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Direct evidence for coastal iodine particles from Laminaria macroalgae – linkage to emissions of molecular iodine

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Abstract. Renewal of ultrafine aerosols in the marine boundary layer may lead to repopulation of the marine distribution and ultimately determine the concentration of cloud condensation nuclei (CCN). Thus the formation of nanometre-scale particles can lead to enhanced scattering of incoming radiation and a net cooling of the atmosphere. The recent demonstration of the chamber formation of new particles from the photolytic production of condensable iodine-containing compounds from diiodomethane (CH_2I_2), (O'Dowd et al., 2002; Kolb, 2002; Jimenez et al., 2003a; Burkholder and Ravishankara, 2003), provides an additional mechanism to the gas-to-particle conversion of sulphuric acid formed in the photo-oxidation of dimethylsulphide for marine aerosol repopulation. CH_2I_2 is emitted from seaweeds (Carpenter et al., 1999, 2000) and has been suggested as an initiator of particle formation. We demonstrate here for the first time that ultrafine iodine-containing particles are produced by intertidal macroalgae exposed to ambient levels of ozone. The particle composition is very similar both to those formed in the chamber photo-oxidation of diiodomethane and in the oxidation of molecular iodine by ozone. The particles formed in all three systems are similarly aspherical. When small, those formed in the molecular iodine system swell only moderately when exposed to increased humidity environments, and swell progressively less with increasing size; this behaviour occurs whether they are formed in dry or humid environments, in contrast to those in the CH_2I_2 system. Direct coastal boundary layer observations of molecular iodine, ultrafine particle production and iodocarbons are reported. Using a newly measured molecular iodine photolysis rate, it is shown that, if atomic iodine is involved in the observed particle bursts, it is of the order of at least 1000 times more likely to result from molecular iodine photolysis than diiodomethane photolysis. A hypothesis for molecular iodine release from intertidal macroalgae is presented and the potential importance of macroalgal iodine particles in their contribution to CCN and global radiative forcing are discussed.

Final Revised Paper (PDF, 1474 KB) Discussion Paper (ACPD)

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