Insights from colder and darker places – The Alaskan Layered Pollution and Chemical Analysis (ALPACA) project

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Organizers: Kerri Pratt, Jingqiu Mao, Steve Arnold, Kathy Arnold, Julia Schmale, Bill Simpson
ALPACA workshop 14-16 May 2018

https://alpaca.community.uaf.edu

44 participants from Universities, NOAA, EPA, state/local regulators, community, health researchers

Sponsors
Fairbanks vs. SLC
PM$_{2.5}$ composition

PM peaks in winter, similar magnitude, longer winter in Fairbanks.

- Fairbanks has OC + sulfate, small nitrate. Summer peak from wildfire
- SLC has ammonium nitrate, lower sulfate and OC
Gas composition

Similar CO and NO$_y$, but Fairbanks has ~20x more SO$_2$ and SLC has 2x more O$_3$. O$_3$ is often below detection limits during Fairbanks wintertime.
Sulfur oxidation ratio

Potential sulfate = (sulfate + 100% conversion of $\text{SO}_2$ to sulfate)

$\text{SOR} = \text{sulfate} / \text{potential sulfate}$

- SLC SOR is higher, indicating SLC is more oxidative
- Fairbanks SOR peaks in winter, potentially indicating a wintertime oxidation mechanism.
Very strong temperature inversions

- Tower data courtesy of Telyana Wong and Martin Stuefer, UAF
- Over 8 meters vertical. The lofted sensor is typically 2-4 °C warmer at night
- Inversions do not break every day, even in February
Differences between Fairbanks and SLC

• In the cold and dark, there is lower conversion of sulfur to sulfate and less conversion of nitrogen to nitrate – less photochemistry

• However, the observed SOR is larger than expected primary emissions, so there may be dark chemistry

• With an assumed OM/OC = 1.4, the mass balance closes in the cold/dark while it appears a higher OM/OC ratio is needed in Salt Lake City – maybe OM is less oxidized in cold/dark

• Ammonia is an unknown in Fairbanks, but there is less Ag in winter.

• Temperature inversions are stronger in cold/dark, likely trapping pollution in shallower layers near the ground
Sustainably Navigating Arctic Pollution Through Engaging Communities (SNAP-TEC)

Bill Simpson, Jingqiu Mao, Nathan Kettle, Krista Heeringa, Laura Conner (UAF), Kerri Pratt (U. Mich), Peter DeCarlo (Drexel U.), Brent Williams (Wash. U. St. Louis), Rodney Weber (Georgia Tech), and Jochen Stutz (UCLA)

A National Science Foundation “Navigating the New Arctic” project that supports part of ALPACA goals and will carry out intensive field studies in Jan-Feb 2021.
(SNAP-TEC) seeks improved understanding of wintertime Arctic outdoor and indoor air pollution, built in collaboration with community members, to assist sustainable development of the Arctic and improve air quality for Arctic people.
SNAP-TEC (Jan/Feb 2021) research foci:

• Community outreach and research into community perceptions of the problem
• Focused on a typical house in downtown neighborhood
• Indoor/outdoor air composition differences
• Indoor sources from heating (wood, pellet, oil)
• Semi-volatile organic partitioning
• Indoor air oxidative potential
• Sulfur oxidation mechanisms
# Measurements (Jan/Feb 2021)

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2019-Sep-26
Aspects in ALPACA that are not in SNAP-TEC

- Blue background a bold aspects are in SNAP-TEC
- We lack:
  - Nitrogen chemistry
  - Health studies
  - Modeling / 3-D understanding
  - Ecosystem Impacts
  - Meteorology

We welcome collaborative projects! Please contact me or any organizer.