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Temperature trends and interannual variability in the tropical upper troposphere and lower stratosphere: connections with sea surface temperatures and implications for water vapor and ozone

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Satellite data and chemistry-climate models are used to investigate the forcing of variability in the tropical lower stratosphere and upper troposphere. The observations show significant zonal variations in the in upper tropospheric (UT) and lower stratospheric (LS) tropical temperature trends (with largest UT warming and LS cooling over the Indo-Pacific region). Chemistry-climate models (CCMs) are used to demonstrate that SST trends are driving the zonal asymmetry, and that the anomalous circulation set up by the changing SSTs has led to zonal structure in the ozone and water vapor trends near the tropopause, and subsequently to less water vapor entering the stratosphere.

CCM experiments are also used to demonstrate that seasonality and the location of the peak warming of SSTs dictate the response of stratospheric water vapor to El Nino, with response varying with season and between different variants of the El Nino. The difference in water vapor in the lower stratosphere between the central and eastern El Nino events is around 0.3 ppmv, while the difference between the winter and spring responses exceeds 0.5 ppmv.