The downward influence of uncertainty in the Northern Hemisphere stratospheric polar vortex response to climate change.

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General circulation models display a wide range of future predicted changes in the Northern Hemisphere winter stratospheric polar vortex. The downward influence of this stratospheric uncertainty on tropospheric climate change has previously been inferred from regression analyses across models and is thought to contribute to model spread in tropospheric circulation change. Here we complement such regression analyses with idealized experiments with one model where different changes in the zonal mean stratospheric polar vortex are artificially imposed under increased greenhouse gas concentrations, to mimic the extreme ends of polar vortex change simulated by models from the Coupled Model Intercomparison Project, phase 5 (CMIP5). The influence of the stratospheric vortex change on the tropospheric circulation in these experiments is quantitatively in agreement with the inferred downward influence from across-model regressions, indicating that such regressions depict a true downward influence of stratospheric vortex change on the troposphere below. With a relative weakening of the polar vortex comes a relative increase in Arctic sea level pressure (SLP), a decrease in zonal wind over the North Atlantic, drying over Northern Europe and wetting over Southern Europe. The contribution of stratospheric vortex change to inter-model spread in these quantities is assessed in the CMIP5 models. The spread, as given by four times the across-model standard deviation, is reduced by of the order 10\% on regressing out the contribution from stratospheric vortex change, while the difference between models on extreme ends of the distribution can reach up to 50\% of the overall model spread for Arctic SLP and 20\% of the overall spread in European precipitation.