

HYCOM and GODAE in Relation to Navy Ocean Prediction

An Overview Presented by

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U.S. Navy Present and Planned Global Ocean Prediction Systems

Global Product	Mid-Lat Resolution	Vert. Coord.	Inputs	Run By	Actual or Target Date
1/16° NLOM	7 km	Layered	SSH, SST, hydro, FNMOC NOGAPS atmospheric forcing	NAVO	OP 9/01-3/06
1/8° NCOM ¹	15 km	σ/z		NAVO	OP 2/06
1/32° NLOM ²	3.5 km	Layered		NAVO	OP 3/06
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
Near Real-time demonstration					
1/12° Atl. HYCOM ⁴	7 km	$\rho/\sigma/z$		NRL	2002

OP = operational

¹ High vertical resolution for mixed layer prediction. Assimilates SSH from NLOM via T and S synthetic profiles. Web page http://www.ocean.nrlssc.navy.mil/global_ncom

² Web page http://www.ocean.nrlssc.navy.mil/global_nlom

³ For coupled ocean-atmosphere prediction.

⁴ Under the National Ocean Partnership Program (NOPP), 1/12° Atlantic HYCOM demo is running in near real-time. Includes the Mediterranean Sea. Results at <http://www.hycom.org> (100Tb LAS server soon)

User Interest in Real-time Global Ocean Products

NRL Oceanography Division Web Site Hit Statistics during 2005

Total # U.S. Military hits	1,526,968
Total # hits	36,452,092
Avg hits/day	99,869
# hits used in country breakdown	36,342,270
# countries with ≥ 1000 hits	70
# countries with ≥ 100 hits	127
Total number of countries	181

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

Altimeter data

MODAS SSH & SST analyses

Ocean prediction systems

1/16° and 1/32° global NLOM

1/8° global NCOM

1/12° Atlantic HYCOM

Top 25 Countries and # Hits

United States	27,468,102
Japan	7,190,216
Taiwan	152,085
China	150,733
Russia	109,211
Germany	103,376
Great Britain	98,845
Greece	88,603
Spain	72,452
Canada	66,011
France	62,260
Mexico	60,198
Philippines	56,034
Vietnam	53,749
South Korea	53,536
Italy	42,297
Australia	41,128
Singapore	40,215
New Zealand	37,724
Sweden	36,014
India	27,820
Denmark	26,664
Peru	25,642
Netherlands	24,191
Norway	22,805

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	→	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, FY06 – 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

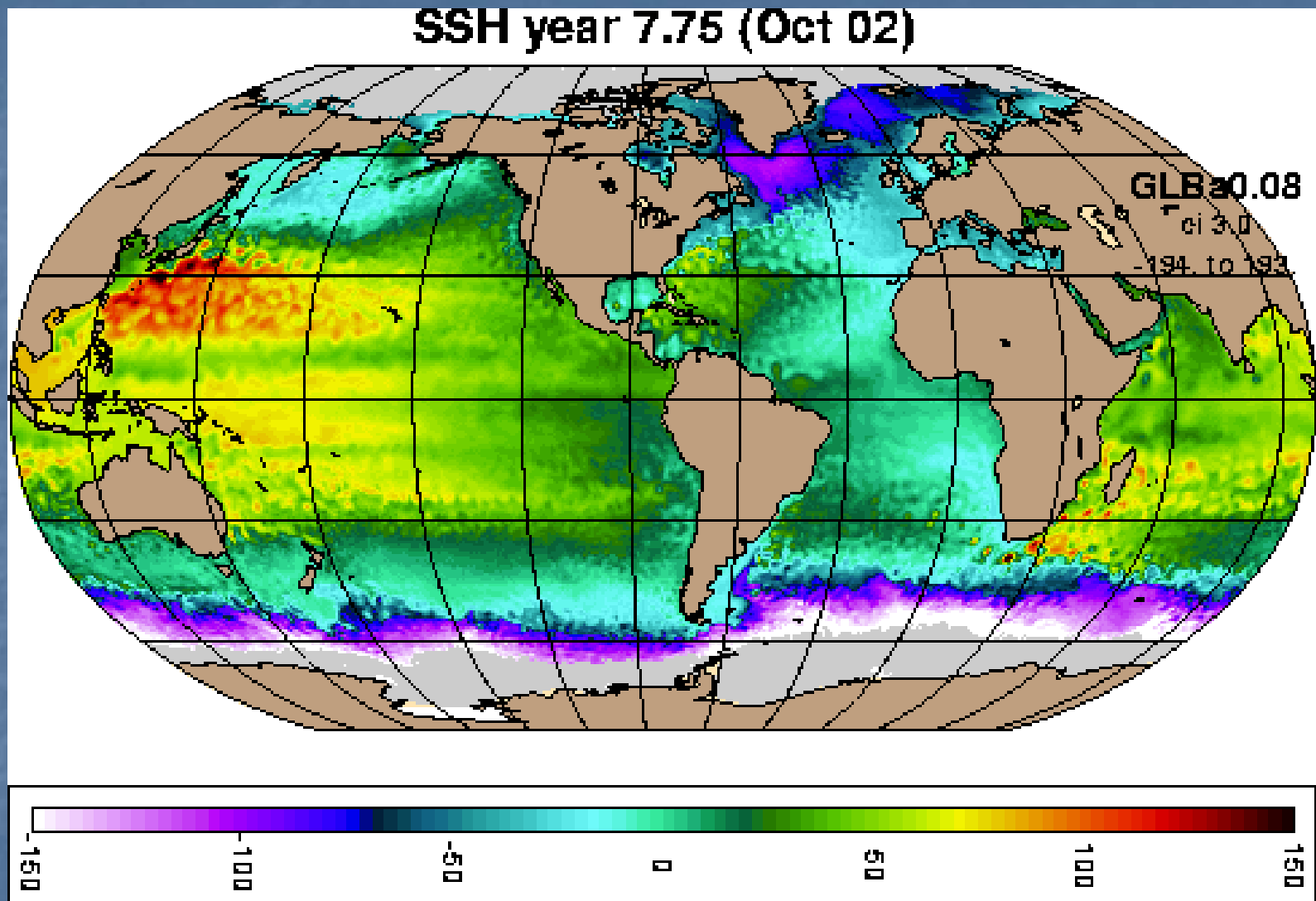
Long-term: FY07-FY10 in R&D, FY10 and beyond operational, including transition

*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 will provide research results needed to make the appropriate choice. An alternative model such as ROMS may also be considered.

+1/25° HYCOM gives useful littoral resolution globally

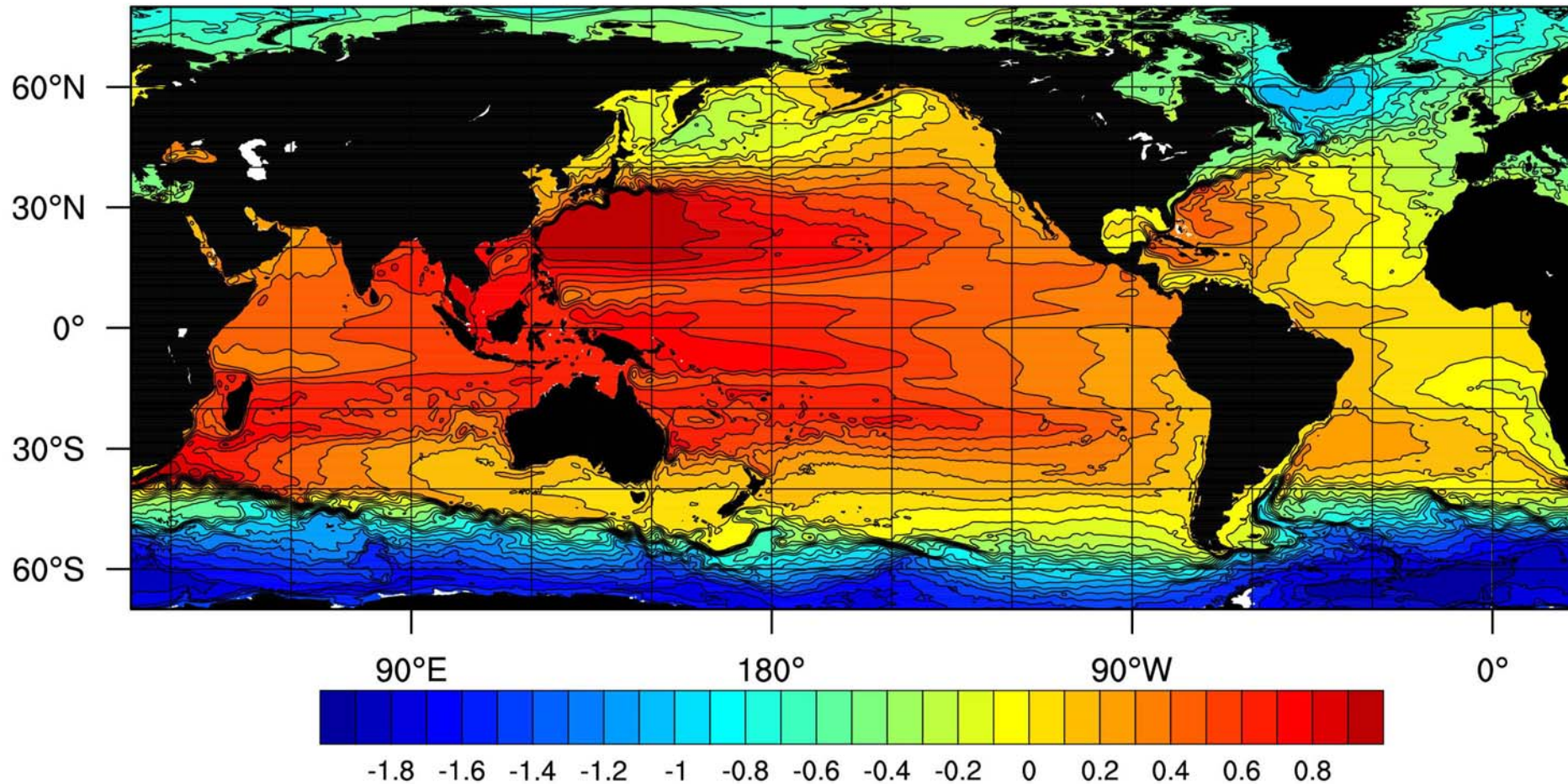
.08° Global HYCOM Sea Surface Height and ice (gray)



- Monthly climatological atmospheric forcing from ECMWF ERA15 reanalysis
- Running at NAVO under DoD Challenge on 784 CPUs

Long-term Mean Global Sea Level

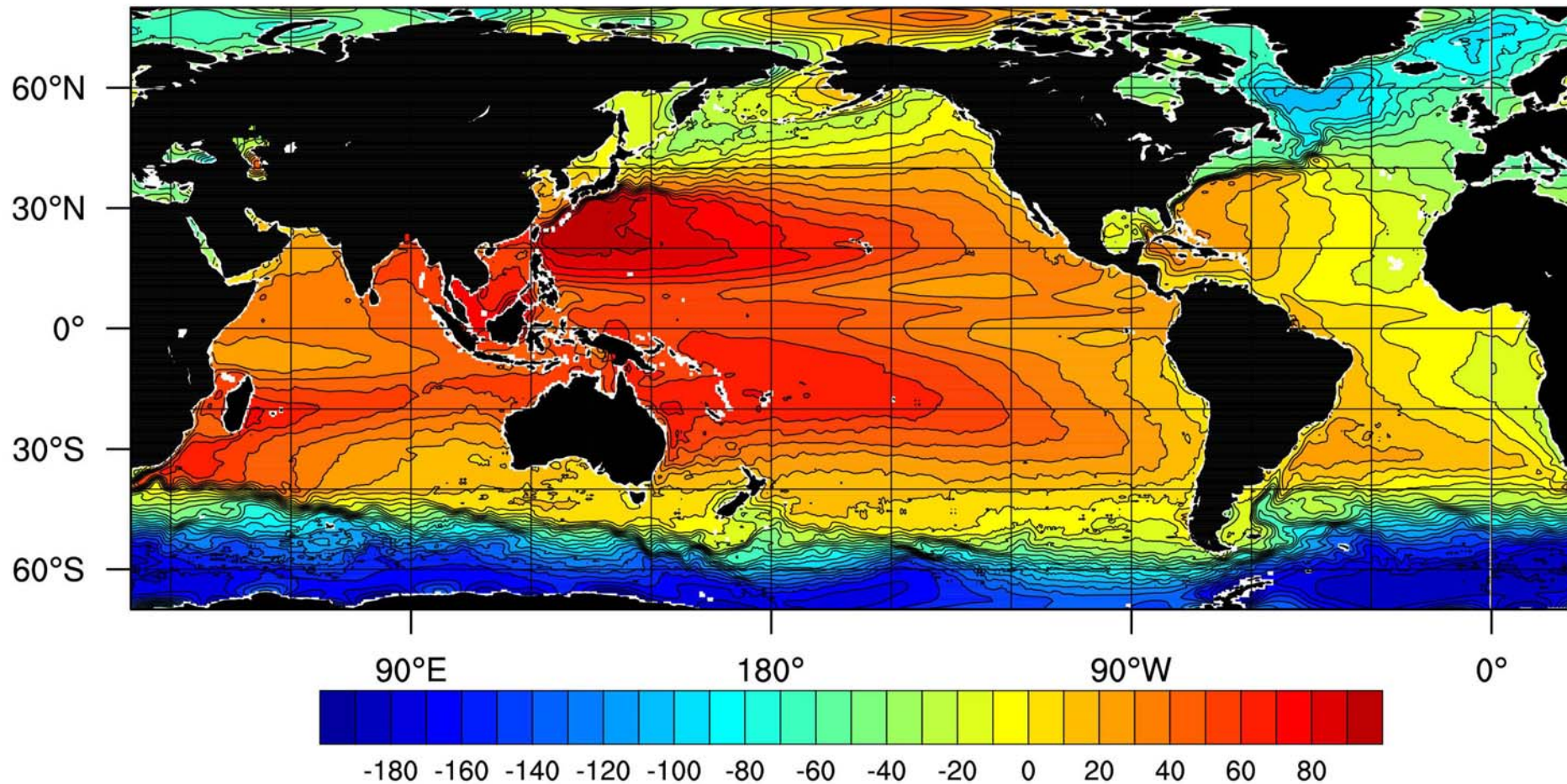
1/12° global HYCOM – Exp. 5.6



5 year model mean using climatological ECMWF wind and thermal forcing

Long-term Mean Global Sea Level

Maximenko and Niiler (2005)

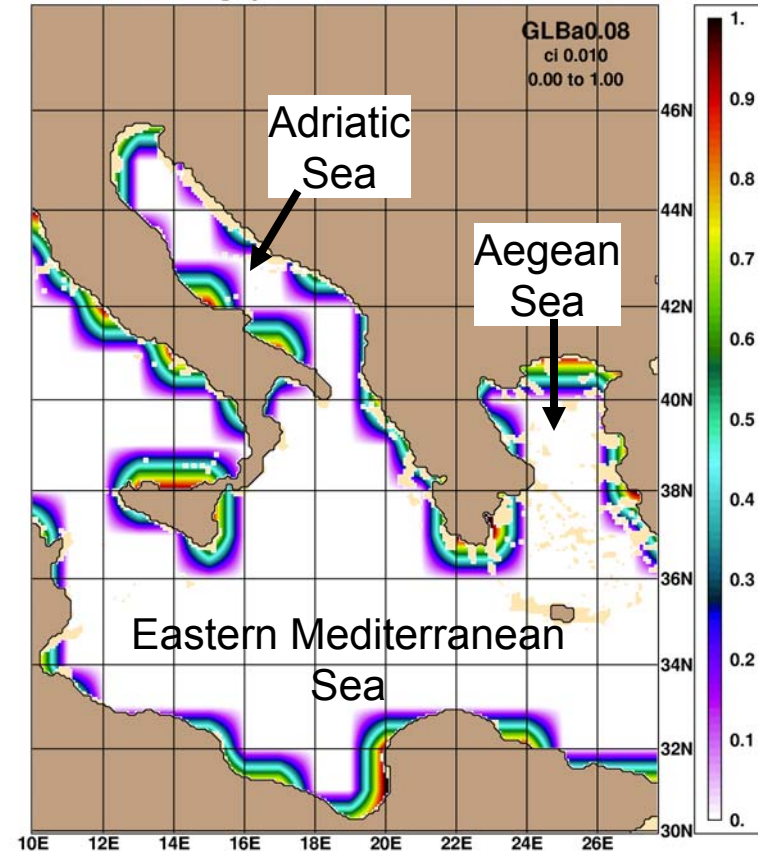


1992-2002 Mean Dynamic Ocean Topography calculated using satellite altimeter data, near-surface drifters, NCEP wind and GRACE output

Ongoing Work on Atmospheric Forcing

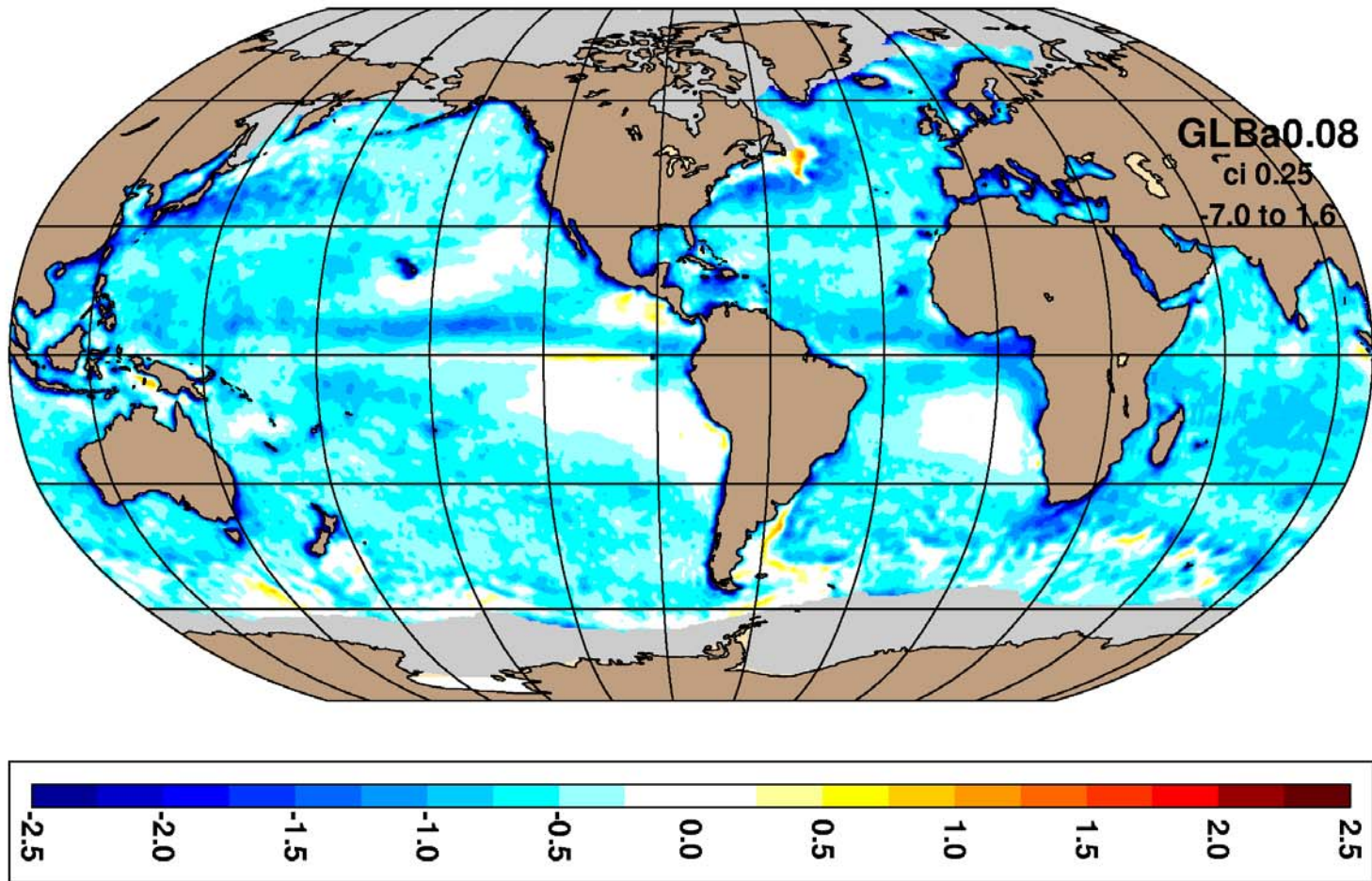
- New schemes for shortwave radiation penetration with turbidity
 - Kara et al. (2005, JPO), Lee et al. (2005, JGR-O)
- Creeping Sea Fill (Kara et al., 2006, JPO in press)
 - For removal of land contamination of sea grid points from any scalar atmospheric forcing field
 - Or filling data gaps, e.g. near land
- Satellite-based corrections to short and longwave radiation, wind speed, and precipitation monthly mean climatologies
 - Approach can be used for any sub-daily inter-annual or real-time atmospheric forcing product of choice, e.g. NOGAPS
 - Short and long wave radiation corrected using ISCCP climatology
 - Wind speed corrected using scatterometer or SSM/I climatology
 - Product wind direction retained
 - Precipitation is corrected using GPCP climatology

NOGAPS Land/Sea Mask over the Eastern Mediterranean Sea Region



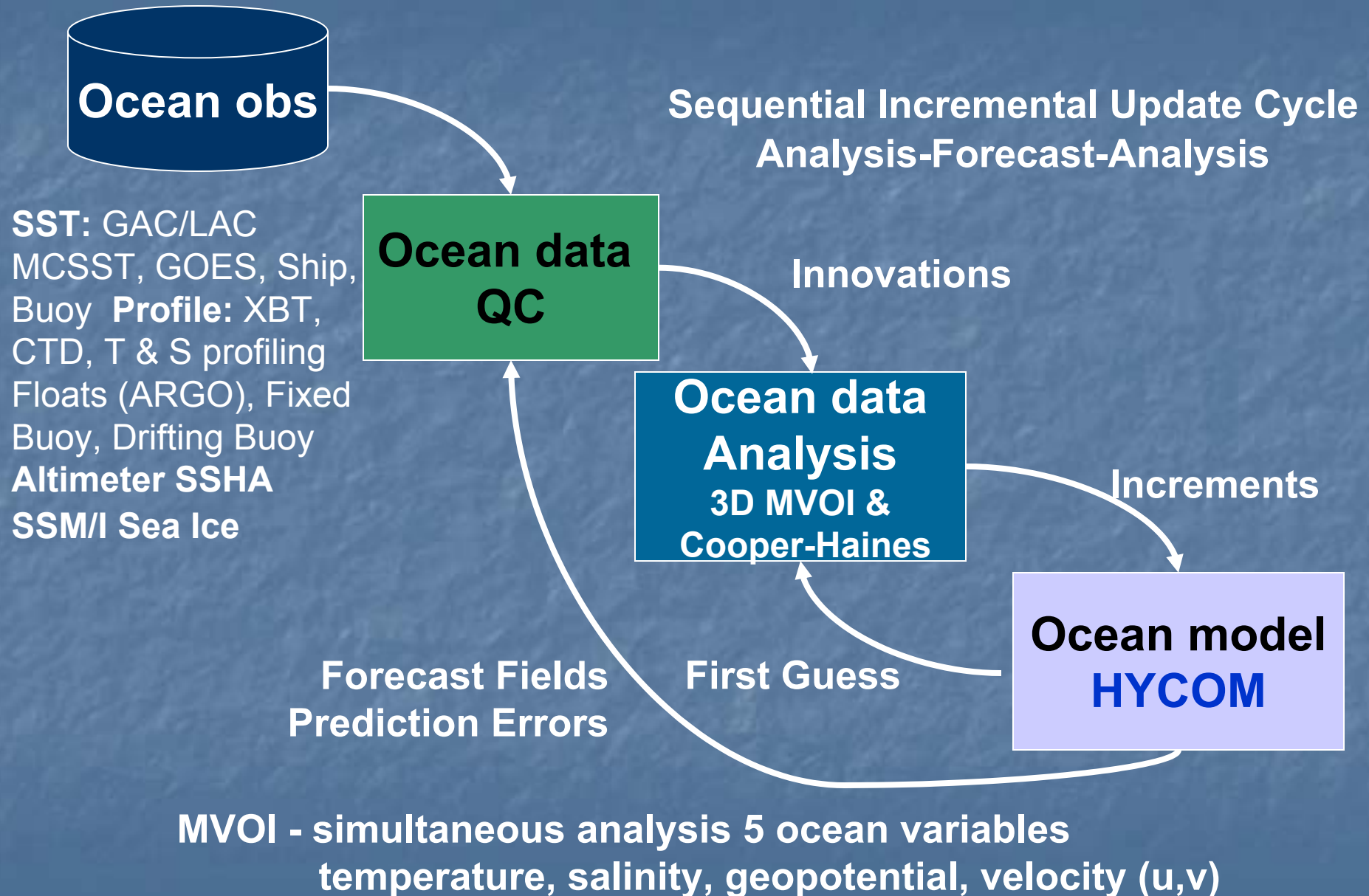
Annual Mean Wind Speed Bias

ECMWF ERA40 reanalysis minus the QuikScat scatterometer during 2001



meters/sec

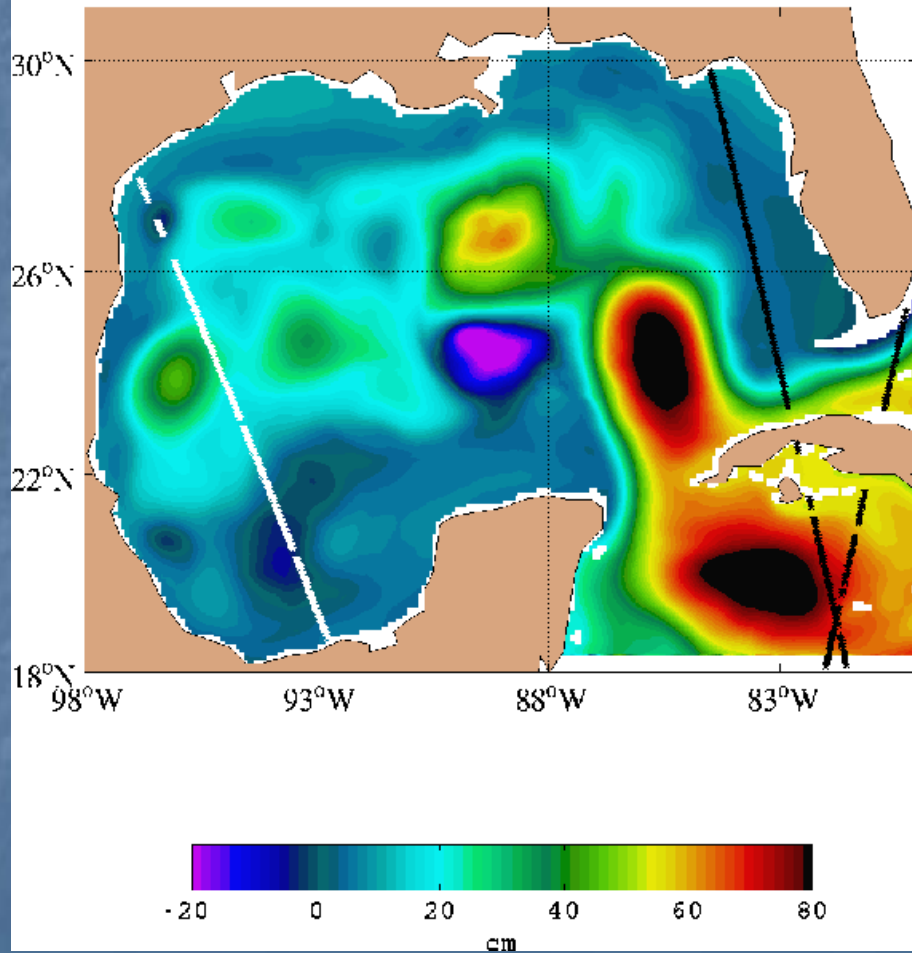
NRL Coupled Ocean Data Assimilation (NCODA)



HYCOM identical twin SSH and SST data

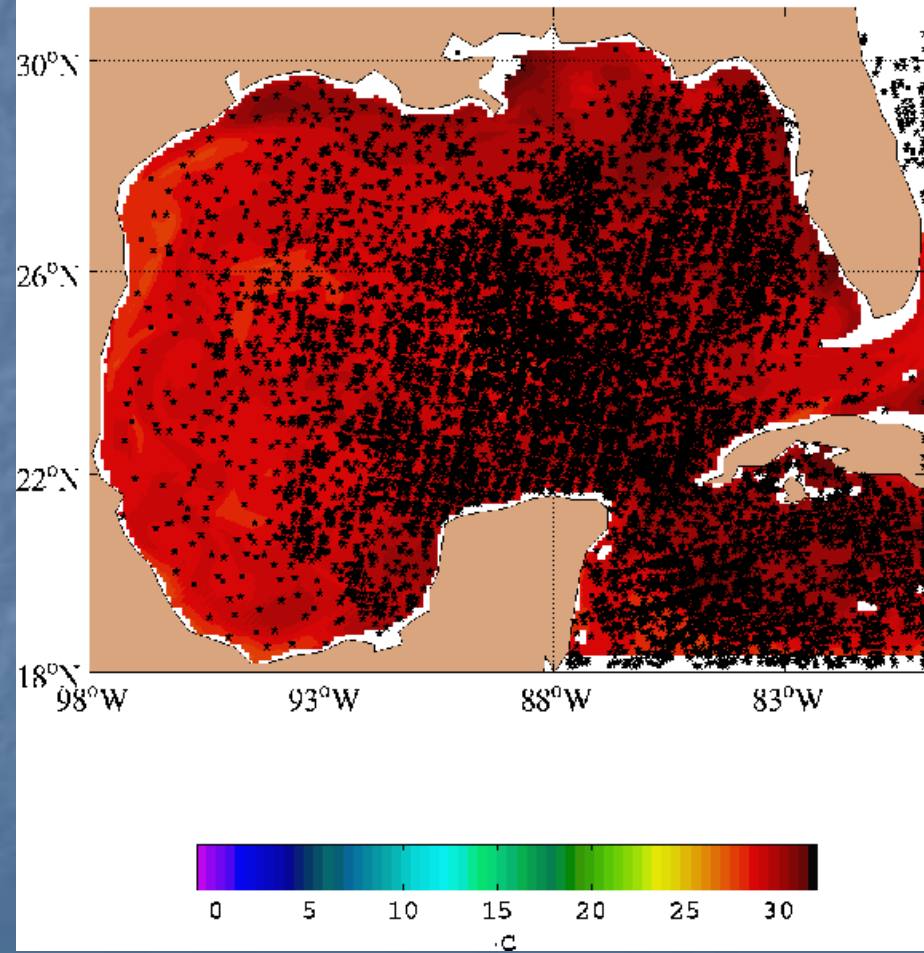
Ocean model sampled
along observed tracks

1/12° HYCOM SSH noassim (0.0) 19990825



Model sampled at observed
MCSST locations

1/12° HYCOM SSH noassim (0.0) 19990825



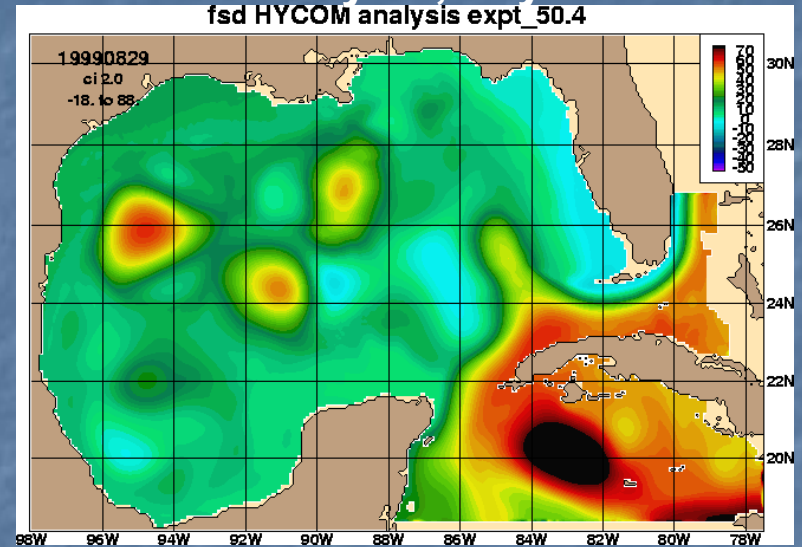
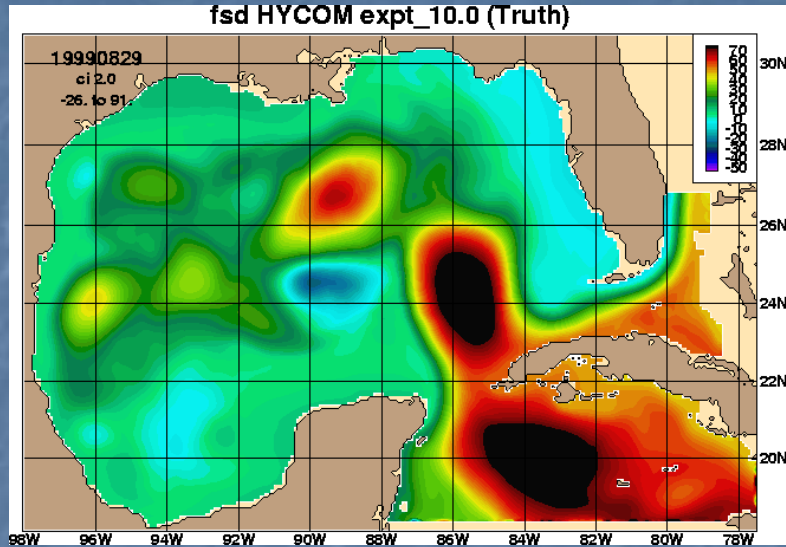
HYCOM identical twin results

“Observed” track and MCSST locations

Truth

29 August 1999

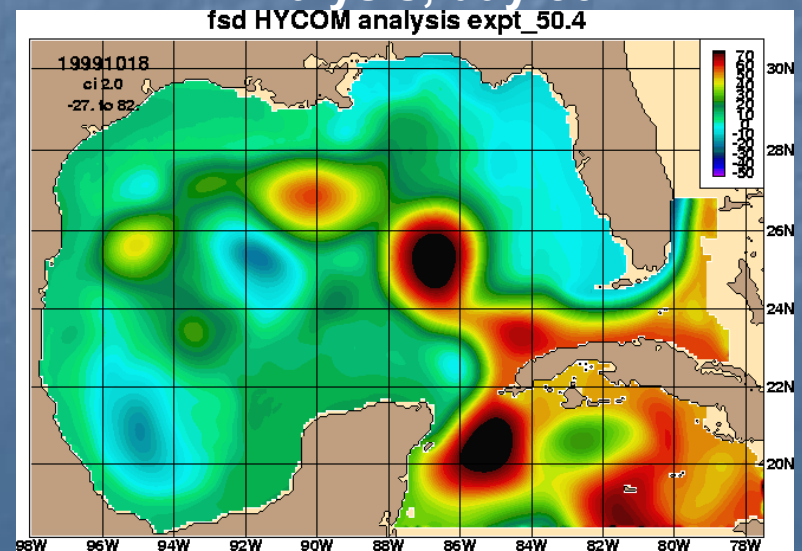
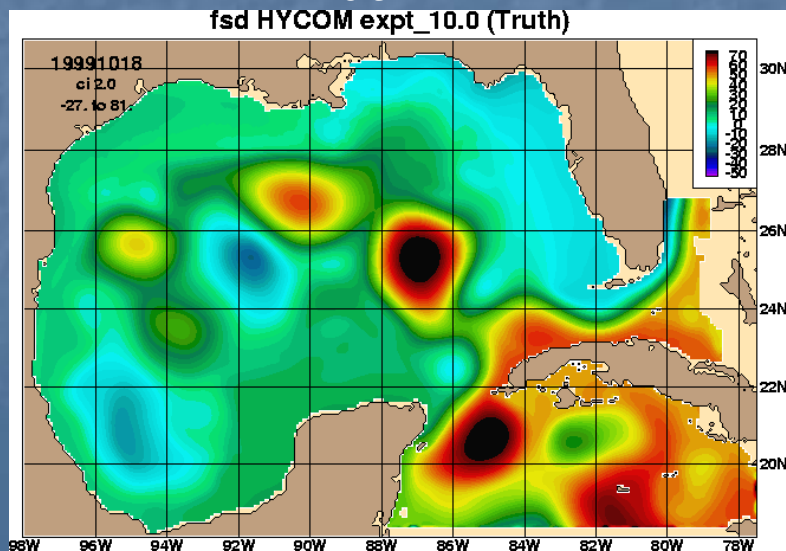
Analysis, day 1



Truth

18 October 1999

Analysis, day 50



HYCOM identical twin results

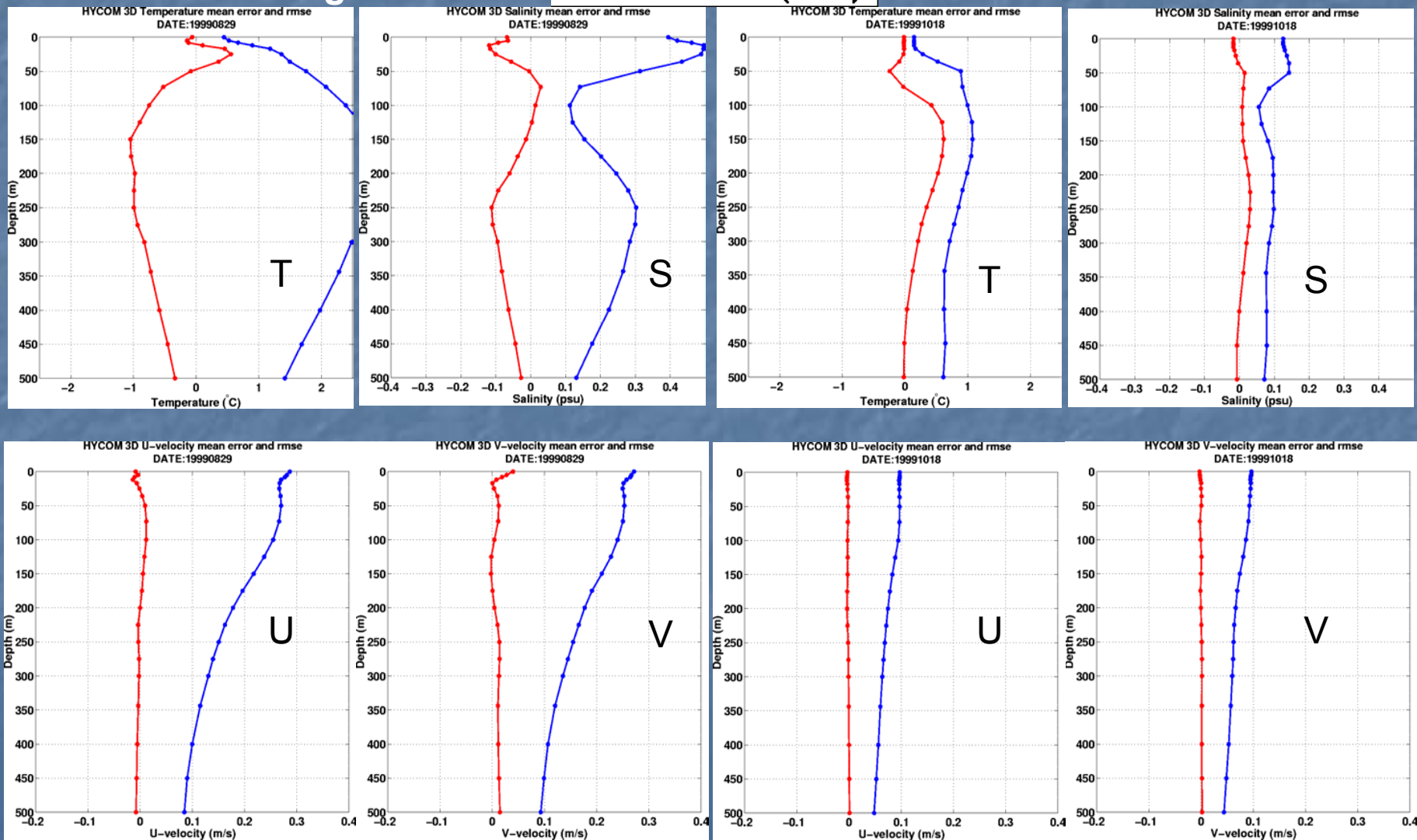
RMSE vertical profiles (0-500m)

“Observed” track and MCSST locations

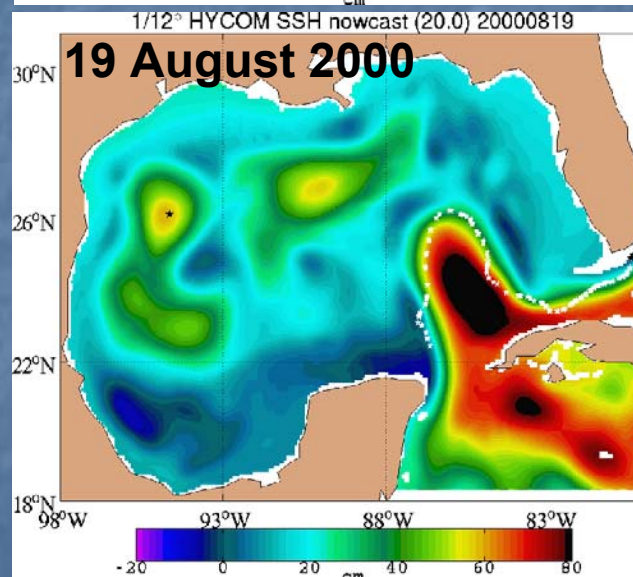
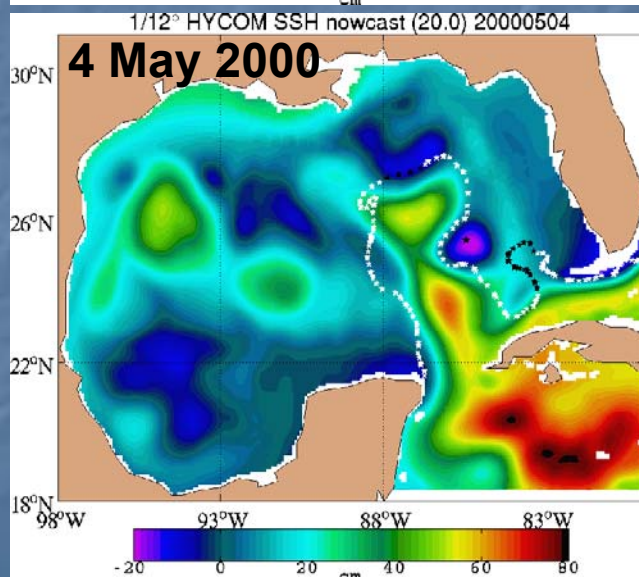
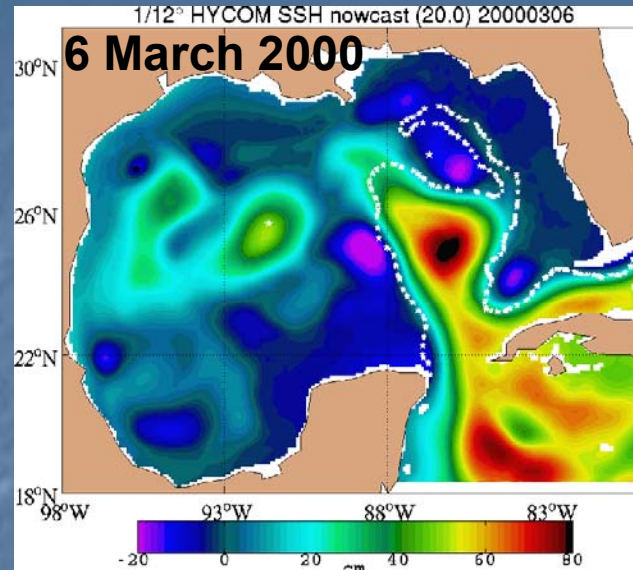
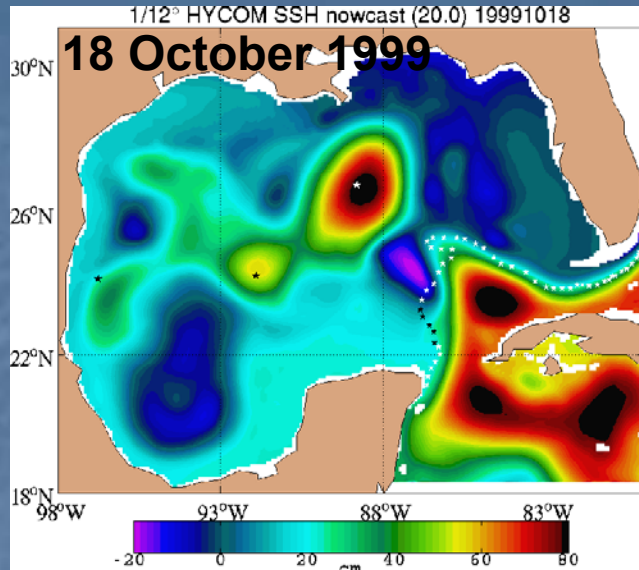
29 August 1999

18 October 1999

—●— RMS error (50.4)
—●— Mean error (50.4)



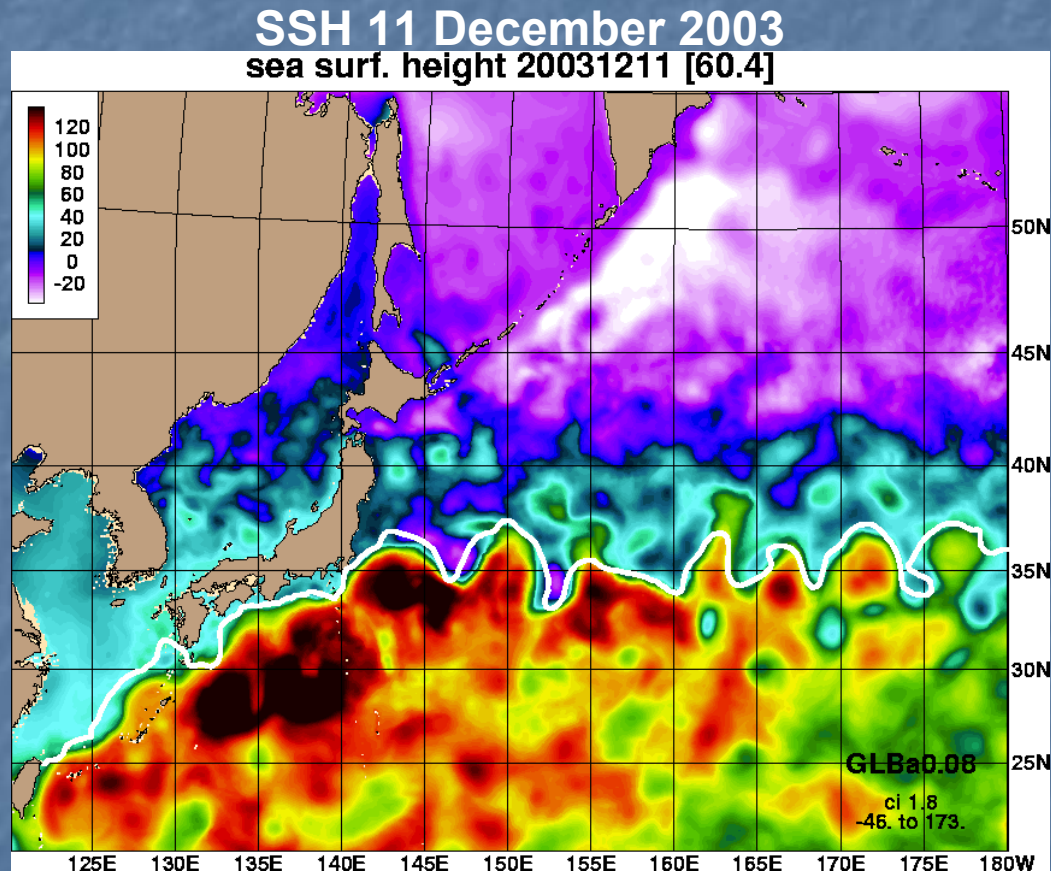
HYCOM/NCODA assimilation of real SSH, SST & XBT profiles



HYCOM nowcast SSH with the NAVO frontal analysis of MCSST observations (white/black lines, black data > 4 days old)

1/12° Global HYCOM

Hindcast started 12 November 2003



HYCOM nowcast SSH with the NAVO frontal analysis of
MCSST observations (white/black lines, black data > 4 days old)