

Interactive comment on “A climatological perspective of deep convection penetrating the TTL during the Indian summer monsoon from the AVHRR and MODIS instruments” by A. Devasthale and S. Fueglistaler

Anonymous Referee #2

Received and published: 16 March 2010

Review for “A climatological perspective of deep convection penetrating the TTL during the Indian summer monsoon from the AVHRR and MODIS instruments” by A. Devasthale and S. Fueglistaler

The authors provide a climatological view of opaque high clouds in the TTL using synergistic analysis of AVHRR, MODIS, and AIRS data. Using cloud top brightness temperature as indicator of deep convection during the Indian summer monsoon, the vertical structure, spatial distribution and variations during active and break monsoon conditions are analyzed in detail. The authors found that most of deep convection

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occurs over the Bay of Bengal and Central Northeast India. Very deep convection over the Tibetan plateau is comparatively weak, and may play only a secondary role in troposphere-to-stratosphere transport. A significant fraction of high opaque clouds over the latitude belt of 10–25°N is found to reach and penetrate into the TTL during active monsoon condition, while the high opaque clouds tend to be persistently equatorwards during break conditions. The present findings are of general interest for the community of cloud climatology and helpful for understanding the impact of deep convection on the water budget and thermal structure of the TTL which is still not well quantified. The manuscript can be accepted after address the following comments, particularly the general ones.

General comments:

1. In the present study, the brightness temperatures measured from AVHRR on board the NOAA-16 satellite are converted to cloud amounts at several different vertical levels using temperature profiles from the AIRS on board the Aqua. This method is not explained clearly and it is a little confusion. What I think is that the AVHRR measured brightness temperature is compared to the temperature vertical profile from the AIRS to get known the level of ice clouds. Please add some descriptions on the method used here. How does this method work? Can you do some validations?
2. The level of zero radiative heating (LZRH). The clear sky LZRH is used, but as explained by the authors, the LZRH is strongly affected by cloud. It is better to do a sensitivity study to check how clouds (particularly optical thick cloud which of interest in the present study) affect the LZRH and thereby the corresponding results.

Specific comments:

1. Page 2813, line 15. The channel 4 alone is not sensitive to optically thick opaque clouds. Its brightness temperature becomes saturated when optical thickness around 8–10. Maybe you mean that the AVHRR brightness temperature measurements from the channel 4 are used to detect optically thick opaque clouds. Also please give the

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wavelength of channel 4.

2. Page 2814, line 2. Give a definition of optically thicker clouds which are studied in the present study.
3. Page 2815, figure 3. Caption of Figure 3. Do you mean “temperature data from AIRS is used to determine occurrence of cloud from AVHRR brightness temperatures”?
4. Page 2818, line 25. When comparing the MODIS cloud fraction for ice cloud with optical thickness larger than 23 to NOAA-16 cloud fraction, please note that MODIS only has cloud optical thickness at the daytime.
5. Page 2819, line15-20. Check these sentences, it seems they are not consistent.
6. Page 2819, second paragraph. The contexts for Figures 8 and 9 are not clear.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 2809, 2010.