CIMS MEASUREMENTS OF GAS AND PARTICLE ORGANIC COMPOUNDS DURING CLEARFLO – DETLING UK
Acknowledgements

- DOE ASR!
- Claudia Mohr and Felipe Lopez-Hilfiker (UW)
- Aerodyne Research Inc (esp. Leah Williams)
- Georgia Tech (Sally Ng)
- LANL Group (Manvendra)
- Berk Knighton (Montana)
- Amon Haruta, Kim Nitschke
- U.K. collaborators
Organic Aerosol

\[ C_xH_y \rightarrow C_xH_yO_z \]
MOVI-HRTToF-CIMS

- Pre-concentration and gas-particle separation using inertial impaction
- Temperature-programmed desorption for volatility information
- Chemical ionization high-resolution time of flight mass spectrometry
Micro-Orifice Volatilization Impactor

Thermally isolated impaction post
130 nm cut-point
10% pressure drop from ambient
10 slpm sample flow
Micro-Orifice Volatilization Impactor

Gas Detection/Particle collection

Temperature-programmed thermal desorption

Signal Arb. Units

Time

06:12 06:16 06:20 06:24 06:28 06:32 06:36 06:40
CI Schemes Used

- Proton abstraction — selectively reacts with acids
  
  \[ CH_3C(O)O^- + RC(O)OH \rightarrow CH_3C(O)OH + RC(O)O^- \]

  - Multifunctional Carboxylic acids, phenols, inorganic volatile acids (HNO$_3$, HCl, HNCO…)

- Proton transfer — more general, polar organic compounds
  
  \[ H_3O(H_2O)_n^+ + RC(O)R' \rightarrow (n + 1)H_2O + RC(O)R'H^+ \]

  - Multifunctional carbonyls, amines, alcohols and peroxides
ClearfLo MOVI Protocol

Gas Detection/Particle Collection Followed by Desorption (Negative CI) 2x’s – total 50 min

Blank (Positive CI) – 25 min

Blank (Negative CI) – 25 min

Gas Detection/Particle Collection Followed by Desorption (Positive CI) 2x’s – total 50 min
Preliminary Data: (Biofuel Combustion)
m/Q 138: Nitrophenol (in particles)
Preliminary Data: Positive Ion Mode

![Graph showing data for different m/Q values over a period from 25.01.2012 to 14.02.2012. The x-axis represents date and time, and the y-axis represents arbitrary units and concentration in µg/m³.]
Preliminary Data: Many more
Future Work: Statistical Patterns

- Use multi-dimensional nature of data set to develop a highly constrained apportionment of gas and particle time series to sources, aging processes, etc.

- Describe evolution of mass spectra during temperature-programmed thermal desorption to group into relative volatility bins or perhaps other particle characteristics.
Thermal Desorption Example

The graph shows the normalized signal over time for different temperatures. The x-axis represents time, and the y-axis represents the normalized signal. Each line corresponds to a different temperature, as indicated by the legend on the right. The data appears to peak at certain times for each temperature and then decreases over time.
Summary

- We (Clearflo-Detling) have a rich data set!

- Insights into dominant aerosol sources, gas-particle interactions, and connections between particle composition and climate-relevant properties (e.g. optical properties) yet to be explored
Instrument Calibration

ClearfLo Top Of Inlet Gas Calibrations

- Formic Acid
- Acetone