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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Analysis of the decrease in the tropical mean outgoing shortwave radiation at the top of atmosphere for the period 1984–2000" *by* A. Fotiadi et al.

Anonymous Referee #2

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General Comments:

This study examines the anomaly in reflected solar radiation ("outgoing solar reflectance" or OSR) in the tropics using a simple radiative transfer model with inputs from the ISCCP dataset. The study shows a 1.9 W m^{-2}/decade decrease in OSR based on data between 1984 and 2000, consistent with prior studies. The main argument presented is that a change in cloud amount is the likely cause for the change in OSR.

Since the model uses ISCCP cloud amount as input to determine OSR flux, it is not

clear how meaningful it is to perform a correlation analysis between model OSR flux and ISCCP cloud amount. The correlation is simply be a measure of the model's sensitivity to cloud amount. How representative of the real world are the results? The authors should at least check this by comparing the correlation obtained between ES-4 OSR flux and ISCCP cloud amount with that obtained between the model OSR flux and ISCCP cloud amount. Admittedly, they can only do this for 1985–1989, since there is no ERBE-S4 scanner data after that. Nevertheless, this should be useful in verifying their correlation coefficients between OSR anomaly and cloud amount.

The authors should show a difference plot between their model results and the ERBE-S4 OSR values in Fig. 1.

The figure quality needs to be improved. Figs. 3, 5 and 6 are particularly poor. These are amongst the worst quality figures I've seen in years in a paper submitted for publication. There is no excuse for this.

With these important changes and those listed below, the paper is acceptable for publication.

Specific Comments:

Abstract: Specify version number of ERBE S-10N non-scanner data. Is this version 2? Recent corrections to the ERBE-S-10N non-scanner data has resulted in a different tropical mean OSR trend. It is now 2.1 W m^{-2} (see slides 4–7 in Wielicki Science Team Meeting Presentation http://asd-www.larc.nasa.gov/ceres/STM/2004_11/wielicki_how.pdf).

"...indicating an increase in solar planetary heating equal to..."
The authors should remind the reader that the increase in absorbed solar radiation is accompanied by an increase in emitted terrestrial radiation (or OLR), so that there is no change in net radiation. Otherwise, this sentence can be misinterpreted as implying a change in the Earth's TOA radiation budget, which is not the case.

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p. 3 Define acronyms (ERBS WFOV, ERBE/ERBS, ScaRaB, CERES).

p. 5 1st paragraph
"For example, the impact of various cloud types on the OSR trend, as well as the relationship between the trend in OSR and that in the amount of different cloud types should be determined."

This is sentence is unclear. Are you referring to the relationship between OSR anomaly and the anomaly in cloud amount for different cloud types? How is "cloud type" defined?

p. 5 last paragraph
This study appears to be very similar to Hatzianastassiou et al. (2004a). The authors should explicitly state what is different about the present study.

p. 6 middle of page
What is meant by "pixel"? Is this a $2.5^\circ \times 2.5^\circ$ latitude-longitude region?

p. 7 *"Therefore, the ISCCP is appropriate for studying possible trends, while it is very important that, apart from cloud cover, it also provides cloud optical depth, which is essential for modeling studies."*

What are the uncertainties in the ISCCP variables?

p. 7 *"The model required input data for cloud amount and cloud optical depth are taken by the ISCCP-D2, which provides corresponding data for nine cloud types."*

How does the model use cloud amount as input? Does the model assume a plane-parallel atmosphere? If so, does the model assume that flux is a linear function of cloud amount?

"Low-level clouds are considered to be: Cu, St and Sc clouds...".

Note that these classifications should not be taken literally.

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Also, are the cloud phase functions (for ice and liquid water) in the model consistent with those used in the ISCCP retrieval algorithm?

p. 8 *"...but they have only started their operation from the year 2001."*
- Actually, MODIS operation is from 12/99–present; POLDER-I from 08/96–06/97; POLDER-II from 12/02–10/03.

p. 9 *"The validation was performed at pixel level for all pixels within the 30S-30N zone..."*
Use of the word "pixel" is inappropriate since the ERBE instrument scanner pixel resolution is close to 40 km, not 2.5 deg. Use the term "region" when referring to ERBE-S4 2.5 deg latitude-longitude data.

p. 9 Consider adding a difference plot in Fig. 1 (i.e., Fig. 1c = Fig. 1a minus Fig. 1b). Alternatively, show model results in Fig. 1a and model minus ERBE-S4 in Fig. 1b.

p. 10 Consider breaking Section 4 into two subsections. For example, the first section might be called "4.1 Tropical Interannual Anomalies: Model vs ERBE S-10N". Section 4.2 would logically start on p. 12 before the last paragraph ("It has been suggested..."). The title of Section 4.2 might be "Correlation Analysis of Model OSR and ISCCP Cloud Fraction Anomalies".

p. 10 *"...and are shown in Fig. 3 (solid line)."*
There are four solid lines in Fig. 3. Be more specific.

Describe how the anomaly in Fig. 3 is determined. For example, is this a deseasonalized anomaly (dx(yr,mn) = x(yr,mn) - $<$x(mn)$>$)?

The cloud amount anomaly line is difficult to see. Please improve figure quality.

p. 13 *"To further investigate and quantify the apparent correlation between the anomalies of OSR flux and total cloudiness over the tropical region, we performed a correlation analysis between the anomalies of model OSR flux and total Ac at 2.5$\times$2.5 pixel level on monthly mean basis..."*
Since the model uses ISCCP cloud amount as input to determine OSR flux, how mean-

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ingful is it to perform a correlation analysis between model OSR flux and ISCCP cloud amount? Isn't the correlation simply a measure of the model's sensitivity to cloud fraction changes? How representative are these results? The authors should at least check this by comparing the correlation obtained between ES-4 OSR flux and ISCCP cloud amount anomalies with that obtained between the model OSR flux and ISCCP cloud amount anomalies. Admittedly, they can only do this for 1985–1989, since there is no ERBE-S4 scanner data after that.

p. 13 *"To further investigate and quantify the apparent correlation between the anomalies of OSR flux and total cloudiness over the tropical region, we performed a correlation analysis between anomalies of model OSR flux and total Ac at 2.5×2.5 pixel level... The total 704 658 pixel matched data pairs give a correlation coefficient equal to 0.79, indicating that the decrease in tropical cloud cover is mostly responsible for the satellite-observed and model computed decadal trend (decrease) in tropical OSR at TOA."*
Again, you can't really make this conclusion until you've shown that the correlation between model OSR flux and total Ac anomaly is equivalent to the correlation between observed OSR flux and total Ac anomaly.

Why does the relationship in Fig. 4 appear to be nonlinear?

p. 14 *"...the 17-year (1984–2000) time series of monthly mean 10 deg zonally averaged OSR flux and Ac anomalies..."*
Here and in subsequent places, the authors should replace "OSR flux anomaly" with "model-based OSR flux anomaly".

p. 14 *"According to Figs. 5 and 6, both cloudiness and OSR flux anomalies..."*

Much of this discussion is a repetition of the preceding sentences. Please remove redundancy on p. 14–15. The highlights can be made much more concisely.

p. 16 *"...and the OSR is more sensitive to low clouds rather than to mid- or high-level*

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clouds...”
Why is this true? Please explain.

p. 15 *“...and whenever a statistically significant long-term trend was found...”*
How is “statistically significant long-term trend” defined?

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 455, 2005.