

HYCOM code development

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HYCOM NOPP GODAE Meeting

Oct 29, 2004

Report Documentation Page				Form Approved OMB No. 0704-0188	
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1. REPORT DATE 29 OCT 2004		2. REPORT TYPE		3. DATES COVERED 00-00-2004 to 00-00-2004	
4. TITLE AND SUBTITLE HYCOM code development				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Research Laboratory,Stennis Space Center,MS,39529				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES 8th HYCOM NOPP GODAE Meeting, Oct. 27-29, 2004, RSMAS, Miami, FL					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 12	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

HYCOM 2.2 (I)

- First public release of HYCOM 2.2
 - Scheduled for December, 2004
- Maintain all features of HYCOM 2.1
 - Orthogonal curvilinear grids
 - Can emulate Z or Sigma or Sigma-Z models
 - Explicit support for 1-D and 2-D domains
 - KPP or Kraus-Turner or Mellor-Yamada 2.5 or Price-Weller-Pinkel
 - Rivers as bogused surface precipitation
 - Multiple tracers
 - Off-line one-way nesting
 - Scalability via OpenMP or MPI or both
 - * Bit-for-bit multi-cpu reproducibility
- New diagnostics within HYCOM
 - Time-averaged fields (in archive files)
 - Drifters

HYCOM 2.2 (II)

- Alternative scalar advection techniques
 - Donor Cell, FCT (2nd and 4th order), MPDATA
- Vertical coordinate changes
 - Vertical remapping uses PLM for fixed coordinate layers
 - Thin deep iso-pycnal layers
 - Spatially varying iso-pycnal layer target densities
 - Stability from locally referenced potential density
- Atmospheric forcing changes
 - Option to input ustar fields
 - Option to relax to observed SST fields
 - Improved COARE 3.0 bulk exchange coefficients
 - Black-body correction to longwave flux
- Mixed layer changes
 - GISS mixed layer model
 - KPP bottom boundary layer
 - KPP tuning
 - Latitudinally dependent background diffusion

HYCOM 2.2 (III)

- Improved support for rivers
 - Still bogused surface precipitation
 - Better control of low salinity profiles
 - Option for mass (vs salinity) flux
- Nesting no longer requires co-located grids
 - General archive to archive horizontal interpolation
- Hybrid to fixed vertical grid remapper
 - Allows fixed-coordinate nests inside hybrid coordinate outer domains
 - * HYCOM to (fixed-grid) HYCOM
 - * HYCOM to NCOM
- Diagnostic fields to netCDF and other file formats
 - All x-y “hycomproc” fields
 - * Layer space
 - * Velocity interpolated to the p-grid
 - All 3-D archive fields interpolated to z-space
 - * On p-grid, or
 - * Sampled along arbitrary tracks
 - Forcing input fields

HYCOM CURVI-LINEAR GRIDS and NetCDF

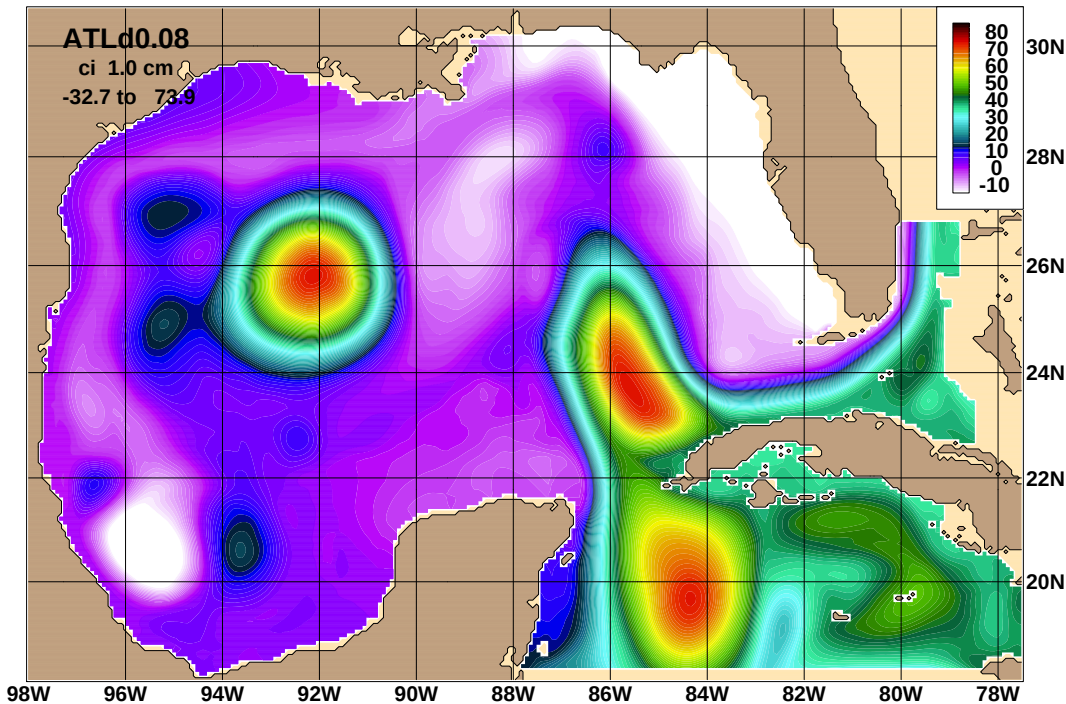
- Most basin-scale cases use a Mercator grid
 - 1-D latitude and longitude axes
 - Handled well by many netCDF packages
- Global HYCOM's Arctic patch grid is curvi-linear
- HYCOM netCDF use the CF-1.0 conventions, which support curvi-linear grids
 - If latitude and longitude are 2-D grids
 - * 1-D axes are array indexes
 - * Longitude and latitude arrays are also in the file and identified as alternative coordinates
- Most netCDF packages are not CF-1.0 aware
 - Can plot in “logical” (array) space
 - Interpolate to a 1-D latitude and longitude grid off-line
 - * General archive to archive horizontal interpolation
- Archive to archive remapper can also be used for standard (non-native) grids
 - Mersea grid is uniform $1/8^\circ$

GoM NESTED TEST DOMAIN

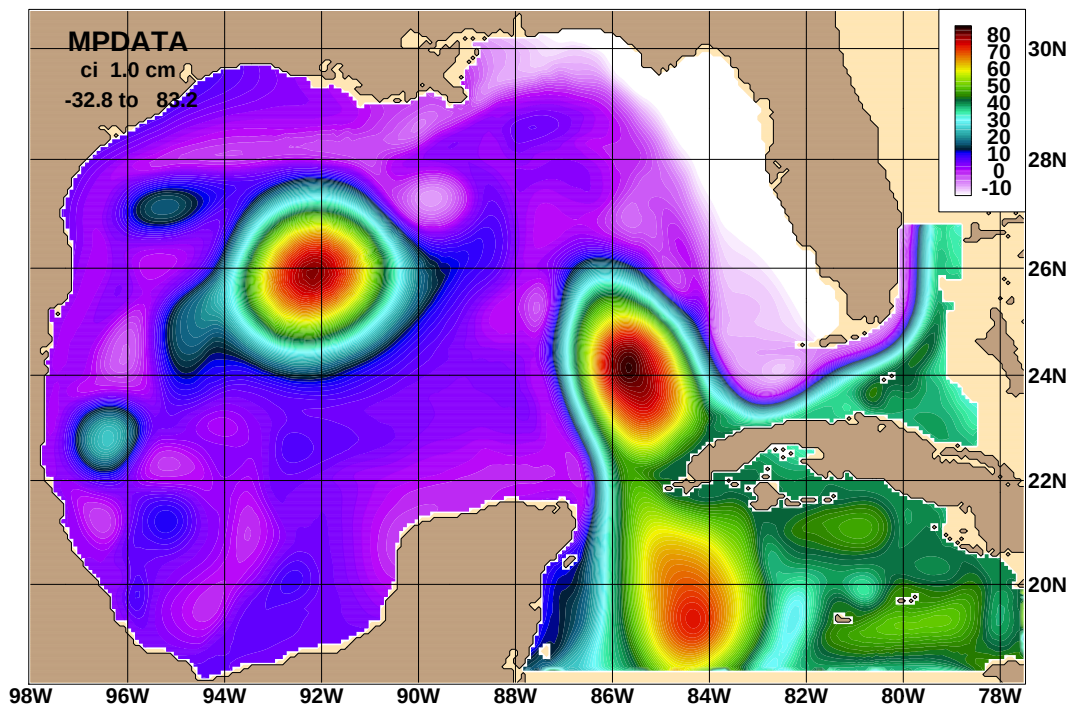
- Same resolution nesting unexpectedly useful
 - No need to rerun large domain
 - Change atmospheric forcing (e.g. use MM5)
 - Change vertical structure
 - Tracer studies (e.g. add biology)
- 1/12°: Gulf of Mexico inside Atlantic
 - Change from 20m to 5m coastline
 - Run for Aug 1999 to equilibrate
 - Run Sep-Nov as standard test case
- Used to test advection schemes

ATLANTIC vs GOM NEST (MPDATA)

sea surf. height Dec 01, 1999 00Z [02.6H]

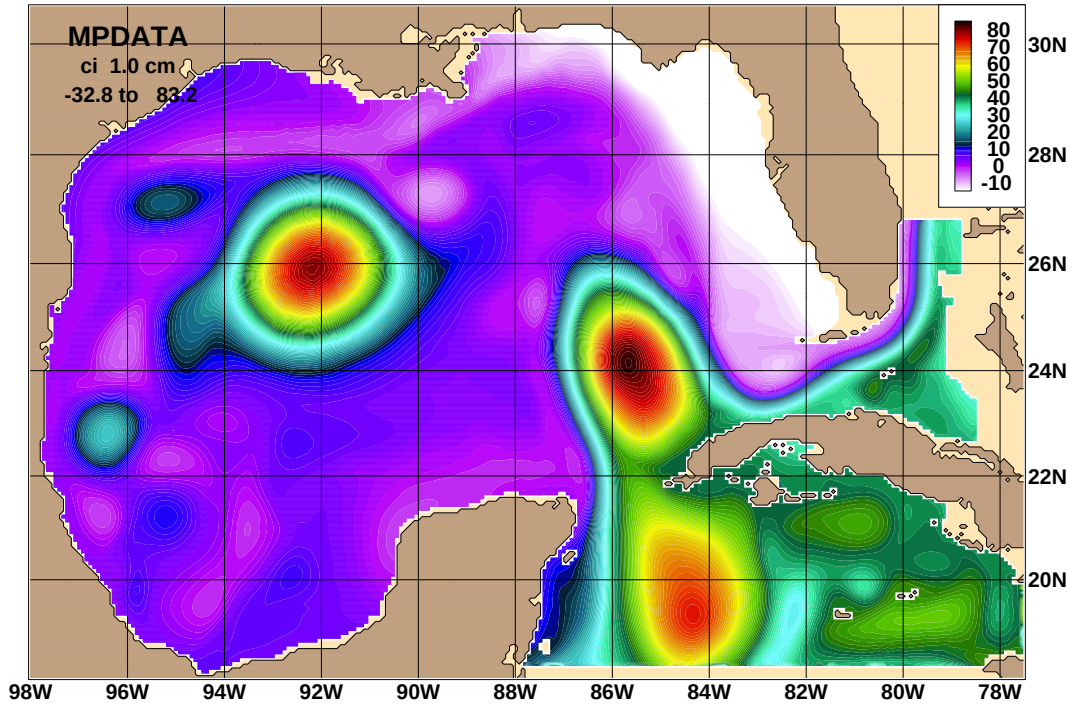


sea surf. height Dec 01, 1999 00Z [02.8H]

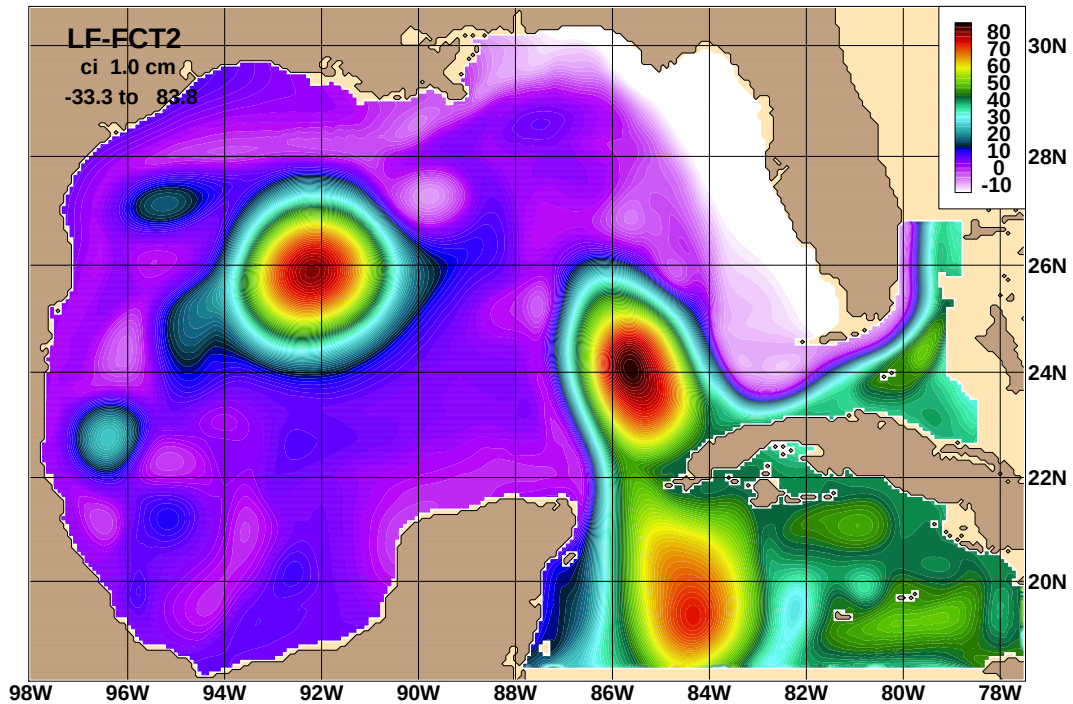


MPDATA VS LEAPFROG-FCT (SSH)

sea surf. height Dec 01, 1999 00Z [02.8H]

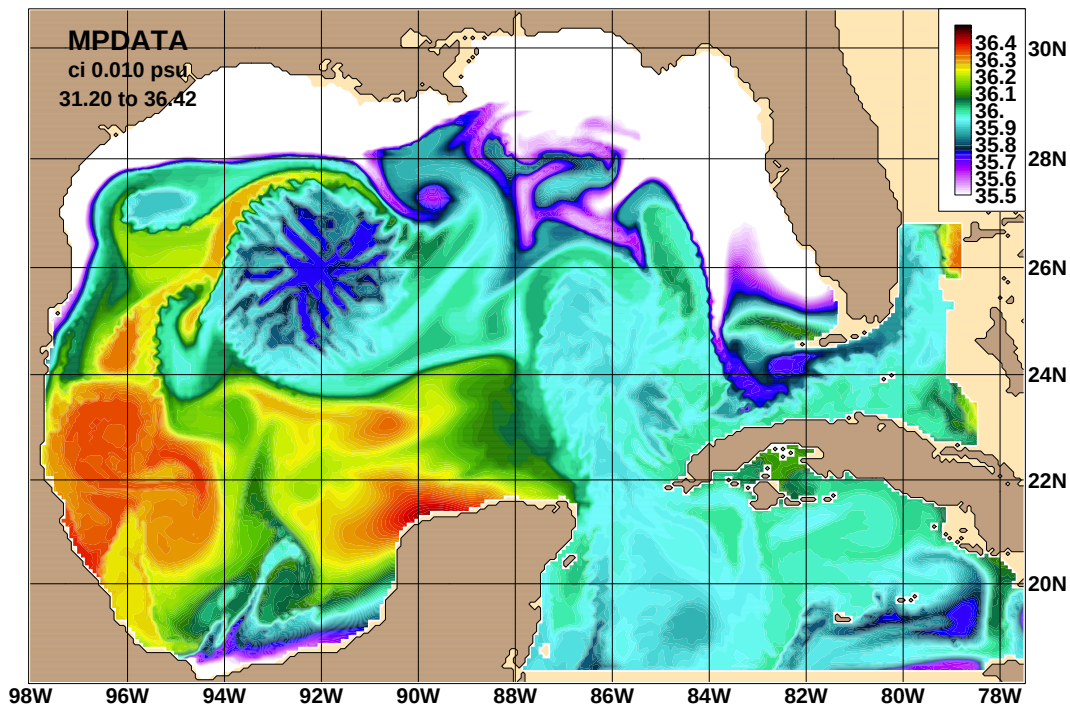


sea surf. height Dec 01, 1999 00Z [03.1H]

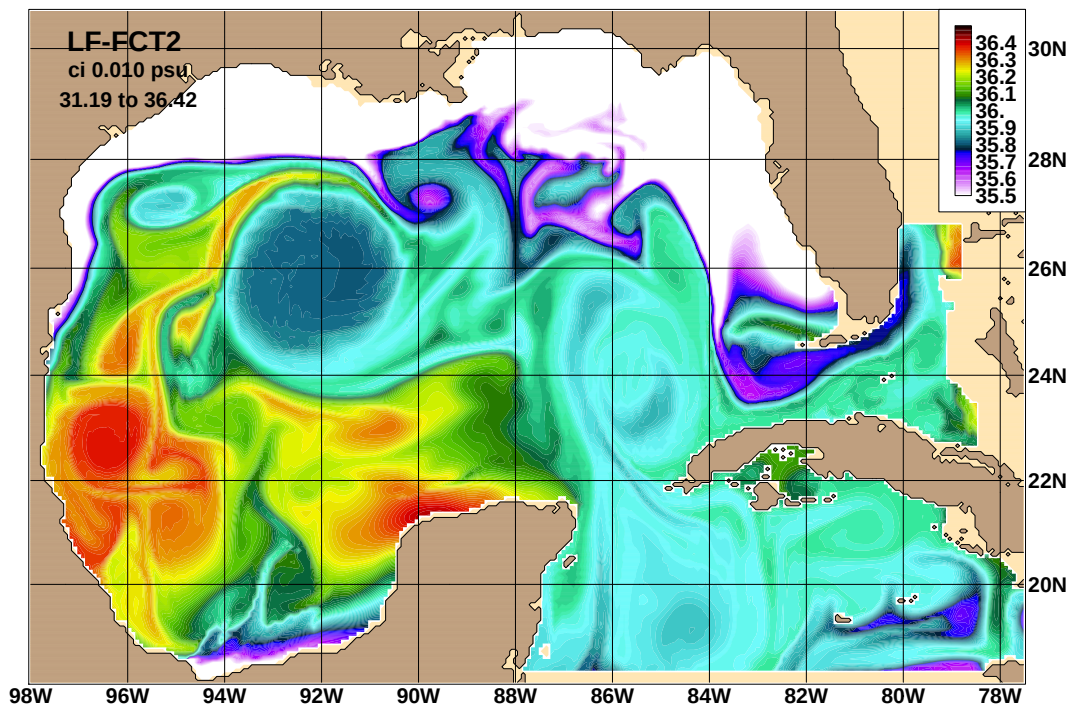


MPDATA VS LEAPFROG-FCT (SSS)

layer=01 salinity Dec 01, 1999 00Z [02.8H]



layer=01 salinity Dec 01, 1999 00Z [03.1H]



CANDIDATE FEATURES FOR HYCOM 2.3

- Stable-code vs new features
 - Released code-base has to be tested and stable
 - New features can be a significant improvement
 - Will add interim releases to web page
 - * Features may be removed in next released code
- Fully region-independent
 - Compile once, run on any region and any number of processors
 - Needed for full ESMF compliance
- Improve split-explicit time scheme
- Tidal forcing
- Diurnal heat flux cycle
- Equation of state that is quadratic in salinity
- Even better support for rivers
- Wind drag coefficient based on model SST
- Initial support for ESMF

HYCOM AND ESMF

- Earth System Modeling Framework
<http://www.esmf.ucar.edu/>
 - Superstructure couples components
 - * Air/Ocean/Ice/Land
 - * Asynchronous I/O component
 - Not yet available via ESMF
 - Infrastructure provides data structures and utilities for building scalable models
- Add a superstructure “cap” to HYCOM
 - Simplifies coupled systems
 - * HYCOM coupled to LANL CICE sea-ice
 - * Convert atmospheric field processing and the energy-loan ice model into ESMF components
 - Use ESMF for I/O
- This initial ESMF support will probably be optional
- ESMF may be required to run HYCOM at some point
 - Harder to get started with HYCOM
 - Will provide many new capabilities

HYCOM AND HOME

- Hybrid Ocean Modeling Environment (HOME)
 - Not one model, but an environment
 - Unify existing isopycnal/hybrid ocean models into a single code base
 - **Still an unfunded proposal**
- There will be a migration path from HYCOM to HOME
 - Re-implement HYCOM in HOME
 - HYCOM with ESMF will simplify the migration
- HOME “best practices” studies may find better alternatives to HYCOM algorithms
 - Exact mass conservation
 - Better free surface formulation
 - Improved time stepping
- Some of these may be back ported to HYCOM
- At some point “HYCOM in HOME” will become the only supported HYCOM
 - Might be very different to HYCOM 2.X
 - Might not even be called HYCOM