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Extending the TSIS-1 Hybrid Solar Reference Spectrum (HSRS) to Span 0.202 to 200 um

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Recently, we incorporated our new understanding of the absolute scale of the solar spectrum as measured by the Spectral Irradiance Monitor (SIM) on the Total and Spectral Solar Irradiance Sensor (TSIS-1) mission and the Compact SIM (CSIM) flight demonstration into a solar irradiance reference spectrum representing solar minimum conditions between solar cycles 24 and 25. This new reference spectrum, called the TSIS-1 Hybrid Solar Reference Spectrum (HSRS), is developed by re-normalizing independent, very high spectral resolution datasets to the TSIS-1 SIM absolute irradiance scale. The high-resolution data are from the Airforce Geophysical Laboratory (AFGL), the Quality Assurance of Ultraviolet Measurements In Europe (QASUME) campaign, the Kitt Peak National Observatory (KPNO) and the Jet Propulsion Laboratory's (JPL) Solar Pseudo-Transmittance Spectrum (SPTS). The TSIS-1 HSRS spans 0.202 μm to 2.73 μm and has a spectral resolution of 0.01 nm or better. Uncertainties are 0.3% between 0.4 and 2.365 mm and 1.3% at wavelengths outside that range

Recently, we have extended the long wavelength limit of the TSIS-1 HSRS from 2.73 μm to 200 μm with JPL SPTS solar line data through ~ 16 μm and theoretical understanding as represented in a computed solar irradiance spectrum by R. Kurucz. The extension expands the utility of this new solar irradiance reference spectrum to include Earth energy budget studies because it encompasses an integrated energy in excess of 99.99% of the total solar irradiance.

In this work, we discuss the TSIS-1 HSRS, the extension and uncertainties, and demonstrate consistency with TSIS-1 SIM and CSIM solar spectral irradiance observations and TSIS-1 Total Irradiance Monitor (TIM) total solar irradiance observations. Additionally, we compare the TSIS-1 HSRS against independent measured and modeled solar reference spectra.