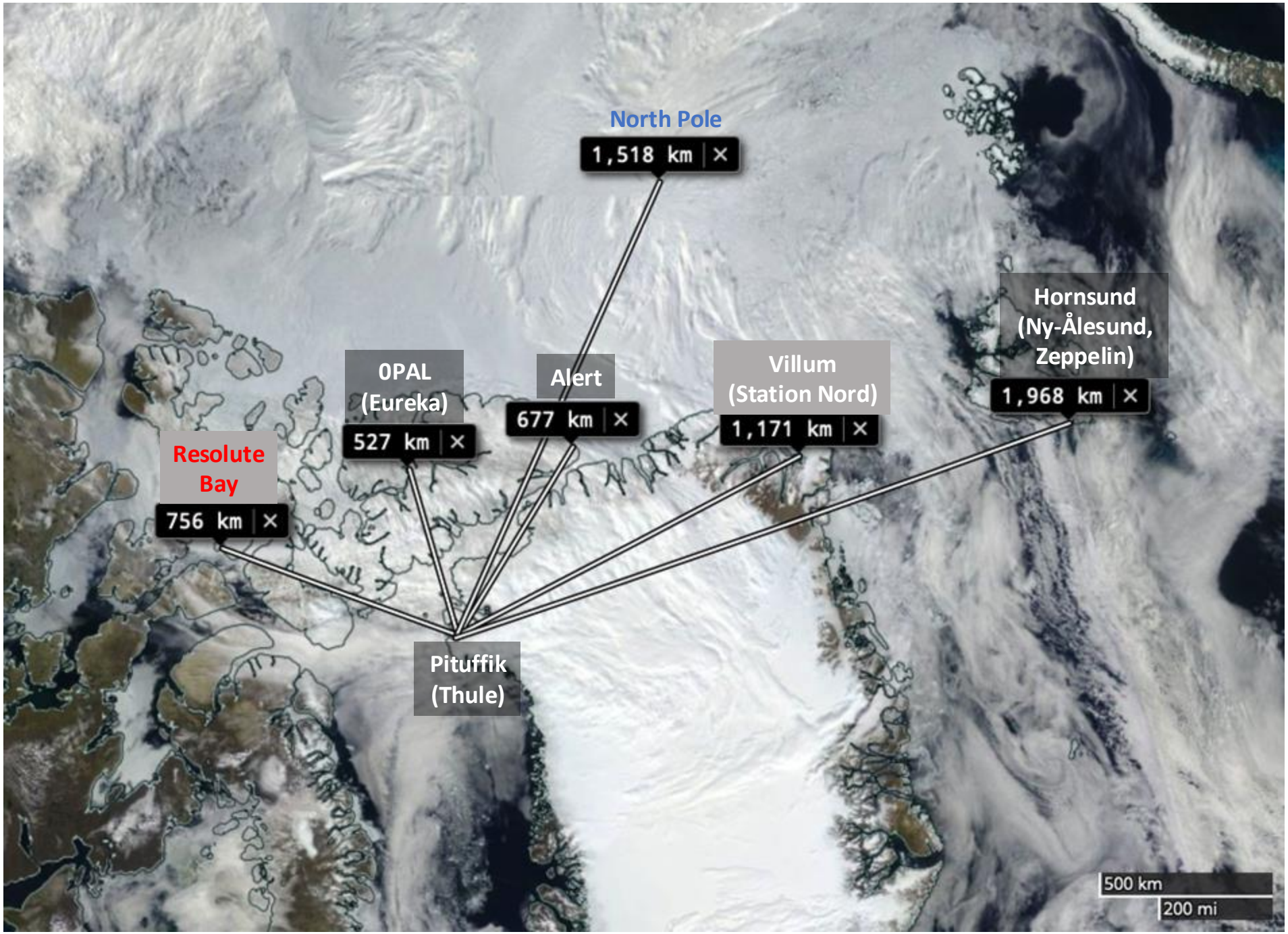
ARCSIX Surface Measurements

Ralph Kahn, ***Lauren Zamora***, *many others*

Surface Stations Offer Ground Truth:

- ***Upwind and downwind constraints*** on aircraft-sampled air masses over multiple days
- ***AERONET*** – total-column AOD + particle properties: ***long-term***; ***diurnally resolved***
- ***Ships of Opportunity*** – mostly ***summer*** deployment; MAN ***AOD*** + various ***surface sampling*** measurements
- ***Svalbard Research Stations*** – many seasonal and long-term *in situ* and remote sensing measurements
- ***Villum Research Station*** –***summer intensive*** + long-term site (*separate presentation on Villum*)



AERONET Stations

Alert
Thule
0PAL (Eureka)
Hornsund

Typical Arctic AERONET Operation

Mid-March or May to September or October (many missing days due to cloud)

AERONET Products

AOD
Angstrom Exponent
[Generally, 8 channels 320 – 1020 + 1640 nm]

Fine-mode Fraction
Size Distribution
SSA/AAOD
Refractive Indices
Non-spherical fraction

THAAO at Pituffik (Thule)

Site contact: Giovanni Muscari
Giovanni.muscari@ingv.it

- Ceilometer
- AERONET
- Radiosondes
- All sky camera
- Radiation
- Wind speed
- Radar
- R/T profiles

During ARCSIX, Pituffik was our base, so we overflew it a lot

We also overflew the THAAO South Mountain observatory

P-3 aircraft: May 30
G-III aircraft: June 10
Other overflights on June 6 and August 1

Alert

Site contact: Tak Chan
Tak.Chan@ec.gc.ca

- Spectral aerosol **scattering** coefficient
- Spectral aerosol **light-absorption** coefficient
- Particle **number concentration**
- Aerosol **size distribution**
- TSP **chemistry**
- AERONET (2024-present)
- Radiosondes

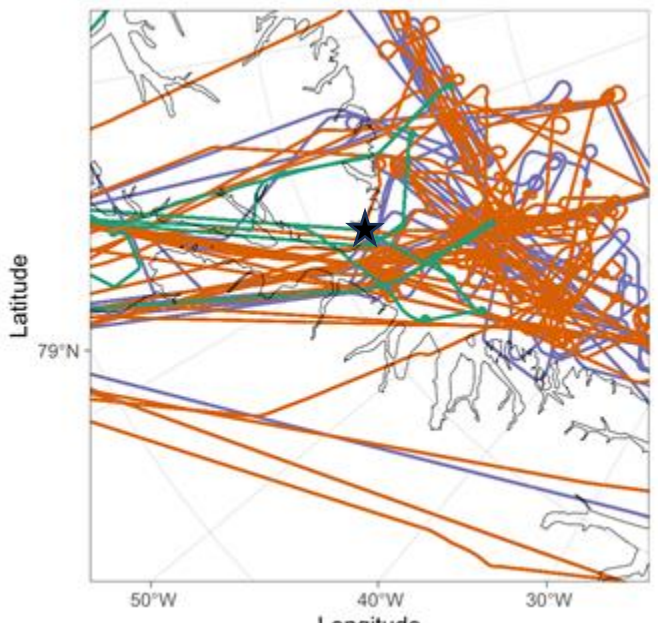
Long aerosol time series
←2006-ongoing for those
Other aerosol measurements 1980-2013

During ARCSIX, we flew near Alert a lot

P-3 *(15 days):*
- May 28, 30, 31; June 3, 5, 6, 7, 11, 13
- July 25, 29, 30; August 2, 8, 15

G-III *(10 days):*
- May 30, 31; June 3, 5, 6, 7, 10, 11
- Aug 8, 15

Lear *(4 days):*
- July 25, 30; Aug 8, 15

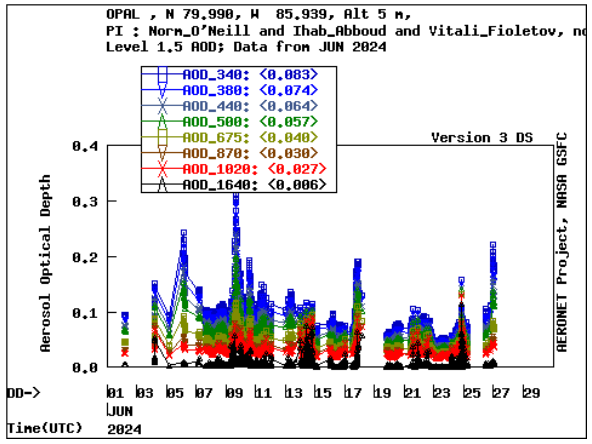


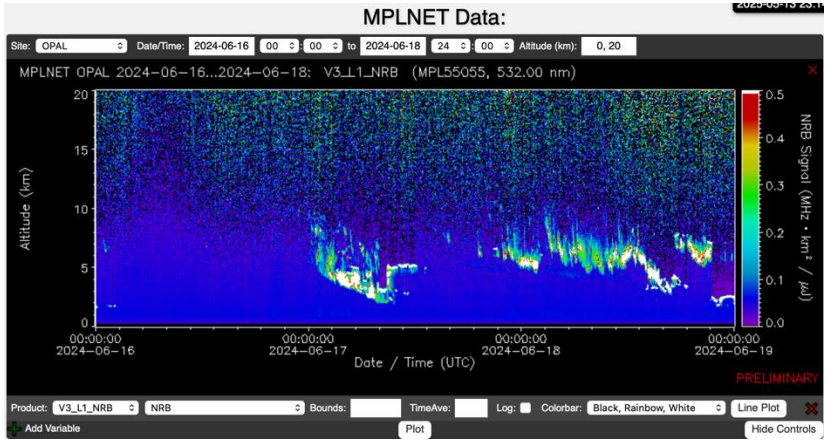
Lear
P-3
G-III

OPAL (PEARL, Eureka)

PEARL is the academic/research side of things at Eureka, whereas the Eureka Weather Station is a Canadian government met station.

- **Radiosondes**, **surface weather** variables
- **AERONET**
- **MPLnet**
- **Trace gases** during polar day (e.g., N_2O, O_3, CO, NH_3, CH_4) with Fourier Transform Infrared Spectrometer (FTIR)
- **Particle size distribution** (OPC)
- **Fine particle size distribution** (SMPS)
- **Pandora, All-sky imager, BSRN**



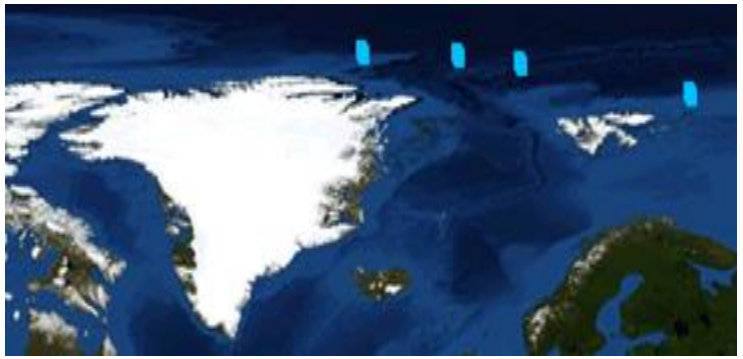


AERONET Marine Aerosol Network (MAN)

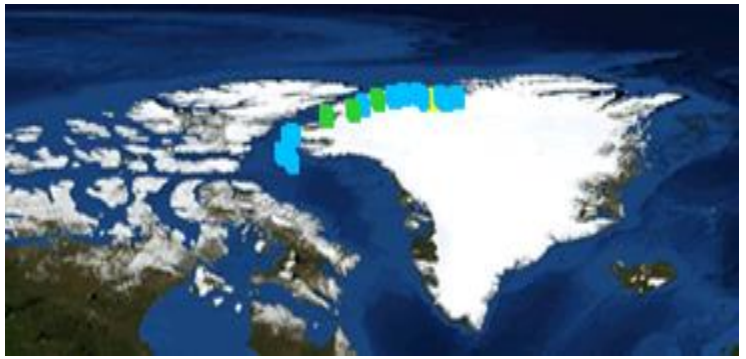
AOD Observations on Ships of Opportunity

MAN contact: A. Smirnov
alexander.smirnov-1@nasa.gov

Thanks to participating researchers and crew!



KP Haakon, July 21-Aug 3

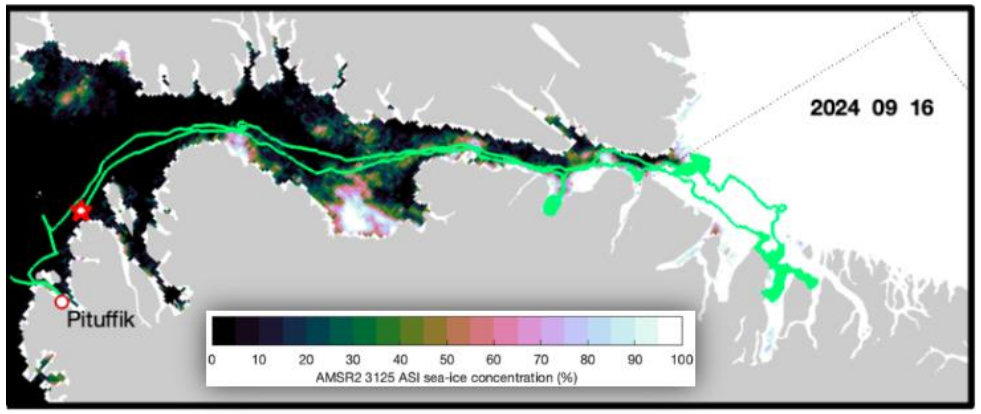


Oden (GEOEO), Aug. 7-Sept 15

Polarstern, Aug. 10-25

Oceania, June 11-Aug 11

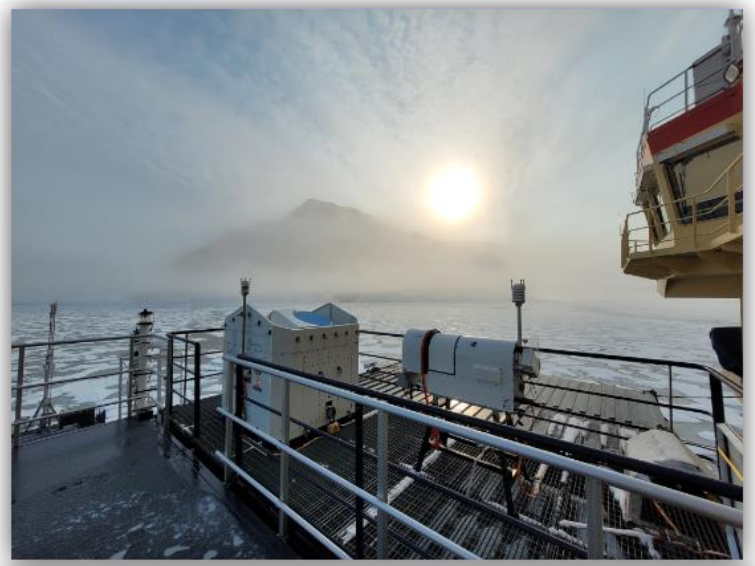
Color Scale for AOD Plot Points



Meteorological observations from Icebreaker Oden during GEOEO – ARCSIX collaboration
Data processing & QC update

John Prytherch, Michael Tjernström, Åsa Lindgren

Stockholm University & Swedish Polar Research Secretariat

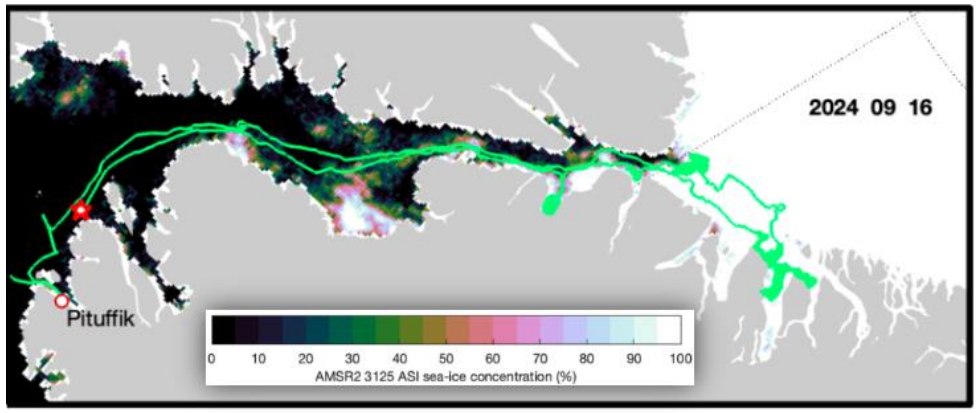


Data, frequency, vertical range	Coverage	Status
Surface turbulent fluxes (momentum, heat, CO2, CH4) 10 min	Aug 11 – Sep 15	complete
Surface radiative fluxes (LW up, dwn, SW dwn)	Aug 14 – Sep 15	In processing…
Surface meteorology (T, RH, P, visibility)	Aug 7 – Sep 15	In processing…
Radiosoundings (T,RH,P,wind profiles) 12hrly, ~0-30km	Aug 7 – Sep 15	In processing…
Ceilometer (cloud heights, coverage, backscatter prof) 0-10 km	Aug 7 – Sep 15	complete
HATPRO Radiometer (T, RH profiles, LWP) 0-10 km	Aug 7 – Sep 15	In processing…
W-Band radar (backscatter, Doppler spectra, velocity) 0-10 km	Aug 7 – Sep 15	In processing…
Ship meteorology sensors (T, RH, P, visibility)	Aug 6 – Sep 15	published

Ambition is to have all data processing & QC complete by Autumn 2025.
Data will be shared at https://bolin.su.se/data/

Contact: John Prytherch, john.prytherch@misu.su.se

Icebreaker Oden



During ARCSIX, we overflew the Oden 3 times

P-3: August 7, 8 (Nares St.)

Lear: August 15
(with a 3-plane cloud wall a bit to the north of the Oden near the Lincoln Sea)

Other data collected during GEOEO include:

- MAN **sun photometer**

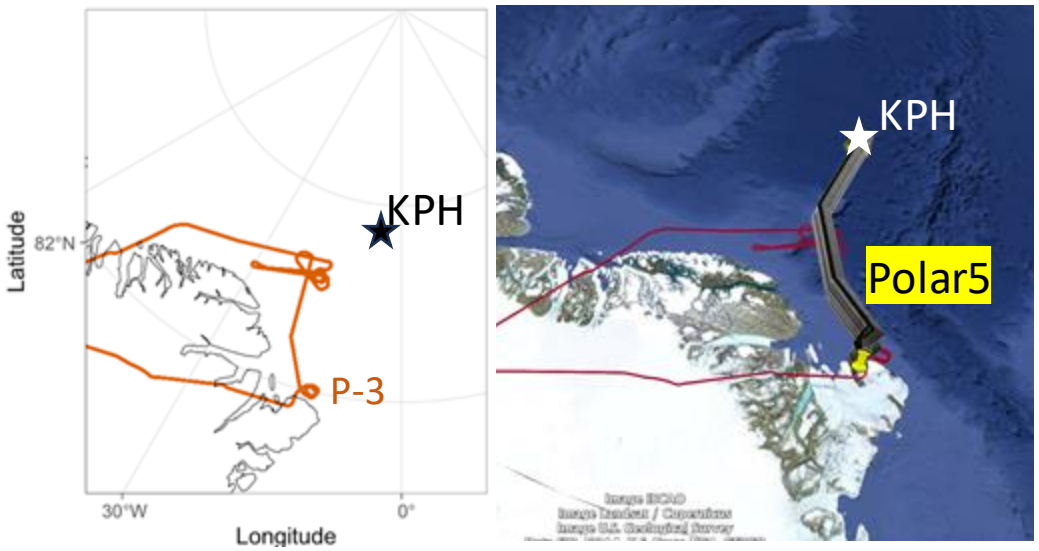
- **Cryo data** (IceRadar, high resolution imagery of glacier front, underwater T buoys, Autonomous Underwater Vehicle with sonar, Uncrewed surface vehicles to map bathymetry, icebergs)

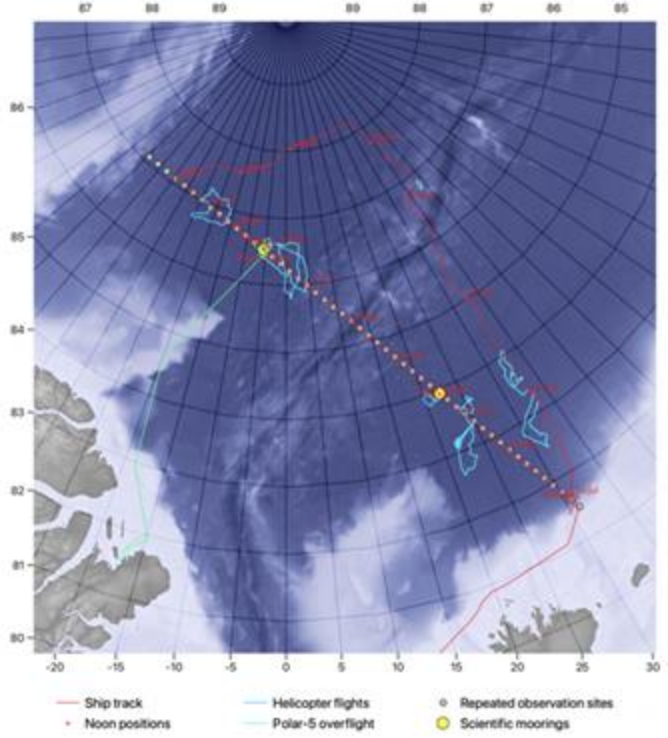
- **Biological/oceanographic data** (photosynthetically active radiation, profiles of sea water temperature, salinity, chlorophyll a, nutrients & biogeochemistry, DNA)

Polar5 contact: Jack Landy
jack.c.landy@uit.no

KP Haakon Contact: Paul Dodd
paul.dodd@npolar.no

Polar5 aircraft & the KP Haakon





KPH: 19 July – 12 August

During ARCSIX, Polar5 flew along the ARCSIX P-3 track and we flew a bit south the KP Haakon
P-3: August 1

- **Polar5:** EM bird (ice thickness) laser scanner (freeboard, roughness), hi-res camera (Vis, NIR, thermal IR)
- **KP Haakon:** radiosondes, MAN sun photometer**,** CTD profiles (with which they can calculate long-term geostrophic currents), acoustic water Doppler profiler in the top 250 m, hyperspectral TriOS RAMSES radiometers, chlorophyll a, ocean biogeochemistry. & biology (including algae from melt ponds), spectral measurements downwelling light fluxes under ice, sea ice thickness, melt pond depth, Sea ice mass balance buoys, ROV overview of the sea ice from below, Radarsat II ScanSAR images

Villum

Site contact: Henrik Skov
hsk@envs.au.dk

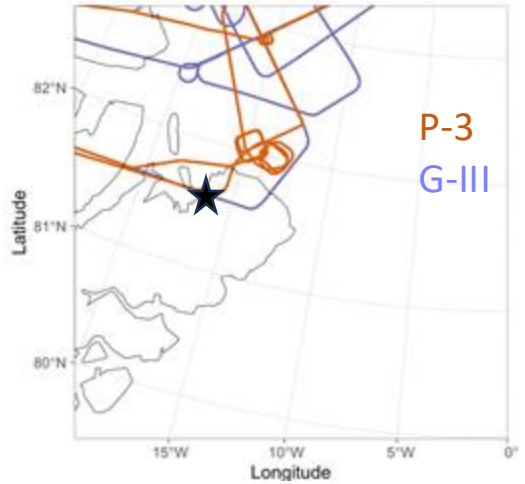
- Particle physics, chemistry
- CCN, INP
- Gases
- Ceilometer
- Lidar, 16 July to 12 Aug 2024 (CleanCloud)
- Tethered balloons with aerosols, 20 March to 13 April 2024 (CleanCloud)
- T, RH, winds, precip.
- Radiation

Long aerosol time series
←Multi-year aerosol time series, some going back to 2014

During ARCSIX, we overflew Villum twice

P-3 (2 days):
- June 13
- August 1

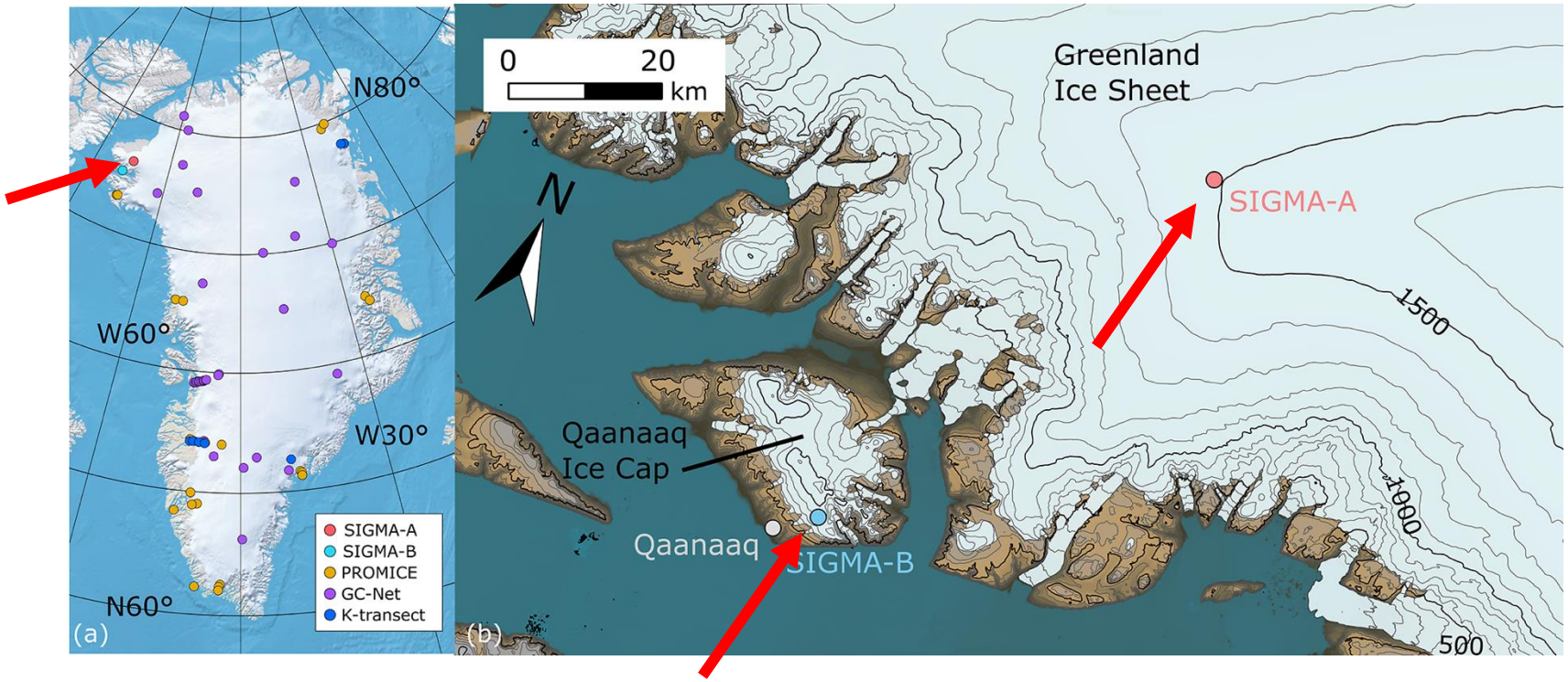
G-III (1 day):
- June 13



Svalbard (Hornsund, Ny-Ålesund, Zeppelin, Longyearbyen)

- **Hornsund** (*S. part of Svalbard*): **AERONET**
- **Zeppelin**: (*Near Ny-Alesund*)
- **Ny-Ålesund** (*east-central part of Spitsbergen*):
  - **Weather** mast
  - **Surface radiation**
  - **Ceilometer**
  - **Radiosonde**
  - **Ozone sonde**
  - **Sun Photometer**
  - **Star Photometer**
  - "KARL" Koldewey **Aerosol Raman Lidar**
  - **Doppler Lidar** (WindCube)
  - **Microwave Radiometer** (HATPRO)
  - 94 GHz **Cloud Radar**
  - Micro **Rain Radar** (MRR)
  - **Radiometer** for Atmospheric Measurements (RAM)
  - **Fourier Transform Infrared Spectrometer** (FTIR)
- **Longyearbyen**: The SIOS Research **Aircraft**, **UAVs**: aerial imagery and hyperspectral remote sensing data, optical imaging sensors – from vis to IR, **meteorology**

Japanese SIGMA Automatic Meteorological Stations



Two Stations: in Qaanaaq Ice Cap accumulation region and at equilibrium line ~100 & 150 km north of Pituffik

Surface Variables 2012 - present

- Air & snow temperature
- Surface pressure, RH
- Wind speed & direction
- Surface height
- Surface albedo
- Up + down SW radiation
- Up + down LW radiation
- Up + down NIR radiation

During ARCSIX, we overflew SIGMA-B twice

P-3: July 29, 30

Ref.: Nishimura et al. 2023, Earth Syst. Sci. Data, doi:10.5194/essd-15-5207-2023