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Contributions from DMS and ship emissions to CCN observed over the summertime North Pacific

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Abstract. Measurements of cloud condensation nuclei (CCN) made over the North Pacific Ocean in July 2002 are analysed with concurrent measurements of aerosol number, mass and composition. Overall the CCN are controlled by the sulphate, including one case that suggests particle nucleation and growth resulting from dimethyl sulphide oxidation that enhanced CCN concentrations. Hourly CCN concentrations are correlated with concentrations of sulphate plus methanesulphonic acid (MSA) over the entire study period (r^2=0.43 and 0.52 for supersaturations of 0.34% and 0.19%, respectively), and are not well correlated with other organics (r^2<0.2). One case study reveals elevated mass and number concentrations of ultrafine and fine organic particles due to regional ship emissions, identified through quadrupole aerosol mass spectrometer (Q-AMS) measurements, during which organic mass concentrations are correlated with CCN values (r^2=0.39 and 0.46 for supersaturations of 0.19% and 0.34%, respectively). The evolution of the time series and mass distributions of organics, sulphate and MSA over this timeframe indicate that the regional distribution of small, diffuse ship-sourced organic particles act as condensation sites for sulphur species, resulting in a subsequent increase in number concentrations of CCN. We conclude that, where present, direct emissions of anthropogenic organic particles may exert a strong control on marine CCN concentrations once diffused into the marine atmosphere, by acting as condensation sites for biogenic and anthropogenic sulphur species.

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