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Solar irradiance variability

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Abstract. We study solar irradiance variability. The current generation of models show that the irradiance since then has increased by between 0.9 and 1.5 $\mathrm{W\,m^{-2}}$.

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The total irradiance of the Sun (the wavelength and solar disk integrated radiative output as seen above the Earth's atmosphere) is observed to vary by approximately $1\,\mathrm{W\,m^{-2}}$ over the solar cycle. Unfortunately, the instruments that measure this variation have not survived for the full length of time that observations have been carried out, so that cross-calibration issues become important. Different composites of irradiance have been put together from the observational data which show different trends.

There are different reasons for carrying out a detailed modelling of the Sun's irradiance. Firstly, such models are needed to uncover the physical causes of the irradiance variability. This may also be important for stellar astrophysics, since similar (and stronger) variability is also seen in many Sun-like stars, in particular in more active ones. Secondly, the time span over which solar irradiance has been directly observed is too short for a meaningful comparison with the Earth's climate. Models are needed in order to extend the irradiance further back in time.

Such models have now been constructed by various groups, based on a variety of assumptions and techniques. The most successful have been those that reproduce variations of both the total as well as the most sensitive measurements of spectral irradiance of the Sun with just a single free parameter. These models show that over 90 more of the irradiance variations of the Sun on time scales of days to decades are due to the magnetic field at the solar surface. The models have also been used to extend the irradiance back in time until the Maunder minimum. The current generation of models show that the irradiance since then has increased by between 0.9 and 1.5 $\mathrm{W\,m^{-2}}$.