Geophysical Research Abstracts
Vol. 12, EGU2010-1658, 2010
EGU General Assembly 2010

Predictions of solitary wave dynamics at Luzon Strait.

Alex Warn-Varnas (1), J. Hawkins (2), K. Lamb (3), S. Piacsek (1), S. Chin-Bing (1), D. King (1), and G. Burgos (4)

(1) Naval Research Laboratory, Oceanography Division, Stennis Space Center, United States (varnas@nrlssc.navy.mil), (2) Planning Systems Inc., Slidell, LA 70458, USA, (3) University of Waterloo, Waterloo, Ont., Canada N2L, USA, (4) University of Puerto Ricco, San Juan 00936, Puerto Rico, USA

A high resolution modeling study is undertaken, with a 2.5-dimensional nonhydrostatic model, of the generation of internal waves induced by tidal motion over the ridges in Luzon Strait. The model is forced by the barotropic tidal components K1, M2, and O1. These tidal components, along with the initial density field, were extracted from data and models. As the barotropic tide moves over the Luzon Strait sills, there is a conversion of barotropic tidal energy into baroclinic tidal energy. Depressions are generated that propagate towards the Asian Seas International Acoustics Experiment (ASIAEX) test site on the Chinese continental shelf. Nonlinear effects steepen the depressions, frequency and amplitude dispersion set in, and disintegration into large amplitude solitary waves occurs. The effects of varying the initial density field, tidal component magnitudes, as well as adding a steady background current to represent the occasional excursions of the Kuroshio Current into the strait, are considered.

The solitary waves propagating towards the ASIAEX test site have been observed to reach amplitudes of 120–250 m, depending on the tidal strength. ASIAEX observations indicate amplitudes up to 150 m and the Windy Island Experiment (WISE) measurements contain magnitudes over 200 m. The model results yield solitary wave amplitudes of 70–300 m and half widths of 0.60–3.25 km, depending on parameter values. These are in the range of observations. Measurements by Klymak et al. (2006), in the South China Sea, exhibit amplitudes of 170 m, half widths of 3 km and phase speeds of 2.9 m/s.

The energy in the leading soliton of the large amplitude wave trains ranges between 1.8 and 9.0 GJ/m. The smaller value, produced using barotropic tidal currents based on the Oregon State University data base, is the same as the energy estimated to be in a solitary wave observed by Klymak et al. (2006).

Baroclinic fluxes of available potential energy, kinetic energy and linear are calculated for various parameter combinations. The solitary wave trains produced in the simulations generally consist of large amplitude wave trains alternating with small amplitude wave trains. Estimates of the conversion of barotropic tidal energy into radiating internal wave energy yield conversion rates ranging between 3.6% and 8.3%.