Total Solar Irradiance Diverges from Sunspot Record during Solar Cycle Minima

Ted Amdur *[amdur@g.harvard.edu] and Peter Huybers, Harvard University, Dept. of Earth and Planetary Sciences, Cambridge, MA, USA*

Total Solar Irradiance (TSI) reconstructions using sunspot area and facular brightening as predictors capture most TSI variability observed by satellites, and are used to estimate solar forcing since 1610 through sunspot count records. Interdecadal and longer timescale variability in TSI is difficult to constrain, however, due to two major sources of uncertainty. First, the stability of the satellite-derived TSI record is hampered by long-term drift due to instrumentation degradation, calibrations between up to 9 satellite records with varying instrumental configurations, and limited periods of overlap between observing missions. Second, TSI reconstructions using sunspot counts are susceptible to uncertainties in the sunspot record, as well as nonlinearity or nonstationarity in the sunspot-TSI relationship. We present a linear mixed-effects model framework to evaluate the degree to which sunspots are an accurate and stationary predictor of TSI. We explore the sunspot-TSI relationship between solar cycles using magnetic activity proxies, including solar radio flux and the Mg II index. This analysis provides an estimate of the inter-cycle variability of TSI during solar minima, which is relevant for exploring whether a grand minima of solar activity, such as the Maunder Minimum, maintains an accurate and stable sunspot-TSI relationship. An improved record of long-term solar forcing will help distinguish between internal variability and external forcing as sources of climate variability.