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Sensitivities of Marine Cloud Brightening Studied with a Lagrangian Cloud Model

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Marine cloud brightening (MCB) is a proposed climate engineering technique in which shallow liquid clouds are deliberately seeded with aerosol particles to increase their albedo and lifetime. Development of accurate models is essential to assess the feasibility of MCB; however, this is complicated by the large number of interacting microphysical processes that occur during cloud formation and the many environmental parameters that influence them. To simulate these microphysical processes in the required detail, a Lagrangian cloud model has been coupled to a simple adiabatic parcel model for this study.

Using this modelling framework, a sensitivity analysis is performed to determine the susceptibility of MCB to the aerosol particle size distribution, meteorological conditions, and several cloud microphysical choices. Attention is paid to the effect of varying the number of giant cloud condensation nuclei (GCCN) in the aerosol distribution, as these are known to enhance precipitation, with potentially deleterious effects to MCB. The results of this analysis provide insight for understanding the susceptibility of cloud formation to environmental conditions and practical considerations for any possible future MCB implementation.