ATMOSPHERICALLY FORCED MESOSCALE BAROTROPIC MOTIONS IN THE CENTRAL NORTH PACIFIC

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAI'I IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

OCEANOGRAPHY

AUGUST 2003

By

Réka Domokos

Dissertation Committee:

Douglas Luther, Chairperson
Mark Merrifield
Peter Müller
Bo Qiu
Gary Barnes

Abstract

Characteristics of atmospherically forced mid-latitude, subinertial barotropic motions in the oceans are studied with measurements of bottom pressure, barotropic currents, surface winds and air pressure from the central North Pacific. The bottom pressure is found to be dominated by atmospherically forced variability within the periods of about 1.5 to 300 days. The bottom pressure exhibits characteristics of evanescent, non-free-wave motions at periods shorter than the shortest allowable free Rossby wave (from linear theory this cutoff period is about 2.6 days for the study area). At longer periods, the bottom pressure variability is consistent with the propagation of topographic Rossby waves. The main features of the bottom pressure energy densities and the patterns of coherence of bottom pressure with local and non-local atmospheric variables are predicted reasonably well by simple analytical models, both above and below the Rossby wave cutoff period. The spatial patterns of coherence between bottom pressure and the wind stress curl are shown to be the result of the generation of Rossby waves from specific locations, as opposed to a uniform generation of a spectrum of Rossby waves throughout the North Pacific. There is clear evidence for the existence of "hot spots" at which the atmosphere is strongly forcing oceanic Rossby waves that then propagate to all five bottom pressure measurement sites.

In contrast to the bottom pressure, the barotropic current energy densities and their coherences with the atmospheric variables are predicted poorly by the simple models. Filtering the barotropic currents by spatial averaging results in a current field more clearly related to atmospheric forcing that exhibits the signatures of large scale, westward propagating topographic Rossby waves.

As opposed to simple analytical models, the POP numerical model predicts energy densities of the observed bottom pressure exceptionally well and shows high significant coherences between model and observational bottom pressure with near zero phases. On the other hand, energy densities of the barotropic currents are not predicted as well by the POP model, although the model's ability to reproduce the barotropic current field improves significantly when the currents are filtered using large spatial averages.