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The influence of solar variability past, present and future, on North Atlantic climate.

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There has long existed observational evidence for a link between solar activity (both the semi-regular 11-yr cycle and longer term variability) and regional climate variability. In the last few years progress is starting to be made in understanding such observational correlations from physical mechanistic viewpoint. Firstly, new observations of solar spectral irradiance from the SORCE satellite have raised the possibility of much larger variability in the UV than previously appreciated. Secondly, state of the art computer climate models now explicitly resolve the Earth's stratosphere allowing the influence of solar variability to be simulated here. By driving such climate models with the larger solar UV variability implied by the latest satellite observations, surface climate impacts have been shown in the Northern Hemisphere winter that are consistent with late 20th century climate data. Low solar activity is associated with the negative phase of the North Atlantic Oscillation (NAO) and hence colder winters over northern Europe and the USA. We discuss the implications for seasonal/decadal climate prediction.
Further work has examined the role of ocean feedbacks in amplifying this tropospheric response. There is robust statistical evidence that such a feedback operates in the observations and gives a lag of 3-4 years for the maximum tropospheric response after the maximum solar forcing. This lag does not generally appear to be reproduced by current climate models. We discuss how this observational evidence may be a valuable way of assessing the relative strength of ocean-atmosphere coupling in the present generation of climate models.
The prolonged solar minimum during the transition between solar cycles 23 & 24, combined with the relatively low maximum activity of cycle 24, have increased suggestions that we may be coming to the end of the grand solar maximum which dominated the 20th century. A return to Maunder Minimum like solar activity is therefore a possible scenario during the 21st century. We illustrate the possible regional climate impacts that an associated projected decline in the UV flux would have and how this would interact with regional anthropogenic climate change.