# Climate change response of the Northern Hemisphere polar vortex in CMIP6 models: uncertainty and coupling to surface climate

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**Abstract**

Changes in the wintertime stratospheric polar vortex are known to influence surface climate in the Northern Hemisphere at timescales from weeks to decades and centuries. However, the response of the stratospheric vortex to anthropogenic forcing remains unknown and models disagree on the sign of the stratospheric zonal wind response. In this study we analyze climate change simulations by CMIP6 models looking at several scenarios and utilizing wave forcing diagnostics available from DynVarMIP. For more than half of the models the forced response exceeds internal variability; however, similarly to the previous generations of the climate models, CMIP6 models project both weakening and strengthening of the vortex with a roughly equal number of the models falling into each category. Most models simulate the same sign of response regardless of scenario, suggesting that the response is controlled by internal model properties such as background climatology. Potential observational constraints on the zonal mean response are identified and discussed. At the same time, an eastward shift of the polar vortex appears to be a more robust response across models. Finally, we analyze coupling between polar vortex changes and changes in the surface climate.

**Keywords:** Stratosphere, polar vortex, stratosphere troposphere coupling, climate models, CMIP6

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