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14. ABSTRACT
An objective is to improve the Mellor-Yamada turbulence closure model for ocean surface and bottom boundary layers and, specifically, to include the effects of surface waves. It is observed that there is a mismatch in surface wave modeling and ocean circulation modeling. The wave community models surface waves but neglects vertical variations in the mean current fields in which the waves are physically imbedded. The ocean circulation community explicitly models the vertical structure of the ocean but generally ignores surface waves and their contribution to vertical mixing of ocean properties. There are researches (e.g., Craig and Banner 1994, Terray et al. 2000) that do recognize wave-mixed layer interaction but, generally, the aforementioned mismatch prevails.

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Turbulence Closure and 3-D Ocean Modeling for CBLAST

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LONG-TERM GOALS

As part of the CBLAST-DRI Program, my long-term goal is to improve the numerical modeling of the coastal ocean and its interaction with atmospheric forcing.

OBJECTIVES

An objective is to improve the Mellor-Yamada turbulence closure model for ocean surface and bottom boundary layers and, specifically, to include the effects of surface waves. It is observed that there is a mismatch in surface wave modeling and ocean circulation modeling. The wave community models surface waves but neglects vertical variations in the mean current fields in which the waves are physically imbedded. The ocean circulation community explicitly models the vertical structure of the ocean but generally ignores surface waves and their contribution to vertical mixing of ocean properties. There are researches (e.g., Craig and Banner 1994, Terray et al. 2000) that do recognize wave-mixed layer interaction but, generally, the aforementioned mismatch prevails.

APPROACH

I have begun this work by investigating the effect of surface waves on bottom boundary layers wherein the oscillations imposed by the waves in shallow water, 100 m or less, increase the bottom friction and play a significant role in the transport of sediments. The focus is on the incorporation of these effects in turbulence closure models which are imbedded in three-dimensional ocean models. This work (Mellor 2001) will significantly extend the work initiated by Grant and Madsen (1986).

On another front, I have examined the effect of surface waves on the vertical structure of the ocean. It is noted that the so-called wave radiation stresses are generally derived in vertically integrated form (Phillips 1977, Komen et al. 1994). I have derived vertically variable wave radiation stresses. At this writing, my results have been subjected to a fair amount of peer scrutiny, but I am still not sure that the derivation is novel.

WORK COMPLETED

A paper cited in **REFERENCES**.

RESULTS

It has been learned (Mellor 2001) that it is possible to augment the turbulence production term in the Turbulence Kinetic Energy equation in any closure model that uses the TKE equation to account for the effects of surface wave induced oscillations on the mean current. With the help of numerical modeling, the augmented production has been derived as a function of vertical distance from the bottom, oscillation frequency and amplitude, angle between the wave number vector and mean current stress and the bottom roughness parameter. This information can be easily incorporated into three-dimensional ocean models.

Three-dimensional wave stress radiation terms have derived for inclusion into the momentum equations of ocean models.

IMPACT

The anticipated impact is that the research reported thus far and that expected in the future will significantly improve the verisimilitude of three-dimensional numerical ocean models.

RELATED PROJECTS

This work does overlap with a NOPP sponsored project on the Near-Shore Circulation Zone. In the future, my research on the ONR project and the NOPP project will tend to diverge, the former emphasizing the ocean surface and the latter the ocean bottom, but obviously the two researches will complement each other.

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PUBLICATIONS

Mellor, G. L. : 2001. Oscillatory bottom boundary layers. Submitted to the J. Phys. Oceanogr.