

3.062 Chemical transfer of dissolved organic matter from surface seawater to sea spray aerosol in the marine atmosphere.

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Abstract:

It is critical to understand how variations in chemical composition in surface seawater (SSW) affect the chemistry of marine atmospheric aerosols, because this information is required for quantitative estimate of the atmospheric chemistry and climate impacts of sea spray aerosol (SSA). We investigated the sea-to-air transfer of dissolved organic carbon (DOC) by cruise measurements of both ambient aerosols and SSW during phytoplankton pre-bloom in the Oyashio and its coastal regions, the western subarctic Pacific. SSA was defined by stable carbon isotope ratio of water-soluble organic carbon (WSOC) ($\delta^{13}\text{C}_{\text{WSOC}}$) and the concentrations of organic molecular tracers (e.g., monosaccharides) in marine aerosol samples together with local surface wind speed data obtained during the cruise. For both SSA and SSW samples, excitation-emission matrices (EEMs) were obtained to examine chemical transfer of fluorescent organic material, specifically protein-like and humic-like substances. We found that ratios of fluorescence intensity of humic-like/protein-like substances in the submicron SSA were significantly larger than those in the bulk SSW ($53 \pm 24\%$). The larger ratio was also found for the supermicron SSA compared with the SSW. The result suggests significant decomposition of protein-like DOC on timescale of <12–24 h and/or preferential production of humic-like substances in the atmospheric aerosols regardless of the particle size. This study provides unique insights into the complex transfer of organic matter, mostly related to marine biological activity, from the ocean surface to the atmosphere.