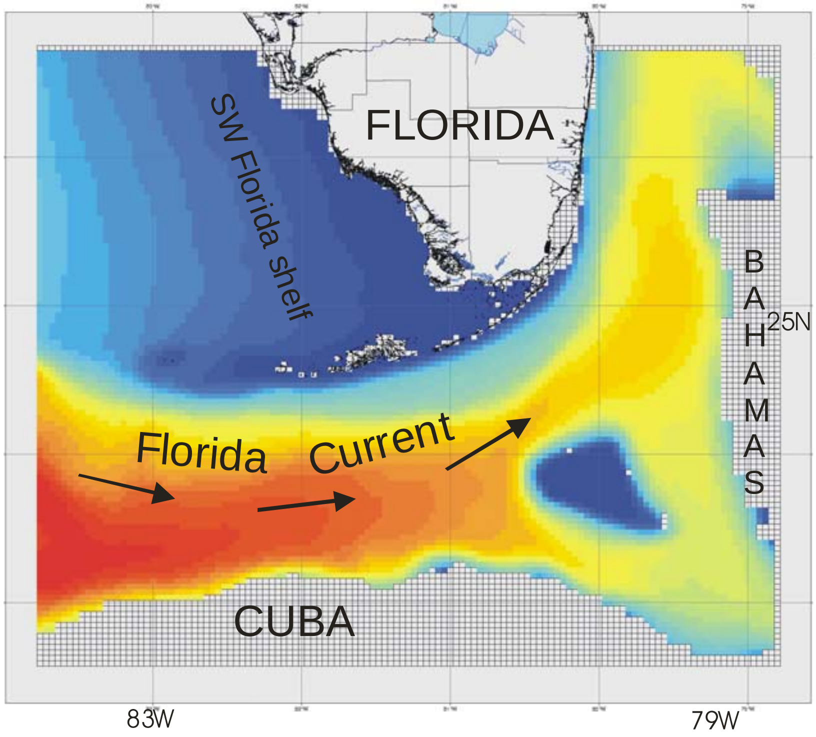
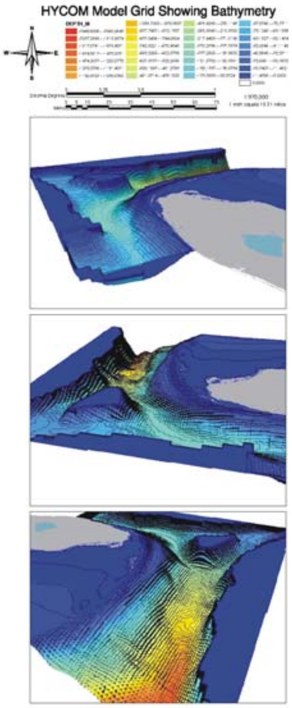
The SoFLA-HYCOM (South Florida HYCOM) Regional Model around the Straits of Florida, Florida Bay and the Florida Keys





Villy H. KOURAFALOU, Rolando S. BALOTRO and Tom N. LEE
Rosenstiel School of Marine and Atmospheric Science, University of Miami
Division of Meteorology and Physical Oceanography, Miami, FL 33149
vkourafalou@rsmas.miami.edu
tel.: (1) 305 421 4905
fax: (1) 305 421 4696

In collaboration with:

Libby JOHNS and Peter ORTNER (NOAA/AOML)

Alan WALLCRAFT and Tammy TOWNSEND (NRL, Stennis Space Center)

University of Miami/RSMAS

Technical Report 2005/03

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **DEC 2005**	2. REPORT TYPE	3. DATES COVERED **00-00-2005 to 00-00-2005**

4. TITLE AND SUBTITLE **The SoFLA-HYCOM (South Florida HYCOM) Regional Model around the Straits of Florida, Florida Bay and the Florida Keys**	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

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**28**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

TABLE OF CONTENTS

Background 3

Model domain and set-up 4

Boundary conditions 7

Simulations 8

Climatological run 8

Inter-annual run 16

Applications 26

Summary 27

ACKNOWLEDGEMENTS 28

Background

The seas that surround the southern part of the Florida peninsula form a unique oceanographic environment that includes ecologically sensitive shallow areas (Florida Bay and the Florida Keys reef tract), shelf areas (the relatively broad southwest Florida shelf and the narrow shelf along the Atlantic side of the Florida Keys) and deep areas (Straits of Florida). The coastal seas around South Florida include Marine Protected Areas that are embedded in the Florida Keys Marine Sanctuary and the Dry Tortugas Ecological Reserve. The South Florida domain is the crossroads between the Gulf of Mexico and the North Atlantic and it has been the focus of long term, ongoing interdisciplinary surveys. The observations have provided concrete evidence that these distinct marine environments around South Florida are strongly inter-connected by circulation and biochemical exchange processes on a regional scale, while oceanic boundary currents connect them to remote regions of the Gulf of Mexico and the Caribbean. The coastal areas around South Florida will be the recipients of potentially drastic changes in freshwater flows associated with the Everglades Restoration Project. Observations and modeling have been employed to study the effects of such changes, in the context of natural disturbances associated with large scale flows, climatic variability and connectivity to remote reef systems.

The South Florida (SoFLA) Regional Model (http://hycom.rsmas.miami.edu/overview/SoFLA_HYCOM.pdf) has been developed to address these challenging tasks so that coastal models of Florida Bay and the Florida Keys are linked together with the adjacent seas through suitable boundary conditions. A nested modeling approach has been employed to ensure the proper representation of such interactions. The modeling activities are supported by ancillary observational projects of NOAA/AOML and UM/RSMAS (see the NOAA South Florida Ecosystem Research and Monitoring Program (http://www.aoml.noaa.gov/sfp/).

Model domain and set-up

The South Florida (SoFLA) Regional Model is an adaptation of the HYbrid Coordinate Ocean Model (HYCOM), thereafter called the SoFLA-HYCOM. The nesting of the SoFLA-HYCOM within a larger scale HYCOM model allows the accurate simulation of the interaction between shallow water dynamics around the Florida Bay and the Florida Keys reef tract with larger scale oceanic flows. The SoFLA-HYCOM performs simulations that are suitable to provide boundary conditions to the EFDC Florida Bay model (Fig. 1) and it is designed to generally support hydrodynamic, water quality and ecosystem modeling activities of the Everglades Restoration Project and of the Florida Bay and Florida Keys Feasibility Study.

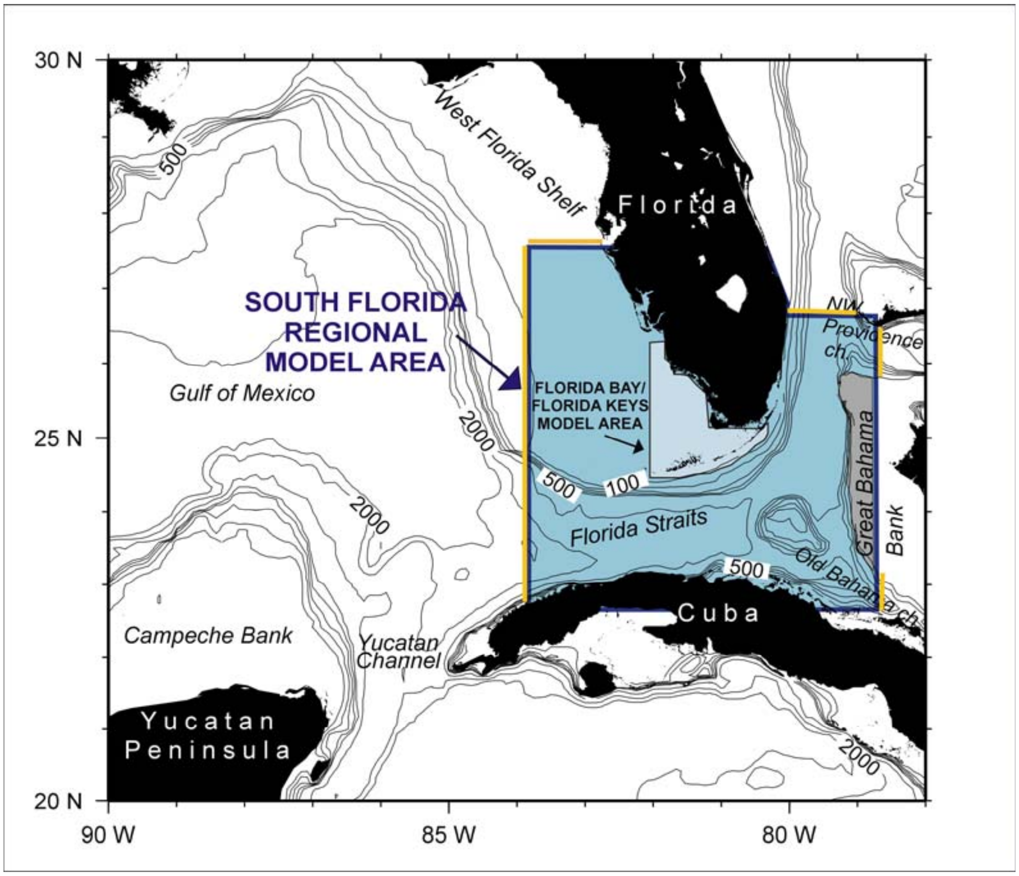


Figure 1: The SoFLA-HYCOM Regional Model domain; embedded is a sub-domain (grey shaded) where model parameters (current Velocity, Temperature, Salinity and Sea Surface Elevation) are archived for use by coastal Florida Bay and Florida Keys models.

The **HY**brid **C**oordinate **O**cean **M**odel (HYCOM) is a state of the art community model (http://oceanmodeling.rsmas.miami.edu/hycom/) supported by code development and operational global/regional simulations associated with the HYCOM Consortium for Data Assimilative Modeling, which is coordinated by UM/RSMAS. HYCOM has been designed as a finite-difference and hybrid isopycnal/sigma/z coordinate ocean model. It is isopycnal in the open stratified ocean, but reverts to a terrain following (sigma) coordinate in shallow coastal regions, and to z-level coordinates near the surface in the mixed layer and or un-stratified seas. This generalized vertical coordinate approach is dynamic in space and time via layered continuity equation, which allows a dynamical transition between the coordinate types. In doing so, the model combines the advantages of different types of coordinates and is particularly suitable for present application that requires the simulation of coastal to open sea interactions.

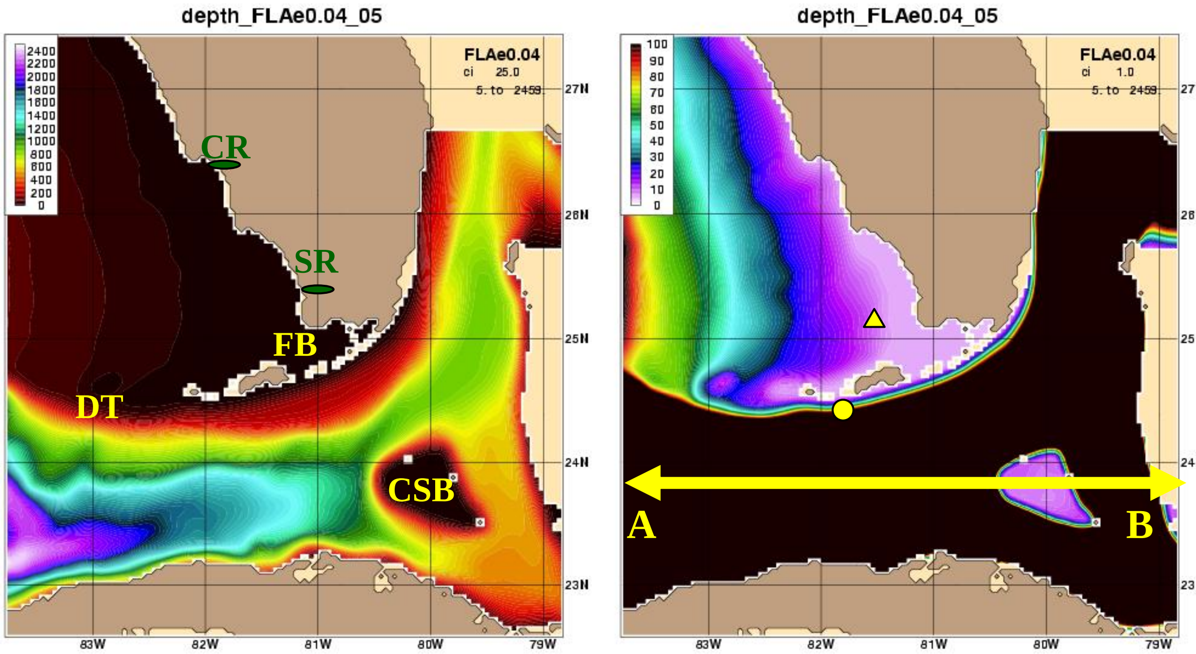


Figure 2: SoFLA-HYCOM bathymetry; details are shown for the deep (left) and shallow (right) depths. FB: Florida Bay; DT: Dry Tortugas; CSB: Cay Sal Bank; SR: Shark River; CR: Caloosahatchee River. The line AB is used in the cross-section of Fig. 5; the locations of selected sites used for comparison with model forcing and results are marked: buoy A (triangle) and CMAN Sand Key station (circle).

The SoFLA-HYCOM domain is shown in Fig. 2 and it extends from 22.59^{0}N to 27.44^{0}N and from 78.80^{0}W to 83.76^{0}W. This includes the south Florida coastal system and also covers the Florida Straits between the Keys and Cuba including the Cay Sal Bank and the Bimini island (Bahamas). The bathymetry (Fig. 2) has been adopted from the 2-minute NAVO/NRL DBDB2 global dataset. The depth values in shallow areas around the Florida Keys reef tract have been corrected so that topographic details are included; this is absent in the larger scale models that provide the boundary conditions (Fig. 3). The deepest portion of the domain (2459 m) is located at the southern end of the Florida Strait and the minimum depth is set at 5 m. The horizontal resolution is 1/25 degree (about 3 to 3.5 km in latitude), giving a mesh of 135 X 125 grid points. The vertical discretization consists of isopycnal layers in the deep Florida Straits and a combination of sigma and z-layers on the shelf areas (a total of 19 vertical layers). The target density values (σ_t) corresponding to layers 1 to 19 are: 19.50, 20.25, 21.00, 21.75, 22.50, 23.25, 24.00, 24.70, 25.28, 25.77, 26.18, 26.52, 26.80, 27.03, 27.22, 27.38, 27.52, 27.64, 27.74 respectively. Time integration steps are 15 s for barotropic/external mode and 240 s for baroclinic/internal mode. The vertical mixing algorithm is based on the K-Profile Parameterization (KPP) while lateral friction and diffusion are computed through a Flux Correction Term (FCT) scheme.

There are 4 distinct open boundaries of the domain (Fig. 3): the west Florida shelf to the north (west Florida coast), the Gulf of Mexico to the west, the Old Bahama Channel to the southeast and the Providence Channel to the east; the north boundary at the east Florida coast extends to the Grand Bahama island.

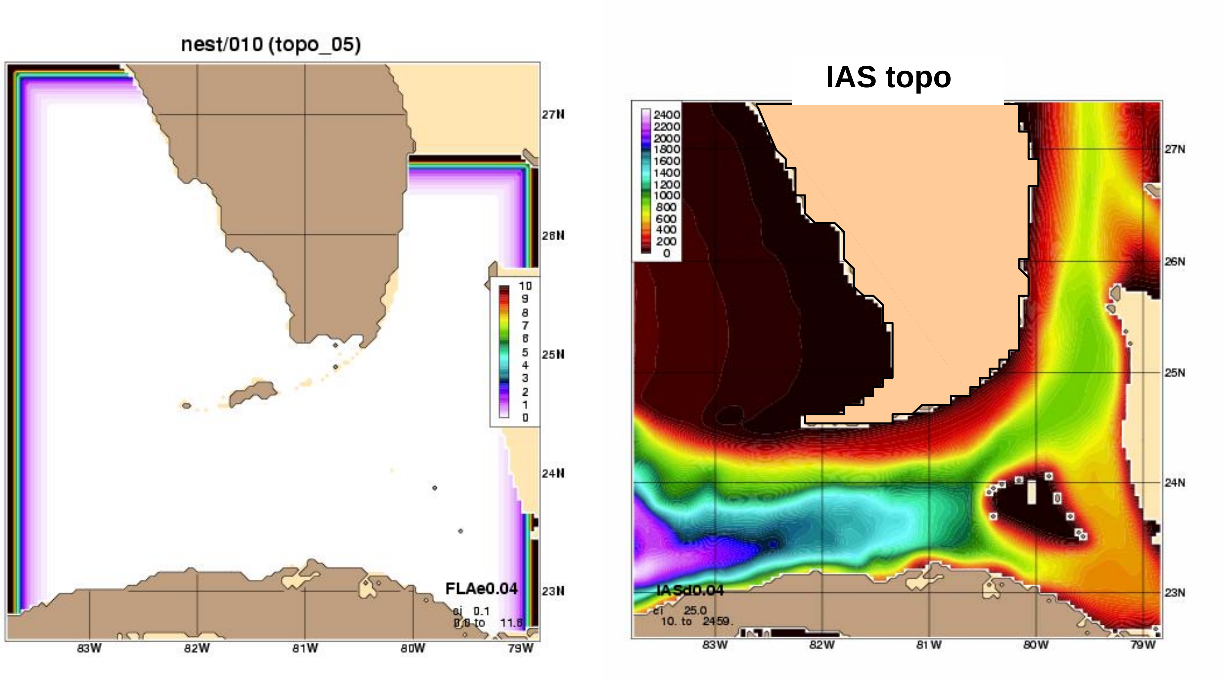


Figure 3: (left): the nested open boundaries of the SoFLA-HYCOM regional model; (right): the topography of the IAS-HYCOM model, where SoFLA is nested on, that has land values over Florida Bay and the Florida Keys.

Boundary conditions

The SoFLA-HYCOM domain has been nested within the NA-HYCOM (North Atlantic HYCOM) that has a resolution of 1/12 degree of latitude (~6-7 km grid size), minimum depth of 20m and includes the entire North Atlantic, the Caribbean and Gulf of Mexico, as well as global thermohaline circulation (through nesting within the global HYCOM). The nesting procedure follows the standard HYCOM robust capability for nesting one HYCOM grid within another, with information passing off-line from the coarse outer grid to the finer inner grid. The method of characteristics is used for the barotropic open boundary condition. Buffer zones with user-chosen e-folding times are used to relax the baroclinic temperature, salinity, pressure and velocity components at a user-chosen frequency (usually as often as model output is available) towards the outer grid model.

Two types of nesting have been implemented in the SoFLA simulations. First a double nest, where the SoFLA-HYCOM is nested within the IAS-HYCOM (Intra-American Sea) which has a 1/25 degree resolution and minimum depth of 10m. This setting was used for the climatological simulation and for sensitivity tests to assure the validity of the nesting procedure. Since both IAS and SoFLA have the same resolution, the role of the improved topography and shallower minimum depth in SoFLA was studied first.

The final model set-up that is now used for the ongoing inter-annual simulation is a 1/25 degree SoFLA-HYCOM nested directly to the 1/12 degree NA-HYCOM. As mentioned above, the SoFLA-HYCOM resolves the Atlantic shelf along the Florida Keys reef tract and the major passages between the Florida Keys and Florida Bay. Furthermore, the SoFLA-HYCOM includes additional sources of freshwater inputs, namely the rivers on the Southwest Florida Shelf from the Shark River to the Caloosahatchee River, which are important sources of low salinity waters that can impact the water properties around and within Florida Bay, as well as the Florida Keys through the neighboring Keys passages.

Simulations

Climatological run

A long-term simulation has been completed with the nested configuration described above. The simulation is cyclic, using the same forcing each year. The employed perpetual year atmospheric forcing is from the European Center for Medium Range Weather Forecasting (ECMWF) and includes monthly mean fluxes of heat, precipitation and winds. In order to allow high frequency variability in the wind field, 6-hourly anomalies have been superimposed on the monthly mean fields, that were extracted from a “typical” (non El-Nino) year.

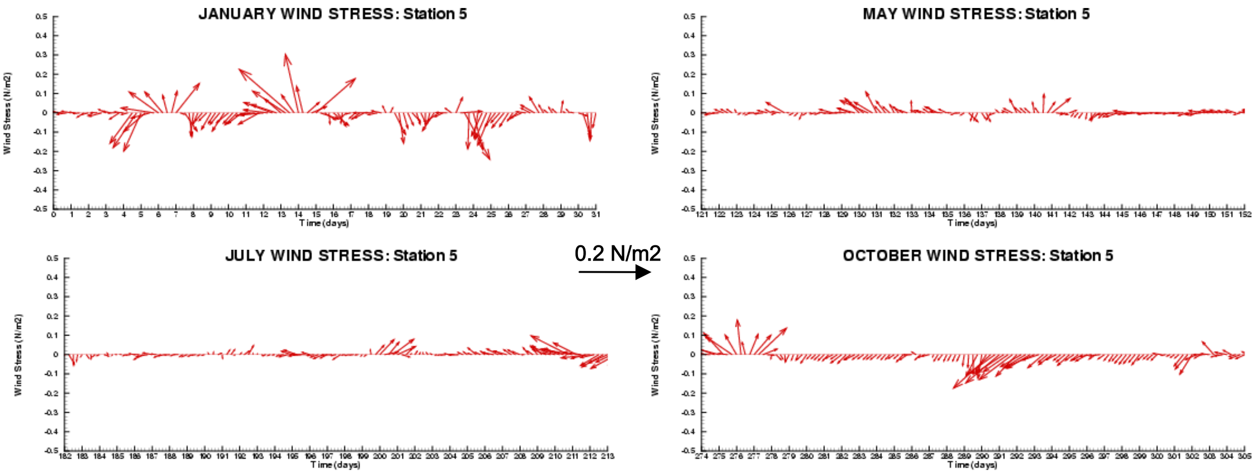


Figure 4: Model atmospheric forcing (perpetual year): daily averaged vectors of wind stress for one month per season at a point near the Sand Key station (marked in Fig. 2).

Examples of the model wind stress are shown in Fig. 4, where daily averaged vectors are plotted for clarity. The January values are largest, as is typical for the winter season, dominated by cyclonic rotation in the wind field during the passage of cold fronts. Such events, but of smaller magnitude, are present in the May (spring) and October (fall) examples, while the July (summer) values are smallest.

The simulation shows the seasonal patterns in the circulation and water properties around the South Florida coastal areas. In particular, the salinity fields exhibit distinct differences between the “dry” (winter to spring) and “wet” (summer to fall) seasons, while the temperature field is dominated by seasonal changes in vertical stratification (Fig. 5), cold air outbreaks in winter and the passage of Florida Current eddies (Fig. 6 and 7).

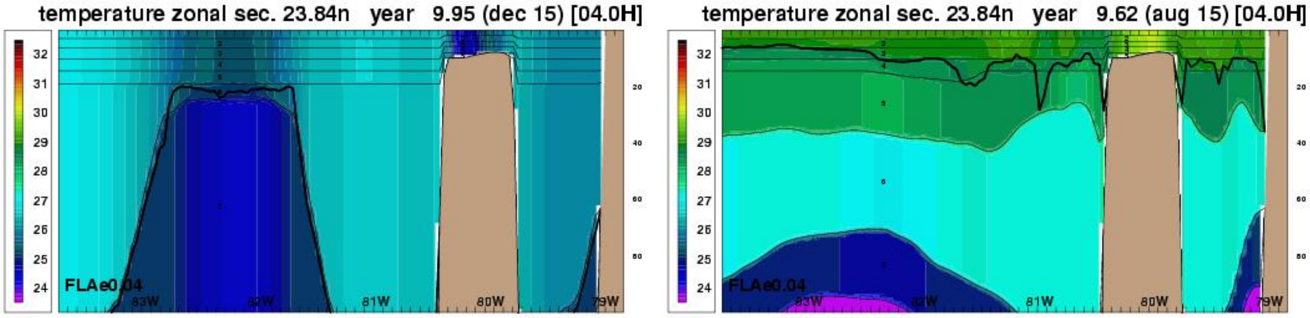


Figure 5: Model computed vertical temperature profiles along zonal section AB (marked in Fig. 2): (left) during summer (Aug 15); and (right) during winter (December 15). Thin lines mark the model layers and the thick line marks the model mixed layer depth.

The Florida Bay domain, although not fully resolved in the regional model, exhibits reasonable patterns of salinity changes, as for instance the modification of the hypersaline conditions in the dry season caused by the influx of low salinity waters from the neighboring Southwest Florida shelf rivers.

The coastal flows are well resolved. A wind-driven flow along the Atlantic shelf of the Florida Keys that is southwestward (opposing the mean northeastward flow along the Florida Current front) is evident in periods that are not dominated by eddy passages; this flow has been documented through drifter data and is absent from the larger scale IAS-HYCOM that does not include the shallow Keys topography. An example is given in Fig. 8, where the intense southeastward wind event that starts around October 16 causes the southeastward flow along the Keys shelf that is evident from October 17 through October 21. Flows on the southwest Florida shelf are dominated by the wind forcing, with buoyancy-driven forcing due to river discharge confined in the nearshore regions. An illustration of the prevailing mean flows is given in Fig. 9, where daily averaged barotropic currents exhibit the dominant Florida Current in the Straits and a persistent southward flow on the southwest Florida shelf. The latter agrees with mean flows derived from long-term current meter measurements.

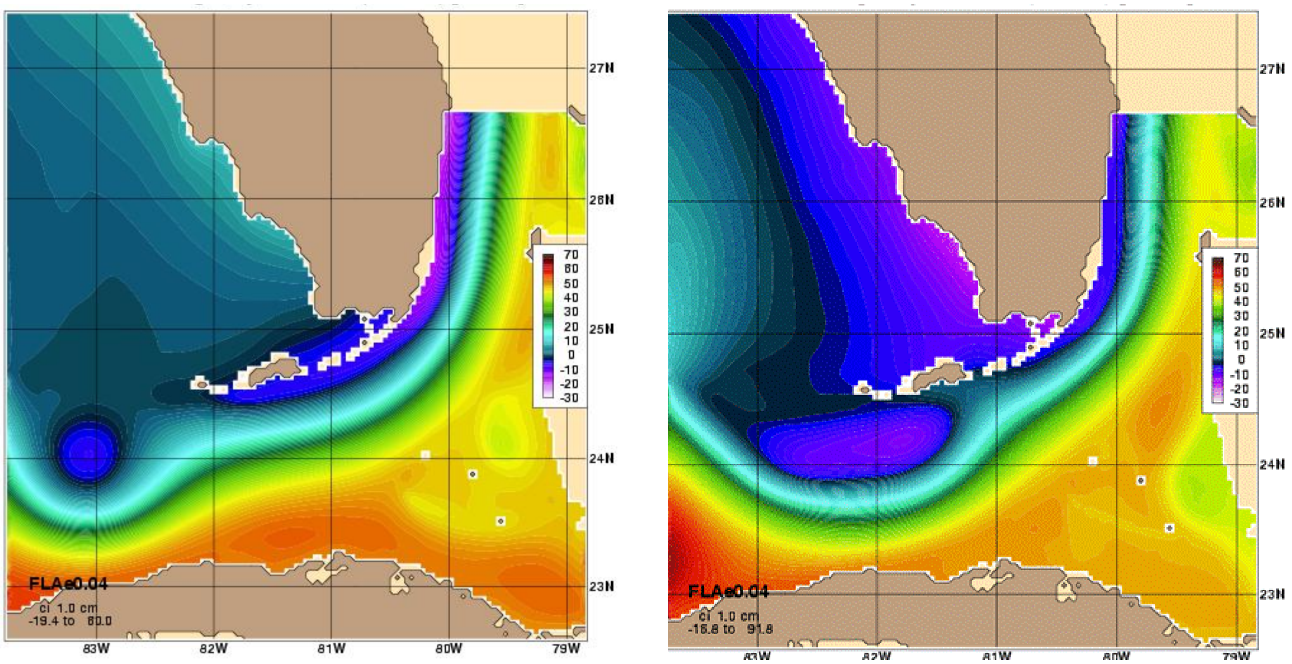


Figure 6: Sea surface elevation (scale in cm) during the formation of a Tortugas eddy (left) and eddy passage through the Straits of Florida (right).

Tracer experiments have been conducted with continuous release of passive tracers at different locations, to study the transport pathways around South Florida. Examples are given in Figs. 10 and 11 from a continuous release at the Dry Tortugas, that seeks to simulate prevailing recruitment pathways that larvae would be inclined to follow. The dispersion of a passive tracer is controlled by the mean flow of the Florida Current that dominates the velocity field in the Florida Straits (Fig. 10). The tracer follows a northeastward route which brings it closer to or away from the Florida Keys, depending on the frontal position. However, other circulation features have a prominent role in the tracer dispersion and the connectivity between the Dry Tortugas and Florida Bay. The mean southwestward flow along the Florida Keys shelf (which is wind-driven, as known from observations and as reproduced by the model) has a strong influence on the coastal tracer

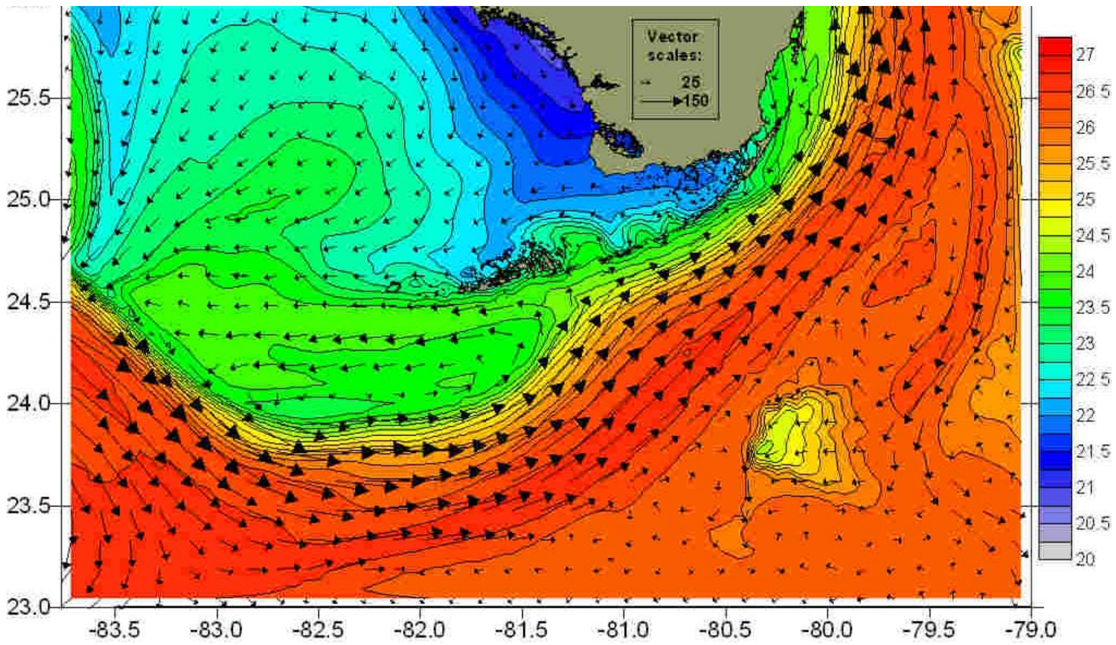


Figure 7: Near-surface temperature and current velocity (every 3^{d} vector plotted; cm/s) during the passage of a mesoscale frontal eddy near the Florida Keys. The model resolves temperature contrasts between cold shallow areas in and around Florida Bay, warm FC, and cool eddy waters that are circulating cyclonically inside the eddy, with clear intrusions toward the Keys passages; some warmer filaments within the eddy can be seen. The eddy was larger before entering the Florida Straits and has begun to elongate as it is squeezed between the FC and the Keys.

pathways, allowing a return toward the southwest Florida shelf and intrusions in Florida Bay through the Keys passages. When a sub-mesoscale eddy is present along the Florida Current front (Fig. 11), the tracer experiences higher rates of retention and as the eddy enters the Florida Straits and interacts with the Keys topography, there is evidence of tracer influence on the Florida Keys reef tract and passage toward Florida Bay.

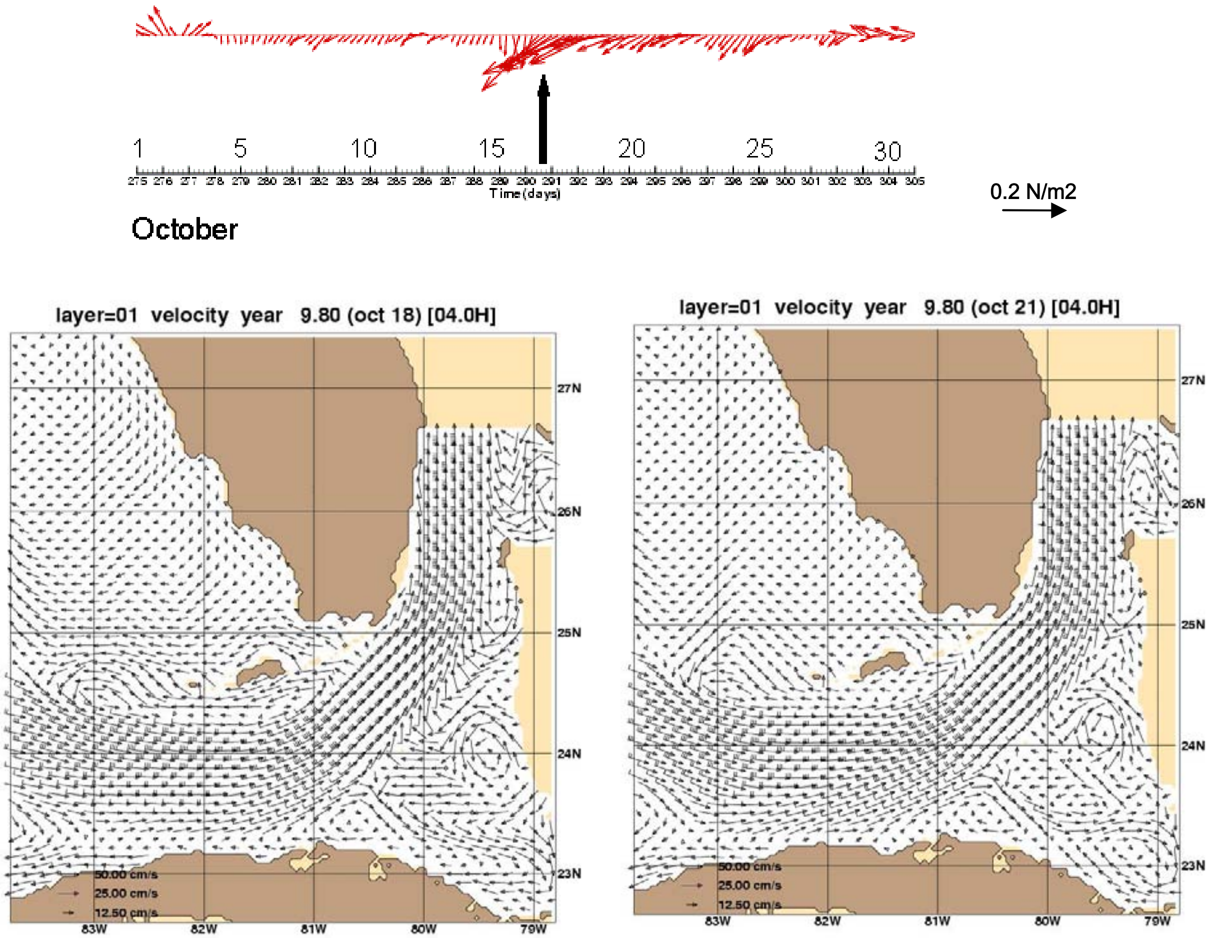
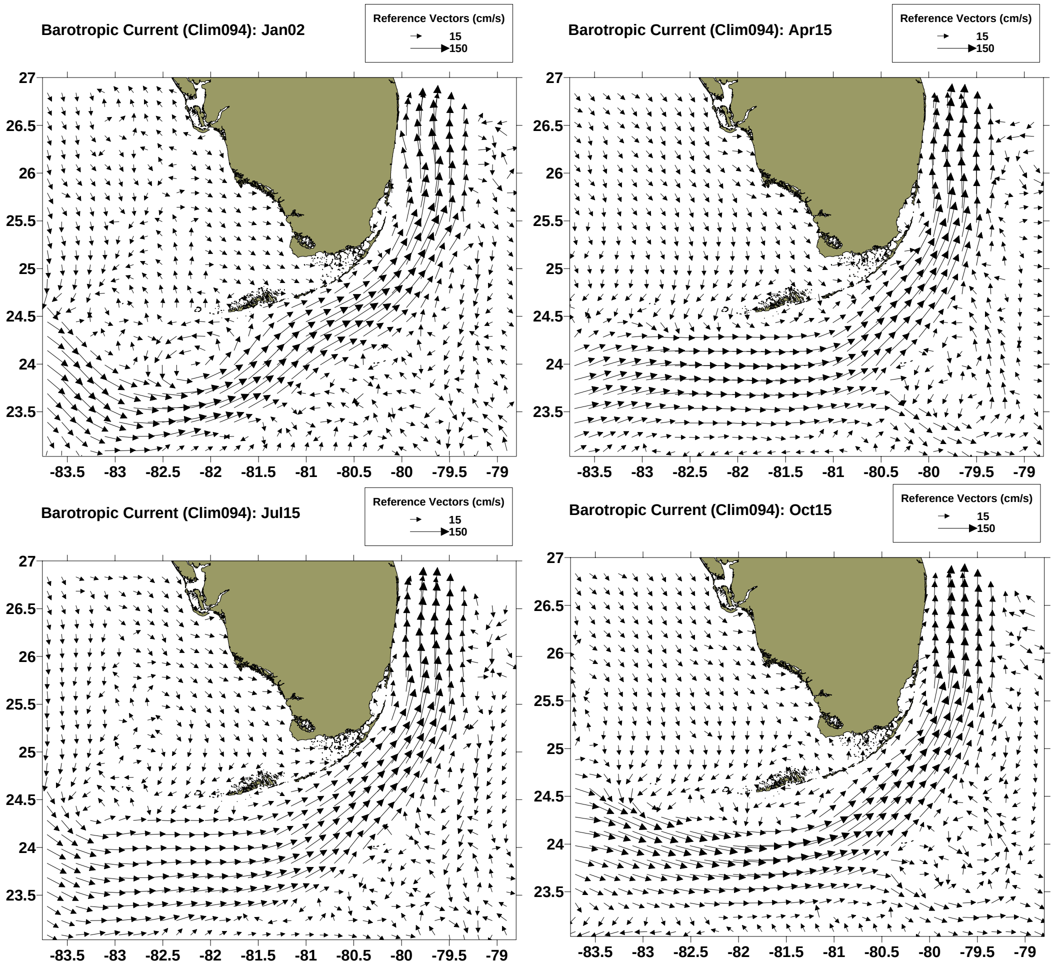


Figure 8: (a) Time series of wind stress at a point near the reef tract in Sand Key (Fig. 2) for the month of October. (b) Model computed near surface currents (every 4th vector plotted; cm/s) daily averaged for October 18 and October 21.



Barotropic Current (Clim094): Jan02

Barotropic Current (Clim094): Apr15

Barotropic Current (Clim094): Jul15

Barotropic Current (Clim094): Oct15

Figure 9: Vertically and daily averaged model currents for certain days during the climatological simulation (every 3d vector plotted; clockwise from top left: January 02, April 15, July 15 and October 15).

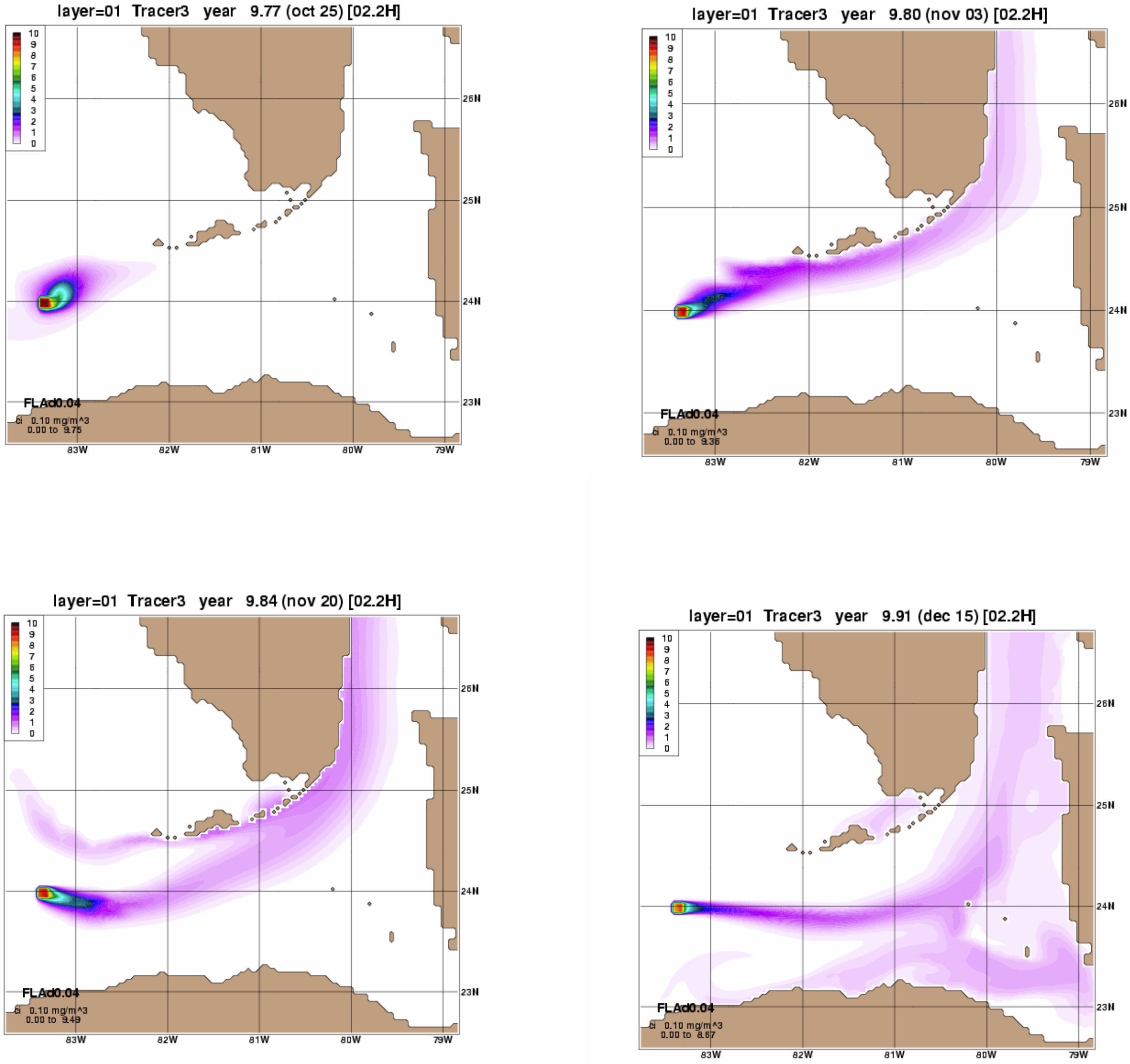


Figure 10: Tracer experiment showing dispersion during continuous release at the Dry Tortugas: tracer patch near the release site (upper left); tracer dispersion influenced by Florida Current front approaching the Keys (upper right) or moving away from the Keys (lower panels). Notice the westward flow along the Keys shelf that allows the tracer to be advected against the dominant Florida Current mean flow.

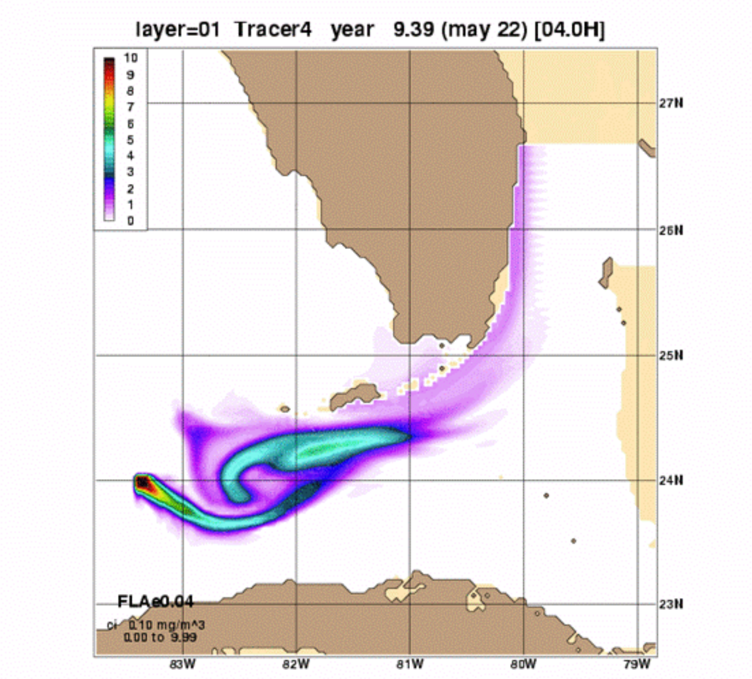


Figure 11: Tracer experiment showing recirculation by a mesoscale eddy with influence on Florida Bay through the Keys passages.

Inter-annual run

An inter-annual simulation is currently in progress, with the same 1/25 degree SoFLA-HYCOM configuration described above, but with boundary conditions from the 1/12 degree North Atlantic and Gulf of Mexico NA-HYCOM. The NA-HYCOM inter-annual run has been started from the multi-year climatological NA-HYCOM simulation at year 1999 with high-frequency atmospheric forcing from the Navy Operational Global Atmospheric Prediction System (NOGAPS). A careful evaluation of the wind forcing has been performed for the SoFLA-HYCOM region, by comparing time series of NOGAPS winds with measured values at C-MAN stations (Coastal-Marine Automated Network of the NOAA/National Buoy Center).

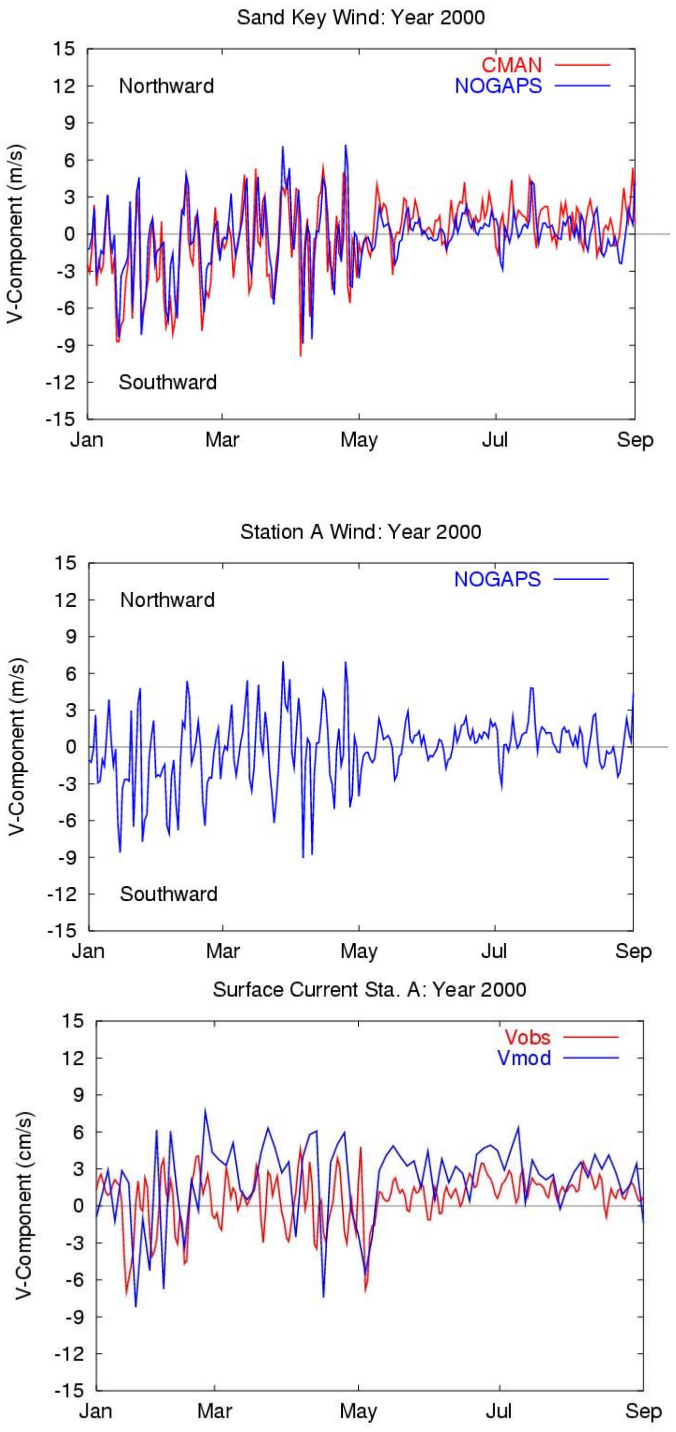


Figure 12 (top to bottom): North-South component of winds at the CMAN Sand Key station with superimposed NOGAPS model winds at the same location; NOGAPS winds at the location of mooring A; near surface model computed currents at the mooring A location with superimposed near surface observed currents at mooring A. (Stations marked on Fig. 2).

An example is given in Fig. 12, where the prevailing along-shore (North-South) component of wind and current fields is plotted in two locations (marked on Fig. 2). As seen in Fig. 12, there is very good agreement between the NOGAPS and measured wind fields at the Sand Key CMAN station; similar results were found for all other CMAN locations. The NOGAPS along-shore wind near mooring A is also given in Fig. 12, along with the along-shore model and measured currents near the surface (at 2 m, over

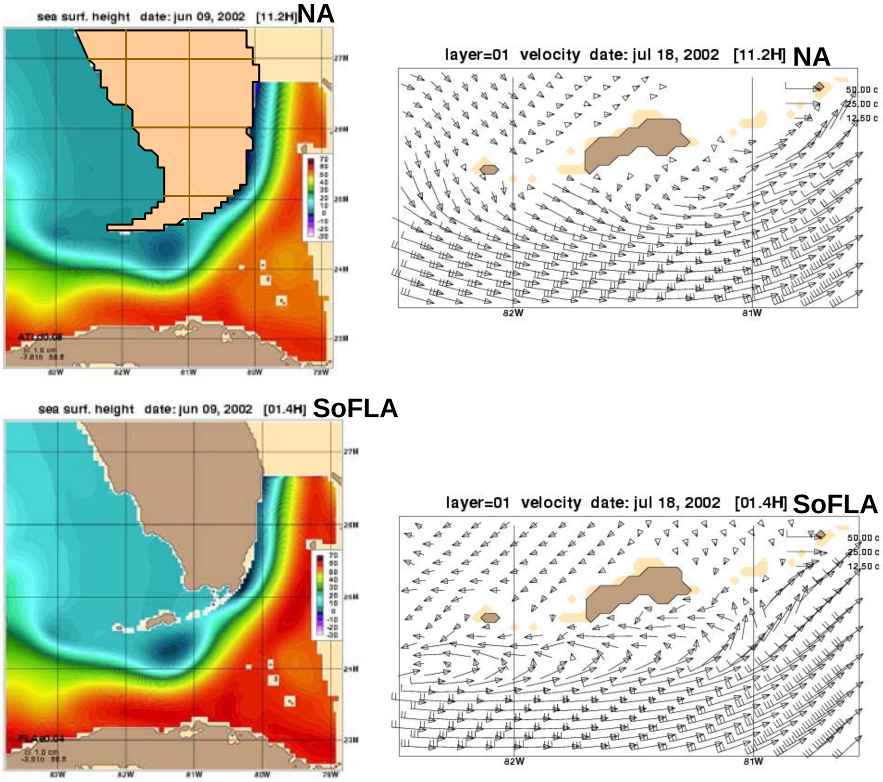
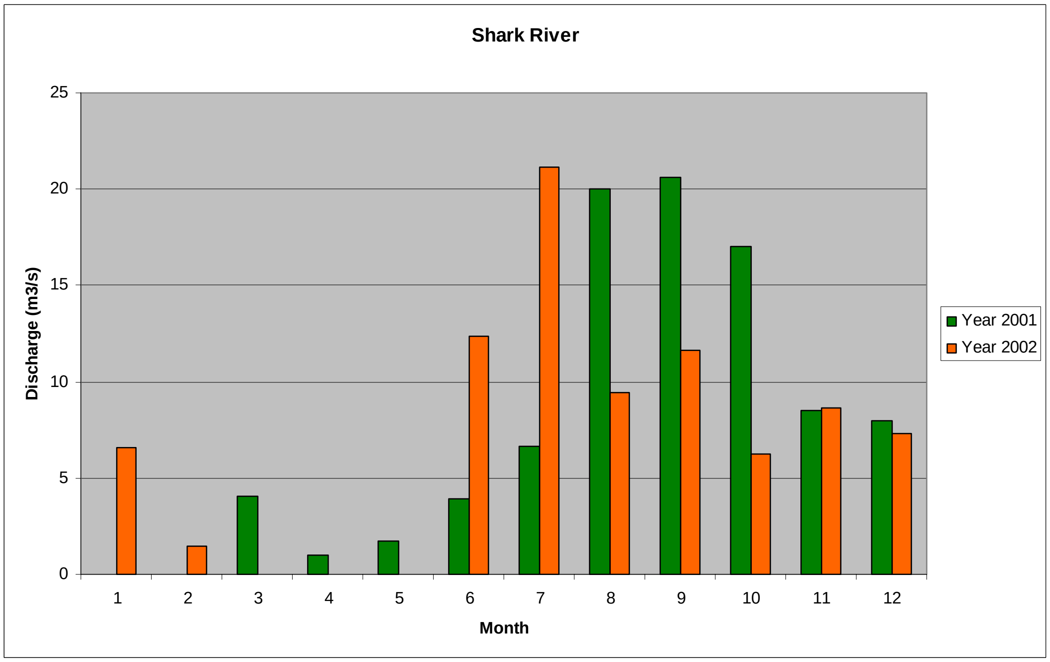


Figure 13: Sea surface elevation (left) on June 2, 2002 during an eddy passage and near-surface current velocity (right) on July 16, 2002 (no eddy present). Bottom panels are from the SOFLA-HYCOM and upper panels are from the larger scale NA-HYCOM, which has coarser resolution and does not include the shallow topography in the Florida Bay – Florida Keys area. For clarity and for compatibility (same number of grid points for both domains), the NA currents are plotted every second vector and the double resolution SoFLA currents are plotted every fourth vector.

a total depth of 6 m). The agreement is excellent in phase and most of the current reversals at the mooring A location seem to be associated with wind forcing. The agreement is also satisfactory in magnitude and is expected to improve in simulations with higher vertical resolution that are currently under way.

The circulation around Florida Bay and the Florida Keys predicted by the SoFLA-HYCOM model includes coastal flows and topographic interactions that are absent in the larger scale NA-HYCOM model, which is coarser resolution and does not include the shallow depths in the study area. An example is shown in Fig. 13, where the sea surface height during an eddy passage (June 9, 2002) and the near surface current when no eddy is present (July 18, 2002) are shown near the lower Keys. The eddy is elongated only in SoFLA (as it feels the Keys topography), while the southwestward flow over the Keys shelf is evident in SoFLA and absent in the larger scale model; both of these processes have implications for cross-shore flows near the shallow passages to Florida Bay, as discussed in the previous section.

River discharge data for the Southwest Florida shelf rivers have been incorporated and salinity data have been employed to evaluate the model computed salinity patterns. Data for river inflows have been supplied by the U.S. Geological Survey, through an ancillary project with the South Florida Water Management District. The seasonal and inter-annual variability in river discharges is evident in Fig. 14, where monthly mean values are plotted for the Shark and Caloosahatchee Rivers marked in Fig. 2. The salinity data are from the long term bi-monthly surveys of South Florida hydrographic properties aboard the UM/RSMAS R/V Walton Smith (NOAA/AOML and UM/RSMAS collaboration under the NOAA South Florida Ecosystem Research and Monitoring Program (http://www.aoml.noaa.gov/sfp/). The surveys last about 10 days and cover the Atlantic Florida Keys shelf, the southwest Florida shelf from the Florida Bay entrance to the Caloosahatchee River and extending offshore to the Dry Tortugas area. The best parameterization of riverine flows in the model was found to be the implementation of a line source of freshwater along the Ten Thousand island coastline (between approximately 25.2 ^{0}N and 25.8 ^{0}N), starting at about the Shark River and with an additional point source for the Caloosahatchee River.



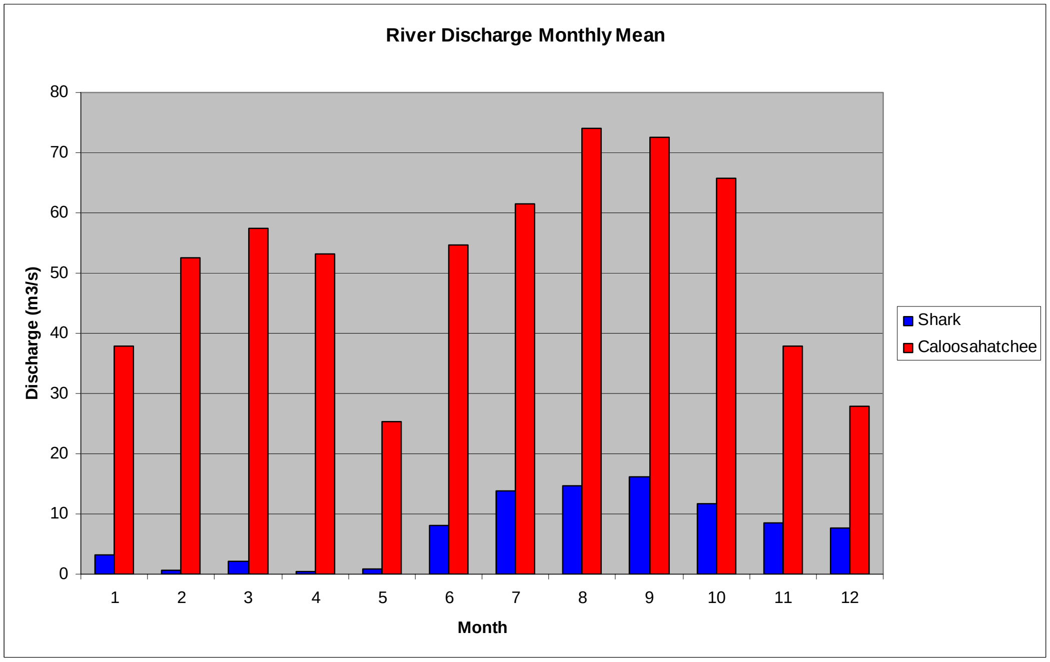


Figure 14: River data for the Shark River and for the Caloosahatchee River. Monthly averaged values for years 2001 and 2002 (upper) and based on a long term discharge data record (lower).

The seasonal variability in salinity for the Southwest Florida shelf area that is in the immediate vicinity of the riverine inputs is depicted in Fig. 15. The monthly mean salinity over a subset of the model area that is close to the monitoring sampling area (marked in Fig. 17a) is shown. The results from three years are employed (2000-2002) and a distinction between “wet” and “dry” seasons is apparent: salinities are generally highest in April-May and lowest in September-October. Furthermore, it is obvious from Fig. 15 that the overall salinity was highest in 2000 and lowest in 2002, reflecting inter-annual variability. The observed salinity patterns confirm that the year 2002 was generally “dry” as compared to a “wet” year 2000. There is a good correlation between salinity and precipitation. For instance, the lowest values in the area averaged salinity of Fig. 15 for the year 2001 (October) follow the peak in precipitation during the middle and late September of 2001 (Fig. 16).

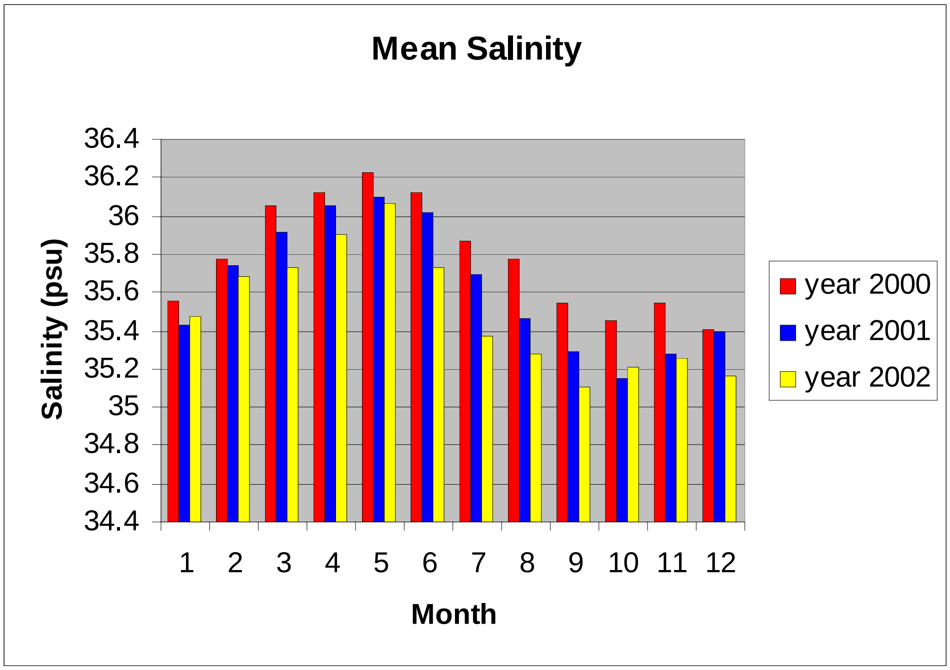


Figure 15: Model computed monthly mean salinity over an area sampled by the R/V Walton Smith (area marked in Fig. 17a) showing a pattern of wet (summer) and dry (winter) seasons over three years (2000 to 2002).

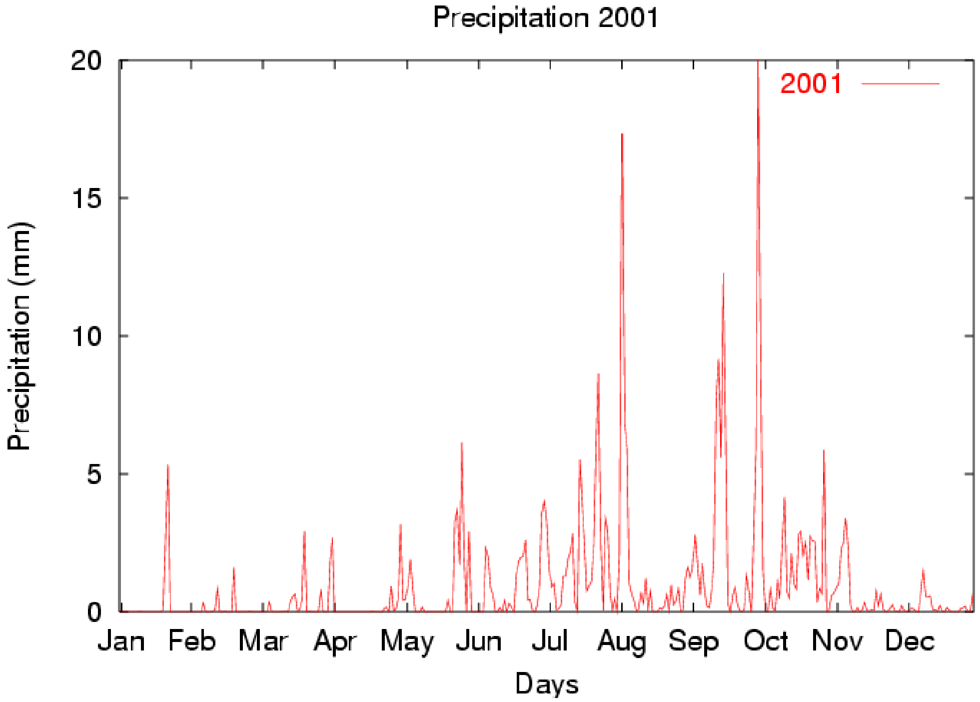


Figure 16: Precipitation in the model input for year 2001.

A comparison of data derived versus model derived horizontal salinity maps are shown in Figs. 17a-b. The near-surface salinity fields capture the highest influence of the local river discharges. It should be noted that no freshwater discharge to Florida Bay is currently prescribed in the regional SoFLA-HYCOM model; direct discharge to Florida Bay is a focus of the hydrodynamic Florida Bay model that is being developed by the South Florida Water Management District and is nested within the SoFLA-HYCOM. It should also be noted that the model derived fields are a true mathematical average of the salinity over the 10-day data survey periods, whereas the data derived distribution is a contour of sequential observations during the data period. However, the comparison is very good, as changes in both coastal and offshore patterns are in agreement, not only qualitatively, in terms of similar patterns, but also quantitatively, as changes in salinity values are similar.

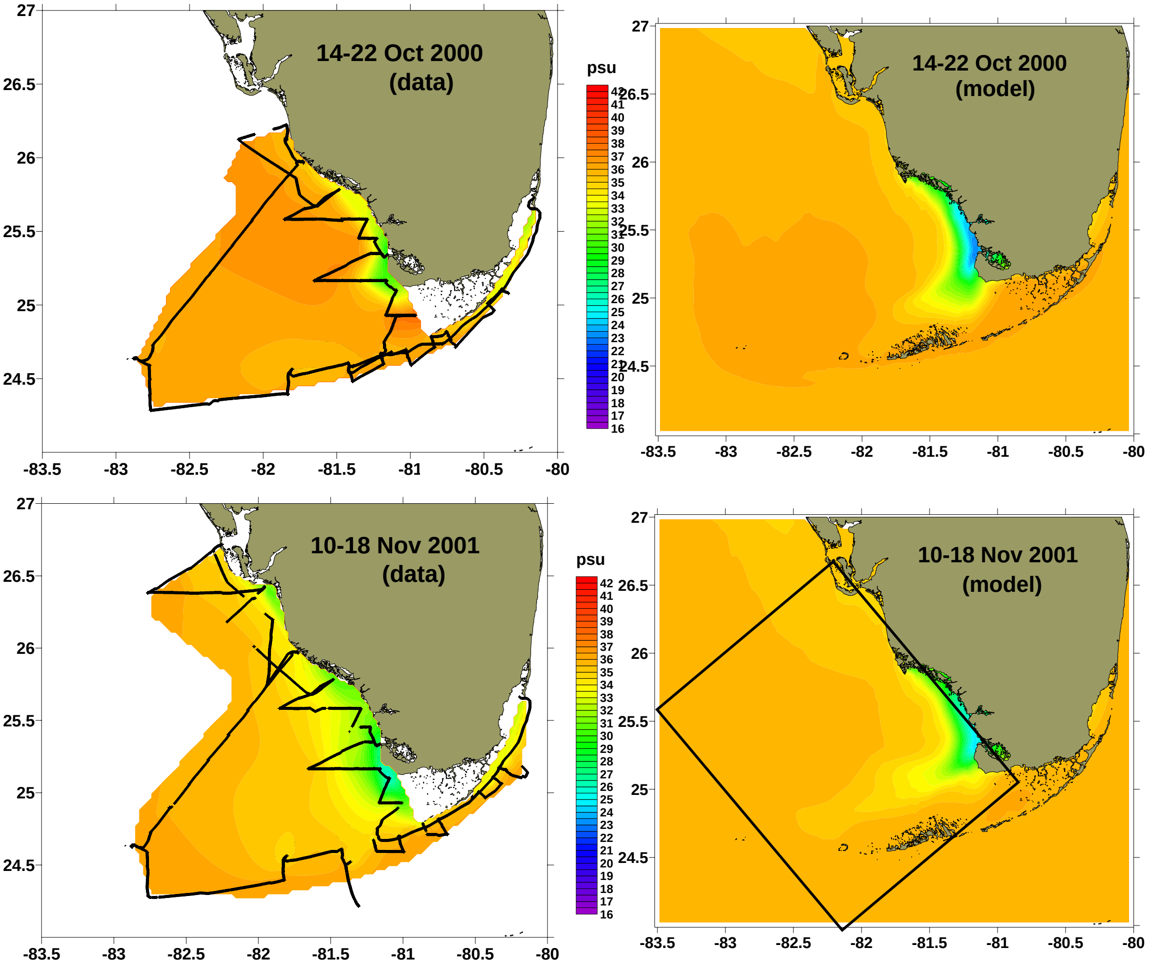


Figure 17a: Near-surface salinity fields computed from the monitoring data surveys (left) and from the model simulations for the same periods: 14-22 October 2000 (upper) and 10-18 November 2001 (lower). The box in the bottom right panel marks the area used for the salinity average depicted in Fig. 8. The color scale is the same in both data and model plots (covering a broad range, suitable for all seasons).

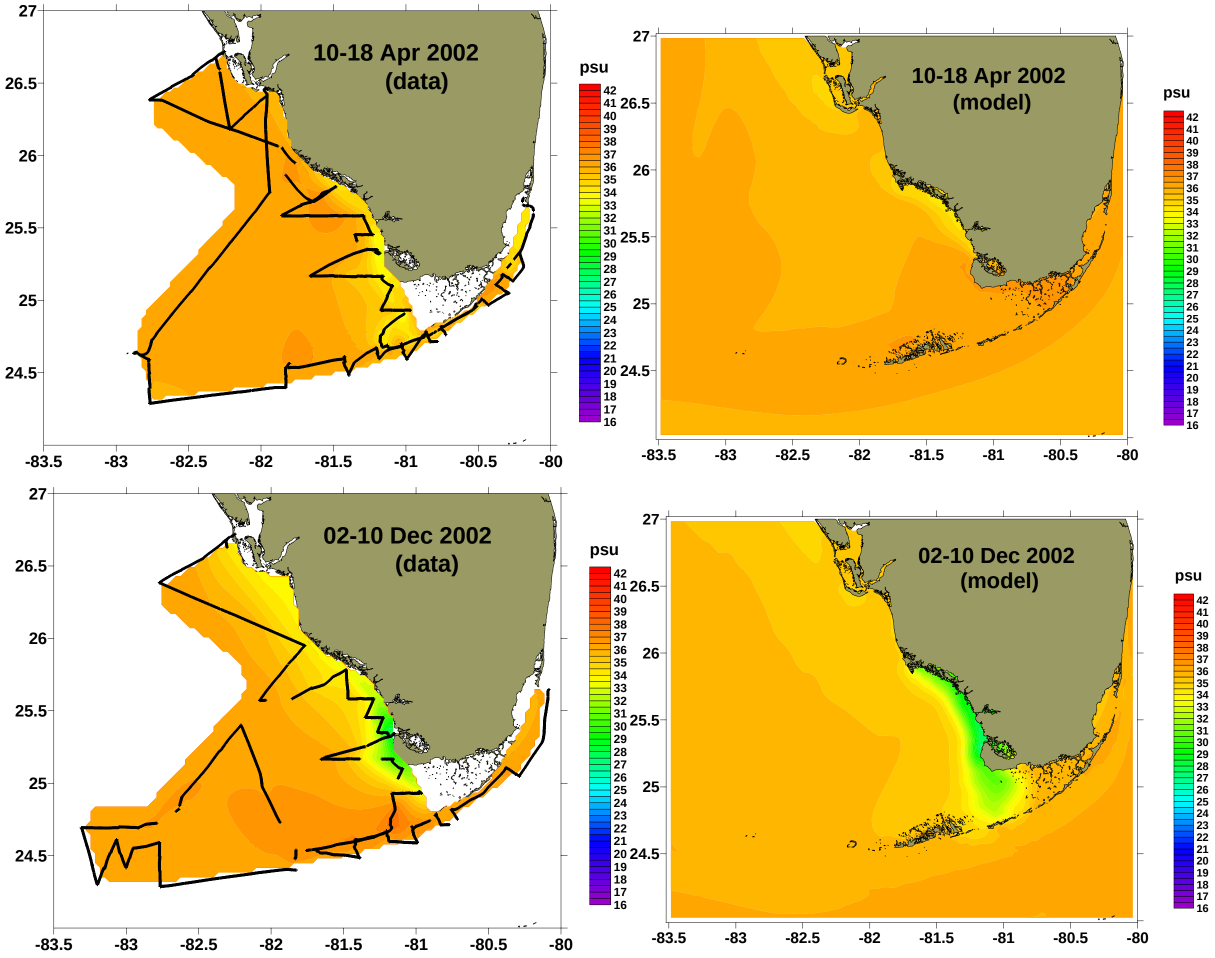


Figure 17b: Near-surface salinity fields computed from the monitoring data surveys (left) and from the model simulations for the same periods: 10-18 April 2002 (upper) and 2-10 December 2002 (lower). The color scale is the same in both data and model plots (covering a broad range, suitable for all seasons).

An interesting process in the model is the simulation of salinity changes around the South Florida coastal areas and in the Florida Straits through intrusions of substantial volume of low-salinity waters that are of Mississippi River origin. This is an important process that is included in the SoFLA-HYCOM simulations through the boundary conditions that are influenced by Gulf of Mexico circulation and water properties. Such intrusions are more frequent during the summer months, in accordance with observational findings. Interdisciplinary studies suggest that intrusions of Mississippi River waters have important implications on water quality for the South Florida coastal ecosystems.

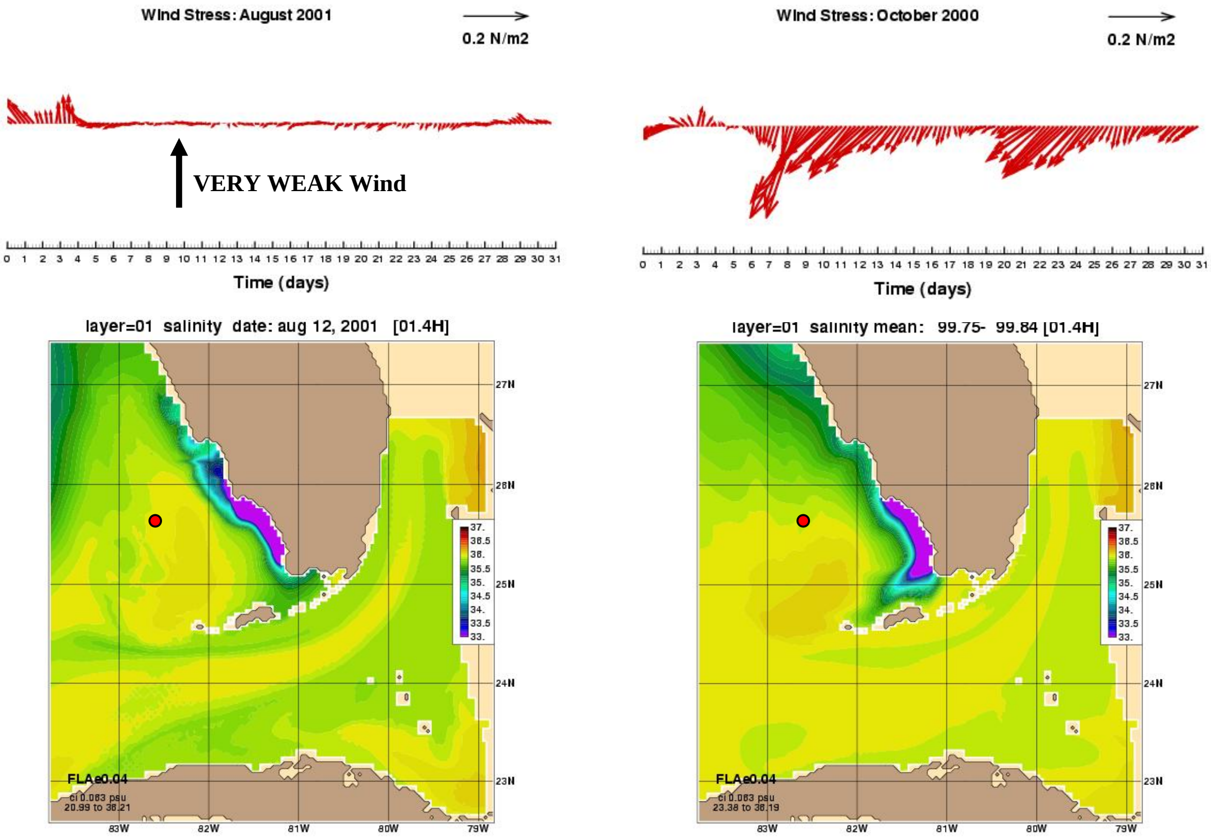


Figure 18: Model computed near-surface salinity patterns during a period that is dominated by the rivers (left) and during a period that is dominated by the wind (right). The wind is given in the vector stick plots above. Note that the color scale is different than in Fig. 17 to allow more detail in salinity gradients.

The inter-annual model simulation identifies periods of wind-driven versus buoyancy-driven and eddy-driven currents. Frequent eddy passages dominate the current field in the Florida

Straits, with substantial influence on the hydrodynamics around the Florida Keys reef tract. The broad Southwest Florida shelf is mostly influenced by the passage of weather systems and by the fresh water inputs from local rivers. A band of low-salinity waters prevails along the coast, with the exception of very dry months (as in the April 2002 example of Fig. 17). The low-salinity band produces buoyancy-driven flows and northward propagation of low-salinity waters in periods of weak winds, therefore not influencing Florida Bay (Fig. 18, left). However, the most common situation is the one depicted in Fig. 18 (right), where prevailing northerly winds cause southward transport of the low salinity band with direct influence on the water properties in Florida Bay and the Florida Keys.

Applications

The SoFLA-HYCOM model computed fields of monthly averaged currents, sea elevation, salinity and temperature have been incorporated in the comprehensive GIS-based decision support system for the Florida Keys and reef tract. The system is a centerpiece of the work by the National Caribbean Coral Reef Institute (NCORE, http://www.ncoremiami.org/GIS/GIS_Main.htm) and it includes layers of socioeconomic parameters, vegetation and habitat, legal and administrative boundaries, atmospheric and oceanographic data, among others. Results from the present study are adopted by NCORE to provide visualization and management tools for the Florida Keys reef tract.

Monthly mean climatological currents are overlaid on GIS topography to show topographic steering of mean currents. By overlaying the predictions of the nested simulation to a highly accurate GIS surface topography, the mean flow patterns around the shallow Florida Keys and the reef tract can be better understood and interpreted by marine conservationists and park managers. An example is shown in Fig. 19 for the mean December current. The flow within the Straits of Florida is dominated by the Florida Current front, while, along the Keys, opposing coastal currents are directed southwesterly. Influences from the west Florida shelf through Florida Bay are evident through the Keys passages.

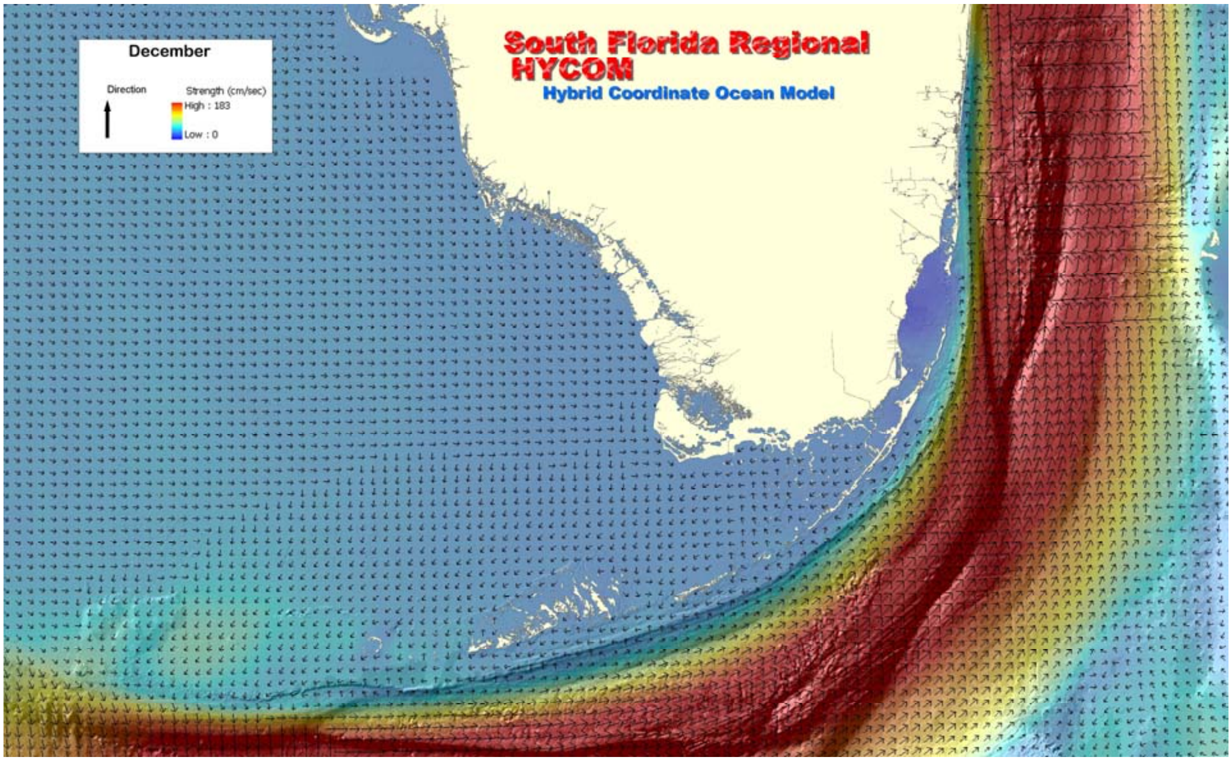


Figure 19: Model computed vertically averaged current layer of the GIS-based multi-layer management tool for the Florida Keys (monthly averaged for December); current direction in arrows, current strength in color.

Summary

A comprehensive three-dimensional hydrodynamic ocean circulation model has been developed for the South Florida coastal system that includes Florida Bay, the Florida Keys reef tract and the Southwest Florida shelf. The model domain encompasses the entire Straits of Florida. The South Florida (SoFLA) adaptation of the Hybrid Coordinate Ocean Model addresses the complex dynamics of this region and the intense coastal to offshore interactions through nesting with larger scale models of the North Atlantic and the Intra-

Americas Sea. Important results include the effect of remote sources of low salinity waters reaching the Florida Keys, the prevailing northeastward Florida Current, the wind-driven southwestward flow along the Florida Keys shelf, the passage of eddies between the Florida Current front and the reef tract and the influence of rivers and weather systems on the Southwest Florida shelf and Florida Bay. Preliminary model validation with data shows reasonable agreement. Model results are provided to support modeling efforts in Florida Bay, associated with the Everglades Restoration Project. Model computed hydrodynamic parameters (sea elevation, temperature, salinity and three-dimensional current velocity) and air-sea interaction parameters (wind and heat and salt fluxes) are archived to support modeling efforts in Florida Bay, associated with the Everglades Restoration Project and the Florida Bay and Florida Keys Feasibility Study. Modeling activities in the Florida Keys can also be supported by the SoFLA-HYCOM; an example is the incorporation of the model computed circulation patterns in a GIS-based decision support system for the Florida Keys reef tract.

ACKNOWLEDGEMENTS

Mike Kohler (South Florida Water Management District) prepared the GIS-based model grid bathymetry shown on the cover page and Amit Hazra (University of Miami, National Caribbean Coral Reef Institute, NCORE) prepared the GIS-based circulation plot (Fig. 19). Alan Wallcraft and Tammy Townsend (NRL, Stennis Space Center) provided help with the model set-up and nesting and the larger scale model archives. Libby Johns and Peter Ortner (NOAA-AOML) provided the salinity data. This study has been funded by the National Oceanic and Atmospheric Administration through the Coastal Ocean Program and through an inter-agency agreement with the South Florida Water Management District (NOAA Contract NA17RJ1226). Initial model development was supported by the Environmental Protection Agency through NCORE (EPA Contract R82802001).