

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE 30 SEP 2001		2. REPORT TYPE		3. DATES COVERED 00-00-2001 to 00-00-2001	
4. TITLE AND SUBTITLE Theoretical and Numerical Studies of Variability and Predictability in an Unsteady Ocean				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) AOS Program,,Princeton University,,Princeton,NJ, 08544				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT Our long-term goals are to understand the nature of variability within the ocean, in particular that due to the motion of mesoscale eddies and their interaction with and dependence on the general circulation.					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a REPORT unclassified	b ABSTRACT unclassified	c THIS PAGE unclassified			

Theoretical and Numerical Studies of Variability and Predictability in an Unsteady Ocean

Geoffrey K. Vallis

AOS Program, Princeton University, NJ 08544

phone: (609) 258 6176 fax: (609) 258 2850 email: gkv@princeton.edu

Award Number: N000149910211

<http://www.gfdl.gov/~gkv>

LONG-TERM GOALS

Our long-term goals are to understand the nature of variability within the ocean, in particular that due to the motion of mesoscale eddies *and* their interaction with and dependence on the general circulation.

OBJECTIVES

Our particular objectives are to understand the nature, scales and amplitudes of mesoscale eddies in the ocean. This includes the mechanisms of their equilibration, their structure and energetics, and their dependence on the large-scale parameters set by the general circulation.

APPROACH

Our approach is to use a hierarchy of numerical and analytic models of the ocean circulation, of varying complexity. At the simplest level are linear quasi-geostrophic models of baroclinic instability. At the next level are nonlinear, eddy resolving quasi-geostrophic models in idealized domains. Finally, we employ eddy resolving primitive equation models in fairly realistic configuration and domain.

WORK COMPLETED

We have completed a sequence of integrations using a quasigeostrophic model to explore the equilibration properties of mesoscale eddies, with oceanically realistic stratification. We have configured a primitive equation numerical model to perform eddy resolving integrations of the Southern Ocean and subtropical gyres. We have performed, for the first time, some primitive equation eddy resolving experiments in which the abyssal circulation is equilibrated.

RESULTS

Progress has been made in understanding the mechanisms that determine the scale and equilibration of mesoscale eddies in the ocean. We have produced a scaling theory that predicts the scales and amplitudes of the mesoscale eddies as a function of the background stratification and shear, and we have made some progress toward incorporating these findings in a parameterization scheme for oceanic mesoscale eddies.

IMPACT/APPLICATIONS

The impact of this lies in understanding and predicting the nature of mesoscale eddies in the ocean, and its parameterization in ocean models.

TRANSITIONS

These results may be used to interpret the results of altimeter measurements and primitive equation numerical models.

RELATED PROJECTS

A related GFDL/NOAA funded project on modeling eddies provides an invaluable insight into eddies in the Southern Ocean, as well as the resources for the extensive primitive equation calculations.

PUBLICATIONS

Huck, T., and G. K. Vallis. 2001. Linear stability analysis of the three-dimensional thermally-driven ocean circulation. *Tellus*, **53A**, 526--545.

Smith, K. S., Others, and G. K. Vallis. Turbulent diffusion in the geostrophic inverse cascade. *J. Fluid Mech.* (submitted).

Vallis, G. K. 2000 Thermocline Theories and WOCE: A Mutual Challenge. *WOCE Newsletter*, **39**, 30—34.

Smith, K. S. and G. K. Vallis. 2001 Scales and equilibration of mid-ocean eddies: Forced-dissipative flow. *J. Phys. Oceanogr.* (to appear).

Smith, K. S. and G. K. Vallis. 2000. Scales and equilibration of mid-ocean eddies: Freely decaying flow. *J. Phys. Oceanogr.* 31, 554--571.

Schonbek, M. and Vallis, G. K. 2000. Energy Decay of Solutions to the Boussinesq, Primitive and Planetary Geostrophic Equations. *J. Math. Analysis & Applics.* 234, 457-481.

Vallis, G. K. 2000. Large-scale circulation and production of stratification: effects of wind, geometry and diffusion. *J. Phys. Oceanogr.*, 30, 933--954.