ALaskan Pollution and Chemical Analysis (ALPACA) project

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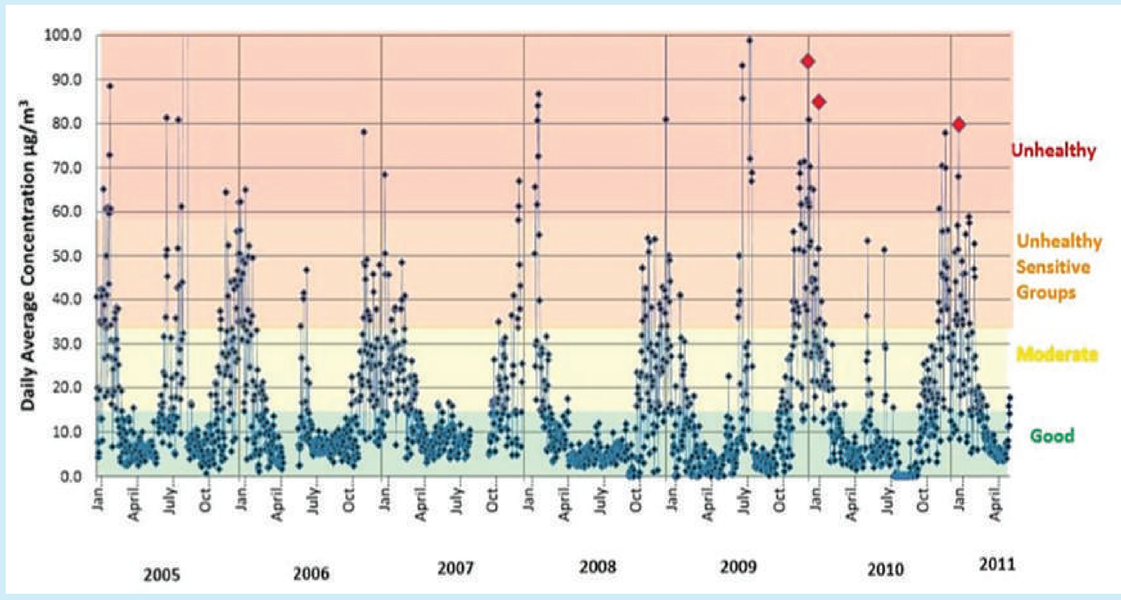
What is the secondary chemistry in cold and dark conditions?

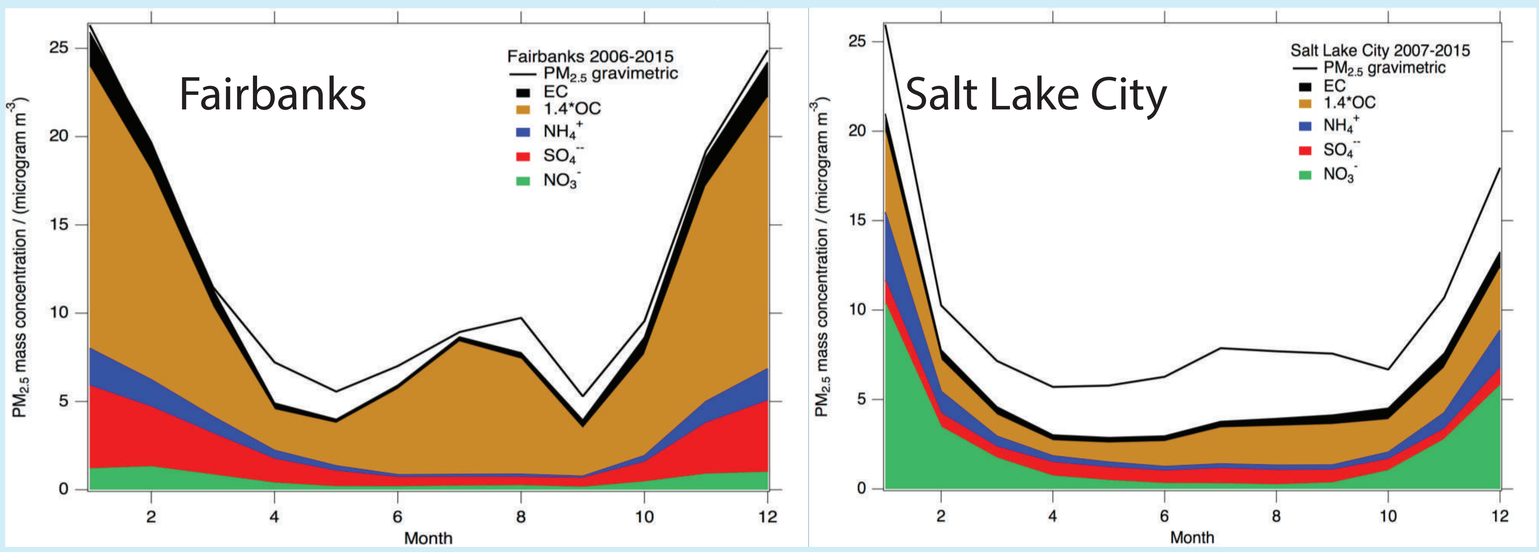
Photo credit: Rob Elleman

Fairbanks is ranked as the #1 polluted city in US for annual PM2.5 (American Lung Association)

2005-2011 Daily Average PM2.5 Concentrations Downtown Fairbanks

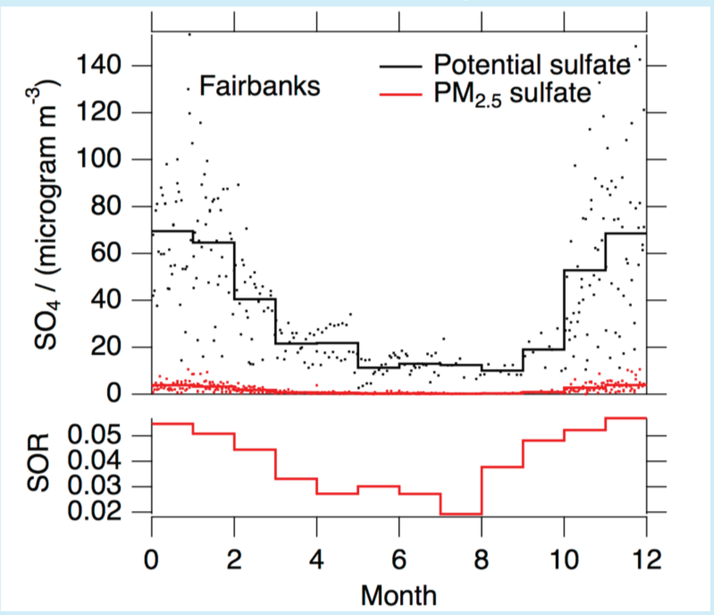


Despite similar seasonal patterns and total PM2.5 concentrations, Fairbanks and Salt Lake City pollution differ in composition



Several major differences between wintertime air pollution in Fairbanks and Salt Lake City:
1. Fairbanks aerosols are dominated by organic aerosols, while SLC is dominated by NH4NO3.
2. Sulfate contributes siginificantly to aerosols in Fairbanks, less so in SLC.
3. Mass balance is closed in Fairbanks, but not so in SLC.

Sulfur Oxidation Ratio (SOR) peaks in winter



1. Traditional pathways for sulfate production is likely unimportant in Fairbanks winters.
2. What is non-tradtional pathway for sulfate production? Transition Metal Ions? NO_2?

ALPACA workshop in May of 2018 in Fairbanks, AK

Scientific questions for a future field campaign:

1. Which organic particle and gaseous emissions and chemical processes are most important for ground-level air quality problems?
   - •non-traditional SOA
   - •phase of organic aerosol (liquid, solid, semi-solid)
   - •mixing state of aerosols

2. Which precursor gases interact to form/grow aerosol particles?
   - •sulfur oxidation
   - •nitrogen oxidation
   - •NH_3 and aerosol acidity

3. How do poor dispersion conditions exacerbate these pollution problems?
   - • the role of boundary layer meteorology in urban air pollution
   - • possible biases with regional air quality models
   - • aerosol-cloud interaction and urban heat island effect

4.What are the impacts, both locally and regionally, of high latitude urban pollution?
   - • toxicology of wintertime urban aerosol
   - • outdoor vs. indoor wintertime air pollution
   - • downwind fate of the pollution and depositional footprint