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Primarily generated 80-100nm *in situ* sea salt particles: Quantification of their organic volume fraction and investigation of their hygroscopic properties

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For many decades it has been suggested that an organic coating is imparted by the ocean's surface onto sea salt (SS) particles that are primarily generated through bubble bursting mechanisms. For example SS particles with fatty acid coatings have been observed (Tervahattu *et al.* 2002). It is expected that this organic material will affect the hygroscopic properties of SS particles.

Bubble chamber measurements were conducted in an attempt to approximate the average volume fraction of the organic component in primarily generated SS particles while simultaneously investigating the hygroscopic properties of the particles. This was achieved with a Volatility-HTDMA (VHTDMA) that simultaneously measured the hygroscopic and volatility properties of 80-100nm particles. Water samples (100L each) used in the bubble chamber consisted of *in situ* North Atlantic Ocean water samples collected from the shore at Mace Head, Ireland during summer, 2007 and NaCl solutions of varying salinity. For the comparison of hygroscopic and volatility properties the measurements were also repeated with an atomised solution of artificial sea water consisting of 6 inorganic salts in ratios known to exist in Atlantic Ocean water dissolved in deionised water.

The volatility curves (volume fraction remaining (V/V₀) against temperature) for 5 different samples of Mace Head ocean water (MH), 2 NaCl solutions and 1 atomised artificial sea water solution (Artificial SS) are shown in Figure 1. Particles generated from both NaCl solution and artificial sea water decreased in volume with increasing temperature. However particles generated from *in situ* MH ocean water showed an even greater decrease in volume with increasing temperature. The NaCl/Artificial SS and MH volatility curves only begin significantly diverging from ~190-260°C. It is reasonable to expect that some organic compounds such as fatty acids or polysaccharides may begin volatilising at these temperatures. At temperatures above 320°C the difference between the NaCl/Artificial SS and MH curves becomes relatively constant, suggesting that any organic components have been volatilised. Linear functions were fitted to the Artificial SS and MH data points above 320°C and found to have very similar slopes. The difference between the two fitted linear functions

averages 8±4%; this is taken as an estimate of the average volume fraction of the organic component in SS particles generated from *in situ* Atlantic Ocean water in this experiment. It is noted that this organic component has a relatively high volatilisation temperature (190-320°C.)

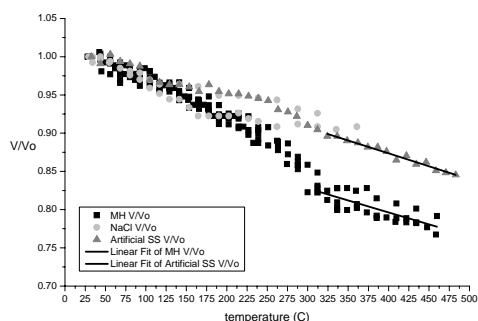


Figure 1: Volatility curves for 80-100nm particles generated from MH- Atlantic Ocean Water, NaCl-NaCl solution and Artificial SS- Artificial sea water

Measurements of the hygroscopic growth factor (HGF) at 90%RH (not shown here) were conducted simultaneously with the volatility measurements. At temperatures below ~260°C the HGF's of the *in situ* particles are systematically, slightly lower than the HGF's of the NaCl and artificial SS particles. At higher temperatures the HGF's of all types of particles are relatively comparable.

To further investigate the effect of the proposed organic fraction on the hygroscopic properties of SS particles deliquescence scans were conducted for the *in situ*, NaCl and artificial SS particles. The NaCl particles deliquesced as expected. The artificial SS and *in situ* particles both absorbed water below the deliquescence relative humidity (DRH) of pure NaCl. As explained above the *in situ* particles had smaller growth factors than both the artificial SS and NaCl particles above the DRH of NaCl.

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Tervahattu H., J. Juhanoja, and K. Kupiainen (2002), *J. Geophys. Res.*, 107 (D16), doi:10.1029/2001JD001403.