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Early Student Support for a Statistical Investigation of Internal Wave Propagation in the Northern South China Sea

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LONG-TERM GOALS

The long-term goal of this project is to predict the generation of internal waves over the ridges in the Luzon Strait and wave propagation across the northern South China Sea.

OBJECTIVES

The objective of this study is to provide a description of internal wave/tide propagation from the Luzon Strait to the edge of the continental shelf off China. Three issues are to be studied: 1) the relationship between the internal waves and the barotropic tides in the Luzon Strait, 2) temporal and spatial variations of internal wave properties during propagation across the deep basin of the northern South China Sea, and 3) wave transmission across the continental margin.

APPROACH

Guided by the description of the internal wave field from nonhydrostatic numerical simulation, time series analysis will be performed on real-time simulated data obtained from the Ocean Nowcast/Forecast System of Naval Research Laboratory during NLIWI. In the generation region, the study will estimate the energy conversion from the barotropic tides to baroclinic waves. Sources of the internal waves are to be identified. In the propagation region, waves will be traced back to the generation region to find the dependence of the amplitude of internal solitary wave on the conditions in the Luzon Strait.

WORK COMPLETED

Funding for this project started in January this year. A Ph.D. student, Michael Angus, was recruited and started to work on the data analysis in August. He will first look at the time series from nonhydrostatic to get familiar with the wave generation process. The real-time data from NRL will be used next to examine the wave generation and propagation.

RESULTS

The phase and amplitude of internal waves over a steep, tall ridge has been investigated by the PI using a nonhydrostatic model in the related project. The results show that internal waves generated by

barotropic tidal currents are characterized by wave beams along slanting paths from the ridge crest. The starting of the wave front can be traced to the reversal of the tidal current toward the direction of internal wave propagation. The speed is fairly uniform and is close to the phase velocity of mode-1 waves. In addition to the phase relationship, a normalization scheme for energy flux has been developed by the PI (Qian, et al., 2010). It is found that for steep, tall ridges (such as those in the Luzon Strait) the normalized energy flux is fairly uniform, independent of the ridge slope and ridge height. Thus, the energy conversion rate from the barotropic tides to the baroclinic waves can be reliably estimated.

These studies provide the basis for studying the correlation of the amplitude and phase of the internal waves in the northern South China Sea to the barotropic tidal currents in the Luzon Strait. The plan in the coming year is to start the investigation using the real-time data from simulations performed at NRL.

IMPACT/APPLICATIONS

The result will be useful to predict the generation of internal solitary waves in the northern South China Sea.

RELATED PROJECTS

This project provides support for a student to work on “A Statistical Investigation of Internal Wave Propagation in The Northern South China Sea” (Award Number: N00014-10-1-0319).

REFERENCES

Shaw, P.-T., D. Ko, and S.-Y. Chao (2009) Internal solitary waves induced by flow over a ridge: with applications to the northern South China Sea, J. Geophys. Res., 114, C02019, doi:10.1029/2008JC005007, 2009.

Qian, H., P.-T. Shaw, and D. S. Ko (2010) Generation of internal waves by barotropic tidal flow over a steep ridge, Deep-Sea Research I, doi:10.1016/j.dsr.2010.09.001.