Seasonal prediction of boreal winter stratosphere

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Advances in the development of seasonal forecast systems allow skillful predictions of the atmospheric flow in the extratropics. Recent studies have highlighted the importance of stratospheric processes in climate variability at seasonal time scales, while their representation and impact in seasonal prediction is yet to be understood. Here stratospheric variability and predictability in boreal winter are evaluated on the seasonal range, using multi-model retrospective forecasts initialised in November. A novel focus is adopted to assess troposphere-stratosphere coupling (i.e., the interaction between upper-tropospheric eddy heat flux and the stratospheric polar vortex) on the basis of the empirical relation derived by Hinssen and Ambaum (2010)\textsuperscript{[1]}. Results indicate that dynamical predictions perform better than persistence forecasts and show significant skill up to lead season one (December to February). We find that seasonal anomalies of stratospheric zonal-mean zonal wind in the extratropics are mostly explained by anomalous tropospheric eddy heat flux; the response to tropospheric wave forcing is weaker in models than in reanalysis. Furthermore, we demonstrate that skillful seasonal stratospheric forecasts benefit from residual predictability of the heat flux over the Pacific sector, while further improvements are limited by current unpredictability of the Eurasian heat flux on the seasonal time scale. Sources of long-term predictability are examined and reveal a potential influence of the QBO, Arctic sea ice, Eurasian snow cover and ENSO. This work is realised using data from the seasonal Copernicus Climate Change Service multi-model (November initialisations from 1993 to 2016) and from ERA-Interim reanalysis.
