Aerosol particles in the marine environment

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Aerosol particles in the marine environment stem from several sources including primary production of sea-spray particles via wind-driven air-entrainment and subsequent bubble bursting, transport from land sources, new particle formation and emissions from ships.

Large uncertainties are associated with the source strength, properties and climate impact of particle from these different sources.

This talk provides a general introduction to aerosol particles in the marine environment with focus on particle properties. The results presented address properties of particles generated from bubble bursting processes in a laboratory environment. In addition, properties of particles sampled from a low-speed ship engine will be presented. Outcomes will be discussed in the context of atmospheric science.

Methods

In *Sea-spray experiments* particles were generated by air-entrainment and bubble bursting processes in laboratory tanks. Bubbles were generated either by aeration through a diffuser or by water jet impingement on the water surface of the tank. Particle properties were determined using a suite of aerosol instruments including SMPS systems and CCN-counter.
In *ship-engine experiments* particles were collected during a 3-week measurement campaign at a MAN B&W low-speed ship engine on test bed in Copenhagen and analyzed using Transmission Electron Microscopy.

Results

Sea-spray aerosols constitute a major fraction of marine aerosols. They can be formed when air bubbles entrained in ocean water as a result of breaking waves rise and burst at the surface (e.g. de Leeuw et al. 2011). Sea-spray aerosol has been shown to contain not only sea salt but also organic molecules and field studies (O'Dowd et al. 2004) have suggested that smaller sub-micron particles are enriched in organic material compared to the ocean water.

In this work a series of laboratory experiments were performed to investigate the mechanism of sea-spray aerosol formation, organic enrichment and physico-chemical properties of sea-spray aerosols. For example, the effect of bubble residence time in the bulk seawater solution on particle size and CCN activity was investigated for artificial seawater containing different organic molecules. CCN activity of particles produced from water jet impingement was compared with CCN activities of particles produced from aeration through a diffuser and suggests a considerable amount of organic enrichment in the particles produced via jet-impingement when the salt water contained an organic surfactant (sodium laurate) (King et al. 2012).

Another type of complex aerosol particles in the marine environment are particles emitted from marine diesel engines. Results will be presented from a study comparing particle properties before and after an exhaust gas recirculation scrubber for a low-speed ship engine on test bed.

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