North Atlantic and Global HYCOM Evaluation

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

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Present Data-assimilative Run
Model Developments Impacting Simulation of The Gulf Stream System (GSS)

Boundary relaxation time scale
  Impact on MOC amplitude – Key component of GSS

Advection scheme (MPDATA vs FCT2)
  Impact on subpolar gyre mixed layer depth – affects MOC amplitude
  Impact on MOC amplitude – Key component of GSS

Bottom topography (sills)
  Impact on flow pathways – Critical for both thermohaline- and Wind-driven components of GSS

Turbulent mixing scheme
  Impact on diffusion which in turn impacts the structure within the GSS

Diffusion parameterization
  Impact on strength, pathway, and energy levels of GSS

Wind Forcing
  Impact on strength, pathway, and energy levels of GSS
# Atlantic/Global HYCOM Experiments Used in Analysis

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Smag. Diffusion</th>
<th>A</th>
<th>Biharmonic Dissipation</th>
<th>Mixed Layer</th>
<th>Wind Forcing</th>
<th>Model Years</th>
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Simulated vs. Observed Surface EKE

GLB a0.08 - 5.6, years 9-10

Fratantoni (JGR – 2001)

• High EKE in the Gulf Stream doesn’t extend far enough to the east
• EKE in North Atlantic Current and its extension is too high
Locations of Simulated EKE Profiles vs. Observations Comparisons in the Gulf Stream System

Gulf Stream @ 68W

Gulf Stream Extension (GSE) Region
Simulated EKE Profiles vs. Observations @ 55W – Gulf Stream Extension (GSE)

- Modeled EKE is too low in comparison to observations, especially deep
- Doubling the resolution didn’t have much effect on upper or deep/abyssal EKE
Simulated EKE Profiles vs. Observations – Gulf Stream @ 68W

Varying degrees of agreement with observations, depending on simulation

ATL d0.08 – 11.4, years 9-10

ATL g0.04 – 01.2, years 11-12
Locations of Simulated EKE Profiles vs. Observations Comparisons in the North Atlantic Current Region

North Atlantic Current Extension (NACE)
Simulated EKE Profile vs. Observations – NAC Extension

Generally good agreement below 350m depth
Divergence near surface

GLBa0.08 – 05.2, years 8-9
Improving the Wind Forcing

Global HYCOM experiment (in progress on Cray XT3 @ ERDC MSRC) forced by ERA40 winds corrected using QuikSCAT wind speed globally (ERA-40 winds are generally too weak) is expected to improve results in the Gulf Stream system.

<table>
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<tr>
<th>Section</th>
<th>Obs. In Sv</th>
<th>GLBa0.08 – 05.2</th>
<th>Linear ERA15</th>
<th>Linear ERA40</th>
<th>Linear-C ERA40</th>
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<td>32.0</td>
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</table>

- ERA = ECMWF reanalysis
- HYCOM was forced by ERA15
- Linear = linear NLIM solution based on Sverdrup (1947) interior flow with Munk (1950) western boundary currents, and islands added
- Allows efficient comparison and evaluation of ocean currents forced by different wind products, 26 different wind sets tested so far.
- Linear-C is ERA40 with annual mean winds corrected by a QuikScat climatology
Simulated Surface EKEs

GLB a0.08 - 5.6, years 9-10
GLB a0.08 – 7.1, year 4

Too early to see improvement (statistics are from second completed year using QuikSCAT scaled ERA-40 winds), stay tuned ...
Future Work

More diverse intercomparisons in the Atlantic and expanding into other basins

- We’ve already done some intercomparisons in the Kuroshio and Agulhas