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Mechanisms for the Downward Influence of Stratospheric Sudden Warmings

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While it is now well accepted that, on average, the tropospheric jet shifts southward in the months following major stratospheric sudden warmings, the details of the mechanism by which this occurs remain controversial. Several mechanisms have been proposed to explain this tropospheric response; however, evaluating these mechanisms is made difficult by the large amount of dynamical noise in the observations and the absence of quantitative hypotheses. We present results from a set of numerical experiments with the Canadian Middle Atmosphere Model which demonstrate unambiguously the downward influence of the stratospheric anomalies that occur during sudden warmings on the troposphere below. Consideration of the vertically- and zonally-averaged angular momentum budget allows several proposed coupling mechanisms to be quantitatively compared, and points clearly to the importance of planetary waves in the downward coupling, while the synoptic-scale eddies amplify this influence through tropospheric feedbacks. The zonally symmetric influence through the meridional circulation is shown to be negligible.