Real-time HYCOM nowcast/forecast systems

O. M. Smedstad
Planning Systems Inc.

J. A. Cummings, E. J. Metzger, P. J. Hogan, H. E. Hurlburt,
A. J. Wallcraft
Naval Research Laboratory

E. P. Chassignet
Florida State University

http://www.hycom.org

11th HYCOM Consortium Meeting
24-26 April 2007
Stennis Space Center

Present nowcast/forecast systems

1/12º Atlantic near real-time system

- Running once a week since July 2002
- Assimilation: gridded surface observations only
- 10 day hindcast, 14 day forecast

1/12º Global real time system

- Running since December 2006
- Assimilation: NCODA
- 5 day hindcast, 5 day forecast

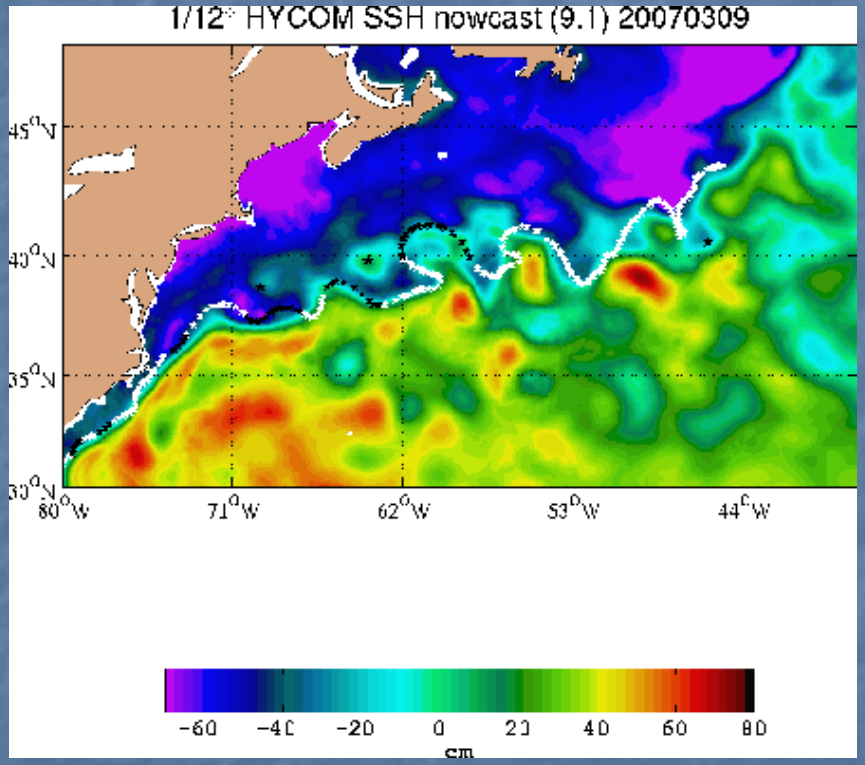
1/25º Gulf of Mexico real time system

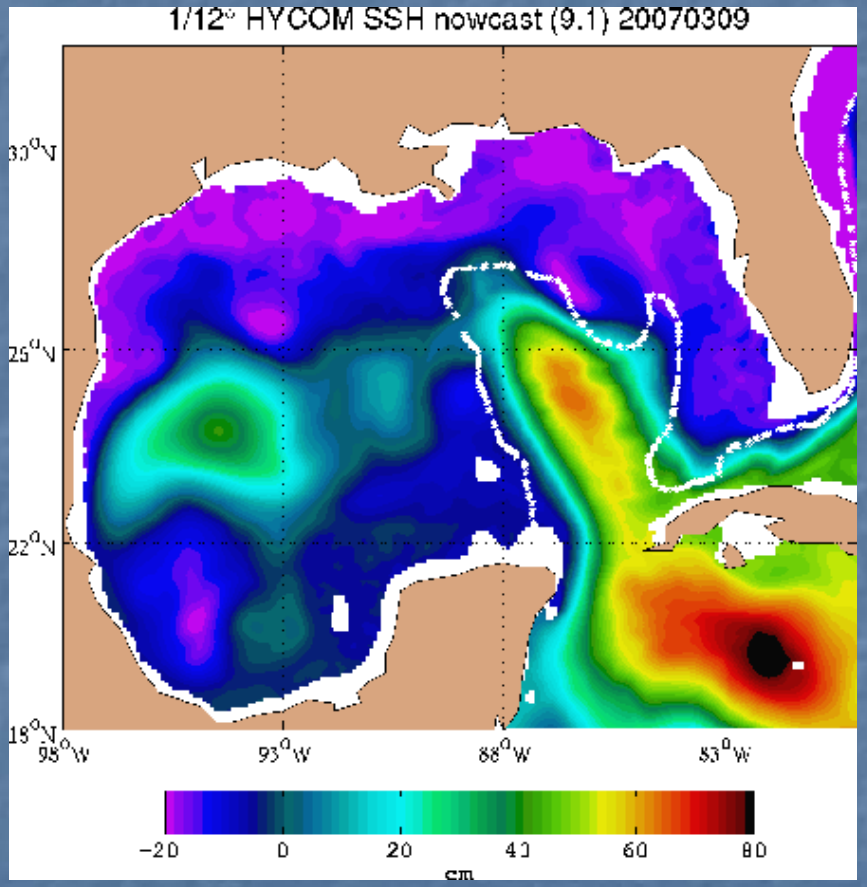
- Running since November 2006
- Assimilation: NCODA
- 5 day hindcast, 7 day forecast

1/12° Atlantic HYCOM

SSH in Gulf Stream and Gulf of Mexico region

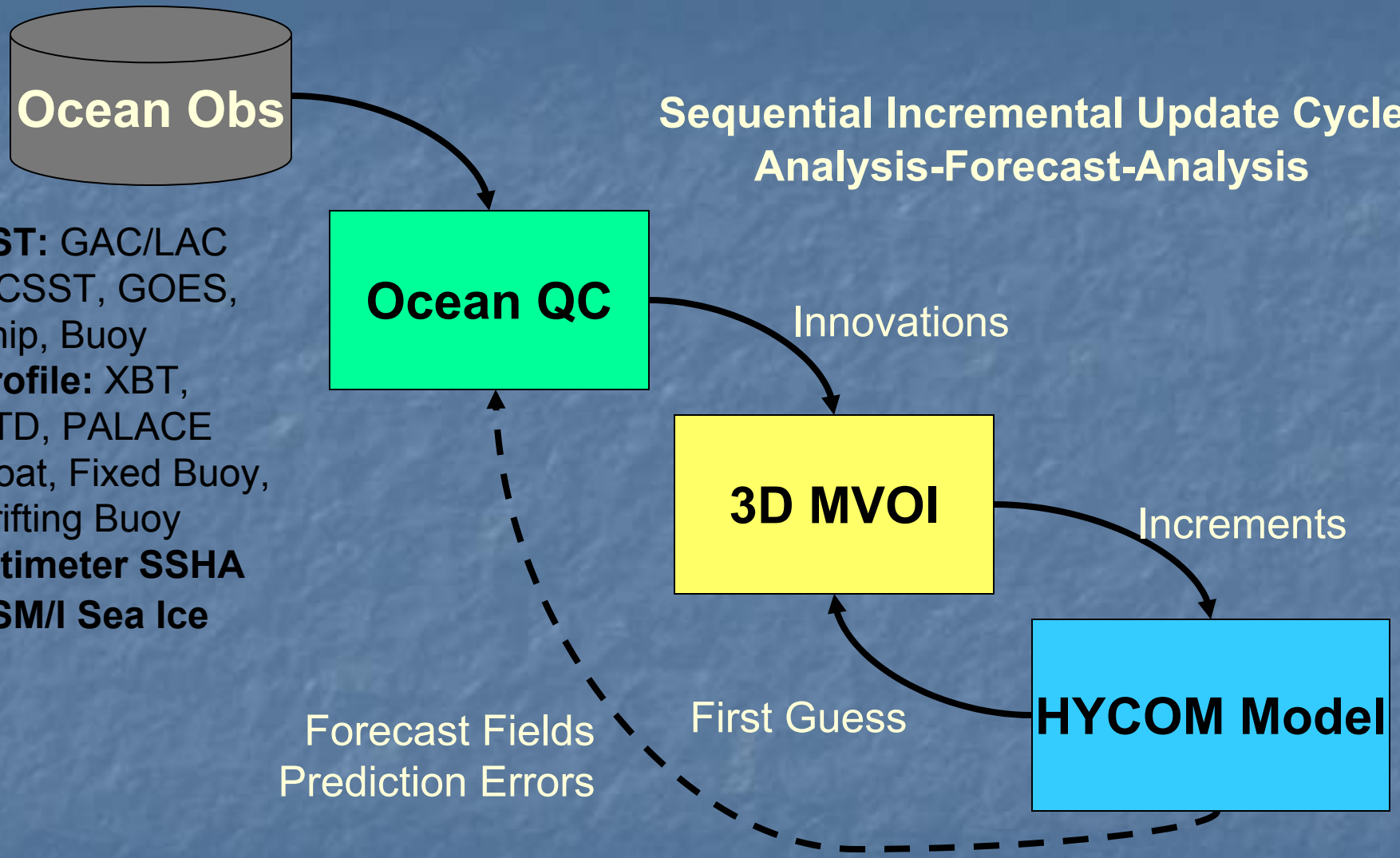
9 March 2007





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

Navy Coupled Ocean Data Assimilation (NCODA)



MVOI - simultaneous analysis 5 ocean variables temperature, salinity, geopotential, layer pressure, 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.
- Run with a daily NCODA analysis

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*
- KPP 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

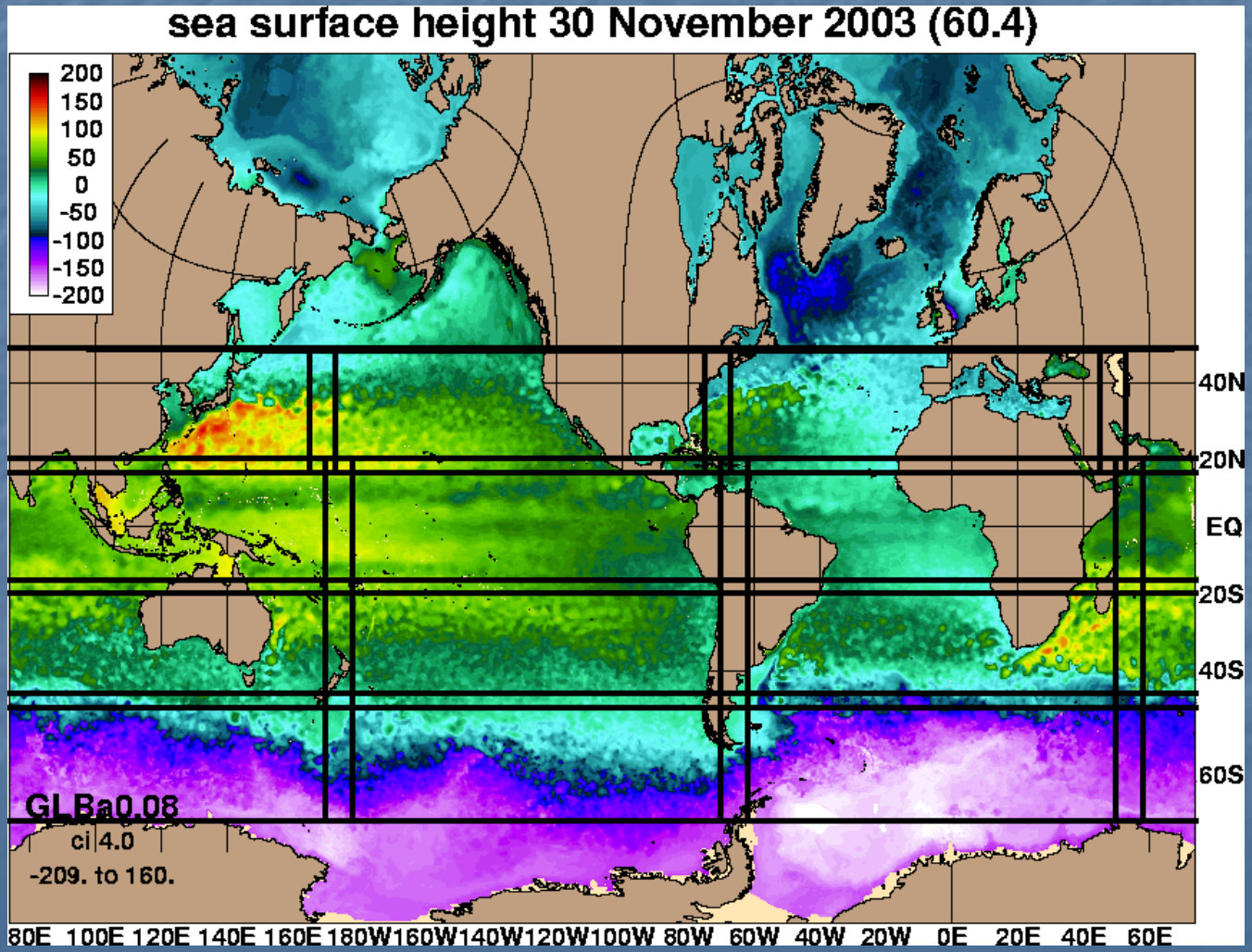
1/12º Global HYCOM

- Two hindcast experiments initialized in November 2003
- Both experiments cover 2004, continuing last experiment through 2005(2006)
- 30 day forecasts once a month from hindcast run
  - With analyzed quality atmospheric forcing
  - With forcing reverting to climatology after 5 days
- Real time experiment started 25 December 2006
  - Running 5 day hindcast and 3 day forecast since mid February

1/12º Global HYCOM

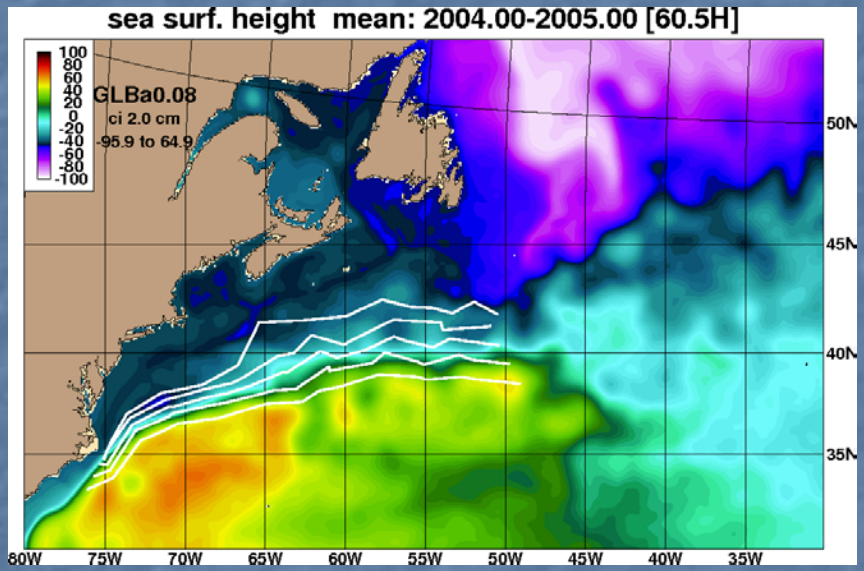
Hindcast started 2 November 2003

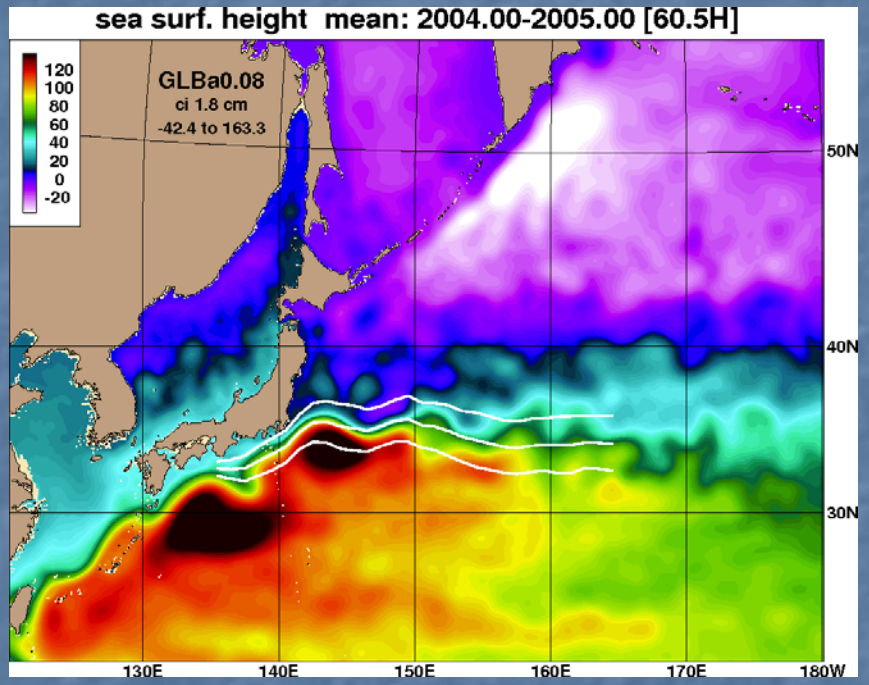
SSH 12 November 2003



1/12º Global HYCOM

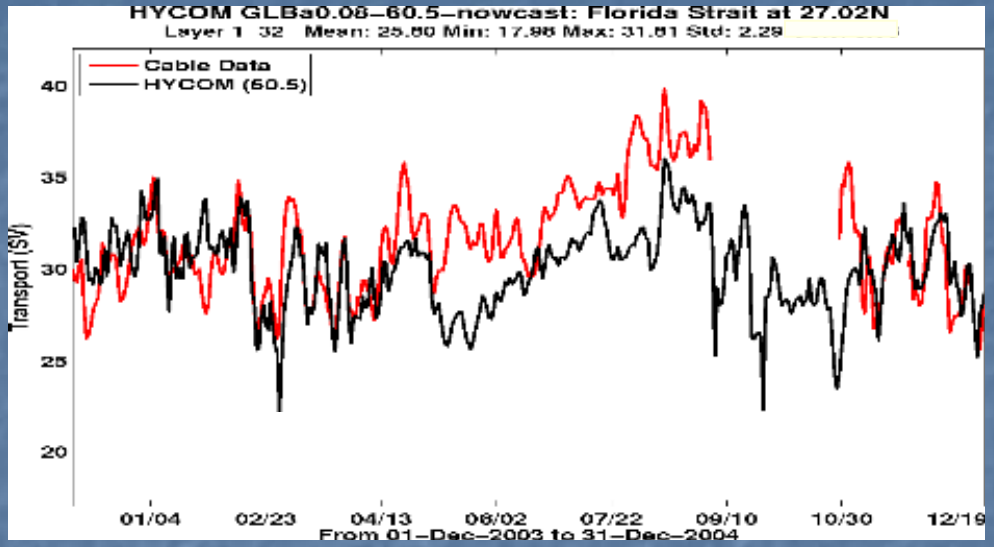
2004 Mean SSH





White lines are the mean position and +- 1 stdv

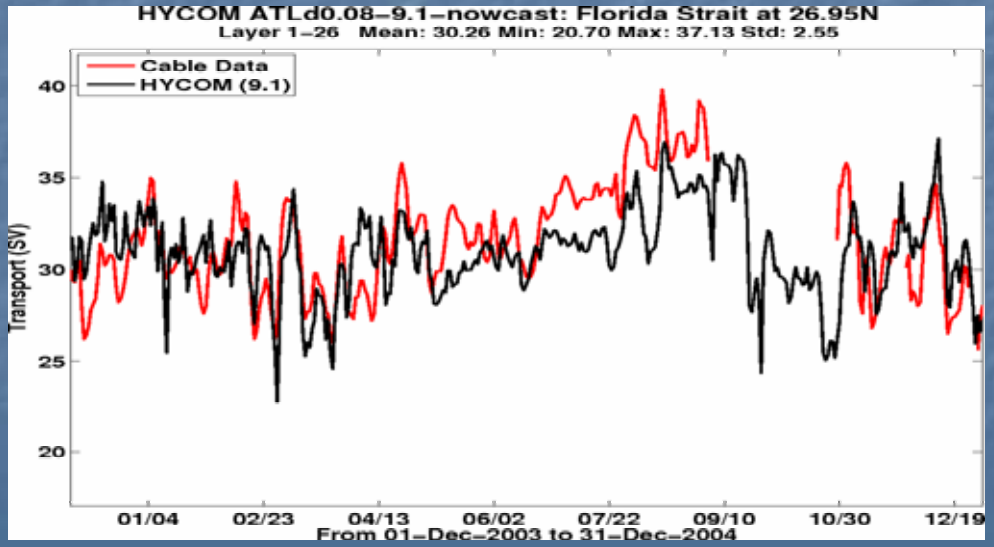
Florida Current transport at 27°N



1/12º Global HYCOM

Offset by 4.2Sv

1 December 2003
to
31 December 2004

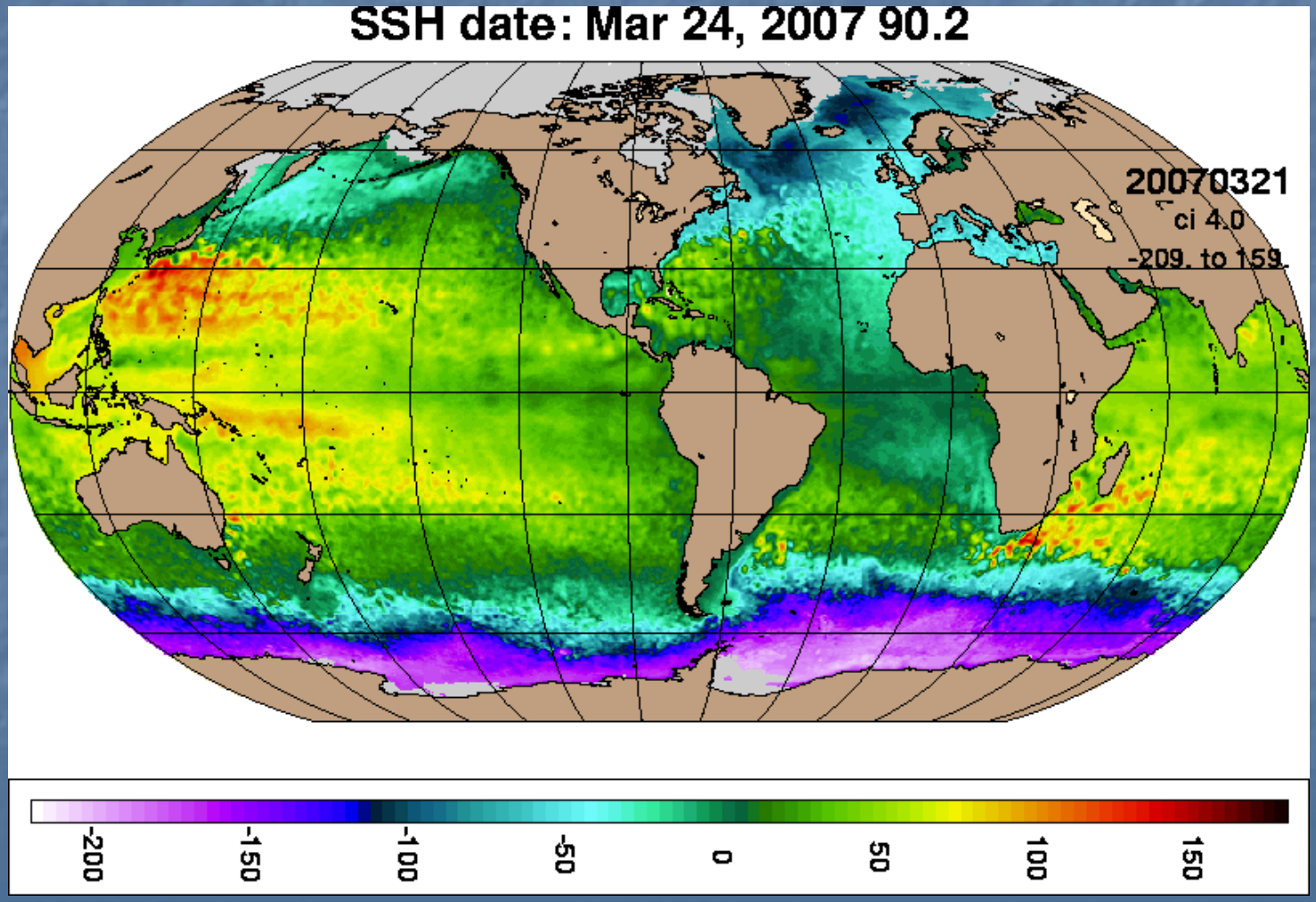


1/12º Atlantic HYCOM

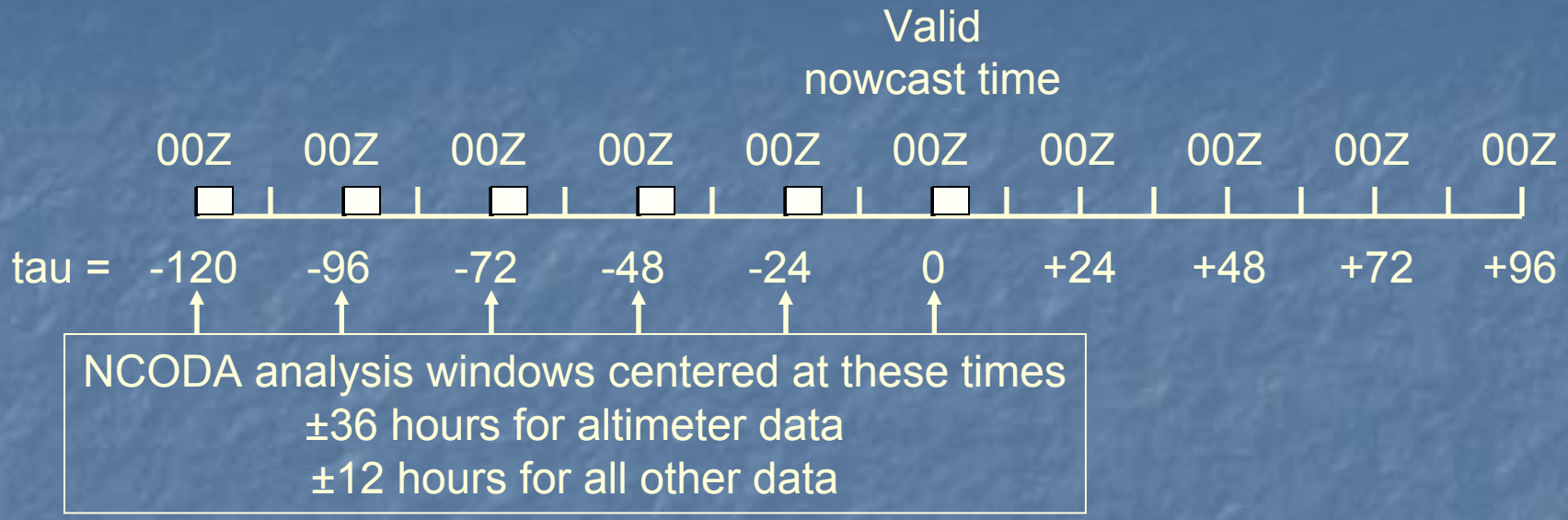
Cable data: http://www.aoml.noaa.gov/phod/floridacurrent/

1/12º Global HYCOM

Real time run started 25 December 2006



HYCOM/NCODA Runstream



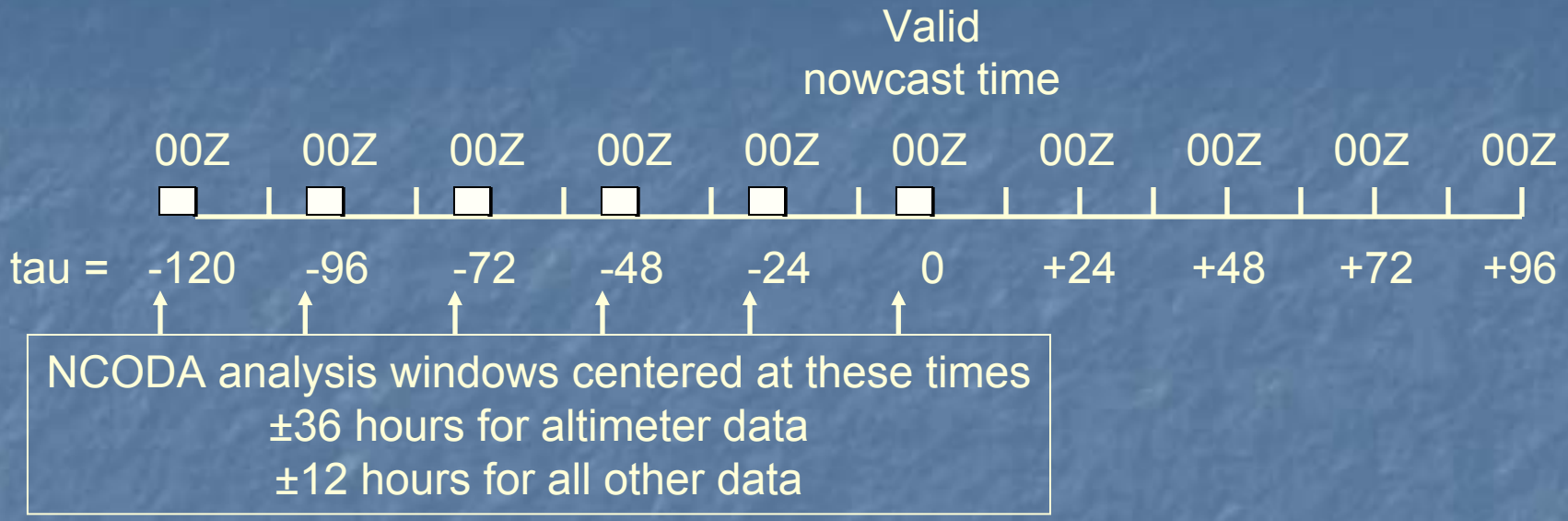
1) Perform first NCODA analysis centered on tau = -120
2) Run HYCOM for 24 hours using incremental updating (▭) over the first 6 hrs
3) Repeat steps 1) and 2) until the nowcast time
4) Run HYCOM in forecast mode out to tau = 96, eventually to tau = 120

Approximate run times* (using 379 IBM Power 5+ processors):

1) Six NCODA analyses: 0.9 hrs/analysis = 5.4 hrs
2) Five HYCOM hindcast days @ 150 sec Δt: 1.1 hrs/day = 5.5 hrs
3) Four HYCOM forecast days @ 150 sec Δt: 1.1 hrs/day = 4.4 hrs
4) Total: 15.3 hrs

* Timings do not include PIPS coupling; assimilation in the Mercator part of grid only

HYCOM/NCODA Runstream



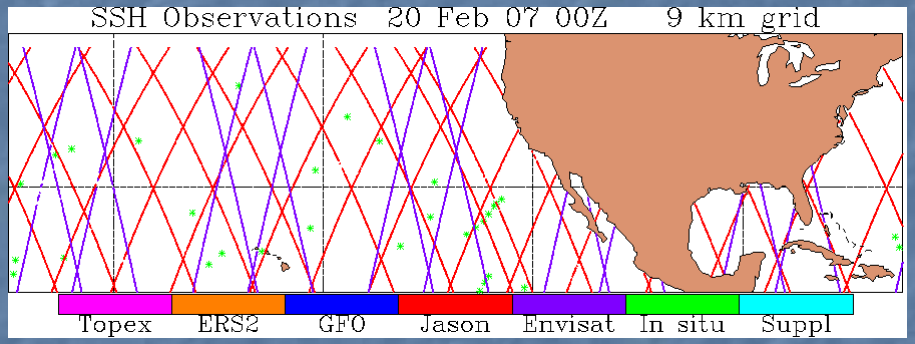
1) Perform first NCODA analysis centered on tau = -126, i.e. 18Z
2) Run HYCOM for 24 hours using incremental updating (▭) over the first 6 hrs starting at 18Z
3) Repeat steps 1) and 2) until the nowcast time
4) Run HYCOM in forecast mode out to tau = 96, eventually to tau = 120

Under this scheme the incremental updating ends at the nowcast time (00Z) whereas in the previous scheme incremental updating ended at 06Z and the 00Z nowcast actually represents an 18-hour forecast from the previous day. Most results shown in this presentation are from 18-hour forecasts.

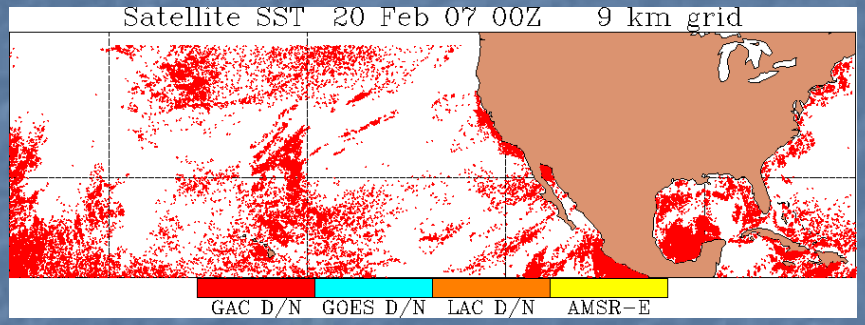
1/12º Global HYCOM

NCODA observations 20 February to 21 March 2007

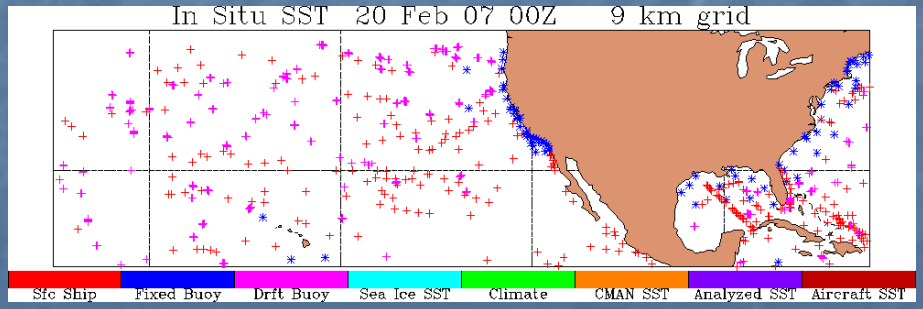
SSH



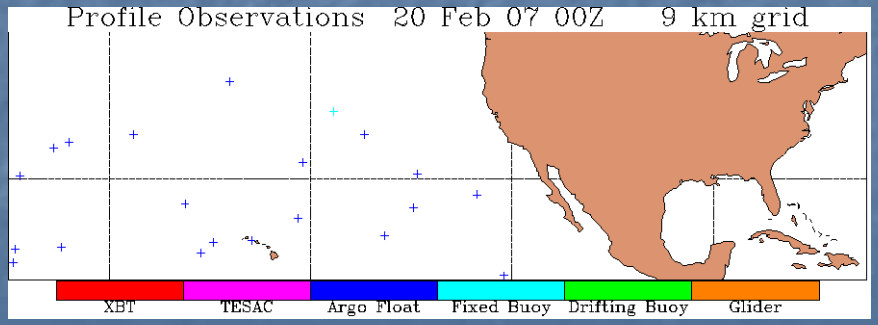
SST



In situ SST



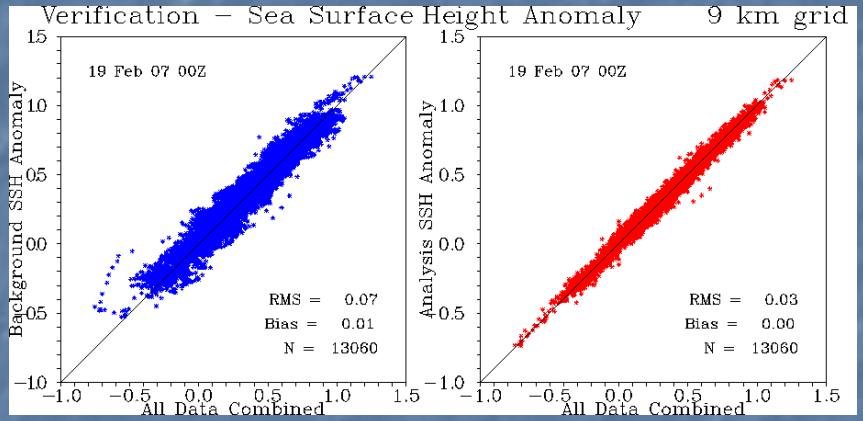
Profiles



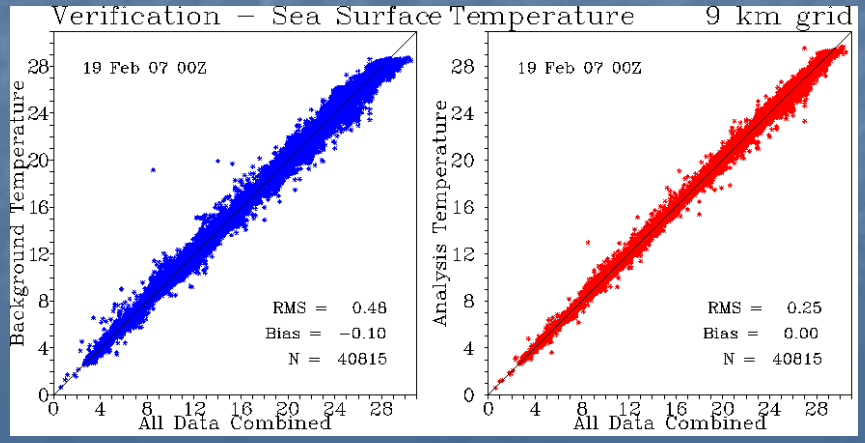
1/12º Global HYCOM

SSH and SST verification 20 February to 20 March 2007

SSH verification

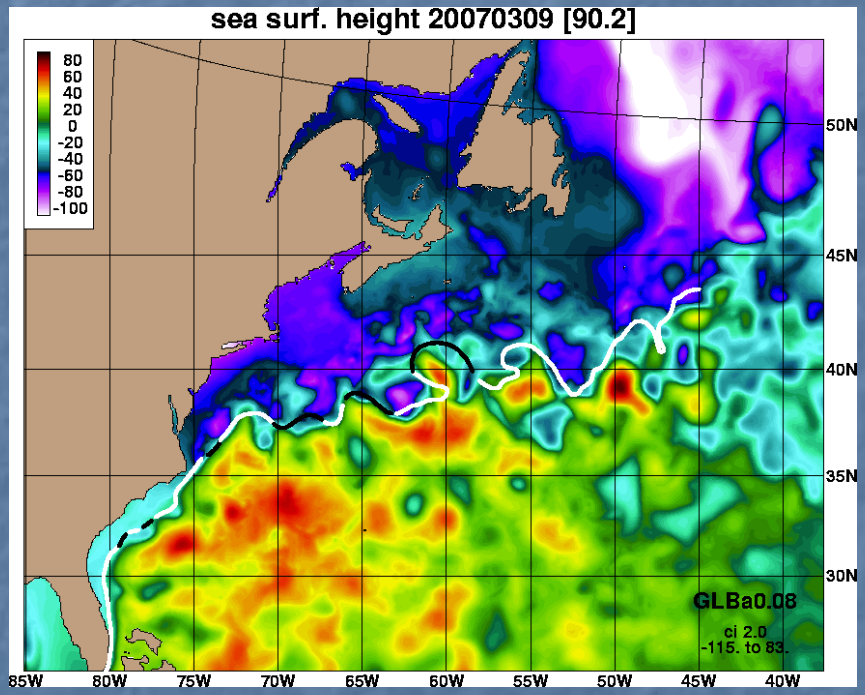


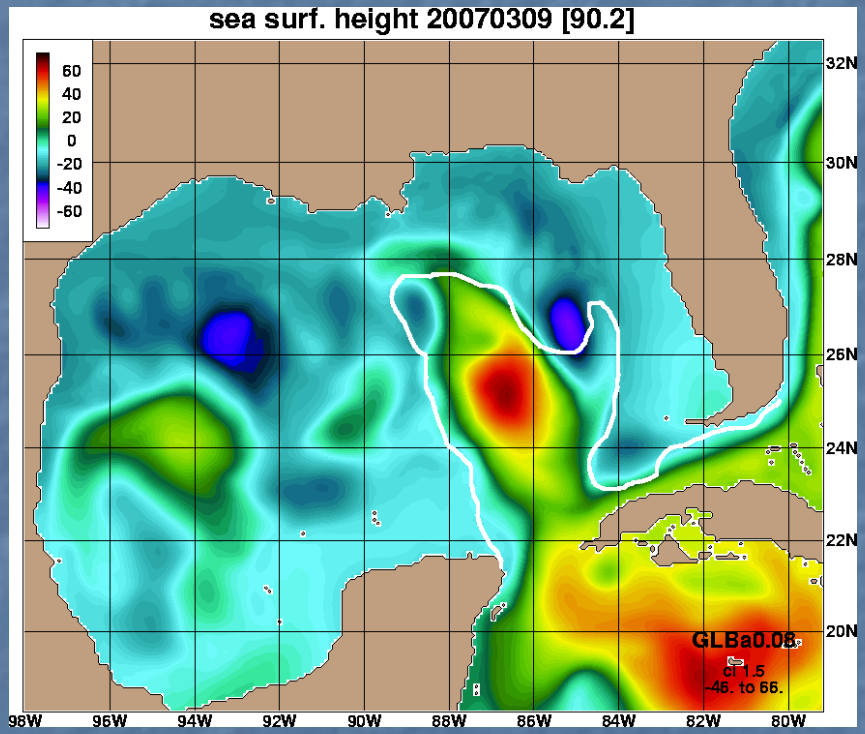
SST verification



1/12º Global HYCOM

9 March 2007





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

1/25º Gulf of Mexico HYCOM CONFIGURATION

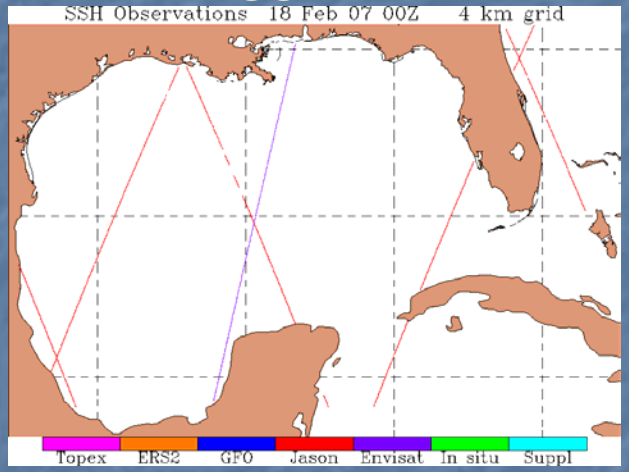
- Horizontal grid: 1/25° (517 x 349 grid points, 4 km spacing on average)
- 18°N to 31°N
- 20 vertical coordinates
- Bathymetry: real coastline (minimum depth 2m)
- Surface forcing from FNMOC/NOGAPS
- Monthly river runoff
- Nested Boundary:

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

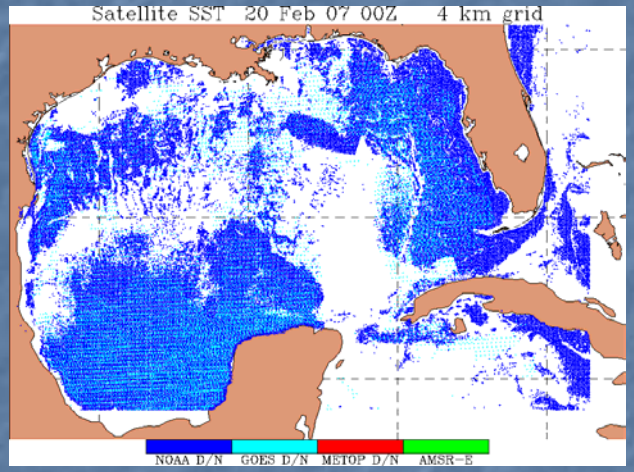
1/25º Gulf of Mexico HYCOM

NCODA observations 20 February to 21 March 2007

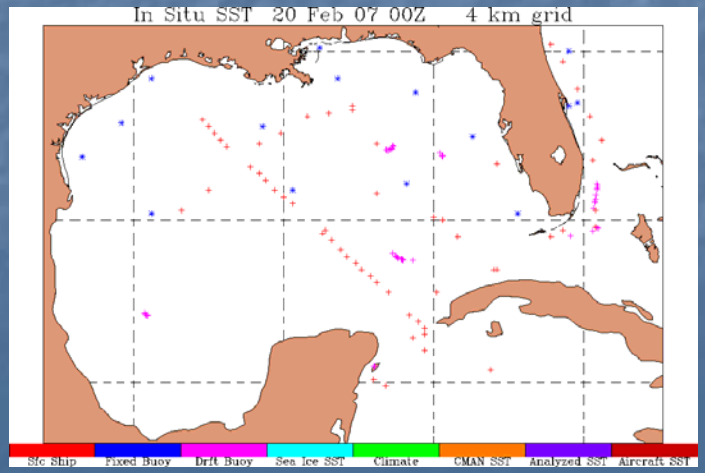
SSH



SST



In situ SST



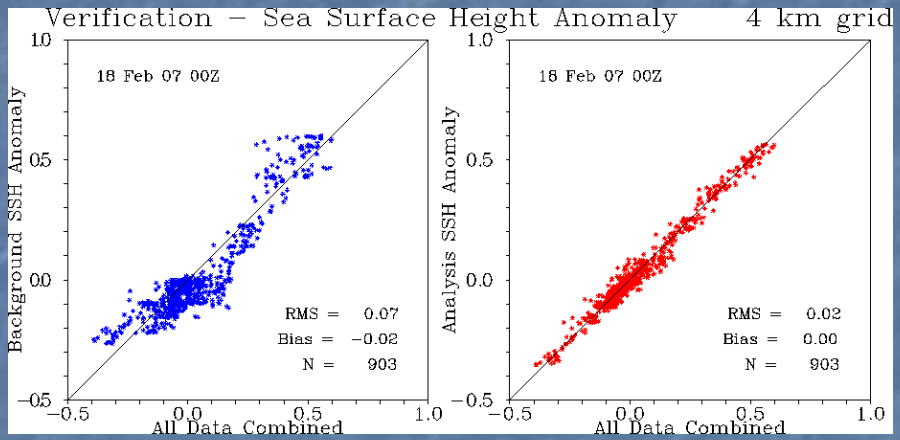
Profiles

Profiles not available

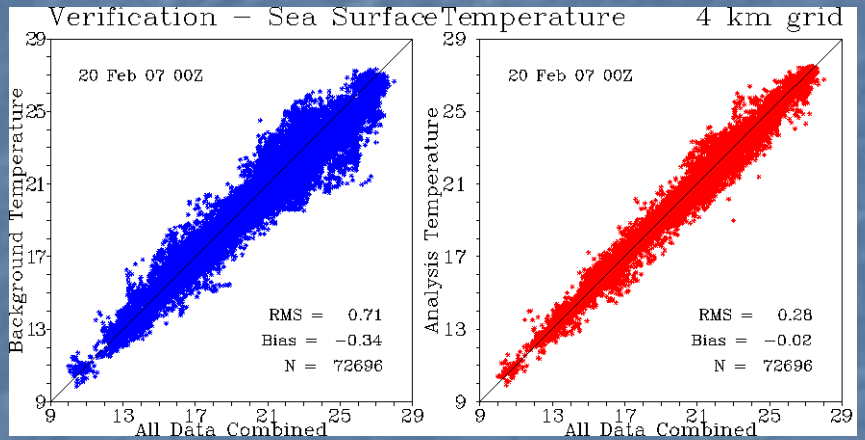
1/25º Gulf of Mexico HYCOM

NCODA observations 20 February to 21 March 2007

SSH verification

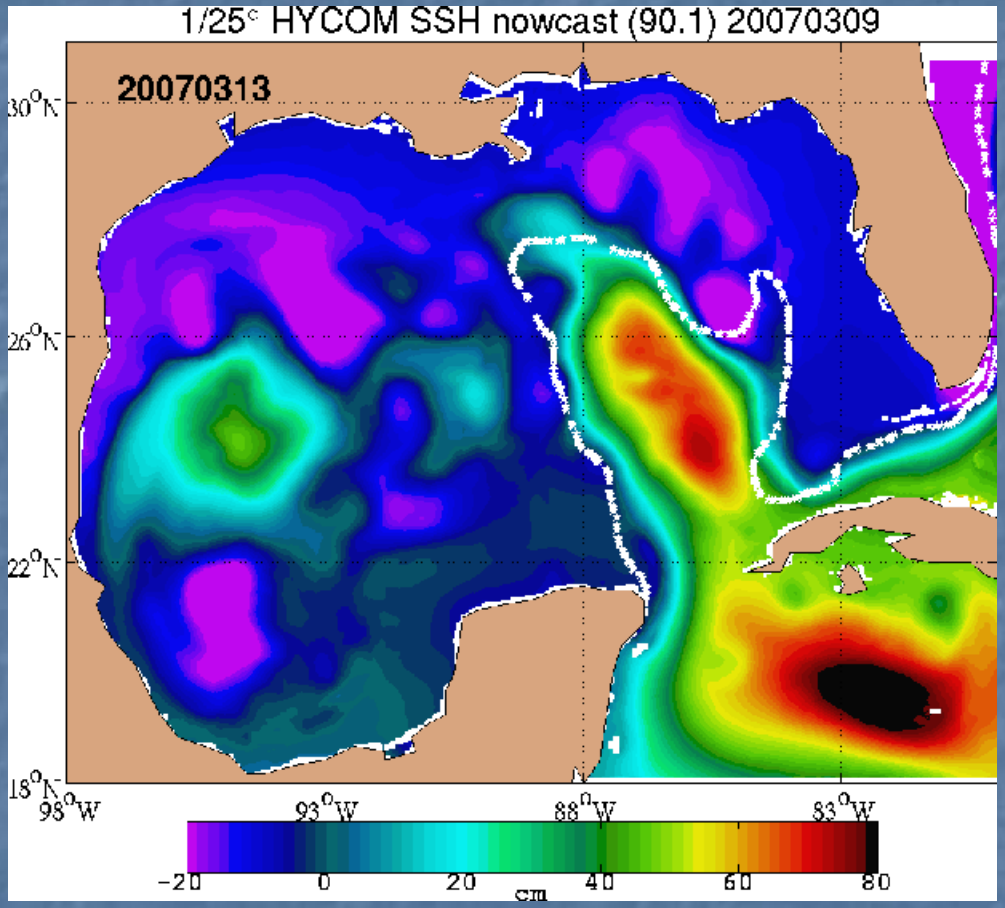


SST verification



1/25º Gulf of Mexico HYCOM

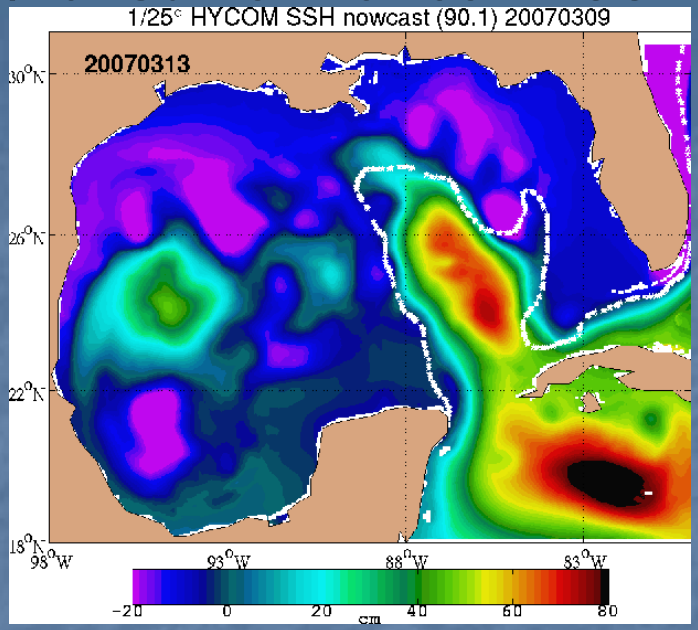
9 March 2007



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

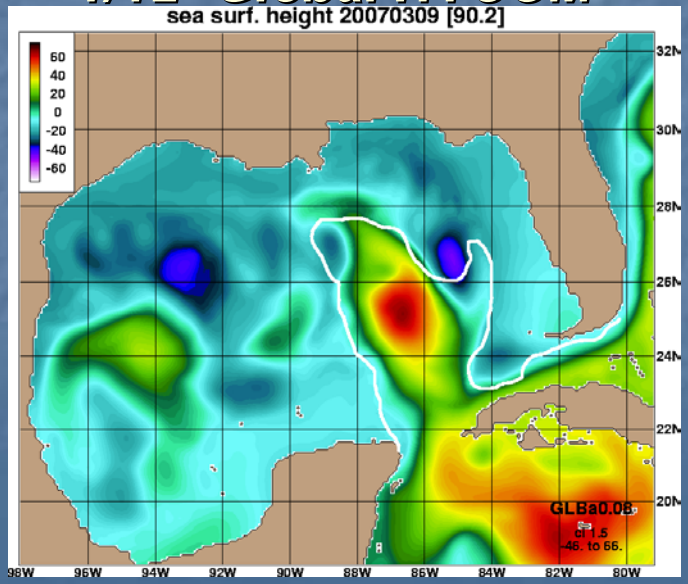
9 March 2007

1/25º Gulf of Mexico HYCOM

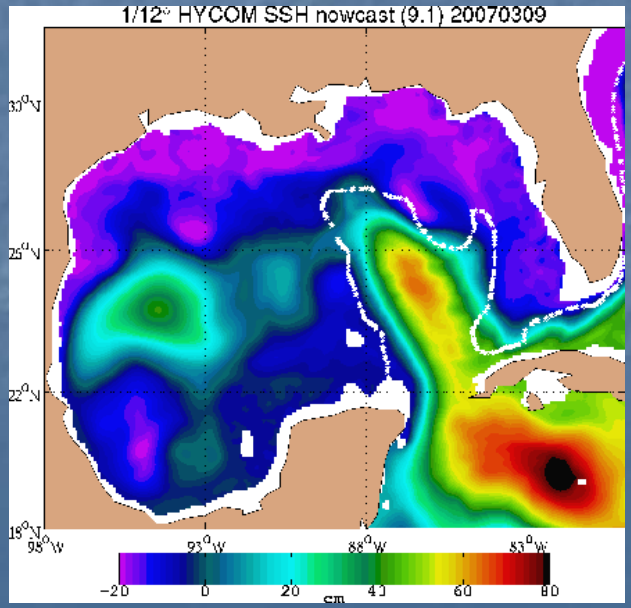


White/black line is the frontal analysis of MCSST observations performed at NAVOCEANO. Black line represents data more than four days old.

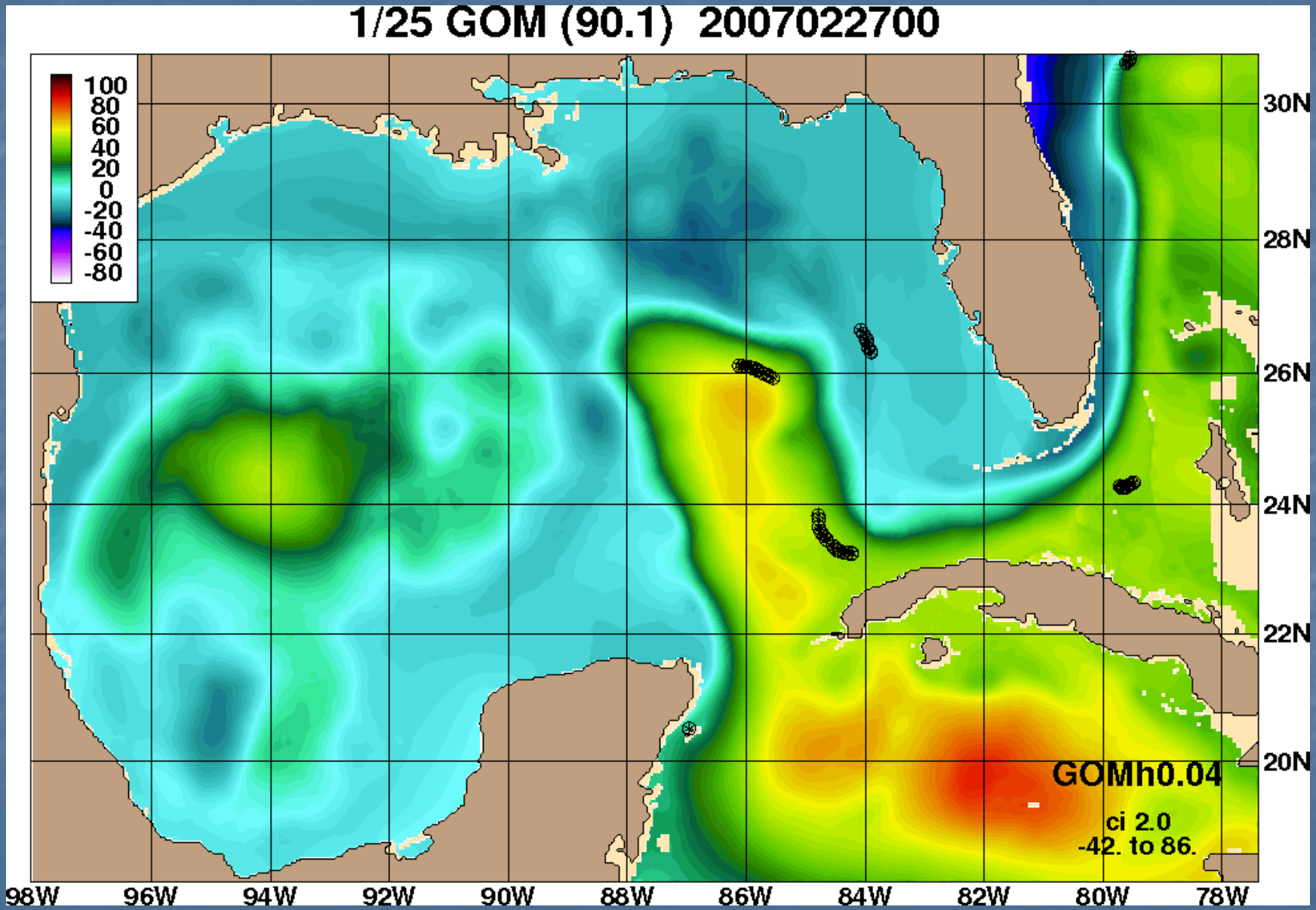
1/12º Global HYCOM



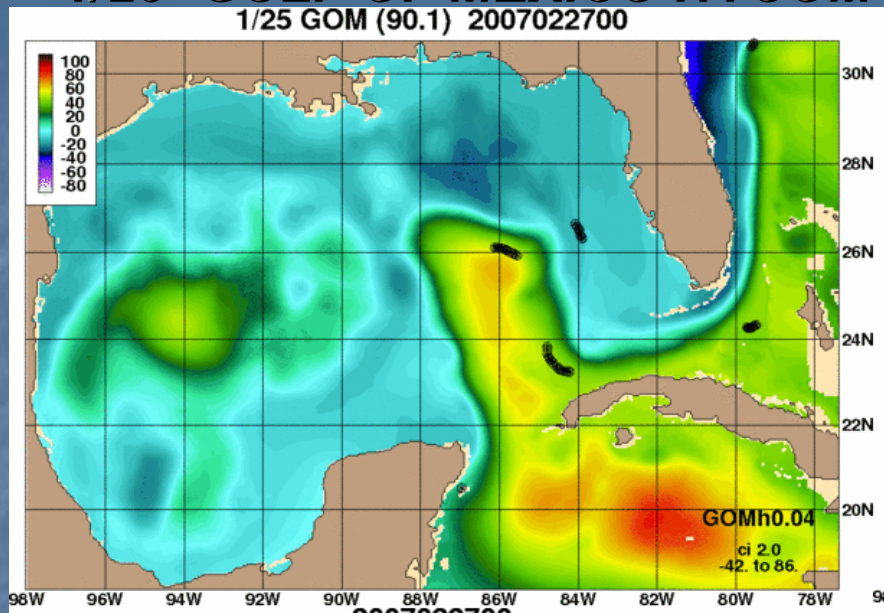
1/12º Atlantic HYCOM



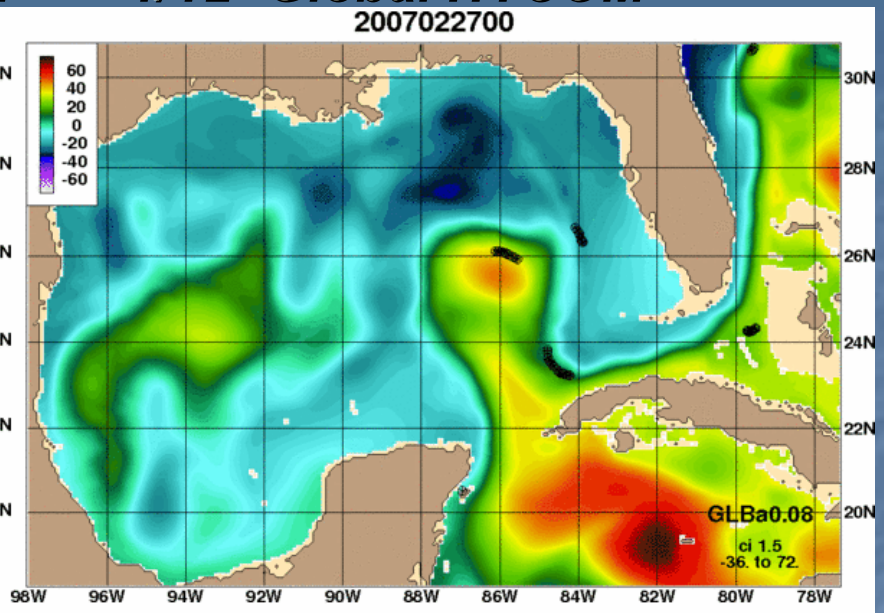
1/25º GULF OF MEXICO HYCOM

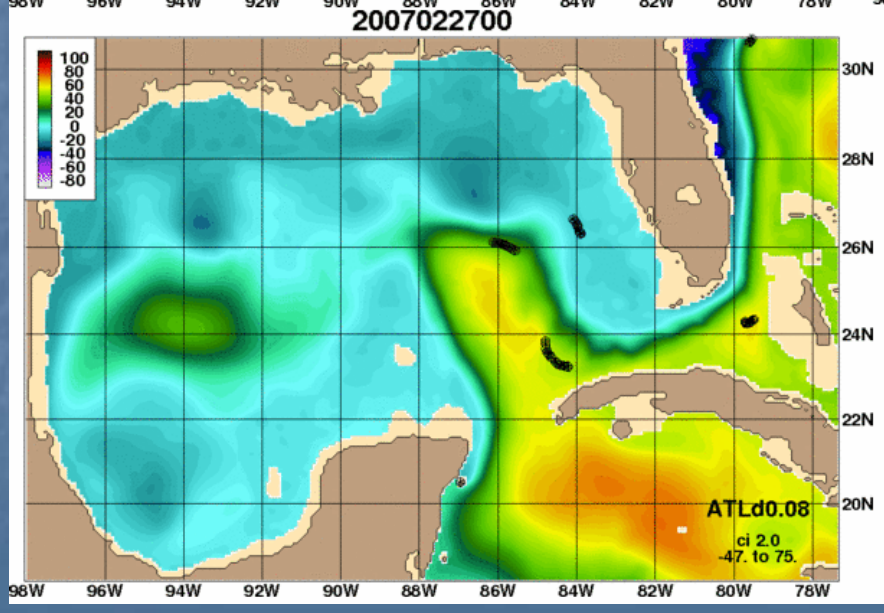


1/25º GULF OF MEXICO HYCOM



1/12º Global HYCOM

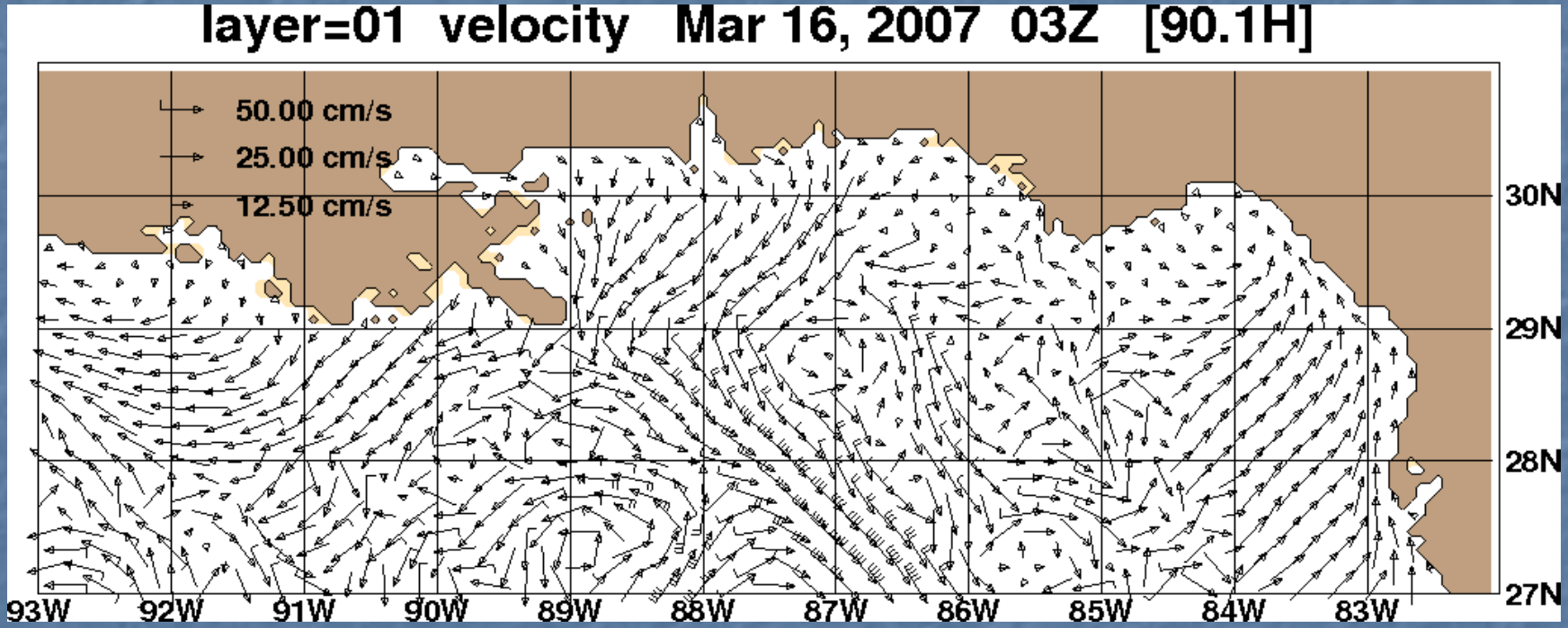




1/12º Atlantic HYCOM

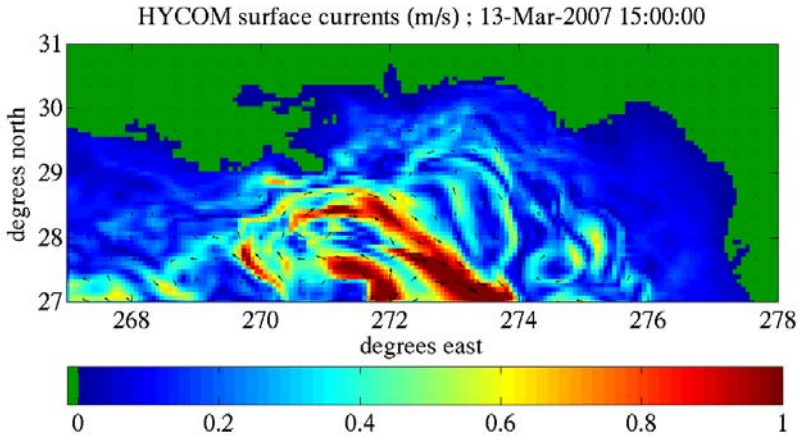
1/25º Gulf of Mexico HYCOM

Currents in Northern Gulf of Mexico



Coupling with SWAN

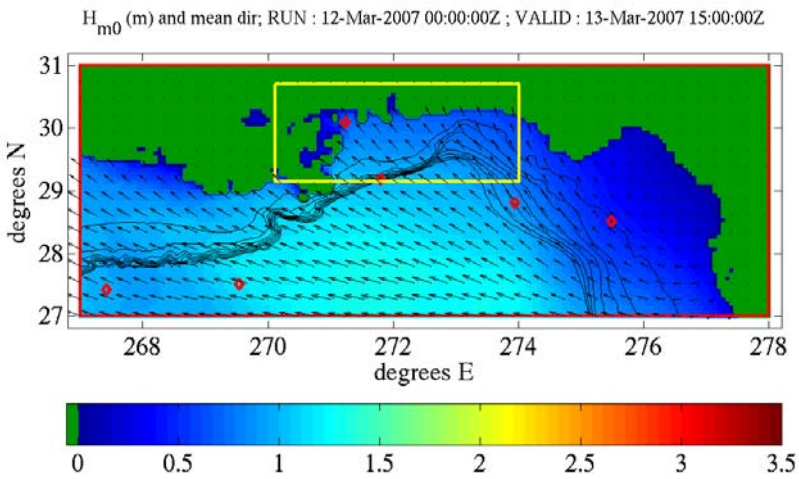
1/25º GOM HYCOM currents



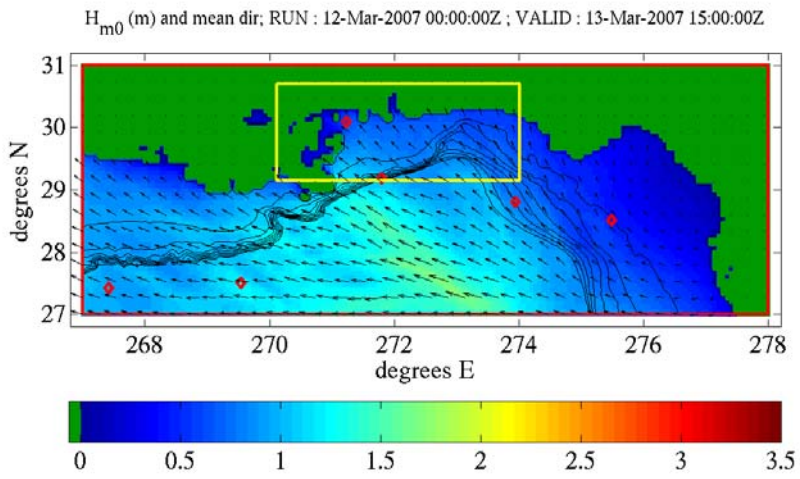
13 March 15:00Z

From Erick Rogers

Wave prediction without accounting for currents



Wave prediction with accounting for currents



Future

- Assimilation in curvilinear part of domain
- Assimilation of ice concentration

http://www.hycom.org