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Numerical simulations of stratocumulus cloud response to aerosol perturbation

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Geoengineering of the Earth clouds is proposed as a one of the methods to offset global warming. Idealized climate model simulations indicate that such an approach may work and stratocumulus cloud seeding may delay global warming by as much as 25 years. However cloud-aerosol interaction is not fully understood yet, and its representation in climate model are very simplified, what may lead to significant uncertainty in climate model predictions. Problem with quantifying aerosol distribution/composition/concentration -> cloud droplet number relation is more general and even higher resolution model models with more sophisticated microphysics have problem with capturing this relation. Stratocumulus clouds are especially difficult to model because these are long living clouds and aerosol can affect these clouds significantly both locally and globally. Before investigating effect of aerosol perturbation on stratocumulus clouds, models should be able to capture observed relation between aerosol and cloud droplets.

Although there are indications that cloud seeding may effect cloud albedo based on results from parcel model(1), assumption made in this type of models about homogeneity and neglected effect of dynamics may affect model results. In the presentation new approach to microphysics, which is represented in Lagrangian framework, with two way coupling between Lagrangian parcels and Large Eddy Simulations model dynamics and theromodynamics(2) will be discussed. Results from this model will be presented and validated against observations from VOCALS field campaign. Model response to aerosol perturbation and its effect on cloud albedo will be shown for cases with high and low initial cloud droplet concentration.

(1) Bower, K. N., Choularton, T. W., Latham, J., Sahraei, J. and Salter, S. H. (2006), Computational assessment of a proposed technique for global warming mitigation via albedo-enhancement of marine stratocumulus clouds. Atmos. Res. 82, 328-336.
(2) M. Andrejczuk, J. M. Reisner, B. Henson, M. K. Dubey, and C. A. Jeffery (2008), The potential impacts of pollution on a nondrizzling stratus deck: Does aerosol number matter more than type?, J. Geophys. Res., 113, D19204, doi:10.1029/2007JD009445.