Geophysical Research Abstracts
Vol. 14, EGU2012-8861, 2012
EGU General Assembly 2012

Investigating primary marine aerosol properties: CCN activity of sea salt and mixed particles

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Sea salt particles ejected as a result of bubbles bursting from artificial seawater in a closed stainless steel tank were sampled for size distribution, morphology, and cloud condensation nucleus (CCN) activity. The two-component artificial seawater consisted of salt, either NaCl or sea salt, and one organic compound in deionized water. Several organic molecules representative of oceanic organic matter were investigated. Bubbles were generated either by aeration through a porous diffuser or by water jet impingement on the surface of the artificial seawater. The effect of bubble lifetime, which was controlled by varying the depth of the diffuser in the water column, on particle size and CCN activity was investigated and was found to be insignificant for the organic compounds studied. The CCN activities of particles produced from diffuser-generated bubbles were generally governed by the high hygroscopicity of salt, such that activation was indistinguishable from that of salt, except in the case of very low mass ratio of salt to organic matter in the seawater solution. There was, however, a considerable decrease in CCN activity for particles produced from jet impingement on seawater that had a salinity of 10‰ and contained 0.45 mM of sodium laurate, an organic surfactant. The production of a thick foam layer from impingement may explain the difference in activation and supports hypotheses that particle production from the two methods of generating bubbles is not similar. Accurate conclusions from observed CCN activities of particles from artificial seawater containing organic matter require knowledge of the CCN activity of the inorganic component, especially as a small amount of the inorganic can heavily influence activation. Therefore, the CCN activity of both artificial sea salt and NaCl were measured and compared. Part of the discrepancy observed between the CCN activities of the two salts may be due to morphological differences, which were investigated using electron microscopy.