# S2S forecast skill for Southern Hemisphere early spring vortex variability

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In the Southern Hemisphere (SH) there is a strong downward stratosphere-troposphere (S-T) coupling observed in the spring to summer seasons. The SH S-T coupling starts its life cycle in winter with SH mid-latitude meridional dipole anomalies of zonal mean zonal wind around the upper stratospheric jet and persistent anomalous vertically propagating planetary wave activity (onset stage). In late winter to early spring, the midlatitude upper stratospheric wind anomalies propagate poleward, causing the polar cap circulation anomalies to become a monopole, and the wind anomalies and associated temperature anomalies start propagating down to the surface in spring (mature stage). From late spring to early summer, the upper stratospheric zonal wind anomalies begin to reverse back to the climatological state while the tropospheric zonal wind anomalies persist from spring through to early summer (decaying stage) (e.g. Kuroda and Kodera 1998; Hio and Yoden 2005).

In this study, we have assessed the skill of sub-seasonal to seasonal (S2S) climate forecast models to predict the upper stratospheric polar vortex variability in August and September that leads to this downward coupling and resultant changes in the lower stratospheric polar ozone concentration and tropospheric Southern Annular Mode (SAM) in October and November. The observed upper stratospheric polar vortex variability is captured by the leading modes of Empirical Orthogonal Function analysis (EOF1) of August and September zonal winds over 30-90°S at the 10 hPa level (U10hPa). Predictions are then made by projecting eleven S2S model forecast U10hPa fields onto the observed EOF1, and the predictive skill is measured by anomaly correlation skill and root-mean-square error between the observed and forecast expansion coefficients over 1997-2010, which is the common hindcast period of the eleven models.

Our assessment shows that dynamical model forecasts outperform persistence forecast in predicting the pre-conditioning dipole and the quasi-monopole of the upper stratospheric wind anomalies associated with the polar vortex variability in August and September at greater than 10 day lead times, with some models also demonstrating useful skill out to 50 days. Skill is highly sensitivity to initialization and ensemble generation methods. The model bias in predicting the upper stratospheric polar vortex in August and September is mainly found in the zonal structure of the polar vortex.

Key words: SH polar vortex, S2S, predictive skill

**References**

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