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Role of upper-level PV anomalies in polar low development and their significance for forecasting

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Increased model resolution and improved observational capabilities have permitted advances in the forecasting of polar lows, but the phenomenon's space and time scales ensure that the task remains a major challenge. This study is based on the premise that polar lows are often triggered by distinct tropopause-level structures in the form of highly localised positive potential vorticity (PV) anomalies.

The PV perspective offers valuable insights into the pre-genesis phase of the systems. In particular, potential precursors may be identified many days in advance. This points to the importance of accurately capturing the upper-level anomalies in the analysis fields to aid the forecasting of the onset and development of polar lows.

Here a study is undertaken using ECMWF forecast and analysis data sets and PV-inversion techniques to examine the evolution of the anomalies in the pre-genesis phase and their subsequent role in the development of polar lows in the Norwegian and Barents seas. Consideration is given to the performance of ECMWF forecasts of different ranges. In the case of misforecasts, the sensitivity of the anomalies' evolutions to processes in the initial fields is identified and characterised. Ensemble forecasting is applied at sensitive stages to provide a set of upper-level evolution scenarios and an increased probability of capturing a subsequent polar low genesis.