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Solar influences on surface climate

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In this talk I will review some of the observational evidence for an influence of solar activity on the climate of the lower atmosphere and I will discuss mechanisms which might produce the apparent signals.

When the Sun is more active we have found that the response in atmospheric temperature is not a warming of the tropics, which might have been be anticipated in response to a higher input of solar energy, but bands of warming throughout the mid-latitude troposphere. Associated with this the jet streams weaken and move polewards, along with the mid-latitude storm-tracks. Using climate models we have found that an important factor driving this response is the warming of the lower stratosphere, initiated by absorption of solar UV radiation. By running idealised model experiments, we have been able to identify a mechanism for dynamical coupling between the stratosphere and the atmosphere below. These results have more general application in understanding the climate effects of other stratospheric perturbations such as due to ozone or volcanic aerosol.

During the most recent solar cycle minimum (2008-9) the Sun was in a state of very low activity and its ongoing behaviour suggests that the next maximum will be of low amplitude. Further, measurements from the SORCE satellite have suggested that the solar spectrum has been behaving in a strange and unexpected way. These data have yet to be validated but theoretical models of the solar spectrum show a wide range of potential behaviour. The implications of these spectral variations for the stratosphere, for radiative forcing of climate and for tropospheric effects through dynamical coupling will be discussed.