The Navy Coupled Ocean Data Assimilation (NCODA) system in HYCOM

O. M. Smedstad[1], J. A. Cummings[2], A. J. Wallcraft[2], H. E. Hurlburt[2], P. J. Hogan[2], E. P. Chassignet[3], W. C. Thacker[4], H. Kang[5]

[1]Planning Systems Inc.
[2]Naval Research Laboratory
[3]Florida State University
[4]Atlantic Oceanographic and Meteorological Laboratory
[5]University of Miami

http://www.hycom.org

HYCOM NOPP/GODAE
Tallahassee, Florida
7-9 November 2006

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
NOV 2006		**00-00-2006 to 00-00-2006**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
The Navy Coupled Ocean Data Assimilation (NCODA) system in HYCOM	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**	**Same as Report (SAR)**	**28**	

Atlantic near real-time system

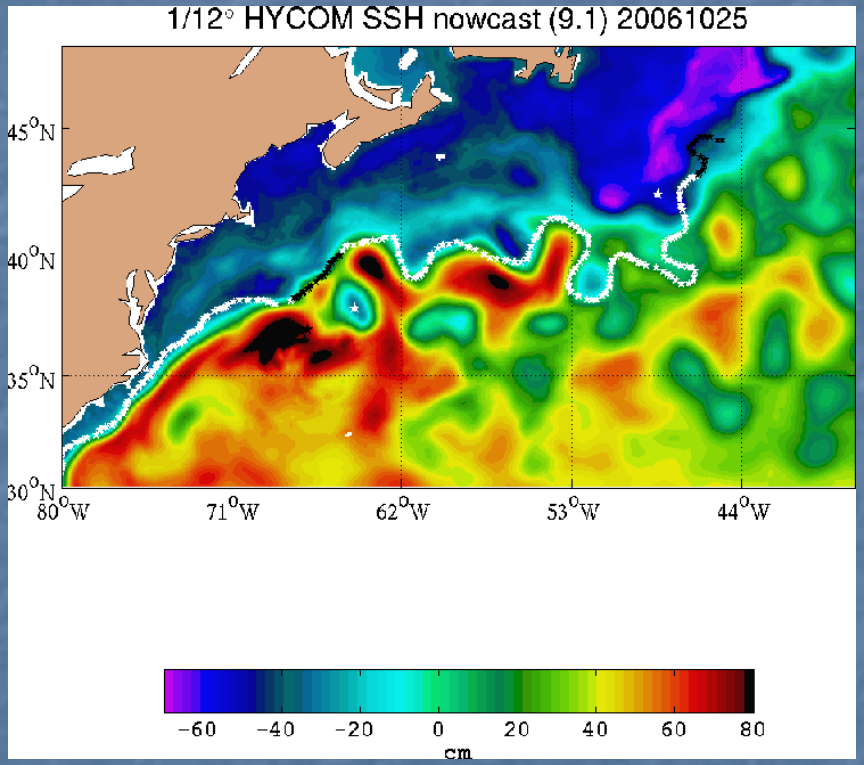
- 1/12º Atlantic (28ºS to 70ºN)
- Running in near real-time (on Wednesday)
  - . Assimilates the satellite altimeter analysis from the MODAS operational system at the Naval Oceanographic Office (NAVOCEANO)
  - . Mean SSH from the 1/12° MICOM (ECMWF)
  - . Vertical projection via the Cooper and Haines technique (1996, JGR)
  - . FNMOC/NOGAPS atmospheric forcing
  - . Relaxation to the MODAS SST analysis
- 10 day hindcast, 14 day forecast
- Provide boundary conditions for coastal models

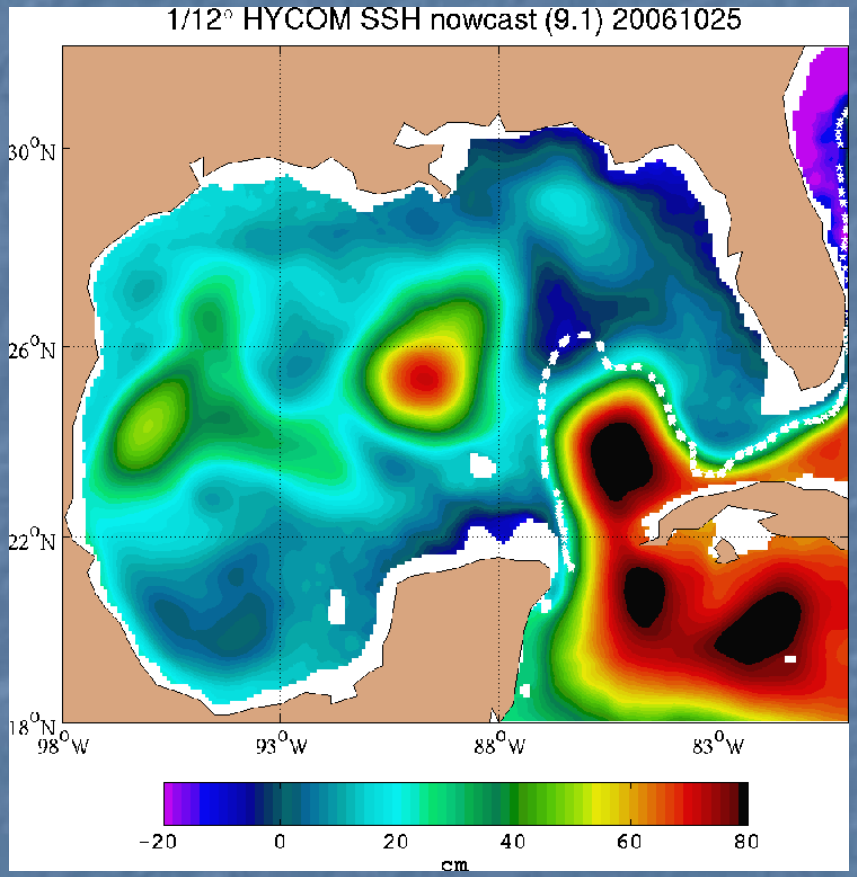
http://www7320.nrlssc.navy.mil/ATLhycom1-12/skill.html
http://www.hycom.org

1/12° Atlantic HYCOM

SSH in Gulf Stream and Gulf of Mexico region

25 October 2006

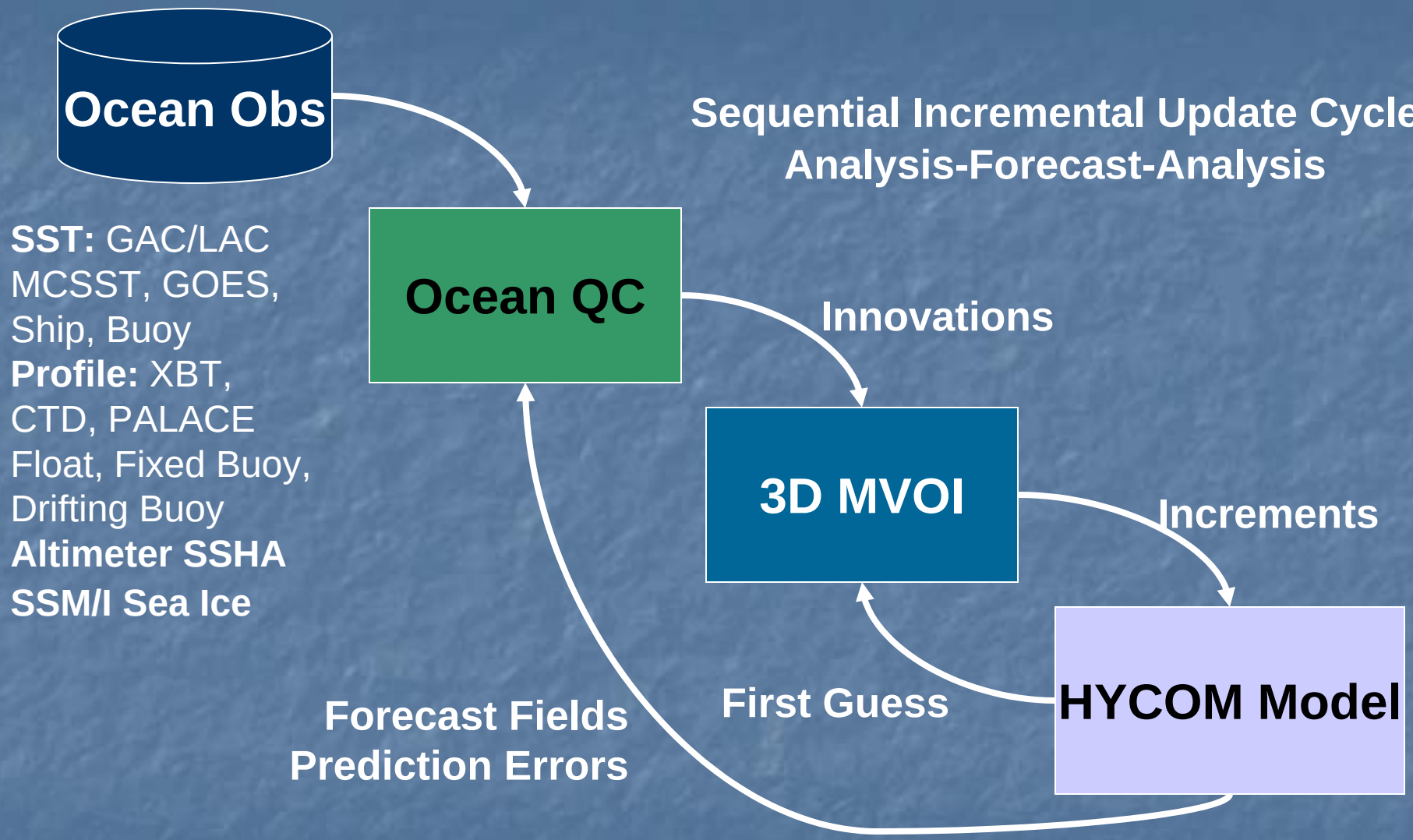




White/black line is the frontal analysis of MCSST observations performed at NAVOCEANO. Black line represents data more than four days old.

http://www.hycom.org

Navy Coupled Ocean Data Assimilation (NCODA)



MVOI - simultaneous analysis 5 ocean variables
temperature, salinity, geopotential, velocity (u,v)

HYCOM/NCODA coupling

- **HYCOM to 3D z-grid**
- **NCODA analysis on z-grid**
- **Use the NCODA analysis in an incremental updating of the HYCOM variables.**
- **Daily NCODA analysis**

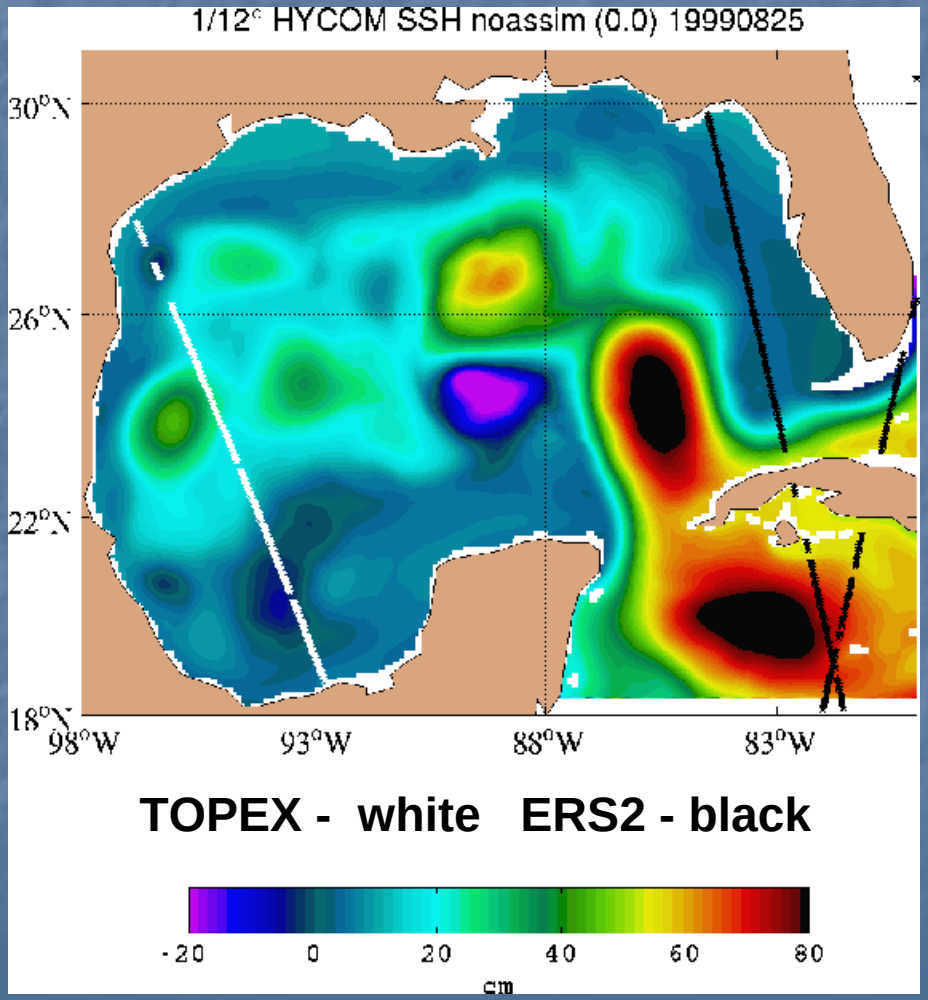
1/12º GULF OF MEXICO HYCOM CONFIGURATION

- **Horizontal grid: 1/12° (258 x 175 grid points, 6.5 km spacing on average)**
- **18°N to 31°N**
- **20 vertical coordinates**
- **Bathymetry: 5m coastline**
- **Surface forcing from FNMOC/NOGAPS**
- **Monthly river runoff**
- **Nested Boundary:**

  relaxation to the 1/12° Atlantic HYCOM T, S, U and V along open boundary, (no assimilation in these experiments)

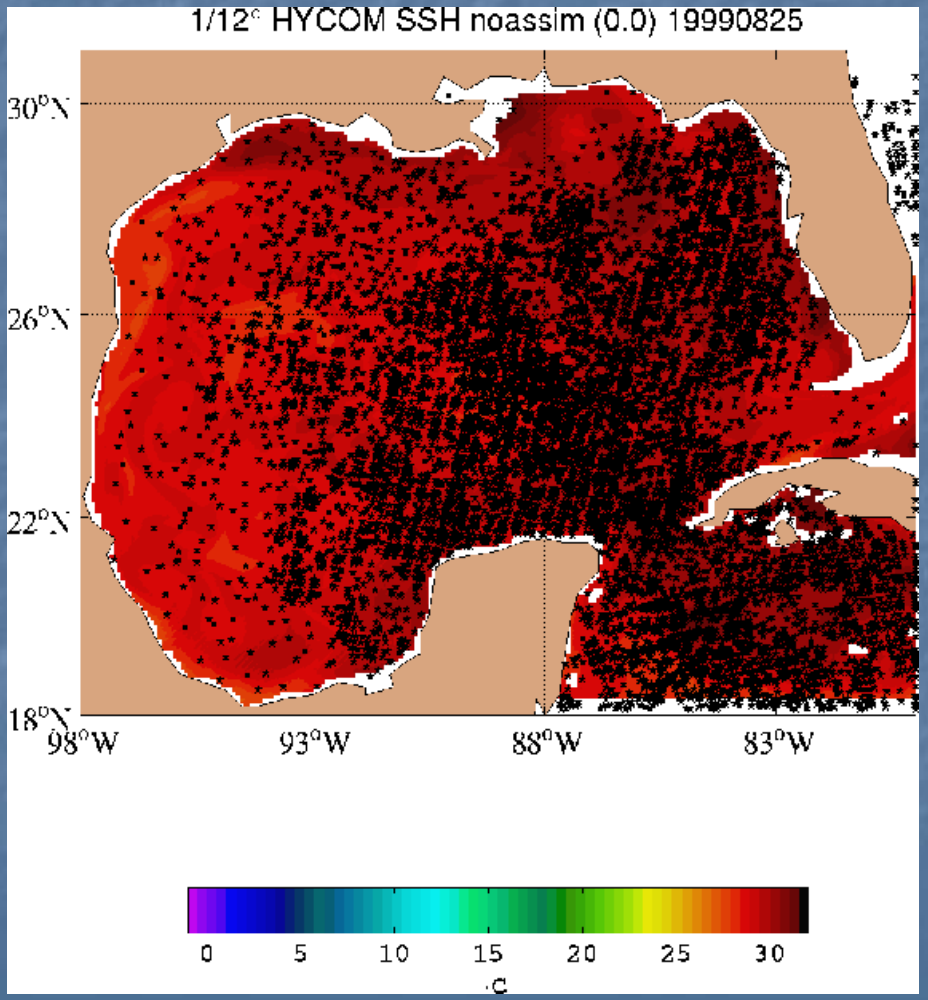
HYCOM identical twin SSH and SST data

Ocean model sampled along observed tracks



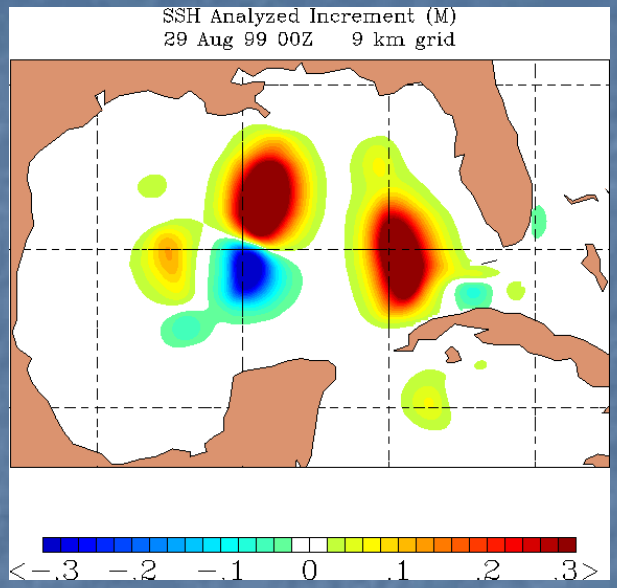
TOPEX - white ERS2 - black

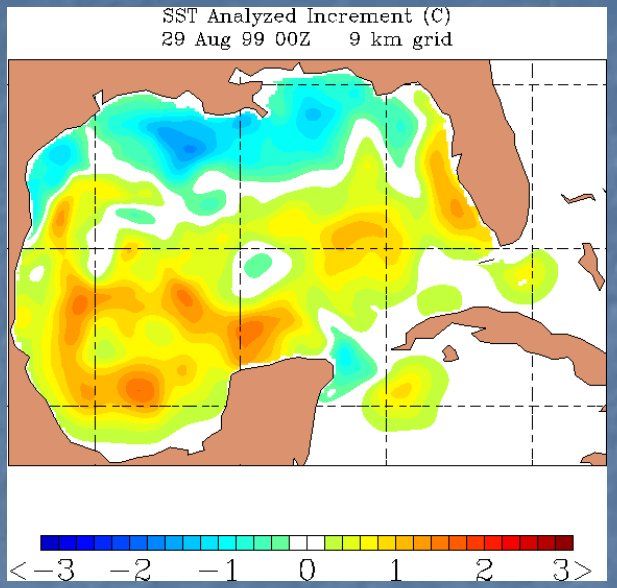
Model sampled at observed MCSST locations



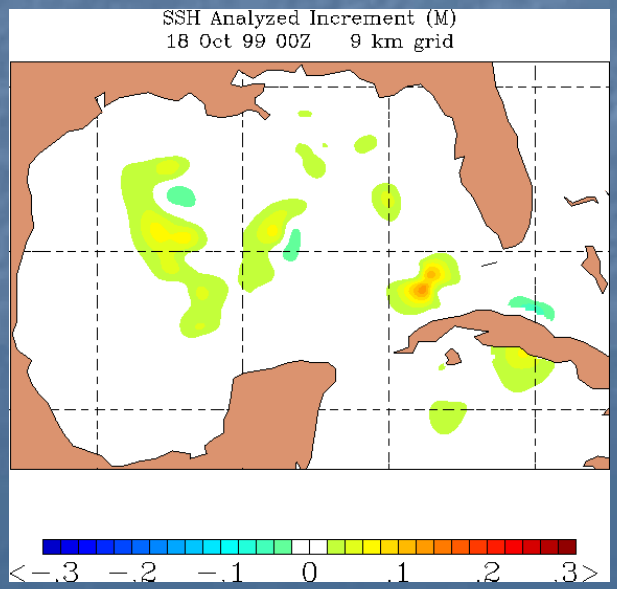
HYCOM identical twin results
"Observed" track and MCSST locations

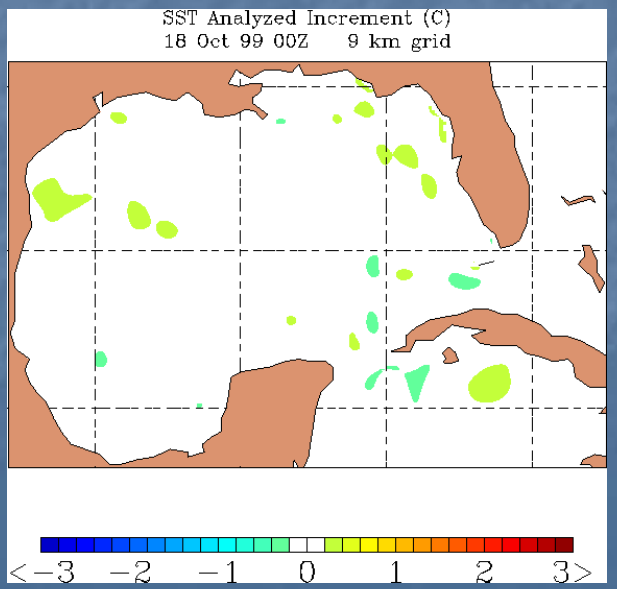
SSH ← increments → SST





29 August 1999
Day 1

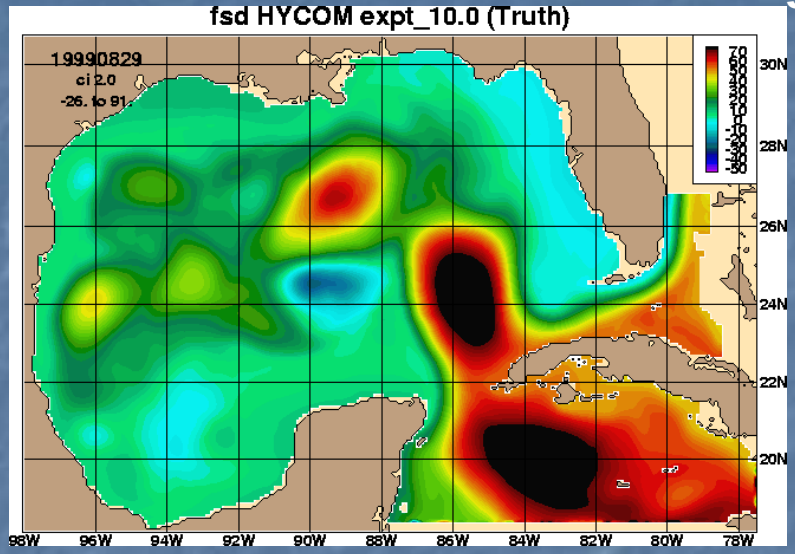


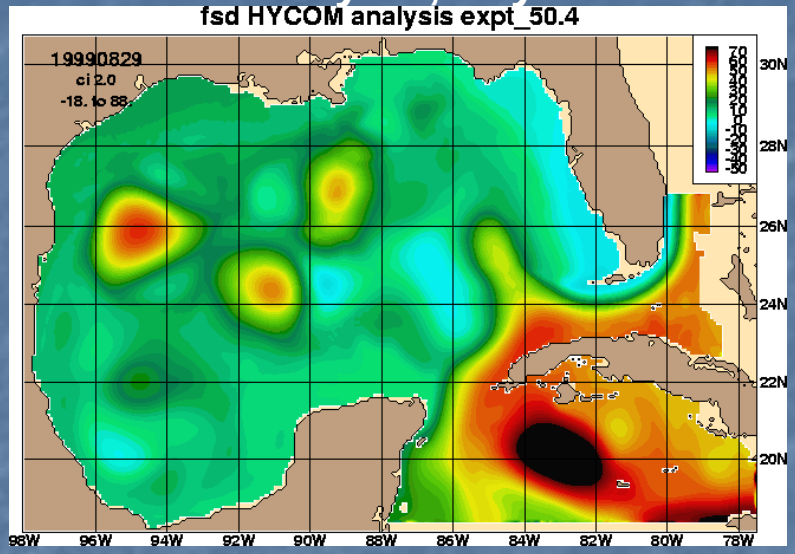


18 October 1999
Day 50

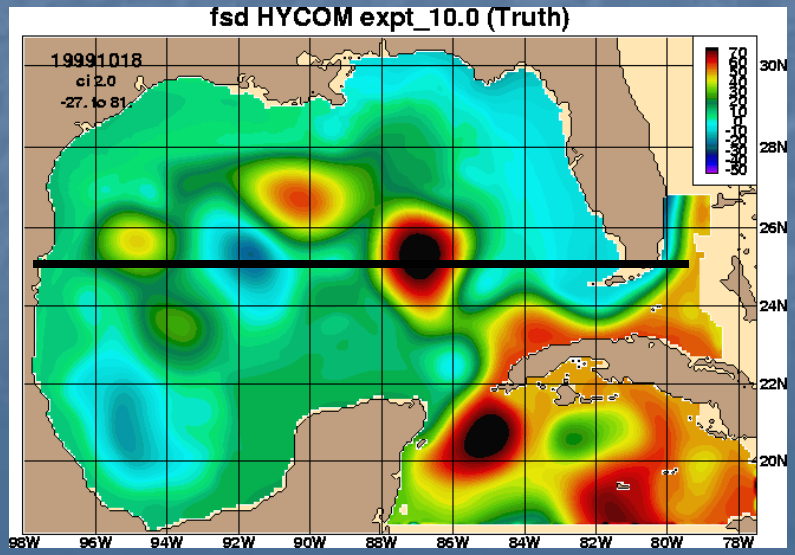
HYCOM identical twin results
"Observed" track and MCSST locations

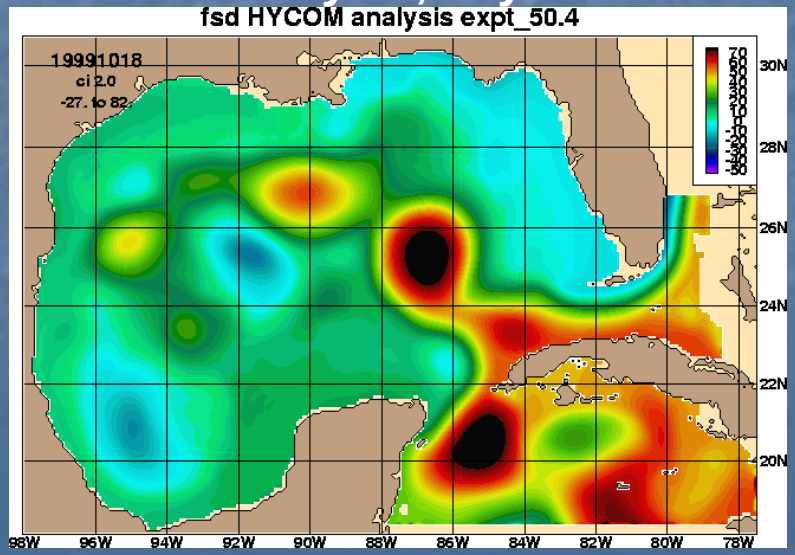
Truth 29 August 1999 Analysis, day 1





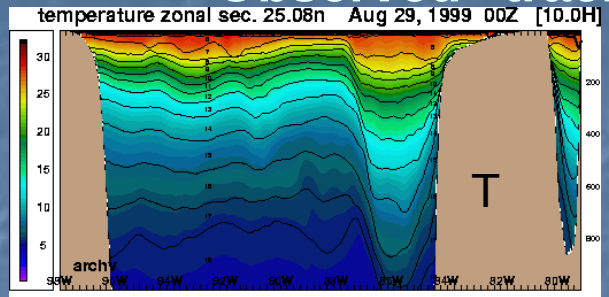
Truth 18 October 1999 Analysis, day 50

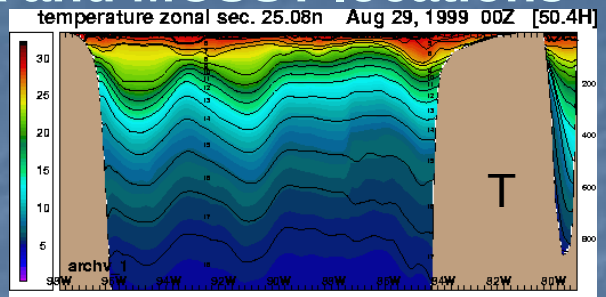


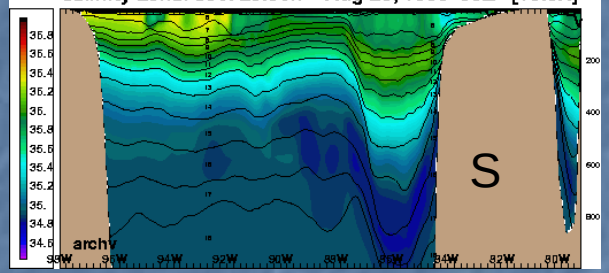


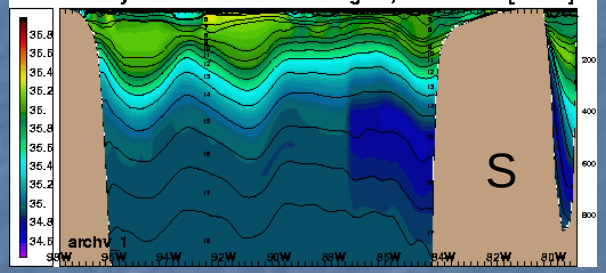
HYCOM identical twin results
Temperature and salinity sections along 25.08ºN
"Observed" track and MCSST locations

Truth



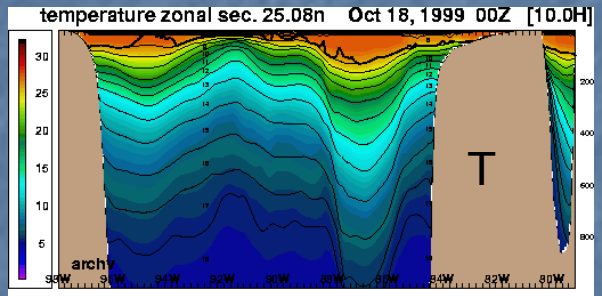


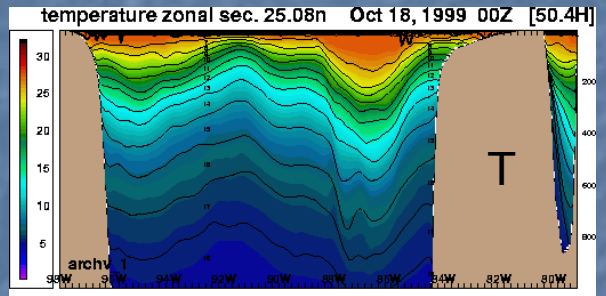


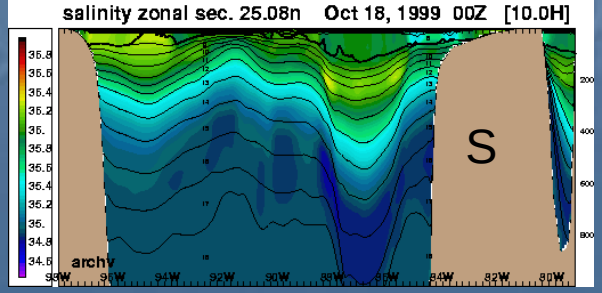


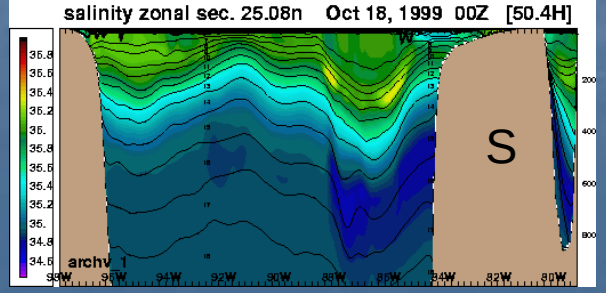
Analysis, day 1
29 August 1999

Truth







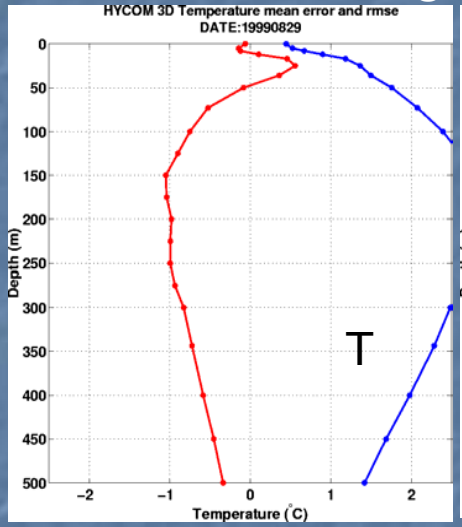


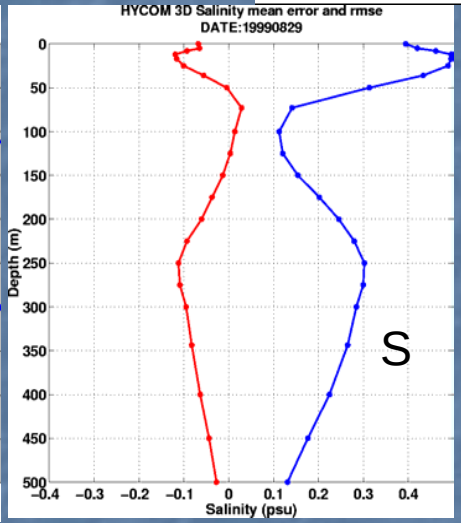
Analysis, day 50
18 October, 1999

HYCOM identical twin results
RMSE vertical profiles (0-500m)
"Observed" track and MCSST locations

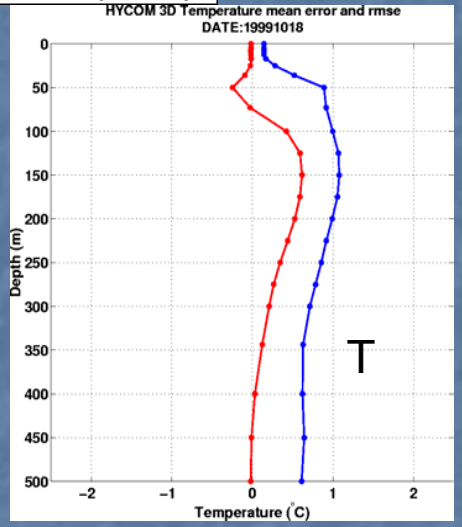
RMS error (50.4)
Mean error (50.4)

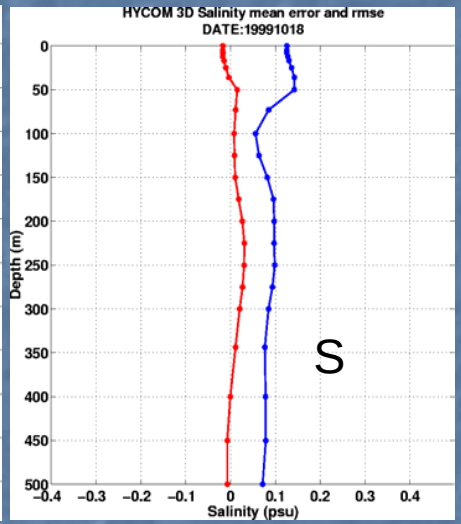
29 August 1999

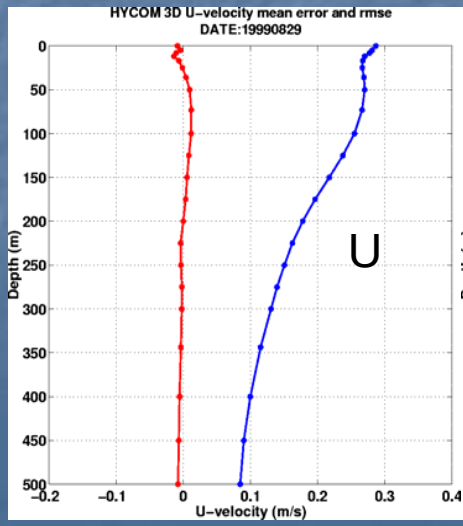


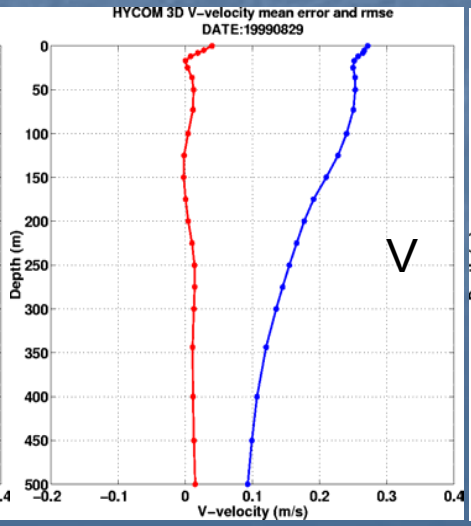


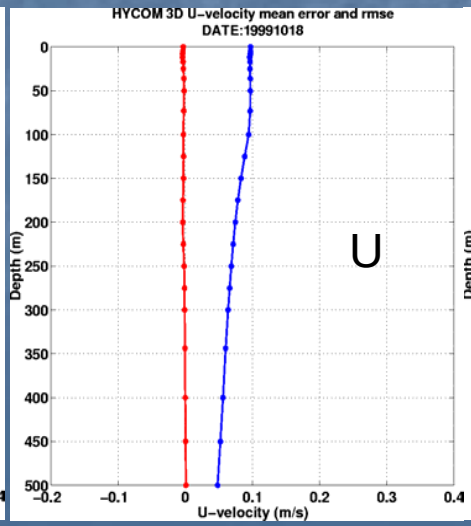
18 October 1999

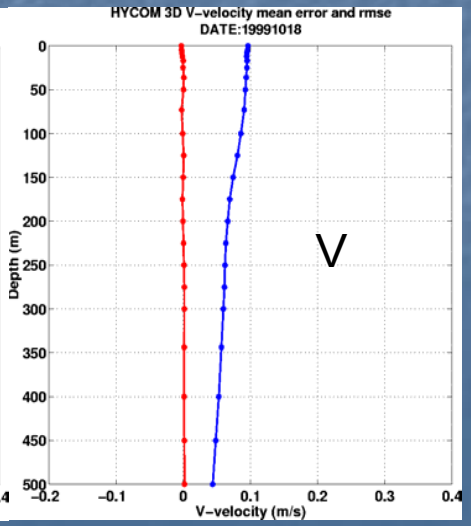












1/25º GULF OF MEXICO HYCOM CONFIGURATION

- Horizontal grid: 1/25° (517 x 349 grid points, 3.5 km spacing on average)
- 18°N to 31°N
- 20 vertical coordinates
- Bathymetry: real coastline (minimum depth 2m)
- Surface forcing from FNMOC/NOGAPS
- Monthly river runoff
- Nested Boundary:

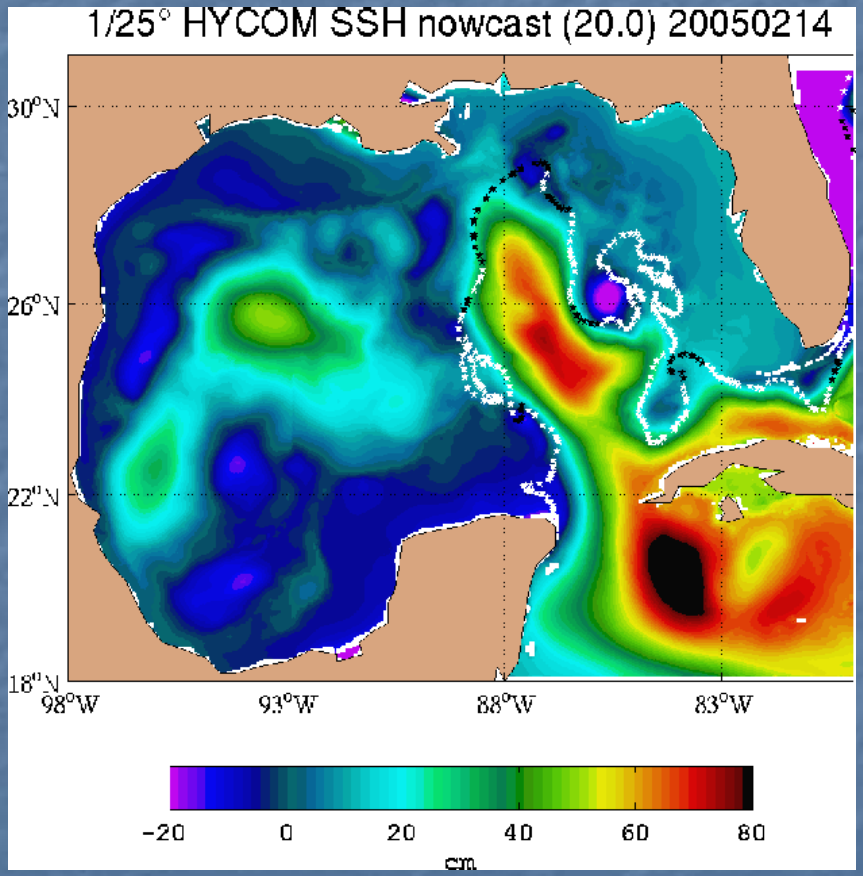
  relaxation to the 1/12° Atlantic HYCOM climatological T, S, U and V along open boundary

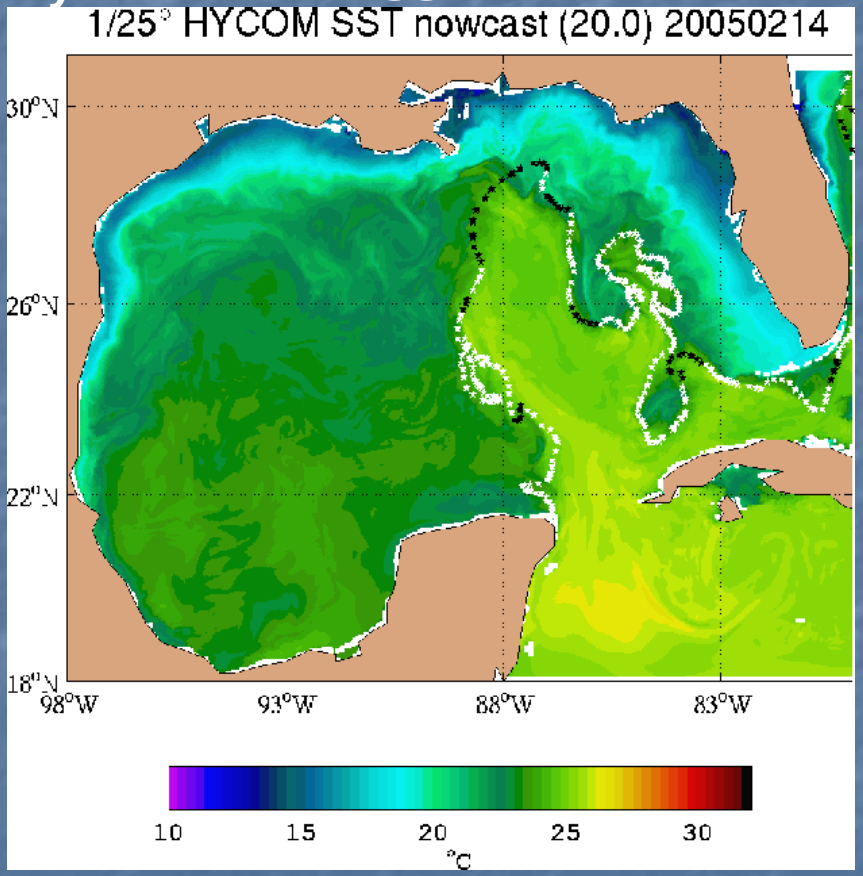
1/25º Gulf of Mexico HYCOM

Hindcast started 2 September 2003

webpage

SSH 14 February 2005 SST





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

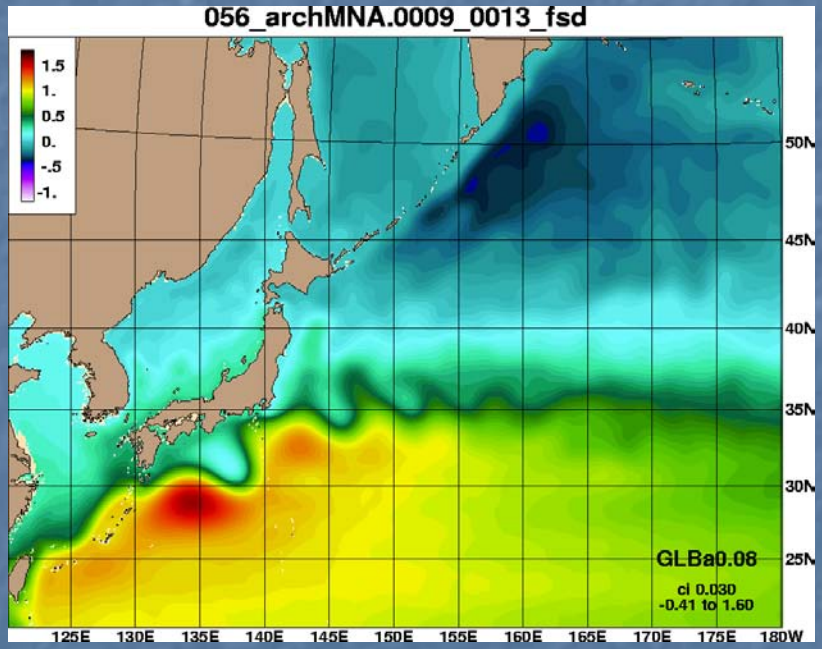
1/12º Global HYCOM Configuration

- Horizontal grid: 1/12° equatorial resolution
  - 4500 x 3298 grid points, ~6.5 km spacing on average, ~3.5 km at pole
- Mercator 79°S to 47°N, then Arctic dipole patch
- Vertical coordinate surfaces: 32 for σ_2*
- GISS mixed layer model
- Thermodynamic (energy loan) sea-ice model
- Surface forcing: wind stress, wind speed, thermal forcing, precipitation, relaxation to climatological SSS
- Monthly river runoff (986 rivers)
- Initialize from January climatology (GDEM3) T and S, then SSS relaxation from PHC 3.0
  - No subsurface relaxation to climatology

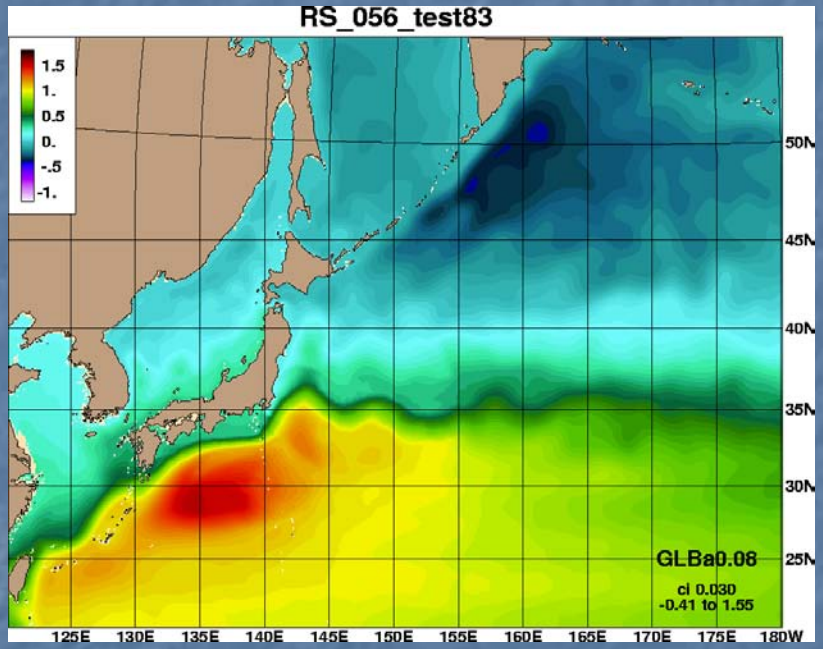
1/12º Global HYCOM

Mean SSH (05.6)

Original



Rubber sheeted

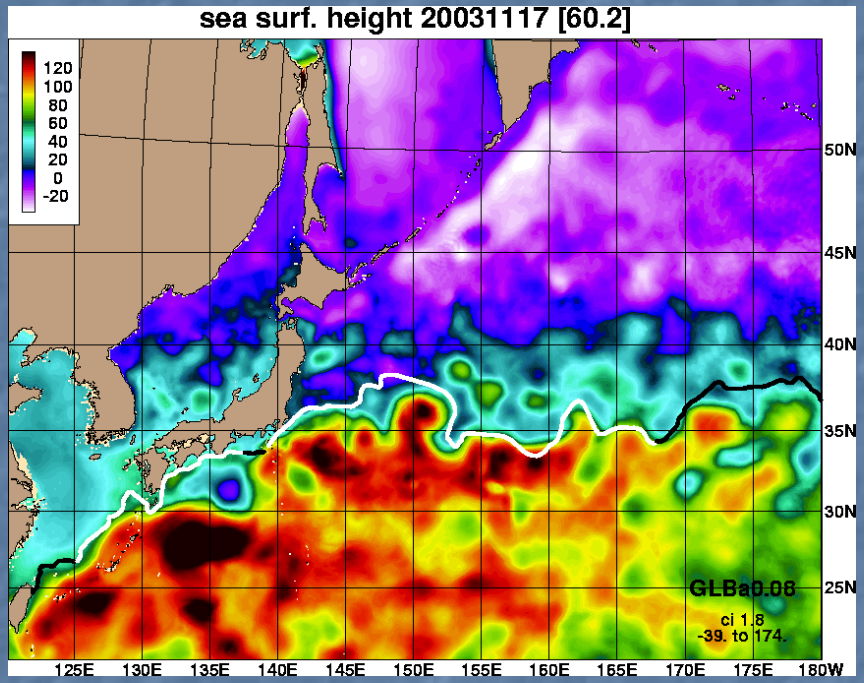


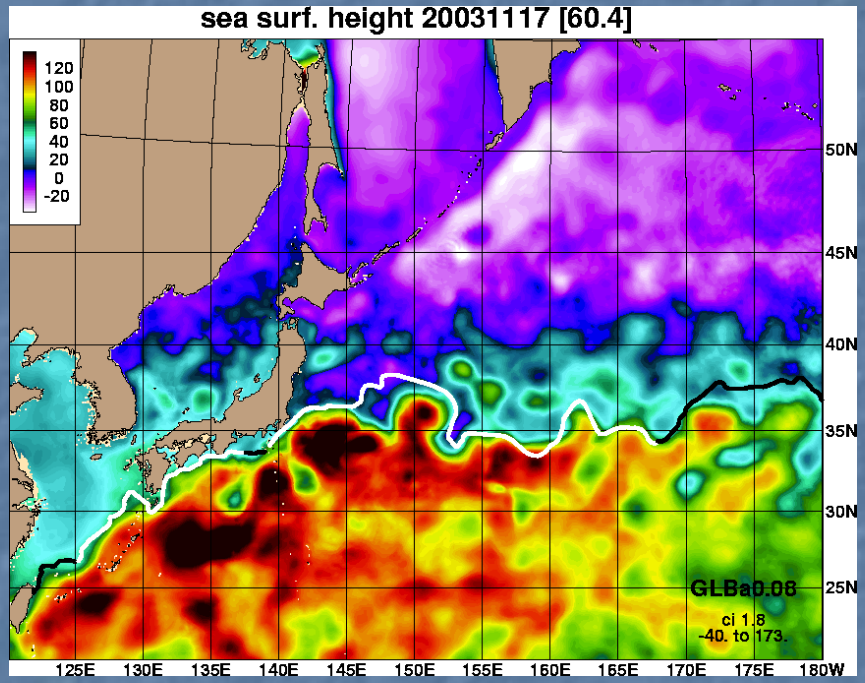
Nicolas Choplain

1/12º Global HYCOM

Hindcast started 12 November 2003

SSH 17 November 2003





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

1/12º Global HYCOM

Mean SSH (05.6)

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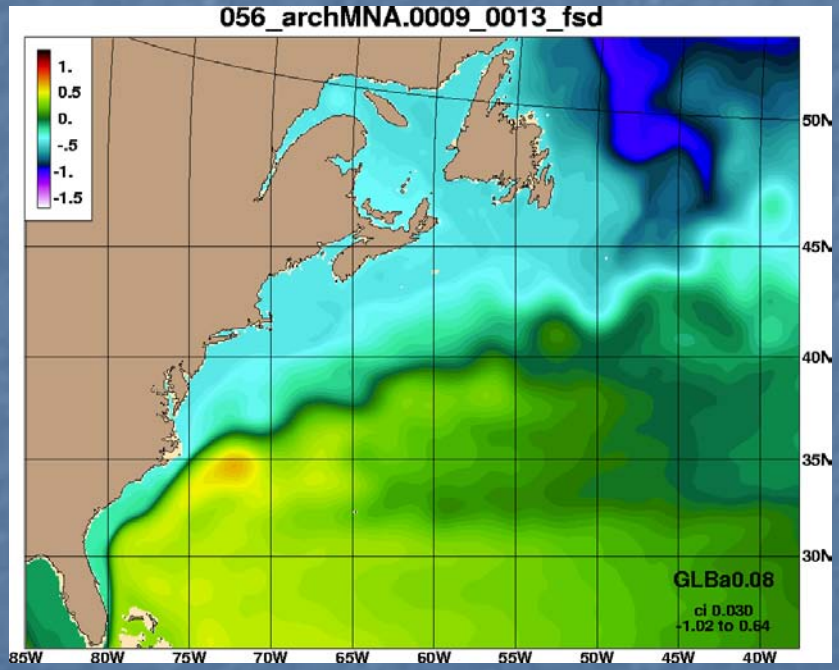

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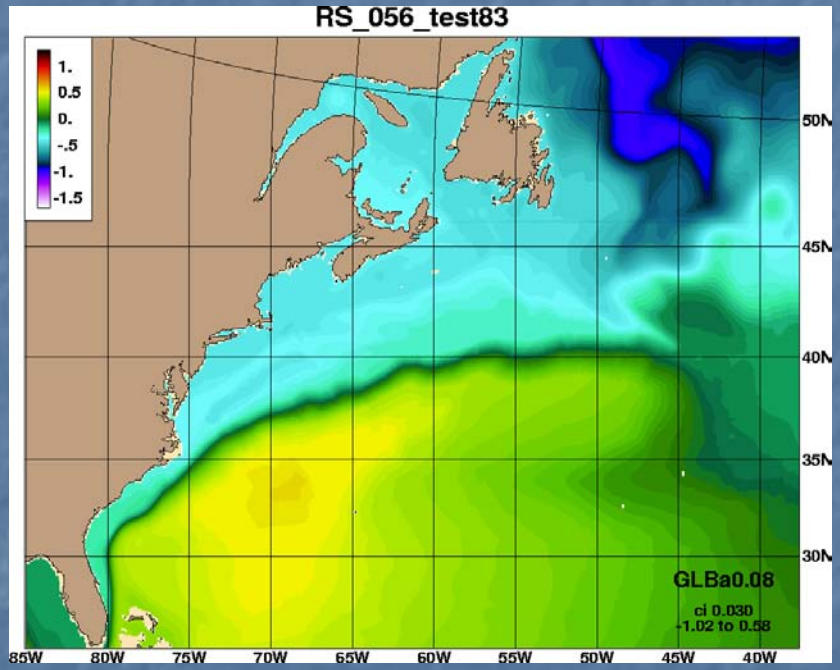

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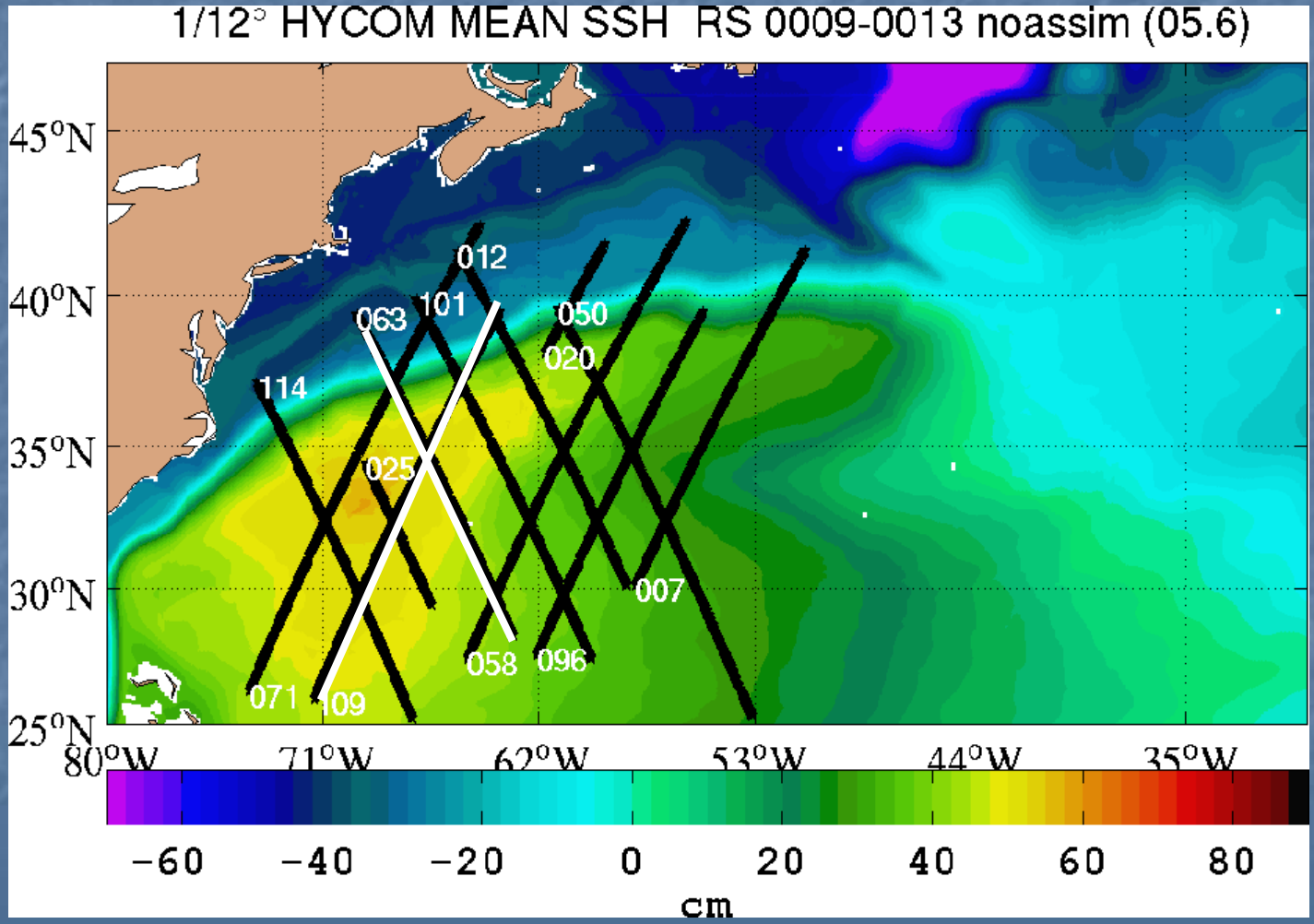
1/12º Global HYCOM

Mean SSH (05.6)

Rubber sheeted



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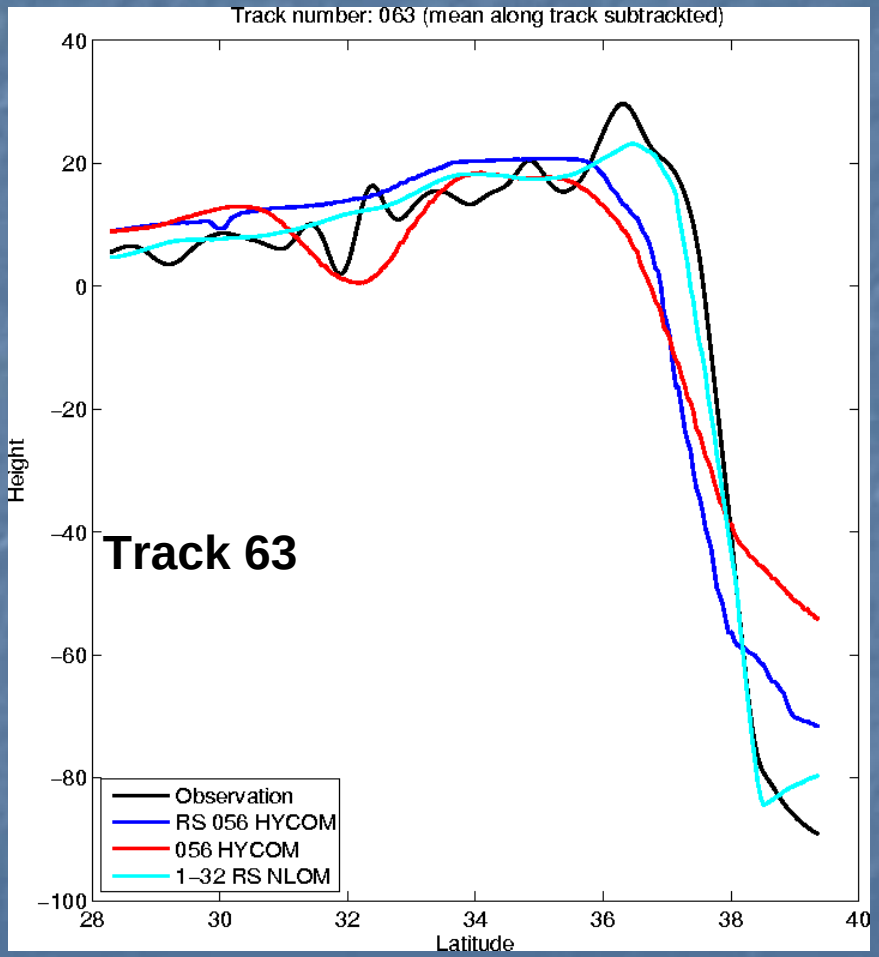
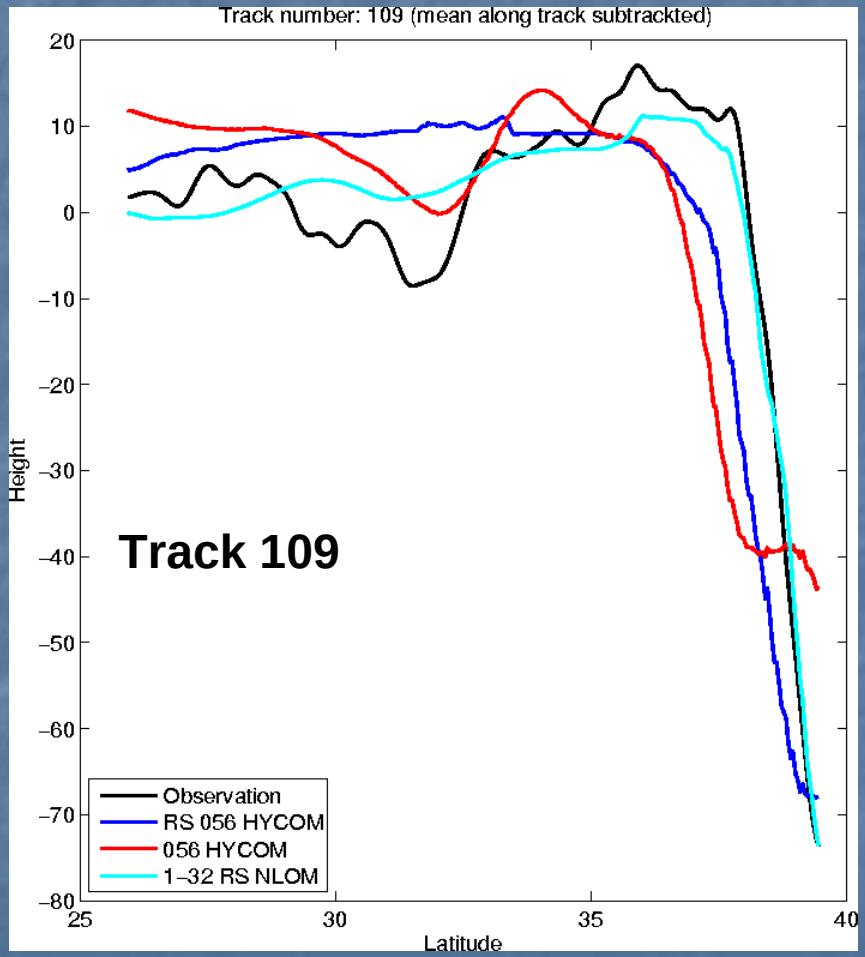
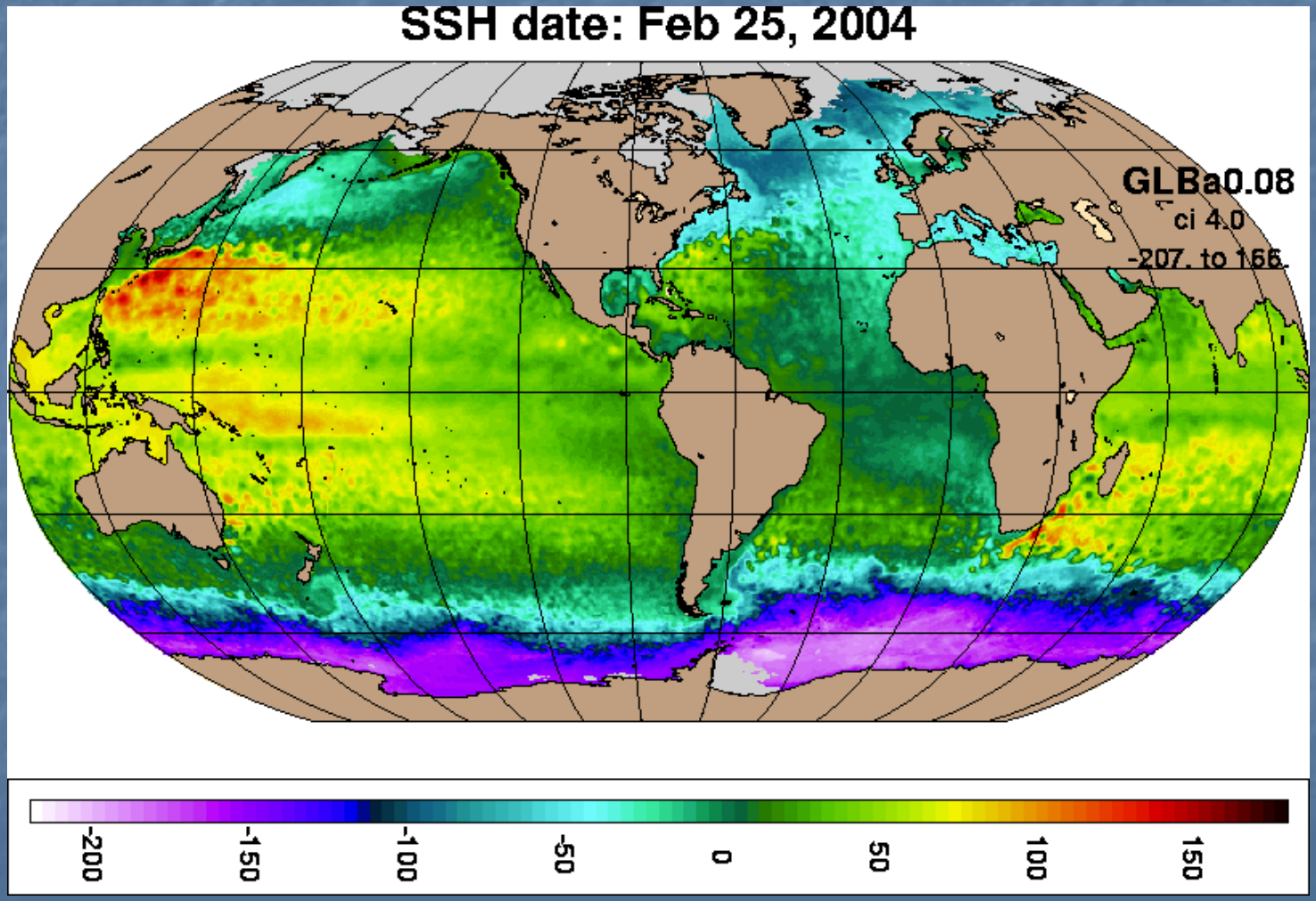
Comparison of mean SSH to mean dynamic topography from XBTs





1/12º Global HYCOM

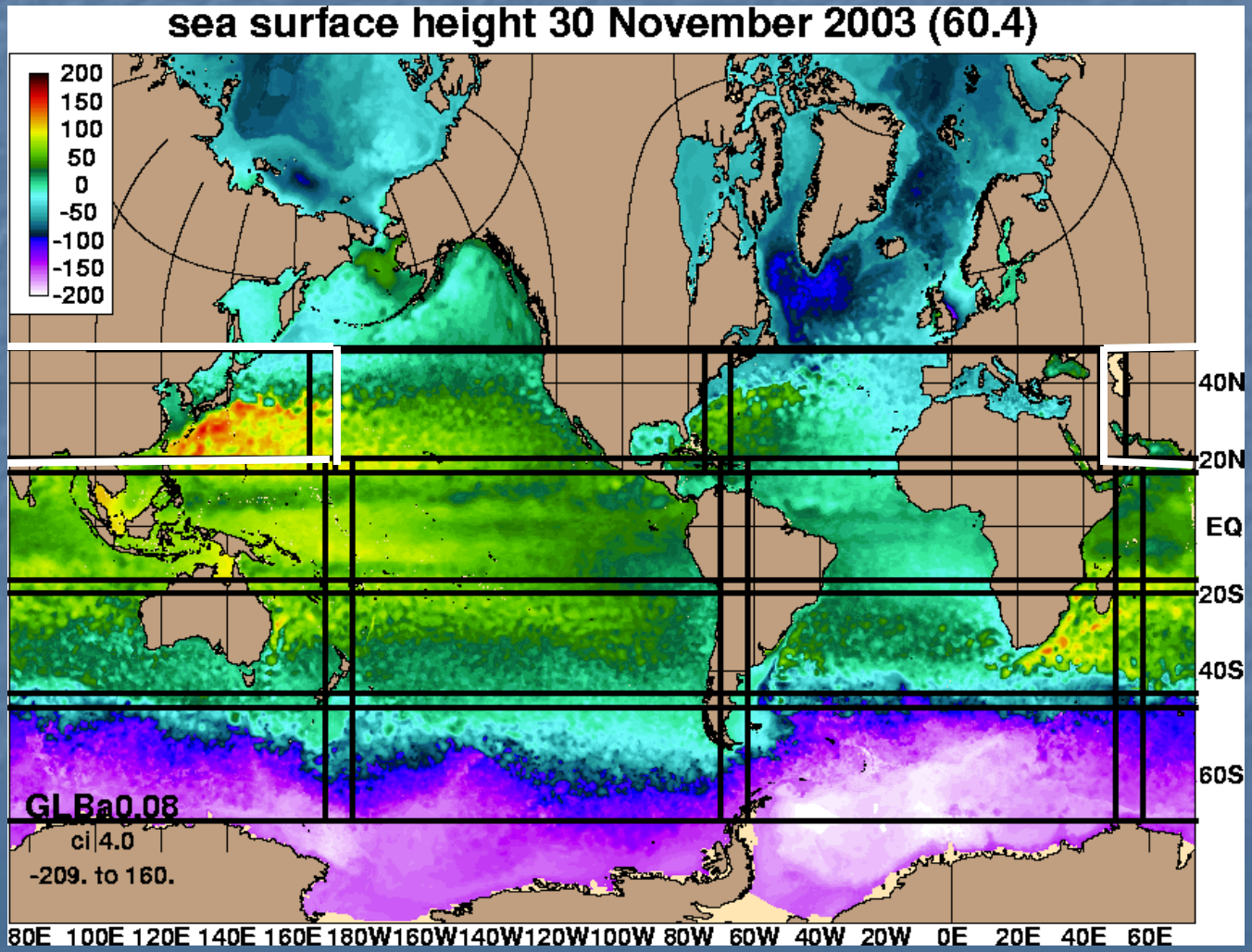
Hindcast started 12 November 2003



1/12º Global HYCOM

Hindcast started 12 November 2003

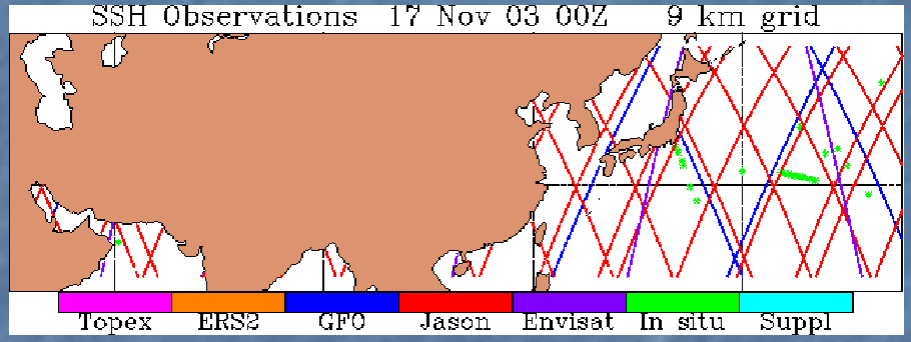
SSH 12 November 2003



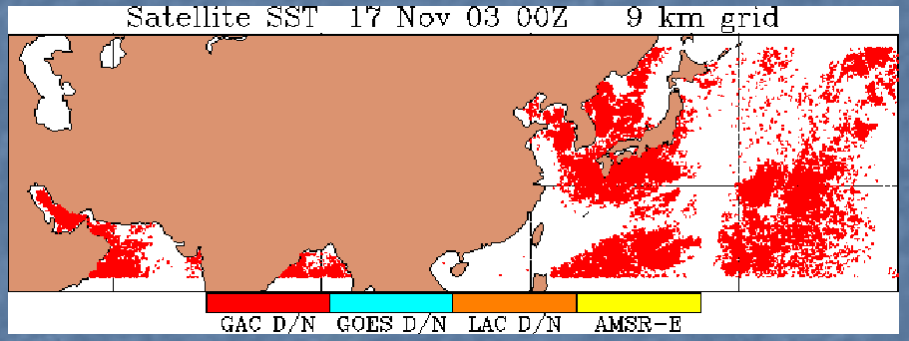
1/12º Global HYCOM

NCODA observations 17 November 2003

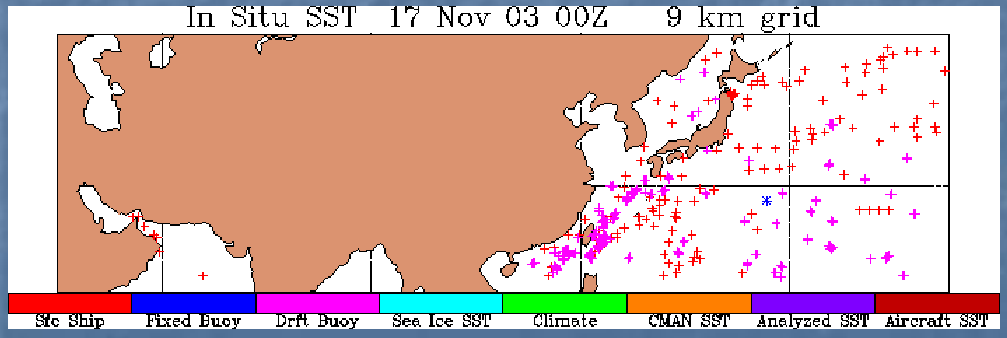
SSH



SST



In situ SST



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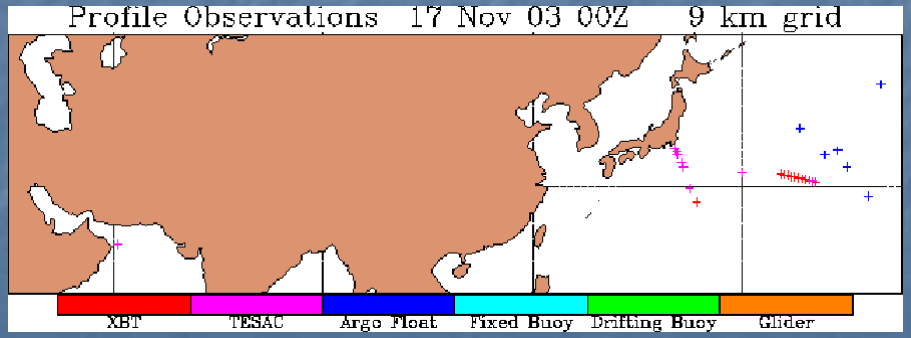
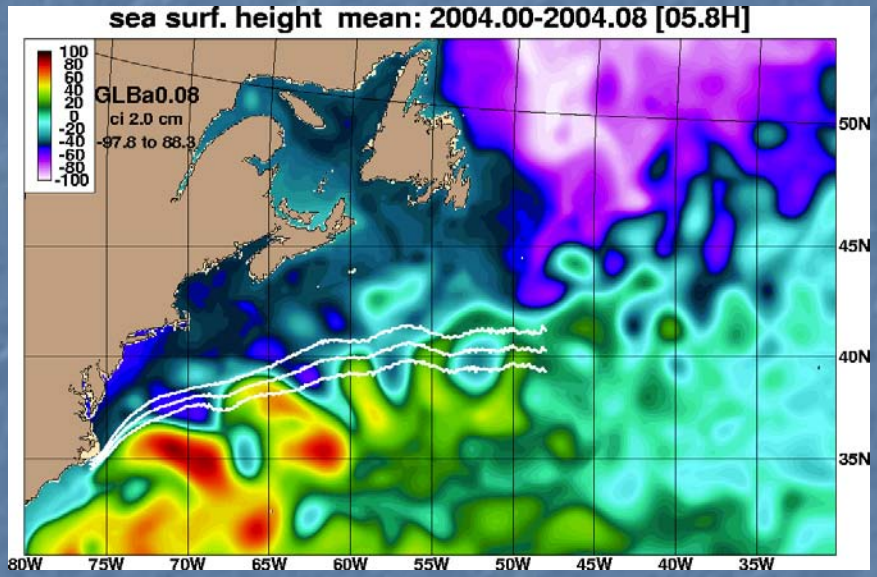


1/12º Global HYCOM

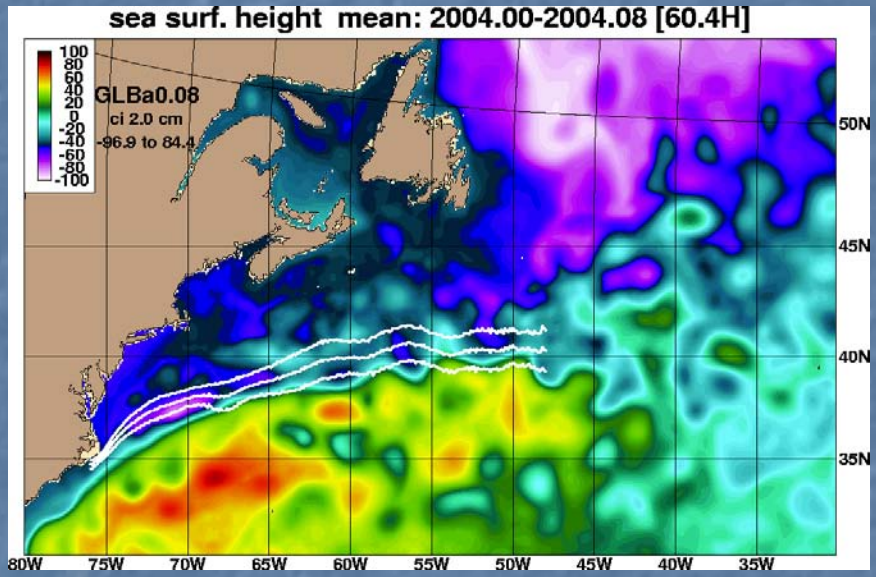
Hindcast started 12 November 2003

Mean SSH January 2004

No assimilation



Assimilation



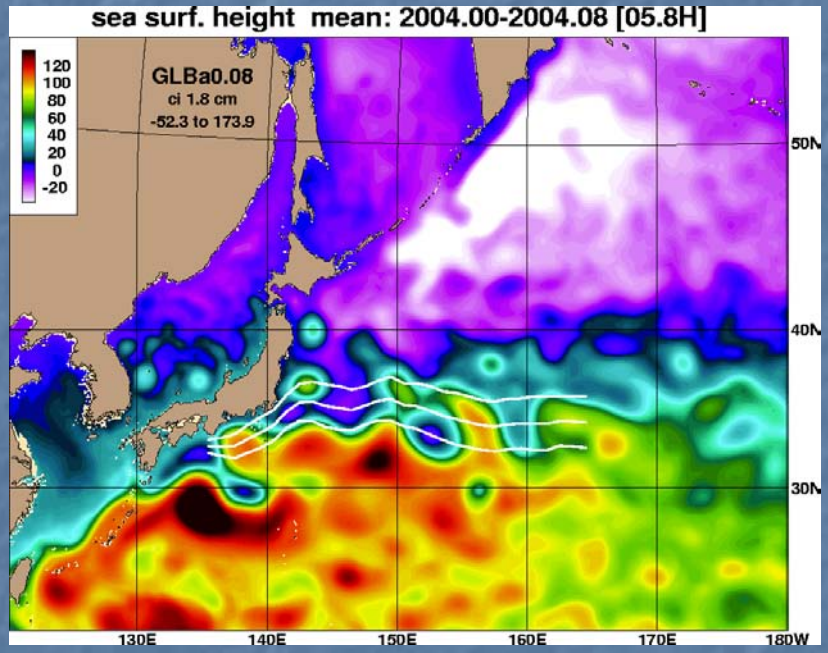
HYCOM mean SSH with the mean pathway of the Gulf Stream ±1 stdv

1/12º Global HYCOM

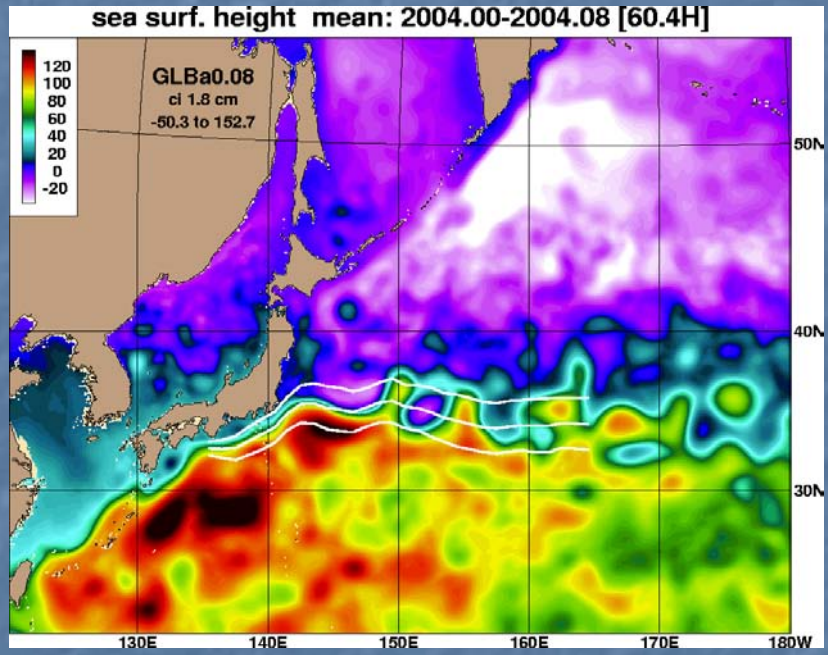
Hindcast started 12 November 2003

Mean SSH January 2004

No assimilation



Assimilation



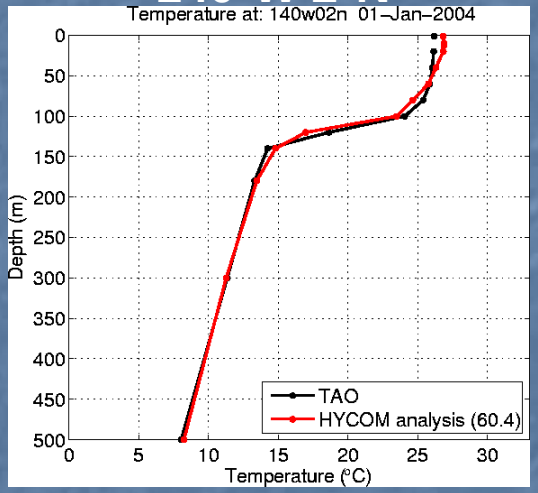
HYCOM mean SSH with the mean pathway of the Kuroshio ± 1 stdv

1/12º Global HYCOM

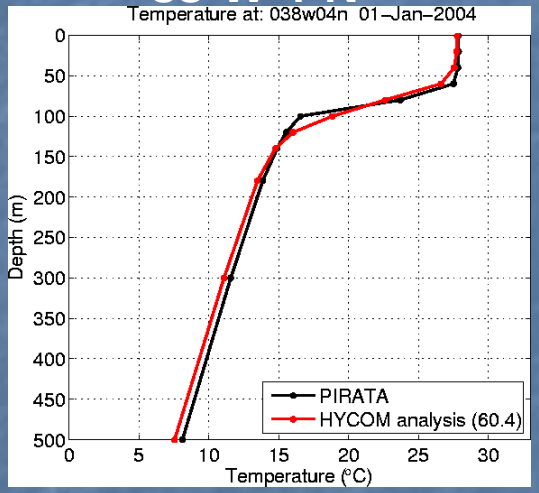
Hindcast started 12 November 2003

January 2004

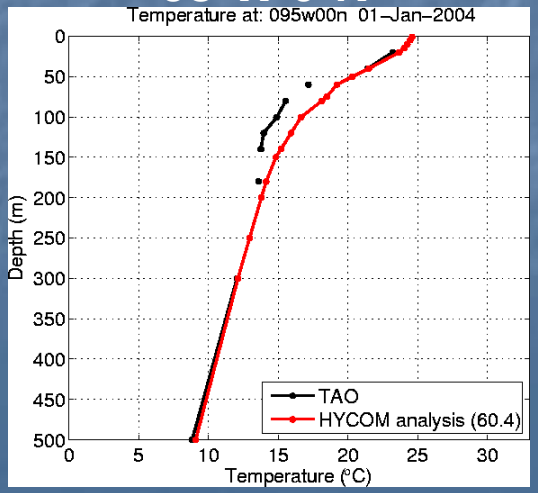
140ºW 2ºN



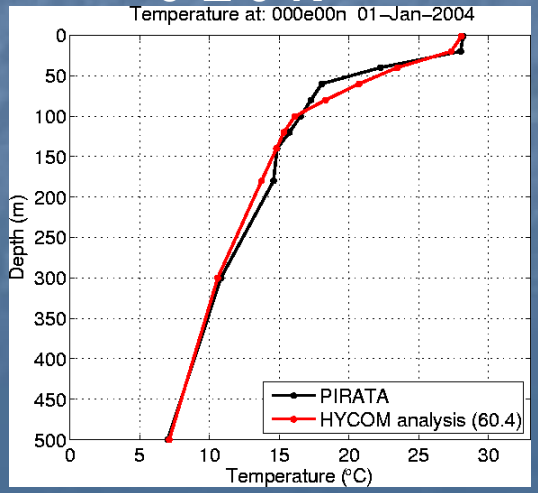
38ºW 4ºN



95ºW 0ºN



0ºE 0ºN

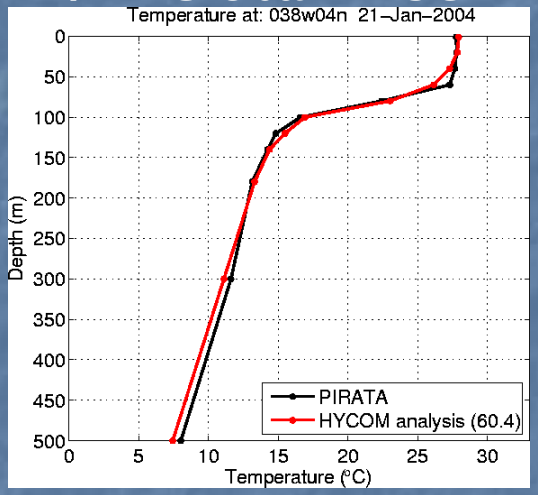
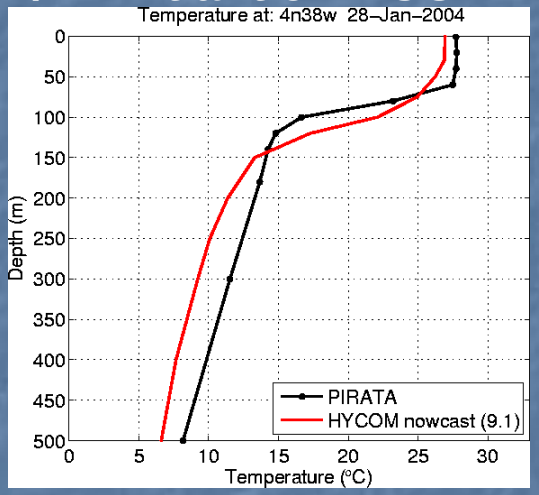
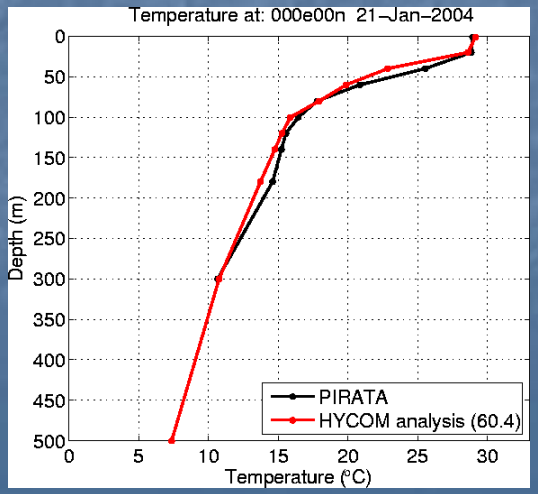
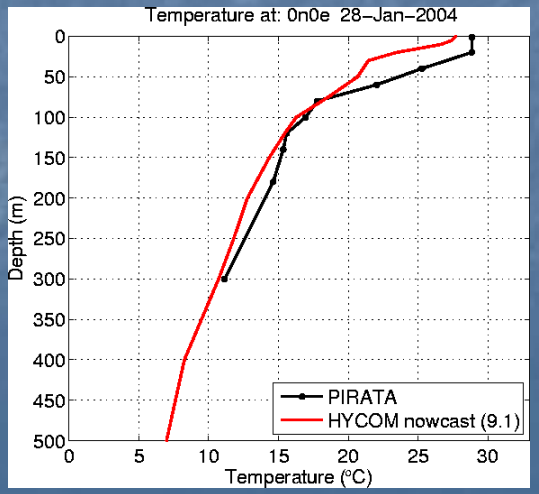


Future

- **Update rubber sheeted mean SSH (in the Gulf Stream region)**
- **Continue present run (to real time)**
- **Include rest of domain in assimilation**
- **Test assimilation of ice concentration in the Bering Sea**

1/12º Global/Atlantic HYCOM

February 2004

	1/12º Global HYCOM	1/12º Atlantic HYCOM
38ºW 4ºN		
0ºE 0ºN		

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