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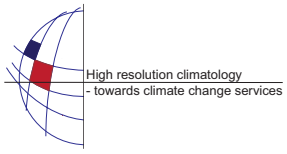

Total Solar Irradiance during the Holocene using cosmogenic 10Be measured in polar ice cores

F. Steinhilber (1), J. Beer (1), and C. Fröhlich (2)

(1) Eawag, Dübendorf, Switzerland (friedhelm.steinhilber@eawag.ch), (2) PMOD/WRC, Davos Dorf, Switzerland

The Sun is the main source of energy for the Earth, and its activity has changed between states of high and low activity during the Holocene. From paleo records it is known that climate changes coincide with these changes in solar activity, raising the question about the solar radiative forcing in past, present, and future climate. To answer this question, one has to quantify how much the solar forcing has changed. One important measure of the solar radiative forcing is total solar irradiance (TSI). It has been measured with instruments onboard spacecrafts since 1978. Besides the distinct 11[U+2010]year solar cycle variation, these measurements show also a decreasing trend in the 11-year cycle minima. This indicates that like other solar activity records TSI also varies on time scales longer than 11 years. Prior to 1978 TSI has to be reconstructed. Of special interest is thereby to know TSI not only for periods of high solar activity as we had in the past 50 years, but also for periods when the Sun was very quiet, such as during the Maunder Minimum (1645-1715). Here we present the first record of TSI covering almost the entire Holocene. Our record is based on a relationship between TSI and the open solar magnetic field both observed with spacebased instruments. The open solar magnetic field is obtained for the past from cosmogenic radionuclides, such as e.g. 10Be, which is measured in polar ice cores. Using 10Be enabled us to reconstruct TSI much further back than the existing record of sunspots, which is widely used as a proxy for TSI. The resulting increase in the 11[U+2010]year cycle averaged TSI from the Maunder Minimum to the present is (0.9±0.4) Wm^-2, corresponding to a global average radiative forcing of about (0.16±0.07) Wm^-2. This change compares well with very recent sunspot[U+2010]based reconstructions of TSI, but is smaller by a factor of three than those TSI reconstructions commonly used in climate studies. Our reconstruction together with climate models allows for exploring the role of solar forcing in climate change.