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Stratospheric impact on subseasonal forecast uncertainty in the Northern extratropics

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Extreme events of the stratospheric polar vortex can modulate subsequent surface weather at subseaonal to seasonal (S2S) timescales. Moreover, they are considered to form windows of opportunity for tropospheric forecasting. This study aims to improve understanding of how the canonical surface response of polar vortex events translates into modulated surface predictability.

First, we confirm that in the ECMWF extended-range prediction model, the mean signal of weak (strong) polar vortex events projects onto a negative (positive) phase of the North Atlantic Oscillation. The associated equatorward (poleward) shift of the eddy-driven jet then enhances or suppresses synoptic variability in specific regions. By constructing a leadtime, seasonal and model version-dependent climatology of forecast ensemble spread, we link these regions to anomalous forecast uncertainty. For example, sudden stratospheric warmings (SSWs) are followed by a southerly jet shift, which translates into suppressed Rossby wave breaking over Northern Europe, resulting in anomalously high forecast confidence in that region.

In general, both signatures in the mean and spread can contribute to predictability. However, when forecasts are compared to reanalyses, they manifest differently in different skill scores, such as the Root-Mean-Squared Error or the Continuously Ranked Probability Skill Score. We therefore discuss how separate consideration of anomalies in the ensemble mean and ensemble spread may aid to interpret predictability following polar vortex events.

Finally, we apply the diagnostics also to tropical teleconnections. We find indications that windows of forecast opportunity might be dominated by stratospheric polar vortex variability over the Atlantic and by ENSO variability over the Pacific.