Final Report

submitted to the

National Aeronautics and Space Administration

Project Title:	Eastern Boundary Effects on General Circulation Structure
Principal Investigator:	William K. Dewar
Report Period:	June 1, 1992 through May 31, 1996
Institution:	Department of Oceanography Florida State University Tallahassee, FL 32306-4320
Agency Award No.:	NAGW-3087

William K. Dewar
Professor
Florida State University
Tallahassee, FL 32306-4320

Nov. 18, 1997
Date

Addendum

The following report was originally submitted to NASA in 1995 to cover the period June 1, 1992 - May 31, 1995. We now update that report to include the one-year, no-cost extension which ended May 31, 1996.

All the research tasks outlined below were completed within the one-year extension period.

A bibliography of publications which resulted from this NASA Research Project is attached.

Summary of Overall Progress

My NASA proposal included plans to examine the dynamics of the eastern oceanic boundary, with a view towards those processes important to the interior. Several relevant tasks have been completed and either have appeared or will appear soon in the refereed literature.

Current Problems

I am currently involved in a study of the interaction of open ocean planetary waves, generated at the eastern margin, with large scale topography. This study is still in the exploratory numerical stage, although analytical investigations necessary to the interpretation of the results have begun. The initial results are quite interesting, and hint at possible applications to the problem of open ocean interdecadal variability; namely, the presence of topography appears to be associated with a Hopf bifurcation and the appearance of thermocline variability. I anticipate completion of a first project in the next several months and that a few follow on projects, initiated by this study, will commence.

A second stated objective of my NASA research involves the dynamics of Meddies. Relative to this, Dr. Killworth and I have been studying the stability properties of oceanic vortices. The connection here to Meddies has to do with their observed long lifetimes (in excess of two years). Our initial studies have focused on the primitive equation stability of upper ocean vortices, and here we have found an interesting and unexpected suppression of instability by barotropic flow. We are currently analyzing related models to clarify the mechanisms. We anticipate the submission of a manuscript in the next few months.

Finally, a project not explicitly stated in my NASA contract, but which has been partially supported by it, involves a study of the onset of chaos in a simple thermohaline model. This work, done in collaboration with Dr. Huang, has focused on loop models and the resident convection therein. A recent discovery

is an apparent sensitivity of the pathways to chaos on the applied boundary conditions. Further, we have identified critical parametric dependencies in these models controlling the presence of such important features as the appearance of Hopf bifurcations. We are currently preparing a manuscript on our work.

Completed Tasks

In addition to the finished tasks mentioned above, a paper on the dynamics of Meddies in the general circulation, which examines the relative role of wave-drag, mean-flow and b-plane propagation, will appear in the Journal of Physical Oceanography. The application of this work is to the observed tendencies for Meddies to move south relative to their environment, an observation for which our work provides an explanation.

Budgets

This NASA contract terminated in May 1995. A one-year, no-cost, extension is now in effect in order to complete all aspects of the research.

Bibliography of Publications

Supported by NAGW-3087

Nof, D. and W.K. Dewar, Alignment of lenses: Laboratory and numerical experiments, ***Deep-Sea Research, 41***, 1994, 1207-1229.

Dewar, W.K. and P.D. Killworth, On the stability of oceanic rings, ***Journal of Physical Oceanography, 25***, 1995, 1467-1487.

Dewar, W.K. and H. Meng, The propagation of Submesoscale coherent vortices, ***Journal of Physical Oceanography, 25***, 1995, 1745-1770.

Dewar, W.K. and R.X. Huang, Fluid flow in loops driven by freshwater and heat fluxes, ***Journal of Fluid Mechanics, 297***, 1995, 153-191.

Dewar, W.K. and R.X. Huang, On the forced flow of salty water in a loop, ***Physics of Fluids***, *8*(4), 1996, 954-970.

Huang, R.X. and W.K. Dewar, Haline Circulation: Bifurcation and Chaos, ***Journal of Physical Oceanography,26***, 1996. 2093-2106.

Killworth, P.D., J.R. Blundell and W.K. Dewar, Primitive-equation instability of wide oceanic rings. I. Linear theory, ***Journal of Physical Oceanography,*** 1997, 941-962.