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Solar influence on stratosphere-troposphere dynamical coupling.

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There is increasing evidence that changing solar activity over the 11-year solar cycle influences the Earth's climate. However, as yet the mechanisms involved remain uncertain. One of the main problems is that the observed tropospheric response appears to be too large and too non-uniform to be explained by changes in the direct radiative forcing of the troposphere due to primarily changes in visible and infra-red radiation over the solar cycle.

The temperature changes observed in the troposphere over the solar cycle are non-uniform and these are accompanied by variations in tropospheric circulation. A weakening and poleward shift of the mid-latitude jets along with a weakening and expansion of the Hadley cells and a poleward shift of the Ferrell cells is found at solar maximum compared to solar minimum. These circulation changes along with the non-uniform temperature changes points towards a dynamical response rather than simply altered direct radiative forcing. With the now widely accepted view that there is a two way dynamical coupling between the stratosphere and troposphere a possible explanation for these tropospheric temperature and circulation changes is through a dynamical response to stratospheric heating by increased UV absorption by stratospheric ozone.

In some previous studies using a simplified GCM we have shown that similar circulation and temperature changes to those found over the solar cycle can by produced by a dynamical response to increased heating of the equatorial stratosphere. We now extend that work by using a spin-up ensemble experiment to investigate the mechanisms by which altered stratospheric heating could produce such a response in tropospheric circulation. Results suggest that changes in eddy propagation are important in transmitting the effect of altered stratospheric heating to the troposphere below.