

Chemical and physical characteristics of nascent aerosols produced by bursting bubbles at a model air-sea interface

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Abstract

Breaking waves on the ocean surface produce bubbles that, upon bursting, inject seawater constituents into the atmosphere. Nascent aerosols were generated by bubbling zero-air through flowing seawater within an RH-controlled chamber deployed at Bermuda and analyzed for major chemical and physical characteristics. The composition of feed seawater was representative of the surrounding ocean. Relative size distributions of inorganic aerosol constituents were similar to those in ambient air. Ca^{2+} was significantly enriched relative to seawater (median factor = 1.2). If in the form of CaCO_3 , these enrichments would have important implications for pH-dependent processes. Other inorganic constituents were present at ratios indistinguishable from those in seawater. Soluble organic carbon (OC) was highly enriched in all size fractions (median factor for all samples = 387). Number size distributions exhibited two lognormal modes. The number production flux of each mode was linearly correlated with bubble rate. At 80% RH, the larger mode exhibited a volume centroid of $5\text{-}\mu\text{m}$ diameter and included 95% of the inorganic sea-salt mass; water comprised 79% to 90% of volume. At 80% RH, the smaller mode exhibited a number centroid of $0.13\text{-}\mu\text{m}$ diameter; water comprised 87% to 90% of volume. The median mass ratio of organic matter to sea salt in the smallest size fraction (geometric mean diameter = $0.13\text{ }\mu\text{m}$) was 4:1. These results support the hypothesis that bursting bubbles are an important global source of CN and CCN with climatic implications. Primary marine aerosols also influence radiative transfer via multiphase processing of sulfur and other climate-relevant species.