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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Cirrus cloud radiative effect on surface-level shortwave and longwave irradiances at regional and global scale" *by* J.-C. Dupont et al.

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GENERAL COMMENTS

Point 1 : In general, you have presented too many tables for people to focus on. You may shorten your Tables or condense them into a few. Response 1 : As suggested by the referee, we decide to remove two Tables (previously table 3 and table 6). We add this information in the text body. See modifications in [22] and [33] .

SPECIFIC COMMENTS

Point 1 : CRE: In the paper, you use the Cloud Radiative Effect on the surface, while

most of studies used Cloud Radiative Forcing. Although it is not big deal to use CRE or CRF, it is better to consistent with other studies. Also in your Tables 9 and 10, you used CRF.

Response 1 : We agree with the referee and we replace "cloud radiative effect (CRE)" with "cloud radiative forcing (CRF)" in all the document. See modification in all the document.

Point 2 : Table 2a, After comparing your results with ours I find that your SGP IWV results are nearly the same as ours although the time periods are different from two studies, this is a good sign. However, I find your NSA IWV values a slight off comparing with our 10-yr results as listed in our table 1, especially for Autumn season. Later on I find that you used only Sept value (in your Fig. 1) to represent Autumn, this is not right. You should delele the Autumn value in your Table 2 if you have only one month results. Also, you need to mention your results are the averaged for all-sky conditions because you study CRF, people may think they are under clear-sky conditions.

Response 2 : As suggested by the reviewer, we remove the NSA IWV for the fall season in the Table 2. In fact, September month only is not representative of all the season. Moreover, we follow the reviewer's suggestion and we add the information concerning the state of the sky (in Table 2 caption and in [11]). Here is the new Table 2 caption "Table 2: Seasonal and annual averages of integrated water vapor (IWV in cm, for all-sky conditions) and aerosol optical thickness (AOT, for clear-sky conditions) in the Table 2A, cirrus cloud base altitude (CBH in km) and optical thickness (COT) in the Table 2B at ARM SGP Lamont, ARM TWP Nauru, ARM NSA Barrow, and SIRTA Palaiseau sites (for cloudy-sky conditions). See modification in Table 2 and in [11].

Point 3 : Table 3: Your average SW CRF at the SGP is -40.9 Wm-2, which is close to ours (37 Wm-2), however, it is inconsistent to the Table 9 value (-33.1 Wm-2). What's different between two tables? You use different data sets or use different methods to average them? I also find the Table 10 (cumulative cirrus CRF) is confusing, what is

the cumulative CRF?

Response 3 : We agree with the referee's remark concerning the difference between SW CRF values in Table 2 and 9. This is due to the different methods to calculate the CRF. In fact, in Table 2, we calculate directly the CRF in using the difference between measured cloudy-sky flux value and clear-sky model ([22] and [33]). Whereas in Table 9, we use equation 1 and 2 to process CRF*SW and CRF*LW and next we multiply by the cloud properties derived from lidar and radiosoundings. Hence, the dataset are different, lidar COT rather than sun-photometer COT, and the methods to process CRF are also different. These methods are explained in [42] : "[42] Cirrus cloud optical thickness values used to adjust equations 1 and 2 are collocated with the SW and LW downwelling irradiance at the ground-level. However, the method developed and explained in section 3.1.3 significantly limits the sampling over each site. Hence, in this section, we used directly the equations 1 and 2 providing CRFSW and CRFLW starting from cirrus cloud properties and atmospheric composition. To significantly increase the data set and be able to study the annual variability of cirrus cloud forcing, we derive the cirrus cloud optical thickness from lidar observations (Morille et al., 2007 and Cadet et al., 2005) rather than AERONET. Cloud optical thickness is retrieved for cloud layers using a standard transmission-loss algorithm (Platt, 1973).". See modification page 18. We agree with the referee suggestion and we add some comment concerning the calculation of the cumulative cirrus CRF. In our study, the term "cumulative" is defined as the cirrus cloud instantaneous forcing "normalized" for all-sky and for all-time. We obtain the cumulative CRF by multiplying the instantaneous CRF with the cloud fraction for daytime and nighttime period. We add "Cumulative forcing corresponds to the instantaneous CRF multiply by the cloud fraction distinguishing the daytime and nighttime period". See modification page 19, [45].

Point 4 : Table 11: Although I do not have global observations to validate your results, I find that your CRFs between 15S to +15N, 15-45N and 45-75N are inconsistent to your Table 9 (ARM TWP and SGP results) and our NSA Table 1 results. Please double

check your results.

Response 4 : As suggested, we double check our results concerning the Table 11, the Table 9. Finally, we validate our results concerning the CRF at global scale. In fact, we explain the major difference between regional forcing and global forcing with the very high heterogeneity of IWV and COT for a similar latitude/longitude. In fact, considering the COT and IWV map shown below, we conclude that: - Nauru is not totally representative of 15°S-15°N region. This site is characterized by very strong IWV and COT values which engender high CRFSW and relatively low CRFLW and hence a strong value of CRFNET at regional scale. - The regional sites, i.e. Palaiseau and Lamont sites, have a cirrus cloud optical thickness stronger than the average 15°N-45°N region hence the CRFSW and CRFLW tend to be stronger at regional scale. However, Palaiseau and Lamont sites are wetter than the average IWV in the 15°N-45°N and hence the CRFLW is a little bit stronger at regional global scale compared to CRFSW. - Barrow cloud radiative forcing calculated in your table considers all clouds and not only high altitude clouds. Consequently, your CRF is logically stronger that our CRF and it is difficult to compare each CRF.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 26777, 2009.

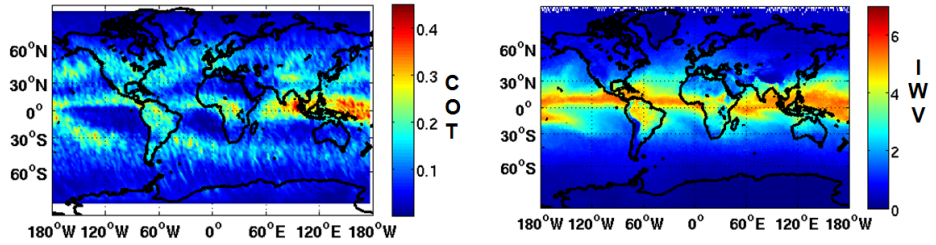
60°N
30°N
0°
30°S
60°S
180°W 120°W 60°W 0° 60°E 120°E 180°W
0.4
0.3
0.2
0.1
COT
60°N
30°N
0°
30°S
60°S
180°W 120°W 60°W 0° 60°E 120°E 180°W
6
4
2
0
IWV

Fig. 1.