IRS2012-182
International Radiation Symposium 2012
Dahlem Cube, Berlin, Germany, 06 – 10 August 2012

Surface Validation of Clouds & the Earths Radiant Energy System (CERES) Energy Balanced and Filled (EBAF) Data Product

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The CERES project produces the Energy Balanced and Filled (EBAF) product that contains global one-degree monthly mean top-of-atmosphere (TOA) and surface broadband shortwave and longwave irradiance based upon 10 years (Mar2000-Feb2010) of TOA broadband irradiance observations from CERES instruments on board NASA's TERRA and AQUA satellites. CERES longwave (shortwave) irradiances are known to have a 1% (2%) uncertainties leading to a TOA net imbalance in CERES Level 3 products. The calculation of EBAF irradiance includes a bias removal technique applied to force agreement with global ocean heat storage estimates from the Argo Program (Loeb et al., 2012). In the latest EBAF edition, surface irradiance is adjusted as well to remove biases consistent with recent measurements including active sensor measurement of cloud base, GEOS4 re-analysis of upper tropospheric humidity biases seen by AIRS retrievals and biases revealed by surface flux measurements. In this work we evaluate the calculated monthly mean surface irradiance provided by the EBAF product against observed surface fluxes from a number of surface locations around the globe. As well we compare the surface irradiance against the CERES SYN product that produces similar surface values but does not include the adjustments to balance the energy budget of the globe against independent variables, as does the EBAF product.

Comparisons are done of modeled monthly mean irradiance to observations at 37 surface sites for both un-adjusted and adjusted calculations. These sites are also grouped by similar phenology. Adjusted calculations show a significant reduction in modeled surface downward longwave irradiance compared to observations with a decrease in mean bias from -3.6Wm-2 to -1.3 Wm-2. Root mean square error is also reduced in the downward longwave irradiance from 10.6Wm-2 to 9.7Wm-2. Improvements in surface longwave irradiance are nearly uniform across scene types with the best improvement in the bias at the 5 desert sites considered. There was a slight worsening of bias at the 5 polar sites considered of $\sim$0.4Wm-2 though RMS was still improved at the polar locations by nearly 1Wm-2. In the downward surface shortwave irradiance we find an improvement of the mean bias error from 1.3Wm-2 to 0.2Wm-2 however there is essentially no change in the RMS which stays the same at approximately 12Wm-2. For downward shortwave irradiance the overall RMS did not change significantly from the unadjusted model calculations to the model with only a slight improvement of less than $\frac{1}{2}$ Wm-2 for the variously grouped surface sites.