Atmos. Chem. Phys. Discuss., 3, S2536–S2537, 2003
www.atmos-chem-phys.org/acpd/3/S2536/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "A new feedback mechanism linking forests, aerosols, and climate" *by* M. Kulmala et al.

W. Conant (Editor)

billc@cheme.caltech.edu, wconant@caltech.edu

Received and published: 9 February 2004

This thought-provoking study suggests that present-day increases in CO_2 concentrations (and perhaps the associated warming) will induce forests to produce larger concentrations of VOCs. Oxidation and nucleation of these VOCs would then cause increased concentrations of cloud condensation nuclei (CCN). The higher CCN concentrations would result in increased cloud radiative forcing (Twomey, 1977) which acts as a negative feedback on the CO_2 induced warming. This line of reasoning closely follows related arguments made by Charlson et al. (1987), who proposed a similar feedback between marine phytoplankton, DMS emissions, and aerosol radiative forcing of climate. The forest-aerosol-climate feedback hypothesis is supported using measured seasonal cycles in gross primary production, monoterpene concentrations, solar radiation, ozone, and particle size distribution that were made in a Finnish pine forest.

One wonders if the proposed effect is as relevant today as it was in pre-industrial climates. The postulated increase in cloud drop concentrations would be moderated strongly when there is a large concentration of preexisting CCN. First, pre-existing CCN act as a sink for condensable vapors and nucleation-sized particles, and thus limit the formation of new CCN. Second, aged anthropogenic aerosols, which are efficient as CCN because they are rich in sulfate, can actually suppress the activation of (formation of a cloud drop by) the relatively less soluble organic aerosol particles by limiting the maximum supersaturation experienced within a forming cloud. In more pristine pre-industrial climates, however, a large background sulfate aerosol concentration was probably not present over inland boreal regions, and the forest-aerosol-climate feedback mechanism may have played a more important role.

References:

Charlson, R.J., Lovelock, J.E., Andreae, M.O., Warren, S.G.: Oceanic phytoplankton, atmospheric sulfur, cloud albedo and climate, Nature, 326, 655-661, 1987.

Twomey, S.: Influence of pollution on shortwave albedo of clouds, J. Atmos. Sci., 34, 1149-1152, 1977.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 6093, 2003.