

Ocean Sciences 2004 – Portland, OR

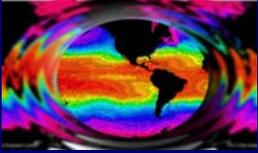


# Operational Applications of Ocean Satellite Observations through the Global Navy Coastal Ocean Model

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Robert C. Rhodes    Jan M. Dastugue

Naval Research Laboratory Code 7323  
Stennis Space Center, Mississippi

Supported by Oceanographer of the Navy  
through SPAWAR PMW155

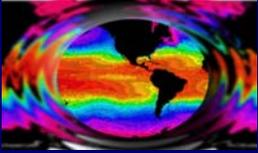


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# Operational Applications of Ocean Satellite Observations through the Global Navy Coastal Ocean Model

- Global NCOM System
- Validation Tests
- Operational Applications

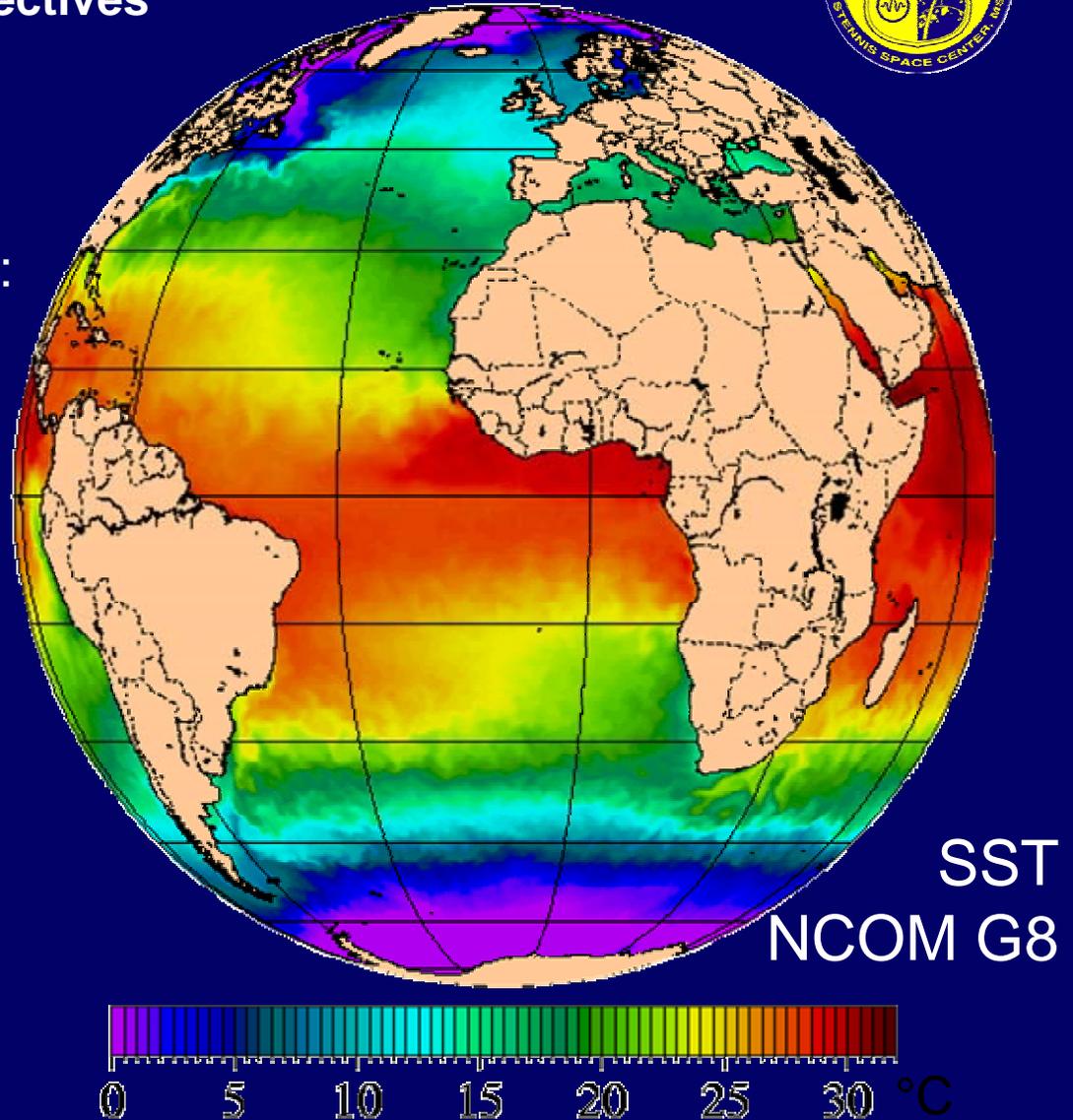


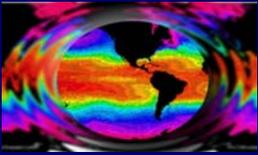
## 1/8° Global Navy Coastal Ocean Model (NCOM G8) Operational Objectives



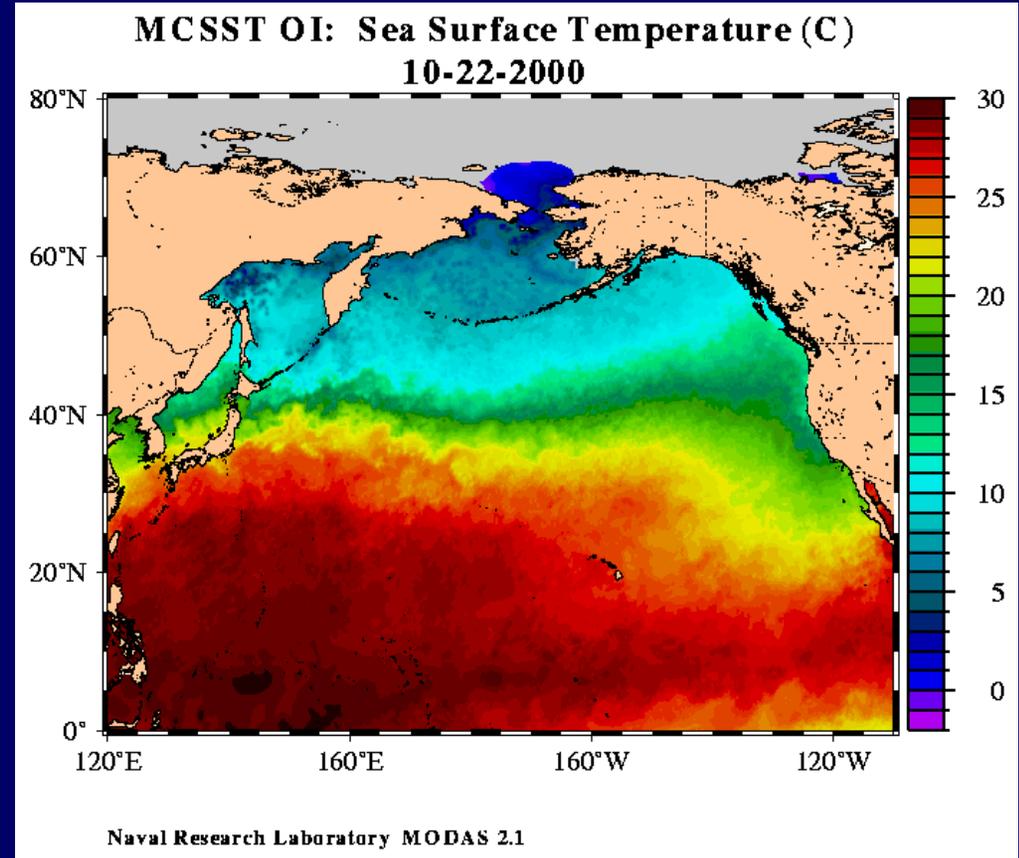
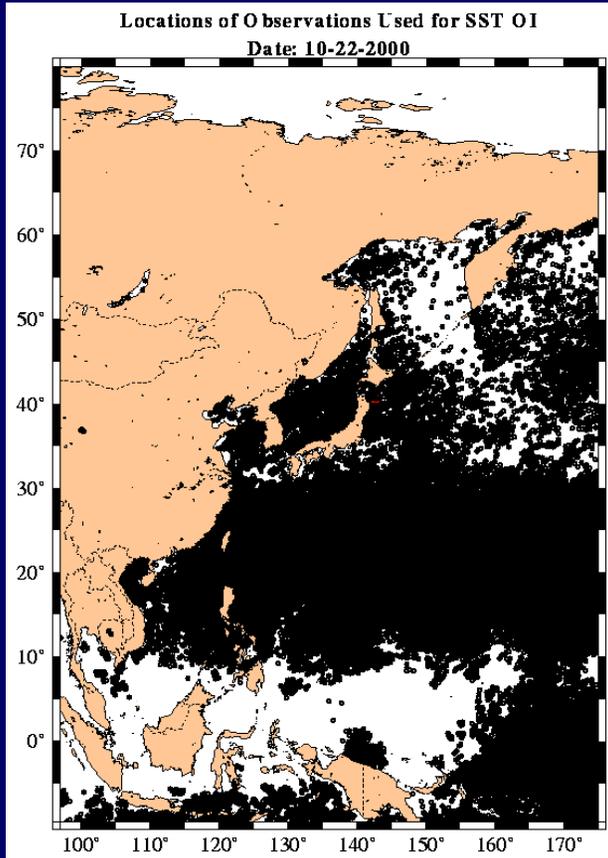
NCOM G8, a moderate resolution, fully-global ocean forecast system, is to provide:

- initial/boundary conditions for real-time regional models
- short-term upper ocean predictions
- ice model host
- capability for a global coupled air/ocean system (NOGAPS)



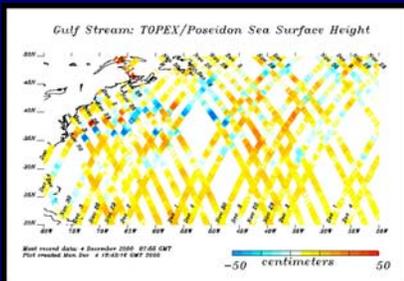
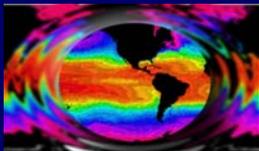


# Daily MODAS2D OI of SST

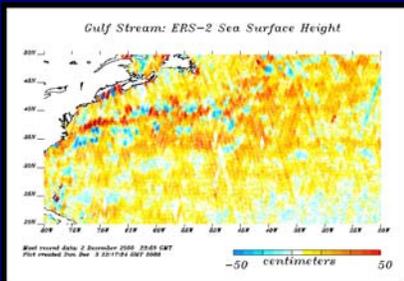


A first guess field and scattered satellite SST observations are combined in an optimal interpolation procedure to produce daily global  $1/8^\circ$  SST fields. see <http://www7300.nrlssc.navy.mil/altimetry>

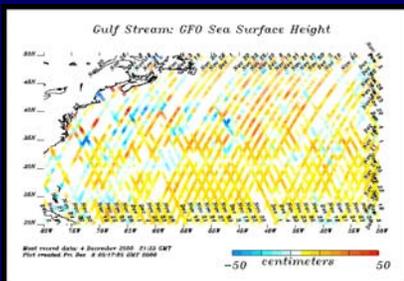
# NLOM assimilation of altimeter data



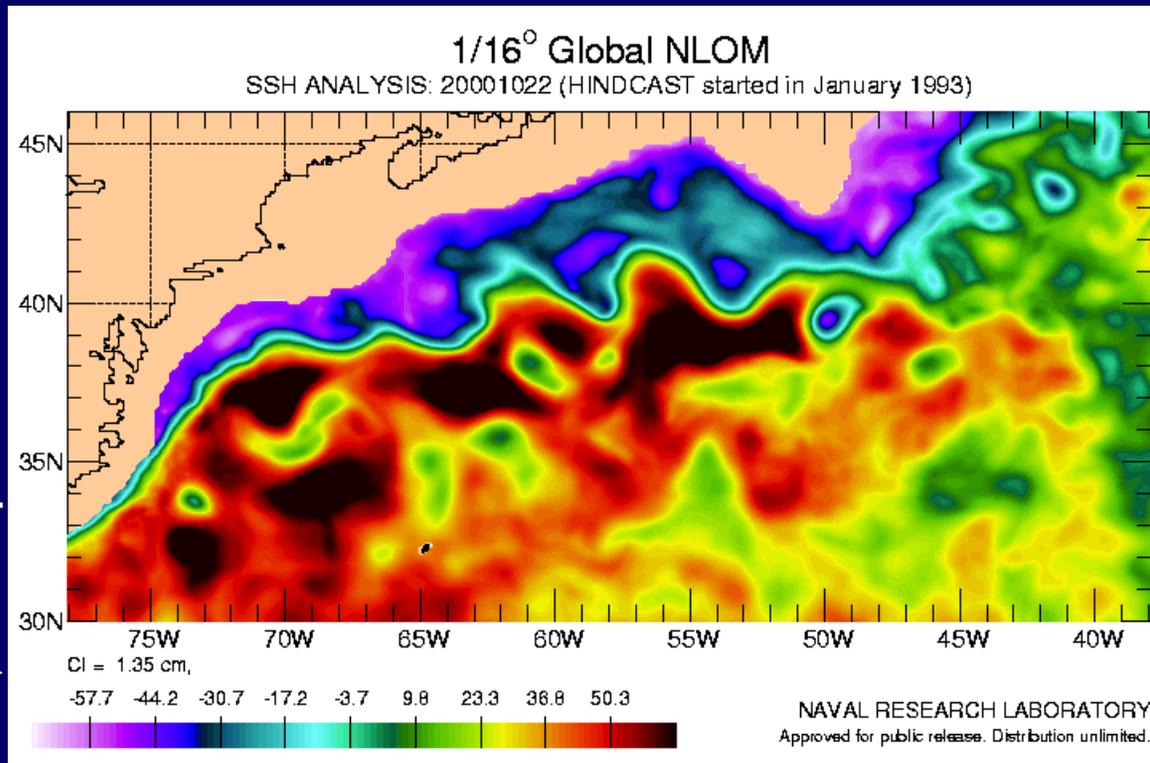
TOPEX,  
JASON



ERS2,  
ENVISAT



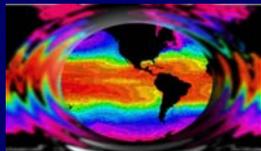
GFO



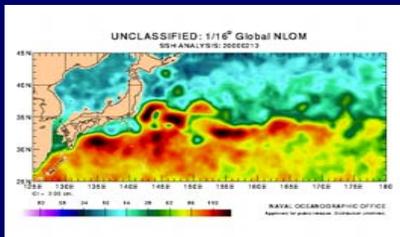
Operational  $1/16^\circ$  global NLOM assimilates gridded SST and track by track altimetry. NLOM bottom pressure anomaly can be used to partition height deviation into steric and non-steric SSH. MODAS uses SST and steric SSH estimate subsurface T,S. See [http://www7320.nrlssc.navy.mil/global\\_nlom](http://www7320.nrlssc.navy.mil/global_nlom).



# NCOM G8 Data Assimilation



ALPS



1/16° NLOM

SSH

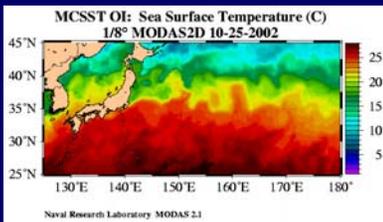
IN SITU DATA

MODAS 3D

MODAS 2D

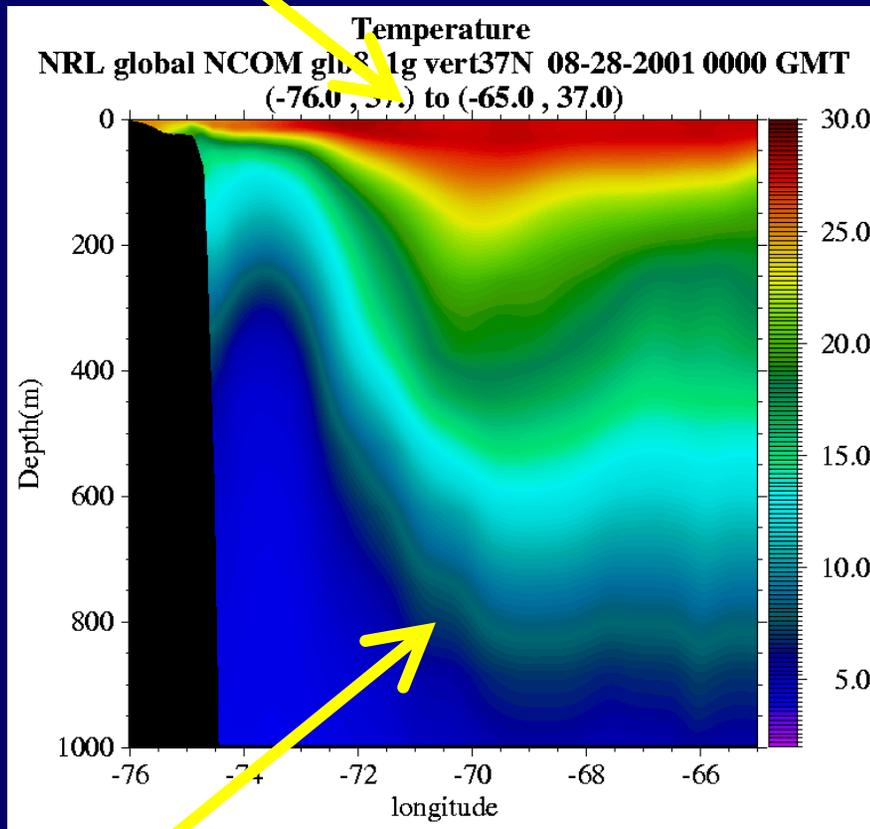
SST

MCSST



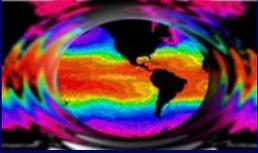
SST & SSS

Surface flux



3D T & S

Relaxation



# Global NCOM VTR: Experiments and Validation

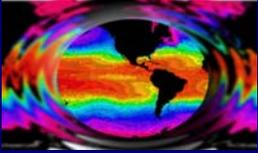


## Model Experiments Covered

- NCOM G8 free-funning hindcast 1998-2000
- NCOM G8 assimilative hindcast 1997-2002
- bi-monthly NCOM G8 7 day forecasts 1998-2002

## Validation Tests (vs. Unassimilated Data)

- Sea Surface Height (analysis vs. sea level data)
- Sea Surface Temperature (analysis/forecast vs. MCSSTs & buoys)
- Mixed Layer Depth (analysis vs. profile data)
- Large, meso-scale circulation features (mean, analysis position)
- Eddy kinetic energy/SSH variability (means)
- Current cross sections (events, means)
- Drifter trajectories (Comparison with buoys Jun. – Nov., 2000)
- 3D profiles and vertical cross sections (analysis vs. profile data)
- Transport through straits (total, means)
- Evaluation of NCOM + OSU global tides
- Evaluation of NAVO model response to NCOM boundary conditions



# Global NCOM VTR: Experiments and Validation

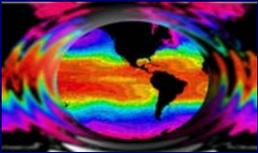


## Model Experiments Covered

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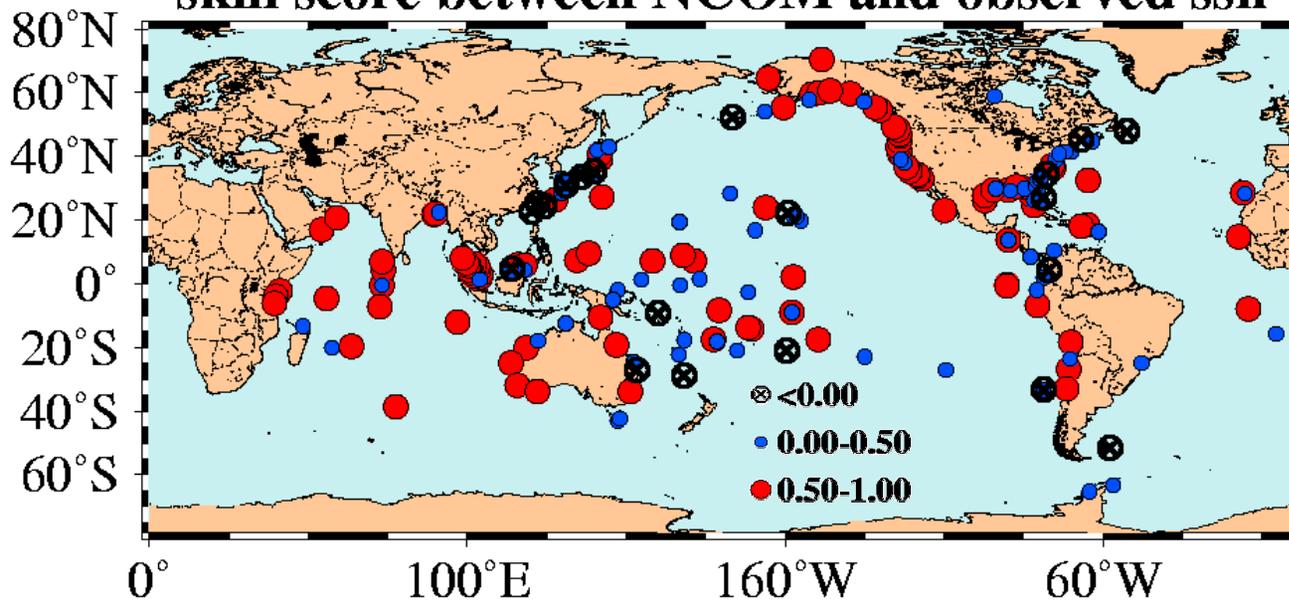
- **Sea Surface Height (analysis vs. sea level data)**
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# NCOM G8: SSH validation



**1-day running mean for 1998 case glb8\_2f  
static inverse barometer effect applied  
skill score between NCOM and observed ssh**

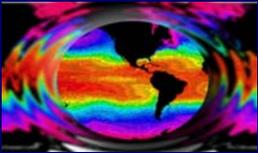


Daily medians

1998-2002	free	assim
Correl. R	.70	.76
Skill Score	.42	.51

Perfect skill is 1  
Any positive score  
indicates skill

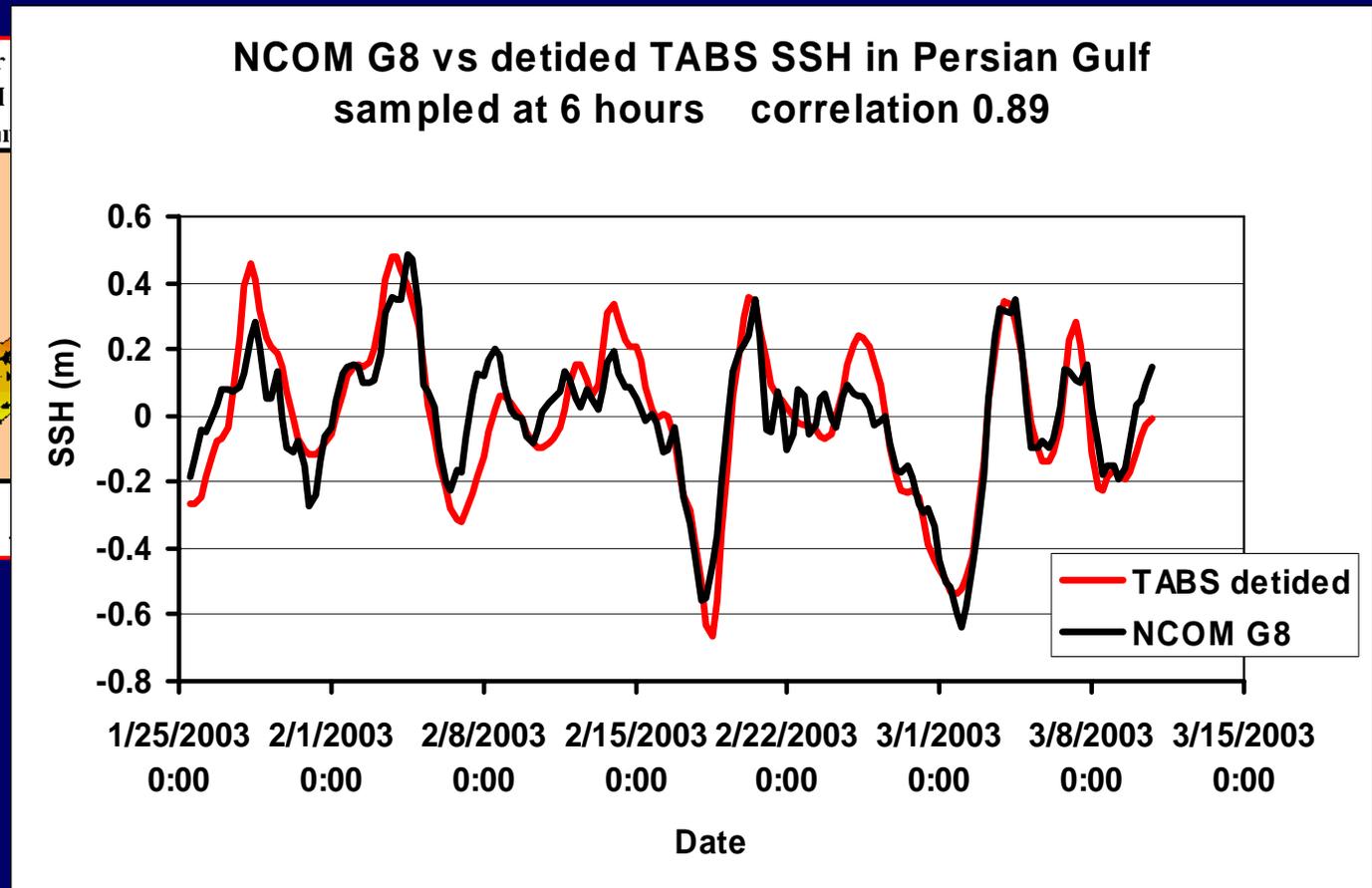
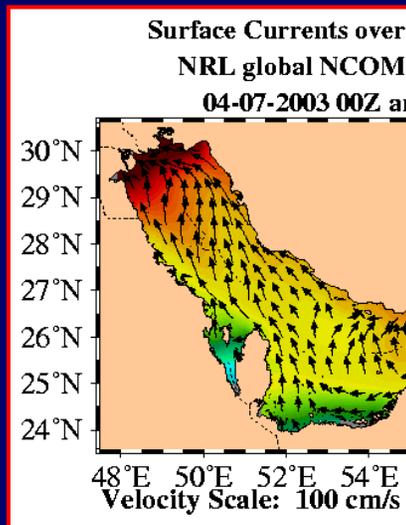
From 1998-2001, the NCOM G8 hindcast is compared with 612 unassimilated year-long sea level time series from global stations, where the data are referenced to common means and adjusted for the static inverse barometer effect. Assimilative median daily skill score is 0.51.

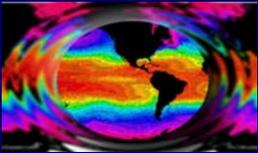


# Persian Gulf extracted from NCOM G8



A Navy buoy deployed in late January 2003 measured sea level in northwestern Persian Gulf until damaged in mid March. Comparisons of the detided buoy observations with the independent NCOM G8 model results referenced to the same mean demonstrates the accuracy of the model predictions.





# NCOM G8 Mixed-Layer Depth

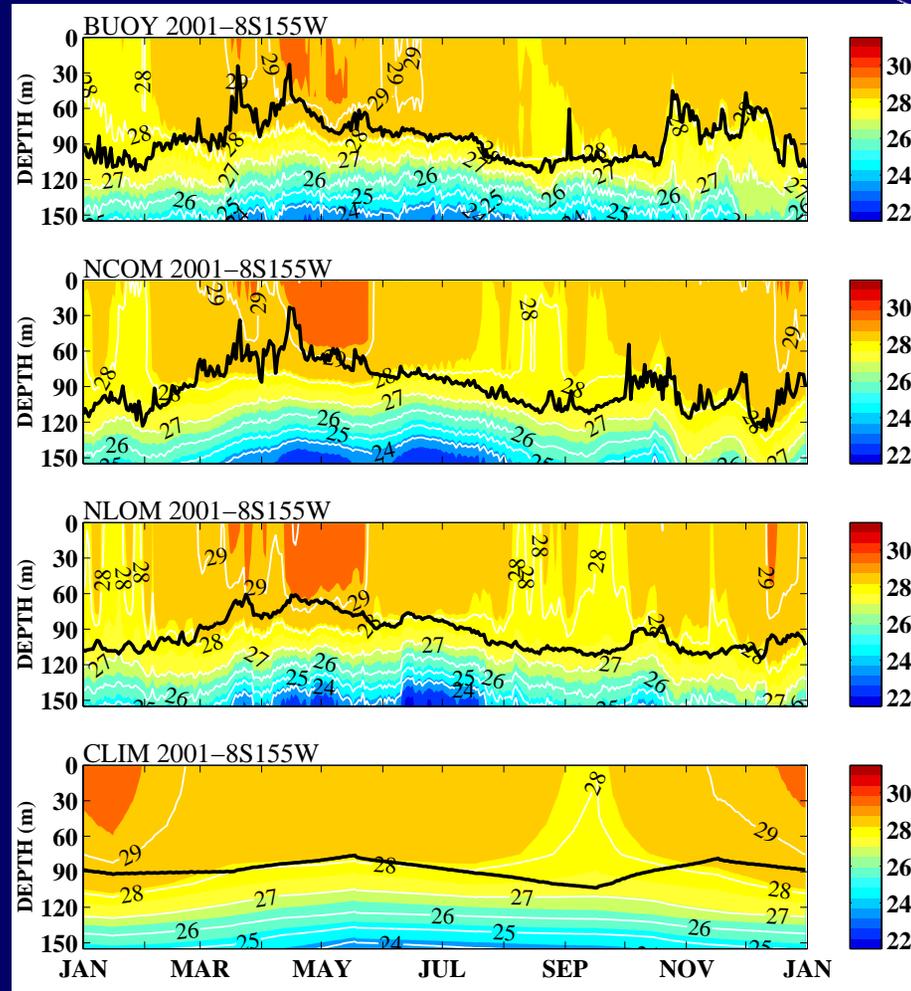


Daily temperature  
(5°S, 155°W)  
TAO buoy

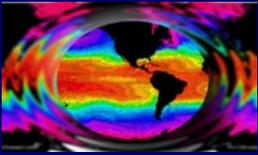
1/8° Global NCOM

1/8° MODAS  
dynamic climatology  
with NLOM SSH

1/8° MODAS  
climatology



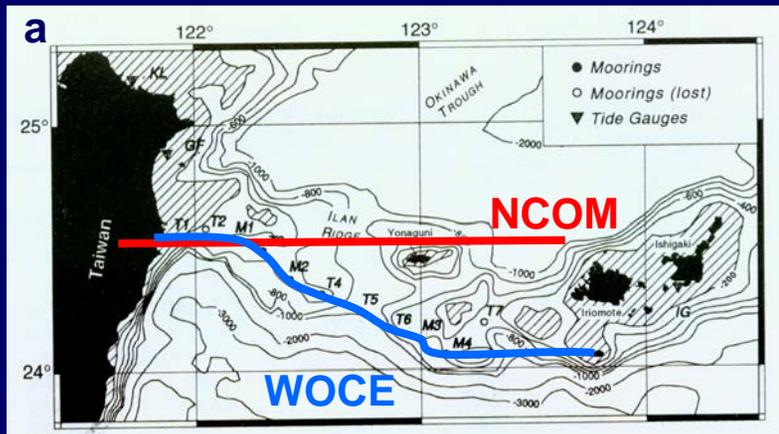
In comparison with 71 unassimilated, equatorial year-long time series of MLD (1998-2000), assimilative NCOM G8 had -8.6 m bias and 19.4 m RMS error for MLD on the order of 100 m.



# NCOM G8 Current Section



Velocity section along the WOCE PCM\_1 line east of Taiwan. Mean NCOM G8 agrees with the current structure while underestimating peak mean velocities by 20-30 cm/s.

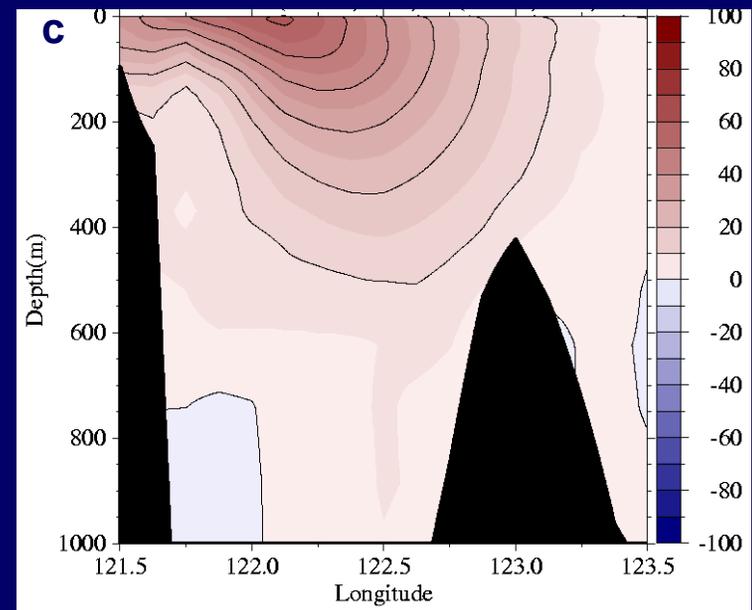
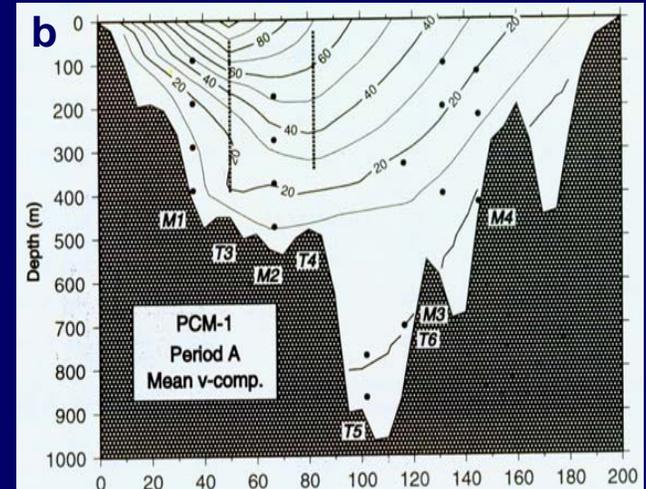


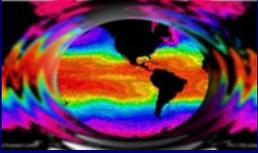
(a) Locations of the PCM-1 current meters

(b) Northward speed from PCM-1 data September 1995 to May 1996.

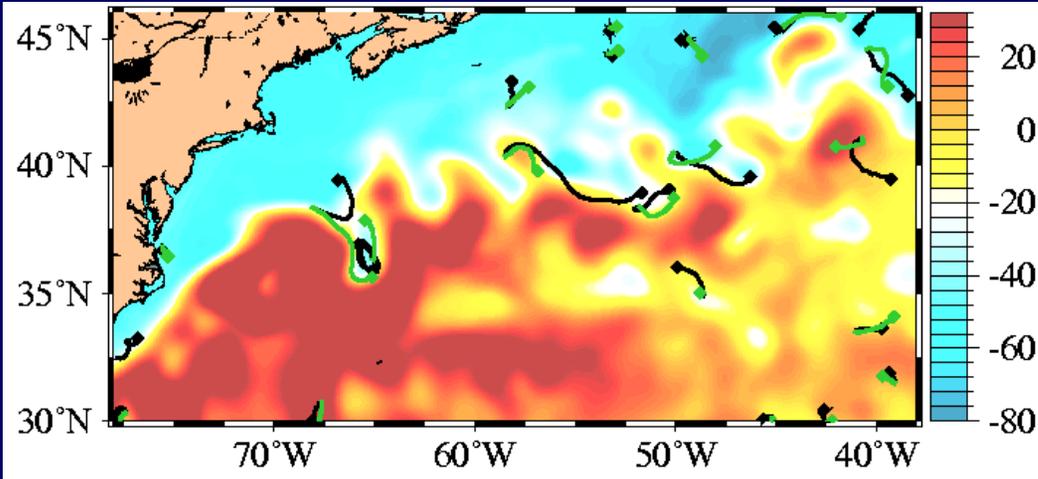
(c) Northward speed from assimilative  $1/8^\circ$  global NCOM 1998-2000 mean.

(a) and (b) are from Lee *et al.* (2001).



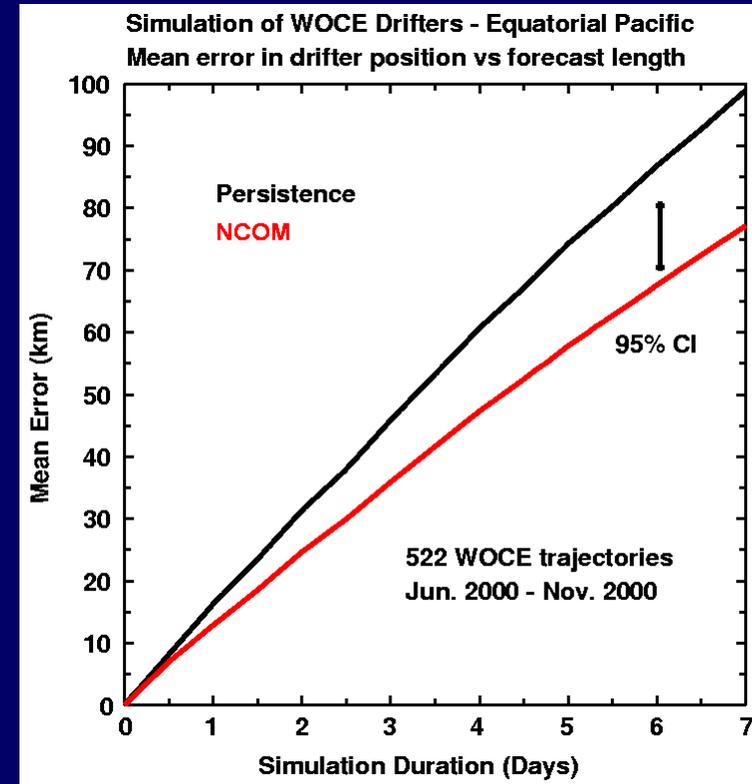


# NCOM G8 Drifter Trajectories

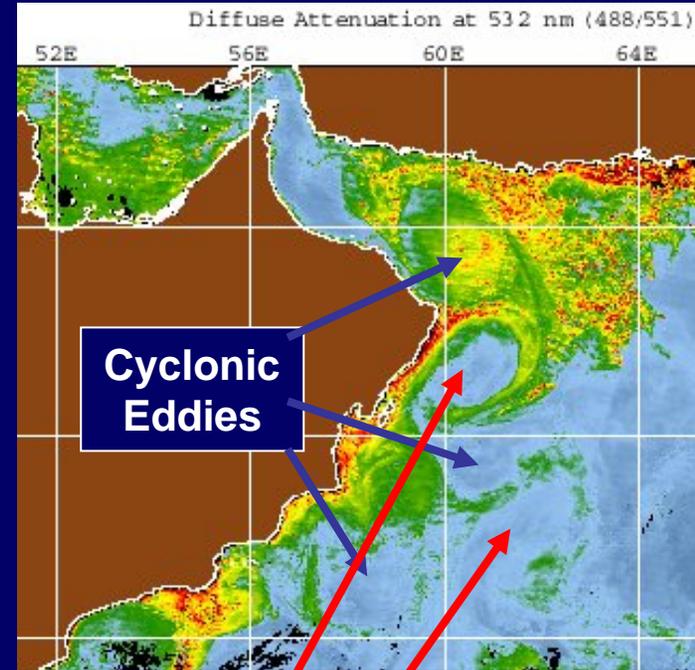
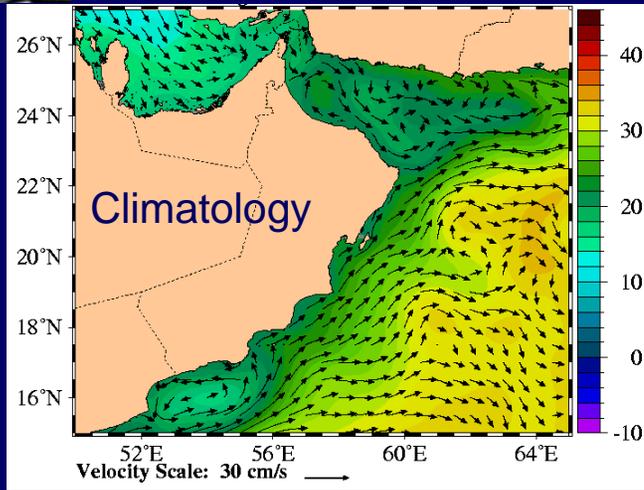
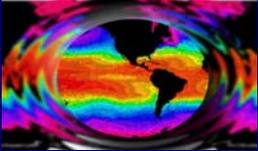


Above: Comparison between WOCE drifter trajectories (black) and trajectories simulated in data-assimilative global NCOM (green). Seven-day trajectories starting on 31 July 2002, superimposed on NCOM SSH.

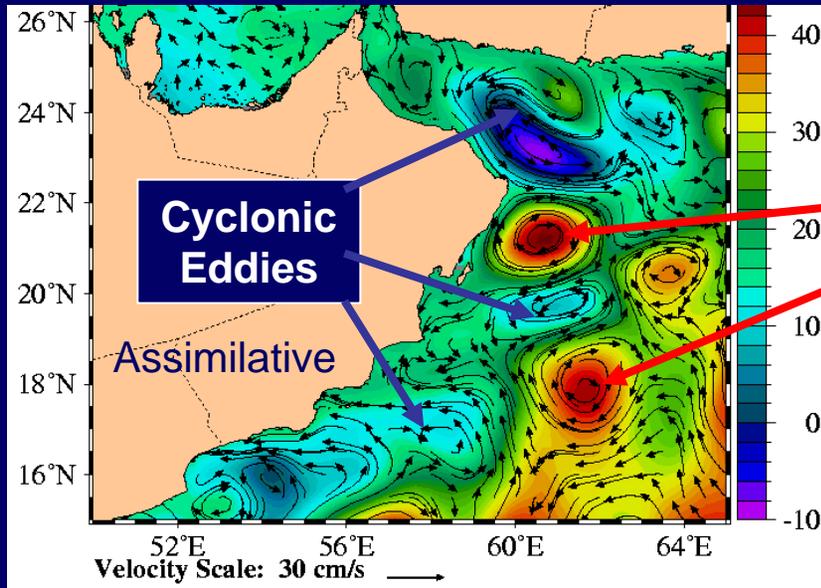
Right: Mean error in drifter position predicted by assimilative NCOM hindcasts (red) or persistence (black).



# NCOM G8 Mesoscale Features

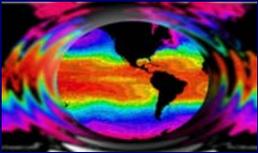


**Global NCOM 3 Oct 2002  
Surface Currents over Height (cm)**



**Anticyclonic Eddies**

**MODIS composite  
30 Sep – 7 Oct 2002  
Diffuse Attenuation  
Coefficient at 532 nm  
NRL Ocean Optics  
[www7333.nrlssc.navy.mil](http://www7333.nrlssc.navy.mil)**

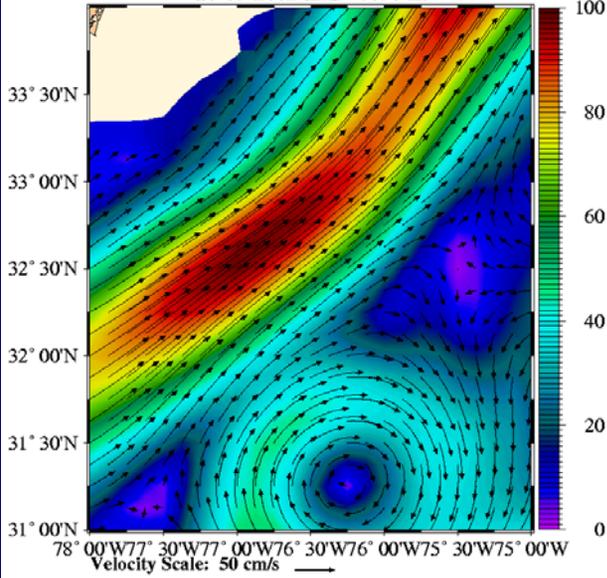


# NCOM G8 for JTFEX 03-1

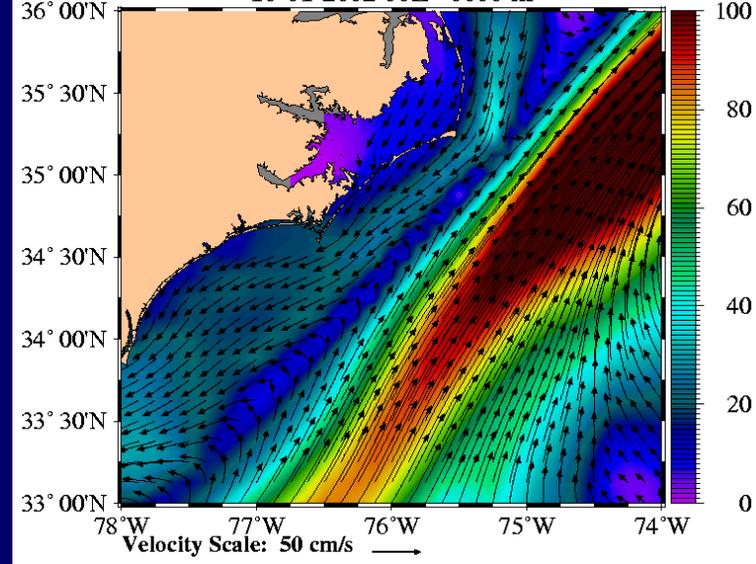


**NCOM G8 data was used in support of Joint Task Force Exercise (JTFEX) 03-1 in October 2002.**

Currents over Speed (cm/s)  
NRL global NCOM glb8\_1g hindcast  
10-03-2002 12Z 0030 m



Surface Currents over Speed (cm/s)  
NRL global NCOM glb8\_1g hindcast  
10-01-2002 00Z 0000 m

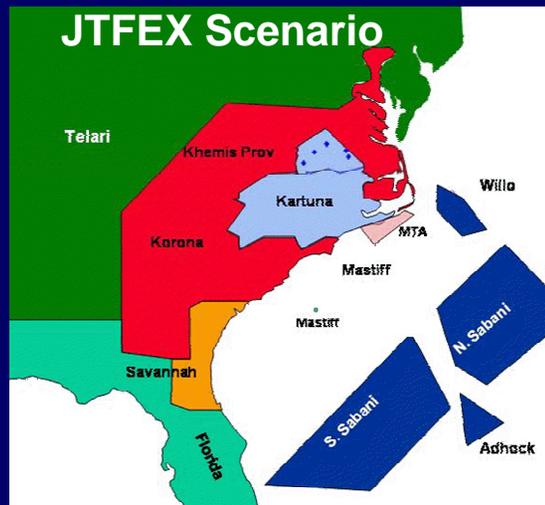


30m currents around Gulf Stream

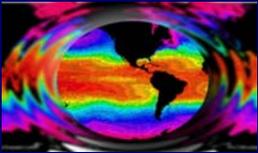
Surface currents near Cape Hatteras



HS Truman Battle Group



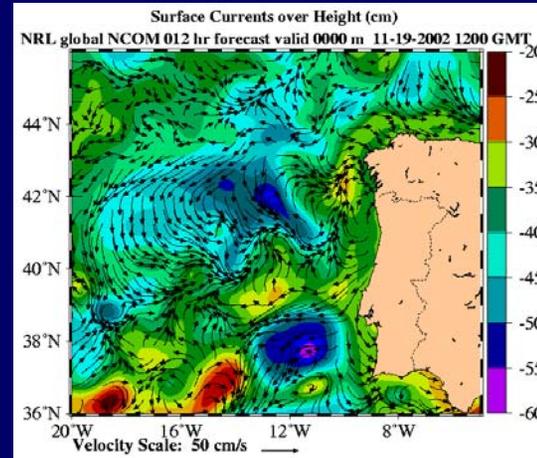
Helicopter from anti-submarine squadron 7 engaged in ASW



# NCOM G8 for Prestige Oil Spill

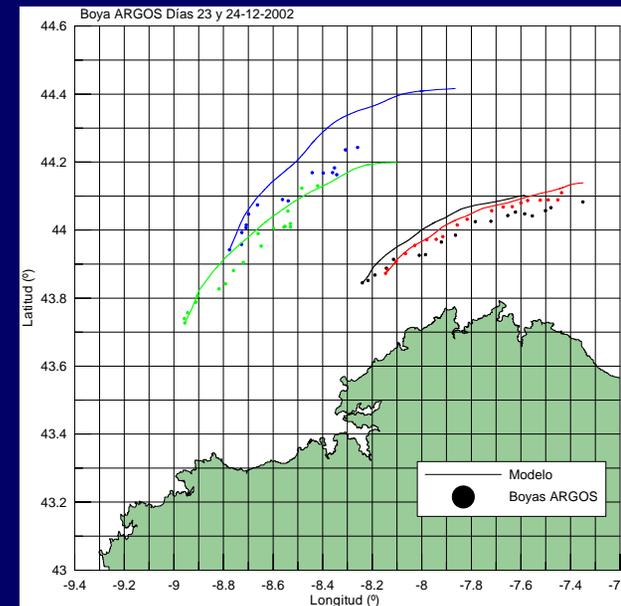


When the MV Prestige split and sank off the coast of Galicia, Spain, NRL aided response by providing forecasts from NCOM G8 within 6 hours of the request. A relocatable model was soon nested in NCOM G8 to improve forecast accuracy.

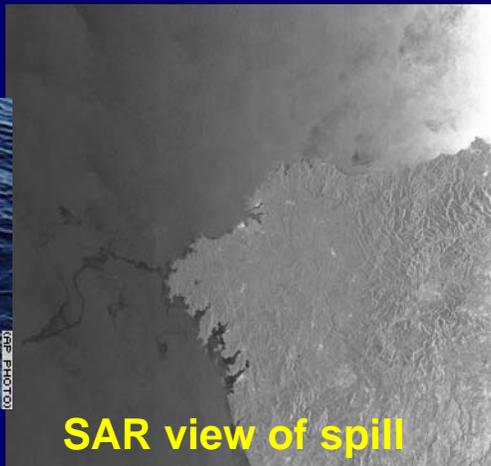


**NCOM G8**  
surface  
currents,  
sea  
surface  
height

**Comparison**  
of observed  
trajectories  
with forecasts  
from NRL  
Galicia model  
(G. Peggion)  
nested in  
NCOM G8

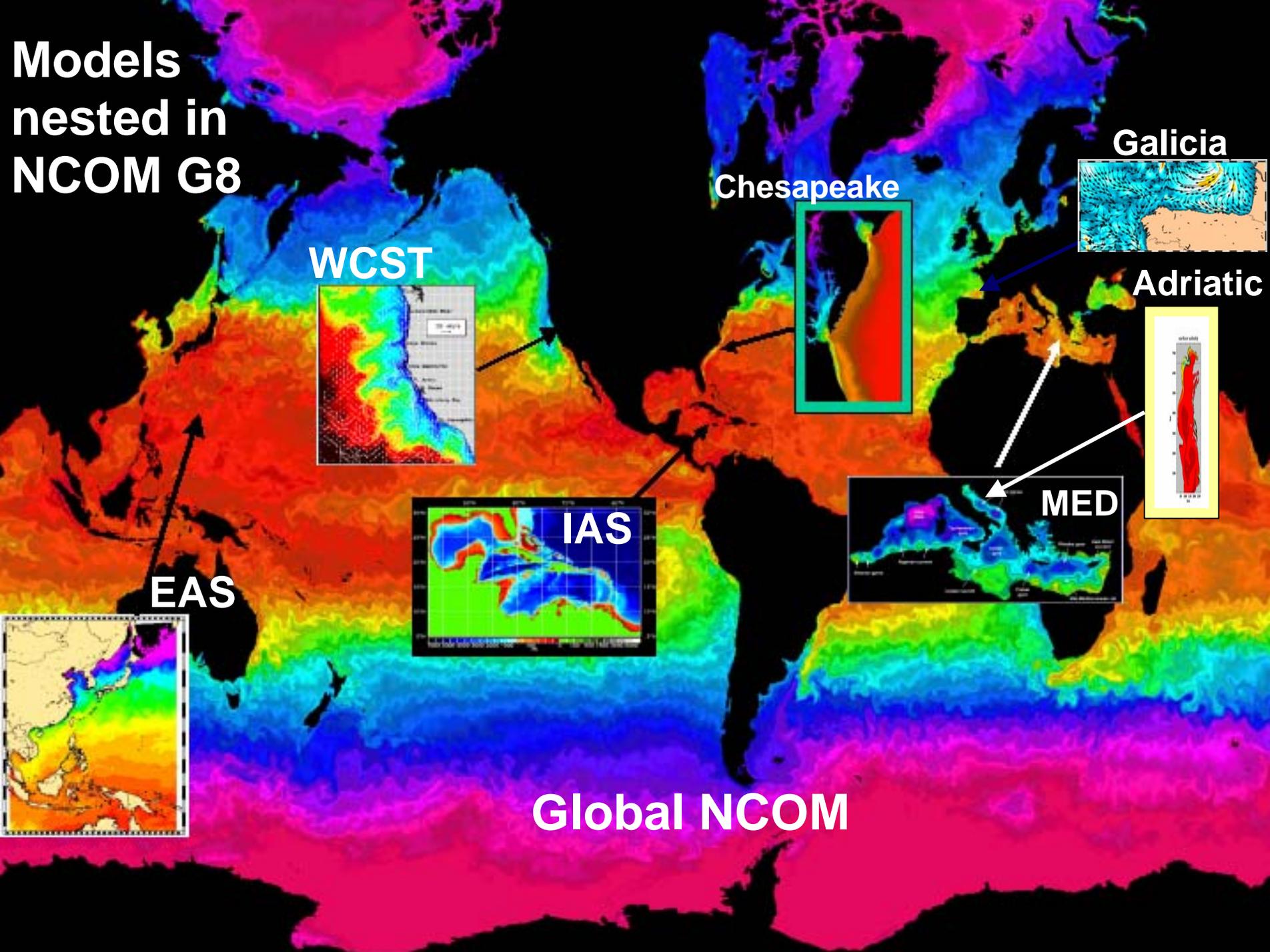


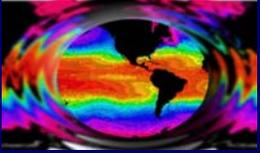
**Prestige sinking**



**SAR view of spill**

# Models nested in NCOM G8





# Operational Application of Ocean Satellite Observations through Global NCOM



For more information on global NCOM,  
please refer to the website:

[www.ocean.nrlssc.navy.mil/global\\_ncom](http://www.ocean.nrlssc.navy.mil/global_ncom)