

Update on U.S. Navy Ocean Analysis and Prediction: Existing and Future Plans

presented by

**Harley E. Hurlburt
Naval Research Laboratory
Stennis Space Center, MS USA**

**HYCOM NOPP GODAE Meeting
RSMAS, University of Miami
27-29 Oct. 2004**

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 OCT 2004		2. REPORT TYPE		3. DATES COVERED 00-00-2004 to 00-00-2004	
4. TITLE AND SUBTITLE Update on U.S. Navy Ocean Analysis and Prediction: Existing and Future Plans				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) Naval Research Laboratory, Stennis Space Center, MS, 39529				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					
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			

Present U.S. Navy Operational Capabilities Related to GODAE Viewable on the web

http://www.ocean.nrlssc.navy.mil/global_nlom

<http://www.fnmoc.navy.mil/PUBLIC>

<http://www.navo.navy.mil>

Operational Global Ocean Product	Inputs	Run by
~1/2° 2D MVOI SST Analysis ¹	IR + in situ	FNMOCC
1/8° MODAS SST Analysis ²	IR	NAVO
1/4° MODAS SSH Analysis ²	ENVISAT+GFO+JASON-1 ³	NAVO
1/16° global NLOM nowcast/forecast system ²	ENVISAT+GFO+JASON-1 ³ SST FNMOCC winds+thermal	NAVO

¹ T239 or ~1/2° for atmospheric model boundary condition (on GODAE server)

² Provide subsurface temperature

³ T/P is planned

- Real-time altimetry via NAVO Altimeter Data Fusion Center (ADFC)
- NLOM: NRL Layered Ocean Model
- GODAE: Global Ocean Data Assimilation Experiment
- FNMOCC operates a GODAE data server with data and products from a variety of sources, including real-time altimetry from the NAVO ADFC

U.S. Navy Future Operational Transitions Related to GODAE

Participants: FNMOC, NAVO, NRL, ONR, Univ, Contractors

Global Product	Mid-Lat Resolution	Vert. Coord.	Inputs	Run By	Target Date	
1/8° NCOM ¹	15 km	σ/z	SSH, SST, hydro, FNMOC NOGAPS atmospheric forcing	NAVO	2004	
1/32° NLOM ²	3.5 km	Layered		NAVO	2004	
1/12° HYCOM	7 km	$\rho/\sigma/z$		NAVO	2007	
1/4° HYCOM ³	20 km	$\rho/\sigma/z$		FNMOC	2009	
1/25° HYCOM	3.5 km	$\rho/\sigma/z$		NAVO	2011	
Semi-operational Product ⁴						
1/12° Atl. HYCOM ⁵	7 km	$\rho/\sigma/z$		NAVO	2005	
1/12° Pac. HYCOM	7 km	$\rho/\sigma/z$		NAVO	2005	
1/25° Black Sea HYCOM	3.2 km	$\rho/\sigma/z$		NAVO	2005	

¹ High vertical resolution for mixed layer prediction. Assimilates SSH from NLOM.

Running in real-time, see http://www.ocean.nrlssc.navy.mil/global_ncom

² Running in near real-time, see http://www.ocean.nrlssc.navy.mil/global_nlom

³ For coupled ocean-atmosphere prediction.

⁴ To give NAVO/Navy experience with HYCOM without official operational status; to be replaced by global HYCOM including the 1/25° Black Sea HYCOM

⁵ Under the National Ocean Partnership Program (NOPP), 1/12° Atlantic HYCOM demo is already running in near real-time. Includes the Mediterranean Sea.

Results at http://hycom.rsmas.miami.edu/ocean_prediction.html

Nesting Strategy for Ocean Prediction



Near-term: present-FY04 in R&D, FY04-FY07 operational, including transition

1/8° NCOM	→	NCOM or SWAFS	→	NCOM or SWAFS	→	**ADCIRC
15-16 km mid-lat resolution	→	4 - 8 km, larger regions	→	< 1 to 2 km res	→	< 2 km resolution finite element

Mid-term: FY04 - FY07 in R&D, FY07 – FY10 operational, including transition

1/12° HYCOM	→	HYCOM	→	*NCOM or HYCOM	→	ADCIRC
7 km mid-lat resolution	→	2 - 4 km, smaller regions	→	.5-1.5 km res	→	< 1.5 km res

Long-term: FY07-FY11 in R&D, FY11 and beyond operational, including transition

⁺ 1/25° HYCOM	→	Regional generally not needed	→	*NCOM or HYCOM	→	ADCIRC
3 - 4 km mid-lat resolution	→	Not used	→	≤ 1km res	→	≤ 1 km res

*Hogan and Kindle CO-NESTS project should provide research results needed to make the appropriate choice. An alternative model such as ROMS may also be considered.

Nested model may be a component of COAMPS.

⁺1/25° HYCOM gives useful littoral resolution globally.

**ADCIRC needs a robust baroclinic capability before it can properly fill this role.

User Interest in Real-time Global Ocean Products

NRL Oceanography Division Web Site Hit Statistics during 2003

Total # hits	18,327,137
Avg hits/day	50,211
# hits used in country breakdown	16,322,753
# countries with ≥ 1000 hits	59
# countries with ≥ 100 hits	100
Total number of countries	169

Includes the following real-time global Ocean products and other results

Altimeter data

MODAS SSH & SST analyses

Ocean prediction systems

1/16° global NLOM

1/8° global NCOM

1/12° Atlantic HYCOM

Top 25 Countries and # Hits

United States	11,680,841
Australia	1,919,691
Japan	929,849
South Africa	525,233
China	311,852
Taiwan	303,221
Great Britain	56,025
Canada	55,825
Germany	50,895
France	44,899
Russian Federation	44,408
Spain	36,724
South Korea	35,216
Switzerland	34,809
India	28,579
Italy	20,987
Netherlands	20,504
Vietnam	16,747
Peru	15,667
Sweden	11,969
Chile	10,965
Puerto Rico	9,704
New Zealand	9,540
Mexico	8,100
Ukraine	7,877