2.113 Air/sea interfacial photochemistry is a global source of organic vapors and aerosol particles .

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Abstract:

The most prominent example of a surfactant-enriched surface is probably the ocean, covering more than 70% of Earth. Studies have shown that this air/water interface is almost ubiquitously covered by a thin film of amphiphilic compounds, which are enriched there with respect to the bulk water. Such sea surface microlayers (SMLs) were found to have significant effects on marine biogeochemical as well as climate related mechanisms by directly affecting processes such as exchange of trace gases (*e.g.*, CO_2), heat, and aerosol particles. In addition, recent field studies confirmed for the first time previous laboratory observations suggesting that irradiation of this air/water interface by sunlight produces organic vapours, known to enhance particle formation in the atmosphere. These emissions were attributed to purely photochemical reactions occurring in the SML. However, current model calculations neglect this abiotic source of reactive compounds and account only for organic vapours that are produced directly by biological processes. Here, we combine for the first time results on the formation and presence of SMLs with observations of photochemical production of organic vapours from irradiation of surfactant-enriched air/water interfaces, to identify locations and time periods in which such photochemistry is of major importance for marine VOC levels. We show that interfacial photochemistry serves as a major abiotic source of volatile organic compounds (VOCs) on a global scale, capable to compete with emissions from marine biology. Our results indicate global emissions of 65.0–257 Tg yr^{-1} (46.4–184 Tg C yr^{-1}) of organic vapors from the oceans into the marine atmosphere and a potential contribution to organic aerosol mass of more than 60% over the remote ocean. Moreover, we provide global distributions of VOC formation potentials, which can be used as simple tools for field studies to estimate photochemical VOC emissions depending on location and season.