HYCOM & Navy Ocean Prediction

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HYCOM & Navy Ocean Prediction
Role of Ocean Modeling

Important (Not Sole) Tool for the Operational Oceanographer Providing Oceanographic Environmental Intelligence Relevant to the Warfighter
HYCOM & Navy Ocean Prediction
Nested Approach & Focus on the Littoral

Global
Regional
Coastal

Adriatic Sea
Kings Bay

Kings Bay (RMA-2)
While much of the ocean’s mesoscale variability can be forecast, routine global forecasts (at 1/32 degree resolution) remain a Grand Challenge computational goal potentially achievable in 2009 with current level of expenditure.
HYCOM & Navy Ocean Prediction
Near-Term Global Baseline Prediction System

NOGAPS Heat & Momentum Fluxes

SSH&SST

1/16° Global NLOM

2D SSH 2D SST

1/8° Global MODAS

15-30 Day Front, Eddy & SSH Forecast

15-30 Day Mesoscale T,S, U,V Forecast

3D T,S Nowcast

3D T,S,U,V Forecast

5 Day 3D T,S,U,V Forecast
## HYCOM & Navy Ocean Prediction

### Nesting Strategy for Ocean Prediction

<table>
<thead>
<tr>
<th>Global</th>
<th>→</th>
<th>Regional</th>
<th>→</th>
<th>Littoral</th>
<th>→</th>
<th>Nearshore</th>
</tr>
</thead>
</table>

### Near-Term: present-FY04 in R&D, FY03-FY06 operational, including transition

<table>
<thead>
<tr>
<th>1/8° NCOM</th>
<th>→</th>
<th>SWAFS &amp; NCOM</th>
<th>→</th>
<th>SWAFS &amp; NCOM</th>
<th>→</th>
<th><strong>RMA2/ADCIRC</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>15-16 km mid-lat resolution</td>
<td>→</td>
<td>4 - 8 km, larger regions</td>
<td>→</td>
<td>&lt; 1 to 2 km res</td>
<td>→</td>
<td>&lt; 2 km resolution finite element</td>
</tr>
</tbody>
</table>

### Mid-Term: FY04 - FY07 in R&D, FY06 – FY10 operational, including transition

<table>
<thead>
<tr>
<th>1/12° HYCOM</th>
<th>→</th>
<th><em>SWAFS/NCOM/HYCOM</em></th>
<th>→</th>
<th><em>SWAFS/NCOM/HYCOM</em></th>
<th>→</th>
<th><strong>ADCIRC</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>7 km mid-lat resolution</td>
<td>→</td>
<td>2 - 4 km, smaller regions</td>
<td>→</td>
<td>.5-1.5 km res</td>
<td>→</td>
<td>&lt; 1.5 km res</td>
</tr>
</tbody>
</table>

### Long-Term: FY07-FY10 in R&D, FY10 and beyond operational, including transition

<table>
<thead>
<tr>
<th>^+1/25° HYCOM</th>
<th>→</th>
<th>Regional generally not needed</th>
<th>→</th>
<th><em>NCOM/HYCOM</em></th>
<th>→</th>
<th><strong>ADCIRC</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>3 - 4 km mid-lat resolution</td>
<td>→</td>
<td>Not used</td>
<td>→</td>
<td>≤ 1km res</td>
<td>→</td>
<td>≤ 1 km res</td>
</tr>
</tbody>
</table>

*Hogan and Kindle CO-NESTS project should provide research results needed to make the appropriate choice. An alternative model such as ROMS may also be considered.

*1/25° HYCOM gives useful littoral resolution globally.

**Nearshore models need a robust baroclinic capability before they can fully fill this role.*
**HYCOM & Navy Ocean Prediction**

**Planned Operational Transitions**

<table>
<thead>
<tr>
<th>Global Product</th>
<th>Vert. Coord.</th>
<th>Inputs</th>
<th>Run By</th>
<th>Target Date (Operations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8° NCOM ¹</td>
<td>σ/z</td>
<td>SSH, SST, hydro, FNMOC</td>
<td>NAVO</td>
<td>2003</td>
</tr>
<tr>
<td>1/32° NLOM</td>
<td>Layered</td>
<td>atmospheric forcing</td>
<td>NAVO</td>
<td>2003</td>
</tr>
<tr>
<td>1/12° HYCOM ²</td>
<td>ρ/σ/z</td>
<td></td>
<td>NAVO</td>
<td>2007</td>
</tr>
<tr>
<td>1/25° HYCOM</td>
<td>ρ/σ/z</td>
<td></td>
<td>NAVO</td>
<td>2010</td>
</tr>
</tbody>
</table>

¹ High vertical resolution for mixed layer prediction. Assimilates SSH from NLOM. Running in real-time, see [http://www.ocean.nrlsscnavy.mil/global_ncom](http://www.ocean.nrlsscnavy.mil/global_ncom)

² 1/12° Atlantic and coarser global HYCOM are GODAE-related pilot projects under the National Ocean Partnership Program (NOPP). 1/12° Atlantic HYCOM demo is running in near real-time. Results at: [http://hycom.rsmas.miami.edu/ocean_prediction.html](http://hycom.rsmas.miami.edu/ocean_prediction.html)
HYCOM & Navy Ocean Prediction
A Validation Baseline for Operational Ocean Prediction – NCOM G8

Model experiments to be tested
- Free running 1998-2001
- Assimilative 1998-2003
- Bimonthly 7-day forecasts 1998-2002

Validation Tests (vs. Unassimilated Data)
- Sea Surface Height (analysis vs. sea level data)
- Sea Surface Temperature (analysis/forecast vs. MCSSTs & buoys)
- Mixed Layer Depth (analysis vs. profile data)
- Large-scale, meso-scale circulation features (mean, analysis position)
- Eddy kinetic energy/SSH variability (means)
- Current cross sections (events, means)
- Comparison with drifting buoys (June, 2000 – Nov., 2000)
- 3D profiles and vertical cross sections (analysis vs. profile data)
- Transport through straits (total, means)
- Regional evaluations by collaborators
A U.S. Navy buoy deployed in late January 2003 measured sea level in northwestern Persian Gulf until damaged in mid-March. Comparisons of the detided buoy observations with the independent NCOM G8 model results referenced to the same mean demonstrates the accuracy of the model predictions.

NCOM G8 vs detided TABS SSH in Persian Gulf sampled at 6 hours correlation 0.89
HYCOM & Navy Ocean Prediction
NCOM 48 hr. SST Forecast Verification – (Relevant to Coupled Air/Ocean)

2 Day SST Forecast Verification Statistics
Mean RMS (°C) over 40 forecasts made 4 Jan 2001 – 12 Feb 2001
HYCOM & Navy Ocean Prediction
Summary of Planned Long-Term Operational Capability

- **.08° fully** – global ocean prediction system transitioned to NAVO in 2006 (Expected Operational 2007)
  - ~7 km mid-latitude resolution
  - Include shallow water, minimum depth 10 m (or less)
  - Bi-polar (PanAm) grid for Arctic
  - FY05-07 DoD HPC Challenge project essential
  - Embedded ice model
  - Account for Tides (internal or external to HYCOM)
  - General Nesting Capability (Regional SWAFS/NCOM/HYCOM)

- **Increase to .04° resolution globally and transition to NAVO by the end of the decade**
  - ~3.5 km mid-latitude resolution
  - Good resolution for coastal model boundary conditions globally
  - “Baseline” resolution for shelf regions globally