Formation and Transformation of Sea Spray Aerosols: Insights from Laboratory Studies

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Abstract

Sea spray aerosol (SSA) represents a major source of aerosol particle populations and significantly impacts the Earth's radiation budget, cloud formation, and microphysics. It is thus crucial to investigate SSA formation and its atmospheric transformation. In our work, we used a plunging jet sea spray aerosol generator to produce submicron SSA particles that match the real marine environment. On this basis, we investigated the effects of different organics on SSA production efficiency, geometric mean diameter, and particle morphology. The results show that soluble organic matter can promote the production of SSA, while surface-active organic compounds can inhibit the production of SSA. In addition, the presence of surface-active organic compounds prefers to form an organic layer on the surface of SSA particles, which makes SSA show a core-shell structure. By combining Langmuir trough and infrared reflection and absorption spectroscopy, we investigated key chemical processes at the air-water interface. It was found that soluble organic pollutants can interact with the monolayer to achieve the enrichment of hydrophilic organics in the organic film of the aerosol. This interaction can facilitate its air-sea transport and transfer to inland and polar regions. It was also found that the incorporation of lipase would also lead to the expansion of the organic film, destroying its orderly arrangement at the interface. This expanding and disorder will promote the uptake of water, which in turn affects the reactivity and light scattering properties of SSAs. These findings help to explain atmospheric processes and changes in real SSAs observed in the field measurements.

Early Career Scientist

NO, I am not an early career scientist.

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