The Effect of Nitric Acid on Cloud Processing of Glyoxal
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Introduction
Volatile Organic Compounds (VOCs) such as isoprene are emitted into the atmosphere and oxidized in the gas phase to form water-soluble compounds (e.g., glyoxal). These compounds partition into cloud droplets, become further oxidized (e.g., by \(\cdot OH\)) and form low volatility products such as organic acids and oligomers. Low volatility products partition into the particle phase upon cloud droplet evaporation, forming secondary organic aerosol (SOA). Nitric acid in the atmosphere may play a role in SOA production through cloud processing.

Motivation
• SOA contributes to particulate matter (PM), which is linked to human health issues such as asthma, heart disease, and lung cancer.
• PM scatters and absorbs light, affecting the Earth’s albedo, visibility, and climate.
• Current models under-predict organic PM in the atmosphere.
• There is increasing evidence that SOA is formed through cloud processing\textsuperscript{3}.
• Cloud processing is a potential source of SOA, and will contribute to terrestrial and open-ocean deposition of organic compounds, including organic nitrogen compounds.

Objectives
1) Conduct aqueous photochemical experiments with glyoxal and \(-OH + HNO_3\) to simulate cloud processing
2) Identify unexpected products formed (e.g., organic acids, high molecular weight compounds, organonitrates)
3) Determine the effects of HNO_3 on cloud processing of glyoxal

Results: ESI-Mass Spectrometry-Negative Mode

![Graph showing results of ESI-Mass Spectrometry-Negative Mode](image)

"Similar formation times for expected products
Even-numbered \(m/z\) suggest presence of nitrogen compound
Unexpected products form in I and II, in addition to those unique to II
Unexpected products detected in experiment I not in II (not shown)
Expected products not formed in control experiments (not shown)"

Results: Ion Chromatography-Negative Mode

![Graph showing results of Ion Chromatography-Negative Mode](image)

"Concentration dynamics of organic products (oxalic, succinic, and malonic acid) exhibited no change with addition of nitric acid
Nitric acid concentration decreased <1%"

Conclusions
• Aqueous reactions of glyoxal and \(-OH (\pm HNO_3)\) form low volatility products that will contribute to SOA.
• No changes seen in concentration dynamics of most products with the addition of nitric acid.
• Even-numbered \(m/z\) products found in experiment II may be organonitrates.
• Organonitrates formed from cloud processing will be a small fraction (<1%) of total nitrogen compounds.

Future Work
- Identify organic nitrogen products from experiments.
- Determine formation pathways for organonitrate production in cloud water.
- Expand kinetic and mechanistic data for air quality and climate models.

References

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