Characterization of Oceanic Turbulence in a Multiple-Scale Model

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Abstract

Quasi-geostrophic (QG) dynamics has been the theoretical workhorse in physical oceanography for the last several decades. However, QG suffers in realism in at least two potentially important ways. First, while the beta effect appears in the potential vorticity, elsewhere, the Coriolis parameter appears as a constant. Second, mean state stratification is specified and assumed independent of horizontal position. To overcome these two limitations, we use a multiple scale expansion to derive a quasi-geostrophic equation forced by a large scale planetary geostrophic (pg) solution (as originaly derived by Pedlosky (1984)). This model is an extremely powerful tool to study oceanic turbulence in a closed basin (as opposed to a doubly periodic domain or channel). The quasi-geostrophic solution obtained with this model is used to characterize eddy dynamics at the gyre scale. The inverse cascade eventually leads to the emergence of a QG recirculation gyre with low-frequency variability that has a minimal feedback on the pg structure.

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