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Solar influence on stratosphere-troposphere dynamical coupling

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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 solar heating of the stratosphere.

Based on our previous results using a simplified (dynamical core) GCM, which demonstrated that similar tropospheric circulation and temperature changes to those seen over the solar cycle can be produced by a dynamical response to increased heating of the equatorial lower stratosphere, we present some new experiments designed to study further the mechanisms involved. We adopt two approaches: in the first we use an ensemble of model spin-ups to investigate the evolution of interactions between the eddies and the mean circulation. The results demonstrate the importance of changes in eddy momentum flux in driving the tropospheric response. In our second approach we study the impact of the stratospheric perturbations on the leading modes of variability in tropospheric zonal wind. We find that the tropospheric response projects strongly onto dominant modes of annular variability but that there are distinct differences in

behaviour at high (<30 days) and low frequencies.