Eddy potential vorticity flux structure in the strongly and weakly unstable limits

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I will discuss a scaling theory which predicts the steady-state energies, scales and vertical structure of the potential vorticity flux for homogeneous baroclinic turbulence. The theory, which applies equally to systems with uniform and non-uniform stratification, utilizes the neutral stratification modes and the projection of the mean shear onto these modes. The original theory, valid in the strongly unstable limit, is now extended to apply in the weakly unstable limit. In both cases, the predicted eddy potential vorticity flux automatically conserves momentum. In the (more interesting) weakly-unstable case, β contributes non-neglibibly to the mean potential vorticity gradient, so that the potential vorticity flux can no longer be proportional to the vortex-stretching part of the PV gradient and still conserve momentum.

The proposed theory has obvious implications for eddy parameterization in ocean general circulation models, but might be useful in the direct interpretation of ocean data as well. For example, Klein, Tregurier and Hua (1997) recently proposed that mesoscale eddy stirring is responsible for small-scale T-S fluctuations (spice variance), and consistent with density compensation. The present theory, in conjunction with assumptions about the direct cascade of tracer, can be used to predict the observed levels of T-S variance in the North Atlantic Tracer Release Experiment. Preliminary work in this vein will be briefly discussed.

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11:00 a.m., 234 Ames Hall