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From Aleph to TAV: A Project to Improve the SORCE/SIM Calibration Using TSIS

The Spectral Irradiance Monitor instrument (SIM), a Féry prism spectrometer onboard the Solar Radiation and Climate Experiment (SORCE) mission, has been taking daily Solar Spectral Irradiance (SSI) measurements from a ~90-minute low-earth orbit since April 2003. We present a comparison of SORCE/SIM SSI measurements to near-simultaneous Total and Spectral Solar Irradiance Sensor (TSIS) observations. TSIS has been taking data from the International Space Station (ISS) since March 14, 2018.

SORCE/SIM's SSI measurements (200–2400 nm) have a spectral resolution from 0.25 nm (UV) to 33 nm (IR). SIM uses three photodiodes, and an Electrical Substitution Radiometer (ESR) detector. The diodes are referred to as the UV (200–310 nm), VIS (310–950 nm), and IR (950–1600 nm) diodes.

We selected six distinct 28-day periods of SORCE/SIM-TSIS/SIM overlap (Mar, Jun, Oct, and Nov 2018, and Feb and May 2019). During these periods (all ~ Solar minimum), SORCE and TSIS produced near-continuous SSI measurements during times of low Solar variability. These periods were selected to be 28 days to each cover a full Carrington rotation (~27.3 days).

Post-processing of publicly available data included:

1) a daily zero-point wavelength alignment of each SORCE/SIM diode bandpass, and
2) a spectral convolution to account for the spectral resolution difference of SORCE/SIM to TSIS/SIM.

During the commissioning of SORCE/SIM, its absolute irradiance scale was defined by a comparison to the best available solar spectrum at the time (Harder et al., 2009). This process was given the name "ALEPH"-correction, as aleph is the first letter in the Hebrew alphabet.

Here, we repeat a similar process, but with the TSIS V1 release spectra. As "TAV" is the last letter in the Hebrew alphabet, we designate our correction as the TSIS Adjusted Value, or "TAV" correction.

The TAV correction allows a recalibration of the entire SORCE/SIM mission, resulting in improved constraints on Solar models. For example, here we examine its impact on the Solar brightness temperature (T_B), i.e. solving the Planck equation for brightness and temperature based on our corrected SORCE/SIM SSI measurements.