



Sources of PM_{2.5} Organic Carbon in the Midwest

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Overview

- What do we really need to support policy
- OC and EC measurements for policy
- How can organic speciation measurements be used to support policy
- How can organic speciation measurements be implemented for policy
 - Sampling
 - Chemical Analysis
 - Data Analysis

What do we need to support policy

- Measure accurately the concentrations of OC and EC
- Need to be able to quantify the “nominal” source contributions of carbonaceous aerosols
 - Annual Average Standard
- Need to be able to identify major changes in source impacts that lead to excursions
 - 24 hour Standard
- Need to be able to assess if sources are local or result from long range transport
 - Where to implement controls

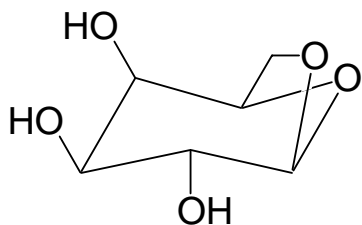
Receptor Modeling Approach

- Utilize “features” or “characteristics” of the pollutants to identify and quantify source contributions
 - Forensic analysis
- Two major approach
 - Factor Analysis
 - Uses temporal changes in particulate matter concentrations to identify “factors,” which are related to sources
 - Requires large data sets
 - Chemical Mass Balance
 - Determine the source “fingerprints” that can re-create the composition of particulate matter measured in the atmosphere
 - Requires measurement of the detailed feature of particulate matter
- Again, agreement between these two approaches would give a high level of confidence in the results

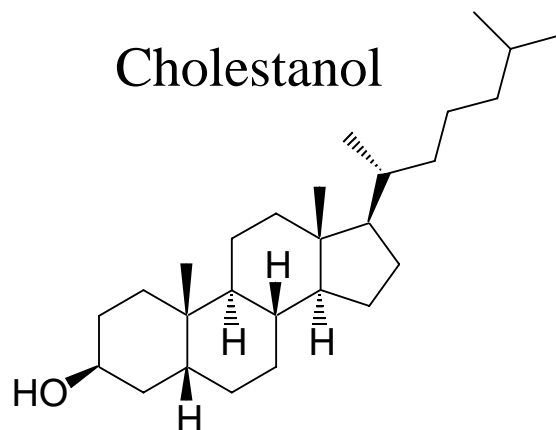
Recent Advances

- Semi-continuous (hourly) instruments to measure bulk composition of particulate matter - 5 years
 - Trace metals
 - Organic and Elemental Carbon
 - Water Soluble Ions
- More specific chemical analysis techniques – 15 years
 - Speciation of organic compounds in particulate matter
 - Molecular Markers
 - Gas Chromatography Mass Spectrometry (GCMS)
 - Detailed speciation of trace metals
 - Inductively Coupled Mass Spectrometry (ICPMS)
 - Isotope analysis
- Creates new opportunities for receptor based models

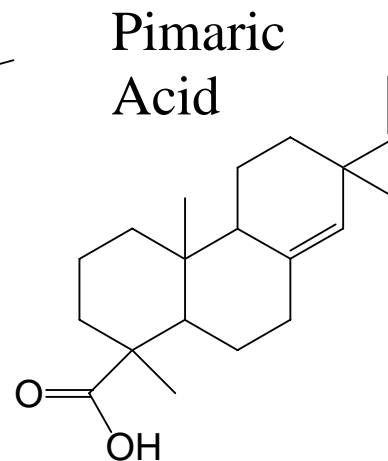
Examples of Molecular Markers



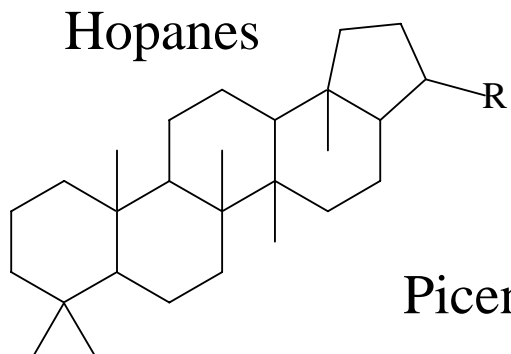
Levoglucosan



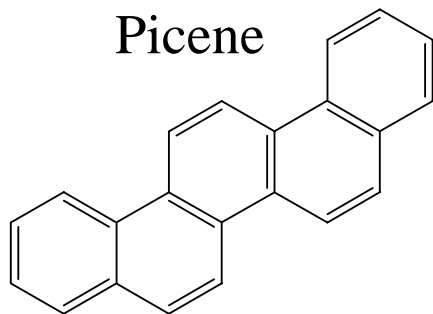
Cholesterol



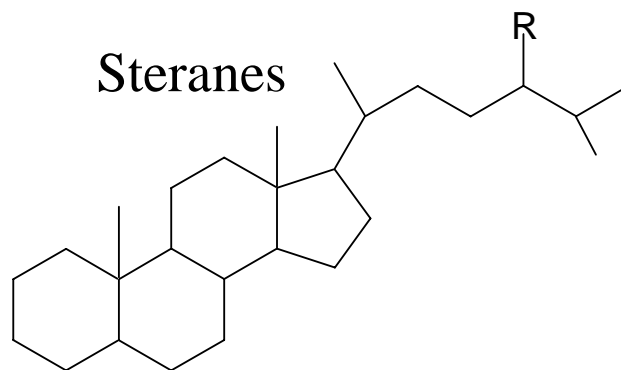
Pimaric Acid



Hopanes



Picene



Steranes

Relevant Sources

■ Profiles in the literature

- Internal Combustion Engines
 - Gasoline-Powered Vehicles
 - Diesel Trucks
 - Smoking Vehicles
- Biomass Burning
 - Residential
 - Open Burn
- Food Cooking Operations
- Resuspended Road Dust and Soil Debris
- Vegetative Detritus

■ Profiles in progress

- Point Sources – site dependent
- Secondary Organic Aerosol – biogenic and anthropogenic tracers are being developed

Big Picture

- CMB and PMF tools provide significant insight in OC sources
 - Inherent biases and assumption
 - CMB is limited by source profile literature
- Policy Perspective
 - Weight of evidence
 - Cautionary Principle
- Scientific Perspective
 - The necessary next steps are very clear
 - Limited by resources

Current organic speciation studies at ECT

- St. Louis
 - PMF and CMB of OC using organic molecular markers
 - PMF of EC using select organic molecular markers and trace elements
- Urban Midwest
 - Characterization of urban organic aerosol
 - CMB of OC using organic molecular markers
 - PMF of OC using organic molecular markers + newly developed organic tracers for SOA
- Sensitivity testing of CMB for biomass burning profiles
 - Determine uncertainty of biomass burning contribution to OC
- Water-soluble organic carbon (WSOC) characterization
 - Develop method to characterize the origins of WSOC
 - Characterize trends in WSOC in Mexico City