1/12° North Atlantic HYCOM Development

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HYCOM NOPP GODAE Meeting
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
1/12° ATL-HYCOM Development

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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

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Smag. Diffusion</th>
<th>Spatially Constant A</th>
<th>Mixed Layer</th>
<th>Model Years</th>
<th>C&lt;sub&gt;b&lt;/sub&gt;</th>
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Yucatan Channel Annual Mean Velocity
1/12° Atlantic HYCOM

- m/s
- σ₀
- MPDATA
- σ₂
- FCT2
- A=20
- S=.05
- A=25
- S=.05
- A=30
- S=0.1
- 12.1 + 1.2x winds
- 12.1 + GISS
1/12° Atlantic HYCOM 2-Year Mean SSH

- 12.1
- A=30, S=0.1
- + 1.2x winds

- 12.2
- 12.1
- + S=.05

- 12.3
- 12.1
- + GISS
1/12° Atlantic HYCOM
Layer 1 EKE (cm²/s²)
**1/12° Atlantic Hycom**  
**Two-year Mean Transports***

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<th>Expt.</th>
<th>FC 27°N</th>
<th>Abac (nrth)</th>
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<th>OBC</th>
<th>Yuc Chan</th>
<th>WW</th>
<th>Mona</th>
<th>Aneg</th>
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* 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