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Modelling the precipitation enhancement by cloud seeding with hygroscopic aerosol using UCLALES-SALSA

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Weather modification and, in particular, rain enhancement via cloud seeding by aerosol particles are subjects of increasing interest because of the need to improve water security in many regions across the globe. In this work we employed the coupled large-eddy – aerosol microphysics model UCLALES-SALSA to conduct modelling studies of the aerosol induced rain enhancement. While field experiments to increase rainfall by deliberate emission of aerosol particles inside the clouds (i.e. cloud seeding) have been conducted for decades, solid scientific understanding of the subject is relatively poor.

Since UCLALES-SALSA is designed for investigations of the aerosol-cloud interactions and cloud processing and scavenging of the aerosol, it is very well suited to study the cloud seeding efficiency. In our work, the main focus is on hygroscopic seeding particles, while seeding with ice nucleating particles is also part of our future plans. To evaluate our model, a comparison against observations from a simple cloud seeding field experiment in a marine stratocumulus regime was performed. The simulated microphysical properties of the clouds show a response to the aerosol injection, which is consistent with the observations. In addition, the precipitation rate is increased, although the increase is somewhat smaller than the observed. The modelling work is ongoing with convective cloud regimes, focusing on clouds observed over the United Arab Emirates, from which we will present our key findings. While the initial results are encouraging, the convective cloud systems comprise a much more complicated environment due to pronounced dynamical features and the mixed-phase cloud structure. Even though we focus on hygroscopic seeding, we must also account for the subsequent effects on the ice phase and the cold precipitation process. All things considered, it is evident that in addition to aerosol properties, the meteorological forcings and boundary conditions are very important considerations in terms of the seeding efficiency.