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# Stratospheric contribution to winter temperature trends in a warming climate

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## Abstract

Variability in the circumpolar westerly winds of the Northern Hemisphere winter polar stratosphere– the stratospheric polar vortex– has a known downward influence on the extratropical surface climate on timescales of weeks to months. On longer timescales, observed trends towards a weakening stratospheric polar vortex have been linked to cooling surface temperatures over Eurasia from 1990-2009. Here, we show that 10-40 year polar vortex weakening trends occur as often as strengthening trends in large-ensemble historical climate simulations, and that variability in polar vortex trends is significantly linked to regional surface temperature trends across the Northern Hemisphere even as the climate warms. We find that 74% of all ensemble members with cooling trends over Eurasia during the 1850-2100 climate simulation also exhibit a weakening polar vortex, while 70% of members with accelerated warming over Eurasia exhibit a strengthening polar vortex. Decadal trends in the polar vortex thus modulate extratropical anthropogenically-forced warming trends.

**Keywords:** stratosphere, polar vortex, decadal variability

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