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Dynamics of combined initial-condition and model-related errors in a Quasi-Geostrophic prediction system

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Atmospheric prediction systems are known to suffer from fundamental uncertainties associated with their sensitivity to the initial conditions and with the inaccuracy in the model representation.

A formulation for the error dynamics taking into account both these factors and intrinsic properties of the system has been developed in a study by Nicolis, Perdigao and Vannitsem (2008, in press).

In the present study that study is generalized to systems of higher complexity. The extended approach admits systems with non-Euclidean metrics, multivariate perturbations, correlated and anisotropic initial errors, including error sources stemming from the data assimilation process.

As in the low-order case, the formulation admits small perturbations relative to the attractor of the underlying dynamics and respective parameters, and contemplates the short to intermediate time regime. The underlying system is assumed to be governed by non-linear evolution laws with continuous derivatives, where the variables representing the unperturbed and perturbed models span the same manifold defined by a phase space with the same topological dimension.

As a core ilustrative case a three-level Quasi-Geostrophic system with triangular truncation T21 is considered.
While some generic features are identified that come in agreement with those seen in lower-order systems, further properties of physical relevance, stemming from the generalizations, are also unveiled.