Geophysical Research Abstracts
Vol. 19, EGU2017-14618, 2017
EGU General Assembly 2017
© Author(s) 2017. CC Attribution 3.0 License.

Scale-dependent estimates of the growth of forecast uncertainties in a global prediction system

Nedjeljka Žagar (1), Martin Horvat (1), Žiga Zaplotnik (1), and Linus Magnusson (2)

(1) University of Ljubljana, Faculty of Mathematics and Physics, Department of Physics, Ljubljana, Slovenia (nedjeljka.zagar@fmf.uni-lj.si), (2) European Centre for Medium-range Weather Forecasts, Reading, England, UK

The representation of the growth of forecast errors by simple parametric models has a long tradition in numerical weather prediction (NWP). A well-known three-parameter model introduced by A. Dalcher and E. Kalnay in 1987 describes the error growth rate proportional to the amount by which the errors fall short of saturation. This standard model has traditionally been applied to estimate the root mean square errors of the geopotential height at 500 hPa level in extratropics. The two model parameters, the so-called α and β terms, have been used to discuss the chaotic error growth and the growth due to model deficiencies.

Geopotential height field at 500 hPa is dominated by large-scale features and quasi-geostrophic balance which is well analysed by data assimilation schemes. Small scales which tend to grow at a faster rate than the larger scales of motions, have little variance at 500 hPa. It is thus interesting to provide a picture of the forecast errors growth as a function of scale from the initial uncertainties simulated by the operational ensemble prediction systems. We conducted such study to assess the scale-dependent growth of forecast errors based on a 50-member global forecast ensemble of the European Centre for Medium Range Weather Forecasts.

Simulated forecast errors are fitted by a new parametric model with an analytical solution given by a combination of hyperbolic tangent functions. The new fit does not involve computation of the time derivatives of empirical data and it proves robust to reliably model the error growth across many scales. The results quantify a scale-dependent increase of the period of a slow exponential growth. The asymptotic errors in each scale are computed from the model constants. According to the new fit, the range of useful prediction skill, estimated as a scale when the growth of simulated forecast errors reaches 60% of their asymptotic values is around one week in large scales and 2-3 days at 1000 km scale. These estimates appear realistic in comparison with the anomaly correlation criteria used in the global NWP models, primarily on large scale. It takes 10 days to 2 weeks for the synoptic and planetary-scale errors, respectively, and only about a day for errors at 200-km scale to reach 90% of their asymptotic values.

The parameters α and β of the standard model can easily be computed from parameters of the new model. The comparison of the two parameters shows that their values diverge beyond the zonal wavenumber 15 (around 1000 km scale in the extra-tropics). At small scales, the most of a rapid exponential growth of errors towards saturation is described by the β term.