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Climatic effects of sea spray geoengineering simulated by ECHAM5 model

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Different geoengineering techniques have been under extensive study in recent years. One of the proposed methods is to inject sea salt particles into marine stratocumulus clouds in order to increase their reflectivity by providing additional cloud condensation nuclei. Previous climate model studies have shown that large-scale cloud modification could have significant global changes in surface temperature, sea ice extent and precipitation. However, different models have predicted highly different regional patterns especially considering precipitation. We calculate climatic effects of cloud brightening using climate model ECHAM5 and compare the results to the results from previous model studies.

Here we analyze changes in precipitation patterns from aerosol-climate model ECHAM5-HAM simulations with climatological sea surface temperature. Later, we will use a coupled atmosphere-ocean version of the model to perform transient climate simulations. We present two different geoengineering simulations: 1) Sea salt is injected over all oceans and 2) Sea salt injections are confined to three optimal stratocumulus regions.

In the preliminary results from simulation with explicit sea salt injections in three optimal regions and interaction between aerosol particles and clouds, the mean precipitation decreased about 1% in the three seeding regions. However, there was strong spatial variation also inside the seeding regions. The simulation did not show significant decrease in precipitation over the Amazonia as one previous climate model study which predicted potentially very detrimental decrease over that region. In our simulation with three injection regions, the model predicted a notable increase of precipitation over the northern Africa. This result was not reproduced in the simulation with sea salt injections over all ocean area.

These preliminary results show that different models and injection scenarios may have totally different effects on precipitation patterns. However, these results are based on simulations with climatological sea surface temperature and more reliable results will be obtained by later simulations with fully coupled ocean model.