Geophysical Research Abstracts
Vol. 21, EGU2019-11880, 2019
EGU General Assembly 2019

Generation and propagation of M2 internal tides modulated by the Kuroshio northeast of Taiwan

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The variability and energetics of M2 internal tides during their generation and propagation through the Kuroshio background field northeast of Taiwan are investigated using a high-resolution numerical model. The corrugated continental slopes, particularly the I-Lan Ridge and Mien-Hua Canyon, are firstly identified as energetic sources for M2 internal tides. The domain-integrated M2 barotropic-to-baroclinic conversion rate under the Kuroshio influence is ∼2.35 GW, ∼0.9 GW of which is generated at the I-Lan Ridge, ∼0.93 GW at the Mien-Hua Canyon and ∼0.52 GW at the north shelf. The M2 internal tide generation is influenced by horizontal variable and zonal tilt stratification associated with the Kuroshio, with the conversion rate decreased by ∼30% at the I-Lan Ridge but increased within ∼10% at the Mien-Hua Canyon and north shelf compared to the ideal simulation initiated with horizontal homogeneous stratification. Internal tides from multiple sources interfere to form a three-dimensional baroclinic field. The interference of internal tides from the Mien-Hua Canyon and north shelf are refracted by the Kuroshio to exhibit a meso-scale gyre pattern, which can explain the frequent occurrence and variable direction of internal solitary waves therein. An energetic along-slope tidal beam from the I-Lan Ridge radiates southward against the northward Kuroshio flows, with the strongest energy located in the intermediate layer, which compares favorably with recently reported field measurements. The M2 internal tide energy dissipates primarily near the source sites, and the remaining energy radiates outward over limited distances. Various geometry and background currents enhance internal tide dissipation which induces strong, inhomogeneous vertical mixing.