Atmos. Chem. Phys. Discuss., 14, C5772–C5775, 2014
www.atmos-chem-phys-discuss.net/14/C5772/2014/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Satellite observations of cirrus clouds in the Northern Hemisphere lowermost stratosphere" *by* R. Spang et al.

Anonymous Referee #2

Received and published: 12 August 2014

General comment:
In the article observations from the CRISTA instrument are investigated about the occurrence and properties of cirrus clouds in the lower most stratosphere during August 1997. In addition, comparisons with CALIOP observations and with model calculations (CLaMS) were carried out. Cirrus clouds in the stratosphere constitute an important topic; however, our knowledge about these clodus is quite limited. Therefore, this manuscript is an appropriate contribution for ACP. However, there are some issues, which should be clarified before the manuscript can be accepted for publication. In the following, I will list the critical issues in more details.

Major point
The formation of cirrus clouds in the lower most stratosphere (LMS) is not addressed in

this contribution. However, it is very crucial if the clouds are formed in the troposphere and then are just advected into the stratosphere or if the clouds are directly formed in the stratosphere. The authors should use the model results to investigate this issue at least qualitatively. Although the model might not be able to reproduce the ice water contents in a correct way, the humidity values along the trajectories should give some hints about the formation and even on the location of the nucleation event in terms of stratosphere vs. troposphere.

Minor points:

1. Comparison with former investigations: I miss some former investigations, which might be used for comparison. Actually, there are some recent activities of cirrus climatologies using LIDAR data in the French community (Dionisi et al., 2013; Hoareau et al., 2012, 2013; Dupont et al., 2010, 2011), which might be used for comparison. The SAGE data analysed by Wang et al. (1996) are available as gridded data; thus, they can be easily compared with the CRISTA data in a climatological sense. Finally, Spichtinger et al. (2003) reported ice-supersaturated layers in the stratosphere. Since thin cirrus are often embedded into a supersaturated environment, these data might also be used for comparison.

2. Broken cloud fields: The authors mention in the text that CRISTA is very sensitive to homogeneous thin clouds but most cirrus clouds are inhomogeneous. They mention some errors for broken cloud fields; however, these sources of uncertainties should be explained in more details (maybe in the appendix).

3. Model parameterisation: It is obvious that the model has problems in reproducing thin cirrus clouds. From my point of view, the very simple cirrus scheme suffers from the fact that as soon as ice is formed (at a given threshold of 100-150%) all excess water vapour is transferred to ice. This is not realistic, since the relaxation time is usually quite large depending on the surface area of ice crystals. Thus, in a zeroth order correction a relaxation time could be included: The relative

humidity could be reduced due to the following equation

$$\frac{dRHi}{dt} = -\frac{1}{\tau}(RHi - 100\%) \quad (1)$$

prescribing typical relaxation times τ in order of minutes to hours. A long as ice crystal number concentrations are not available, this simple approach would at least lead to more realistic variations in the results.

Technical comments:
Figures 1, 4,5 are heavily overloaded and are hard to read. Please make them much larger and think about reducing the amount of information. Maybe it would be better to produce two figures instead of only one.

References

Dupont, J.-C., M. Haeffelin, Y. Morille, V. Noel, P. Keckhut, D. Winker, J. Comstock, P. Chervet, and A. Roblin, 2010: Macrophysical and optical properties of midlatitude cirrus clouds from four ground-based lidars and collocated CALIOP observations, J. Geophys. Res., 115, D00H24, doi:10.1029/2009JD011943.

Dupont, J.-C., M. Haeffelin, Y. Morille, J. M. Comstock, C. Flynn, C. N. Long, C. Sivaraman, and R. K. Newson, 2011: Cloud properties derived from two lidars over the ARM SGP site, Geophys. Res. Lett., 38, L08814, doi:10.1029/2010GL046274.

Dionisi, D., P. Keckhut, G. L. Liberti, F. Cardillo, and F. Congeduti, 2013: Midlatitude cirrus classification at Rome Tor Vergata through a multichannel Raman-Mie-Rayleigh lidar. Atmos. Chem. Phys., 13, 11853-11868

Gierens, K., U. Schumann, M. Helten, H. Smit, P.H. Wang, 2000: Ice-supersaturated regions and sub visible cirrus in the northern midlatitude upper troposphere. J. Geophys. Res. 105, 22743-22754.

Hoareau, C., P. Keckhut, J.-L. Baray, L. Robert, Y. Courcoux, J. Porteneuve, H. Vömel, and B. Morel, 2012: A Raman lidar at La Reunion for monitoring water vapour and cirrus distributions in the subtropical upper troposphere: preliminary analyses and description of a future system. Atmos. Meas. Tech., 5, 1333-1348

Hoareau, C., P. Keckhut, V. Noel, H. Chepfer, and J.-L. Baray, 2013: A decadal cirrus clouds climatology from ground-based and spaceborne lidars above the south of France. Atmos. Chem. Phys., 13, 6951-6963.

Spichtinger, P., K. Gierens, U. Leiterer, H. Dier, 2003: Ice supersaturation in the tropopause region over Lindenberg, Germany. Meteorol. Z., 12, 143-156.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 12323, 2014.