Nested simulations in the South Florida coastal seas with the HYCOM model

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In Collaboration with

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Peter Ortner, Libby Johns (NOAA-AOML)
SOUTH FLORIDA NESTED MODELS
Nested in GOM-HYCOM: GOMh0.04

SoFLA-HYCOM
1/25° resolution:
- idm=161
- jdm=163
- kdm=20
- 83.76°W–77.36°W
- 22.78°N–28.61°N

FKEYS-HYCOM
1/100° resolution
- idm=437
- jdm=361
- kdm=26
- 83.36°W–79.00°W
- 22.78°N–26.05°N

GOMh0.04 1/25° resolution:  
idm=517  jdm=349  kdm=20;  
98°W–77.36°W; 18.90°N–30.71°N; 2 m minimum water depth

minimum water depth: 2m
The complex South Florida coastal system

Lee et al., 2002
Local Observational Data Coverage in the SoFLA Domain

WERA coverage

CSTAR coverage

USF buoys locations

△: moorings
●: c-man stations
DT: Dry Tortugas
LK: Looe Key
san: Sand Key
smk: Sombrero Key
SR: Sharker River
CR: Caloosahatchee River
-: Cable
Interdisciplinary monitoring around the river influenced areas in support of the Everglades Restoration Project
<table>
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<tr>
<th>RunID</th>
<th>Layers</th>
<th>Atm. Forcing</th>
<th>Nesting BC</th>
<th>Simulation Period</th>
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</table>

**HYCOM v. 2.1.34, 2.1.35**
Model-Data Comparison: inner shelf

- Energy peaks are in phase over all.
- For the **SW Florida shelf** shallow moorings (#A1 and #B1):
  - No obvious phase bias between model and data.
  - The maximum cross-correlations occur at the zero lag which are above the 99% significance level.
  - Model currents larger in amplitude.
  - Wind-driven circulation dominates.
  - Free and NCODA runs very similar.
- For the **Florida Keys shelf** mooring at Looe Key:
  - Model currents have energy comparable to observations in the low-frequency band but are less energetic for the synoptic bands, suggesting FC influence.
Simulation of coastal to offshore interactions during an eddy passage April 2004
Along-Shore Current reversal at Looe Key during the eddy passage

81.4W, 24.65N

Model to Data comparison

eddy enters

April 2004

• 40 HLP data (rot. 73 deg.)
  prepared by Ryan Smith, NOAA/AOML
Noticeable improvement on positions of Loop Current and eddies

7-days, 5/24-31/2004, Aqua-chla
Provided by Viva Banzon, RSMAS
Satellite group
Model-Data Comparison: #C13  (COAMPS 27 km winds)

Observed/Simulated V5m at C13 (83.1°W & 26.1°N) For 2004

(a) Free BC
mean: -3.2
std: 6.7

(b) NCODA BC
mean: -7.1
std: 13.1

(c) ATL BC
mean: 5.0
std: 6.8

(d) coamp-27km wind-V
mean: 0.08
std: 0.04

“Floats” code by G. Halliwell
3-hourly winds & hourly mooring data => Daily filtering
Model-Data Comparison: #C17 (COAMPS 27 km winds)

3-hourly winds & hourly mooring data
=> Daily filtering
Model-Data Comparison: #C19 (COAMPS 27 km winds)

3-hourly winds & hourly mooring data => Daily filtering
Vertical-Time Section: FLAh0.04  C19  01/01/04-12/31/05  LP Rot=15°
Locations of the Cable and Model Sections

Bathymetry in SoFLAh0.04 Domain

Cable
SoFLAh0.04

West Palm Beach
Eight Miles Rock
**Statistic Characteristics:** SoFLA[h0.04
Florida Current Transport: 2004 and 2005

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<thead>
<tr>
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<th>Year 2004</th>
<th>Year 2005</th>
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<td><strong>Free</strong></td>
<td>31.85</td>
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<td><strong>NCODA</strong></td>
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<td><strong>STD</strong></td>
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<tr>
<td><strong>Year 2005</strong></td>
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</table>

Missing Cable data:
2004: 9/04-10/28; 12/26-12/28
2005: 7/26-8/03; 10/25-10/26; 12/08

Model data for those days are removed before computing the means and stds.
Cable Data and HYCOM: FC Transport at 26.7N Year 2004

The Atlantic basin-wide circulation plays an important role in inducing larger fluctuations of the FC transport.

FC transport at 27°N is not sensitive to the current changes in resolution of the local atmospheric forcing or the adopted increase in vertical layers.

FC transport of ATLd091 and archive files of GOMh200 were provided by Ole Martin Smedstad, NRLSSC.
High resolution FKEYS domain: nested open boundaries and topography

20 grids relaxation zone along boundaries
E-folding scale of 0.1 to 5-days in a relaxation zone
Daily updating for barotrophic & baroclinic BCs

NRL_DBDB2 with
2m minimum water depth
More realistic passages between Keys
FKEYS-HYCOM SSH: mesoscale and submesoscale eddy activity
FKEYS vs. SoFLA
Near sfc currents and salinity
Future Work

- Compare FKEYS results with data (same as SoFLA plus WERA)
- Determine the relative importance of resolution, BC’s, forcing in nested simulations
- Couple FKEYS with BOLTS (BiOlogical Lagrangian Transport System)
BOLTS: Coupled with 1/12° NAT-HYCOM
Will be done with 1/100° FKEYS-HYCOM

Spatial recruitment of Damselfish onto coral reefs resulting from monthly virtual spawning events along the Florida Keys

Paris et. al (in prep.)

Spatial distribution of passive particles released from the same reef areas after a 30-day pelagic transport within the upper layer (10-20m) of the 1/12° NAT-HYCOM

Paris et. al (in prep.)
Regional HYCOM modeling at UM/RSMAS