

# **HYCOM & Navy Ocean Prediction**

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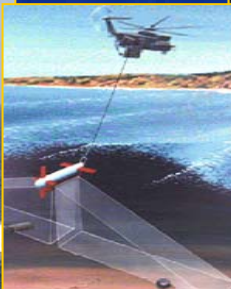
**8<sup>th</sup> Hybrid Coordinate Ocean Model Workshop  
August 19-21, 2003**



# HYCOM & Navy Ocean Prediction

## Role of Ocean Modeling

Important (Not Sole) Tool for  
the Operational Oceanographer  
Providing Oceanographic  
Environmental Intelligence  
Relevant to the Warfighter



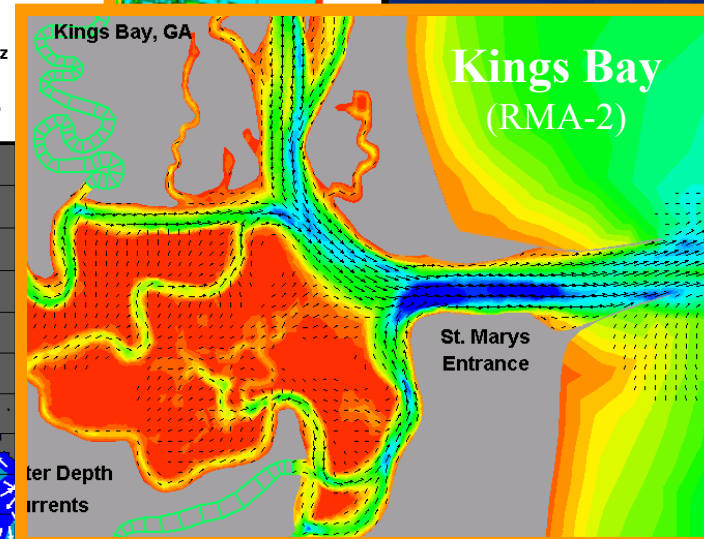
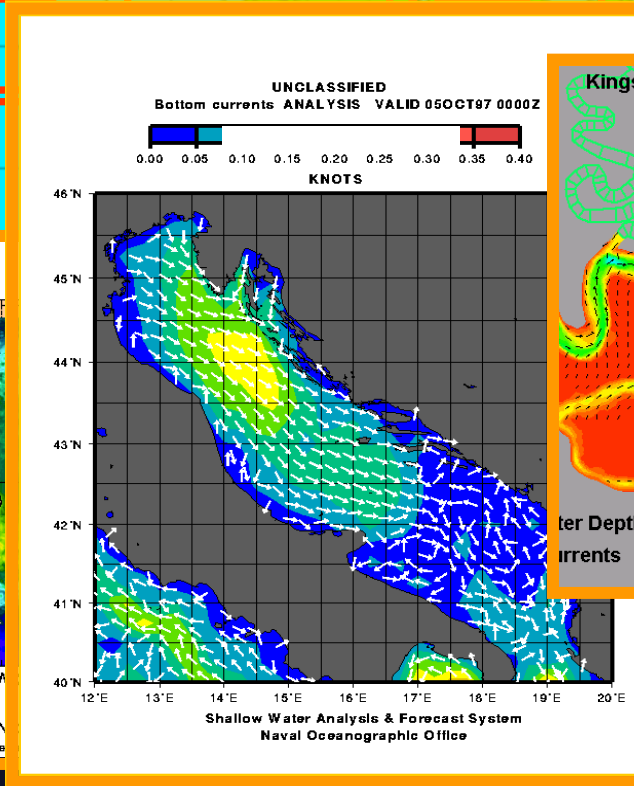
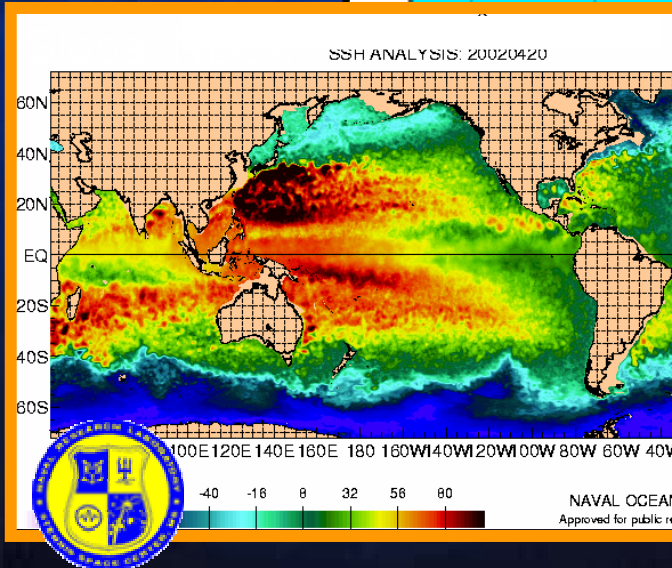
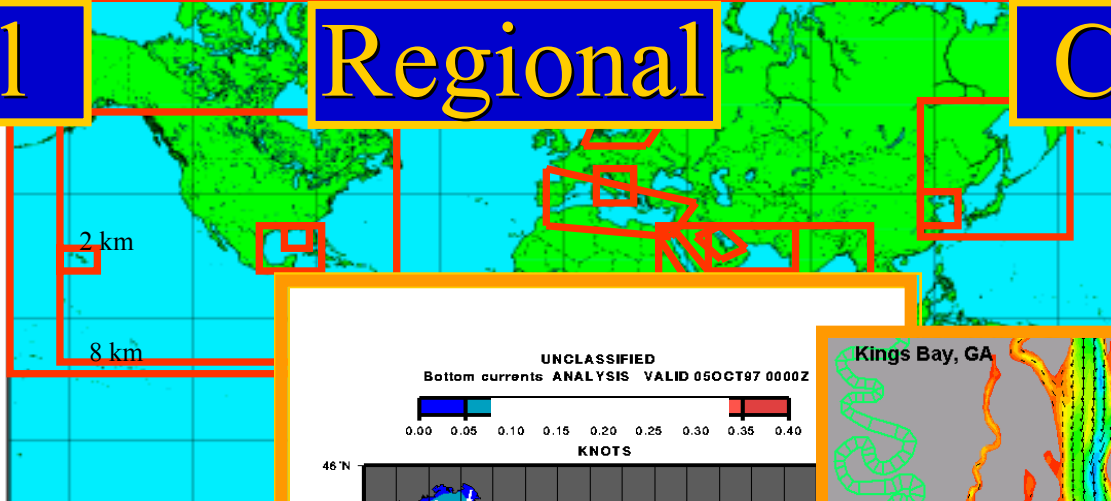
# HYCOM & Navy Ocean Prediction

## Nested Approach & Focus on the Littoral

Global

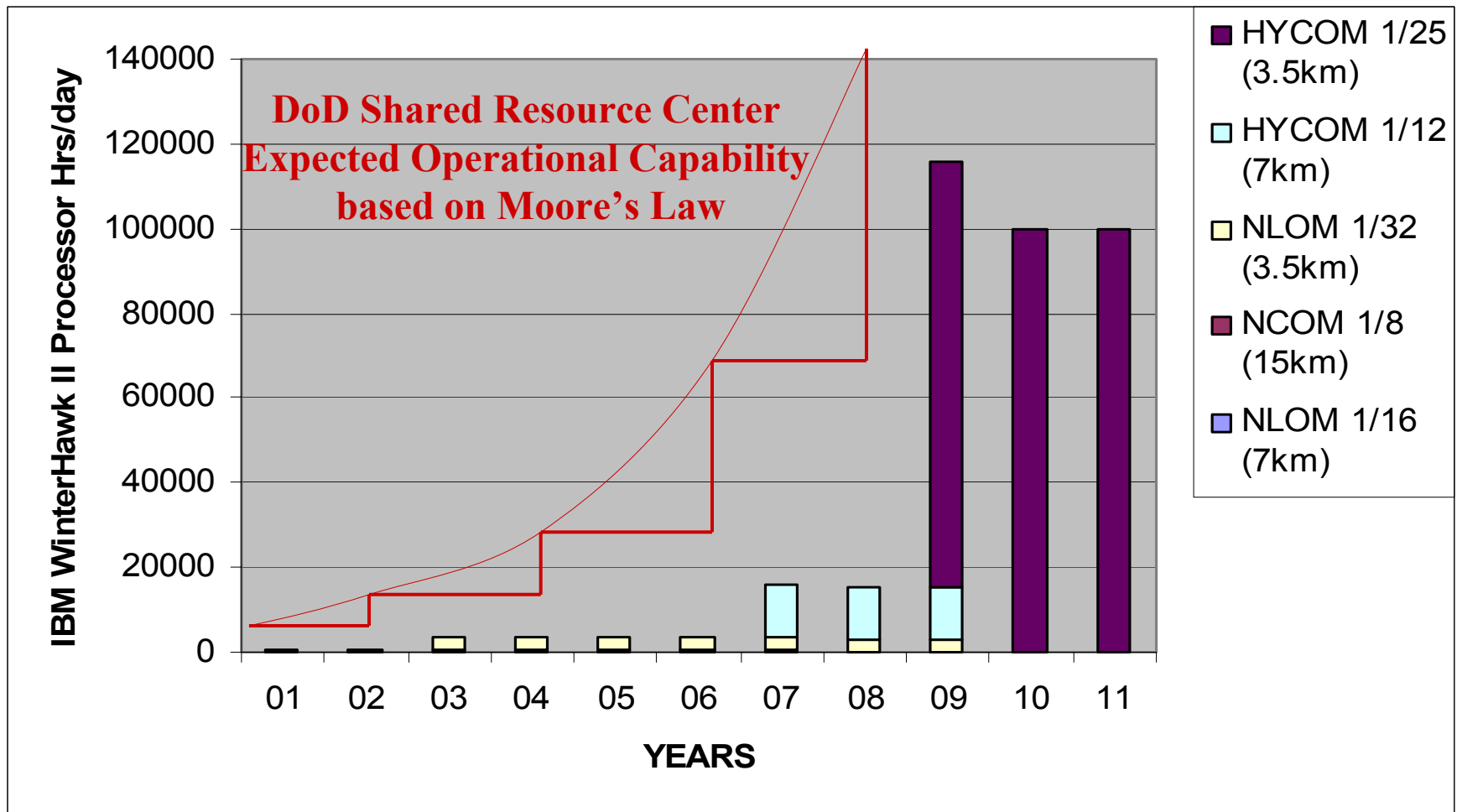
Regional

Coastal



# HYCOM & Navy Ocean Prediction

## Computing Resources – Critical Role of the NAVO MSRC (Global Example)

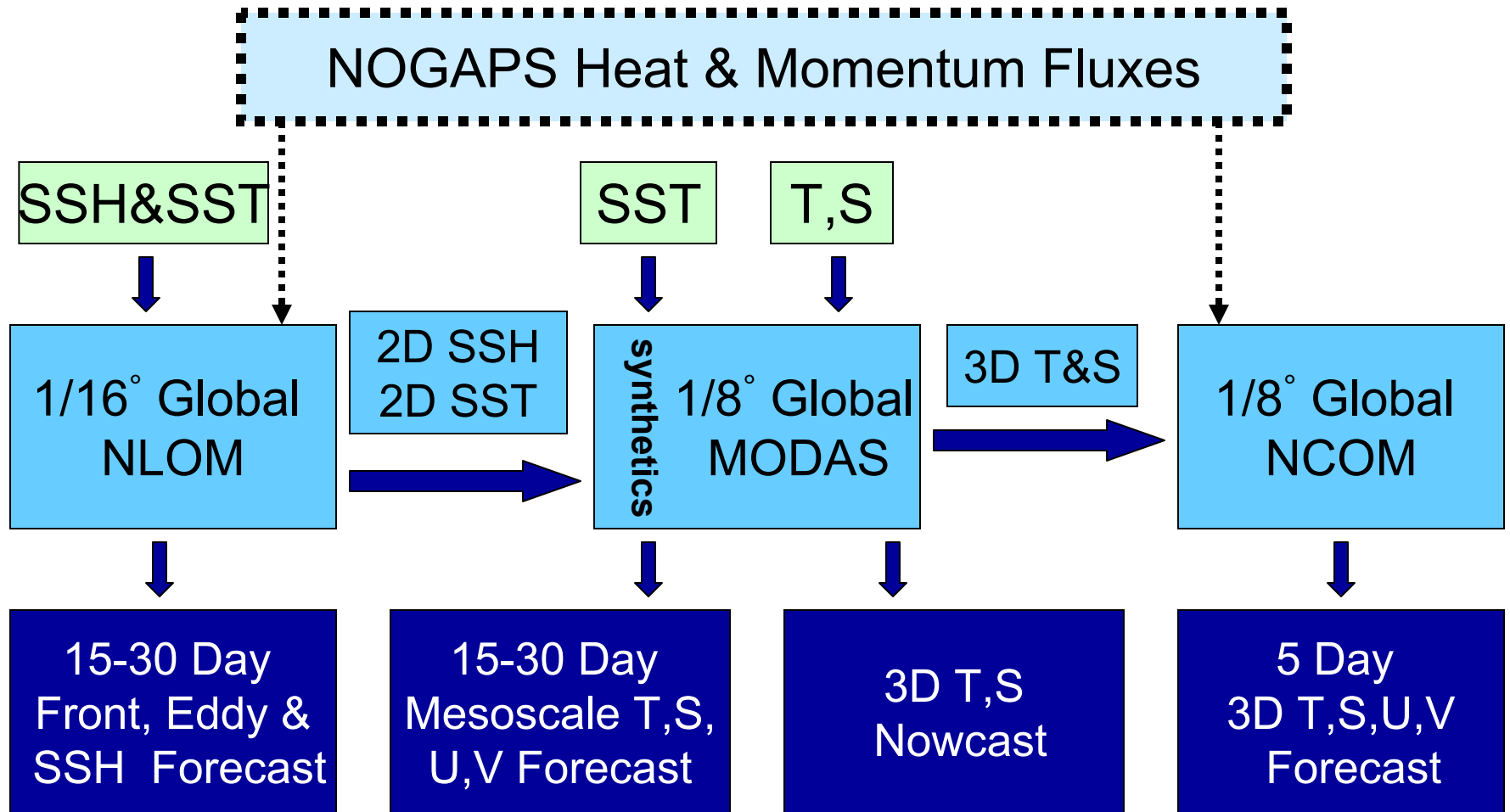


While much of the ocean's mesoscale variability can be forecast, routine global forecasts (at 1/32 degree resolution) remain a Grand Challenge computational goal potentially achievable in 2009 with current level of expenditure.



# HYCOM & Navy Ocean Prediction

## Near-Term Global Baseline Prediction System





# HYCOM & Navy Ocean Prediction

## Nesting Strategy for Ocean Prediction

Global	→	Regional	→	Littoral	→	Nearshore
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***Near-Term: present-FY04 in R&D, FY03-FY06 operational, including transition***

1/8° NCOM	→	SWAFS & NCOM	→	SWAFS & NCOM	→	**RMA2/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, FY06 – FY10 operational, including transition***

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

***Long-Term: FY07-FY10 in R&D, FY10 and beyond operational, including transition***

<sup>+</sup> 1/25° HYCOM	→	Regional generally not needed	→	*NCOM/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.

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

\*\*Nearshore models need a robust baroclinic capability before they can fully fill this role.



# HYCOM & Navy Ocean Prediction

## Planned Operational Transitions

<u>Global Product</u>	<u>Vert. Coord.</u>	<u>Inputs</u>	<u>Run By</u>	<u>Target Date</u> (Operations)
1/8° NCOM <sup>1</sup>	$\sigma/z$	SSH, SST, hydro, FNMOC atmospheric forcing	NAVO	2003
1/32° NLOM	Layered		NAVO	2003
1/12° HYCOM <sup>2</sup>	$\rho/\sigma/z$		NAVO	2007
1/25° HYCOM	$\rho/\sigma/z$		NAVO	2010

<sup>1</sup> High vertical resolution for mixed layer prediction. Assimilates SSH from NLOM. Running in real-time, see [http://www.ocean.nrlssc.navy.mil/global\\_ncom](http://www.ocean.nrlssc.navy.mil/global_ncom)

<sup>2</sup> 1/12° Atlantic and coarser global HYCOM are GODAE-related pilot projects under the National Ocean Partnership Program (NOPP). 1/12° Atlantic HYCOM demo is running in near real-time. Results at:

[http://hycom.rsmas.miami.edu/ocean\\_prediction.html](http://hycom.rsmas.miami.edu/ocean_prediction.html)



# HYCOM & Navy Ocean Prediction

## A Validation Baseline for Operational Ocean Prediction – NCOM G8

### Model experiments to be tested

- Free running 1998-2001
- Assimilative 1998-2003
- Bimonthly 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-scale, meso-scale circulation features (mean, analysis position)
- Eddy kinetic energy/SSH variability (means)
- Current cross sections (events, means)
- Comparison with drifting buoys (June, 2000 – Nov., 2000)
- 3D profiles and vertical cross sections (analysis vs. profile data)
- Transport through straits (total, means)
- Regional evaluations by collaborators



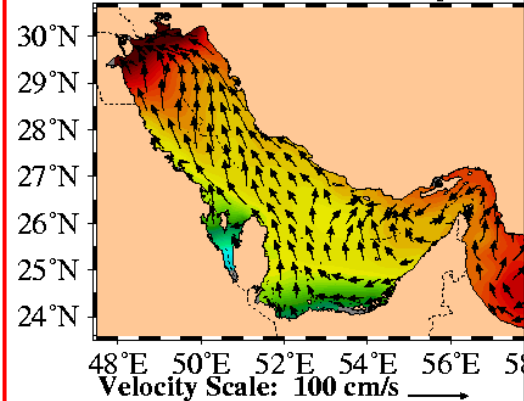


# HYCOM & Navy Ocean Prediction

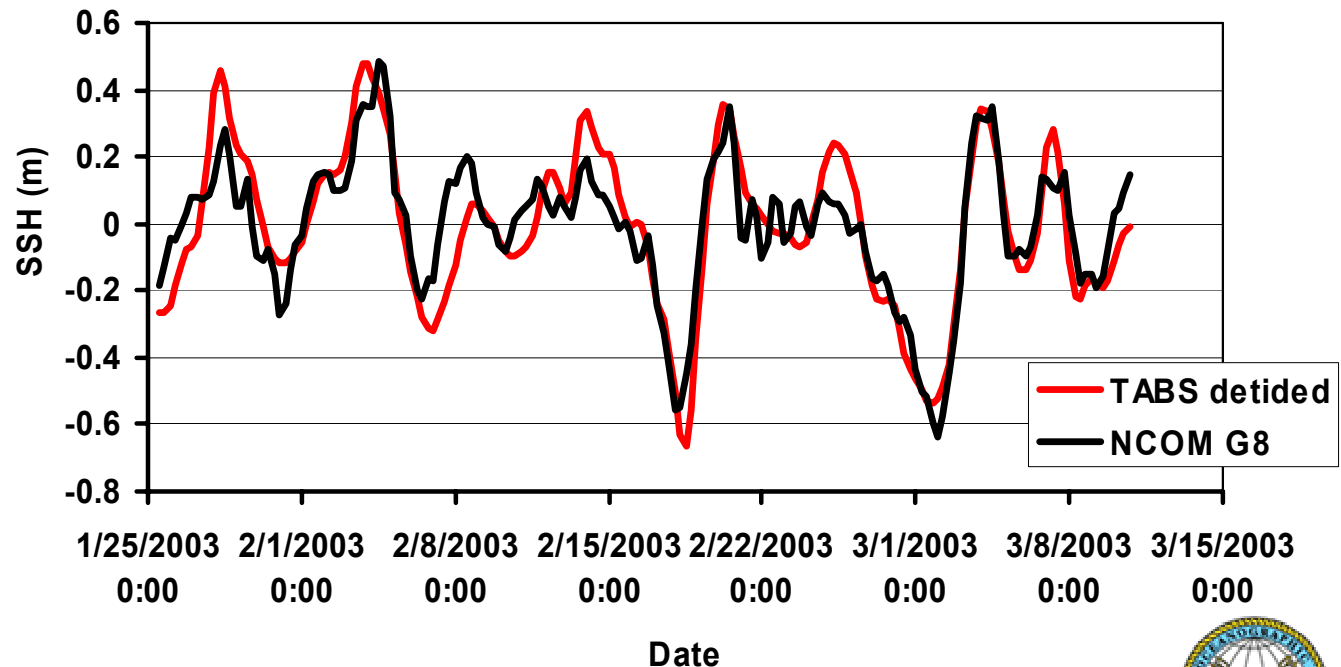
## Persian Gulf SSH Validation of NCOM G8 relative to Buoy

A U.S. 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.

Surface Currents over Height (cm)  
NRL global NCOM nowcast  
04-07-2003 00Z analysis

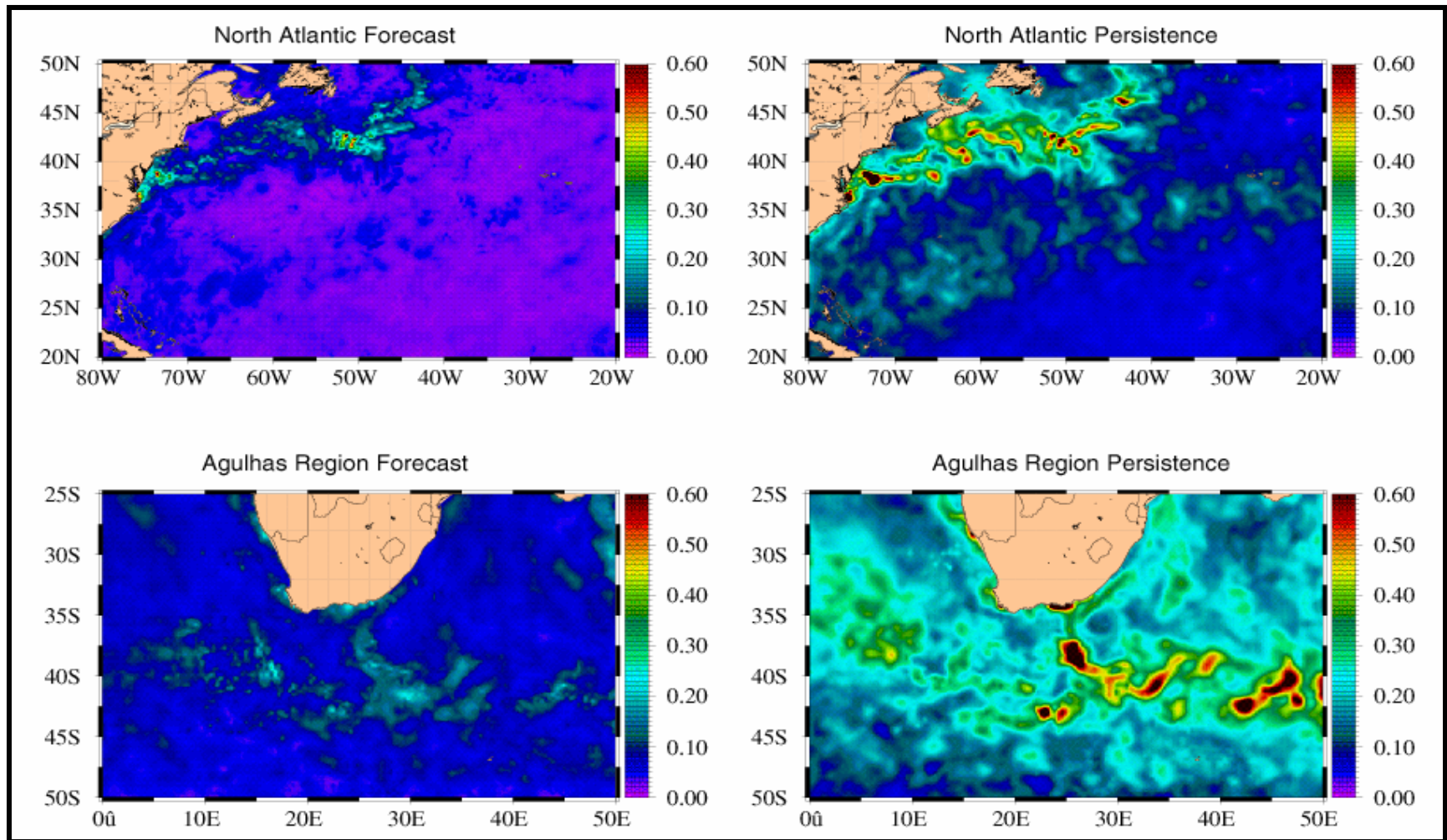


NCOM G8 vs detided TABS SSH in Persian Gulf  
sampled at 6 hours correlation 0.89



# HYCOM & Navy Ocean Prediction

## NCOM 48 hr. SST Forecast Verification – (Relevant to Coupled Air/Ocean)



### 2 Day SST Forecast Verification Statistics

Mean RMS ( $^{\circ}\text{C}$ ) over 40 forecasts made 4 Jan 2001 – 12 Feb 2001



# **HYCOM & Navy Ocean Prediction**

## **Summary of Planned Long-Term Operational Capability**

- **.08° fully – global ocean prediction system transitioned to NAVO in 2006 (Expected Operational 2007)**
  - ◆ ~7 km mid-latitude resolution
  - ◆ Include shallow water, minimum depth 10 m (or less)
  - ◆ Bi-polar (PanAm) grid for Arctic
  - ◆ FY05-07 DoD HPC Challenge project essential
  - ◆ Embedded ice model
  - ◆ Account for Tides (internal or external to HYCOM)
  - ◆ General Nesting Capability (Regional SWAFS/NCOM/HYCOM)
- **Increase to .04° resolution globally and transition to NAVO by the end of the decade**
  - ◆ ~3.5 km mid-latitude resolution
  - ◆ Good resolution for coastal model boundary conditions globally
  - ◆ “Baseline” resolution for shelf regions globally



