Sub-micron aerosol chemical composition at the Montseny site

Aerodyne High-Resolution Time-of-Flight Mass Spectrometer

University of Colorado team:
Mike Cubison, Amber Ortega, Carly Robinson, Sanna Saarikoski, Jose-Luis Jimenez

CEH Edinburgh team:
Chiara Di Marco, Eiko Nemitz

Regional haze

Barcelona

27/2/2009
Regional haze

Barcelona

Montserrat (?)

27/2/2009

Field-Deployable, High-Resolution, Time-of-Flight Aerosol Mass Spectrometer

Peter F. DeCarlo,†,‡ Joel R. Kimmel,† Achim Trenborn,† Megan J. Northway,† John T. Jayne,† Allison C. Aiken,†,‡ Marc Genin,§ Katrin Fuhrer,§ Thomas Horvath,§ Kenneth S. Doherty,¶ Doug R. Worsnop,¶ and Jose L. Jimenez†,‡

Aerodyne
Colorado
Tofwerk

Aerodynamic Lens

Chopper / Particle Drift Region

10^1 Torr 10^2 Torr 10^3 Torr

Signal to ADC

Ion Transfer Optics

Thermal Vaporizer & 70 eV Electron Ionization

Anal. Chem. 2006, 78, 8281–8289
SOA Measurements vs. Models

- Much higher SOA than predicted with current models
- Extrapolating to global models: 14-22 Tg / yr “Extra SOA”


Sub-micron composition

- Nitrate is often the dominant species
  - Maybe some organic nitrate
- Aerosol appears neutralised
- CEH: Eiko Nemitz & Chiara DiMarco: $\text{HNO}_3 + \text{NH}_3 + \text{HCl}$
Size-resolved composition

- Note difference in vertical scales
- Sizes too large, they will be reduced owing to inlet pressure reduction since calibration

OA: OOA and local BBOA

Regional background of fairly oxidised organic aerosol... mixed in with high levels of inorganic nitrate

Wood burning plumes
Less-oxidised organics

Traffic
Biomass Burning
Local Biomass-burning OA

- dilute, but clear signals from local wood-burning sources

Potential Aerosol Mass (PAM): Penn State (Bill Brune) & Colorado


Hg Lamps produce 185 nm and 254 nm light

O$_3$ and OH formed by photochemistry, oxidizing sample

OH exposure in the chamber on the order of days, variable based on the following parameters and equation:

\[ OH_{\text{Exposure}} = (1.3 \times 10^{12}) \frac{[O_3(\text{ppm})][H_2O(\%)]}{[\text{flow(LPM)}]} \]
Our First PAM Time Series
Other topics

- Proposed Data policy
  - Based on MILAGRO
  - Upload data to FTP site every ~2 days
  - Do not present field data w/o permission of owner
  - Analysis phase: need permission of data owners, offer coauthorship

END
Oxidation of organics

Low signal => ratio difficult to quantify

[Graph showing m/z 44/ΩA for OOA-I and OOA-II over time from Sat 21 Feb to Fri 27 Feb.]
**HR fitting routine**

- Custom peak shape is fit to the open (= particle beam + background) and closed (= background only) mass spectra
- Multiple ions are fit for each mass/charge
- Aerosol signal is the open stick less the closed stick … can be –ve
- Sensitivity study is performed moving mass calibration and determining consistency of peak heights

**Size-resolved AMS**

- Particle Time-of-Flight (PTOF)
- Lens
- Pump
- Pump
- Pump
- Pump
First High Resolution Aerosol Field Data

SOAR-1 Campaign
Riverside, Jul/Aug 2005

Integrated "Stick" Signal

SOAR-1 Campaign
Riverside, Jul/Aug 2005

Morning Size Distribution

m/z 81

HSO₃⁺ C₂H₂O⁺ C₆H₉⁺

Total signal

Morning Size Distribution

dᵥ (nm)

HSO₃⁺ C₂H₂O⁺ C₆H₉⁺ Total signal