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The effect of organics on the growth rate of cloud droplets

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The goal of this work is to determine the role of organic aerosols in the nucleation of cloud droplets and hence the indirect effect of aerosols on climate. Previous measurements of the droplet growth rates of laboratory-generated cloud condensation nuclei (CCN), both organic and inorganic (Shantz et al., 2003) compared well with simulations from a modified adiabatic cloud parcel model. The growth rates of cloud droplets on pure organics of lower solubility were delayed compared with ammonium sulphate. The delay in the growth rate of the organic significantly reduced the number of cloud droplets based on the parcel model calculations. But what happens in a natural environment when there is not a pure organic but rather a mixture of chemicals?

The first C-SOLAS field study, which took place in the North Pacific in the summer of 2002, offered an opportunity to evaluate the model with cases of both relatively pure natural inorganic aerosol and mixtures of smaller quantities of organics. Using the measured chemical composition (from an Aerosol Mass Spectrometer) and size distributions (SMPS and PCASP) to initiate the model, the droplet growth rates from the model output are compared with the CCN counter measurements, to examine CCN closure in a kinetic sense. Reasonable agreement between the modelling and the observations was found for the 3 cases tested. The case with the organic mixed with inorganic suggested that the organic component did not contribute very much to the CCN growth. Rather, the sulphate component appeared to control the CCN growth and the organic possibly acting only as a site for condensation of the sulphate.

Measurements from a land study in a forest are also considered in the same way. The observations were collected as part of the Pacific 2001 study (Lower Fraser Valley, August 2001: Atmospheric Environment 38, 2004), at Golden Ears Provincial Park, near Maple Ridge, B.C., Canada. The particular objective of these measurements was to improve our knowledge of the potential contribution to the regional aerosol and CCN from the oxidation of monoterpenes. A degree of mass closure of the aerosol at Golden Ears was obtained (Shantz et al., AE, 38, 2004). Attempts to close the measured CCN growth rates with the model are considered.