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Developing a Stochastic Parameterization of Mesoscale Eddies

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A study of a stochastic parameterization of mesoscale eddies in the case of a quasi-geostrophic, idealized mid-latitude ocean model at mesoscale-eddy-permitting (30 km) and non-eddy-resolving (120 km) resolutions, is here presented.

The mathematical form of the parameterization is obtained from four requirements: that the quasi-geostrophic equations at the coarser scales be given by a Reynolds-like averaging from the eddy-resolving scale; that the parameterization be 'intrinsic' to the fluid, i.e. invariant under the invariance-group of the quasi-geostrophic equations; that the parameterization have a simple form of memory dependence; linearity. These requirements lead to a parametrization in the form of an additive, stochastic source term whose probability distribution is conditional on a variable corresponding to the extra stress of a Rivlin-Ericksen fluid of second grade.

The numerical values of the conditional probability distribution of the parameterization are then numerically diagnosed from the output of a single run of an eddy-resolving (7.5 km) model, coarse-grained to resolutions of 30 km and 120 km, used as the 'truth' to which the coarser models should conform.

The stochastic parameterization thus derived is then implemented in the eddy-permitting and a non-eddy-resolving models. The preliminary results obtained are here presented and discussed; possible extensions to more general circulation models are also discussed.