Results from High Resolution North Atlantic HYCOM Simulations

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1/12° North Atlantic HYCOM

 $28^\circ S$ to $70^\circ N$

First simulation restarted from true MICOM (20 layers) 5 "light" layers added for increased vertical resolution in ML

First simulation designed to be as similar as possible to MICOM run

- 50% relax to COADS SSS, 50% E-P
- ECMWF 10 m monthly climatological forcing
- Relaxation to Levitus at north and south boundaries
- Laplacian scalar diffusion
- Smagorinsky Laplacian momentum diffusion
- Radiation flux correction (-25 w/m²)
- Energy loan ice model
- River runoff included

1/12° North Atlantic Simulations

2.4 years monthly climatological ECMWF

3 years: 6-hourly high frequency monthly climatological (Oct. 1994-Sept. 1995 6-hourly added to climatology)

3 years: 6-hourly hybrid NOGAPS /ECMWF July 1999 - July 2002

(6-hourly NOGAPS wind stress over 1999-2002 replaces the ECMWF reanalysis variability; ECMWF mean retained)

3 years with strong relaxation at southern boundary

3 years with weak relaxation at southern boundary

3 years with weak relaxation at southern and northern boundary

10 x 16 Equal Ocean Decomposition



- > Running on Brainerd (ARL)
- > 58,000 CPU hrs/model year on 160 CPUs
- > 770 GB/model year for daily 3-D output
- > MPI parallelization

High-resolution 1/12° North Atlantic HYCOM simulation



SSH snapshot

1/12° HYCOM ATLANTIC SIMULATION ~7 km resolution at mid-latitudes



Forced by ECMWF 10 m reanalysis monthly climatological wind and thermal fluxes, climatological surface salinity and relaxation to MODAS climatology at the northern and southern boundaries (themohaline component)



Forced by monthly climatological ECMWF 10 m winds and fluxes and relaxation to Levitus climatology at the zonal boundaries



RED = Model too warm BLUE = Model too cool

Monthly means of MLD and BLD along equator from 1/12° North Atlantic

Mixed layer depth

Boundary layer depth



Diagnostic – equivilent density change that corresponds to 0.2° temperature change

Prognostic

18 degree Mode Water formation



18 degree Mode Water formation



Mean ML depth from 1/12° North Atlantic HYCOM



1/12° North Atlantic HYCOM

Forced with ECMWF 10m climatology



Includes relaxation to Levitus at the north/south boundary



Denmark Straits Overflow





temperature

Evolution of Loop Current Eddy Shedding from 1/12° North Atlantic HYCOM



Yucatan Channel Normal Velocity



North Atlantic HYCOM Abyssal Volume Transport

1/12°

			-						
	Clim	Clim	Ir	iterannua		Micom-	clim	clim+	Interann
	Year 12	Year 13	1996	1997	1998	mode		6hrly	2000
							-		
47°N	14.89	15.01	20.39	22.49	17.78	18.40	20.72	25.15	27.43
34°N	17.04	17.02	18.50	17.52	20.30	21.10	24.07	26.62	28.29
27°N	18.03	17.20	18.83	17.14	16.47	22.26	24.10	29.54	26.30
9°N	16.34	15.63	18.09	15.76	18.02	23.25	24.84	26.22	23.46
EQ	16.52	16.35	21.44	16.67	16.16	22.99	27.58	31.44	26.21
9°S	16.70	16.33	17.98	15.16	14.87	21.98	28.75	31.46	27.98

 $1/3^{\circ}$

Barotropic Volume Transport

Miami	21.14	21.36	21.69	22.07	22.31	22.72	25.67	29.28
STACS	23.66	25.23	25.85	25.54	25.38	24.40	27.12	30.44
Yucatan	21.54	21.63	21.64	22.27	22.57	23.16	26.17	30.40

Abyssal Volume Transport from 1/12° North Atlantic HYCOM

	strong 1/3 timescale S.B.	benchmark 15-30 days	weak 3x timescale S.B.	weak * 3x south/north
47°N	26.67	26.30	27.49	27.01
34°N	29.69	28.93	27.54	28.78
27°N	32.03	30.74	29.38	29.78
9°N	28.76	26.10	25.30	25.58
EQ	31.46	31.88	25.71	26.35
9S	32.58	29.67	25.79	25.88
20S	32.93	31.12	25.68	25.69

Barotropic Volume Transport

STACS 29.77 28.13 29.60 29.32

* one-year mean transports (all others two-year means)

Changes to latest 1/12° North Atlantic simulation

- Sigma-2 with thermobaricity
- 5 m coastline, 10 m minimum depth
- GDEM3 boundary relaxation and initialization
- Monthly river input
- kPAR based turbidity based on SeaWIFS
- Weaker relaxation to climatology at southern boundary
- Staggered sigma levels





20 m coastline

5 m coastline (10 m minimum depth

(sorry - different colorbar)

Sigma-2 GDEM3 Monthly Climatology

Interpolated to 26 layer 1/3° North Atlantic Domain



GDEM3: 78 levels, 1/4° horizontal resolution (M. Carnes, NAVOCEANO)





Future Plans



(Hogan, Kindle, Wallcraft)

Slope to Shelf Energetics And Exchange Dynamics

(Jacobs, Teague, Hogan, Arnone)

Measuring and modeling of processes that affect crossslope exchanges in the GoM



•Develop HYCOM coastal capabilities

- •Evaluate coastal HYCOM and NCOM
- •Evaluate coupling and boundary conditions



Mississippi Bight Domain



26-layer HYCOM

temperature merid.sec. 87.68w date: nov 30, 2002 [03.2H]

salinity merid.sec. 87.68w date: nov 30, 2002 [03.2H]



Remapped to 40 levels



HYCOM σ -z configuration

Hybrid coordinates



SSH after 7 days both taking boundary conditions from $1/12^{\circ}$ basin scale North Atlantic model remapped to 40 σ -z levels

Both enclosing model and nested models have 1/12° resolution



Next: Hybrid coordinates in the nested domain Higher resolution (vertical and horizontal) in the nested domain Assess accuracy of coastal circulation processes