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Seasonal forecast skill in the winter stratosphere

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Variability in the stratosphere is mainly ascribable to upward propagating waves with a wave source in the troposphere. In the Northern Hemisphere, intense propagation of waves can lead to sudden stratospheric warmings (SSW), i.e. a reversal of the westerly flow of the stratospheric polar vortex. These extreme events are often associated with a surface impact that implies significant modifications of the circulation on the hemispheric scale, and increased probability of occurrence of continental scale cold air outbreaks. Progress in understanding and modelling these phenomena has been stimulated by potential impacts of stratospheric variability on surface weather, still little is known about the forecast skill on time scales longer than few weeks.
In this study we present an assessment of the prediction skill for the winter stratosphere in a multi-model ensemble of state-of-the-art seasonal forecast systems. The analysis is based on 6-month hindcasts initialised on November 1st available through the Copernicus Climate Data Store. Model bias in the stratosphere circulation is assessed and the model relationship between stratospheric wind and poleward heat flux at the tropopause is established. Deterministic and probabilistic skill scores are computed for the zonally averaged zonal wind at selected pressure levels above the tropopause. SSWs are detected with a combination of different algorithms published in the scientific literature and the forecast probability of occurrence is estimated and analysed in comparison with observed events.
Results from this study can help link stratosphere predictability with surface weather and can contribute to the design of targeted applications, further advancing our capability of exploiting the stratosphere as a source of predictability on long time scales.