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Short-Term (3 Days - 6 Months) Variabilities in the SORCE and OMI Spectral Solar Irradiance

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The transition of spectral solar irradiance (SSI) variabilities from ultraviolet (UV) to visible (VIS) is important to understand how the solar radiation is absorbed and scattered in the Earth's atmosphere and surface. While it remains challenging to measure this transition accurately from space over the 11-year cycle, it is feasible to determine the weak variabilities in this spectral region where both SORCE and OMI measurements overlap. Short-term stability of the SORCE and OMI instruments is key to make these observations such that the observed solar irradiance variability is significantly above the measurement precision. In this analysis we first detrend the SSI measurements with a second-order polynomial function to remove long-term (> 1 year) variations, and then normalize the residual variations with the standard deviation for each spectral channel. The standard deviation is also determined from the data by differencing the time series from its 3-day running mean. The normalized SSI variation should preserve the 27-day solar rotational variability, the strongest component in the period of between 3 days and 6 months. We apply the same algorithm to SORCE and OMI SSI independently to evaluate their sensitivity to solar rotational variability on an annual basis for 2004-2015. The signal-to-noise ratio (rotational variation vs red noise), or SNR, needs to be > 1 in order to detect any SSI variability at the 300-400 nm region. We find that the SORCE sensitivity is poorer than OMI in this spectral region, based on the SNR of solar rotational signals. Our analysis has an important implication for the recent launched TSIS-1 and TropOMI missions. The new SSI measurements will have much improved sensitivity and spectral coverage to shed new light on the solar irradiance variabilities in this spectral region.