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Geostrophic Turbulence and the stability of Ocean models

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Despite multiple efforts, predictions of climate change remain uncertain. Where precision is an issue (e.g., in a climate forecast), only ensembles of simulations made across model families which differ for parameterizations, discrete algorithms and parameter choices allow an estimate of the level of imprecision. Is this the best we can do? Or is it at least conceptually possible to reduce these uncertainties? Focusing on ocean models in idealized domains we describe chaotic space-time patterns and equilibrium distributions that mimic nature. Using the Navier-Stokes equations for barotropic flows as a zero-order approximation of analogous flow pattern, we then investigate if is possible, in this overly-simplified set-up, for which smooth-solutions exist, to bound the uncertainty associated with the numerical domain discretization (i.e. with the limitation imposed by the Reynolds number range we can explore). To do so we analyze a series of stationary barotropic turbulence simulations spanning a range of Reynolds number of 10^4.