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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Lagrangian simulation of ice particles and resulting dehydration in the polar winter stratosphere" *by* Ines Tritscher et al.

Anonymous Referee #1

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The manuscript by Ines Tritscher and coauthors addresses the problematics of polar stratospheric clouds through Lagrangian simulations performed using an advanced version of CLaMS model featuring a new ice sedimentation module. The simulation covers 2009/2010 Arctic winter, characterized by an unusually strong outbreak of ice PSCs and a typical Antarctic PSC season of 2011. The results of CLaMS simulation are validated using satellite observations of PSCs by CALIOP and MIPAS. The intercomparison is done for vortex-wide temporal evolution of PSC areal coverage as well as for water vapour and nitric acid observed by MLS. A more detailed insight into the performance of CLaMS PSC scheme is provided by comparing individual clouds sampled by CALIOP with model simulations. The simulation is shown to reproduce well the observed extent and timing of the PSC occurrence as well as the related dehy-

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dration and denitrification in both hemispheres. The detailed comparisons based on single CALIPSO orbits demonstrate an impressive capacity of CLaMS to match high-resolution PSC profiling by CALIOP. While some discrepancies do remain, the results clearly suggest the applicability of the new CLaMS ice nucleation scheme for studies of PSC formation and their effect on polar vortex composition. Overall, these results represent a valuable contribution to the PSC science. The manuscript is well structured and nicely written, the applied methods are described in a comprehensive way and the presentation quality is excellent. I recommend the article for publication in ACP subject to minor revisions as follows.

p.11, l.13-14. The maximum of PSC occurrence seen by MIPAS at 15 km is explained by the possible contamination of PSC detection by cirrus clouds and/or aerosol remaining in the stratosphere after Sarychev eruption. I think the occurrence of cirrus clouds at this level during winter at high latitudes is too rare to introduce such a strong signal. Post-Sarychev sulfuric aerosol sounds more reasonable however I wonder if this aerosol could also bias the CALIOP PSC detection. I suggest that the authors clarify this point. A more general question on the subject: could the presence of volcanic aerosol in the polar vortex enhance the formation of PSC?

p.13, l.10-11. If I understood correctly this sentence, it suggests that the overestimation of NAT occurrence by CLaMS with respect to CALIOP observations may be caused by denitrification (supposedly underestimated by simulation). However, this statement is at odds with what can be inferred from Fig. 10, where CLaMS produces even stronger denitrification than that derived from MLS observations.

p.13, l.26-28. “The total magnitude of dehydration is slightly smaller in the simulations than in the observations, which agrees with the impression that CLaMS simulations produce less ice than observed.” I did not get the same impression. Instead, Fig. 6 rather shows that CLaMS produces at least as much ice PSC as observed by CALIOP or even more.

Fig. 6. There seem to be different upper limits of the color scale in the upper-row plots. Do these plots really have a unique color scale?

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