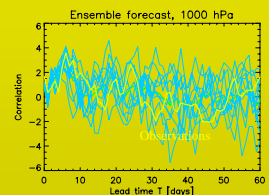
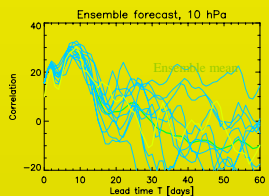


Contribution from the Stratosphere to the Skill of a Dynamical Seasonal Prediction System

Bo Christiansen, Danish Climate Centre, Danish Meteorological Institute, boc@dmi.dk



An example of a dynamical ensemble forecast

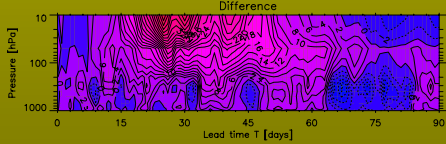
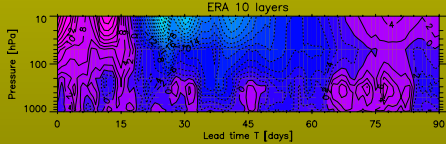
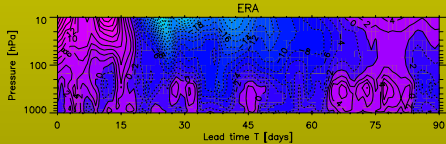
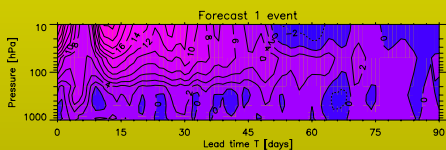
It is well known that at mid-latitudes, during winter months, statistically significant correlations can be found between the stratospheric circulation and surface weather parameters when the stratosphere leads with 5-60 days.

In this study we analyze to which extent this stratosphere-troposphere coupling is already represented in ECMWF's new dynamical seasonal prediction model (system 3). With this system, re-forecasts are available for 25 years starting in 1980. We investigate the connection between the stratospheric vortex and the large scale surface circulation – the zonal mean wind at 60 N. The results are compared to a simple linear statistical forecast model.

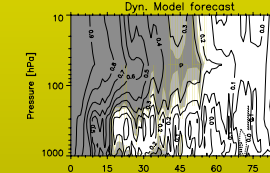
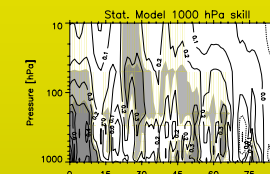
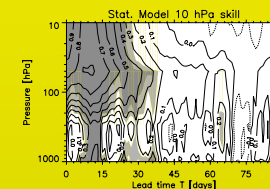
We show that the dynamical prediction system does include the coupling between the stratosphere and the troposphere. However, this coupling is too strong compared to observations. This overestimation may be connected to a comparable overestimation of the decorrelation time in the dynamical model.

ECMWF's dynamical ensemble seasonal prediction system:

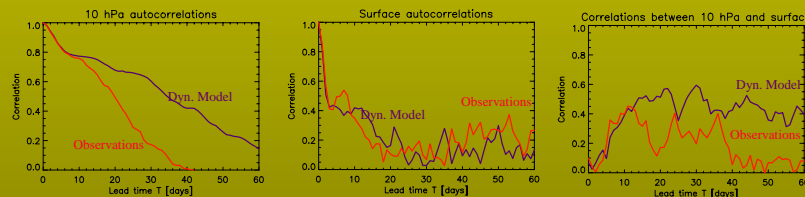
- Hindcasts with 11 ensemble members 1981-2005
- Model has 62 vertical levels with top at 5 hPa
- **But:** Only archived at 10 levels: 200, 50, 10 hPa. ERA40 has 200, 150, 100, 70, 50, 30, 20, 10 hPa
- Initial conditions based on ERA40 for 1981-2001 and operational analysis for 2002-2005
- Model started the first day of every month, giving 3x25 different DJF events



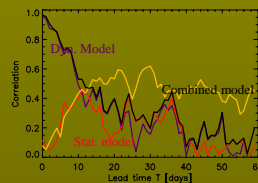
A single ensemble mean forecast of zonal mean wind at 60 N, the target, and the difference. The limited resolution of the archived forecast seems sufficient.



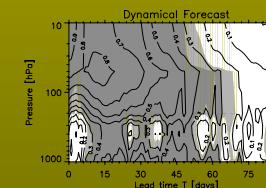
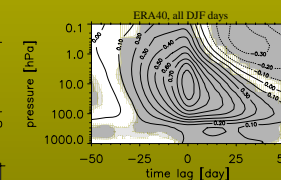
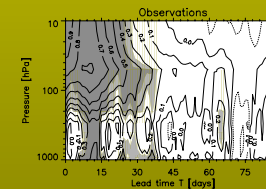
Forecast skill measured as the correlation between forecast and target over 75 predictions. Top and middle panels show simple statistical regression models with a single predictor at 10 hPa or at the surface, respectively. Bottom panel shows the dynamical forecast. Shaded regions are where correlations are significantly different from zero at 99 and 95 % levels. Calculated by a t-test assuming normality and independent predictions.



Autocorrelations at the surface and in the stratosphere for model and observations and cross-correlations between stratosphere and troposphere. The stratosphere is too coherent and the stratosphere-troposphere coupling too strong in the model compared to observations.



The skill at the surface of the statistical model with stratospheric information and the dynamical model.



Lagged correlations between the zonal wind at 10 hPa and the zonal wind at other levels. The dynamical model shows a clear downward propagation. However, correlations are too strong both in the troposphere and in the stratosphere.