We thank the Reviewers for their helpful comments on our manuscript. Below, we present our response to each comment by both Reviewers. The Reviewer comments are given in *italics, highlighted with yellow,* followed by our response in plain text. Figures referred to in the responses are shown at the end of this document.

Reviewer #1

Major comments

There is a lack of a quantitative comparison to results from the observations in J15. '..a remarkable resemblance' (line 227) does not provide enough evidence to support the claim that the 'model simulations skillfully reproduced the seeding effects. . . as compared with J15' (line 255). Please can you include values in the manuscript or data in the figures to show this comparison.

The quantitative description of the similarities between the modeled size distributions and those from observations (in J15) will be made more clear and extended. The notion of remarkable resemblance in the original manuscript refers to the increases in concentrations at approximately the 100 µm size range, as well as in droplets larger than about 400 µm. These features are closely associated with similar increases in the observed size distributions, which indicate increased concentrations at around 100-200 µm and above 300-400 µm, sampled near cloud base after the seeding. Moreover, the simulated size distribution shape in general is quite similar to the observations in J15 for the activated droplets (above about 10 µm) with a similar slope as the droplet size approaches 1 mm in the log space.

Other than hydrometeors there is no discussion of the impact to other aspects of the cloud properties. In particular I am surprised that the liquid water content was not presented, as this provides an easy diagnostic to compare to J15 (table 3). There is also no discussion on the radiative impact, nor the temporal evolution of the cloud. For instance, why are there seemingly two peaks in the precipitation rate (Figure 6) at 1 hour and 2 hours? What is the temporal evolution of the CDNC? How long would we expect to see an effect last for? What happens to the sub-cloud fluxes of moisture and buoyancy? What happens to cloud-top entrainment? Do any of these thermodynamic responses counteract or enhance the microphysical effect?

We will add discussion about the cloud temporal evolution in terms of the liquid water content and CDNC. Figures 1 and 2 of this document show the evolution of LWC and CDNC, respectively, near the cloud base in the CTRL and Seed2 experiments. We see that our simulations overestimate the LWC in general (approximately 0.14 g m^{-3} vs 0.09 g m^{-3} in J15 prior to seeding) and that the response to seeding is quite modest, especially if considering the pre and post seeding values in the Seed2 experiment alone, whereas the observed values in J15 show a clear decrease from pre to post seeding. However, considering the overall low precipitation rate in this case, we remain doubtful, that the seeding effect on precipitation would be enough to yield a considerable decrease in LWC, especially as considerable portion of the precipitation is also evaporated in the below-cloud layer and recirculated back. At the same time, we do recognize that the results suffer from simplifying assumptions, such as the fixed surface fluxes and large-scale subsidence, which are known to affect LWC and thus most likely explain the overestimation, as well as the increasing slope seen in CTRL in Figure 1 of this document.

The CDNC, shown in Figure 2 of this document, generally decreases during the simulation, with somewhat stronger decrease caused by the seeding. The overall decrease is mainly due to the scavenging of CCN by drizzle (we do not include aerosol replenishment in our simulations), collision-coalescence (which allocates droplets to drizzle bins starting from D=20 µm; this limit likely overlaps somewhat with the size range considered as CDNC in the observations) as well as by decreasing vertical velocities, shown in Figure 3 of this document. The runs (the spinup) starts around 4 AM local time and the seeding is started at 8 AM local time, which coincides approximately with the start of of the flight legs performed in the field experiment (quoted 16 UTC). Thus, the decreasing vertical velocities and CDNC coincide with reducing cloud top radiative cooling after dawn. As discussed later in this document, the seeding is shown to accelerate the collision-coalescence process, which explains the enhanced decrease in CDNC in Seed2, as compared to CTRL in Figure 2. Again, the change in CDNC between the CTRL and Seed2 experiments is weaker than that attributed to seeding effects in the observations.

The decreasing vertical velocity variability also suggests a general decrease in sub-cloud fluxes during the simulation, but at the same time, the fixed surface fluxes maintain a steady supply of moisture in particular, which we agree is probably not fully realistic.

Further analysis of the radiative effects were left out of the scope of the paper, since the purpose of the manuscript was to show how UCLALES-SALSA represents the short-term seeding effects on precipitation.

The exact explanation for the slightly non-monotonic behavior of the precipitation time series (in Figure 6 of the original manuscript) could not be determined, but is in all likelihood caused by the combination of a small doubly periodic computational domain and random variability associated with the overlapping effects of seeding and the background evolution of the cloud and aerosol. In general, we often see such fluctuations in small-domain simulations and they are typically reduced if the domain size is extended.

Due to the computational cost of the simulations, we did not extend the runs further than approximately 3 hours after the seeding, which is not enough to robustly estimate the longevity of the seeding effect.

The coincident changes in CDNC and in LWC, partly caused by the seeding, surely affect the subsequent cycles of precipitation formation. However, quantifying such feedbacks based on this single case is very difficult because of the very high number of degrees of freedom associated with these variables. Again, the purpose of this work is to show how UCLALES-SALSA compares with the observed microphysical effects in this seeding experiment, as this is the first time the model has been applied for such work. Comprehensive investigation into the sensitivities of the seeding effect warrants a dedicated study covering a wider range of conditions.

The discussion section needs to be expanded. There is no discussion on uncertainties that may arise due to the model microphysics. Are there any? As the authors point out the results may be impacted due to variations in the meteorology – there are many studies focusing on MSCs that could be used to provide examples of how the results may be affected. For example, the cloud dynamics are highly sensitive to the buoyancy profile – too strong surface fluxes or cloud-top entrainment rate may make your cloud more or less susceptible to changes in CDNC. Could this be a possible reason you don't see the same 'seeding efficacy' as J15? I believe the authors should spend more time discussing this. Finally, have there been any other cloud-seeding modelling studies? How do the conclusions and results compare? Can this study be compared with other MSC modelling studies focusing on aerosol-cloud-interactions?

We will extend the discussion on the model uncertainties, which surely do arise both from the numerical representation of processes as well as from the initial conditions. Following the suggestions by Reviewer #2, we have performed a series of sensitivity tests, which show that the results are somewhat sensitive to e.g. the boundary layer moisture content. Moreover, simplifying assumptions like the fixed surface fluxes and large-scale subsidence most likely reduce the realism of the simulations, as discussed above. We will extend the discussion as suggested.

Modeling studies on cloud seeding exist, some of which have already been referenced in the manuscript. We will enhance the discussion of our findings with further references. Regarding studies on aerosol-cloud interactions, the works by Jensen et al. for example on the role of GCCN in precipitation formation are of course very relevant to this work and have already been cited in the manuscript. We will reiterate these in the discussion. Considering studies on aerosol-cloud interactions in MSC in a more general context, we should investigate more carefully the impact of cloud adjustments over a longer period of time and changes due to a broader spectrum of particle sizes, which goes outside the scope of the current paper.

Minor comments:
Title. I believe airbourne should be spelled airborne.
The spelling is corrected in the revised manuscript

Line 63 (Model description): how is mixing of air parcels represented? e.g., homogeneous or inhomogeneous?
The subgrid scale mixing is homogeneous.

Line 118: The 8.5K inversion strength appears a lot stronger than in J15. Is this correct? What impact does this have on the simulations?
The upper boundary of the inversion layer is not particularly well defined in the measured profiles (J15 figure 3), so our interpretation was to set the inversion layer in the model as the layer between approximately 650 and 700 m, between which the observed potential temperature changes from about 288 K to 296.5 K or so, resulting in 8.5 K, which is quite typical for marine Sc. One could argue that the observed inversion layer stops at around 293-294 K, which would yield about 5-6 K inversion strength. However, the observed potential temperature slope above this level continues as approximately 5 K/100 m, which is still much more stable than one would generally expect for the lower troposphere above the boundary layer.

Line 120: Why were fluxes and subsidence prescribed according to Ackermann 2009? Were values for the campaign not available? Are they appropriate for the time and place of the campaign? Please include these values in the manuscript. Also, I presume being prescribed they are not interactive. Please clarify this in the text.
We are not aware of these values specifically from the observed period reported in J15. However, the field experiments took place approximately in the same area and the same time of the year as DYCOMS-II, for which the values in Ackermann (2009) are accepted as a general reference, so most likely they are representative of the local conditions. These values are indeed fixed and not interactive, which simplifies the setup, but does reduce the realism of the simulations, as discussed above. We will make the suggested additions to the revised manuscript.

Line 113 (Initial conditions): Was there any vertical damping applied within the domain? Please clarify in text.
A damping layer is present in the top 100 m of the model domain throughout the simulation. We will mention this in the manuscript.

Line 140: What is the objective of using a domain-wide injection? This isn't realistic so there must be a reason for it?
The objective was to map the effect of different emission strategies, including the extreme (yet surely not practical) case of domain wide injection. Essentially, this affects the total emitted mass and the mixing dilution of the seeding aerosol. We will clarify this in the manuscript.

Line 143: vertical cross-section?
Corrected.

Line 162: What are the total masses released for each of the three experiments and how does this compare with the campaign?
Calculated simplistically from the mode mean diameters, in Seed1 the mass released is approximately 20 kg and in Seed2 it is 200 kg. In the domain wide seeding setup (Seed3) the released mass is approximately 4000 kg. Obviously, Seed3 does not portray a realistic scenario and was performed exclusively to investigate the sensitivity of the simulated seeding effect. It shows that in terms of the total released mass, the seeding effect shows signs of saturation, although we don't expect to be able to robustly estimate this saturation point using a periodic boundary conditions for the model domain.

We note that the released mass in the simulations depends strongly on the assumption about the volume occupied by the initial plume (the assumed plume cross-section was 50 x 50 m^2). J15 do not directly quote the total mass they released in the field experiments. Therefore, we instead targeted the plume concentrations after allowing some time for mixing, which J15 estimated to be at maximum on the order of 10^{-2} cm^{-3}, which we also reached in our simulations (Figure 7).

Line 167: What is the simulated precipitation rate that is 'rather low'?
Line 167: J15 table 3 states a pre-seeding precipitation rate at the cloud base of 0.04 mm/hr - why was 0.05 used to constrain the control case?
As a response to the two comments above: The statements on the precipitation rate were directed to the case in general, since the overall precipitation rates, both in model and observations, are indeed quite low. We will reword this sentence in the revised manuscript to make it more clear. The mentioned observed precipitation rate should indeed be 0.04 mm hr^{-1}, which will be corrected. But we did not use this information to "constrain" the simulated precipitation rates.

Line 168: On seeding efficacy.. this sounds like this should be a metric for dP/dM and is something I was expecting to be quantitatively evaluated later in the manuscript. Is this possible? It could provide a good way to compare different models or observations. . .
Perhaps this is a misuse of terminology on our part. We simply refer to the magnitude of the seeding response or seeding effect. We will revise the use of this terminology in the manuscript.

Line 184: It is stated that '10m vertical resolution has been shown to be inadequate to fully represent the effects of entrainment mixing' yet the 10m vertical resolution is used. Is entrainment not an important process? Did you see differences in entrainment rate between the two simulations? Were there any changes to other BL processes?
Here we are mainly concerned with the sensitivity of precipitation to the resolution. It is true, that works such as Stevens et al. (2005) point out the challenges of representing entrainment mixing even with resolutions much higher than 10 m. However, this comes with a significant increase in the computational cost, which is already very high in our model. In spite of this, the sensitivity tests already reported in the manuscript showed a convergence of results in terms of the precipitation rates at 10 m resolution, so this was selected for our main experiments as a compromise between accuracy and computational cost. Nevertheless, we do not claim that this would provide a perfect representation of the entrainment mixing.

Line 189: What is the cloud base height?
About 250 m after the seeding.

Line 195: What is the injected mass?
Please see the response for Line 162.

Line 199: Can you provide an estimate of how quickly the particles are activated?
Since the particles are in the micrometer size range, injected into saturated cloudy air, within a few timesteps.

Line 204: Can you please provide a value for how long 'not long' is?
The timescale is about 10-15 minutes, we will reiterate this in the manuscript.

Line 206: Could you provide a description for seeding efficacy?
As stated above, we simply refer to the magnitude of the seeding response or seeding effect. We will revise the use of this terminology in the manuscript.

Line 207: Please change 'concentration' to 'concentration of seeding particles'.
Done.

Line 208: Is this simply the mean of the Seed2 profile in figure 7? Please could you clarify in the text.
Added "… suggested by the mean of the Seed2 profile in Figure 7"

Line 210: is this statement just for MSCs or for all cloud types?
In a more general context, yes these pathways are hypothesized also in convective clouds in the case of hygroscopic cloud seeding, even though in convective clouds the dynamical perturbations and mixed-phase processes become relevant and make the issue more complex. Therefore, in line with the focus of this manuscript, we will mention the focus on warm clouds in this sentence in the revised manuscript.

Line 214: A crux of the argument for dismissing water-vapour competition (between ambient and seeded particles) is based on the RH yet this is not shown, nor are values provided. Please include this. Also, do other modelling studies see the same response? For example, MSC modelling studies with above-cloud plumes (such as in the SE Atlantic) are potentially analogous to this seeding experiment..
We will include a figure showing the supersaturation profile averaged over updraft areas, where only very minor decrease is seen around cloud base for Seed2 and Seed3 (shown in Figure 4 of this document). In addition, as per request by Reviewer #2, we have also analyzed the effect of seeding to the process rates using the new set of sensitivity tests. The results do not indicate any significant effect in the cloud activation rate caused by the seeding. However, a significant effect is seen in the mean drizzle formation rate, which we derive directly from the collision-coalescence process in our model.

Line 217: The competition between activation of ambient and seeding particles is discussed, but what about competition between ambient droplet growth and activation of seeding particles at cloud top? Does this enhance or suppress the width of the DSD?
The competition for water vapor surely does have an effect on the growth of droplets. Since UCLALES-SALSA solves condensation equations for water vapor in non-equilibrium conditions in a size-resolved framework, the model does allow the injection of particles larger than the background population to shift the allocation of water from smaller to larger CCN, whose equilibrium saturation ratio is smaller. This would contribute to the increase DSD width. However,

this effect depends on the particle concentration and is not easily distinguished with the relatively small concentration of the seeding aerosol. This discussion will be added in the manuscript.

Line 219 / Figure 8: Why does the cloud base and cloud top height change with increasing seeding mass?
The figure is a bit misleading, because we zoom the x-axis into larger values in CDNC in order to show the difference between the experiments more clearly. We don't see a clear change in the cloud boundaries due to seeding, at least in the relatively short timescales investigated. We will make this clear in the caption.

Line 219: How much of the decrease in CDNC is attributed to increased removal via precipitation?
We attribute the change in CDNC between the control and seeding experiments to be primarily due to collision-coalescence and accretion by drizzle and rain drops as noted above. However, we cannot robustly quantify the direct contribution of precipitation fall-out to CDNC decrease in particular, since we can not track the number of collisions undergone by each drop.

Line 224 to 230: Referring back to a previous comment please make this comparison to DSDs in J15 quantitative, including the terminology (e.g., '..bear a remarkable resemblance to..'). Including the DSDs from J15 onto the figure 9 would provide a very good comparison.
We will provide a more quantitative description.

Line 234: Saying 5 hours is confusing – change to 1 hour after emission or something to that effect..
We will follow the suggestion.

Line 249: 'In successful cases' do you not see this in all three cases?
Yes we do, we will remove this from the manuscript.

Line 249: 'sustained effect up to 2-3 hours' without extending the simulation length you can't really give a maximum timescale. Please clarify.
This is true, as we also mentioned in a comment above. We will revise this statement accordingly, that we cannot robustly estimate the longevity of the effect using the data we have.

Line 250: 'peak enhancement. . .. within 1-1.5 hours' Seed1 and Seed2 appear to reach a maximum enhancement at ∼ 2hours. Please clarify.
This statement will be revised as suggested.

Line 253: 'on the high end of the diluted plume concentration. . .' i don't think this was ever discussed before - what were the estimated concentrations in J15?
J15 estimated the plume concentrations to be in the range from 10^{-2} … 10^{-4} cm^{-3}. We will note this in the revised manuscript.

Line 255: 'The model simulations skillfully reproduced..' What measure of skill was used? Perhaps replace skilfully with qualitatively unless the quantitative comparison is provided in section 4.2.
We will revise this statement accordingly.

Line 268: Are there other processes that could produce the required concentration?
Unfortunately, we are unsure what this question refers to?

Discussion section: Are the results and conclusions applicable to different locations? MSCs have a very strong diurnal cycle – what would happen if the seeding took place at a different time when the MSC may be more sensitive to the perturbation?
In the pilot runs performed when preparing the model experiments we saw that the results are somewhat sensitive to the droplet concentration, and the results in the mini ensemble introduced in our response to Reviewer #2 show that the results are also sensitive to the boundary layer moisture content. Also, according to J15, Aug 3 case was the only one where significant seeding effects were measured from the number of flights conducted during the field campaign.

Therefore, we do expect the seeding effects to change diurnally as well as in different regions. The result are also somewhat sensitive to the model initial conditions. We feel that a more in-depth study into the different sensitivities goes beyond the focus of the current manuscript and should be investigated in a separate paper. The purpose of the current work is rather to present the ability of UCLALES-SALSA to represent the basic microphysical processes controlling the seeding effect, than to provide a comprehensive estimate of the sensitivities of the rain enhancement.

Throughout figures: 'function of time' please clarify what time this refers to - since injection I presume?
This is correct, we will clarify this in the manuscript.

Figures 7,8,9,10. The manuscript refers to concentrations in units of cm-3 and diameters in um - but these figures are in m-3 and m. Please update figure axes units so that they are consistent with the usage in the manuscript.
We will make this correction.

Reviewer #2

1. Uncertainties associated with the simulations

It is probably well known that the evolution of a nonlinear system such as the atmosphere is very chaotic and sensitive to initial conditions and any perturbations. For a numerical model that simulates the atmosphere dynamics and relevant physics in an Eulerain framework, errors from the numeric are inevitable to propagate across the domain when sensitivity experiments are conducted (Ancell et al. 2018). It is reasonable and probably recommended to conduct ensemble simulations of the control and sensitivity experiments using perturbations in initial conditions (such random noise in thermodynamics and the back ground aerosol concentration) and some physics parameters (such as the large-scale subsidence rate) to separate the physical responses of the sensitivity experiment from the natural and numerical uncertainties. Or, the authors can apply the "piggybacking" methodology proposed by Wojciech Grabowski (Grabowski 2014; 2015 and many others) to single out the microphysical impacts in this case. Though the authors mentioned the multi-realization approach of this study, I did not see the spirit of the ensemble approach in this case.
We do appreciate the sensitivity of the simulations to perturbations in initial conditions and to numerical uncertainties. However, we do think the solid steady stratocumulus deck, such as in our simulations, is a relatively straightforward environment to test specific microphysical effects, like the cloud seeding.

Unfortunately, running large ensembles covering extensive parameter space is not practical with our model because of its very high computational cost. Moreover, we have considered implementing the piggybacking methodology in our model, but complexities arising from the full bin treatment of the microphysics have so far refrained us from engaging in this action, and therefore it is not pursued in the scope of this revision.

Nevertheless, we have performed a small ensemble with 20 members, each assigned with a randomly selected pair of values for the initial boundary layer moisture content and the large scale subsidence so that the samples are within +-10 % of the ones in the original manuscript. Figure 5 of this document shows the rain enhancement due to seeding as a scatter plot, where we see that varying the subsidense (within the 10 % range) has a minor effect on the precipitation enhancement by seeding, while varying the boundary layer moisture has a more pronounced effect. However, in terms of the relative change in precipitation, the results are more uniform and suggest a stronger relative change for lower moisture content (and lower overall precipitation), which is somewhat expected.

The additional sensitivity experiments provided here as well as the data already present in the manuscript do show, that the results are sensitive first of all to the specifics of the seeding operation and also to the initial and boundary conditions of the model. In addition, the bin representation of the particle size distributions comes with inherent uncertainties related e.g. to numerical diffusion as well as to the process representation, as do any other microphysics schemes. However, based on all of our data, the cloud seeding effect in this case remains qualitatively consistent. We also note, that the case on 3 Aug was the only case in the field experiment where J15 reported a significant observed seeding effect. The purpose of the current work is to show the ability of UCLALES-SALSA to represent the seeding effect in this case, instead of pursuing an exact case study or estimating the full range of sensitivity of the seeding effect to various factors. The simulated seeding effects on the microphysics, particularly the droplet size distributions, are in agreement with the observations and, together with the rather consistent rain enhancement seen in our data, this is an encouraging result.

2. Hypothesis test

I understand that the purpose of this study is not to test any of the hygroscopic seeding hypotheses as mentioned in the introduction. But when I saw the authors speculating the hypothesis of increasing C-C by introducing GCCN as rain embryos from the cloud top led to the reduced CDC as discussed in Fig. 8, I could not help suggesting the authors to spend slightly more effort to prove or disprove this point. Could it be possible that these GCCN are mixed through the cloud volume by turbulence and start to suppress background aerosol activation at cloud base (Fig 7 kind of show this in action)? The authors should be able to configure the model and test out these hypotheses, which will contribute to the field more significantly than the current form.

Using the results from the mini ensemble, we included additional diagnostics for process rates. Indeed, the autoconversion rate, derived directly from the collision-coalescence process (sampling the rate of collisions producing drizzle) within the model, shows a clear peak after the seeding in Figure 6 of this document. However, the cloud activation rate shown in Figure 7 of this document does not show a clear signal in either direction, other than the gradual decrease caused by the radiatively induced decrease in vertical velocities and the gradual scavenging of CCN. In addition, as requested by Reviewer #1, we will include a figure showing the supersaturation profile averaged over updraft areas (Figure 4 of this document): this shows that in Seed2 and Seed3 the supersaturation is decreased, but the magnitude of the change is very small, and not enough to yield significant changes in the activation rate.

We will elaborate on the GCCN effect in the manuscript using the process rate diagnostics.

3. Model setup and analysis

The authors show the sensitivity of the simulated precipitation flux to the vertical resolution. How sensitive are the results to the prescribed large-scale subsidence? According to Chen et al. (2010), the simulated clouds are sensitivity to this factor.
In the context of the mini ensemble, the seeding results are not particularly sensitive to small variations of the subsidence rate. However, our simulations do show sensitivity to larger changes in subsidence, such as those presented in Chen et al. (2010). For this, we rerun the control simulation with the large-scale divergence set at 8.0e-6. This causes the precipitation rate to decrease significantly, to about 0.01 mm h^{-1}, as shown in Figure 8 of this document. This result is qualitatively in agreement with Chen et al. (2010), even though not directly comparable because of the shortness of our simulations and the simplified treatment of the diurnal cycle.

How long did you simulate the seeding operation? That basically gives you the total seeding particles released in your model domain. By assuming a well-mixed MSc boundary layer, you can easily calculate the seeding particle concentrations from each experiment.
In Seed3 all the particles were released during a single timestep. In Seed1 and Seed2 the release along the trajectory with the assumed airspeed of the source at 60 m s^{-1} takes about 8-9 minutes. The estimated concentration of the seeding particle plume slightly after release is shown in Figure 7. The particle release rates are commented on in Section 3.2. Please also refer to our response to the comment about Line 162 by Reviewer #1.

How do you treat the sedimentation of the GCCN particles?
In practice this undergoes a similar treatment as cloud droplets. With SALSA we know the wet diameter of the particles/droplets. With that we calculate the terminal velocity according to a simple set of equations found in R.R. Rogers: A Short Course in Cloud Physics,(Pergamon Press Ltd., 1979) and calculate the flux divergence to determine the change in particle concentrations in consecutive levels, taking also into account the associated effects on latent heat.

In order to support the hypothesis associated with the Fig. 8, the authors should directly compare the microphysical process rates (C-C rate) from the model outputs. As what the study shows right now, we don't know what happens exactly.
Please see our response in the previous section.

The topic of this manuscript is on rain enhancement. Would it be more helpful to show the effects from seeding on ground precipitation amount and distribution?
The purpose of this work was to demonstrate how UCLALES-SALSA represents the seeding effects in the case based on field observations. The measurements in the field experiment were performed using an airborne platform at the height of cloud base as well as in-cloud, so we wanted to perform the analysis with similar sampling strategy. However, qualitatively similar increase in precipitation is seen close to the surface as well, albeit smaller in magnitude due to evaporation.

Technical issues:
Line 20: I will replace "somewhat" with "very".
Done.

Line 21: "true effects" is not an appropriate expression.
Removed "true".

Line 158: shown in Figure 3.
Corrected.

Figures

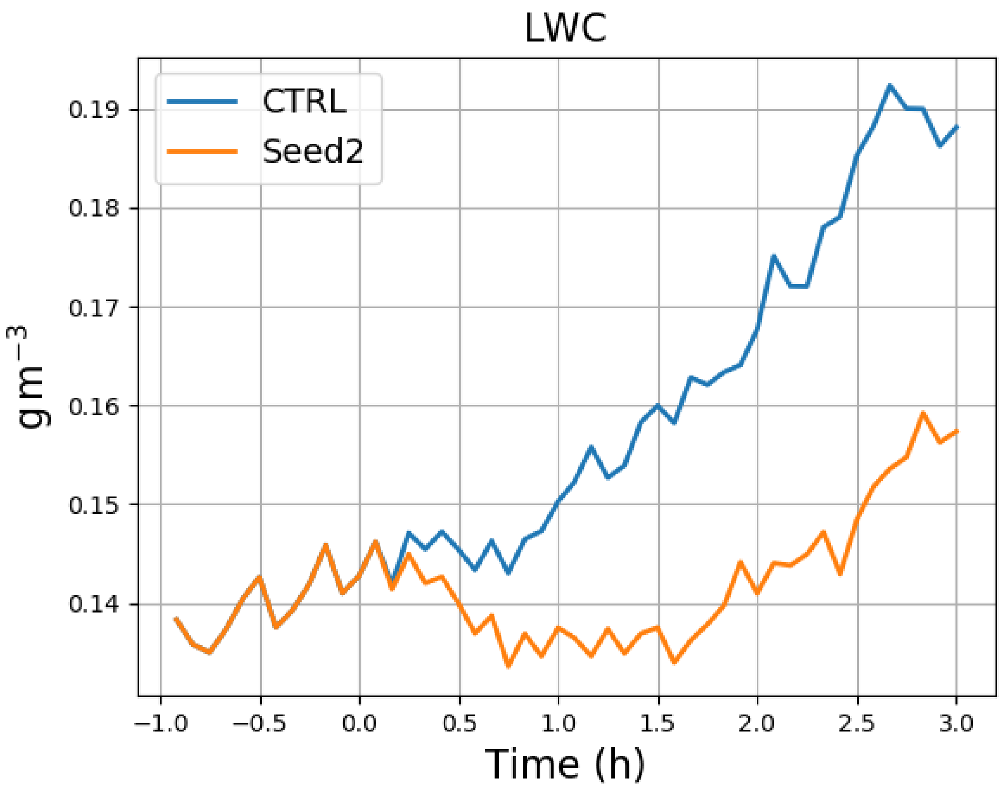

Figure 1: Domain mean LWC timeseries near cloud base (0 h is the time of seeding) in the CTRL and Seed2 experiments.

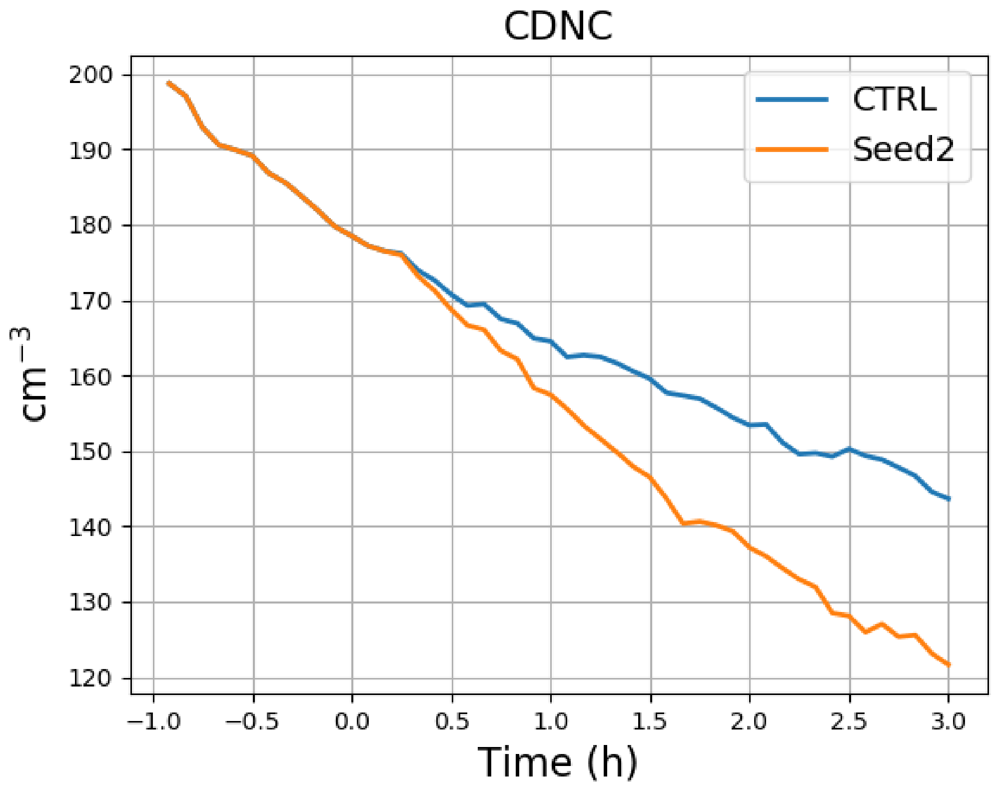

Figure 2: Domain mean CDNC timeseries near cloud base (0 h is the time of the seeding) in the CTRL and Seed2 experiments.

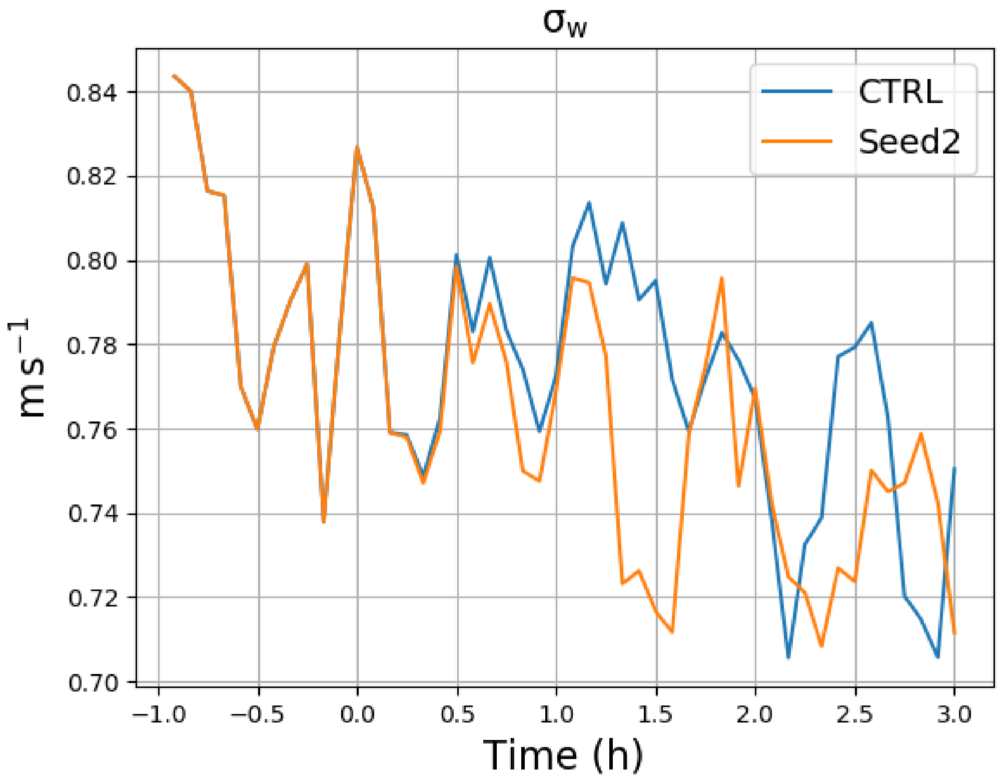

Figure 3: Time series of the standard deviation of vertical velocity near cloud base (0 h is the time of the seeding) in the CTRL and Seed2 experiments.

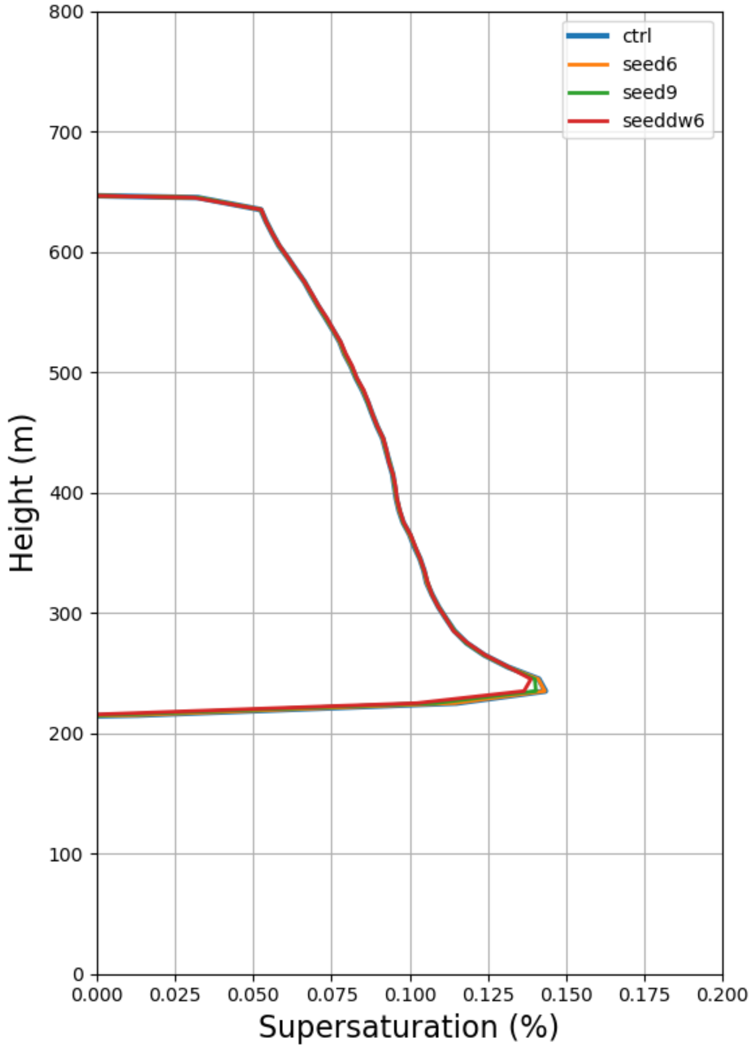

Figure 4: Supersaturation averaged over updraft areas in per cent in the control run and the seeding experiments.

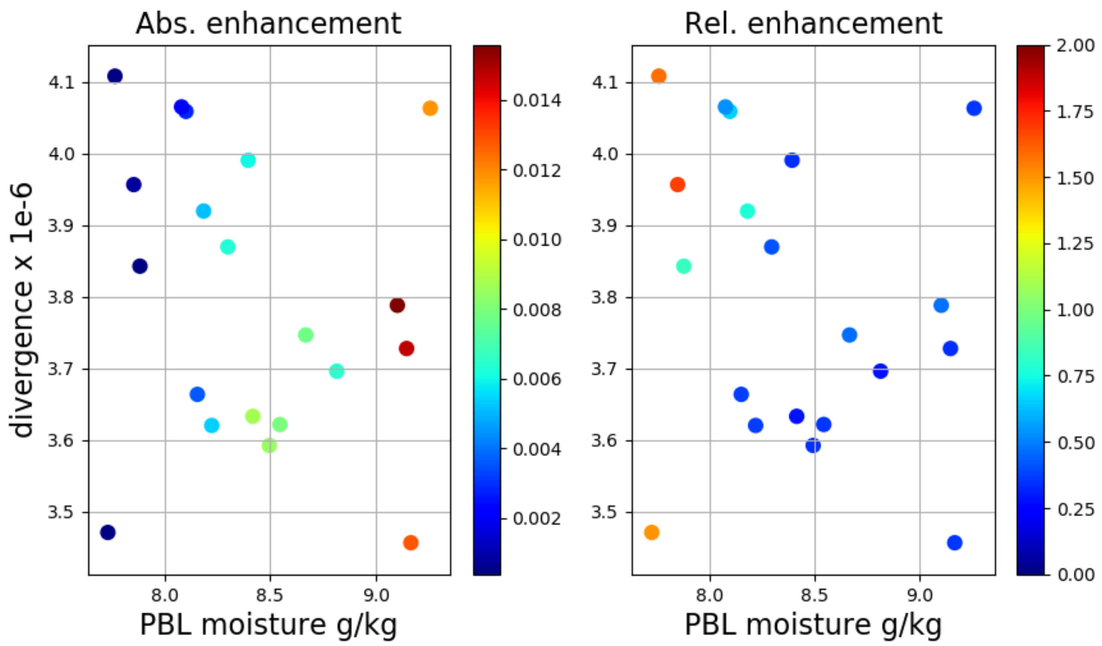

Figure 5: Absolute and relative enhancements of rainfall near cloud base altitude, sampled as domain means, 1 hour after seeding in the 20 ensemble members.

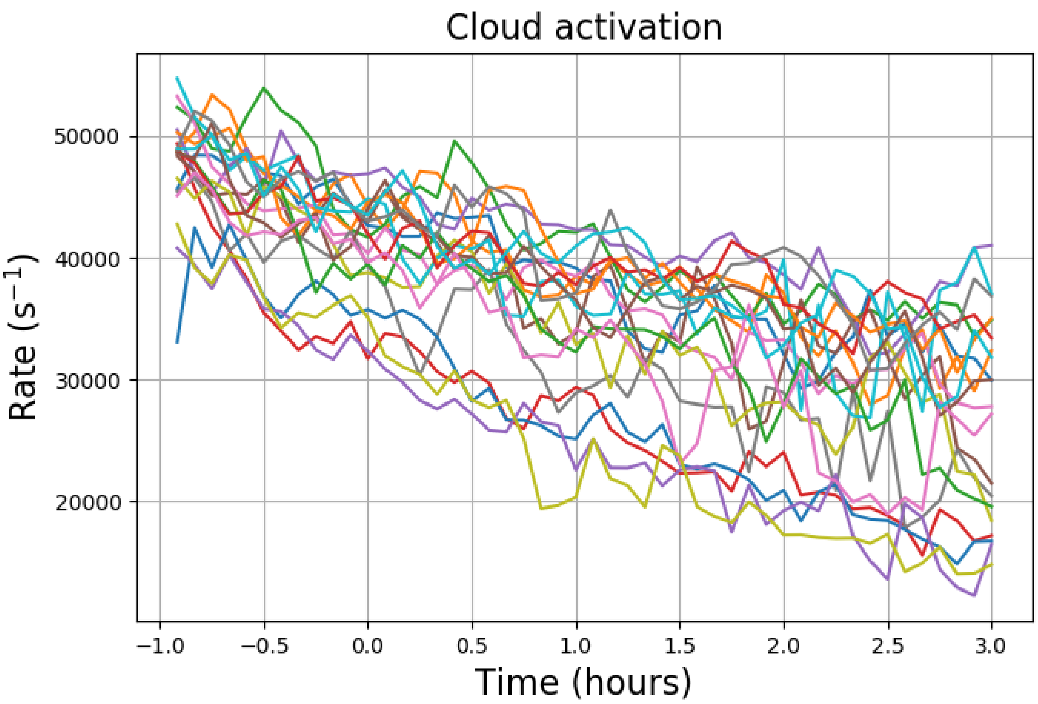

Figure 6: Mean cloud activation rate as a function of time (0 h is the seeding time) in the seeding run in each member of the ensemble experiment.

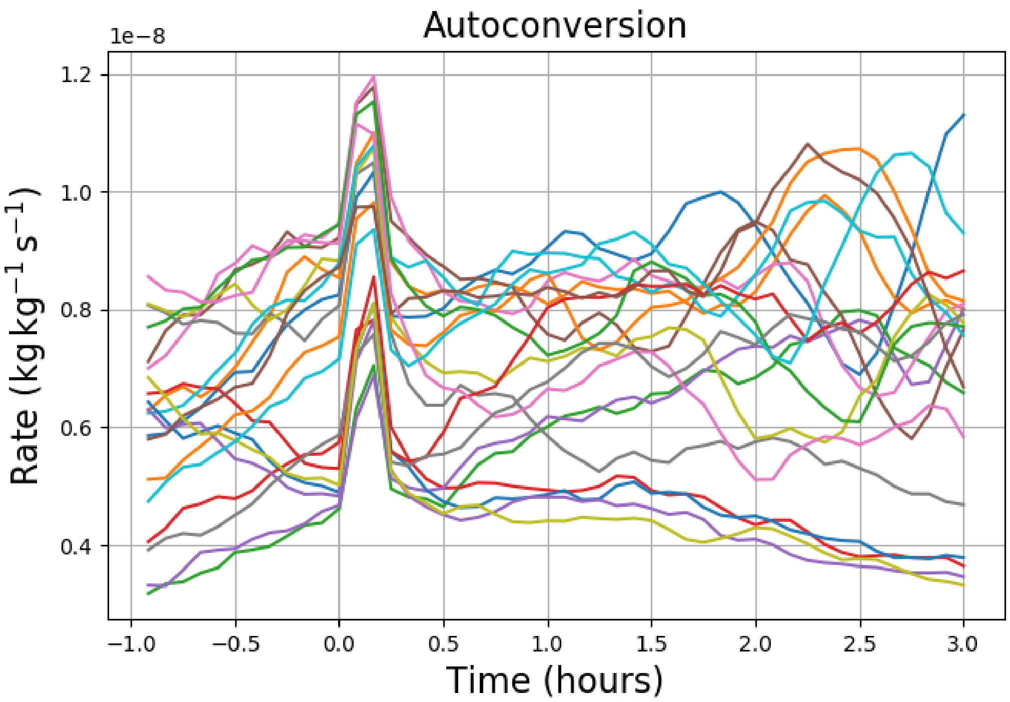

Figure 7: In-cloud mean autoconversion rate as a function of time (0 h is the seeding time) in the seeding run in each member of the ensemble experiment.

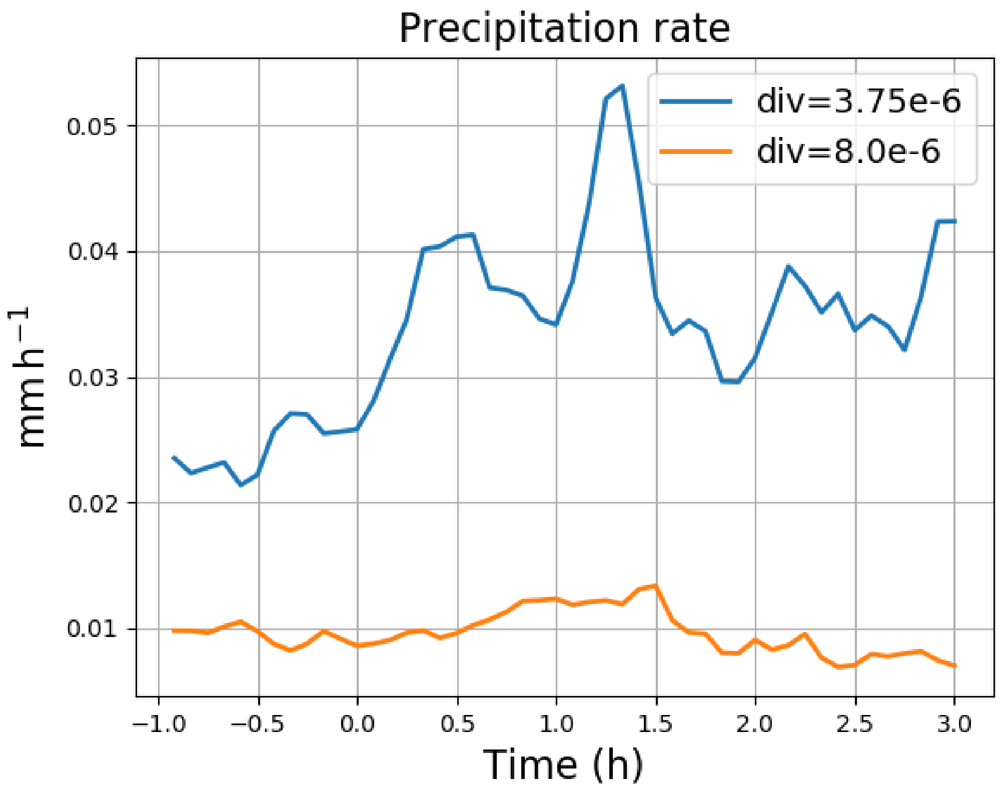

Figure 8: Precipitation rate in the control run configuration with low (3.75e-6) and high (8.0e-6) large-scale divergence.