Construction of a Matched Global Cloud and Radiance Product from LEO/GEO and EPIC Observations to Estimate Daytime Earth Radiation Budget from DSCOVR

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Introduction

With the launch of the Deep Space Climate Observatory (DSCOVR), new estimates of the daytime Earth radiation budget can be computed from a combination of measurements from the two Earth-observing sensors onboard the spacecraft, the Earth Polychromatic Imaging Camera (EPIC) and the National Institute of Standards and Technology Advanced Radiometer (NISTAR). Although these instruments can provide accurate top-of-atmosphere (TOA) radiation measurements, they lack sufficient resolution to provide details on small-scale surface and cloud properties. Previous studies (e.g., Loeb et al. 2000) have shown that these properties have a strong influence on the anisotropy of the radiation at the TOA, and ignoring such effects can result in large TOA-flux errors. To overcome these effects, high-resolution scene identification is needed for accurate Earth radiation budget estimation.

Global GEO/LEO Composites

Selected radiance and cloud property data measured and derived from several low earth orbit (LEO), including NASA Terra and Aqua MODIS, NOAA AVHRR) and geosynchronous (GEO, including GOES, east and west), METEOSAT, INSAT-3D, MTSAT-2, and HIMAWARI-8) satellite imagers were collected at the time of each EPIC image to create 5-km resolution global composites of data necessary to compute angular distribution models (ADM) for reflected shortwave (SW) and longwave (LW) radiation.

EPIC-view Composites

Cloud and radiance data from the LEO/GEO retrievals within the EPIC fields of view (FOV) are convolved to the EPIC point spread function (PSF) in an analogous manner to the Clouds and the Earth’s Radiant Energy System (CERES) Single-Scanner Footprint TOA/Surface Fluxes and Clouds (SSF) product, but with a modified procedure to optimize spatial matching between EPIC measurements and the high-resolution composite cloud properties.

Producing EPIC Composites

To optimize PSF calculations, global composite data are re-projected to EPIC-perspective coordinates, and converted to proper physical units, if necessary (e.g., brightness temperature to radiance), to retain accuracy in the PSF averaging. To minimize under-sampling of the global composite data and to improve overall accuracy, the resolution of the EPIC-perspective coordinates is doubled, and nearest-neighbor sampling is used to re-project the composite data to the EPIC-perspective coordinates.

The PSF-weighted average value of each radiance and cloud property parameter is computed for each cloudiness type within every EPIC footprint based on the cloud mask parameter (cloud phase) from the global composite. The weighted values for each parameter are then stored (after any appropriate inverse conversion) within the five available data subsets, as well as surface type fractions within each EPIC footprint.

The composite data files provide well-characterized and consistent regional and global cloud and surface property datasets covering all time and space scales to match with EPIC.

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