

Review for:

“Modelling mixed-phase clouds with large-eddy model UCLALES-SALSA”

by J. Ahola et al.

General Comments:

This paper offers a description of the microphysical updates regarding freezing processes in the LES model UCLALES-SALSA. A cloud case observed during ISDAC, that has been used for LES intercomparisons in the past, is also simulated here. This demonstrates the general agreement of the model with other LESs that are widely used for the study of mixed-phase clouds. A comparison of the newly implemented prognostic treatment of ice nucleation to a more simplified method is also presented. This paper will be useful to future users of UCLALES-SALSA, as it will serve as reference for the model’s ice nucleation scheme. The few scientific findings are also interesting, specifically the role of INP treatment in cloud glaciation time and the impact of entrained INPs on ice formation throughout the cloud layer. For these reasons I recommend the paper for publication. However, I have a few suggestions that aim to (1) improve the documentation of the implemented freezing processes and (2) expand the scientific analysis and thus increase the scientific impact.

Major Comments:

- (1) Since this paper will likely serve as a documentation of the freezing processes in future studies conducted with this model, I recommend to provide a description of all processes in the Appendix, not just the immersion mode.

- (2) The prognostic simulation is conducted with assumed aerosol concentrations to reconstruct an IWP similar to the ICE4 experiment. However I recommend to use aerosol measurements from ISDAC in an additional simulation (e.g. as in Savre and Ekman 2015) and compare the results to the observations. If the prognostic scheme results in good agreement with reality or not is a critical piece of information for the cloud modelling community. Moreover, you can conduct a few more sensitivity simulations and activate other freezing processes as well, and show how these experiments compare with microphysical measurements.

Minor Comments:

Line 40: Do you mean that a high aerosol load is associated with higher occurrence of mixed-phase clouds or with more liquid in the mixed-phase clouds? Please clarify.

Lines 246-249: I don't see any point in comparing with observations since you simulated random aerosol conditions and not the observed.

Both INP and IN terms are used. I suggest to use the same term throughout the text for consistency (I think 'INP' has become more popular in the past few years)