# 1/12°North Atlantic HYCOM Development

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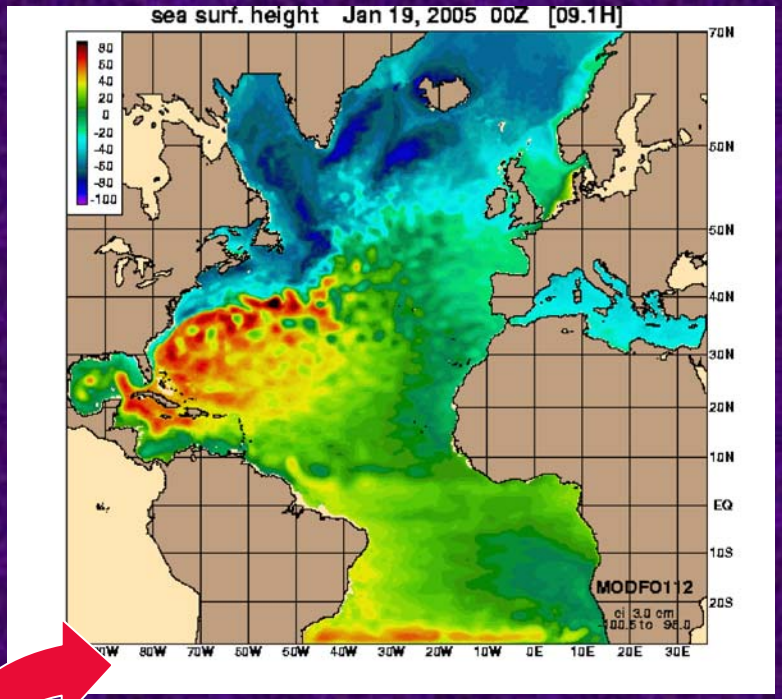
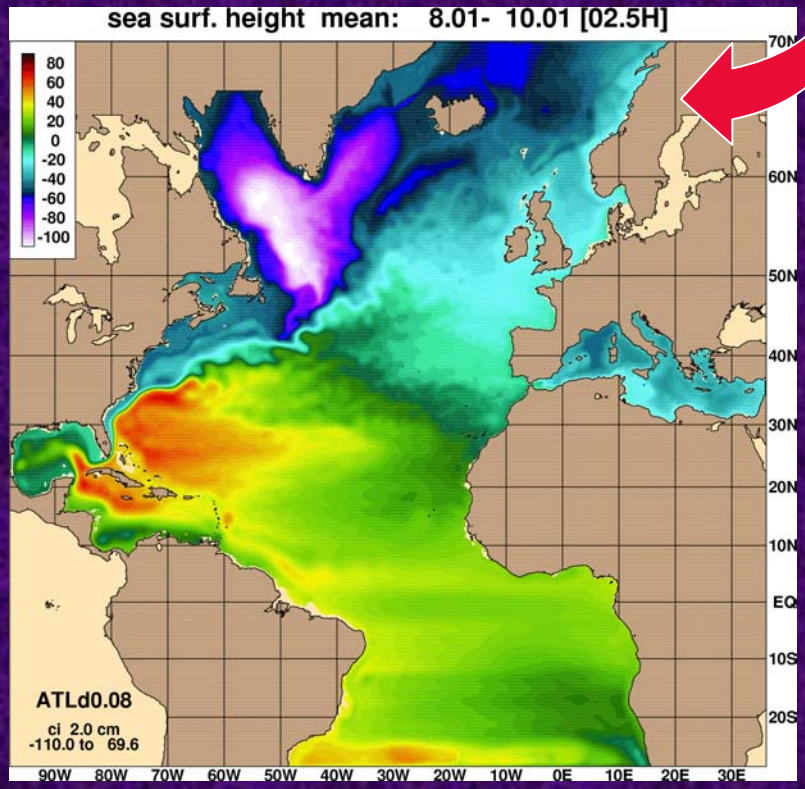
RSMAS, University of Miami, FL
6-9 December 2005

# Motivation: Improved Model Component in 1/12° Atlantic-HYCOM Nowcast/Forecast System




Present Day Near Real Time
Data-assimilative Run
(http://www7320.nrlssc.navy.mil)

Climatological Spin-Up
To Real Time System




Two-Year Mean SSH

# Atlantic Basin-Scale Model Evaluation Methodology: First Order Requirements

Mean and Variability of large-scale currents

Realism of wind-driven flow

Meridional Overturning Cell (thermohaline driven)
- Amplitude
- Characteristics of deep southward and upper return flow

Transports
- Through passages
- Within major currents

Water mass distribution

# 1/12° ATL-HYCOM Development

Boundary relaxation time scale
- Impact on MOC amplitude

Advection scheme (MPDATA vs FCT2)
- Impact on subpolar gyre mixed layer depth
- Impact on MOC amplitude

Vertical coordinate:
- $\sigma_0$ w/ and w/o variable target $\rho$
  - Impact Mediterranean circulation
- $\sigma_2^*$
  - Impact on Mediterranean salinity outflow
  - Impact on AABW

Bottom topography (sills)
- Impact on flow pathways

Diffusion parameterization
- Impact on major currents (strength and pathway) and energy levels

Wind Forcing
- Impact on large-scale current systems

Turbulent mixing scheme
- Impact on diffusion

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# 1/12° Atlantic HYCOM Configuration

28°S to 70°N; 1/12° (7 km mid-lat); 26 or 28 layers; $\sigma_0$ or $\sigma_2$*

Topography from NRL-DBDB2
Hand edited after interpolation to model grid

Monthly GDEM3 climatology
Initialization (July); SSS and lateral open boundary relaxation

KPP or GISS turbulent mixing model

ERA-15 monthly mean forcing + high-frequency wind anomalies
Corrected strength of winds

River runoff included
Major rivers only at this time

kpar turbidity

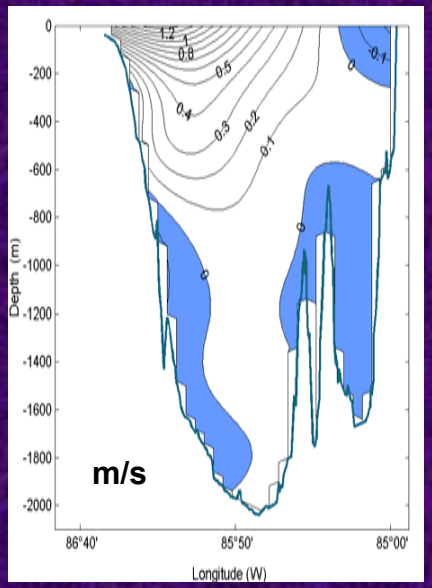
Bulk formulation for sensible and latent heat fluxes

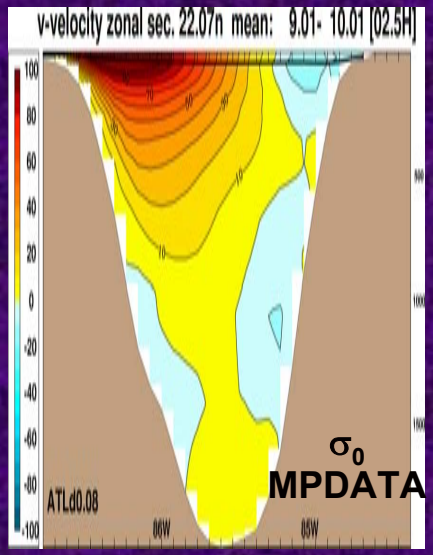
Energy loan ice model

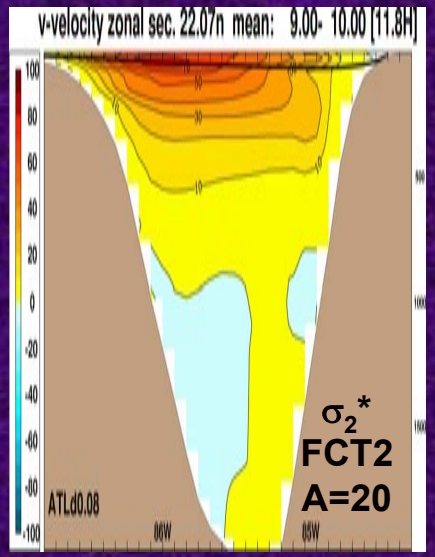
# 1/12° ATL-HYCOM Twin Experiments

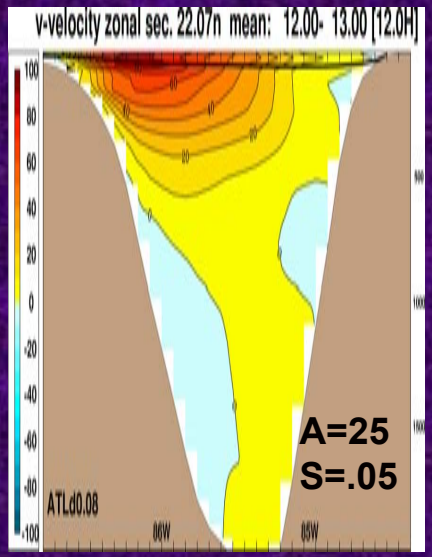
| Experiment | Smag. Diffusion | Spatially Constant A | Mixed Layer | Model Years | $C_b$ | Other |
|---|---|---|---|---|---|---|
| ATLd0.08-11.8 | .05 | 20 | KPP | 09-10 | .02 | Improved WWI sills |
| ATLd0.08-12.0 | .05 | 25 | KPP | 11-13 | .022 | Improved FS sill |
| ATLd0.08-12.1 | .1 | 30 | KPP | 11-15 | .022 | |
| ATLd0.08-12.2 | .05 | 30 | KPP | 11-13 | .022 | |
| ATLd0.08-12.3 | .1 | 30 | KPP | 11-13 | .022 | 1.2x winds |
| ATLd0.08-12.4 | .1 | 30 | GISS | 11-13 | .022 | |

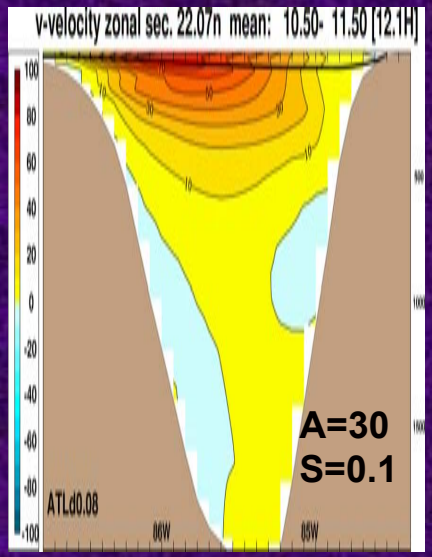
# Yucatan Channel Annual Mean Velocity
# 1/12° Atlantic HYCOM

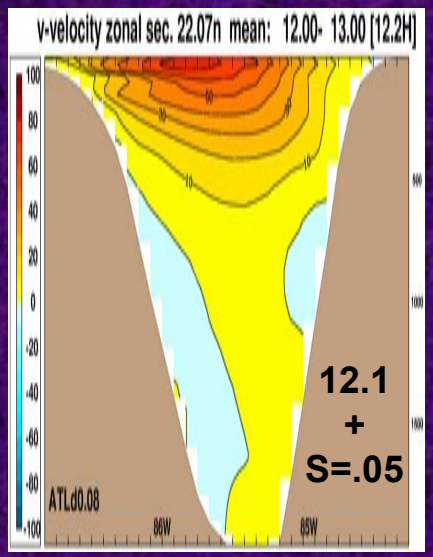


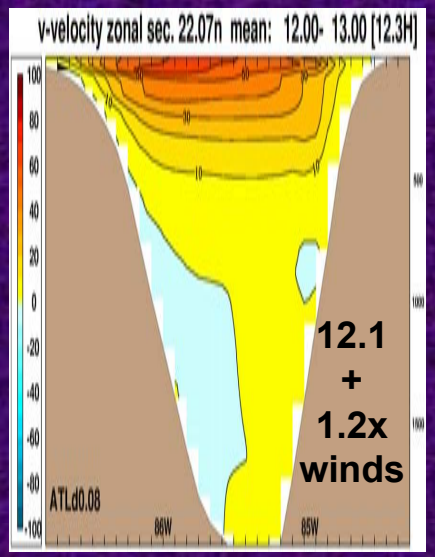



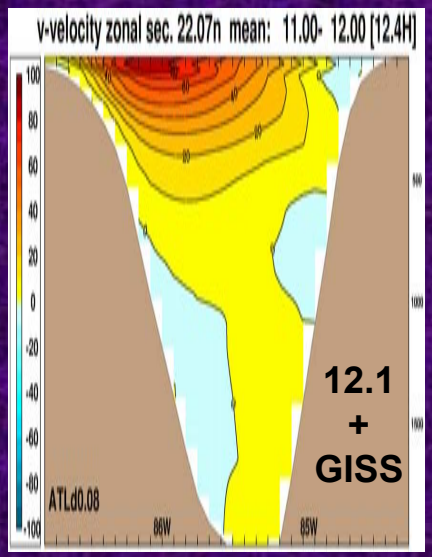



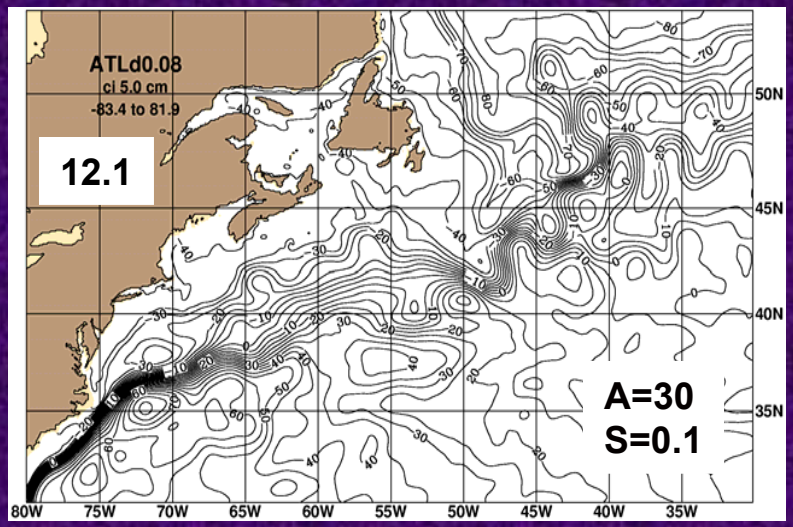



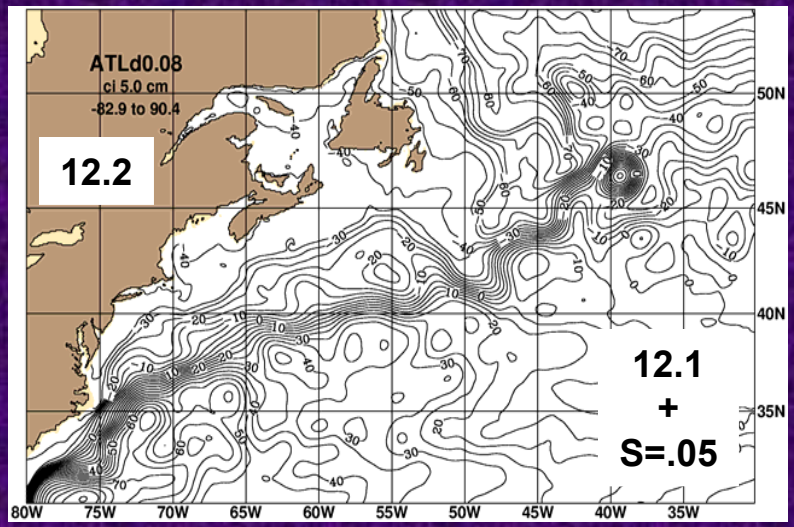



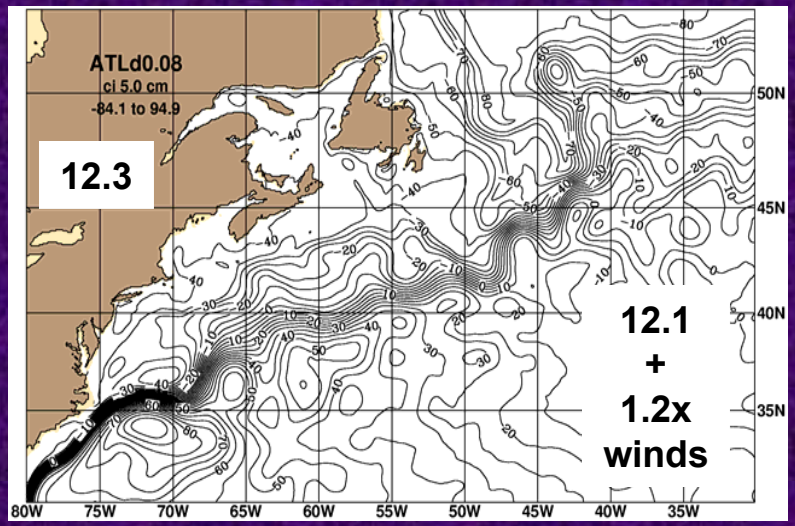



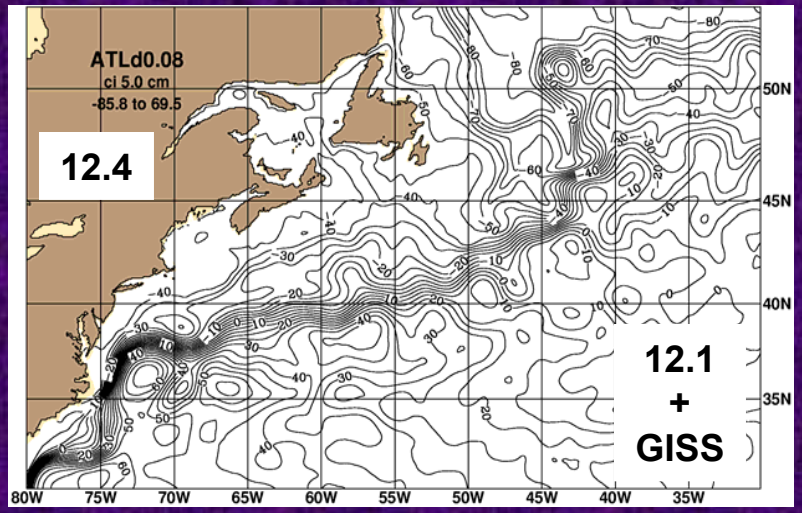



# 1/12° Atlantic HYCOM
# 2-Year Mean SSH

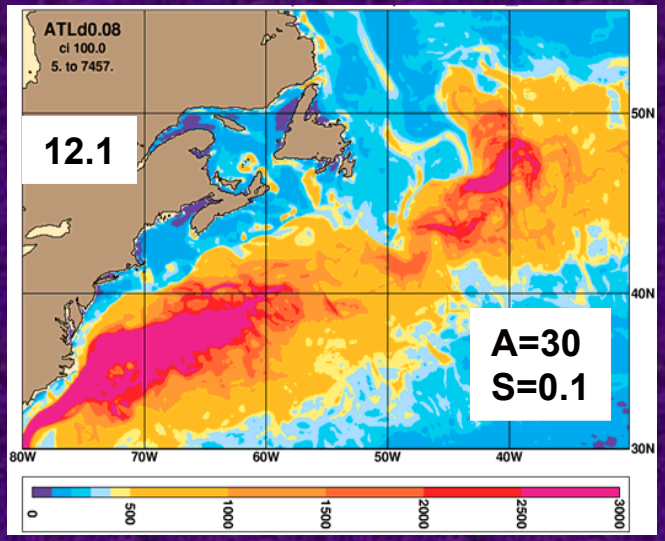


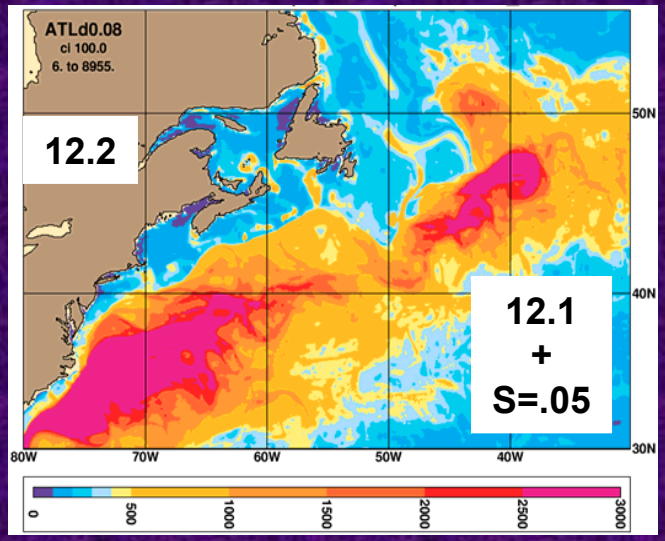



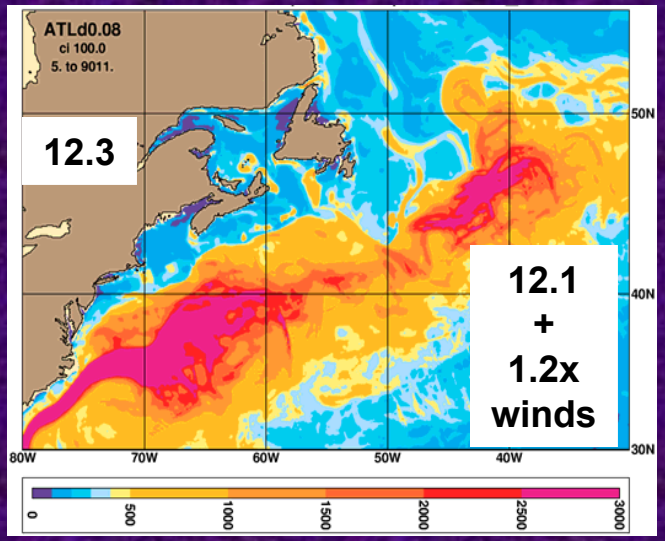



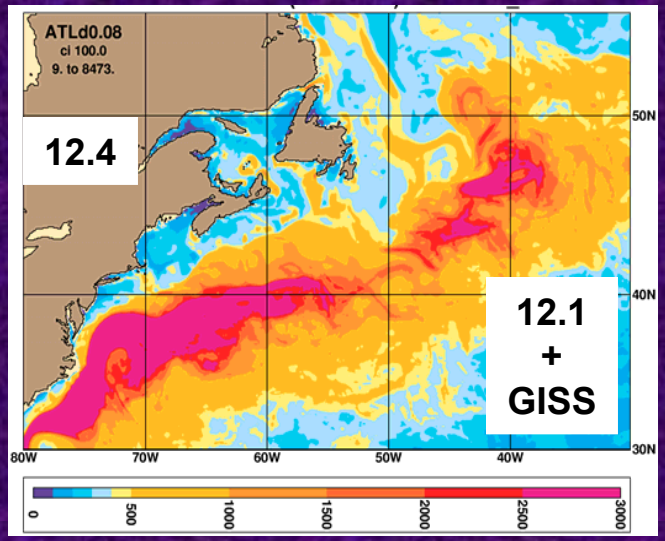



# 1/12° Atlantic HYCOM
# Layer 1 EKE ($cm^2/s^2$)



# 1/12° Atlantic Hycom
# Two-year Mean Transports*

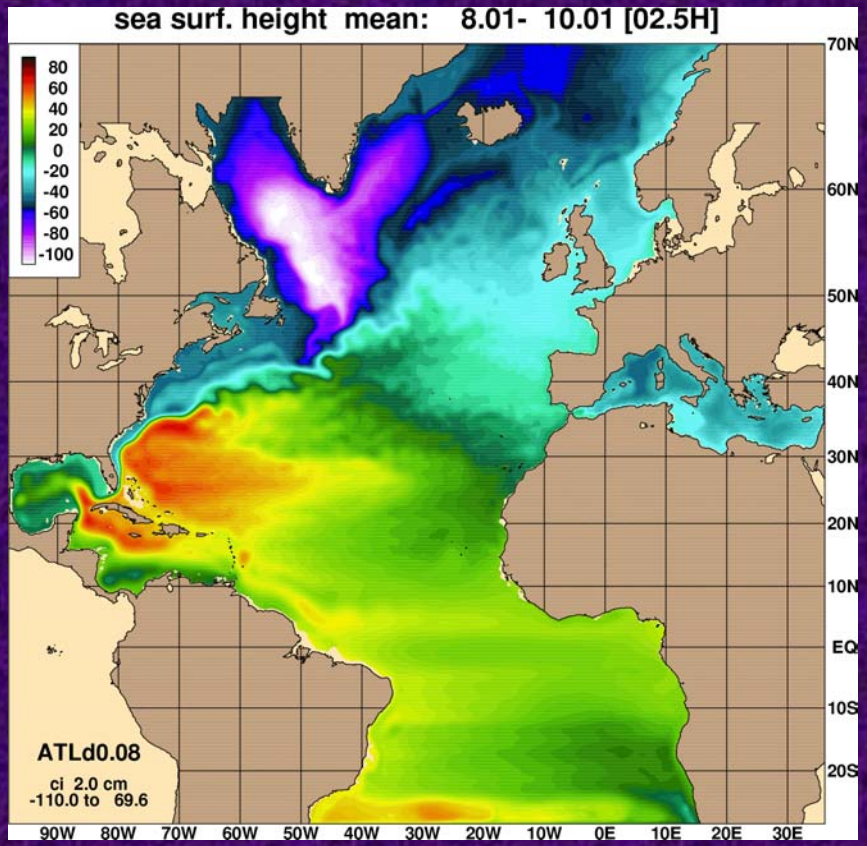
| Expt. | FC 27°N | Abac (nrth) | FC + Abac | NWP | OBC | Yuc Chan | WW | Mona | Aneg | L.A.# | Lucia Vince Gren |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Obs | 32 | 5 | 37 | -1.2 | -1.9 | 29.2 | -7.0 | -2.6 | -2.5 | -17.1 | -10.1 |
| 11.8 | 27.9 | 20.8 | 48.7 | -3.3 | 1.1 | 25.7 | -3.3 | -3.8 | -1.7 | -16.9 | -11.4 |
| 12.0 | 27.7 | 16.6 | 44.3 | -2.7 | 1.1 | 25.8 | -3.2 | -5.7 | -1.7 | -15.5 | -9.9 |
| 12.1 | 26.8 | 6.8 | 33.6 | -3.2 | 1.0 | 24.5 | -3.3 | -3.9 | -1.3 | -16.2 | -10.2 |
| 12.2 | 27.4 | 7.4 | 34.8 | -3.6 | 0.9 | 24.7 | -4.8 | -3.5 | -1.3 | -15.2 | -9.4 |
| 12.3 | 28.3 | 4.7 | 33.0 | -4.0 | 1.0 | 25.3 | -1.9 | -4.9 | -2.3 | -16.1 | -10.3 |
| 12.4 | 25.9 | 5.4 | 31.3 | -3.1 | 0.9 | 23.7 | -2.5 | -3.9 | -1.2 | -16.2 | -11.1 |

* Positive transport defined northward and eastward

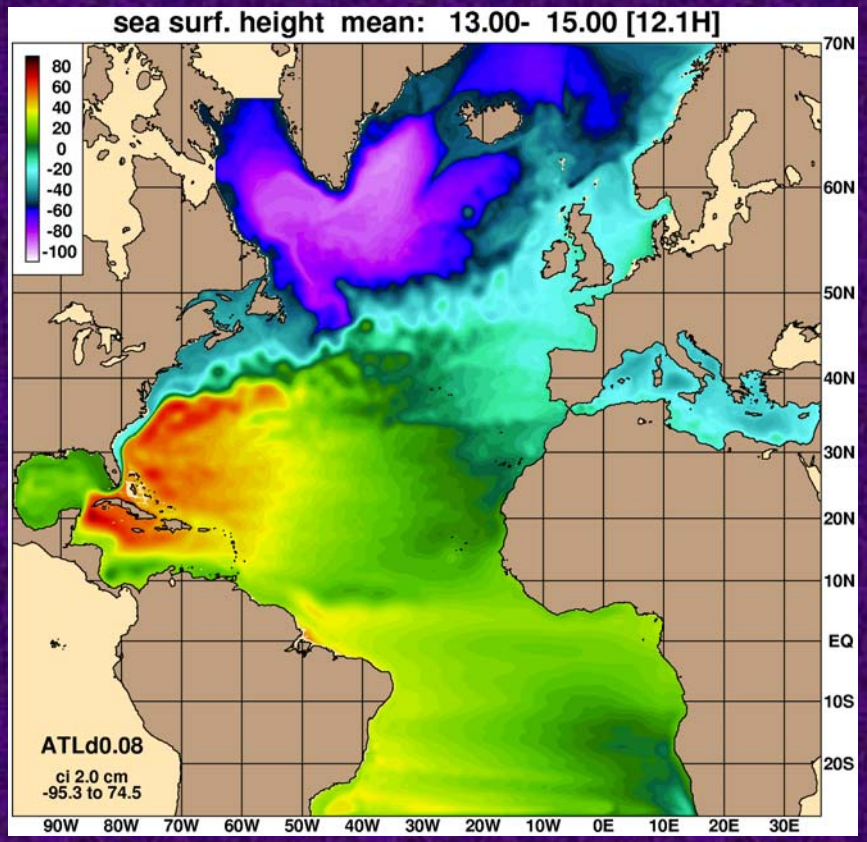
# Residual of Yucatan – WW – Mona - Anegada

# 1/12° ATL-HYCOM Mean Sea Surface Height

**Present Nowcast/Forecast System Model**




**Improved Model**




**ERA-15 wind (+ high-frequency anomalies) and thermal forcing and relaxation to GDEM3 at northern and southern boundaries**

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Variable Reference State