Numerical Simulations of Stratocumulus Cloud Response to Aerosol Perturbations

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Geoengineering of the Earth's clouds is proposed as a one of the methods to offset global. Idealised climate model simulations indicate that such an approach may work and stratocumulus cloud seeding may delay global warming by as much as 50 years. However cloud-aerosol interaction is not fully understood yet, and its representation in climate model is very simplified, and may lead to significant uncertainty in climate model predictions. Problems with quantifying aerosol distribution/composition/concentration leading to a 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 affect cloud albedo based on results from 0D models, assumption made in this type of models about homogeneity and neglected effect of dynamics may affect the solution. In the presentation a new approach to microphysics, which is represented in Lagrangian framework, with two ways coupling between Lagrangian parcels and Large Eddy Simulations model dynamics and thermodynamics will be discussed. (Andrejzcuk et al, 2010, JGR, 115, D22214). Results from this model will be presented and validated against observations from VOCALS field campaign. Model response to aerosol perturbation and it's effect on cloud albedo will be shown for cases with high and low cloud droplet concentration.

Further, these results will be considered in relation to climate model results, using the UK HaDGEM1 climate model, (Latham et al 2011, submitted Phil Trans Roy Soc.), as well as more standard Large Eddy Simulation models,(Stevens et al, PHD 2011, University of Leeds) initialised with VOCALS data.