Evaluation of the 1/12° Global HYCOM Nowcast/Forecast System

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Layered Ocean Model Workshop
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1/12° 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 $\sigma_2^*$

- 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
1/12° Global HYCOM
Real time run started 22 December 2006
Available altimeter data
31 May 2009
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 \( \tau = 120 \)

Approximate run times* (using 619 Cray XT5 processors):
1) Six NCODA analyses: 1.4 hrs/analysis = 8.4 hrs
2) Five HYCOM hindcast days @ 240 sec \( \Delta t \): 0.5 hrs/day = 2.5 hrs
3) Four HYCOM forecast days @ 240 sec \( \Delta t \): 0.5 hrs/day = 2.5 hrs
4) Total: 13.4 hrs
MVOI - simultaneous analysis 5 ocean variables temperature, salinity, geopotential, layer pressure, velocity (u,v) and sea ice
Data Assimilation Subregions

Mean sea surface height 2007-2008 (72.3)
HYCOM/NCODA

- A modification to the NCODA MODAS synthetic profiles has been implemented. The synthetic profiles are modified to reflect the HYCOM mixed layer depth
HYCOM/NCODA

MODAS profile modified over the depth of the HYCOM mixed layer
HYCOM/NCODA

- The daily NCODA analysis is using an increased time window of profile observations (12 days, instead of 1 day)
NCODA Profile Observation Locations

24 hour window

12 day window
NCODA Observation Locations 9 March 2008
NCODA verification
Pacific Ocean

SSH verification

SST verification

PAC 74.2  9 Km Grid

SSH Verification

PAC 74.2  9 Km Grid

SST Verification

SSH Data Counts

SST Data Counts
NCODA verification
Pacific Ocean

Temperature verification

Salinity verification
Gulf Stream and Kuroshio SSH with SST-based frontal analysis overlaid

Frontal analysis < 4 days old = white,
analysis ≥ 4 days old = black
1/12° Global HYCOM
SSH and surface drifters

sea surf. height May 01, 2009 00Z [90.8H]
Comparison to XBT along ship track
Large Scale Prediction
Old Assimilation Subregions
HYCOM/NCODA

Comparison to assimilated profiles (June 2007- May 2008)

HYCOM723 (black), HYCOM742 (red), Region=MER4d

JJA  SON  DJF  MAM  ANL

Mean Error (°C)

N=10431  N=12028  N=8890  N=9903  N=41252
HYCOM/NCODA
Comparison to non assimilated profiles (June 2007-May 2008)
Mixed Layer Depth Median Bias Error using unassimilated profiles

MdBE = -2 m  
RMSE = 37.9 m  
60.2% < 10 m error

Overall shallow bias

MdBE = -6.6 m  
RMSE = 39.7 m  
52.8% < 10 m error
1/12° Global HYCOM Transport at 27°N

HYCOM GLBa0.08–90.8–nowcast: Florida Strait at 27.02N
Layer 1–32  Mean: 30.26 Min: 22.67 Max: 36.84 Std: 2.72

- Cable Data
- HYCOM (90.8)

From 01–Jan–2009 to 30–May–2009
Sea Ice
Arctic

SSH date: May 05, 2009 00Z 90.8
Sea Ice
Antarctic

SSH date: May 05, 2009 00Z 90.8
Black line represent the independent ice edge analysis performed at the National Ice Center.
END