Aerosol Field Campaigns on the North Slope of Alaska

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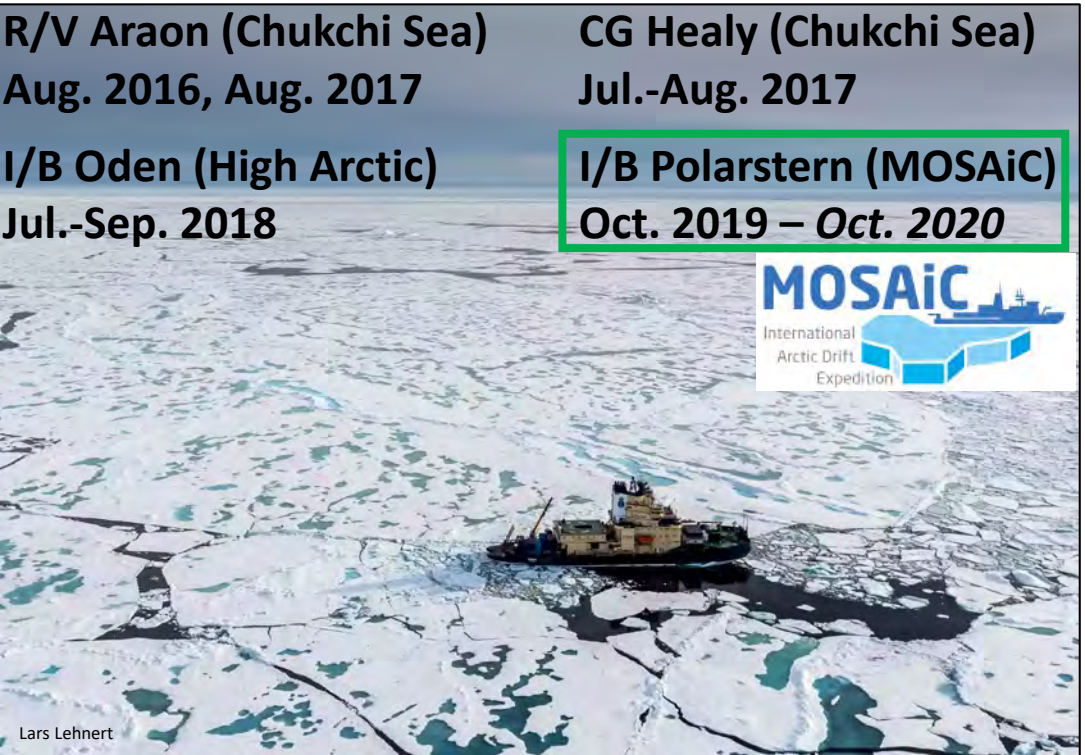
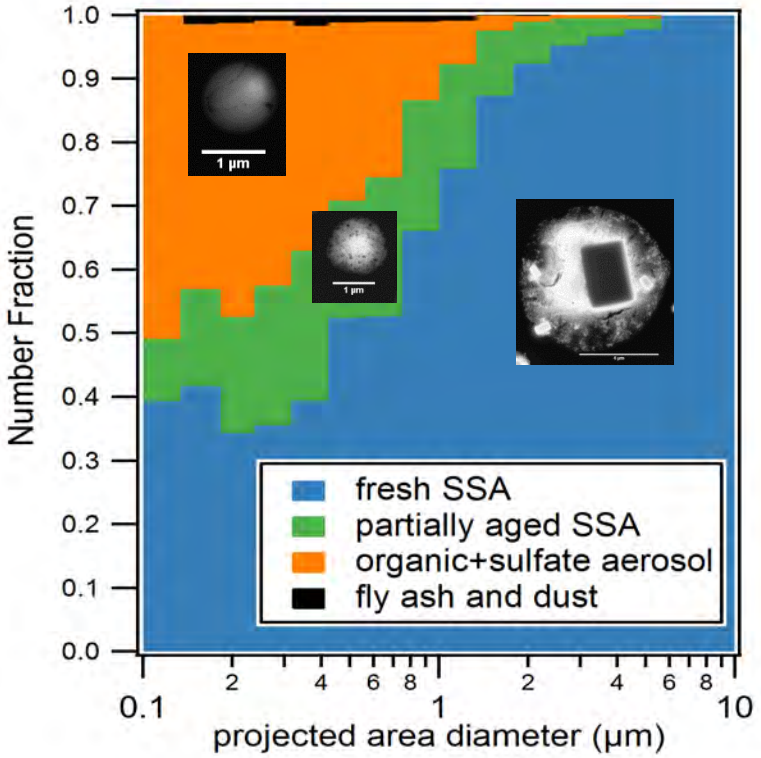
Pratt Lab Arctic Field Campaigns

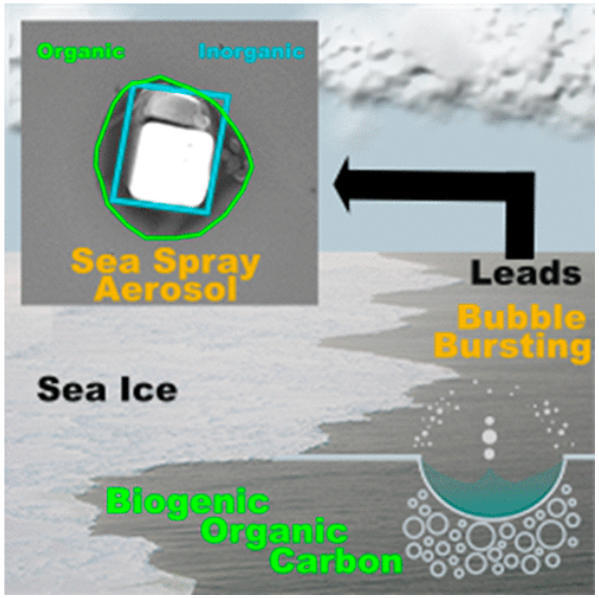
Single-particle chemical composition measurements

- Source identification
- Direct mixing state determination
- Identification of aging processes (reactions, gas-particle partitioning)
- Comparison to INP concentrations (collaboration with J. Creamean, CSU)



Jan. – Feb. 2014: Local Sea Spray Aerosol Production from Sea Ice Leads near Utqiaġvik





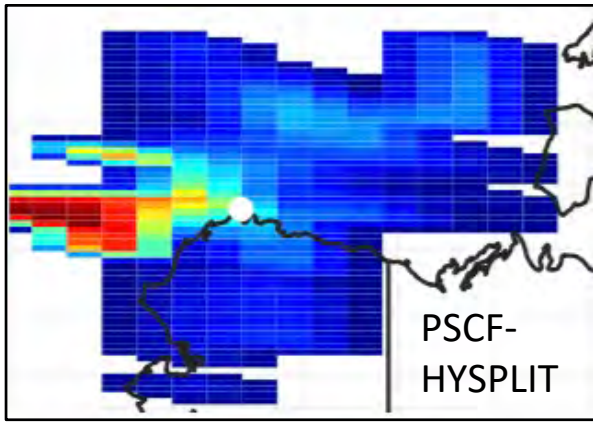
- **Thicker organic coatings in winter compared to summer.**
- Detailed chemical fingerprint analysis showed **organic coatings from exopolymeric secretions from sea ice algae and bacteria.**

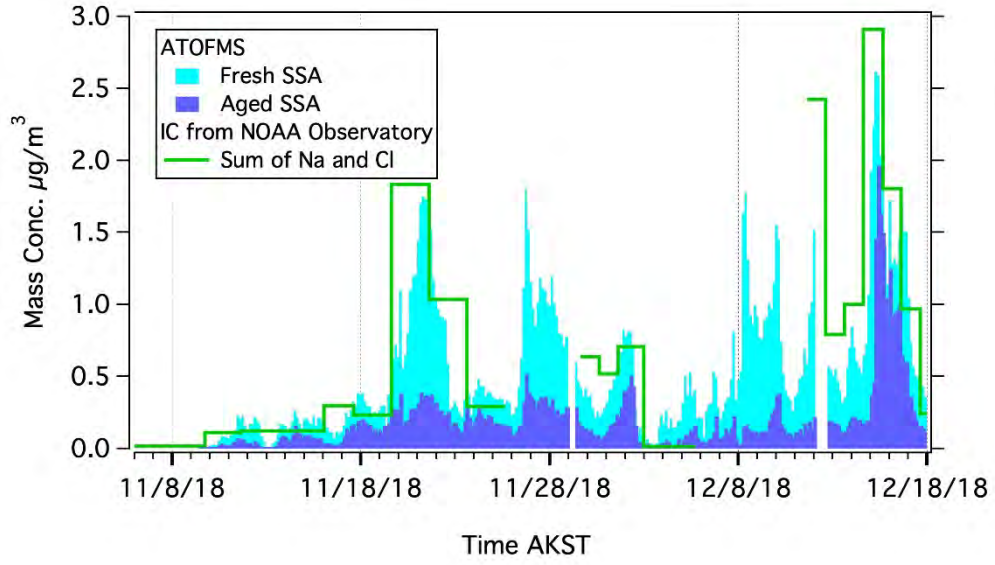
Sea spray aerosol (SSA) is abundant in the winter at Utqiaġvik when open sea ice leads are present.

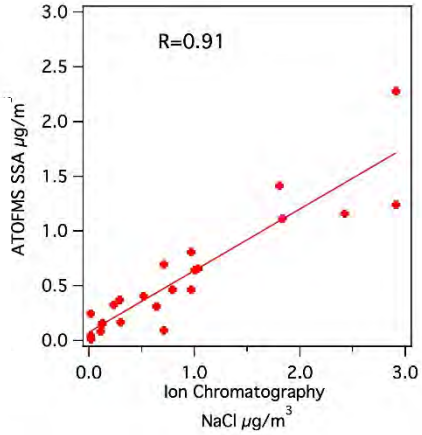
Kirpes et al. 2018, *Atmos. Chem. Phys.* https://doi.org/10.5194/acp-18-3937-2018.
Kirpes et al. 2019. *ACS Central Science*. https://doi.org/10.1021/acscentsci.9b00541.
SSA lead influence from 2006-2009 at Utqiaġvik:
May et al. 2016, *J. Geophys. Res.* https://doi.org/10.1002/2016JD025273.

Nov. – Dec. 2018: Fresh (Local) Sea Spray Aerosol Production at Utqiaġvik

- Local + transported (aged) sea spray aerosol (SSA) influence
- Highest sea spray aerosol concentrations during open water influence from Chukchi Sea



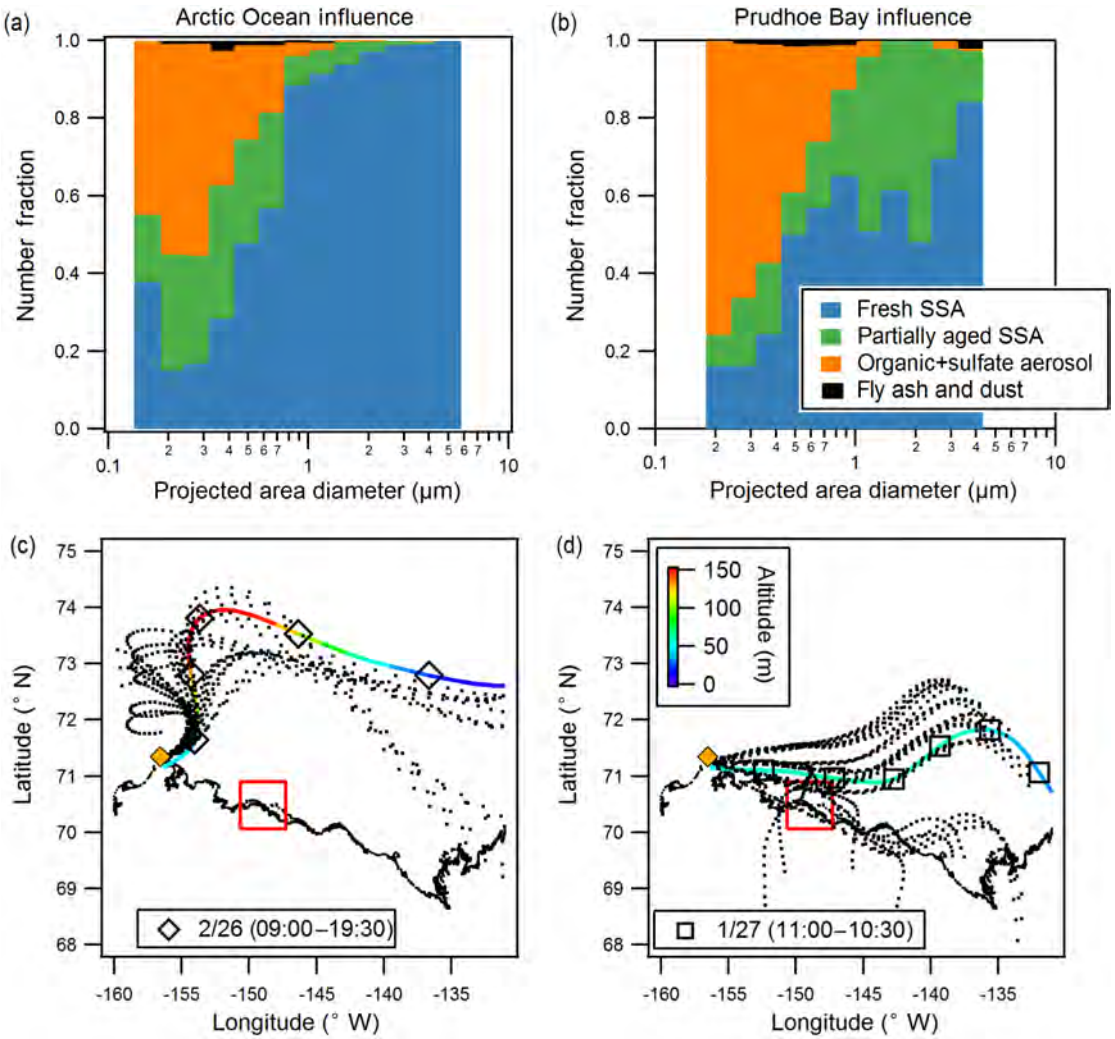




Agreement between ATOFMS (single-particle mass spec) and ion chromatography

Preliminary Analysis by Jun Liu; IC data from Lucia Upchurch & Patricia Quinn (NOAA PMEL)

Jan. – Feb. 2014 & Aug. – Sep. 2015: NSA Oil Fields Change Aerosol Composition at Utqiaġvik



↑ **Aged sea spray aerosol and organic+sulfate aerosol**

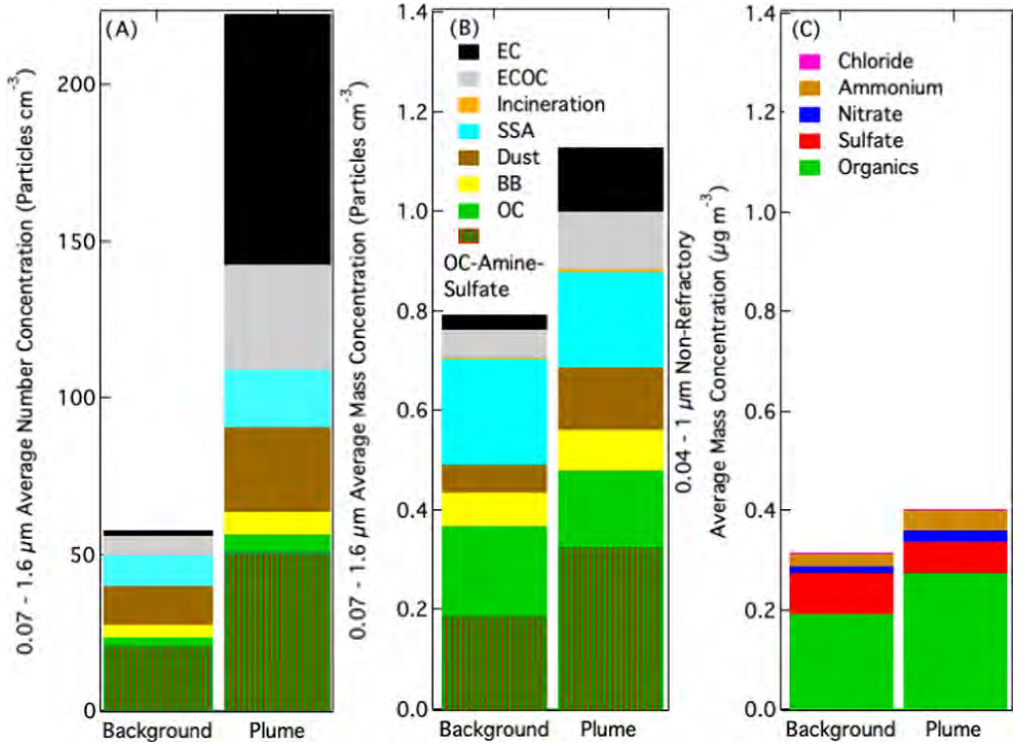
↑ **Ultrafine (<100 nm) particle number concentrations**

Maahn et al. 2017, *ACP*
https://doi.org/10.5194/acp-17-14709-2017

- NSA oil field emissions "affect liquid clouds that form downwind, leading to smaller droplets less likely to fall as drizzle or rain"

Gunsch et al. 2017, *Atmos. Chem. Phys.* https://doi.org/10.5194/acp-17-10879-2017.
Kirpes et al. 2018, *Atmos. Chem. Phys.* https://doi.org/10.5194/acp-18-3937-2018.

Aug. – Sep. 2016: Oliktok Point 'Clean Air' is Polluted



- **Diesel soot and oilfield organic-sulfate particles present in both background air and plumes**
- **Sea spray aerosol (SSA) is a significant contributor to aerosol mass** (average ~0.2 μg/m^3)
- ~37%, on average, of the submicron mass is refractory (not measured by ACSM):
  - diesel soot (EC & ECOC)
  - sea spray aerosol
  - dust
  - incineration (metals) particles

Gunsch, Liu et al. 2019, *Environ. Sci. Technol.* https://doi.org/10.1021/acs.est.9b04825.

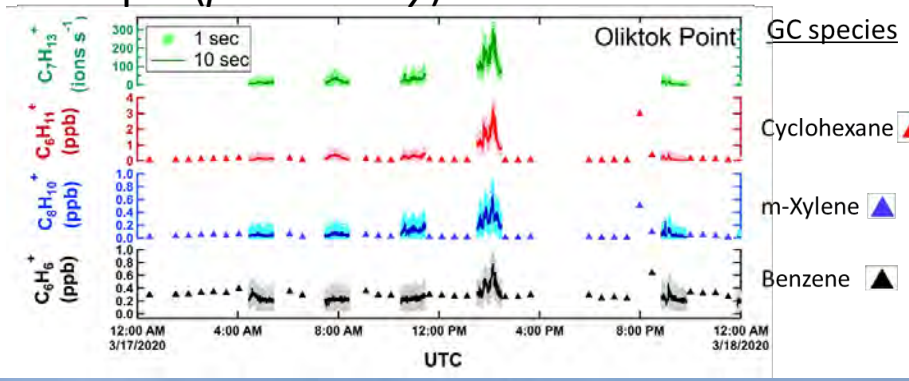
Feb. – Mar. 2020: Atmospheric Oxidation & Secondary Aerosol Formation at Oliktok Point

- Joint ARM-NSF Field campaign (co-PI: Andrew Lambe, Aerodyne)
- Ended early due to COVID-19
- Participants:
  - Kathryn Kulju, Nicole Perkins, Daun Jeong (Michigan)
  - Brian Lerner, Jordan Krechmer, Megan Claflin, Francesca Maljuf (Aerodyne)
- **Goal: Study atmospheric oxidation of volatile organic compounds (VOCs) and aerosol formation in the NSA oil fields**


PhD students Nicole Perkins & Kathryn Kulju

- Measurements:
  - **VOCs** (2 mass spectrometers: GC-NO^+ Vocus-TOFMS; FIGAERO I^- CIMS)
  - **Aerosol number concentrations** (SMPS)
  - **Single-particle mixing state** (CCSEM-EDX analysis planned)

Example (*preliminary*) detection of VOCs:




Brian Lerner