

Robust tropical responses to sudden stratospheric warmings

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'Nudged' GCM integrations have been used by Hitchcock and Simpson (2014,2016) to quantify the effect of sudden stratospheric warmings (SSWs) on the extratropical troposphere and to investigate several different aspects of the relevant dynamics. In these integrations the stratospheric zonal mean circulation is relaxed on a short timescale towards the time evolution of an SSW previously simulated in the standard free running version of the GCM. A large ensemble of integrations is considered with each ensemble member having a different tropospheric initial condition. The effect of the SSW is deduced by comparing with a control ensemble where the stratosphere is relaxed towards the climatological circulation. This approach naturally takes account of the random variability of the tropospheric circulation and expresses the effect of the SSW as a change in the statistics of that circulation. It also allows separation of the effect of the stratospheric SSW from any systematic effect, felt within the troposphere, of tropospheric precursors to the SSW.

It has been suggested on the basis of observational and model evidence that SSWs may also have a significant effect on the tropical troposphere (e.g. Kodera 2006, Kodera et al 2011, Eguchi and Kodera 2015). The set of model integrations previously used by Hitchcock and Simpson to investigate the effect on the extratropics also provides potentially valuable information on any tropical effect. Analysis of the integrations shows that there was a highly robust, tropical response to the imposed stratospheric anomalies, with similar signatures obtained in the ensemble response to two distinct SSW events.

This presentation will present details of the tropical response to the SSWs. Various diagnostics will be used to analyse the possible mechanisms for the response which include a 'direct' response where the tropical troposphere responds to the change in tropical lower stratospheric temperatures associated with the SSW and an 'indirect' response in which the effect of the SSW on the extratropical troposphere is then communicated to the tropics.

Key words: Stratospheric sudden warmings, tropical troposphere.

References

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