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Solar Activity Indices and Earth's Temperature

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In order to study the solar influence on climate variations one needs a long record of both quantities. Until recently, it has been limited by the relatively short length of continuous direct solar observations of less than 400 years. Here we use two recently reconstructed series of the sunspot number and the cosmic ray flux from cosmogenic ^{14}C and ^{10}Be isotopes to study this question over time intervals of up to nearly 1800 years. Comparison of the sun-related data sets with various reconstructions of terrestrial Northern Hemisphere mean surface temperatures reveal consistently positive correlation coefficients for the sunspot numbers and consistently negative correlation coefficients for the cosmic rays. The major part of the correlation is related to the similarity of the long-term trends in the data sets. The trend of the cosmic ray flux correlates significantly better with the terrestrial temperature than the sunspot numbers derived from the same cosmogenic isotope data. Together with a systematically positive correlation between the temperature and the strength of the geomagnetic field, this suggests that effects induced by cosmic rays could have a stronger effect on climate than variations of sunspot number related variables like total solar irradiance and the UV flux.