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Downscale transfer of quasi-geostrophic energy catalyzed by near-inertial waves JIN-HAN XIE, Peking Univ — Wind forcing injects energy into mesoscale eddies and near-inertial waves (NIWs) in the ocean, and the NIWs are believed to solve the puzzle of mesoscale energy budget by absorbing energy from mesoscale eddies. We study the turbulent energy transfer in the NIW–quasigeostrophic mean mesoscale eddy coupled system based on a previously derived two-dimensional model which inherits conserved quantities in Boussinesq equations. The conservation of energy, potential enstrophy and wave action implies the existence of phase transition with changing the relative strength between NIW and mean-flow, quantified by a parameter R.Using forced-dissipative numerical simulations, we justify the existence of second-order phase transition around a critical value R_c. When $R < R_c$, energy transfers bidirectionally, wave action transfers downscale, and vorticity forms strong cyclones. When $R > R_c$, energy transfers downscale, wave action transfers bidirectionally, and vortex filaments are dominant. We find the catalytic wave induction mechanism where the NIW induces a downscale mean energy flux, which differs from the stimulated loss of balance mechanism observed in inertial value problems. The new mechanism is effective in the toy-model study, making it potentially important for ocean energetics.

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