



On Backscatter in Ocean Dynamics

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Downgradient mixing of potential-vorticity and its variants are commonly employed to model the effects of unresolved geostrophic turbulence on resolved scales. This is motivated by the (inviscid and unforced) particle-wise conservation of potential-vorticity and the mean forward or down-scale cascade of potential enstrophy in geostrophic turbulence. By examining the statistical distribution of the transfer of potential enstrophy from mean or filtered motions to eddy or sub-filter motions, we find that the mean forward cascade results from the forward-scatter being only slightly greater than the backscatter. Downgradient mixing ideas, do not recognize such equitable mean-eddy or large scale-small scale interactions and consequently model only the mean effect of forward cascade. Consequently, we consider two alternate approaches to modeling backscatter—one based on the Large Eddy Simulation approach and the other based on regularization approach. We demonstrate the equivalence of the two approaches in a certain limit and present results that use the new parameterizations.