5.011 Moving the full complexity of the ocean-atmosphere system into the laboratory for fundamental chemistry studies.

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Abstract:

The oceans cover nearly three-quarters of our planet, yet our understanding of their impact on Earth's climate remains poor. The ocean represents a significant source of sea spray particles that play a vital role in the climate system as they serve as the essential seeds upon which water condenses and ice forms to create clouds. Understanding the ocean-atmosphere-system is critical for understanding the influence of this large, natural source on our climate. This presentation will describe the unique approach developed by scientists in the Center for Aerosol Impacts on Chemistry of the Environment (CAICE) to study the real-world complexity of the ocean-atmosphere-cloud system in a laboratory setting. To control the chemical complexity of the system, phytoplankton blooms are generated, inducing a myriad of biological processes and interactions between phytoplankton, viruses, and microbes in seawater. When waves break, bubbles rupture at the surface of the ocean, launching microbes and other biological species--as well as particles comprised of salts and organic species--into the atmosphere. The primary objective of CAICE is to use this "ocean in the lab" approach to control and better understand how chemical complexity, morphology, and interfacial composition control the climate properties and reactivity of atmospheric aerosols. In this presentation, I will highlight how a combination of lab and field studies is being used to better understand the influence of the chemical complexity on the cloud forming ability of aerosols. Results from experimental measurements will be presented along with new theoretical methodologies for molecular-level and coarse-grained simulations to explore the complex, heterogeneous and dynamic aspects of aerosol particles. Findings will be presented from detailed interdisciplinary studies and how they are advancing our understanding of the impact of aerosols on clouds and climate.