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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Investigation of negative cloud radiative forcing over the Indian subcontinent and adjacent oceans during the summer monsoon season" *by* B. V. Thampi and R. Roca

B. V. Thampi and R. Roca

bijoyvthampi@yahoo.com

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We thank the Referee for the very constructive suggestions/comments. The specific replies to the comments are given below.

Reply to Comment 1: As the Referee pointed out, the lower level cloud cover is underestimated by satellites over the convective regions which makes the radiative transfer computations difficult. In order to circumvent this, we have used maximum/random cloud overlap approximation (section 3.1.1) in the study to determine the lower level

cloud cover for the TOA flux estimation using RRTM. Figure 1 in the manuscript portrays a typical cloud vertical structure developed the cloud overlap scheme. From Table 4, it can be seen that the lower level cloud cover is relatively lower compared to high and mid level clouds over the negative NETCRF regions. However, for modeling the TOA flux using RRTM, the recomputed cloud cover employing the cloud overlap scheme is used for the lower level clouds. The resulting cloud vertical profile will be having a structure (with cloud cover increasing from top of the atmosphere to bottom) similar to that shown in Figure 1. An inter comparison between RRTM derived and CERES derived CRF and TOA flux (Table 5 and table 6) shows good comparison indicating that the cloud overlap scheme was able to reduce the impact of uncertainty in the satellite derived low level cloud cover.

Reply to Comment 2: Model simulation of TOA flux over the negative NETCRF regions using RRTM showed that changes in cloud optical depth (COD) has little influence in the TOA flux when cloud optical depth is high (for COD >8). Over the Bay of Bengal and the western Pacific, the observed cloud optical depth values for the high level clouds are typically above the range where sensitivity of CRF to changes in COD are very much less. Hence we have not included the particular sensitivity test in the present study. But as the Referee pointed out, more insights in to the cloud radiative forcing can be obtained by the better knowledge of cloud micro-physical properties which can be achieved by making use of the CloudSat data. In the present study, CRF simulation using RRTM have used the single scattering albedo of ice and water cloud particles estimated for the four cloud layers. A better understanding on the vertical structure of cloud single scattering albedo will enable better modeling of CRF and TOA flux. However, this will be addressed in a separate study and will not be with in the scope of this manuscript.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 28895, 2013.