The quasi-geostrophic Eliassen-Palm flux tensor

Maddison James [1]

1 : School of Mathematics and Maxwell Institute for Mathematical Sciences, University of Edinburgh
Edinburgh, EH9 3JZ

Geostrophic ocean eddies are often parameterised either via the Gent and McWilliams closure, or via a closure for the eddy potential vorticity fluxes (which are typically assumed to be down-gradient). The former has demonstrated utility in global ocean modelling, and is a popular choice in practice, but neglects the dynamical influence of horizontal Reynolds' stresses. The latter leads to the required generation of eddy enstrophy, but easily violates momentum conservation.
Here we describe, in a quasi-geostrophic context, the relationship between eddy momentum and buoyancy fluxes, and the eddy potential vorticity fluxes. The eddy-mean-flow interaction is more generally classified in terms of an eddy momentum stress tensor -- the Eliassen-Palm flux tensor -- whose divergence yields the eddy potential vorticity fluxes. Closures for this object can preserve the geometric structure of the interaction and conserve momentum naturally. The structure of the Eliassen-Palm flux tensor will be described, and links to eddy transport properties provided. The relationship to the more general primitive equation case will be outlined.