Determining Critical Open Science Questions Regarding Biosphere-Airplane Interactions

The southeastern United States has not warmed like other U.S. regions in response to global climate change. This anomaly may be related to aerosols derived from biogenic volatile organic compounds (BVOCs) and the resultant direct and indirect radiative effects. To understand the causal relationships that result in this trend, the scientific community must ask what sources and processes control the fate of biogenic compounds in anthropogenically influenced environments? What are the climate-relevant properties and air quality impacts?

Approximately 30 atmospheric scientists with experimental (field and laboratory) and modeling backgrounds met to discuss the most critical open science questions regarding biosphere-airplane interactions. An objective of the meeting was to formulate targeted science questions and broadly discuss the tools, approaches, and measurement needs to answer them.

For example, the degree to which anthropogenic pollution alters biogenic emissions, fluxes, and their fate remains poorly understood. Conventional wisdom regarding biogenic pollution has been that BVOCs are released to the atmosphere, primarily, inorganic, react in the atmosphere to increase ozone (O3) deactivating hydroxyl radical (OH). However, current models cannot adequately describe oxidant concentrations in biogenically dominated areas, and the oxidation pathways are still uncertain and being debated. Until recently, biogenic contributions to the atmospheric particulate matter (PM) burden were thought to be largely due to particle formation from plant volatiles with minor contribution from plant debris (e.g., cellulose, wax). Recently, isoprene has been shown to contribute to regional secondary organic aerosol (SOA), as has interactions between biogenic and anthropogenic emissions. Chemical tracers of BVOC contributions to SOA have been measured in a variety of environments, including the southeastern United States and the free troposphere. Yet adequate process level and regional level understandings of the coupled effects among BVOCs and the atmosphere’s radiation capacity and aerosol burden remain elusive.

Often, substantial losses in progress require collaborative and interdisciplinary approaches that rely on simultaneous colocated measurements, controlled laboratory simulations and physical models, and distributed models. The workshop participants propose that as a community, scientists studying biogeochemical interactions focus their varied talents within the next few years answering the following critical open science questions:

Regional and global models, as well as satellites, indicate that the southeastern United States is a good laboratory in which to address these critical research questions.

1. To what extent do anthropogenic influences affect biogenic SOA formation?
2. To what extent is there aerosol or cloud processing of BVOCs, their oxidation products, and related aerosols?
3. What is the impact of climate-relevant properties of biogenic aerosol (VOC of biogenic origin)?

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