Aerosol Field Campaigns on the North Slope of Alaska

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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)

Utqiaġvik, AK (NSA)

R/V Araon (Chukchi Sea)
Aug. 2016, Aug. 2017

I/B Oden (High Arctic)
Jul.-Sep. 2018

CG Healy (Chukchi Sea)
Jul.-Aug. 2017

I/B Polarstern (MOSAiC)

Oliktok Point, AK

David Oaks

Angela Raso

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

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

- 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 is abundant in the winter at Utqiaġvik when open sea ice leads are present. Kirpes et al. 2018, Atmos. Chem. Phys. [Link](https://doi.org/10.5194/acp-18-3937-2018).

Kirpes et al. 2019. ACS Central Science. [Link](https://doi.org/10.1021/acscentsci.9b00541).

**SSA lead influence from 2006-2009 at Utqiaġvik:**
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

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

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”

Aged sea spray aerosol and organic+sulfate aerosol
Ultrafine (<100 nm) particle number concentrations

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/m³)
- ~37%, on average, of the submicron mass is refractory (not measured by ACSM):
  - diesel soot (EC & ECOC)
  - sea spray aerosol
  - dust
  - incineration (metals) particles

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
- 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: