

Formulation and application of phase-independent energy conversions for quasi-geostrophic eddies

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Estimating energy conversions could be useful to clarify dynamics of low-frequency variability of quasi-geostrophic disturbances. Energy conversion terms are composed of quadratic terms in disturbance amplitudes and shear terms of basic flows, so that they can mean energy conversions between disturbance fields and the basic flows. The quadratic terms in the energy conversions are usually expressed by the velocities of the disturbances, such as momentum transports $u'v'$, so that they inherently include an oscillatory component of one-half wave-length. Therefore, in traditional forms of the energy conversions, phase-averaging such as time-averaging should be needed to express energy-conversion distributions in the phase-independent forms.

In this study, a new formulation of energy conversions for quasi-geostrophic eddies is proposed under an assumption that an eddy is almost a plane wave in the WKB sense. Because of a phase-independent form, the new formulation can be applicable to estimating energy conversions for stationary eddies or snapshot of transient eddies. Actual applications of the new form of the energy conversions to the data analysis will also be given.

Keywords: quasi-geostrophic eddy, energy conversion, low-frequency variability in the extra-tropics