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Long-term global distribution of earth's shortwave radiation budget at the top of atmosphere

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Abstract. The mean monthly shortwave (SW) radiation budget at the top of atmosphere (TOA) was computed on 2.5° longitude-latitude resolution for the 14-year period from 1984 to 1997, using a radiative transfer model with long-term climatological data from the International Satellite Cloud Climatology Project (ISCCP-D2) supplemented by data from the National Centers for Environmental Prediction – National Center for Atmospheric Research (NCEP-NCAR) Global Reanalysis project, and other global data bases such as TIROS Operational Vertical Sounder (TOVS) and Global Aerosol Data Set (GADS). The model radiative fluxes at TOA were validated against Earth Radiation Budget Experiment (ERBE) S4 scanner satellite data (1985–1989). The model is able to predict the seasonal and geographical variation of SW TOA fluxes. On a mean annual and global basis, the model is in very good agreement with ERBE, overestimating the outgoing SW radiation at TOA (OSR) by 0.93 Wm⁻² (or by 0.92%), within the ERBE uncertainties. At pixel level, the OSR differences between model and ERBE are mostly within ±10 Wm⁻², with ±5 Wm⁻² over extended regions, while there exist some geographic areas with differences of up to 40 Wm⁻², associated with uncertainties in cloud properties and surface albedo. The 14-year average model results give a planetary albedo equal to 29.6% and a TOA OSR flux of 101.2 Wm⁻². A significant linearly decreasing trend in OSR and planetary albedo was found, equal to 2.3 Wm⁻² and 0.6% (in absolute values), respectively, over the 14-year period (from January 1984 to December 1997), indicating an increasing solar planetary warming. This planetary SW radiative heating occurs in the tropical and sub-tropical areas (20° S–20° N), with clouds being the most likely cause. The computed global mean OSR anomaly ranges within ±4 Wm⁻², with signals from El Niño and La Niña events or Pinatubo eruption, whereas significant negative OSR anomalies, starting from year 1992, are also detected.

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