A Dance of Aerosols

Research Highlight

In the complex molecular mixer that is the atmosphere, some molecules dance with others and some are wallflowers, according to DOE scientists at Pacific Northwest National Laboratory. The scientists focused on how a specific vapor, responsible for the aromatic scent of fir trees, forms carbon-containing particles that mix with certain carbon-containing acids in the atmosphere. The results showed that organic aerosols from biogenic volatile organic compounds will not mix with all oxidized organic aerosols in the atmosphere, as assumed in existing climate models. Rather, they will only mix with certain, highly oxidized organic aerosols. This finding highlights the need to improve how organic aerosols are currently represented in climate models.

Much of Earth's land is covered by plants and trees, representing a huge source of biogenic organic aerosols. The study measured how, in the atmosphere, these aerosols interact with and mix with other volatile or semi-volatile organic compounds, the carbon-centric chemicals that evaporate from both natural and human-made sources. Existing climate models assumed that these organic compounds will mix equally with those already in the atmosphere.

Song and fellow researchers published research in 2007 that addressed assumptions in the ability of diesel exhaust organic aerosols to mix with organic aerosols from tree evaporate. This new study, published in the journal Environmental Science & Technology, furthered this research by examining the changes in physical properties of these aerosols due to aging, or oxidation, provoked by ozone or other oxidizing agents.

Researchers used PNNL's Environmental Chamber to simulate and study the life cycle of these aerosols. The team injected citric, adipic, and fulvic acid into the chamber as seed aerosols, and then introduced a secondary organic aerosol from #-pinene, a carbon-containing compound derived from pine trees.

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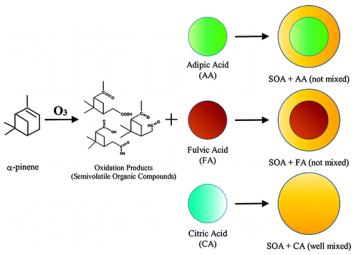
To arrive at regional and global climate projections, scientists must consider thousands of complex variables to simulate climate processes. One of those complex interactions is aerosols, the microscopic particles of dust, soot, and chemicals dispersed in the atmosphere that scatter or absorb sunlight and act as seeds for cloud formation. A large amount of aerosols are organic, or carbon-containing, and exist in two forms based on their origin: primary and secondary. This study focuses on secondary organic aerosols, formed in the atmosphere through interactions that are much more difficult to represent in models. New research from PNNL further defines the role of SOA so that scientists can more accurately depict their effect on the climate.



The injection of alpha-pinene, a secondary organic aerosol, forms secondary organic aerosols condensed on atmospheric relevant organic acids.

Reference(s)

Song C, RA Zaveri, JE Shilling, ML Alexander, and M Newburn. 2011. "Effect of hydrophilic organic seed aerosols on secondary organic aerosol formation from

ozonolysis of #-pinene." Environmental Science & Technology, 45(17), doi:10.1021/es201225c.

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Working Group(s)
Aerosol Life Cycle