# Duration and decay of polar stratospheric vortex events in the ECMWF seasonal forecast model

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Previous studies have documented extreme stratospheric polar vortex events but the factors governing their duration and decay processes have received little attention. Here, we investigate weak and strong stratospheric polar vortex events simulated in ensemble reforecasts for the Northern Hemisphere winter with the operational seasonal forecast model (System 4) of the European Centre for Medium-Range Weather Forecasting, in comparison with the European Reanalysis Interim dataset. The individual strong and weak vortex events are classified into short and long events. A composite analysis is conducted for each of the four categories of events with respect to the initial or end days. We examine the characteristics of each category in the forecast model and reanalyses, including anomalous zonal-mean zonal winds, heat or wave activity fluxes, lower tropospheric temperature and surface pressure, as well as the synoptic evolution of upper-tropospheric anomalies during the precursory and decaying stages.

The main findings are that (i) the forecast System 4 is found to produce both short and long anomalous vortex events of comparable amplitude to the reanalyses, but with polar zonal wind anomalies that are more persistent, for each of the four categories considered. (ii) Short events penetrate as deep as the long events right at their onset, but they rapidly decay under a wave forcing that is less sustained than in the long events. (iii) Subtle differences in the synoptic evolution of blocking Highs and Lows over both oceanic basins or over Northern Eurasia or America appear to condition the duration of the forcing. For short events however, this evolution is dissimilar in the forecast system and in the reanalyses. (iv) During such short events, characteristic signatures of the annular mode paradigm arising from the downward stratospheric influence are not allowed sufficient time to develop neither in the lower stratosphere nor down into the troposphere.

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