Comments on ‘Radiative properties of mid-latitude cirrus clouds derived by automatic evaluation of lidar measurements’

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In this article, an algorithm is developed (FLICA) to retrieve cirrus cloud properties based on lidar measurements at three stations in Europe. Using these retrievals, a cirrus climatology and cirrus radiative forcing in each station are presented. Differences of cirrus at three locations are discussed. Subviusal, thin and opaque cirrus are analyzed. Results are also compared to previous studies, and the differences with results by Chen et al. (2000) are particularly emphasized. This paper is generally completed and well written. My main comments/questions relate to the section of comparisons with previous studies, and methods to calculate ice cloud radiative forcing.

Specific comments.

1. Title of this study, ‘Radiative properties of …’, since a climatology of cirrus is also an important part of this study, is it better to say ‘ Climatological and radiative properties of…’

2. Aerosols
   How the algorithm distinguish aerosols and cirrus in this article? Cirrus clouds with small optical depth (e.g. tau<0.001) look more like aerosols?

3. Page 15. Line 5. How do you make sure such a small optical depth ($< 5 \times 10^{-4}$) is not resulted from noises or from aerosols?

4. Page 17, line 25, The mean solar zenith angle for three locations is 60°. However, JUL and JFJ are about 4 degrees latitude off, and thus the mean length of daytime (mean SZA) in the two locations should also be quite different, which will cause radiative flux biases. Have you ever check the differences?

5. Page 17, line 25, An albedo of 0.3 is globally average planetary albedo. The mean surface albedo is about 0.15 (Kiehl and Trenberth, 1997). Also, surface albedo varies from different locations and in different seasons. In particular, JFJ is located at a high altitude and has a cold climate. How many days of this location will be covered by snow in a year? Surface albedo covered by snow is large (> 50%).

6. Page 17. Line 29: The extinction coefficient can be derived from radar backscattering and then optical depth is obtained as shown in equation 7 in this paper. The tau values are used to calculate ice cloud radiative effect. Have you look at how different cirrus radiative effect will be if the extinction coefficient profile is used? The profiles characterize the vertical details of a cloud, which are more accurate to produce radiative fluxes (Chen 2000).

7. How the asymmetric factor and single-scattering albedo of the clouds are determined?

8. Section 4.2, Comparisons with previous results
   Several paragraphs in Section 4.2 describe how results in this study differ from Chen et al. 2000. I doubt the way of comparisons for the following reasons. 1) different definitions of cirrus as stated in this article, and thus radiative forcing of cirrus is different. 2) different resolutions, it is 280 km resolution in Chen et al. 2000, while in this study, lidar has a small field of view (1.5 mrad by 0.3 mrad); 3) time period is very different (four days in Chen's study and five years in this study); 4) More importantly, although the three stations are located around 50°N, comparing ice cloud properties to zonally average values at 50°N provided by Chen et al.2000 is unreasonable since ice clouds vary significantly around 50° (e.g. Sassen et al. 2008). I'm confused why this section is necessary. Do you want to check that your results are correct? If so, why not compare to CERES fluxes? Could you justify the reasons why such comparison is necessary in this study?

   Besides Chen et al. 2000, this article also lists a series of related studies in Section 4.2 (page 21, lines9-30). It may be better to move these paragraphs to introduction.

9. Page 25, line 11: ' cirrus clouds, which remain undetected by satellites (requiring typically tau>0.2)…', CALIPSO lidar can detect ice clouds with tau< 0.2. It would be better to revise the satellites as ' passive remote sensing'. It'll be better if a related reference added after tau> 0.2.

References

Chen, T., W. B. Rossow, and Y. Zhang, 2000: Radiative effects of cloud-type Variations. J. Climate, 13, 264–286.

Kiehl, J. T., and K. E. Trenberth (1997), Earth's annual global mean energy budget, Bull. Am. Meteorol. Soc., 78, 197–208.

Sassen, K., Z. Wang, and D. Liu (2008), Global distribution of cirrus clouds from CloudSat/Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) measurements, J. Geophys. Res., 113, D00A12, doi:10.1029/2008JD009972.