Effects of Varying Temperature on SOA Yields and Partitioning from North Dakota Crop Emissions

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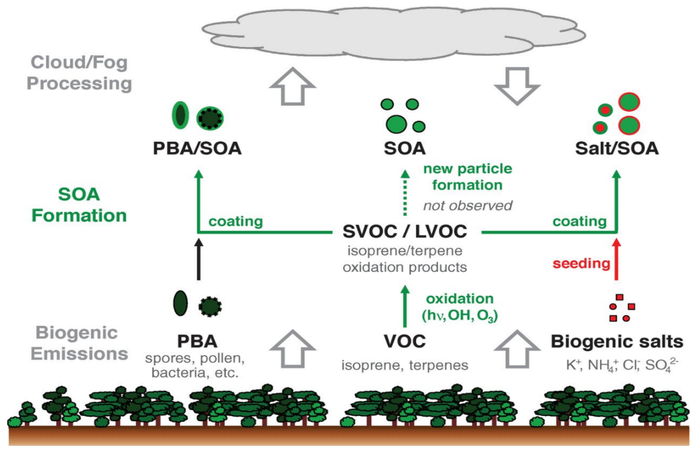
Research Question

What are the effects of varying temperature on secondary organic aerosol (SOA) yields involving the reactions of β-farnesene and α-humulene with ozone?

Abstract

This laboratory study focuses on the effects of varying temperature on SOA yields involving the reactions of beta-farnesene and alpha-humulene with ozone. Experiments will be conducted in the UND aerosol chamber where these gas-phase compounds are able to react, leading to the formation of semivolatile products that partition to the aerosol phase. The chamber is equipped with a scanning mobility particle sizer, ozone generator and analyzer, and an air conditioning unit to vary the temperature inside the chamber. A GC-FID will be used to monitor the crop emission concentration throughout the experiment. The SOA yield will be calculated by measuring the amount of organic material formed and the amount of the crop emission that has reacted. Particle number and mass distributions will be measured throughout the experiment. Concentration variations of the crop emission as the temperature changes will also be measured.

Background

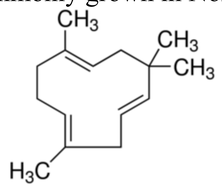


Pöhlker, C., et al.: Biogenic Potassium Salt Particles as Seeds for Secondary Organic Aerosol in the Amazon. *Science*. 337(6098), 1075-1078, 2012.

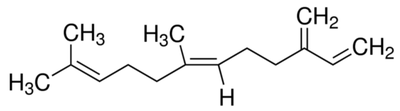
With agricultural land use accounting for much of the land use in North Dakota, it is important to understand biogenic emissions specifically from agricultural crops.

Crop Emissions

Crop emissions to be studied are β-farnesene and α-humulene. These compounds are sesquiterpenes ($C_{15}H_{24}$), and are isomers of one another. From the literature, β-farnesene is emitted from potatoes (Agelopoulous et al. 2000) and corn (Gouinguené and Turlings 2002, Ruther and Kleier 2005) and α-humulene is emitted from sunflowers (Schuh et al. 1997). These crops are commonly grown in North Dakota.

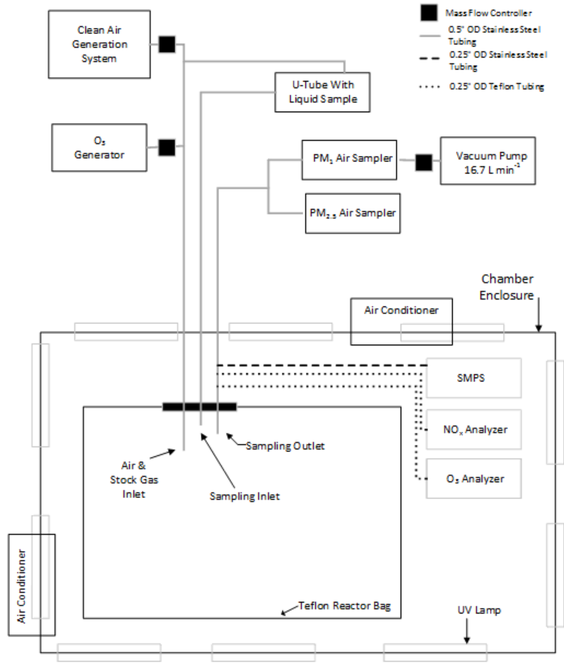


α-humulene



β-farnesene

Laboratory Chamber System

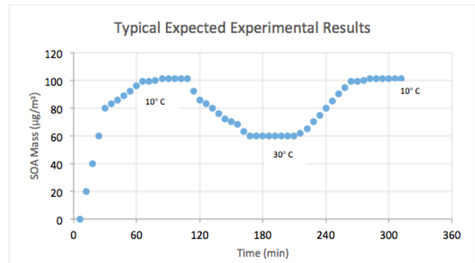


The aerosol chamber at UND consists of a 10 m^3 Teflon reactor bag. The chamber encloses instrumentation that can monitor and measure gas phase and particulate concentrations and particle growth. The chamber includes an air sampling line for off-line sample analysis.

Experimental Setup

The selected crop emission will be injected into the chamber as a gas. The gas will be able to react and form new particles or grow existing particles. The compounds are in liquid form at room temperature. They will be placed into a U-shaped section of tubing, have clean air flow through it and into the chamber. The tubing will be heated to make sure the liquid evaporates. The scanning mobility particle sizer (SMPS) will monitor particle growth. Ozone will also be flowed into the reactor at a specific concentration.

The temperature of the chamber will be varied with the use of an air conditioner and will be monitored throughout the experiment. The use of a GC-FID will help measure how much of the compound is injected into the chamber and how the concentration of the compound changes over time as it reacts.



Typical results will include the mass concentration and how it will vary over time with changing temperature. Results will also include the concentration of the emission and how it changes throughout the experiment.

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- Humphrey Chukwuto, Carlos Bucaram, Jack Gara, UND Chemical Engineering Department
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