Response to Review #2

This paper deals with the estimation of longwave cloud radiative forcing from model outputs and the associated limitations when compared to satellite products. The paper is compact and clearly written. It conveys the point of the authors very efficiently. The overall result of the study is of importance to the climate community. I recommend publication after minor comments are addressed:

1) How such an "clear sky vs. cloud free" error compares with the sampling error found in the satellite products when monthly mean CRF are concerned. I suggest to provide an error budget for the satellite CRF (for instance for CERES e.g. Wielicki et al., BAMS, 1995) and to discuss the present source of error with respect to it.

2) I am not comfortable with the statement that "10% of the total longwave CRF should be added ". I think it is better to convey to the readers that an error of 10% is to be expected with the present computations of CRF in the longwave. Indeed one can easily imagine running from the full resolution model outputs, a broad band radiative transfer model "off-line" and hence computing the clear sky OLR as the satellite would have done. Such comparisons would hence not suffer from the present error. Please discuss how the off-line approach would permit having more consistent satellite and models comparisons.

Thanks for comments. We fully accommodate comments in the revision, and now following discussion is provided in the Summary and discussion section.

The observation errors of monthly mean CERES longwave fluxes at the TOA are claimed to be around 1.7 W m^{-2} for a given region (Wielicki et al. 1995). However, the coarse resolution of CERES seems to induce additional error in the clear-sky flux because cloud-free scenes are determined from 10 km resolution pixels. A recent study of using high-resolution MODIS data suggests that CERES clear-sky flux is overestimated by 0.3 Wm^{-2} due to larger CERES footprints (Loeb et al. 2009). It was interpreted that differences in temperature and humidity near the cloud edge resolved by high-resolution Moderate Resolution Imaging Spectroradiometer (MODIS) measurements may induce decreased clear-sky flux. It is particularly true for UTH because UTH decreases rapidly within 50 km from the cloud edge (Udelhofen and Hartmann, 1995). Thus errors in CERES clear-sky flux (or CRF) amount to 1.9 ±0.3 Wm^{-2}. If we take satellite-derived CRF as a representative, then CRF attributed by a dry bias of clear sky may be considered as an error of model-generated CRF. And the bias larger than 5 Wm^{-2} over most of convective areas must be much higher than expected measurement error. Thus caution should be exercised when model-generated CRFs based on the conventional approach are compared with satellite measurements. In order to compare model-generated CRFs with satellite estimates in more consistent manner, the cloud-free composite method can be used with outputs from full resolution model, in conjunction with off-line radiative transfer calculations. Likewise results suggest that the near cancellation between longwave and shortwave cloud radiative forcing found in satellite measurements (e.g., Hartmann et al, 1992; Kiehl, 1994) should not be same in model simulations unless the cloud-free composite method is used.

Loeb, N. G., B. A. Wielicki, D. R. Doelling, G. L. Smith, D. F. Keyes, S. Kato, N. Manalo-Smith, and T. Wong, 2009: Towards optimal closure of the Earth's top-of-atmosphere radiation budget. J. Climate, 22, 748-766.

Udelhofen, P., and D. L. Hartmann, 1995: Influence of tropical convective cloud systems on the relative humidity in the upper troposphere. J. Geophys. Res., 100, 7423–7440.
Wielicki, B. A., R. D. Cess, M. D. King, D. A. Randall, and E. F. Harrison, 1995: Mission to planet Earth: Role of clouds and radiation in climate. Bull. Amer. Meteor. Soc., 76, 2125–2153.