Investigating Wintertime Sources of Organic Aerosols in Cape Cod, Massachusetts

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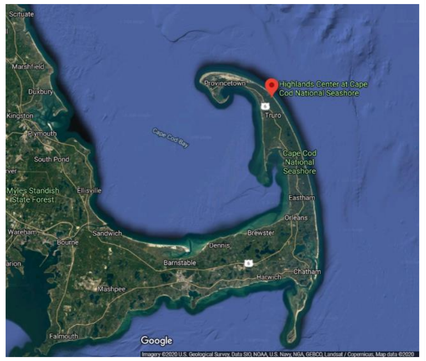
Introduction

- Aerosol sources and chemical processes exhibit seasonal differences as a result of variations in emissions and photochemistry.
- Filed studies have largely focused on understanding summertime conditions leaving winter understudied.
- Aerosol composition was measured with the Aerosol Mass Spectrometer (AMS) measurements during the Two-Column Aerosol Project (TCAP)
- Organic aerosol (OA) is a major component of aerosol observed in winter months
  - Primary organic aerosol (POA) is directly emitted into the atmosphere (biomass burning
  - Secondary organic aerosol (SOA) is the result of oxidation of species in the atmosphere.

Background

- We focus on wintertime measurements taken during the TCAP campaign at the ARM Mobile Facility (AMF) from February 4, 2013 to March 6, 2013 in Cape Cod, Massachusetts.
- This observation site is unique due to Cape Cod's coastal location near urban areas.
- The AMF was located at the Highlands Center at Cape Cod, Massachusetts.



Mass Spectra and PMF Results

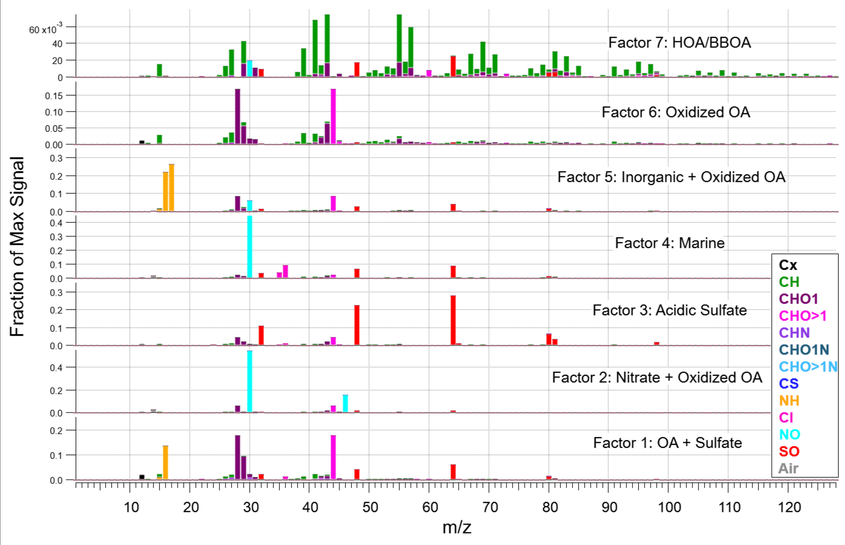


Figure 2: Positive Matrix Factorization[1] (PMF) was applied to the mass spectra of the AMS data to identify different factors that represent the composition of these aerosols.

- We combined organic and inorganic aerosol mass spectra to identify seven factors.

Contribution of PMF Factors to Aerosols

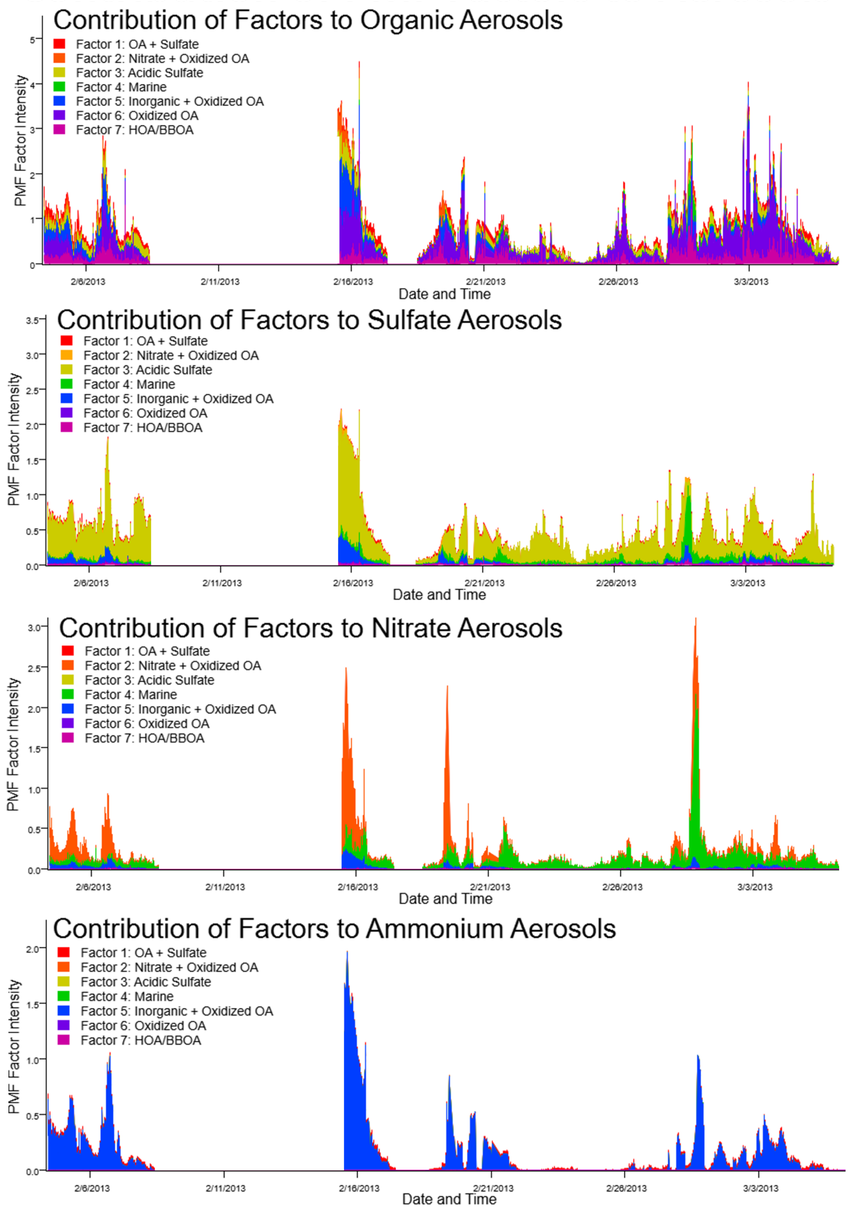


Figure 3 (above): The contribution of each factor to the organic, sulfate, nitrate, and ammonium components of the aerosols measured during the campaign.

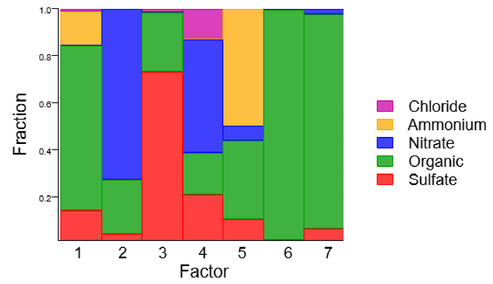


Figure 4 (right): Distribution of chloride, ammonium, nitrate, organics, and sulfate among the PMF factor individual fragments.

Potential Source Contribution

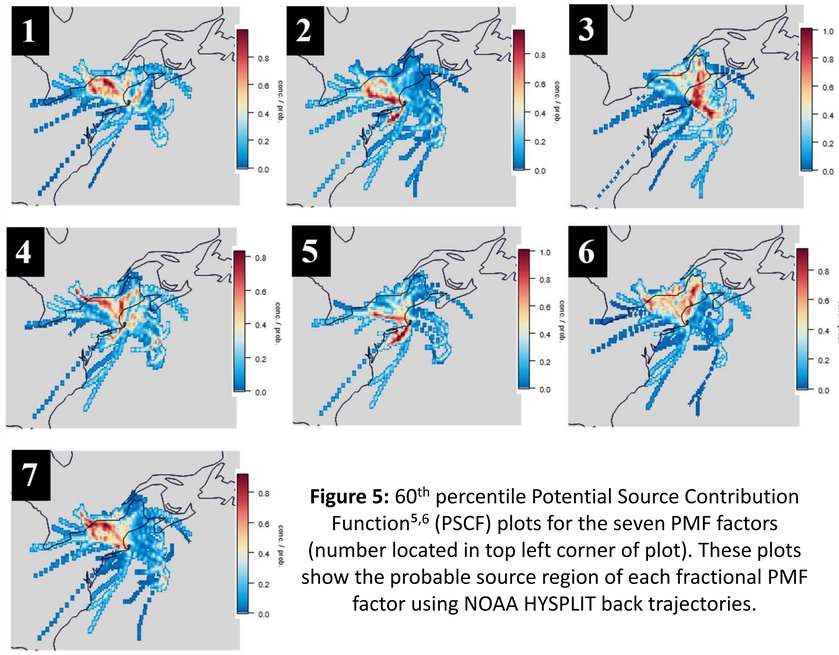


Figure 5: 60th percentile Potential Source Contribution Function[5,6] (PSCF) plots for the seven PMF factors (number located in top left corner of plot). These plots show the probable source region of each fractional PMF factor using NOAA HYSPLIT back trajectories.

Conclusions

- We see that wind direction is a poor indicator of aerosol sources in this region due to the nearby mixing of air from marine and anthropogenic sources.
- The notable presence of oxidized OA combined with the HYSPLIT back trajectories suggest that these aerosols have aged over time and are not freshly emitted primary aerosols from anthropogenic or marine sources.
- The aerosol composition in Cape Cod is highly influenced by both nearby continental and marine air masses.

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