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Tropospheric predictability around stratospheric warming events examined with an idealized forecast ensemble

E. Hörnqvist and H. Körnich
Stockholm University, Department of Meteorology, Stockholm, Sweden (heiner@misu.su.se)

By representing sudden stratospheric warming events (SSWs) in numerical weather prediction models, the predictability length could possibly be improved. It has been suggested that this improvement depends on the initial day of the forecast relative to the central date of the SSW. In this project this hypothesis is tested in the framework of an idealized general circulation model. Furthermore, it will be examined how uncertainties of the initial conditions and model errors in the forecast model affect the predictability around stratospheric warming events.

Identical-twin forecast experiments are performed with the Kühlungsborn Mechanistic general Circulation Model KMCM that extends to the stratopause. In a 20-year truth run with perpetual January conditions, 21 SSWs are identified. Ensemble forecasts using random field perturbations in the initial conditions are conducted with initial dates from 20 days before to 20 days after each SSW central date. In four different experiments, we examine how the tropospheric predictability depends on perturbations in troposphere, stratosphere or both, and on model errors in the stratospheric radiative equilibrium temperature.

The results show that a forecast initialised before the SSW central date has a greater forecast skill than after. On average useful forecast for the zonal mean zonal wind at 60N and 850 hPa are extended by 10 days, when initialized up to 12 days before the SSW. This extension is robust for the different perturbation experiments and also when a model error was introduced. Thus, the experiments confirm that the largest improvement of predictability is achieved, when the forecast is initialised before the sudden stratospheric warming event.