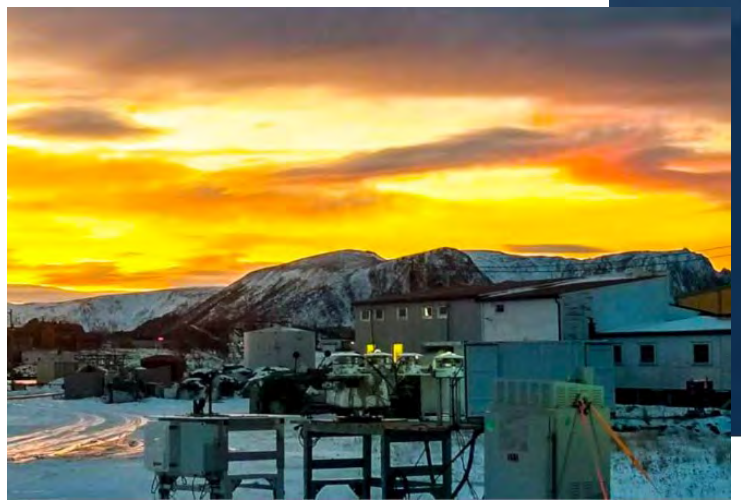
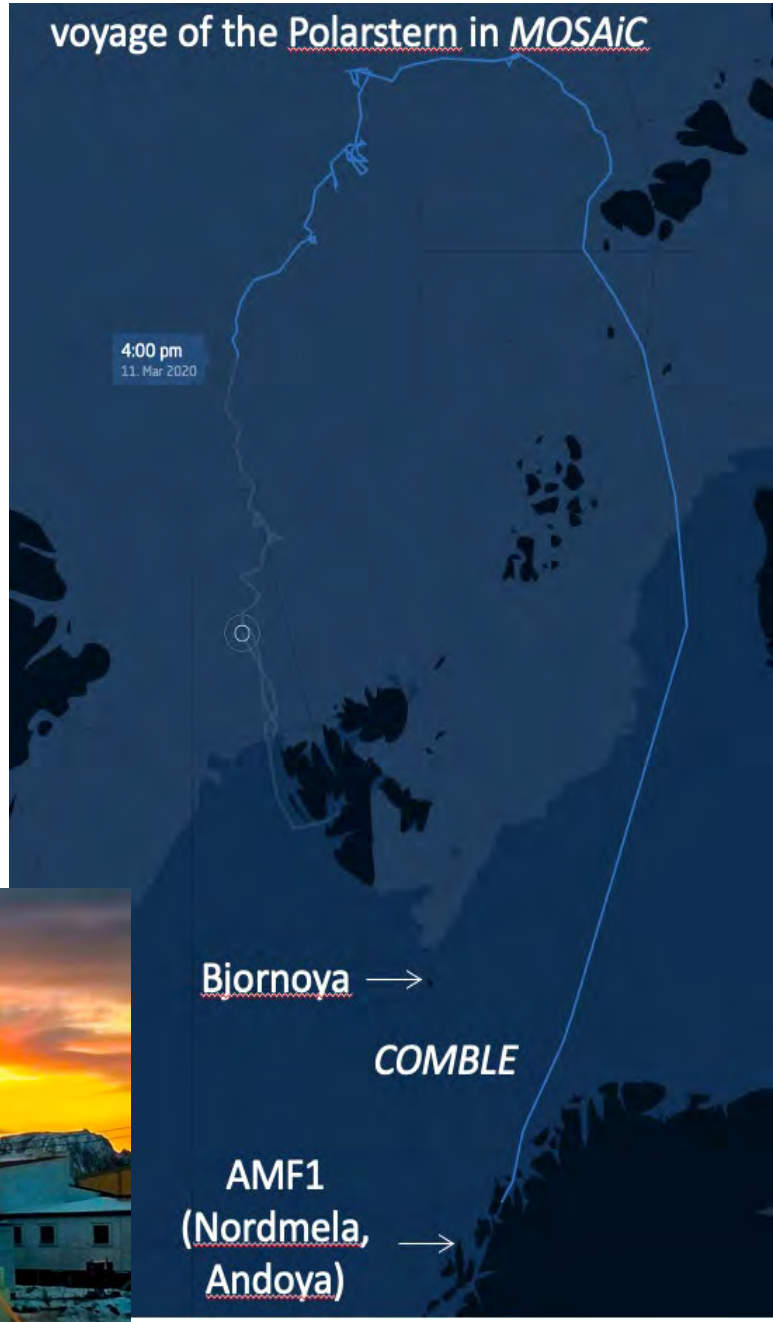
COMBLE

(Cold-air Outbreaks in the Marine Boundary Layer Experiment)

- 1 Dec 2019 – 31 May, 2020
- AMF1 deployed to Andøya just off the N. Scandinavian mainland; supplemental measurements on Bjørnøya further north
- GOAL: Quantify the mesoscale, cloud, and aerosol properties of boundary layer convection and air-mass transformations in cold-air outbreaks over open water in the Arctic
- Campaign completed successfully, although planned synergy with UK FAAM (ACAO campaign) and two other aircraft campaigns (Norwegian King Air near AMF1 site; German Polar5 near Bjørnøya) was aborted last-minute due to COVID-19.

photos courtesy LANL





COMBLE instruments: AMF1

Instrument	Measurement
Ka-SACR and W-SACR (scanning)	35 and 95 GHz reflectivity, Doppler velocity, Doppler spectrum
KAZR (profiling)	35 GHz reflectivity, Doppler velocity
AERI (Atm. Emitted Radiance Interferom.) & MWRP (microwave radiometer)	temperature and humidity profiles
MPL (profiling micro-pulse lidar) part-time	backscatter power
TSI (total sky imager)	cloud fraction
LDIS (disdrometer)	hydrometeor size distribution, fallspeed
MET	surface meteorology, precip
RWP (1290 MHz) down for several weeks	wind profiles
ECOR	eddy correlation surface fluxes
AOS (Aerosol Observing System)	aerosol sizing and chemistry, gas chemistry
Radiosondes (120 in total)	T, q, wind profiles

COMBLE instruments: Bjørnøya

Instrument	Measurement
MWRP	temperature and humidity profiles
MPL (profiling) + CEIL	backscatter power, aerosol layers, cloud base
TSI	cloud fraction
LDIS (disdrometer)	precip size distribution, fallspeed
MET	surface meteorology, precip
RWP (1290 MHz)	wind profiles
ECOR	eddy correlation surface fluxes
CEIL	ceilometer
DL	Doppler Lidar
sun photometer	narrow FOV radiances
VIS and IR broadband radiometer	SW and LW surface radiation budget
Radiosondes (150 in total)	T, q, wind profiles

Aerosol Observing System – AMF1 at **Andøya**

AOS probe	measured variables
~~ACSM (Aerosol Chemical Speciation Monitor)~~	mass concentrations of organics, sulfate, nitrate, ammonium, and chloride
CCN-200	concentration of cloud condensation nuclei at various supersaturations
$CO/N_2O/H_2O$ and O_3	gas mixing ratio sensors
CPC-3772 (fine) (Condensation Particle Counter)	concentration of sub-micron aerosol particles
UHSAS (Ultra-High Sensitivity Aerosol Spectrometer)	concentration and size distribution of sub-micron aerosol particles
~~HTDMA (Humidified Tandem Differential Mobility Analyzer)~~	the rate at which aerosol particles deliquesce at increasing RH
Nephelometer	total scattering and hemispheric backscattering of aerosol, both at ambient RH and at variable controlled RH (like the HTDMA)
PSAP (Particle Soot Absorption Photometer)	change in light transmission on a filter exposed to ambient aerosol, relative to a reference filter

COMBLE ice nucleation measurements

Paul DeMott and Thomas Hill
Colorado State University

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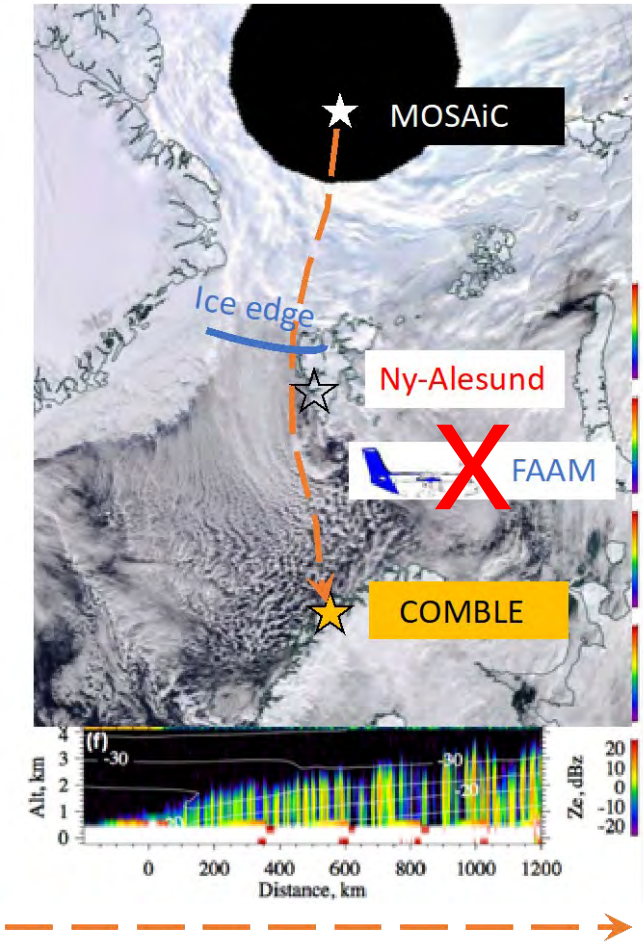
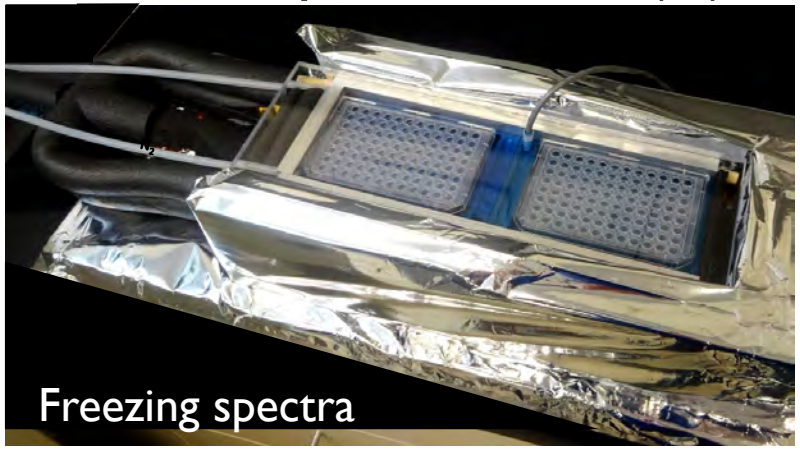
Ice nucleating particle (INP) measurements during COMBLE



CSU Ice Spectrometer (IS)



- Coordination with Yutaka Tobo (NIPR) sampling at Ny-Alesund
- Coordination with sampling in MOSAIC (Jessica Creamean)

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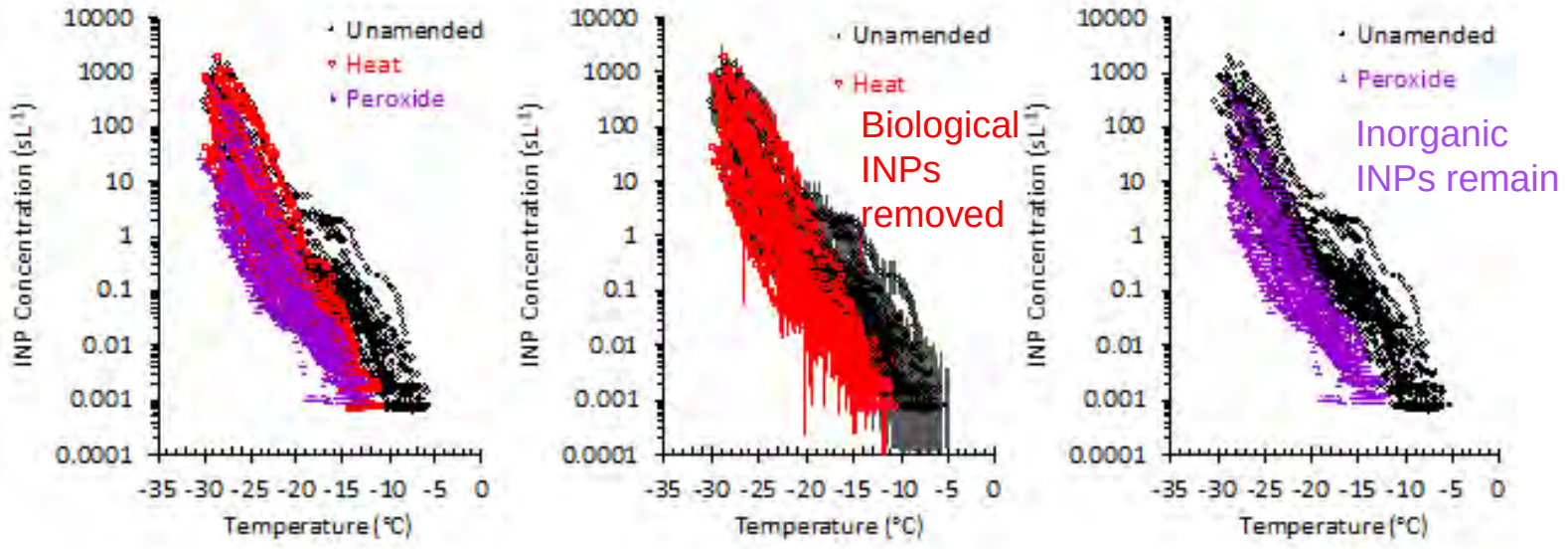
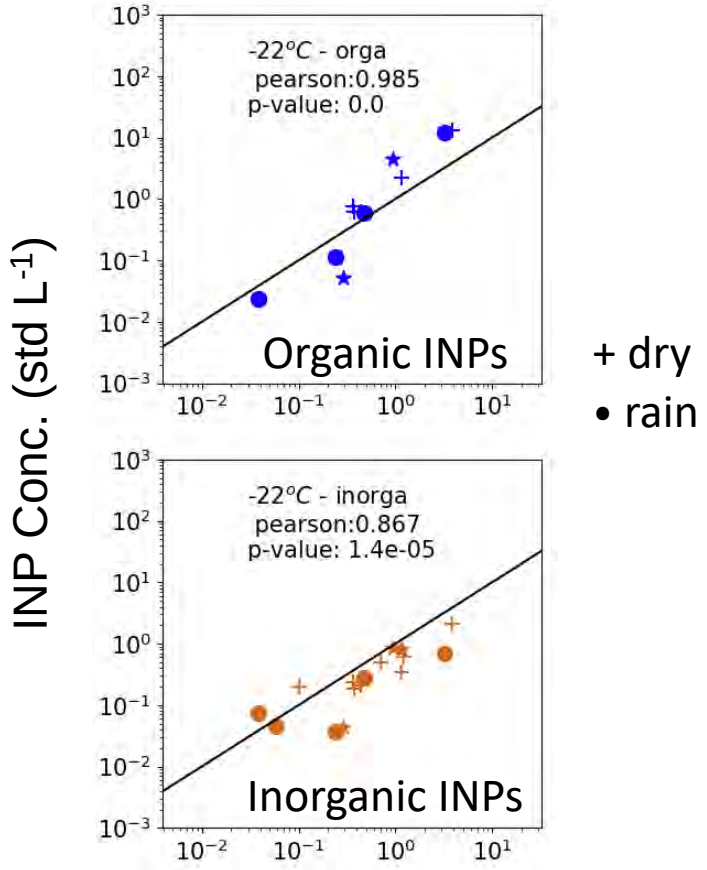
Summary of collections, plans for INP processing and example of integration with AMF data (proposed; CACTI data shown)

- 64 filters collected (6-66 hours each)
  - 35 pre- and post-CAO (N to SW)
  - 29 CAO (NNE to WSW)
  - 4 blanks
- Most will be processed for immersion freezing spectra
- ~1/3 processed to remove heat labile ("Bio-INPs") populations
- ~1/3 processed to remove organic carbon INP contributions

CACTI examples



(Courtesy of B. Testa)



+ dry
• rain

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