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Interactive Comment

Interactive comment on "Radiation budget estimates over Africa and surrounding oceans: inter-annual comparisons" *by* A. Ben Rehouma et al.

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We thank for the very detailed review. We give more quantitative results in the form of statistical error analysis and reply according to the numbering of the review. The revised version will take into account these comments.

1- Compared to the Nonscanner, the Scanner data have a spatial resolution much more appropriate to our regional studies. As outlined in the review, their radiometric accuracy is not as fine as desirable. But it is documented. The ERBE and ScaRaB instrument calibration studies estimate the absolute accuracies of the LW and SW radiances respectively to 1% and 2% (Barkstrom et al., 1989, Kandel et al., 1998). The accuracies of CERES are 0.5 and 1% respectively (Wielicki et al., 1996). For

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CERES, a SW calibration drift of 1.5% has been detected and seems to have occurred when the instrument operated in rotating scan mode (Matthews et al., 2005). This drift is corrected in our datasets. Furthermore cross-checking between two scanners (Haeffelin et al, 2001) and between Scanner and Non scanner (Smith et al, 2006) have shown differences at the 1% level.

2- Regional signals are larger than global variations, but may have larger errors (5-10 Wm**-2) due to combined angular and diurnal effects. These errors are specifically important for the monthly means when they have been generated from only one sun-synchronous satellite. But they are limited for the data we have considered: the ERBS dataset (precessing orbit), the ISCCP-FD data (observations each three hours) and the average of the morning and afternoon data for CERES.

3-Yes, regional anomalies can be related to calibration through the scene identification and the choice of the anisotropy correction. However, because the flux is first related to the radiance, this secondary effect is limited if the calibration errors are reasonable. We were aware of this limitation and moderated our statement by saying in the abstract that 'these anomalies are mostly independent on the observed trends which may be affected by possible calibration drifts'.

But we agree that this simple assertion is insufficient. One of us (MV) has simulated these errors by applying the ERBE-like processing to Radiation Budget data (several months of ScaRaB data, Kandel et al., 1998). We change the SW and LW radiances respectively by 2% and 1% corresponding to the nominal accuracy of the absolute calibration of the scanner instrument (see item1). These modifications affect the scene identification and the instantaneous flux estimate. New monthly regional means are then computed and compared to the original results. In order to be coherent with the method used in the submitted paper, the regional differences are first estimated and then the mean difference over the large area is removed.

The worse cases correspond to opposite changes: decrease of SW (-2%) and increase

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of LW (+1%), both concurring to shift the scene identification towards less cloudiness. In this case, simulations were carried out for four months (March, May, September, December 1994) corresponding to different local times of the ascending node (the orbit was slowly precessing). The standard deviations of the regional differences range from 0.57 to 0.81 Wm**-2 (SW) and from 0.23 to 0.27 Wm**-2 (LW), respectively smaller by a factor 10 and 20 compared to the standard deviation of the regional anomalies shown figures 5 and 6 of the ACPD paper. In the SW domain, these error estimates are maxima, since they are based on only one observation per day. When several observations per day are involved, these errors decrease by compensation effects.

We have also studied the case of an extreme calibration drift (LW +2%, SW -4%). In that case, the impact is higher and increases the risk of misinterpretation. For the May monthly means, it can be confused with a decrease of the net flux over the southern hemisphere. However, even in that extreme case, these errors are significantly smaller than the observed temporal change (by a factor 5).

Conclusion of these studies: the impact of the calibration on the regional anomalies is smaller than the observed change, specifically if the possible calibration drift is reasonable (1-2%). Such a discussion was missing in our ACDP text and will be raised in the revised version.

4- The slope and 2-sigma uncertainty of the trends shown on figure 8 have been calculated according to Weatherhead et al (1998) by taking into account the variance and autocorrelation in the data. The three slopes are positive. However, when taking into account the 2-sigma uncertainty, only the ISCCP-FD case shows a significant increase (slope 3 Wm**-2/ decade, 2-sigma=1.6 Wm**-2 / decade). In that case, the observations shown on figures 7d and 8c are confirmed.

5- The extension of the region to 50° latitude to improve the match with the Nonscanner data has been studied, and the results of table 2 and figure 8 compared. The differences are not significant ($<$0.5 Wm**-2 for table 2, $<$0.1 Wm**-2 /decade for the figure

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8 slopes).

6- Mapping the standard-deviation is the first step to emphasize the areas of large inter-annual variability.

7- Figures 7 d and c of the ACPD paper show an increase of the net flux over the Sahel zone. For a better understanding, we have calculated the 10° W to 10° E flux average as function of latitude and we have studied each month. The increase is specifically marked for the beginning of the rainy season months (April to August). The variation in the Net flux, shown in figures 7d and c of the ACPD article, results from different LW and SW variations. For the May monthly mean for example, the Net flux difference reaches about +10 Wm**-2 around 15° N. It results from negative differences for both LW and SW. Observed both with ISCCP-FD and Scanner data, the LW and SW minima occur respectively between 10 and 15°N and between 15 and 20°N. The decrease of the SW flux is not associated with the increase of LW flux suggesting complex variation of low and high clouds and of surface albedo.

8- In table 2 of the ACPD version, the comparison periods used for each pair of dataset were different, and they were given in table 2 caption. As suggested by the review, we have prepared a new table showing the differences for the periods (1985-1989) when the three datasets were concurrent (1985-1989). The changes don't exceed 1 Wm**-2 and our conclusions remain valid: the largest LW difference does not rise above 3 Wm**-2, the ISCCP-FD SW flux is the highest by about 7 Wm**-2.

9- The slope and 2-sigma uncertainty of the trends shown on figures 3 and 4 have been calculated for the common period 1985-1998, except the years (1991-1992) have been removed (Pinatubo events). Both Scanner and ISCCP-FD slope are significantly different from zero. But, in section 3.3, as well as in the abstract, we write clearly that these observed Scanner and ISCCP-FD trends could be real or spurious (due to calibration draft). It is the reason why we try to limit the impact of possible calibration drift by subtracting the averaged trend to the regional mean flux of these two datasets.

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The Nonscanner data are more robust (Wong et al., 2006), but less appropriate for regional analysis due to their coarse resolution.

10- In section 3.4, second paragraph, regression coefficient is used erroneously instead of correlation coefficient.

11- We will add in section 3.4 that the Nonscanner 20-year change is based on 15-year extrapolation.The slopes and their uncertainties from the above section 4 have been computed for this 15-year period 1985-1998. The mean slopes are slightly larger: 1.8, 1.7, and 5.0 Wm**-2 / decade respectively for Scanner, Nonscanner and ISCCP-FD. But the Scanner slopes become totally insignificant (2-sigma=7 Wm**-2). This is not the case of ISCCP-FD for which the confidence in a positive difference increases (2-sigma=3.1 Wm**-2).

12- The 4 Wm**-2 uncertainty corresponds to the 2-sigma of the ISCCP-FD trend. It corresponds also to the scatter corresponding to the 3 series.

Conclusion: We thank the reviewer to insist on the numerous possibilities to confuse real or spurious changes. The revised version will take into account the reviewer's comments. We have tried to study the relevance of subtle temporal changes by using three independent dataset and by looking to the regional anomalies. Beyond the regional analysis over Africa and surroundings we hope this discussion will be useful to illustrate the difficulty for detecting changes or trends in satellite datasets and to emphasize the need of improved radiometric calibration.

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