Geophysical Research Abstracts
Vol. 19, EGU2017-17803, 2017
EGU General Assembly 2017

Gravity waves catalysed by ageostrophic baroclinic instability

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Internal gravity waves are ubiquitous in the ocean interior and are significantly important for the ocean's energy budget. Most ocean models do not resolve gravity waves explicitly and thus they need to be parametrized. For parameterization of gravity waves the specification and understanding of their sources is important. This includes the energy pathway(s) from balanced flows down to scales where energy is finally dissipated. We discuss if the balanced motions, for instance mesoscale flows, can generate unbalanced motions, i.e. gravity waves, during baroclinic instability in ageostrophic to quasi-geostrophic regimes.

Previous results (Brüggemann and Eden, JPO, 2015) show a dominant forward energy cascade for a large Rossby number (Ro) in an idealized channel model, while for Ro«1 the inverse energy cascade dominates. We discuss the role of gravity waves for the forward cascade of energy. A spectral analysis of energy in frequency-wavenumber space for different regimes characterized by a range of Ro, shows that energy contained in the super-inertial frequencies corresponding to gravity waves is much higher for an ageostrophic regime than for a quasi-geostrophic regime. A modal decomposition into geostrophic and gravity wave modes indicates that the energy associated with the super-inertial frequencies is indeed related to gravity waves. Hence, gravity wave emission could be catalysed by ageostrophic baroclinic instability. A modal decomposition of the spectral fluxes of energy in wavenumber space provides more insight about how much energy is contained in which mode.