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Scale-Dependent Estimates of the Growth of Global Forecast Uncertainties

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The talk discusses the error growth in global forecasts in relation to the spatial scale and quasi-geostrophic and inertia-gravity dynamics.
Scale decomposition based on the 3D orthogonal normal-mode functions facilitates the discussion of the multivariate nature of some of the leading modes of atmospheric variability and their signatures in analysis uncertainties and forecast errors. This is especially useful in the tropics where the role of large-scale inertia-gravity modes in the initial state for NWP is still not clearly identified.
A new parametric model for the representation of the error growth in global NWP and ensemble prediction systems is introduced. In contrast to the commonly used models, the new model does not involve computation of the time derivatives of the empirical data. The asymptotic error is not a fitting parameter, but it is computed from the model constants.
The model is applied to the operational deterministic and ensemble forecasts of the European Centre for Medium-Range Weather Forecasts. Results shown that global analysis uncertainties are largest in the tropics and have biggest amplitudes at the large scales. The growth of forecast uncertainties takes place at all scales from the beginning of forecasts. The growth is nearly uniform in the zonal wavenumbers 1–5 and strongly scale dependent in the larger wavenumbers. Moreover, the growth from initial uncertainties at large scales appears dominant over the impact of errors cascading up from small scales.
The new model is easily transformed to the widely used model of Dalcher and Kalnay (1987) to discuss the scale-dependent growth as a sum of two terms, the so-called α and β terms. Their comparison shows that at planetary scales their contributions to the growth in the first two days are similar whereas at small scales the β term describes most of a rapid exponential growth of errors towards saturation.