Arctic.

Polar Science Objectives

- 1) Study low-level Arctic wind circulations associated with:
 - The Greenland Tip Jet
 - Barrier Winds off the east coast of Greenland
 - Katabatic flows along the Greenland coastline
 - Boundary layer rolls and OLES over the water
 - Flow over transitional ice and water zones
 - Flow over the Greenland Ice Cap
- 2) Provide validation for the models (POLAR-WRF) and Arctic Re-analyses (ECMWF ERA-Interim, the NCEP CFSR , and the regional scale Arctic System Reanalysis (ASR))

Campaign II NASA DC-8, DAWN and YES Dropsondes



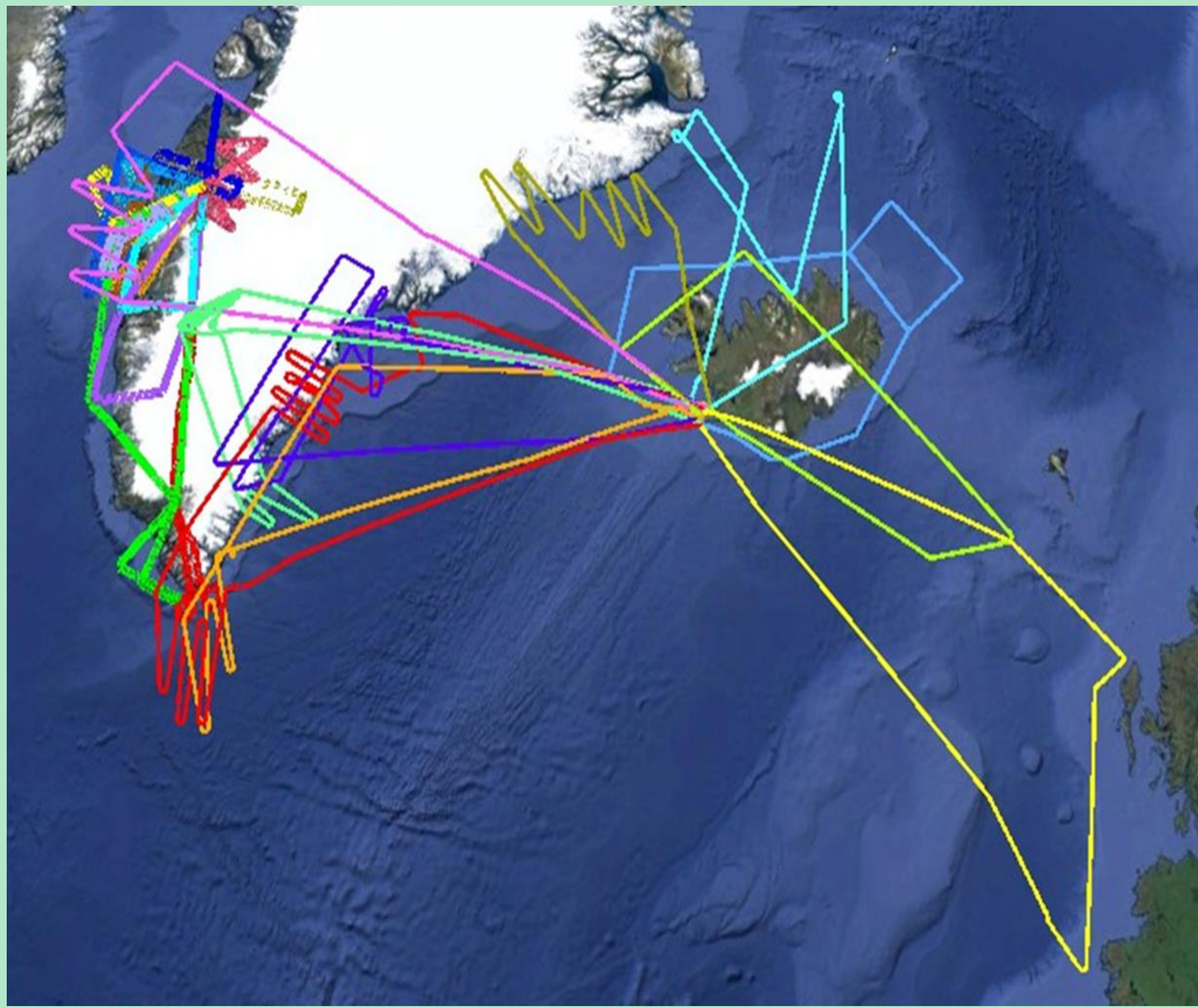
Attribute	Value
Airplanes Flown	DC-8 and UC-12B
Solid-State Laser Crystal and Wavelength	Ho:Tm:LuLiF, 2.053472 Microns
Laser Architecture	Master Oscillator Power Amplifier (MOPA)
Pumping Source, Wavelength, Duration	Laser Diode Arrays (LDA), 792 nm, 1 ms
Laser Pulse Energy E, Rate f, FWHM Duration t	250 mJ, 10 Hz, 180 ns
Telescope Diameter D, Magnification M	15 cm, 20
Light Detection Material, Technique	InGaAs, Coherent, Dual-Balanced
Scanner Diameter, Type, Deflection	15 cm, Step-Stare Rotating Wedge, 30° About Nadir
Eye Safety	Safe at any Range When DAWN Closed Up for Flight
Pointing Knowledge Technique	Dedicated INS/GPS on Lidar
LOS Wind Measurement Precision	< 1 m/s
Maximum LOS, Horizontal Wind	±80 m/s, ±160 m/s
Captured Data Length in Range, Altitude	0 – 16.4 km, 0 – 14.2 km
Vertical Resolution	133 m for 512-Sample Range Gate

Polar WRF Support

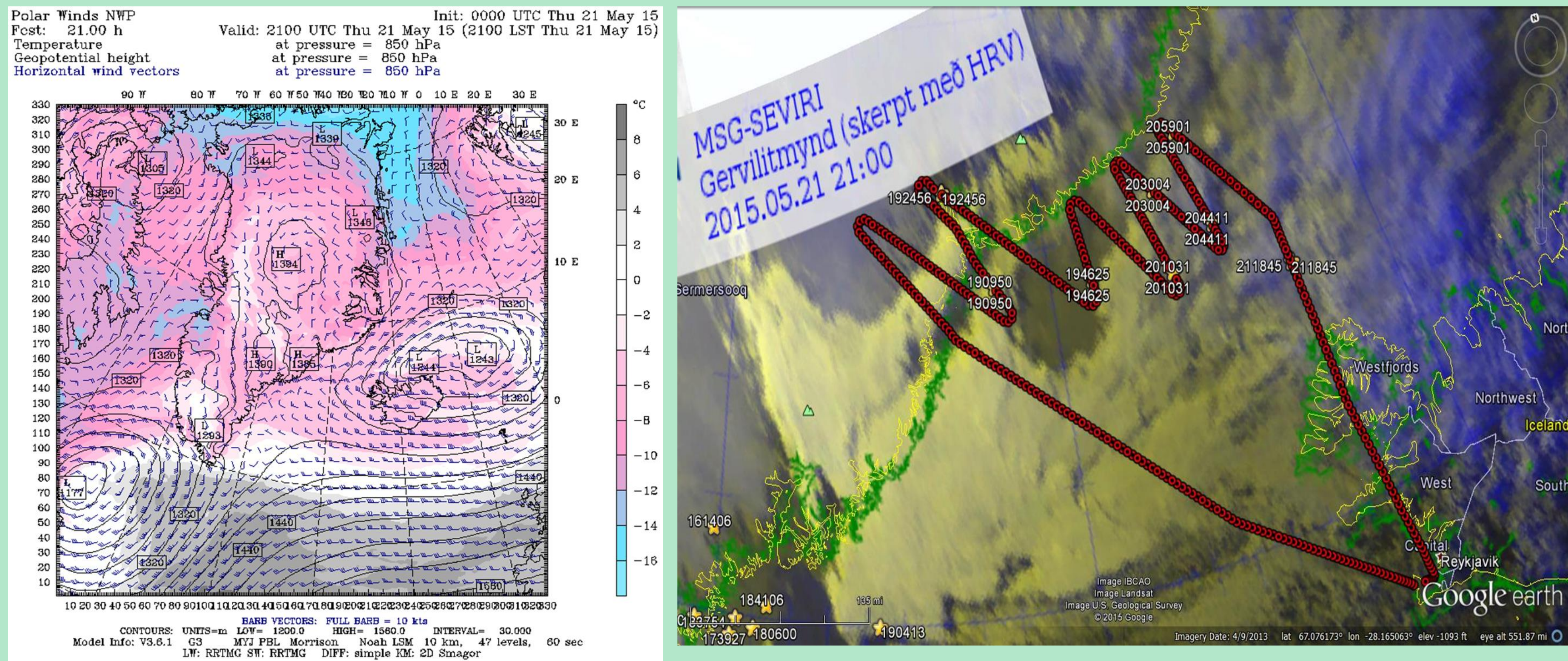
- 330 x 330 one-domain grid with 8 km spacing
- 48 layers: 8 layers at lowest 500 m;
- 60-sec time step; run with 20 tasks;
- 48-hr runs; output every 3 hr
- Morrison 2-moment microphysics
- RRTMG longwave and shortwave radiation
- MYJ PBL
- Noah Land surface model
- Fractional sea ice 1.5 m thick
- Run TWICE a day at 00 & 12 UTC
- IC/BC interpolated from 12hr NCEP GFS

Campaign II Flights

Date	Mission	DC-8	Falcon	Drops	DAWN	TWILITE
5/11	Iceland flow splitting with NE BL winds	X		3/5	X	X
5/13	TDS underflight (DLR/NASA) and Greenland CIZ (NASA)	X	X	5/6	X	X
5/15	Upper level jet between Iceland and Scotland	X	X	10/12	X	X
5/16	ADM cal/val over Greenland ice cap; CIZ and Kat-winds	X	X	8/10	X	X
5/17	CALIPSO, MODIS, ASCAT underflights; CIZ; Tip jet	X		8/9	X	X
5/19	Upper level jet over southern Greenland; Tip jet	X	X	7/8	X	X
5/21	Barrier jet	X		7/11	X	X
5/23	Katabatic flows off Greenland east coast; ADM cal/val CIZ	X	X	15/19	X	
5/24	Baffin Strait ice edge west coast of Greenland; rolls	X		11/12	X	
5/25	Upper level jet south of Iceland	X	X	5/6	X	X



May 21, 2015 – Barrier Wind Case Study



DAWN vs DROPSONDE vs Polar WRF Wind Profiles

