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Comparison of clear-sky outgoing far-IR flux inferred from satellite observations and computed from three newest reanalysis data sets

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Outgoing far-IR flux from 0 to 400 cm^{-1} contributes to ∼20%-40% of total LW flux escaping from earth atmosphere to the space, but no directly spectrally-resolved observations of this spectral region has been made yet. To understand how good current data sets can be used to study the far-IR flux and its variability, we compare the near-globe (80ºS – 80ºN) outgoing far-IR flux inferred from collocated AIRS & CERES observations in 2004 and the counterparts computed from 6-hourly reanalysis data sets sub-sampled to the satellite trajectory. Three latest reanalysis are used: ECMWF ERA-interim, NASA MERRA, and NOAA/NCEP CFSR reanalysis. Following the previous studies (Huang et al., 2008), spectral anisotropic distribution models (spectral ADMs) are developed for five land surface scene types used in the CERES ADMs as well as for the extra-tropical oceans. The spectral flux over the entire longwave can be estimated from AIRS observations collocated with CERES observation. The spectral fluxes estimated by this approach agree well with collocated CERES OLR measurements. For six different surface types (ocean, forest, savannas, grassland, dark desert, bright desert), the monthly mean daytime differences between OLR derived in this way and collocated CERES OLR (OLR_AIRS – OLR_CERES) are -0.7 – 1.7 W m^{-2} with standard deviations ∼ 3 W m^{-2}. The nighttime differences are -0.41 – 1.41 Wm^{-2} with standard deviations ∼ 2 W m^{-1}.

The near-global (80ºS – 80ºN) monthly mean far-IR flux derived from collocated AIRS and CERES observations are then compared with what computes from three reanalysis. The monthly-mean difference is only -0.31, -0.42 and -0.54 Wm^{-2} for the ECMWF ERA-interim, NASA MERRA, and NOAA/NCEP CFSR, respectively. For CFSR and ERA-interim, the differences from observation are similar over two sub-bands, 0 – 200cm^{-1} and 200 – 400cm^{-1}. For MERRA reanalysis, the discrepancies between two sub-bands are much larger. We then further decompose each individual observation-reanalysis differences with respect to the column water vapor (CWV) and temperature. Composite curves from three reanalysis generally agree with each other. The far-IR difference tends to be positive (∼0.9Wm^{-2}) when CWV >6 cm and tends to be most negative (∼ -0.6 Wm^{-2}) when temperature is above 290 K. The spatial distribution of the observation-reanalysis difference is also examined. At last, the inter-reanalysis differences are discussed and linked to the humidity and temperature fields.