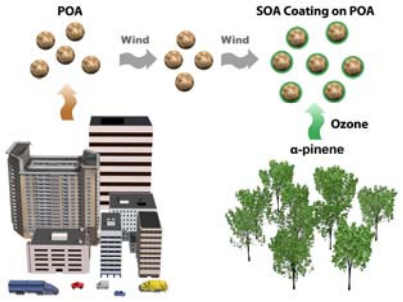
William R. Wiley
EMSL In Brief
Environmental Molecular Sciences Laboratory

Remodeling Atmospheric Organic Aerosols



SOAs may condense as a separate phase on POAs, possibly as a coating.

Scientists need to rethink the way they model atmospheric organic aerosols and their impact on global and regional climate change, given the recent findings of Environmental Molecular Sciences Laboratory (EMSL) users from the National Center for Atmospheric Research, University of Washington, and Pacific Northwest National Laboratory (PNNL). This team, led by Rahul Zaveri of PNNL's Atmospheric Science and Global Change Division, found a discrepancy in the semi-empirical approach commonly used in global models to simulate organic aerosols.

Aerosols are microscopic solid particles or liquid droplets dispersed in the atmosphere. They affect Earth's climate by influencing cloud formation and by absorbing or reflecting the sun's energy. A large fraction of aerosols are organic (carbon-containing), and they occur in two forms. Primary organic aerosols (POA) are directly emitted into the atmosphere, such as diesel exhaust. Secondary organic aerosols (SOA) are formed from gas-to-particle conversion of trace amounts of atmospheric vapors.

The semi-empirical modeling approach makes some assumptions about the complex chemistry of SOA formation. Consider the α-pinene example system: α-pinene, a gaseous organic compound emitted by trees, reacts with ozone and other oxidants in the atmosphere, producing vapors. The semi-empirical model assumes these vapors condense onto POA particles to form SOA, forming a single, well-mixed SOA+POA phase. This assumption significantly enhances the modeled SOA yields.

Zaveri and his colleagues investigated this assumption by measuring SOA yields from ozonolysis of α-pinene in a smog chamber with and without the POA substitute, lubricating oil aerosol. The researchers quantified SOA yields, using EMSL tools, including an Aerodyne aerosol mass spectrometer, a single-particle mass spectrometer, and a proton transfer reaction mass spectrometer. Their results showed that SOA formation is insensitive to hydrophobic POA and suggest that SOA forms a separate phase on the POA. If these results apply to other systems, then global simulations using the semi-empirical model modified per these findings would predict significantly less SOA than previously estimated, worsening the existing large discrepancies between the observed and predicted organic aerosol masses around the world.

Further research is necessary to understand the chemistry and mechanism of SOA formation. In the future, the team will mimic atmospherically relevant conditions in the smog chamber and compare the findings to real-world samples. The team's work appeared in the October issue of *Geophysical Research Letters*. Their research was funded by PNNL's Laboratory Directed Research and Development program and EMSL.

For more information, contact Communications Manager Mary Ann Showalter (509-371-6017).