

Solar Irradiance Decadal Trends: Real Variability or Instrument Instability?

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Observations of total solar irradiance exist now for three 11-year solar activity cycles. Evident throughout the 33-year database are significant deviations among individual measurements that signify the presence of instrument instabilities. These instabilities contribute uncertainty to knowledge of solar irradiance variability during the solar cycle and on longer time scales. Three different composite records of total solar irradiance constructed from the extant database are analyzed to quantify uncertainties, with the result that irradiance levels during the 2008 extended solar minimum cannot be claimed to differ from levels during prior minima. Separating real solar variability and instrumental instabilities in measurements of the solar spectral irradiance that composes the total is even more challenging because the database is very short, lacks independent validation, and has uncertainties that are difficult to establish. Understanding and quantifying the contributions of dark sunspots and bright faculae to solar total and spectral irradiance variability using empirical models can help identify unequivocal solar variability in the measurements. Differences between the observed and modeled solar irradiance are then analyzed for insight as to their origin, whether instrumental instability or real variability missing in the model. This approach is applied to the total solar irradiance composite records and to the SORCE/SIM spectral irradiance measurements.