

A seamlessly diagnosable expression for the energy flux of all waves at all latitudes with equatorial and coastal waveguides

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Some of Rossby waves in the mid-latitude regions of the ocean originate from waves propagating poleward along the eastern boundaries, that may be traced back to the arrival of equatorial Kelvin waves. This kind of interaction between the various types of free waves in the equatorial and mid-latitude regions is fundamental for understanding tropical climate systems, and has sometimes been explained using the concept of equatorial basin mode. In previous studies, the interaction of equatorial and mid-latitude waves has been little mentioned in terms of the transfer of wave energy. The present study provides a formula to calculate the energy flux, from model outputs without relying on a Fourier analysis. The expression of the energy flux of the present study has been determined from the analysis of the group velocity of equatorial Rossby, mixed Rossby-gravity, and inertia-gravity waves. The result is that the energy flux is written as the sum of the pressure flux and the additional rotational flux. The expression of the additional rotational flux reduces, under the approximation of mid-latitude Rossby waves, to that has been derived in previous studies and, under the approximation of mid-latitude inertia-gravity waves, to zero. Thus the expression of the energy flux, as given by the present study, may be used for a seamless diagnosis of waves in both equatorial and mid-latitude regions.

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