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A New Solar Spectral Irradiance Reconstruction based on MGII and Neutral Monitoring Indices for Use in Climate Modelling

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For atmosphere and climate studies, the solar spectral irradiance may be necessary at a time where no data exist. Use of proxies is then mandatory. In order to represent the solar forcing as variable in chemistry-climate numerical models, we need consistent series of temporal solar total and spectral variability covering over the periods of interest. While measurements are available, there is currently no harmonized series with some understanding of its accuracy and precision that can be readily implemented in model simulations. In this paper we present a new method to reconstruct the solar spectrum irradiance in the Ly α-400 nm region, and its variability, based on the Mg II index and neutron monitor data. This approach has the advantage of being independent of the absolute calibration and aging of the instruments.

First, the Mg II index is derived using solar spectra from Ly α (121 nm) to 410 nm measured from 1978 to 2010 by several space missions. The variability of the spectra with respect to a chosen reference spectrum as a function of time and wavelength is scaled to the derived Mg II index. Then, the set of coefficients expressing the spectral variability can be applied to a chosen reference spectrum to reconstruct the solar spectra within a given time frame or a Mg II index values. The accuracy of this method is estimated by calculating the standard deviation between the measured spectra and their reconstruction.

For the second step, the relationship between the Mg II index and the neutron monitor data is searched for the 30-year of Mg II index availability. Finally, the reconstruction at a given date consists in using the neutron monitor data at that date, derive the corresponding Mg II index and use the coefficients of SSI variability to obtain the SSI at that date using a chosen reference spectrum. One major advantage is that using technology of today, we can reconstruct the solar spectral irradiance consistently from today to times when cosmogenic isotope data are available. This calibration can be re-accessed at any time, if necessary. Reconstruction for the Maunder minimum will be shown as well as variation of stratospheric components concentration inferred by solar variability.