6th Aerodyne AMS Users’ Meeting
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Thermal Denuder + AMS

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One thought about quantification

• I am impressed by the continuing work on characterizing instrument and its problems
  – John, Tim, Peter Liu, Leah, Brendan, Ann and many others

• The AMS (with all its imperfections) is the best characterized instrument
  – Many hard problems, but we are making progress
    • Other instruments also have problems, but often ignored or less well-characterized
    • AMS has more internal diagnostics
  – Real hope: many people thinking and trying new things for a sustained period of time, talking to each other

• Keep it going!
  – $E_b$ will hurt us if no solution in 1-2 years
Thermodenuder-AMS II

• From Qi’s time series analysis (& similar techniques): hard to resolve more than 3-4 components unless exceptional time separation
  – Even 2-3 can be challenging
• We need more separation of the organics to look for new areas of separation
  – High m/z resolution
  – Soft ionization
  – Thermal denuder
    • measure change in aerosol composition as a function of volatilization temperature
    • Advantage: can be done immediately & cheaply
    • But adds complication to the analysis

Motivation: add thermal analysis a-la-Ziemann

![Graph showing contributions of organic peroxides to secondary aerosol formed from reactions of monoterpenes with O3](image_url)
Thermodenuder-AMS

• Has been done for physical aerosol measurements many times in the past
  – Tony Clarke
  – Burtcher, Wehner
  – PSI group
  – Volatility TDMA

• Us (Aerodyne + Ziemann + Jimenez groups)
  – TD in front of AMS
    • Also in Schneider et al. ES&T diesel paper
  – Reproduce published Wehner et al. design
  – Focus on organics, time-series analysis, “polymers”
  – EPA wants a database of MS + volatility

Thermodenuder

Thermodenuder Temperature Profile

Old design, Profile is better now

Thermodenuder/TDPBMS
Monocarboxylic and Dicarboxylic Acids

Data from Paul Ziemann, UC Riverside
Motivation: add thermal analysis a-la-Ziemann

**FIGURE 4.** Thermal desorption profiles of SOA formed from reactions of (A) α-pinene, (B) Δ3-carene, and (C) sabinene with O3 in dry air in the presence of cyclodextrins and 1-propanol ON radical scavengers. The $m/z$ 100 signal is indicative of the C9 dicarboxylic acid (e.g., phytic acid for α-pinene), and the total signal is indicative of the total aerosol mass. The profiles have been normalized to the signal at the maximum.

Data from Paul Ziemann, UC Riverside

**Contributions of Organic Peroxides to Secondary Aerosol Formed from Reactions of Monoterpenes with O3**

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Thermodenudogram:

$m/z$ 100 for α-pinene + O3

Riverside, California
Riverside’05: Speciated Time-Series

- Cycle:
  - 10 min ambient, 10 min TD at one T (e.g. 50 C)
  - 10 min ambient, 10 min TD at a different temp (e.g. 75 C)
  - Cycle 8 Ts: ambient / 50 / 75 / 100 / 125 / 150 / 175 / 200 (2.5 hrs)

HR-ToF Time Series
Riverside’05: Thermograms for Nitrate

Nitrate 8/1 5:00am - 10:00am

m/z 30

Riverside’05: Thermograms for Sulfate

Sulfate 8/1 5:00am - 10:00am

m/z 64
Riverside’05: Thermograms for Organics

1.0
0.8
0.6
0.4
0.2
0.0
Fraction Remaining
200
175
150
125
100
75
50
25
Temperature °C

Organics

m/z 57

m/z 43

m/z 44

m/z 43 8/1 5:00am - 10:00 am

m/z 44 8/1 5:00am - 10:00 am

m/z 57 8/1 5:00am - 10:00 am