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Interactive comment on "Global distribution of Earth's surface shortwave radiation budget" *by* N. Hatzianastassiou et al.

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A. General Comments

The present work (dealing with downward surface shortwave, SW, radiation, DSR) is a significant improvement to the previous work by the authors. Not only ISCCP-D2 data are used in this study instead of ISCCP-C2 ones, but other improvements were also achieved. There are various improvements to the model, which are specified in section 2; for example, the treatment of clouds in terms of their optical properties relevant to their liquid/ice phase. In addition, this study is performed at the "grid-cell" level, while the previous ones were carried out on a latitude zonal mean basis, thereby reducing uncertainties related with spatial non-linear relationships between radiative fluxes and the model input physical parameters. Of course, we agree that it is still based on cal-

culations using monthly mean datasets, not daily ones, as mentioned by the Referee. However, we would like to clarify that we also run our model using daily mean data. There are two reasons for which we present the monthly mean input data-based model results in this study. First, the scientific community needs handy and flexible tools (models), which can predict accurately the global distribution of surface SW radiative fluxes. Secondly, the availability of daily mean data is shorter (10-year long) than that of the ISCCP-D2 monthly mean (17 years). This is essential since the SW radiation budget is not stable but changes with time. Nevertheless, to address the Referees' concern, we would like to note that we have made extensive comparisons between our monthly mean input data-based model DSR results, and the corresponding ones obtained using daily mean data. The scatterplot comparison over 1.142.330 data pairs revealed a very good agreement, with a correlation coefficient equal to 98.5% and a standard deviation of differences equal to 13.7 W m-2. The above have been mentioned in the text (Introduction, pg 4550, line 7), as suggested by the Referee. In addition, the term "pixel" was replaced by "grid-cell" throughout the text, as suggested by the Referee. As far as it concerns the slightly better agreement of our model results with GEBA than BSRN measurements, we believe that this rather small difference may be due to different reasons. For example, it might be associated with the quite smaller number of BSRN measurements (939) than that of GEBA (27858), which is in turn attributed to the shorter time period covered (1992-2000 against 1984-2000). Also, it is possible that it has to do with the geographical distribution of the stations: a significant number of BSRN stations (7 out of 22) are located poleward of 50°N and S, while GEBA includes a small fraction of stations (out of the 700 used) located in sub-polar and polar areas. This is essential since it is well known that the high-latitude areas are worst sampled by satellites than lower-latitude areas. This has been stated in the text (section 6, pg 4573, line 9), as indicated by the Referee.

B. Specific Comments

0. Abstract. The word "very" in line 14, page 4546 of the Abstract was removed. Also,

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the part “which is not possible with surface measurements”, lines 17-18, page 4546, was removed from the text. The parts “the commonly reported” in line 28, and “found also in our study” in line 1, page 4547, were also deleted to make the meaning clearer.

1. Introduction. Much of section 2 was removed, as suggested by the referee, in order to shorten the manuscript.

2. Section 2 (Model description). An effort was made to shorten the length of this section, as indicated by the Referee. In lines 21-22, page 4552, the text which reports to comparison between model computed and ERBE-S4 measured incoming solar flux at TOA, was made more clear, as suggested by the referee.

3. Section 3 (The Model data). The water vapour and temperature data used to compute the DSR fluxes shown in this study, were taken from the NCEP/NCAR reanalysis, although in section 5 comparison between DSR fluxes obtained by using either NCEP/NCAR or ECMWF data is addressed. This is now clarified in the text, section 3.1, page 4556, line 11.

4. Section 4 (Model results). Some parts of the description of results were removed from the text to shorten it. Lines 22-25, page 4559, “Ĕ scattering and absorption processes Ĕ between Ĕ radiation and surface Ĕ parameters Ĕ” has been removed. Line 2, page 4560, “and secondarily by clouds” is now removed as well. Lines 6 and 11, page 4561, the words “very” were dropped, as suggested by the Referee. Lines 22-23, page 4562, the sentence “Although the net DSR Ĕ some differences” was rewritten to be consistent. Line 20, page 4562, “should be” was replaced by “are” to underline that present results are better than our previous ones. Line 11, page 4564, a note was made about the uncertainties in trends of DSR and net DSR fluxes, induced by uncertainties in model input data. Pages 4565 to 4566, the occurrence of large negative DSR anomalies in year 1988 has been clarified, and the relevant possible sources have been reported. As for the 1988 El Nino, this can be seen, though not so clearly, in our results. Note that the anomalies presented in Figs. 6 a,b refer to the globe, not just

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the tropics. The 2001-2003 El Nino is not covered by our study period (1984-2000). However, the strong decrease in DSR anomalies by the end of year 2000 (down to values of -2 to -3 W m-2) seems to be related to this El Nino event. The above have been mentioned in page 4566, line 3. Page 4567, end of first paragraph, comments were made on which results are better, in terms of agreement with surface observations.

5. Section 5 (Sensitivity of surface SW radiation budget). A long series of sensitivity studies has been performed with our model, in which each model input physical parameter was subjected to various changes, either in absolute or relative terms. However, we have chosen to show in this paper only the results of those sensitivity tests in which the various parameters were subjected to relatively reasonable changes. This has been done to assess the effect that variability and uncertainty of the atmospheric and surface parameters used by our model can have upon the computed DSR and net DSR fluxes, globally and at the grid-cell level as well. In the future, however, more advanced sensitivity studies will be also performed to meet more realistic changes/tendencies observed in our Earth-atmosphere climatic system. In these sensitivities, combined modifications of different physical model input parameters (surface and atmospheric ones) should be considered.

6. Section 6 (Summary and conclusions). Page 4573, line 20, a note was made to explain the larger differences between our model results and BSRN than GEBA measurements, despite the higher quality control of BSRN than GEBA. The possible causes have been also reported in section 6 (comparison with surface-site measurements), page 4573, line 9.

7. Table 2. Old and less representative references were removed from Table 2. In addition, the list was updated, including the works published since autumn 2004, i.e. after the submission of this paper.

8. Figures 3 and 4. Better latitude labels were used in both Figures, as suggested by the Referee. In addition, count of months (x-axis) has been replaced by month-year

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labels not only in Figs 4 a,b, but also in Figs 3a,b.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 4545, 2005.