CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

S0619

Project Title

A Systemic Spectra Analysis of Organic Aerosols after Ozonolysis and Their Effects on Climate

Abstract

Objectives/Goals

With global warming taking the center stage, more and more research is being done on CO2 and greenhouse gases. However, another lesser known, but equally important contributor to global climate systems comes from aerosols, solid or liquid particles suspended in the air. White or clear aerosols, the most common type, scatter and reflect solar radiation, contributing to global cooling. Certain classes of aerosols, such as black and brown carbon produced by combustion processes, heavily absorb light leading to atmospheric warming.

One of the unresolved questions in aerosol science is to what extent white, non-absorbing aerosols can become colored and absorbing as a results of interactions with atmospheric oxidants.

Methods/Materials

Eight environmentally relevant and ozone-reactable compounds were chosen: most important were indole, imidazole, gallic acid, and 2, 4-DNP. Once chosen, the compound was absorbed onto a Teflon filter and placed inside an impactor. Here it was exposed to a constant flow of ozone. Each compound was tested twice, more if necessary.

After ozonolysis, the compound#s optical properties were analyzed with a UV Spectrometer. The absorption spectra were translated into universal terms with the Mass Absorption Coefficient (MAC), derived from Beer#s Law. MAC is wavelength dependent and considers concentration and cuvette length. Extraction efficiency was also measured to ensure there were no residual chemicals on the filter after the extractions.

Results

Gallic acid and imidazole both displayed large increases in the UV range and small changes in the visible region. 2, 4-DNP absorbed significantly less in the visible region. Indole increased 5,000 MAC in the visible region equating to a change from white to a deep green. The fact that indole absorbs so heavily in the visible regions is alarming because that means that it will absorb visible light, 50% of the Sun#s rays, contributing to global warming.

Conclusions/Discussion

This project confirmed the notion that compounds undergo changes upon exposure to ozone, altering their optical properties. Most alarming are the results from indole, which suggest that initially colorless compounds may become absorbing after atmospheric oxidation, trapping solar radiation and contributing to climate warming. This is an important observation of a new phenomenon that is currently not being considered by climate researchers.

Summary Statement

My experiment focuses on aerosols, their reactions with ozone and how these reactions affect global climate systems.

Help Received

Used laboratory equipment at UCI under the supervision of Professor Nizkorodov, Dian Romonosky for her help with editing and general guidance, Mom and Dad for their help with editing of paper