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Annual Changes in the spectrally resolved global and local Earth Energy Imbalance using the Sun as a Reference Radiation Source

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A new method is presented to derive spectrally resolved global and local annual changes in the Earth Energy Imbalance (ΔEEI(λ, Δλ)) from measurements of Total and Spectral Solar Irradiance (TSI and SSI) and Total Outgoing Radiation (TOR) and the Spectral Outgoing Radiation (SOR) of the Earth. Since TSI space radiometers provide data with a long-term absolute accuracy <0.1 W m^{-2}, the Sun should be used as a TSI referenced radiation source to obtain SSI data using the method of the Solar Auto-Calibrating XUV-IR Spectrometer (SOLACER). By repeatedly calibrating the solar and Earth observation instruments, the degradation should be compensated to accurately determine the outgoing flux Φ(λ, Δλ) entering the instrument. If the instruments on a pointing device are moved within the Angular Range of Sensitivity (ARS) in two angular dimensions through the solar disk, the instruments are also regularly calibrated with regard to their dependence of the angular sensitivity. ARS is independent of the environmental conditions. To improve the accuracy of SOR data, a normalization factor Ω_a / ARS is used to extend the annual averaged outgoing flux data $\Phi(\lambda, \Delta\lambda)_a$ to the $SOR(\lambda, \Delta\lambda)_a$. The strength of the method is demonstrated by describing space-evaluated instruments to be adapted for solar and/or Earth observation from a small satellite. In the spectral range from 120 nm to 3000 nm, spectrometers and highly sensitive photometers with signal-to-noise ratios >1:10^7 are described to generate data records with high statistical accuracy. Given the compactness of the instruments, more than 20 different data sets should be compiled to complement, verify each other and improve accuracy.