Geophysical Research Abstracts
Vol. 20, EGU2018-529-1, 2018
EGU General Assembly 2018

Classification of ISW transformation over the South China Sea shelf

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The mechanisms of breaking of internal waves on sloping boundaries and the resulting localized mixing are important in understanding the parametrization of dissipation and diapycnal diffusion. Mixing efficiency is the proportion of the kinetic energy input to the fluid that has led to irreversible mixing. The aim of the present study is thus to estimate the mixing efficiency of wave breaking event and understand the dependence of mixing efficiency from the such parameters as the slope inclination γ, normalized wave amplitude α and the blocking parameter B (Talipova et al 2013). We introduce the new classification of regimes of internal solitary wave interaction with a shelf-slope topography in the framework of two-layer fluid in the form of three dimensional diagram in space (α, B, γ). Two mechanisms are important during wave transformation over the shelf-slope topography: wave breaking and changing of the polarity of the initial wave of depression on the slope. Range of the parameters at which wave breaking occurs can be defined on the criteria, obtained empirically (Vlasenko and Hutter, 2002). In the three-dimensional space (α, B ,γ) this criteria is represented by the surface $f_1(B, \gamma) = 0$ that separates the region of parameters where breaking takes place from the region without breaking. The polarity change surface $f_2(\alpha, B) = 0$ is obtained from the condition of equality of the depth of upper layer h_1 to the depth of the lower layer h_2 after passing the turning point. Thus three-dimensional diagram is divided onto four zones by intersecting surfaces f_1 and f_2. Zone 1 lies above two surfaces and corresponds to the non breaking regime with a little energy that is converted to an increase in potential energy due to mixing. Zone 2 lies above “breaking” surfaces but below the surface of changing polarity and corresponds to the regime of changing polarity without breaking. This type of interaction is realized for small and intermediate amplitude wave and can be referred as “transition wave” after passing the turning point $(h_1 = h_2)$. Zone 3 lies above surface of changing polarity but below ’breaking’ surfaces and corresponds to regime of wave breaking without changing polarity. This regime is realized for large amplitude waves and characterized by occurrences of supercritical regimes. In this zone gravitational instabilities fully develop and the mixing efficiency that reaches has the maximum values of 30%. Zone 4 that lies below two surfaces and corresponds to the regime of wave breaking with changing polarity. In this zone due to strong blocking most of large amplitude waves energy reflects from the sloping boundary and viscous losses dominate. To verify introduced diagram numerical modelling was carried out for a wide range of values α, B, γ. Results of modeling were accompanied and compared by the results of known laboratory and field observations. Classification is introduced in the form of the map of South China Sea with a of “hot spots” of high levels of energy dissipation.