

## **Response to editor's Comments:**

**Jiming Li et al. (Author)**

**We are very grateful for the editor's detailed comments, which helped us improve this paper significantly. Some grammatical errors already were corrected in the revision. Based on the editor's suggestions, we also added more explanations and scientific discussions in the section 4 to make the manuscript more clear. All changes already were marked by using yellow color in revised paper.**

**L31:** drop "preliminary"

**Response:** We already removed it.

**L36 and L38:** replace standard deviation by another metric (mean absolute deviation positive/negative?) - since mean - 1 std dev is smaller than zero, impossible

**Response:** In revised paper, we added one sentence, "The result which the standard deviations are larger than mean values of cloud scale, was also found in the study of Zhang et al. (2014). They showed that the global mean Ac along-track horizontal scale is 40.2 km, but the standard deviation reaches 52.3 km. It is clear that the along-track horizontal scales of these cloud systems all have considerable variations globally" (See Line 368-373).

**L40:** specify with regard to what the 41% are considered

**Response:** In revised paper, we already added some descriptions in abstract and section 3.3 (see Line 38-42, Line 640-645).

**L43:** specify what the "entire multilayered cloud system" is

**Response:** We already replaced the "entire multilayered cloud system" with "all multilayered cloud systems" (see Line 44).

**L49:** this is probably 40 °N?

**Response:** We already corrected it, and it must be 40 °S (see Line 50).

**L66:** re-formulate "particularly significant" to more precisely say what is meant.

**Response:** We already re-formulated it in the revised paper (see Line 66-69).

**L99:** Also clarify the limits of ground-based radar.

**Response:** We already added the related descriptions of ground based radar in the introduction (see 106-109).

**L103:** “frequencies, respectively” since observers often dont see high, satellites not low clouds.

**Response:** We already revised it.

**L104:** why retrievals and radiative effects?

**Response:** Since passive satellite retrieval techniques are based on the typical single-layered cloud assumption, thus it is difficult to retrieve the exact cloud properties and cloud radiative effects of the multilayered cloud systems (see Line 104-106).

**L105:** should this read: single-layered?

**Response:** It must be “specific multilayered (or single-layered) cloud systems” (see Line 111).

**L141:** comma rather than slash between cirrus and cirrostratus

**Response:** We already corrected it (see 146).

**L167:** In my browser, the link does not work. Please correct.

**Response:** We already corrected it (see 172).

**L266:** More generally, it is the large-scale circulation that matters.

**Response:** we already revised it (see Line 271-275).

**L287:** “near 30<sup>°</sup>” a space is missing

**Response:** we already corrected it (see Line 287).

**L295:** “may even” please specify “over ocean”

**Response:** we already added this information (see Line 304).

**L297:** “under large-scale subsidence regions”: where does this information stem from?  
it is not obvious from Table 1.

**Response:** we already deleted the somewhat vague expression in the revised paper (see Line 306).

**L369:** “cloud radiative effect”: The spectral range needs to be specified (solar? terrestrial? net?)

**Response:** we already added the related information in the revised paper (See Line 202-207 and section 3.3).

**L370:** “during daytime”: how is this averaged? Or is it instantaneous at overpass time?  
Specification needed.

**Response:** In this study, the cloud radiative effect only is the instantaneous net effects at the overpass time of the satellites during the daytime. We added the information in the section 2 (See Line 202-207).

**L392:** atmospheric heating of up to 3 Wm<sup>-2</sup>: from the numbers in L407 it seems 3 Wm<sup>-2</sup> is rather the average effect, and Fig. 7 shows very large differences between toa and sfc. What is the actual range?

**Response:** In the revised paper, we added one figure as the supporting material (see Figure S1), and related descriptions are also added in the section 3.3 (see Line 403-411).

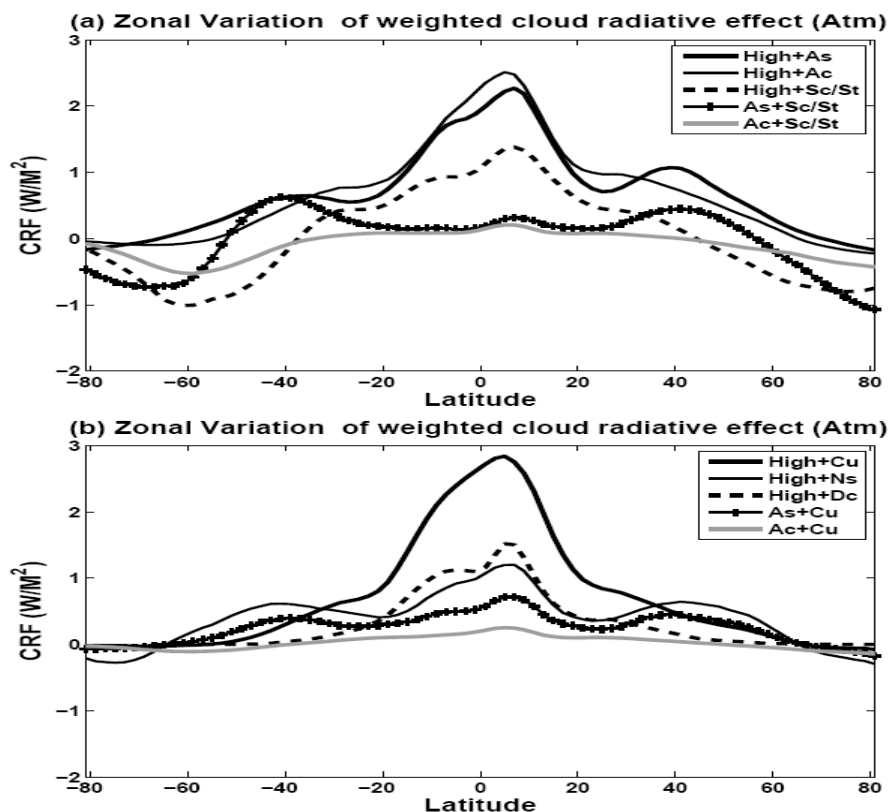


Fig. S1: Same with Figure5, but in the atmosphere during the daytime.

The Fig. S1 shows that the zonal variations of the instantaneous net cloud radiative effects of different multilayered cloud types in the atmosphere are very distinct. Most

of the multilayered cloud types heat atmosphere (their peak values range from 0.5 W/m<sup>2</sup> to 3 W/m<sup>2</sup>) almost at all latitudes except As+Sc/St, Ac+Sc/St and High+Sc/St cloud systems, which cause a weak atmospheric cooling (peak value is approximately -1 W/m<sup>2</sup>) at mid and high latitudes. In addition, statistical results also further show that the combined net CRE of the ten multilayered cloud types in the atmosphere decreases from the tropics to high latitudes, its value ranges from 13 W/m<sup>2</sup> (heating effect) to -3 W/m<sup>2</sup> (cooling effect). The difference of radiative effect between TOA and surface in Figure 7 only is the combined effect of the ten multilayered cloud systems.

**L396:** “on a global scale”: these are, however, in-cloud values, aren't they? Needs explanation.

**Response:** These values are the global mean instantaneous net radiative effects of the ten multilayered cloud systems (range from -100 W/m<sup>2</sup> to -350 W/m<sup>2</sup>), they aren't the weighted radiative effects. (see 412-414).

**L421:** A brief discussion would be useful on the scale-dependency of the overlap parameter (linking back to chapter 3.3) and then a clarification at which scale this analysis is performed.

**Response:** we already added the related discussion and information in the section 4 (see Line 468-477, Line 485-488)), and the scale used in this study is 2 °×2 °.

**L454:** tend to be

**Response:** We already revised it.

**L470:** “rather than”: this sentence is difficult to understand and needs reformulation

**Response:** we already re-formulated this sentence (see Line 503).

**L475:** considered better on which basis?

**Response:** We already revised it (see Line 495-497; 506-508).

**L487:** why “approximately”?

**Response:** We already corrected similar errors.

**L590:** A discussion would be useful on how the result, that minimum overlap tends to be a decent approximation in not few cases, might depend on observation limitations. Truly minimum overlap is what ISCCP or another passive sensor

would observe. Why do the active sensors also tend into this direction?

**Response:** We appreciate the insightful suggestion made by editor. In fact, negative overlap parameters indicate that fractions of cloud overlap are overestimated by random overlap assumption at mid and high latitudes of two hemispheres, and a tendency for an even more minimal degree of overlap than that predicted by the random overlap assumption is exist over there. Due to passive sensors (such as, ISCCP) usually fail to detect effectively the cloud overlap, thus minimum overlap is what ISCCP or another passive sensor would observe. However, why do the active sensors in our results and previous studies (Hogan and Illingworth, 2000; Mace et al., 2002) also tend into this direction over those regions? We consider the reason possible is as cloud features in one bigger grid box (here,  $2^{\circ} \times 2^{\circ}$ ) associated with vertical wind shears (or other dynamical factors in those regions) that are sloped in space to become more grouped together, thus trending toward increasing cloud cover over there. But, similar trend whether can be observed by active sensors in a smaller spatial scale (such as,  $1^{\circ} \times 1^{\circ}$ ) still needs to be confirmed in the future study by using this dataset.

**L603:** “more likely” than what?

**Response:** We already revised it (see Line 635).

**L609:** radiative contributions: the radiative effect numbers are in-cloud?

**Response:** We already revised it in the revised paper (see Line 641-645).

**L1061 (Caption Fig. 5):** please specify how the weighting is done, and whether it is in the solar or terrestrial spectrum, or net, and whether “during daytime” is averaged over a certain period (length of day?).

**Response:** Related information already was added in the caption Fig. 5.

**L1120:** specify “relative difference”, probably “relative difference between real and random overlap”

**Response:** we already revised it.