

Aerosol composition at a rural site southeast of London measured by high resolution mass spectrometry

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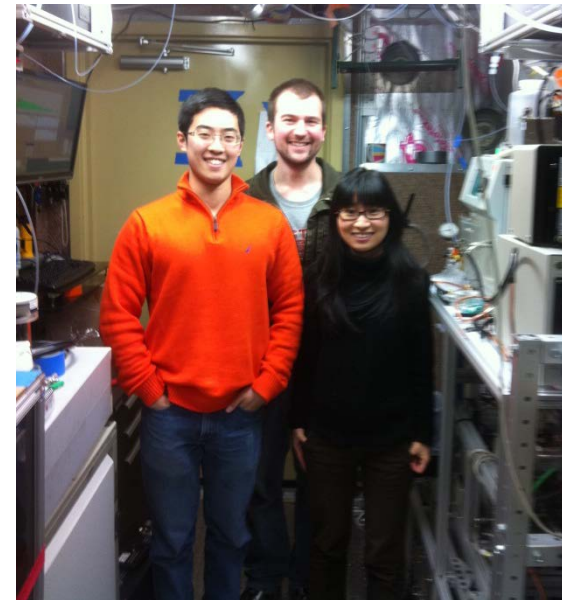
J. Jayne, S. Herndon, B. Brooks, L. R. Williams, P. Massoli, E. Fortner, P. Chhabra,
T. Onasch and D. R. Worsnop
Aerodyne Research, Inc.



March 13, 2012
DOE ASR Meeting

Acknowledgement: DOE

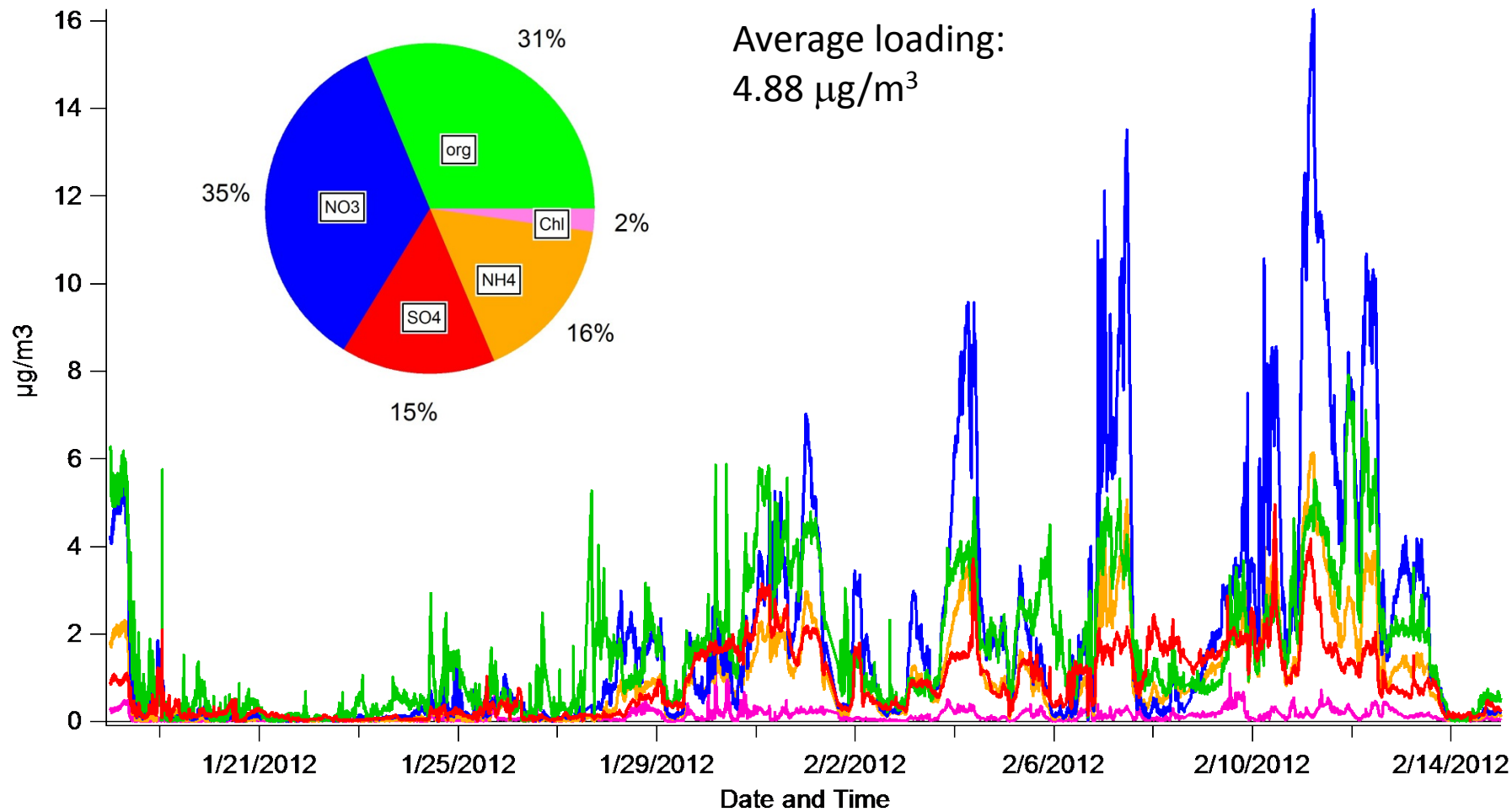
Site: Detling, UK (~ 1 hour SE of London)



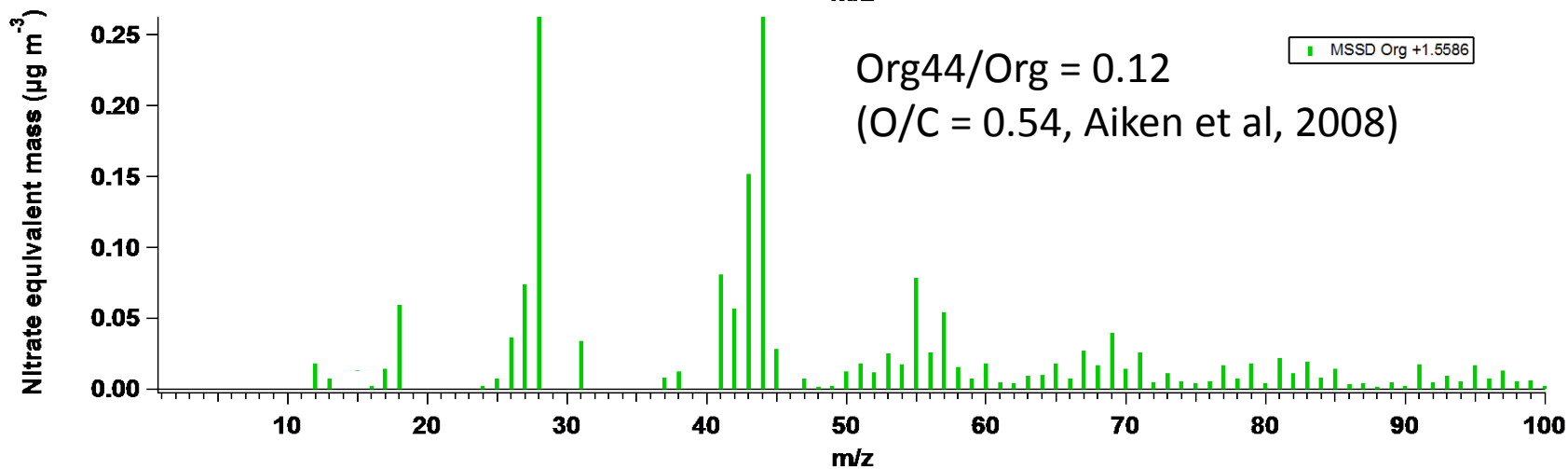
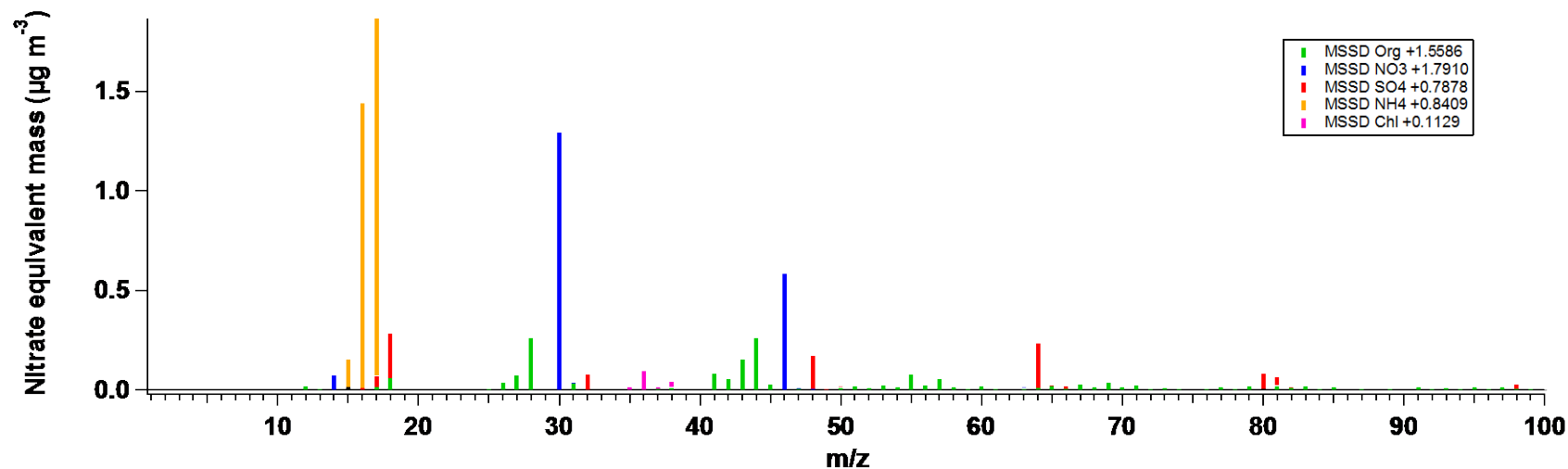
High Resolution Time-of-Flight Aerosol Mass Spectrometer: Data collection

- Good data: 1/18/2012 to 2/14/2012 (27 days)
- Bypass and thermal denuder
 - 10 min by pass, 2 mins each: V, W, V, W, V
 - 10 min TD, 2 mins (V mode only) at each temperature setting
 - Before 2/1/2012, TD temperature cycle: 50, 180, 250, 120 °C
 - After 2/1/2012: TD temperature cycle: 250, 120 °C

Bypass data: Time series

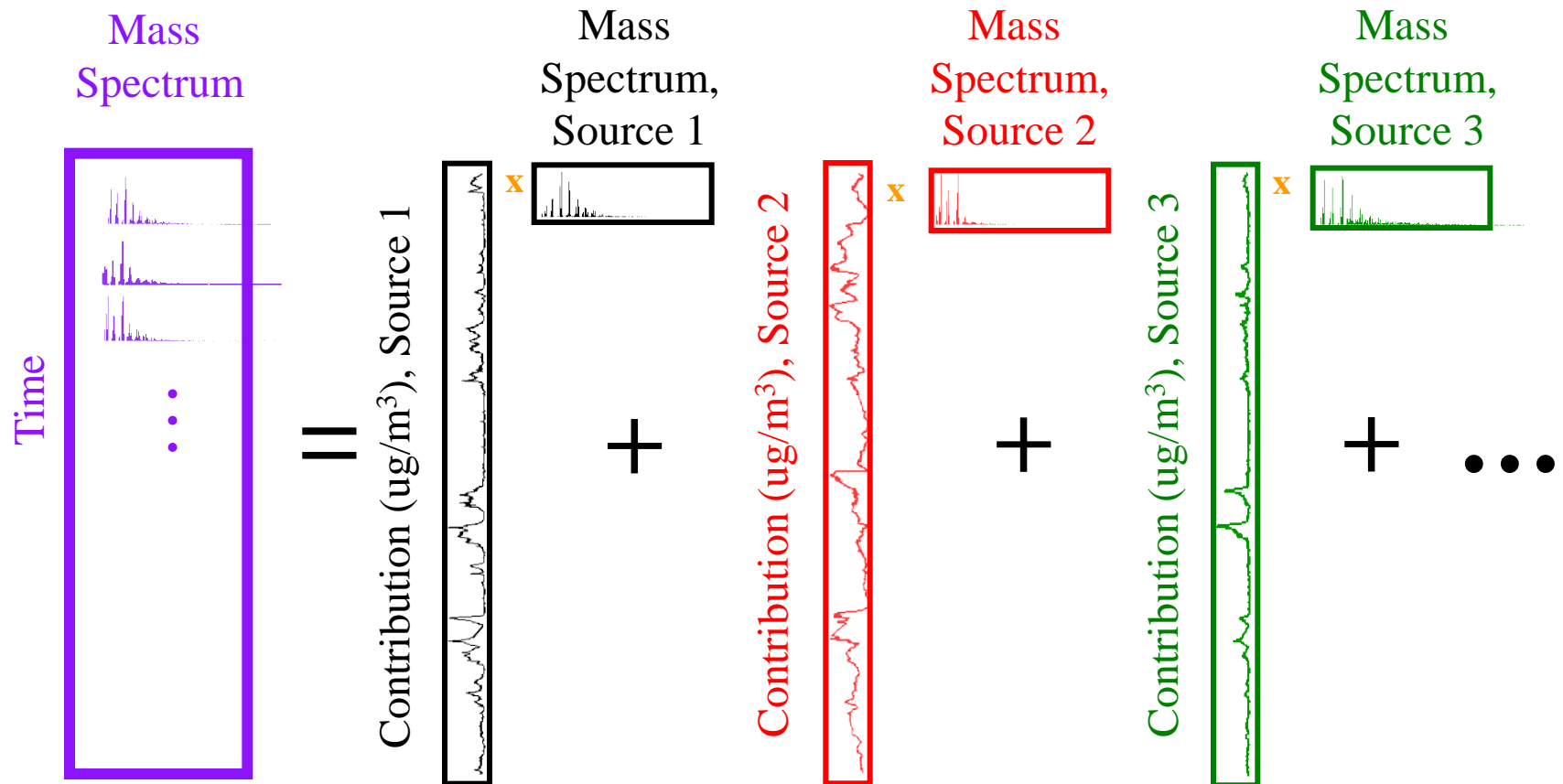


Bypass data: Average mass spectra

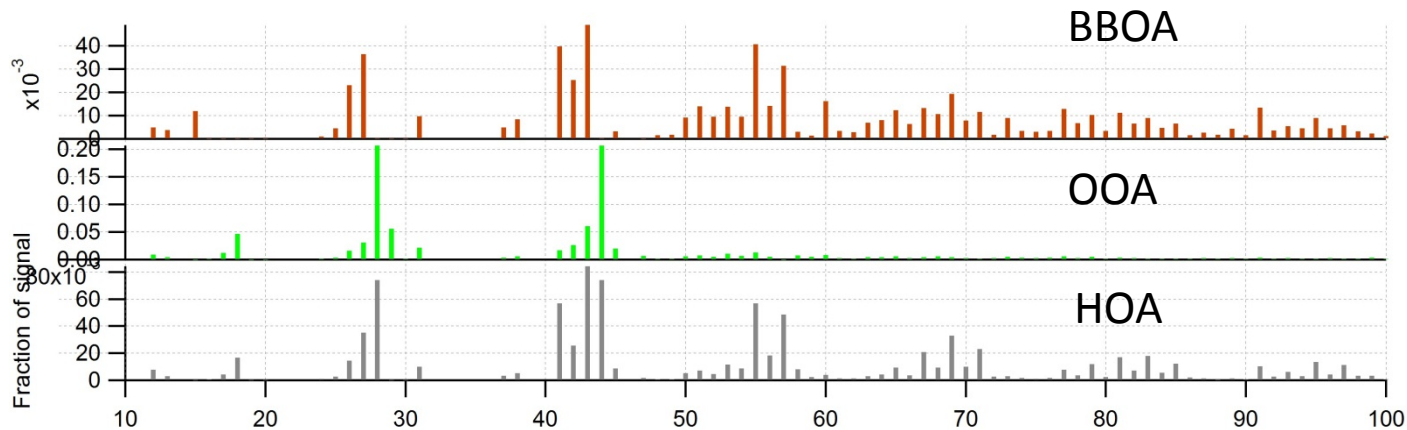
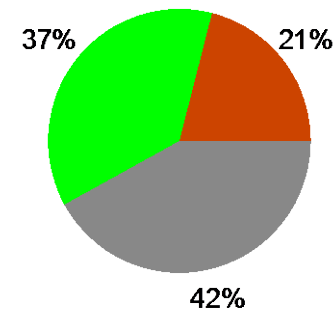
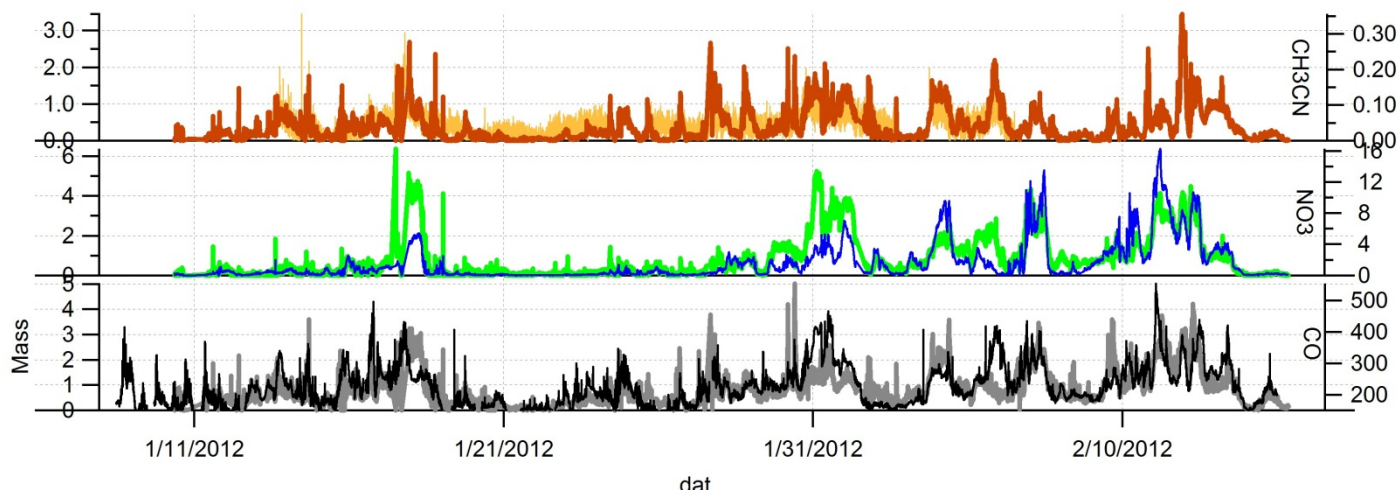


Deconvolution of organics spectra

Positive Matrix Factorization (PMF) (Lanz et al., 2007; Ulbrich et al., 2009)



UMR three factor solution

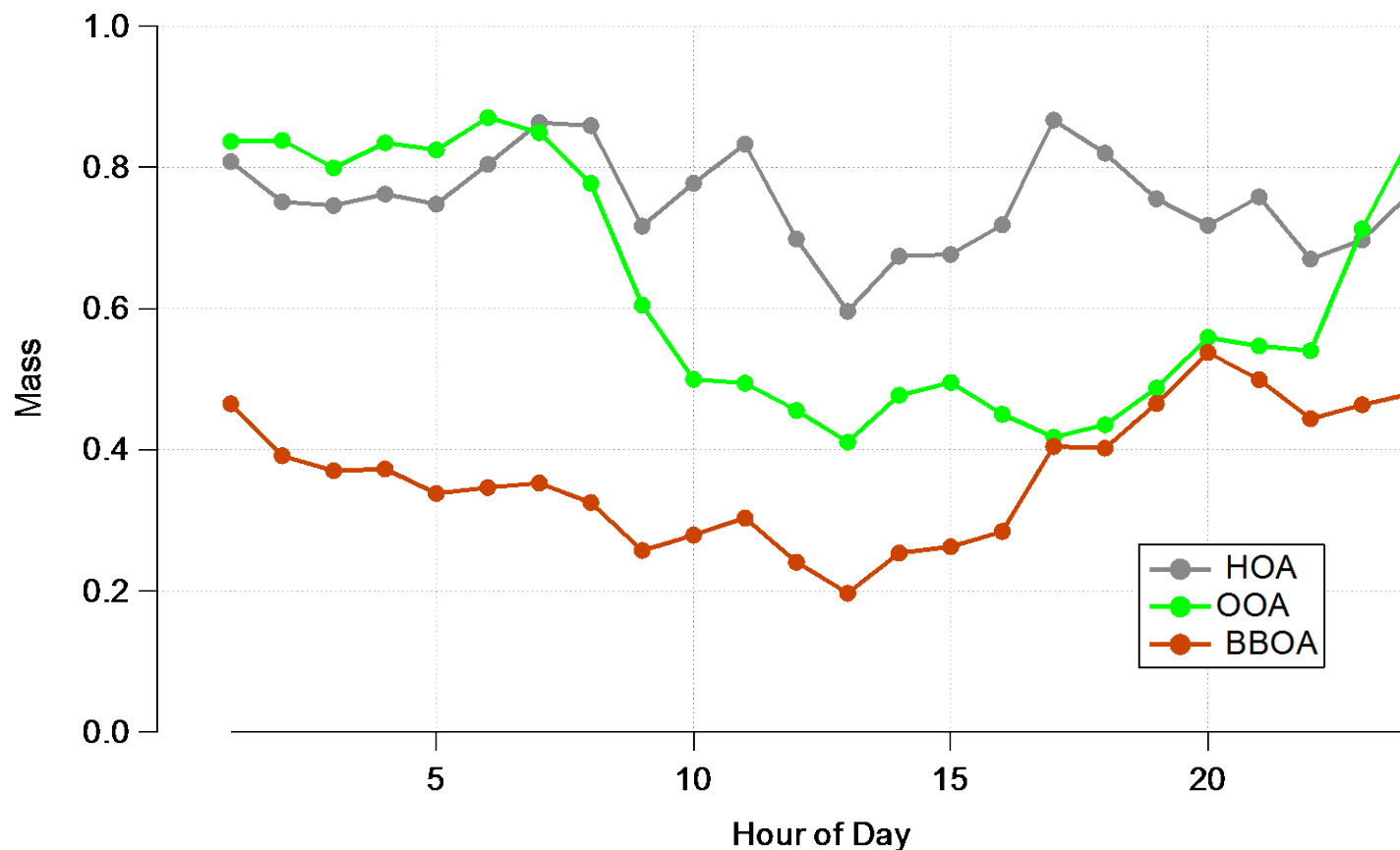


BBOA: fresh OA, correlates with CH₃CN

OOA: correlates better with nitrate

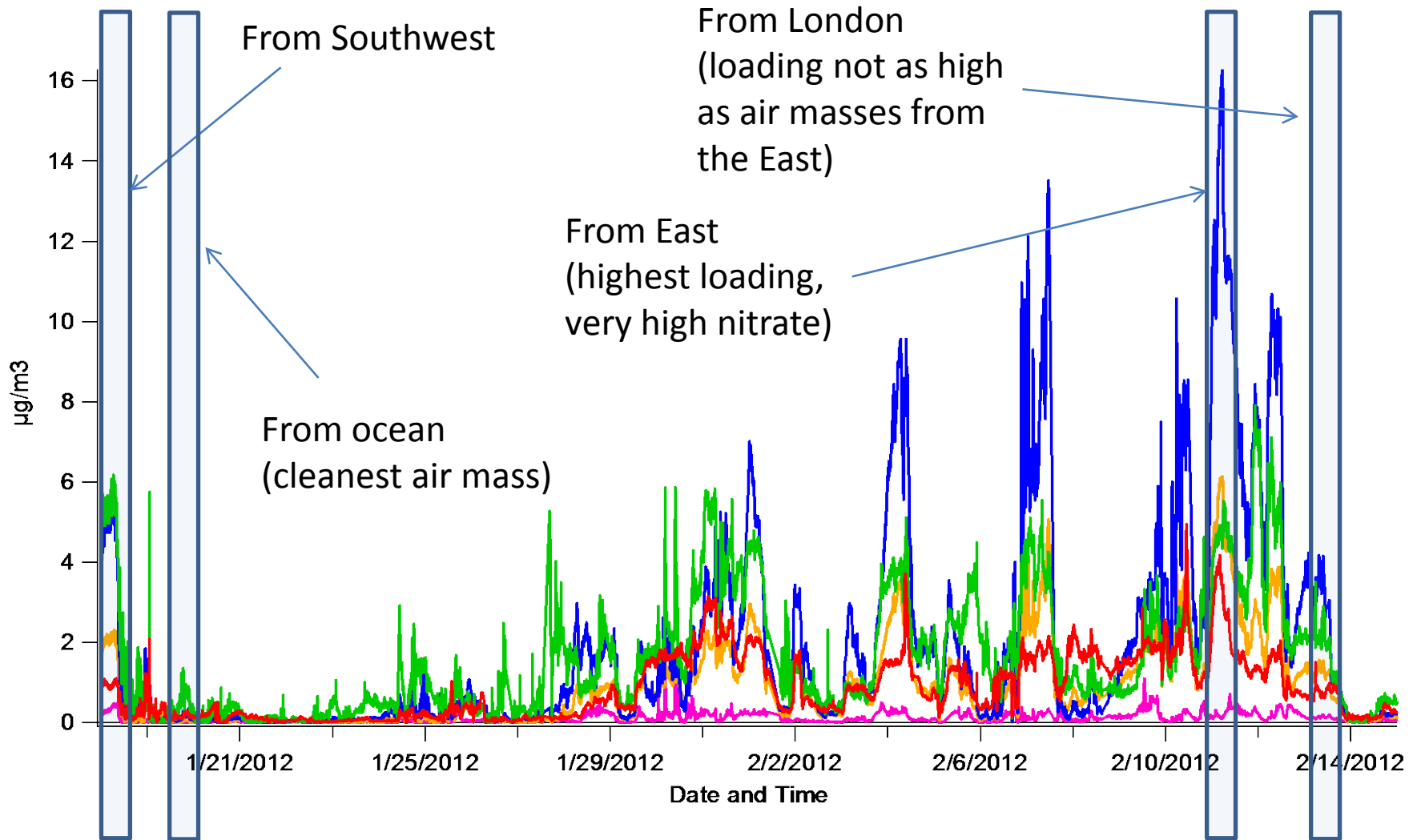
HOA: correlates with CO

Diurnal Cycle

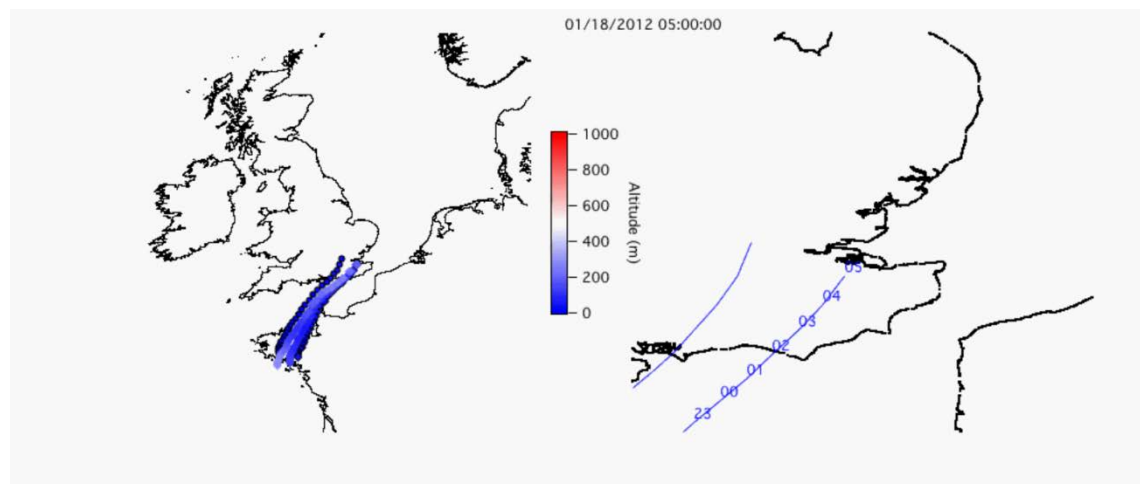


OOA diurnal cycle: similar to nitrate → fresh, semi-volatile OA
BBOA: increases in the evenings (wood/trash burning in the area)

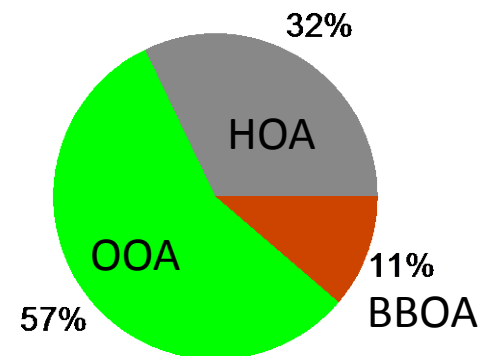
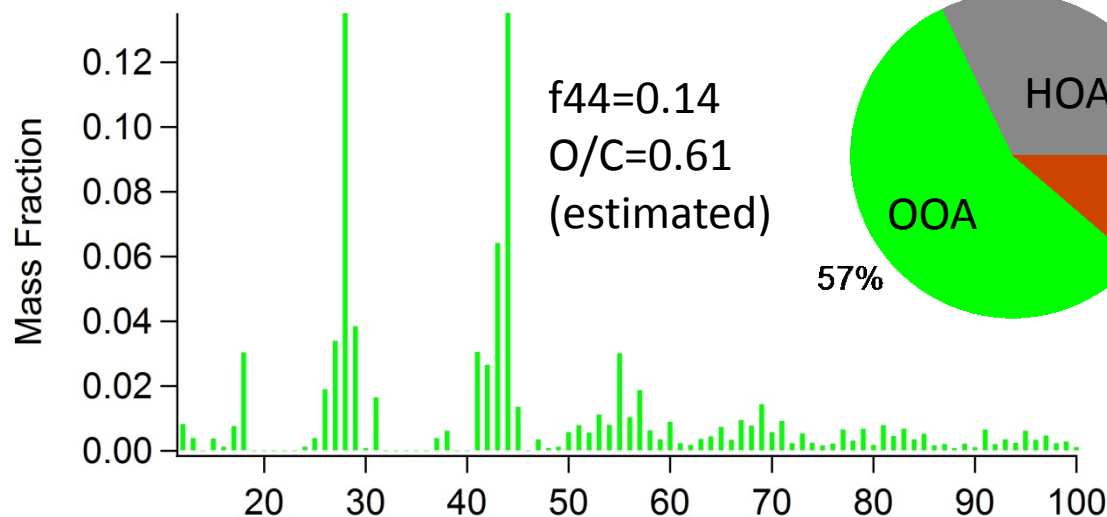
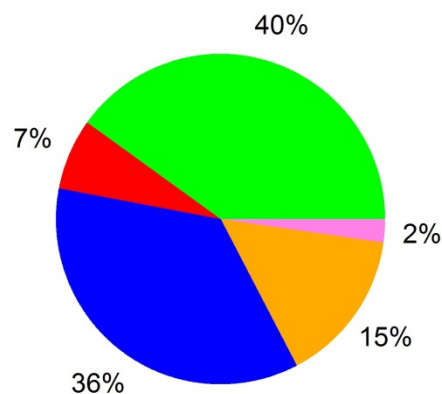
Different air masses



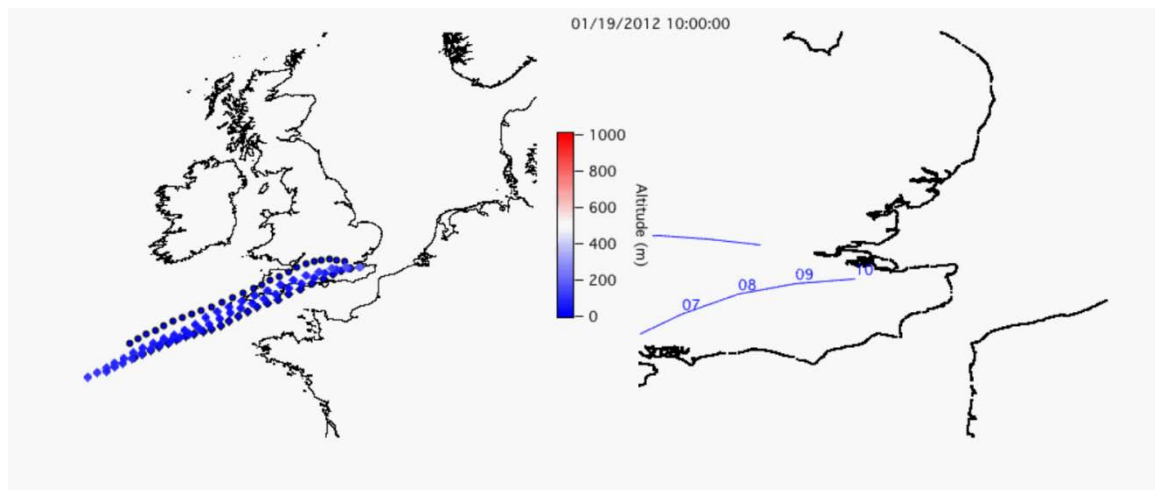
Air mass from Southwest (1/18/12 at 05:00)



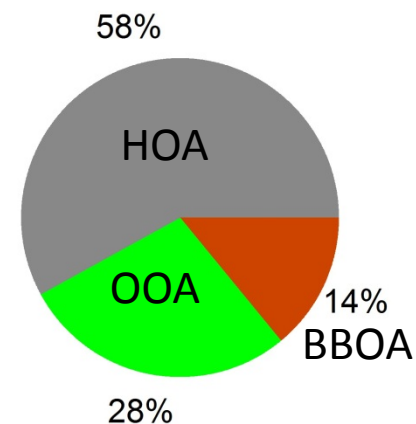
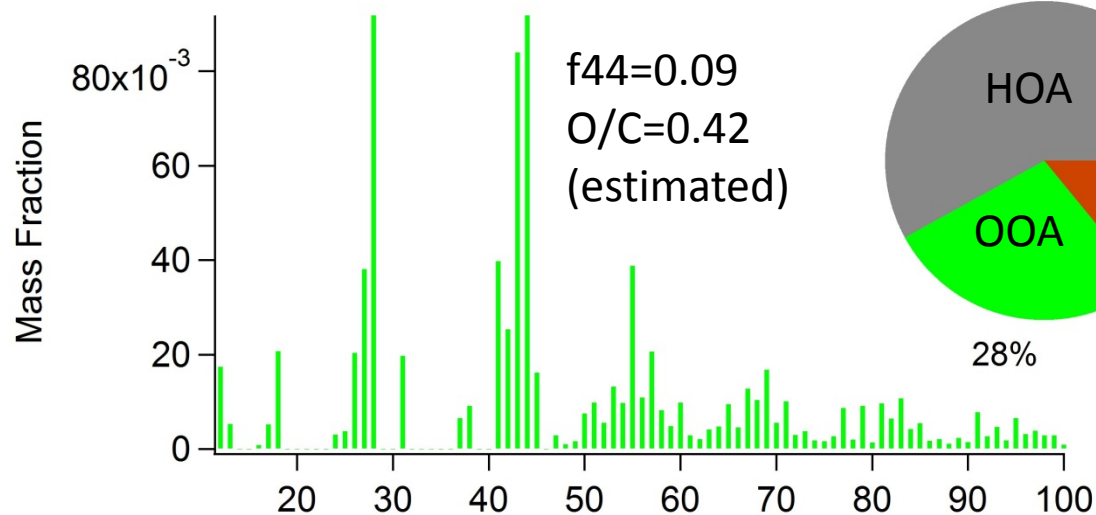
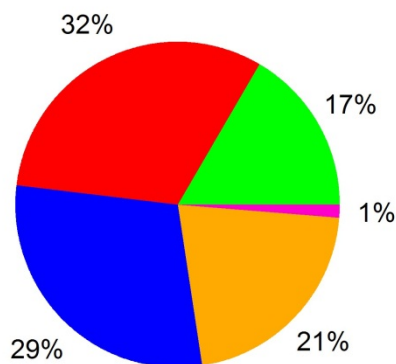
- Similar amount of organics and nitrate
- Organics:
 - Overall mildly oxidized
 - Dominated by OOA



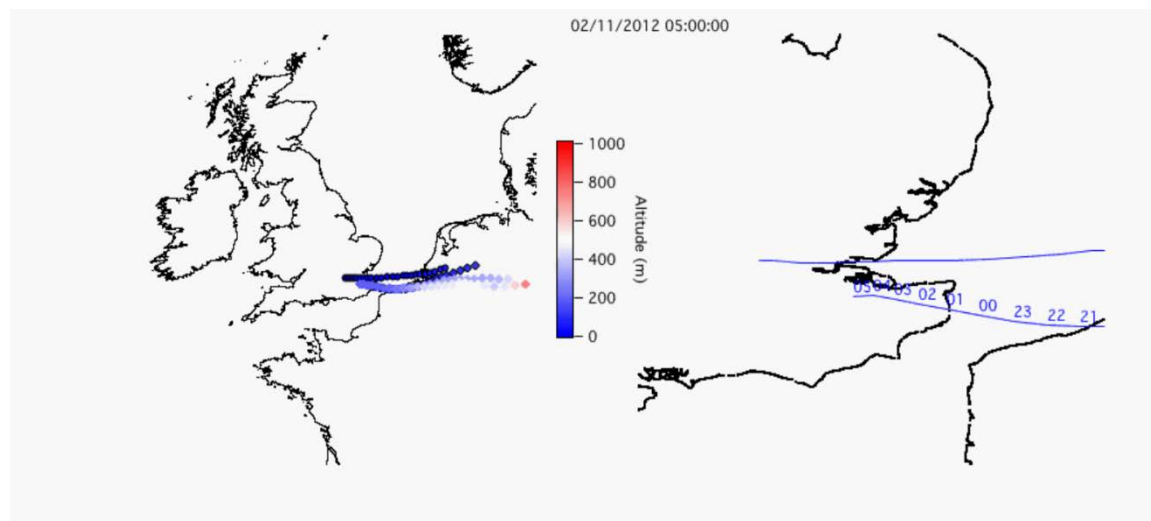
Air mass from ocean (1/19/12 @ 22:00)



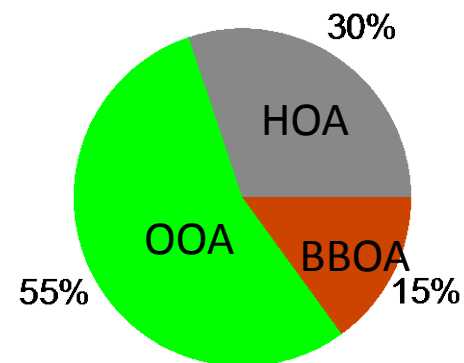
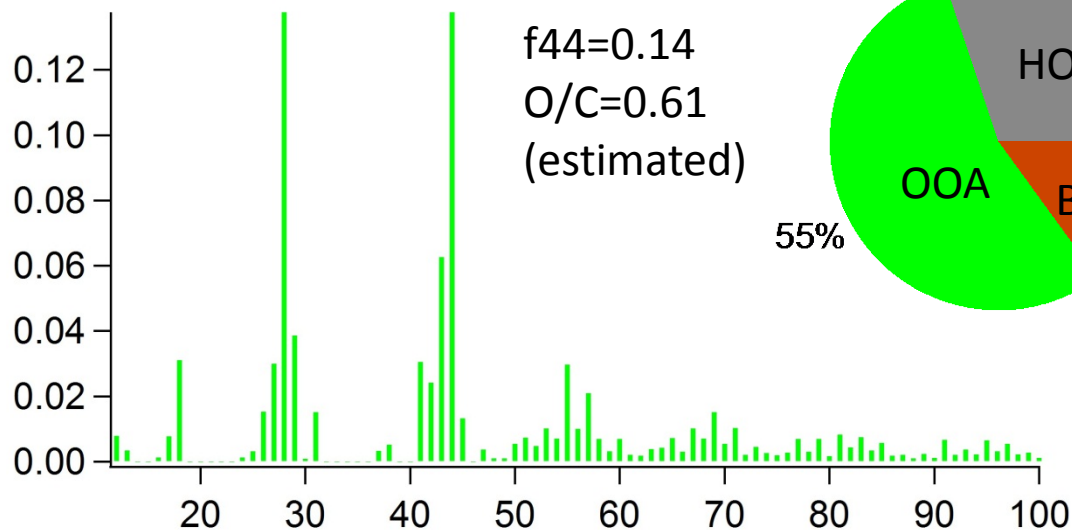
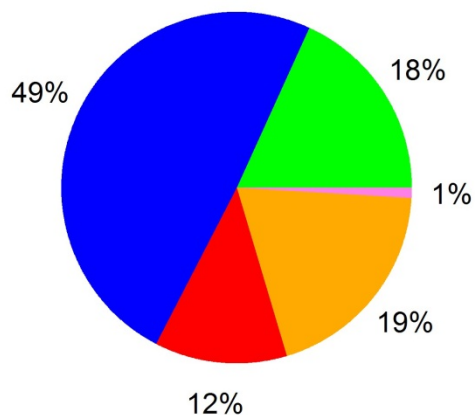
- Larger amount of sulfate compared to other air masses
- Organics:
 - Dominated by HOA
 - Local traffic sources from the nearby highway?



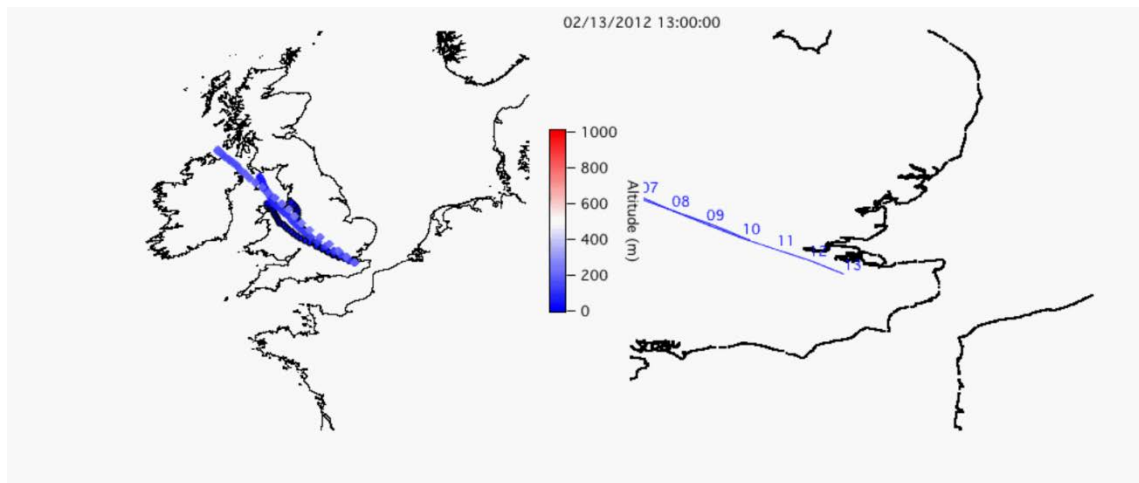
Air Mass from East (2/11/12 at 05:00)



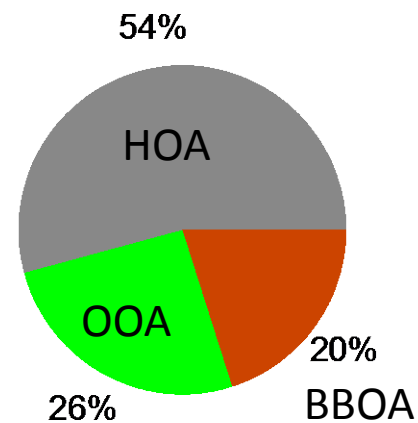
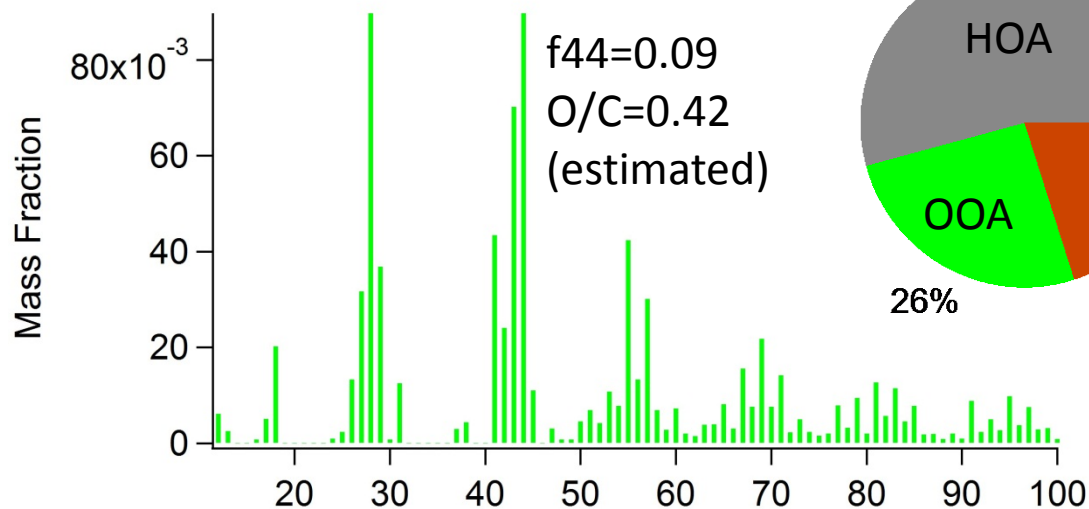
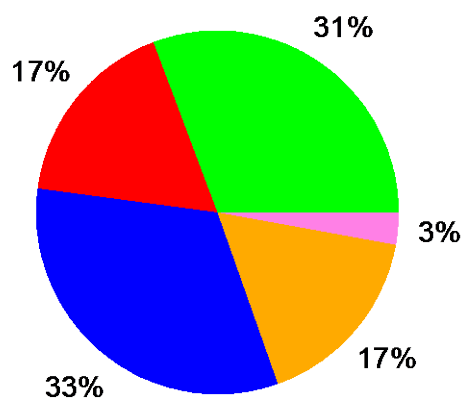
- Highest loading, dominated by nitrate
- Organics:
 - Similar degree of oxidation compared to air masses from the SW
 - Dominated by OOA



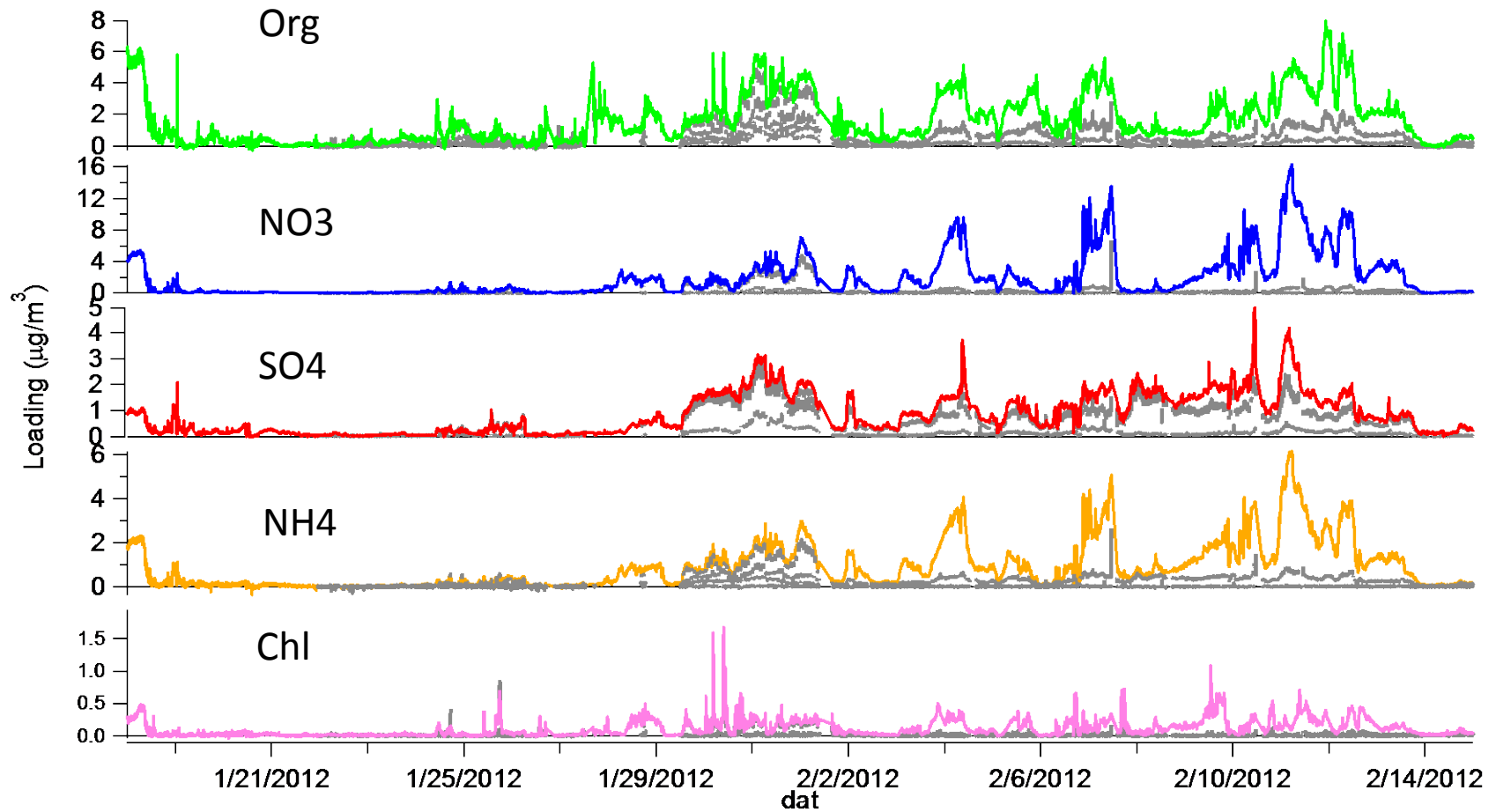
Air Mass from London (2/13/12 at 13:00)



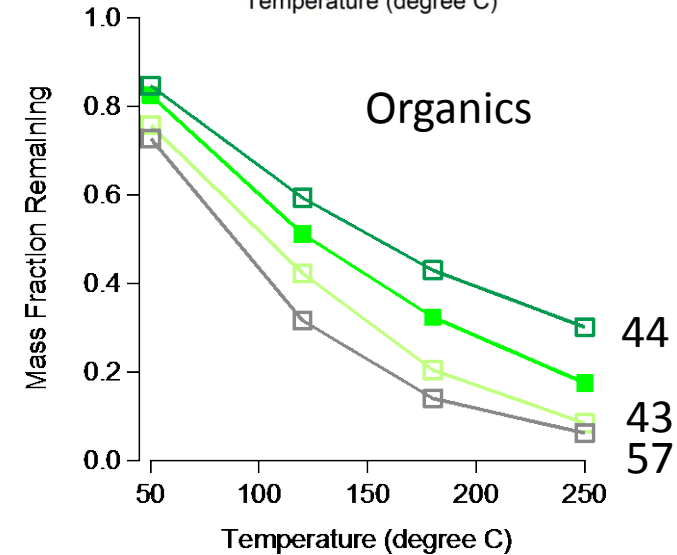
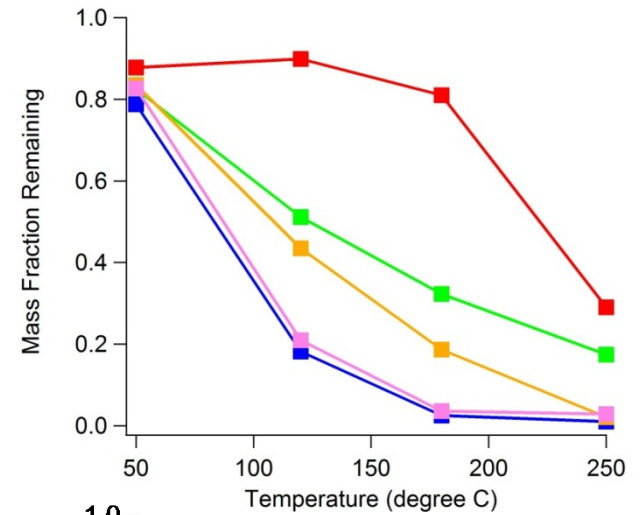
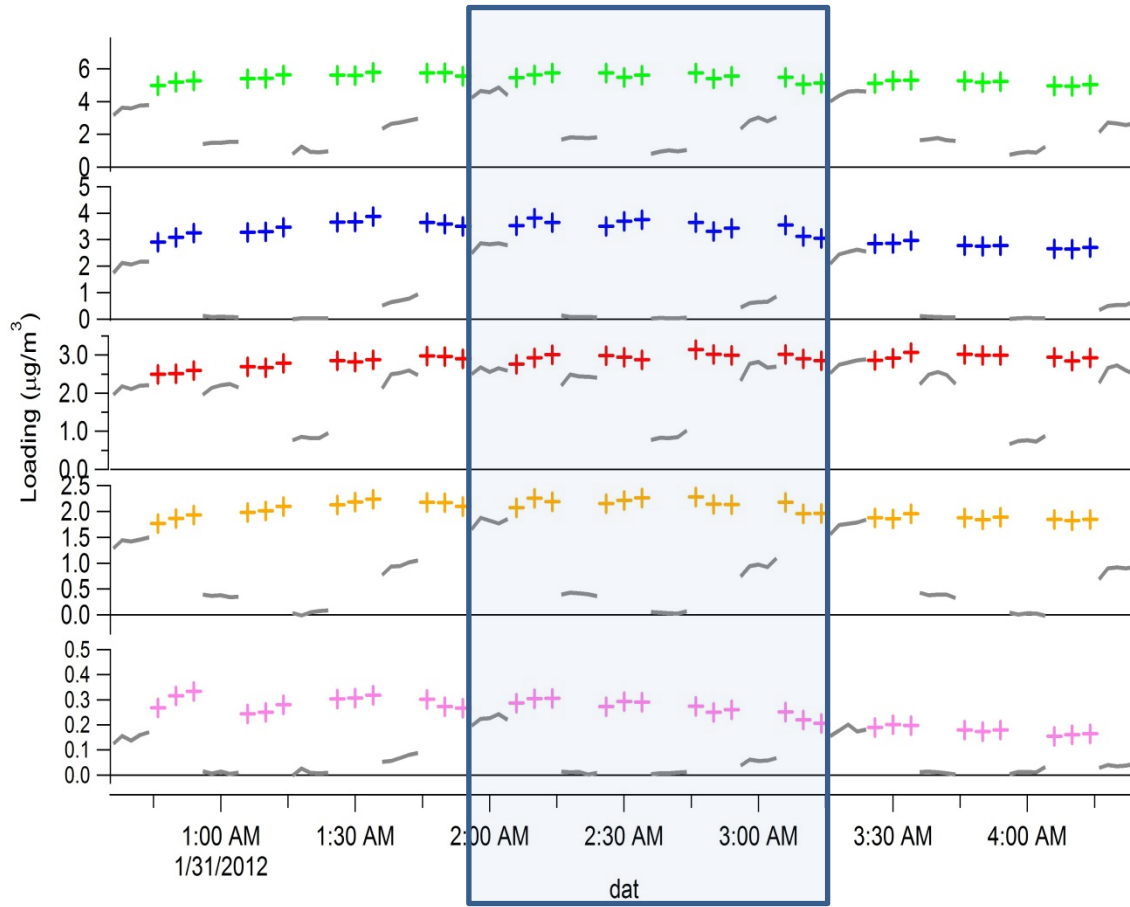
- Similar composition as the air masses from the SW
- Organics:
 - Not very oxidized
 - Dominated by HOA



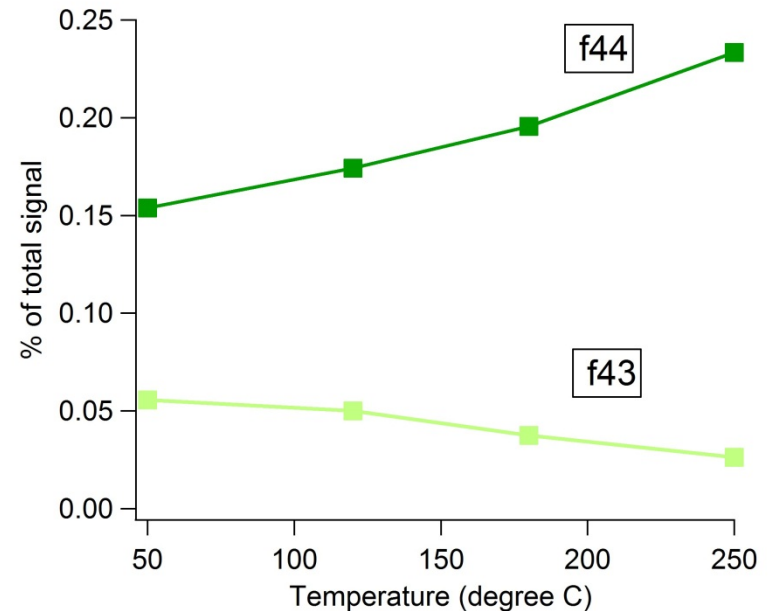
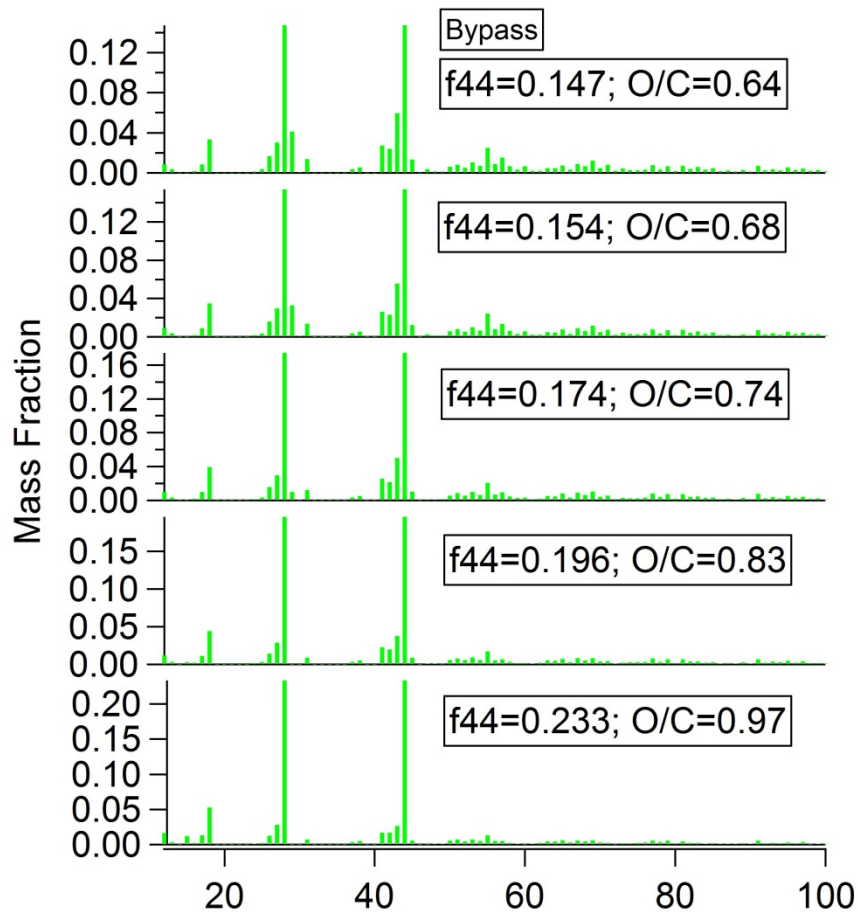
Bypass vs. denuded data



Temperature cycle (°C): 50/180/250/120



Changes in MS with temperature



- f_{44} increases (i.e., higher O/C) with TD temperature
- f_{43} decreases with TD temperature
- Evaporation of semi-volatile compounds, with a temperature of 250 °C, the compounds remaining has an O/C of ~ 1

Summary and Outlook

Summary

- PMF resolved three factors: HOA, OOA, BBOA
- Cleanest air mass comes from the ocean
- Air mass from London: organics loadings not very high ($\sim 1 \mu\text{g}/\text{m}^3$), O/C ~ 0.4
- Air mass from the East : characterized by high loadings, especially high nitrate
- Mass spectrum of remaining materials appears to be more oxidized with increasing TD temperature

Future Analysis

- High resolution analysis
- Thermal denuder data
- Comparison with SP-AMS
- Comparison with other measurements at the Detling site as well as other sites (especially London site)

QUESTIONS?

