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Recent Advances of the NOAA Solar Irradiance Climate Data Record and Comparisons with Independent Datasets

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The Naval Research Laboratory's (NRL) solar variability models estimate total solar irradiance (TSI) and solar spectral irradiance (SSI) changes from quiet Sun conditions due to the presence and evolution of bright faculae and dark sunspots are present on the solar disk. The NRLTSI2 and NRLSSI2 models are constructed from linear regression of proxies of solar sunspot and facular features with irradiance observations from the SOlar Radiation and Climate Experiment (SORCE). These models were transitioned in 2015 as the Solar Irradiance Climate Data Record to the National Oceanographic and Atmospheric Administration's National Centers for Environmental Information Climate Data Record (CDR) Program. This Solar Irradiance CDR, operationally-produced and updated approximately every three months by the Laboratory for Atmospheric and Space Physics (LASP), is made available from 1610 to the present as yearly-average values and from 1882 to the present as monthly- and daily-averages, with associated time and wavelength-dependent uncertainties.

A recently released revision of the Solar Irradiance CDR (v02r01) reduces uncertainties in estimated irradiances due to uncertainties in sunspot darkening, especially prior to 1980. We discuss these improvements and present comparisons between independent sunspot darkening proxies and between modeled irradiance estimates and observations by SORCE, the Ozone Monitoring Instrument (OMI), and the recently launched Total and Spectral Solar Irradiance Sensor (TSIS-1). We have also extended the NRLTSI2 and NRLSSI2 models back in time from 1610 to 850 with cosmogenic irradiance indices, using parameterizations of the Solar Irradiance CDR record during the time period after 1610. We compare these new historical estimates with the irradiances that the Paleoclimate Model Intercomparison Project (PMIP4) recommends for use in simulations of climate change in the pre-industrial millennium. Finally, we discuss new advances in statistical modelling of irradiance variability driven by progress in identifying the causes of differences on solar cycle timescales between the NRL2 models and SORCE observations, relying on the total and Lyman alpha irradiances, which exhibit unprecedented long-term repeatability.