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Quantifying the tropospheric zonal momentum budget following a stratospheric sudden warming

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We present a novel nudging technique for efficiently generating a large ensemble of sudden-warming-like episodes in a comprehensive, stratosphere-resolving model. The method produces events whose stratospheric evolution is close to identical, with very weak zonal asymmetries, but whose tropospheric state is fully independent. The ensemble mean response, relative to a control, confirming in a comprehensive model that the equatorward shift of the tropospheric jets seen in composites of sudden warmings is caused unambiguously by the stratospheric anomalies. Moreover, the influence of the tropospheric initial condition, or of zonal asymmetries in the stratosphere, are of secondary importance.

The zonal mean momentum budget in the troposphere will be discussed, and the relative contribution of the direct, balanced response to the stratospheric wave driving versus the synoptic and planetary scale feedbacks will be quantified.