

Interactive comment on “Sensitivities of Lagrangian modeling of mid-latitude cirrus clouds to trajectory data quality” by E. Kienast-Sjögren et al.

Anonymous Referee #2

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1 General comments

The objective of the research is to identify and reduce uncertainties in cirrus modelling, which is welcome. The approach is case studies using trajectory box modelling and the uncertainties studied are related to the quality of the thermodynamic fields along the trajectories, the representation of unresolved vertical motions, and the initial values of specific humidity and concentration of ice nuclei. It is no surprise that higher temporal resolution of both the background model and the trajectory interpolation improve the results, and adding small scale temperature fluctuations is an established

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technique even in Eulerian models. However, unfortunately there seems to be no way how a better initialisation of specific (or relative) humidity and IN concentration can be achieved. Unfortunately there is no discussion on these points. Otherwise, the paper is interesting and easy to read. The SAL metric in its current presentation is not of much use, mainly because Fig. 10 is much too small and the symbols cluster together and partly cover each other. The authors should replace the figure with a table giving the respective SAL values.

2 Major comments

1. P 7537, ll 5 ff.: To my opinion, it is too convenient to simply state that "mechanisms are not well understood" and to quote a "low level of scientific understanding". These statements are too general. Please describe what exactly is not well understood. The uncertainties of climate predictions are not necessarily due to cirrus clouds. Sherwood et al. (2014) trace it back mainly to uncertainties related to low clouds and convective mixing.

2. Sect. 2.2.1: Please add information on the vertical coordinate and orography treatment in the COSMO-2 model.

3. P 7545, ll 20 ff.: The horizontal spread of the trajectories show that the assumption of a vertical stacking of the boxes that arrive together at Jungfraujoch (JFJ) is not justified at all. While the authors admit that this is a poor assumption there is no discussion on the effect of that assumption. Sedimentation is mentioned to occur before arrival at JFJ and to remove heterogeneously formed ice. This should be no problem for the interpretation. A more important question is whether there are ice crystals falling into a box from above and consuming the excess vapour in that box. Does this occur? Is this effect represented in the model?

4. P 7556, ll 1-4: It is questionable whether the PSD of T is the appropriate quantity for

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describing an influence of T-fluctuations on the resulting cloud, since it is the cooling rate at the nucleation threshold rather than the temperature that matters. I wonder why you do not look at the pdf of the cooling rates. Can you please discuss this?

3 Minor comments

1. P 7539, l 4: It should be noted that cirrus cloud modelling mostly is done in the Eulerian framework, e.g. in NWP and climate models. The question of the quality of trajectories does not apply to such models and this should explain why not much attention has been paid so far to this question.
2. P 7542, l 10: Please rewrite this sentence. Measurement uncertainties never affect the vertical position of any cloud.
3. Fig. 2: Please explain thin and thick contours in the plot. (Thick is evident, but could be mentioned for completeness).
4. P 7549, l 25: change "mediates" into "mitigates".
5. Fig. 3: Colored vertical lines are too thin. Check calculation for f_{max} (currently the units are 1/(s m)).
6. PP 7751: please explain why w^2 is the velocity variance and not simply the velocity squared. These quantities are the same only if the mean w is zero. Is this assumed? Or is it meteorological parlance?
7. Fig. 5: should be larger. I can hardly read the insert text.
8. Figs. 8-10 are too small.

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4 Misprints etc.

- P 7536, l 18: add space after "by".
- P 7542, l 20: "profile variations".
- P 7546, l 18: "compares compares".
l 19/20: extent. Additionally check whether "narrow" is meant or perhaps "shallow" (as the text is about vertical extent).
- P 7551, l 27: data.
- Caption Fig. 8, l 2: temporal.
- P 7556, l 12: moisture content ... IS very uncertain...
l 21: "at a too low altitude"
- P 7559, l 17: these

5 Reference

Sherwood et al., 2014: Spread in model climate sensitivity traced to atmospheric convective mixing. *Nature*, 505, 37-42.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 7535, 2015.

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