

A mid-latitude stratosphere dynamical index for attribution of stratospheric variability and improved ozone and temperature trend analysis – dynamics discussion

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We find that wintertime temperature anomalies near 4 hPa and 50°N/S are related, through dynamics, to anomalies in ozone and temperature, including the tropical stratosphere. These mid-latitude anomalies occur on timescales of up to a month, and are related to changes in resolved-wave forcing. A change in the residual circulation extends from the middle stratosphere into the mesosphere and forms a temperature-change quadrupole from equator to pole. This quadrupole structure is accompanied with changes in zonal wind regime leading to changes in propagation (filtering and refraction) of atmospheric (planetary and gravity) waves to the stratosphere and mesosphere. We attribute changes in the residual circulation with respect to dynamics of particular wave type. Additionally, an effect of running model in specified dynamics mode (nudging) on our results is discussed as well.

While wave-activity drives the processes contributing to the temperature changes, it is not an easily observable quantity. Thus, we developed an index based on detrended, deseasonalised temperature variability at midlatitudes. This index can account for up to 40% of the total variability of temperature and ozone and leads to an improvement in the quality of the ozone trend estimates.

Key words: ozone and temperature trend estimates, atmospheric waves, attribution of stratospheric variability, residual circulation