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Eddies and the General Circulation of an Idealized oceanic Gyre: A Wind and Thermally Driven Primitive Equation Numerical Experiment

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ABSTRACT

We present the results of a multi-level, constant depth, primitive equation general ocean numerical circulation simulation with mesoscale resolution. A single mid-latitude model gyre is driven by wind and heating. After 30 years of spin-up with a relatively coarse grid and large diffusion coefficients, the grid size and diffusion coefficients are reduced. The circulation then adjusts into a nonlinear and time-dependent flow with periods of tens of days and space scales of hundreds of kilometers. After a quasi-equilibrium state is achieved, two years of data are obtained which are separated into time-mean and time-dependent fluctuations, and analyzed. Dynamically distinct regions are intensified, momentum, heat and vorticity balances examined, and energy integrals calculated. Statistical measures of significance and of uncertainty are computed where possible. Eddy energy is produced primarily by Reynolds stress work (barotropic instability) on the mean circulation shear in the recirculation and near-field region of the northern current system. Mean fluctuation correlation terms are presented in some regions at order 1 in the mean heat and vorticity balance and can be the leading ageostrophic effect in the mean momentum balance. The flow is non-quasigeostrophic in some parts of the intense boundary currents.

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