Decoupling Solar Variability and Instrument Trends using the Multiple Same-Irradiance-Level (MuSIL) Analysis Technique

Thomas N. Woods *[tom.woods@lasp.colorado.edu], Frank Eparvier, Jerry Harder, and Marty Snow; Laboratory for Atmospheric and Space Physics (LASP), University of Colorado, Boulder, CO, USA*

OBJECTIVE. Understanding the long-term variations of the solar spectral irradiance (SSI) over time scales of the 11-year solar activity cycle and longer is critical for many Sun-Earth research topics. There are satellite measurements of the SSI since the 1970s that contribute to understanding the solar variability, with most of these SSI measurements in the ultraviolet and only recently in the visible and near infrared since 2003. A limiting factor for the accuracy of the previous results is the uncertainties for the instrument degradation corrections, for which there are fairly large corrections relative to the amount of solar cycle variability at some wavelengths. The primary objective of this investigation has been to separate out solar cycle variability and any residual uncorrected instrumental trends in the SSI satellite measurements from the Solar Radiation and Climate Experiment (SORCE) mission and the Thermosphere, Mesosphere, Ionosphere, Energetic, and Dynamics (TIMED) mission.

METHODOLOGY. A new technique called the Multiple Same-Irradiance-Level (MuSIL) analysis has been developed that examines a SSI time series at different levels of solar activity to provide long-term trends in a SSI record, and the most common result is a downward trend that is most likely from uncorrected instrument degradation. The SSI record is then updated with this residual instrumental trend to provide a more accurate solar cycle variability result.

RESULTS. This technique has been applied to each wavelength in the SSI records from SORCE (2003-present) and TIMED (2002-present) to provide new solar cycle variability results between 27 nm and 1600 nm with about 1 nm resolution at most wavelengths. This technique applied to the highly accurate Total Solar Irradiance (TSI) record indicates that this analysis can provide a relative uncertainty of about 5% of the true solar cycle variability. The MuSIL results are further validated with the comparison of the new solar cycle variability results from different solar cycles.