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Final Technical Report

DYNAMICS OF OCEANIC MOTIONS

ONR Contract N00014-75-C-0225

1 January, 1975 — 29 February, 1984

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by
Allan R. Robinson
Principal Investigator
26 December, 1990

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This project researched the dynamics of oceanic motions: aspects of the theory and modeling of fundamental dynamical and energetic processes in the sea and their interactions, and the relationship of theory and modeling to the interpretation, analysis and design of observational data and experiments. Research was directed towards the dynamics and the forecasting of the low frequency variability of ocean currents (mid-ocean eddies and intense current systems), the mid-latitude general circulation, and surface boundary and internal wave layer interactions. Our modeling research was directed toward studies of the local dynamics of open regions of the ocean (i.e., arbitrary regions with flow across their boundaries), and the relationship of such regional dynamics to the larger scale general circulation in which it is embedded. The approach was adopted as appropriate for application to intensive local data sets and for the development and testing of forecast methods for oceanic synoptic/mesoscale motions. *This report consists primarily of a listing of the*

The project produced 48 refereed publications and 22 additional technical reports which are indexed on attached lists. The research summary will reference the publications since the reports are preliminary or extended versions of the publications except for report # 13 which was the Brunn Memorial Lecture I delivered to the General Assembly of the Intergovernmental Oceanographic Commission and Report # 19 which is the Proceedings of the first Ocean Prediction Workshop (OPW81) at the Naval Postgraduate School which I cochaired and edited. *Produced under this project.*

Highlight contributions include a book on mesoscale eddies (Publication # 36), a pioneering primitive equation EGCM simulation (8), the development and calibration of the Harvard open ocean model (25, 35), the definition of fine mesoscale structure in the California Current System (42), the first real time mesoscale dynamical forecast (43) and the introduction of the Ocean Predictive Descriptive System concept (45). Eight review and overview articles and chapters dealt with the mesoscale (3), modeling for forecasting (13), ocean and climate models (22), eddies and circulation (23), eddy dispersion (34), the results of the MODE and POLYMODE programs (17, 32), and large oceanographic programs (26). There were six Ph.D. theses published (1, 2, 12, 27, 47, 48).

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DIVISION OF APPLIED SCIENCES

ALLAN R. ROBINSON
*Gordon McKay Professor
of Geophysical Fluid Dynamics*

PIERCE HALL
CAMBRIDGE, MASSACHUSETTS 02138
(617)-495-2819

January 2, 1991

Mr. Robert H. Tanner
Department of the Navy
Office of Naval Research
Resident Representative
The Charles Stark Draper Laboratory
555 Technology Square
Cambridge, MA 02139

Dear Mr. Tanner,

Enclosed please find our final technical report for ONR Contract Number N00014-75-C-0225 "Dynamics of Oceanic Motions" which terminated February 1984.

Yours sincerely,


Allan R. Robinson
Principal Investigator

ARR:m

dist.

enclosure: (1) copy Final Technical Report

- cc: (1) Ms. M. Sterns/Harvard - OSR
(1) Ms. R. Demone/Harvard - DAS/accounting
(3) Dr. D. Evans/ONR
(1) Director/NRL
(4) Defense Technical Information Center

Model developments included the horizontal (4) and vertical (44) codes of the HOOM, nonlinear modal analysis (14) and importantly the Harvard objective analysis (46). Data analyses synthesized the MODE-1 data base (5), calibrated the XBT as a scientific instrument (10), and produced large scale maps of mesoscale features from the GEOS-3 altimeter (37). Fundamental theoretical studies were carried out relating to stable and unstable planetary waves (6, 21), and Gulf-Stream meanders and rings (41, 11). The theoretical basis for general energetic study of open regions was established (16), and a parameterization of eddy diffusion hypothesized (15). Studies of the generation and forcing of mesoscale eddies invoked momentum and buoyancy flux (18, 19, 30) and pressure radiation (20) mechanisms. Boundary dynamical studies included the seasonal cycle of the surface boundary layer and its interaction with a deep baroclinic Rossby wave field (24, 38) and wind forced coastal currents (39) and upwelling (40). Topics at higher frequency included substantial studies of internal wave dynamics and interactions (28, 29), the dynamics of long-period tides (33), and the generation of microstructure via a double-diffusive mechanism (9).

Statement "A" per telecon Dr. David Evans
Office of Naval Research/cdoe 1122ML.

VHG

1/17/91

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