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Analysis of Energy Sources along the Kuroshio in the East of Taiwan Island and East China Sea

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The locations and generation mechanisms of energy sources in the Kuroshio were analyzed. The slope of the one-dimensional spectral energy density varies between $-5/3$ and -3 in the wavenumber range of 0.03-0.1 cpkm (wavelengths of approximately 209 to 63 km, respectively), indicating an inverse energy cascade in the Kuroshio; according to the steady-state energy evolution, an energy source which occurs at scale smaller than Rhines scale must be present. By analyzing the wavenumber-frequency spectrum, the period of higher kinetic energy (KE) is about 89-209 days and spatial scale is less than 0.03 cpkm. The locations of energy sources were identified with using the spectral energy transfer calculated by altimetry and model data. At the sea surface, the KE sources are mainly within 23.2°-25.2°N and 28°-30°N at less than 0.03 cpkm and 23.2°-23.6°N and 26°-30°N at 0.03-0.1 cpkm. The available potential energy (APE) sources are mainly within 22.2°-28°N and 28.6°-30°N at less than 0.03 cpkm and 29.2°-30°N at 0.03-0.1 cpkm. Wind stress and density differences (including buoyancy flux, temperature flux and salinity flux) are primarily responsible for the KE and APE sources, respectively. Beneath the sea surface, the energy sources are mainly above 400 m depth, and buoyancy flux plays a major role in the generation of energy sources. The energy cycle process can be summarized as follows: once an energy source is formed, to maintain a steady state, energy cascades (mainly inverse cascades) will be engendered.