Initial progress on

South Florida Regional Model simulations

RSMAS UNIVERSITY OF Miami
ROSENSTIEL SCHOOL OF MARINE & ATMOSPHERIC SCIENCE

Villy Kourafalou

and

Roland Balotro

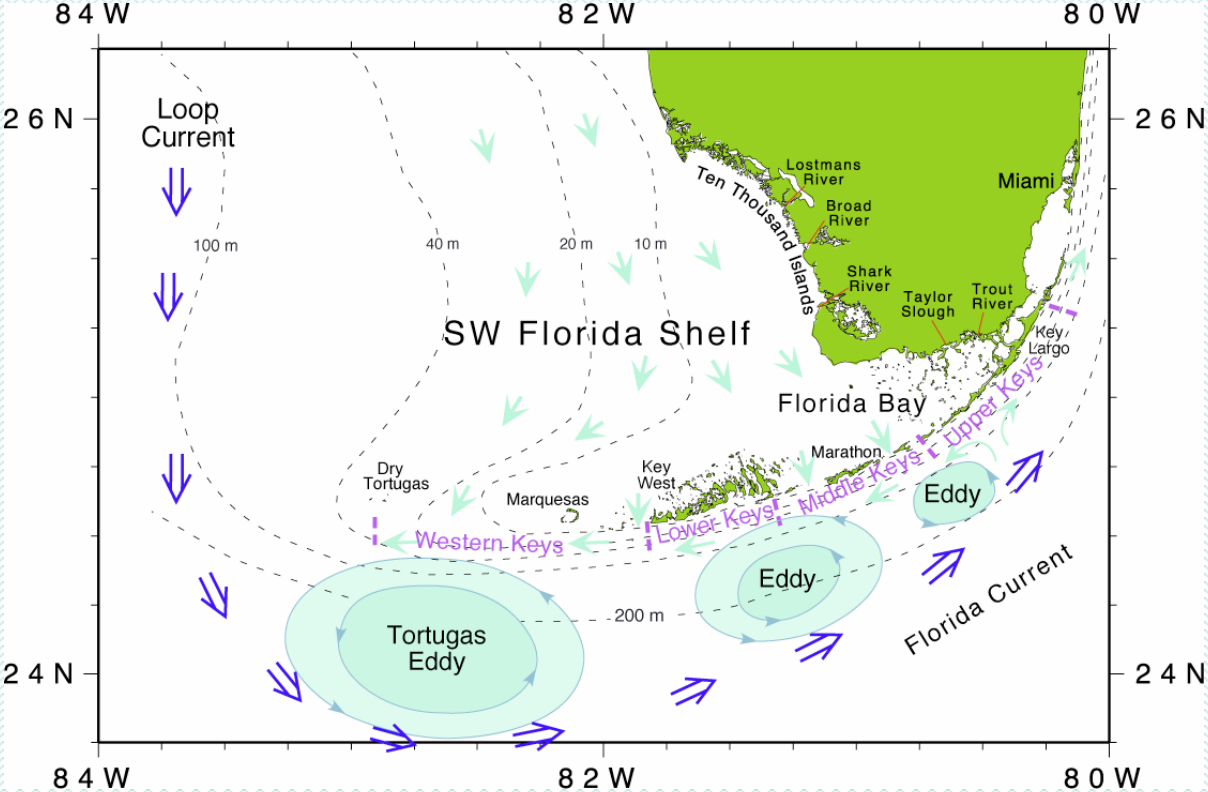
With the collaboration of

Alan Wallcraft and Tammy Townsend (NRL)

SOUTH FLORIDA REGIONAL MODEL: rationale

Recent observational studies provide evidence of
transport processes linking South Florida coastal ecosystems
(hydrographic, buoy, drifter and satellite data)

- physical transport processes impose strong hydrodynamic links between the Florida Keys and the adjacent coastal seas.
- significant transient inputs can reach the Florida Keys reef tract from remote regions of the Gulf of Mexico.
- the Florida Keys reef tract can be influenced by "upstream" remote reef systems



Lee et al., 2001

SOUTH FLORIDA REGIONAL MODEL: setup

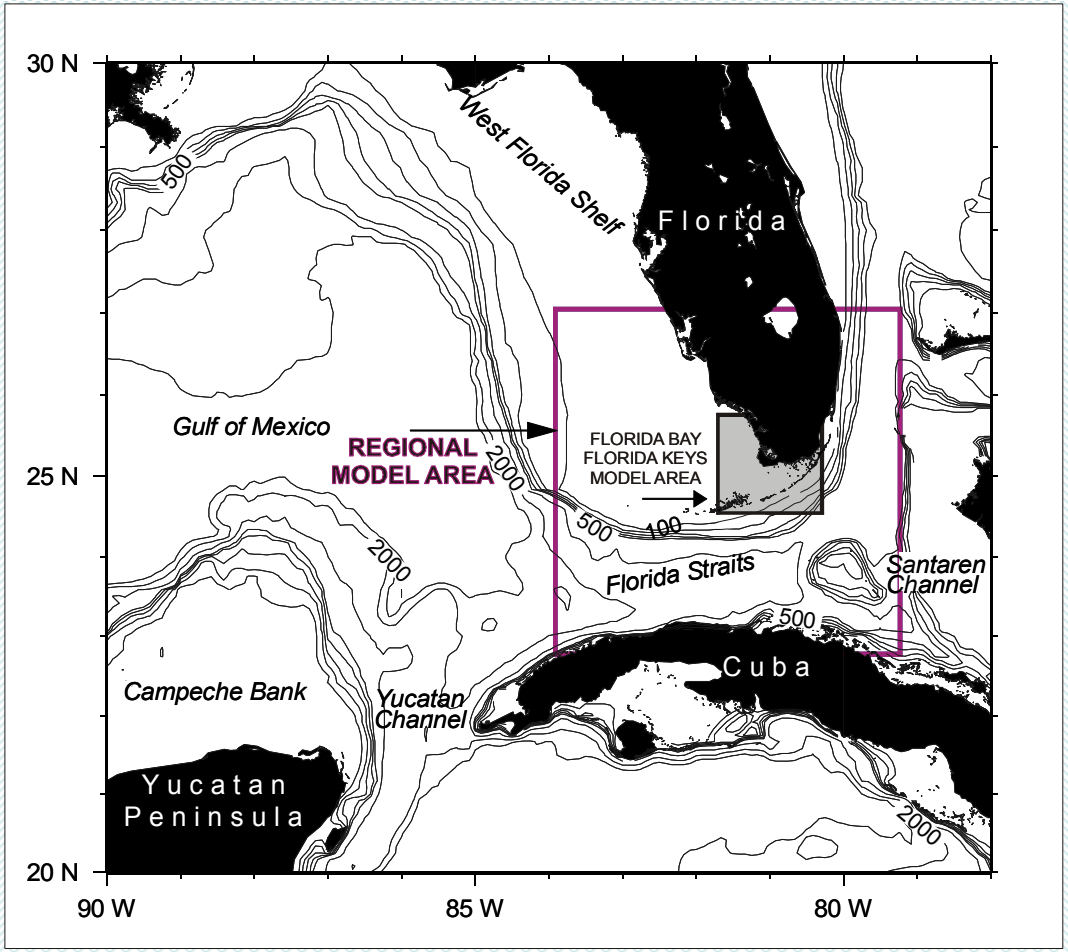
- A nested approach has been employed for a HYCOM application around Florida Bay and the Florida Keys (large scale– regional scale– coastal scale)

- The regional model will provide boundary conditions for smaller scale hydrodynamic and biological models that focus on Florida Bay and the Florida Keys reef tract

- The simulations will be closely linked to ongoing observational studies around the Florida Keys, Florida Bay and adjacent seas

The project is funded by the Environmental Protection Agency and the South Florida Water Management District

SOUTH FLORIDA REGIONAL MODEL: domain



- Grid resolution: 2-3 km
- Nested on a North Atlantic and Gulf of Mexico HYCOM model with 6-7 km resolution

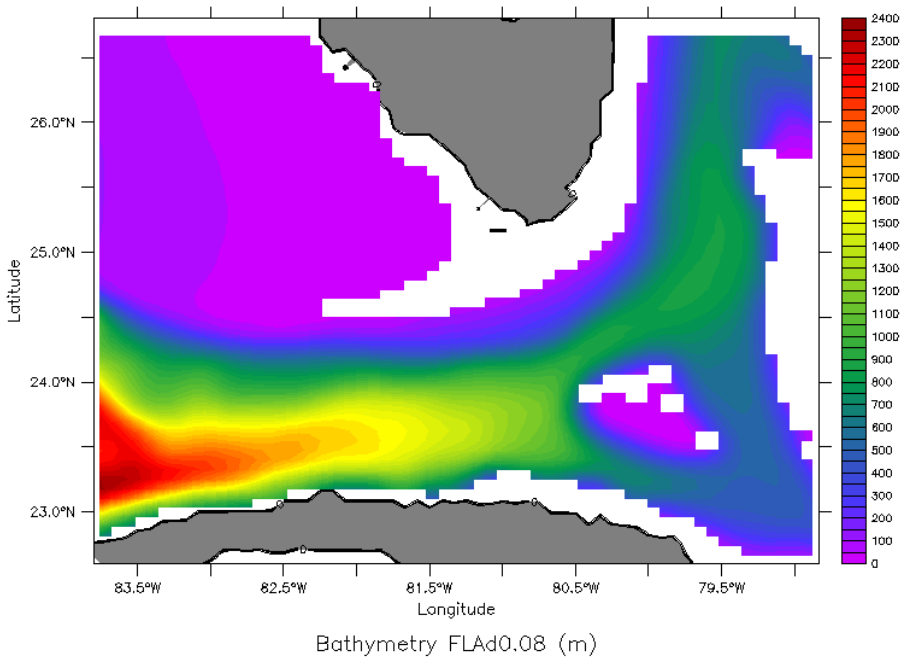
SOUTH FLORIDA REGIONAL MODEL: simulations

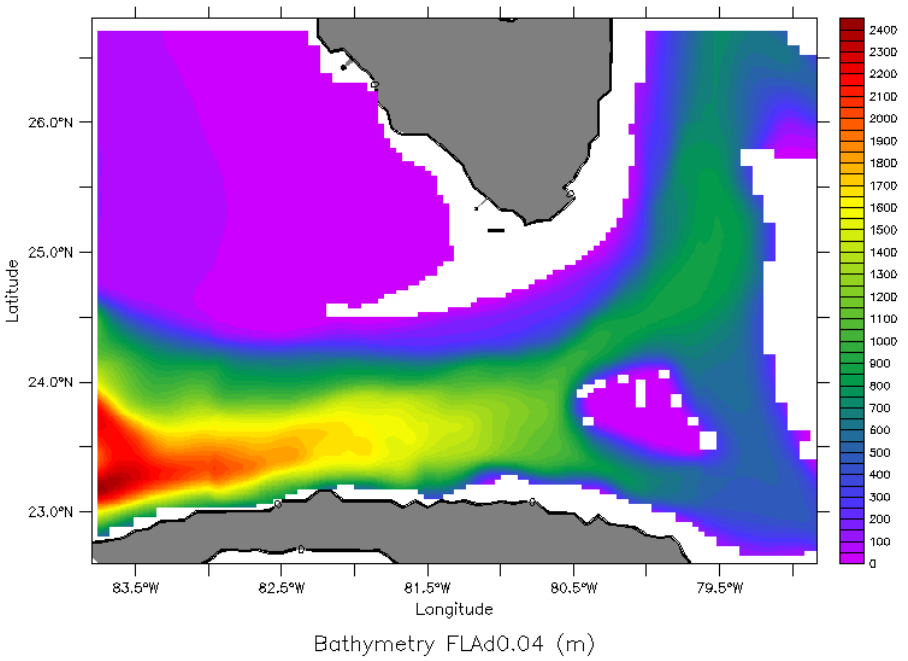
- A 6-month simulation has been completed with a special application of the 1/12 degree North Atlantic (NA) HYCOM with a 10m coastline (initialized from the 20m coastline climatological NA HYCOM and forced with monthly mean fluxes and winds plus 6-hourly anomalies).

- The regional model has been run for the same period with nested boundary conditions and with the same forcing.

- Two resolutions have been employed for the regional model: 1/12 and 1/25 degree (twin experiments).

BATHYMETRY (Hmin=10 m)



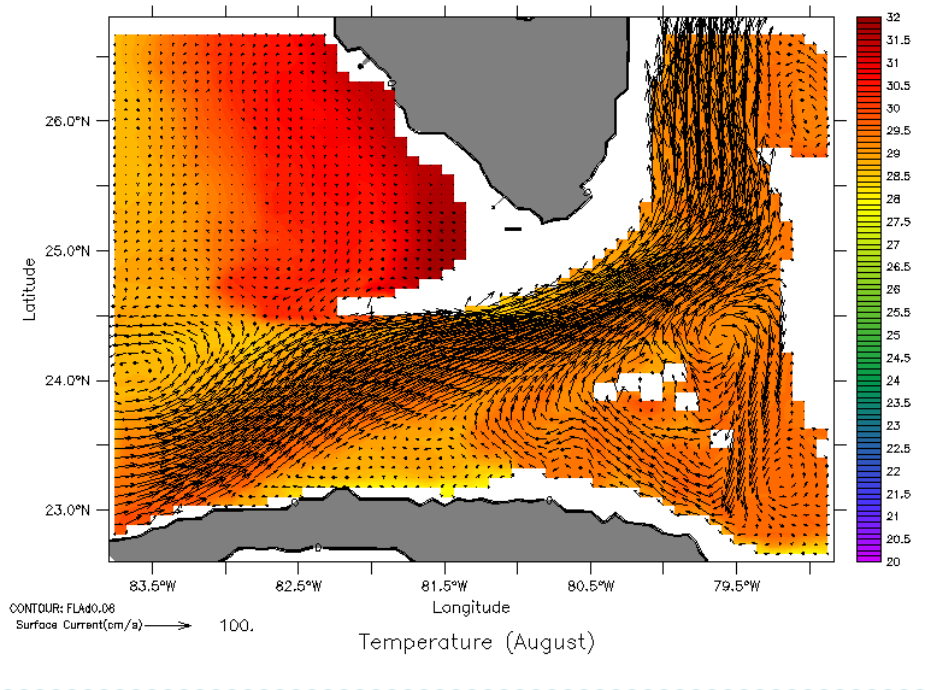


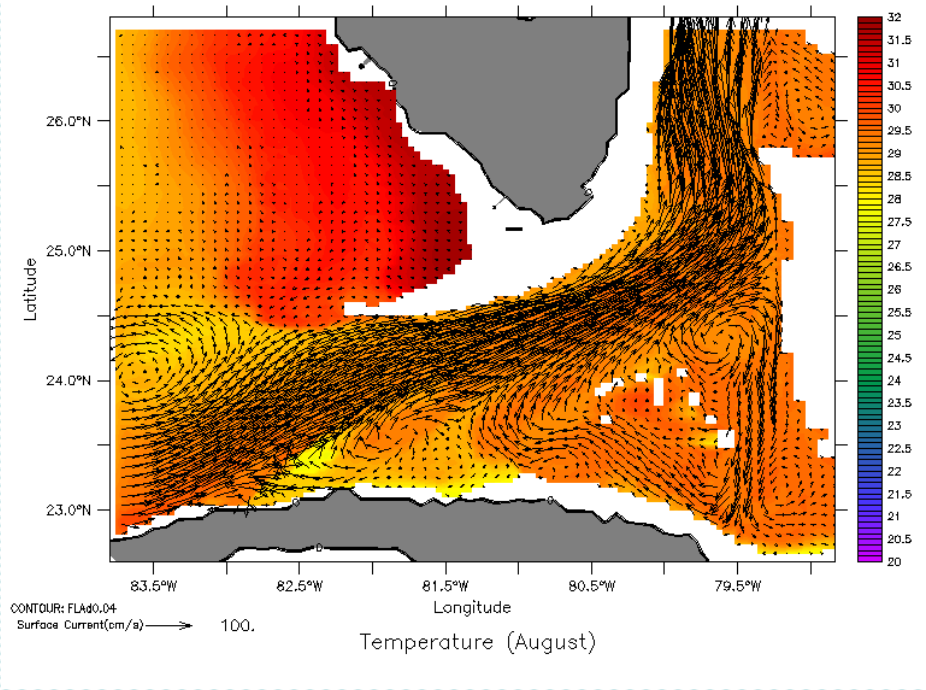
1/12 deg

1/25 deg

Surface TEMPERATURE and CURRENTS

AUGUST





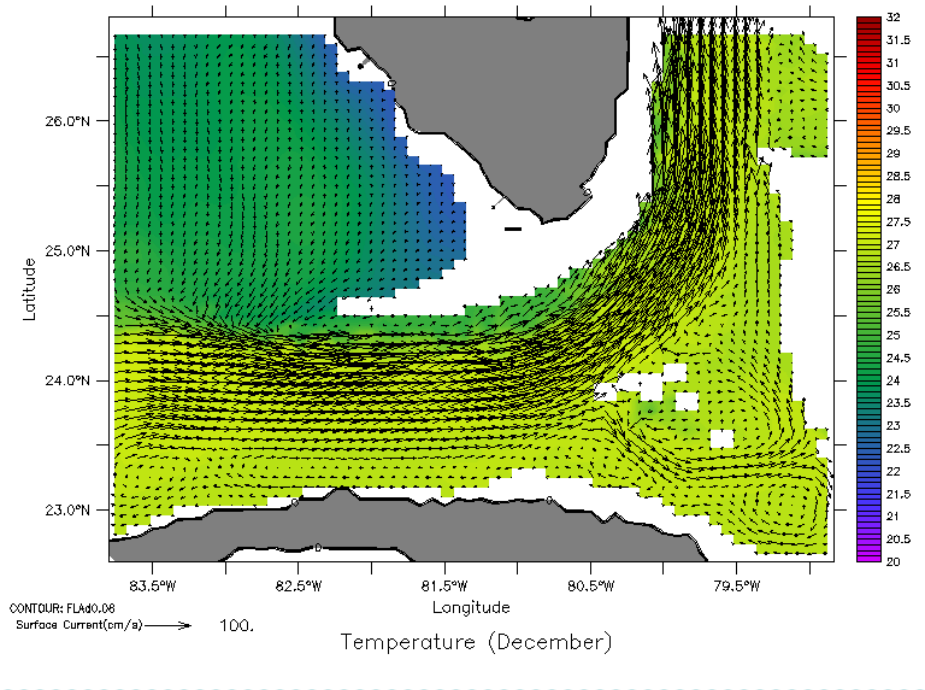
1/12 deg
(every vector plotted)

1/25 deg
(every other vector plotted)

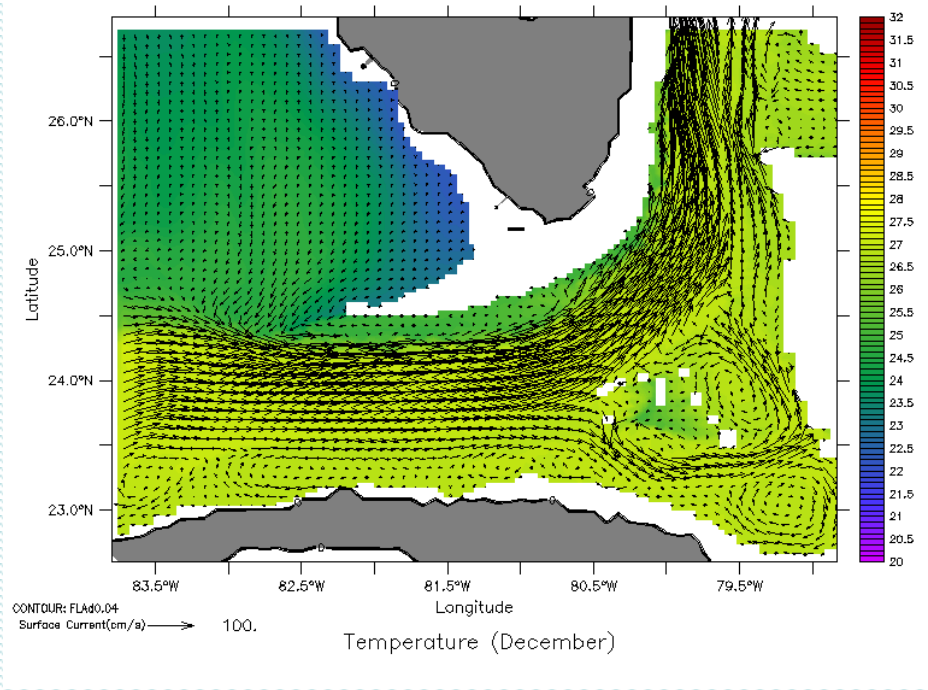
- **Tortugas eddy forming near west boundary**
- **Eddy activity confined to the south of the Florida Current due to 10m “wall” in the Keys area**

Surface TEMPERATURE and CURRENTS

DECEMBER



1/12 deg

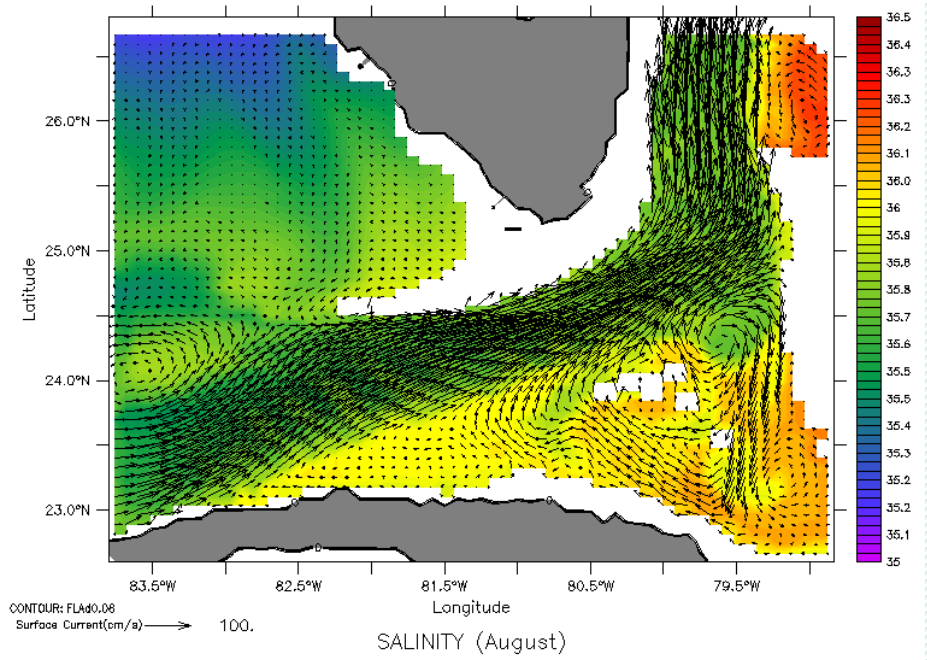


1/25 deg

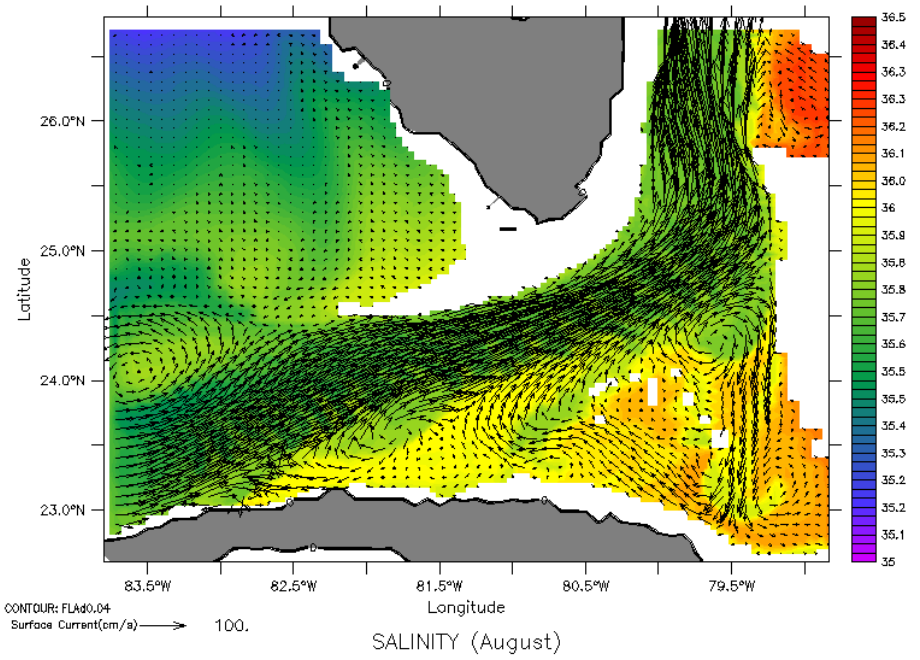
- Intensification of eddy around the banks (NE of Cuba) in the high resolution

Surface SALINITY and CURRENTS

AUGUST



1/12 deg

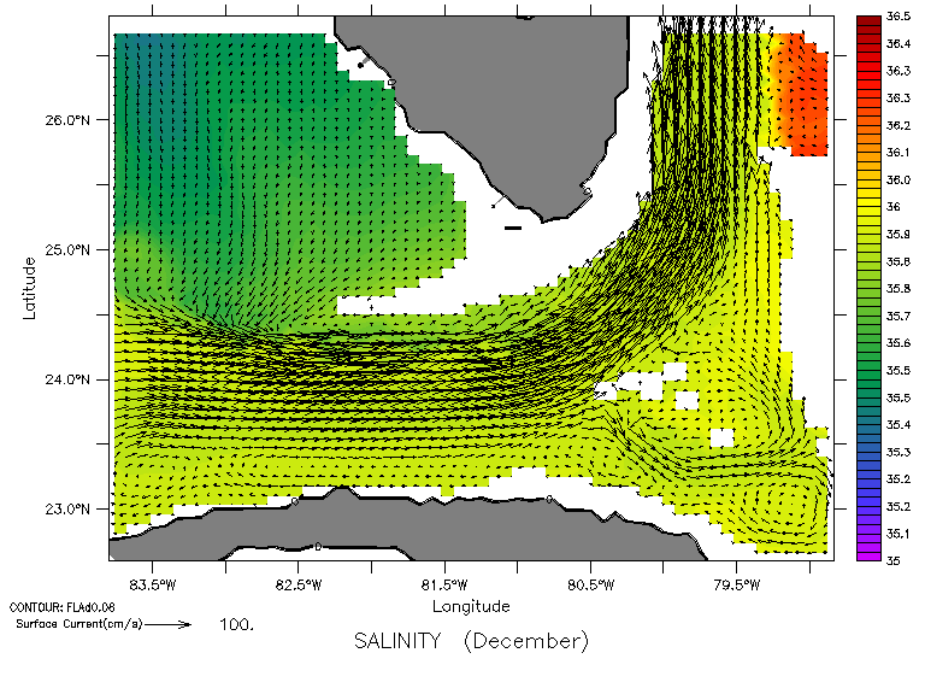


1/25 deg

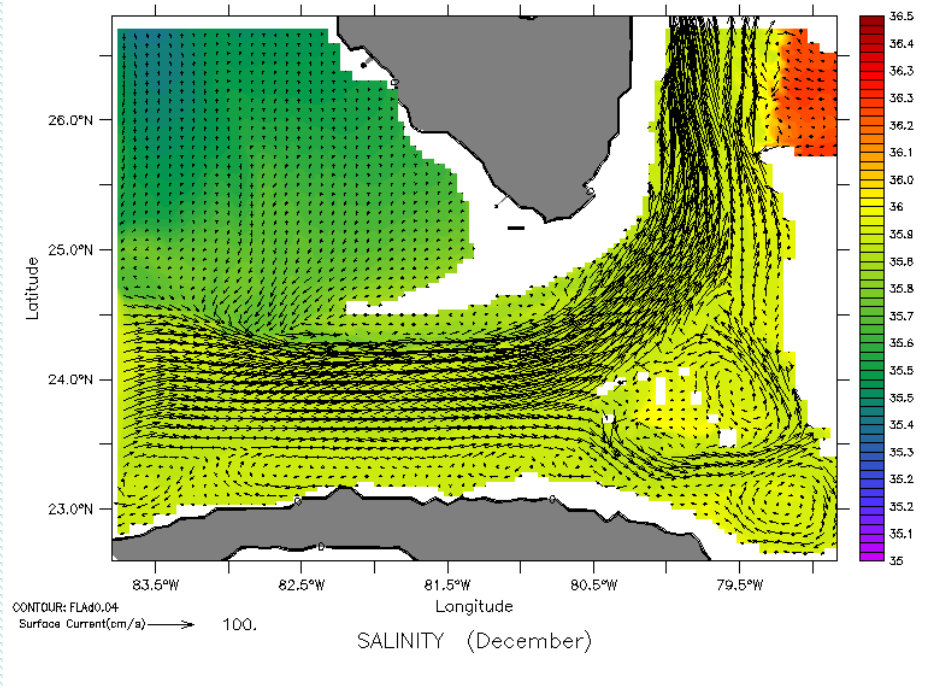
- "Wet" season

Surface SALINITY and CURRENTS

DECEMBER



1/12 deg

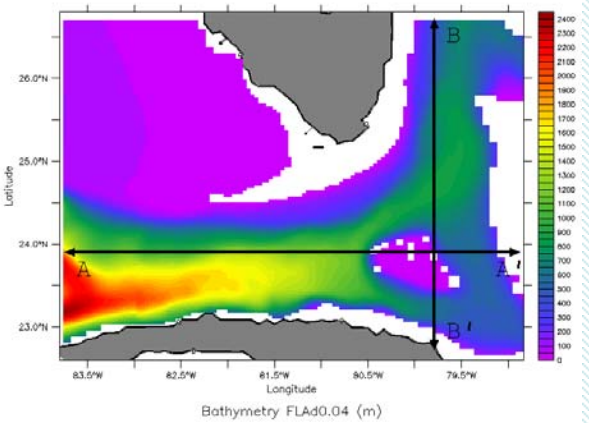


1/25 deg

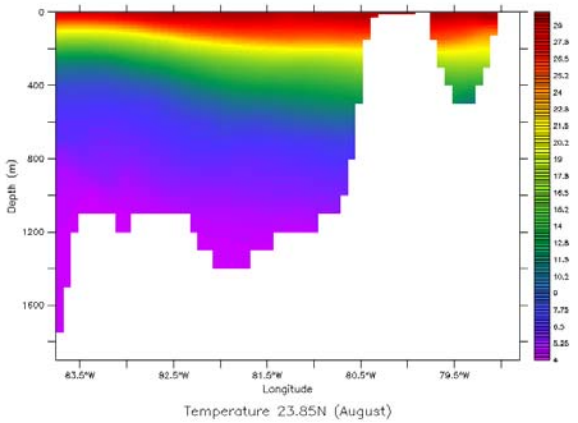
"Dry" season

TEMPERATURE (Latitude 23.85N) – section A

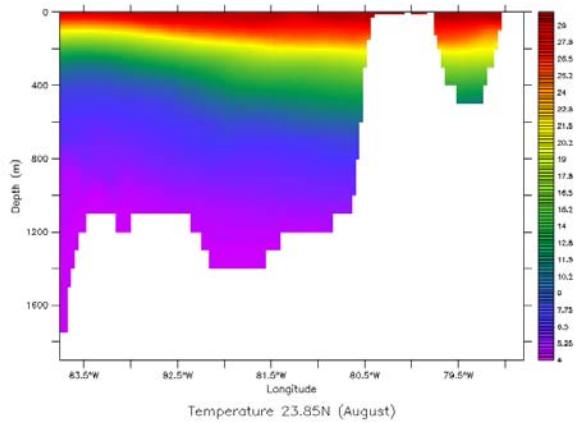
AUGUST



1/25 deg bathymetry

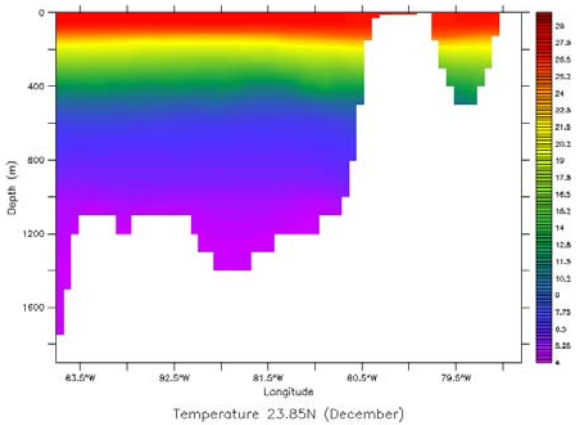


1/12 deg

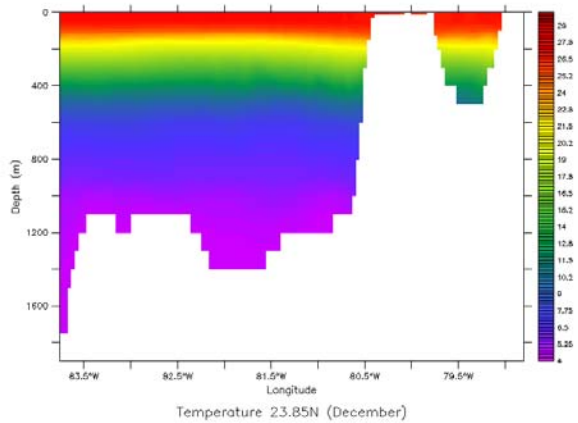


1/25 deg

DECEMBER

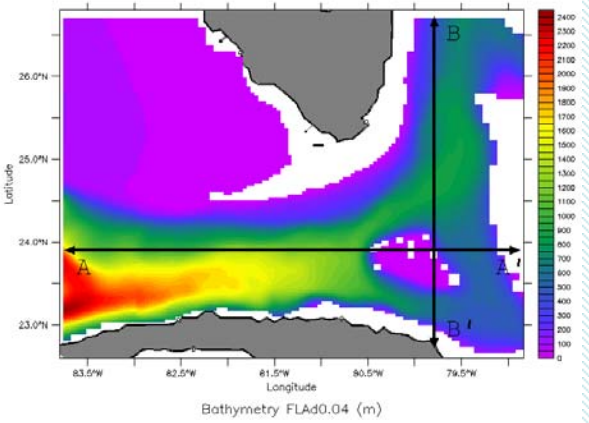


1/12 deg



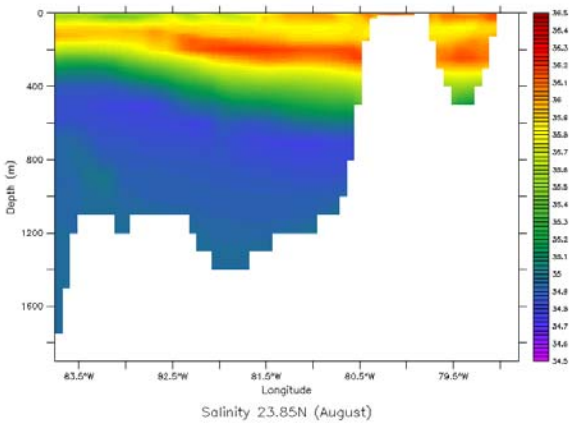
1/25 deg

SALINITY (Latitude 23.85N) – section A

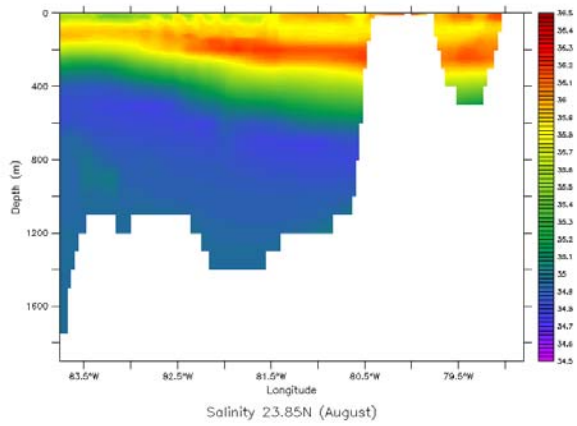


1/25 deg bathymetry

AUGUST



1/12 deg



1/25 deg

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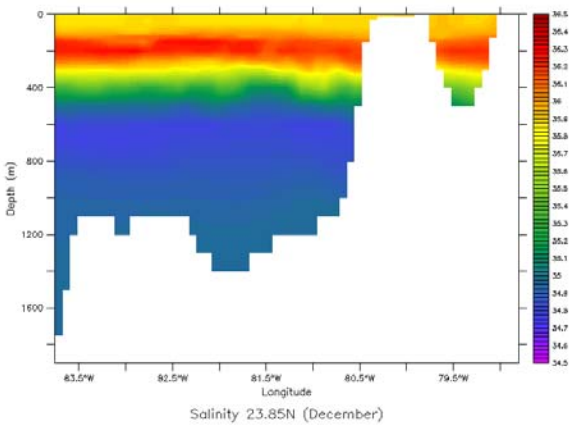
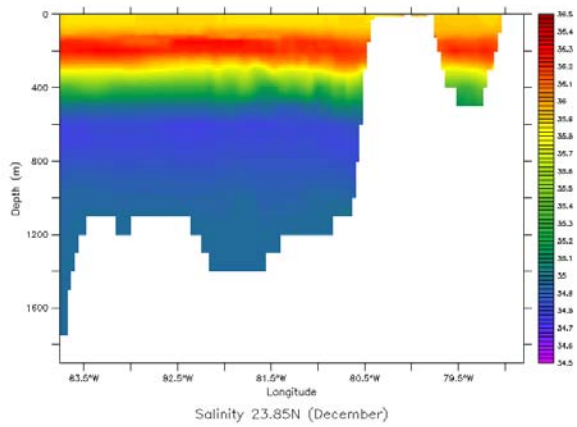


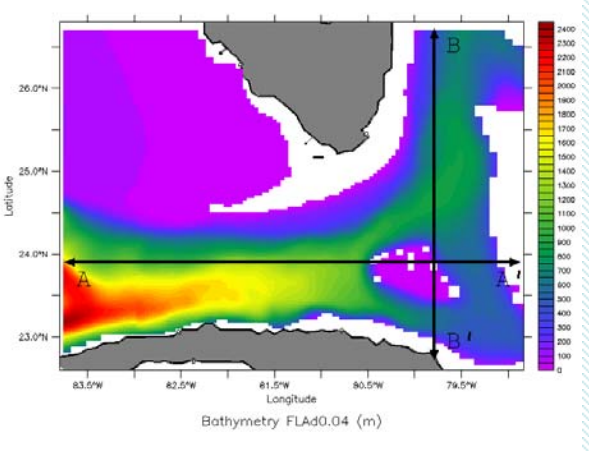
1/12 deg



1/25 deg

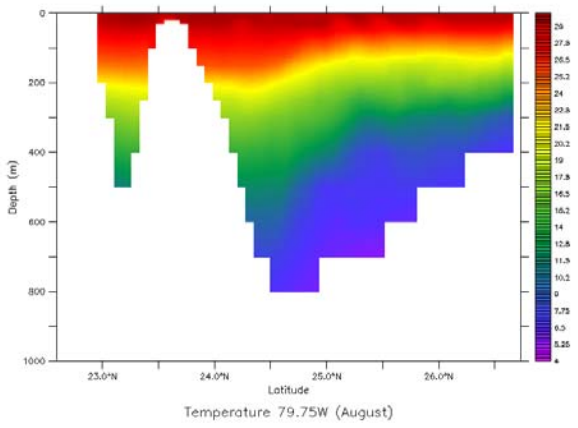
*** Sub-surface salinity max, due to inflow of Atlantic subtropical waters from SE boundary**

TEMPERATURE (Longitude 79.75W)- section B

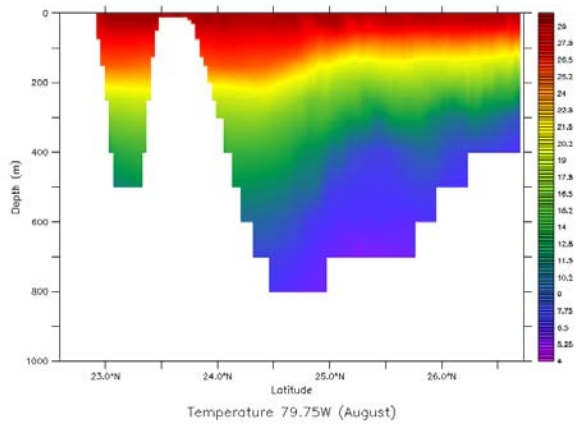


1/25 deg bathymetry

AUGUST

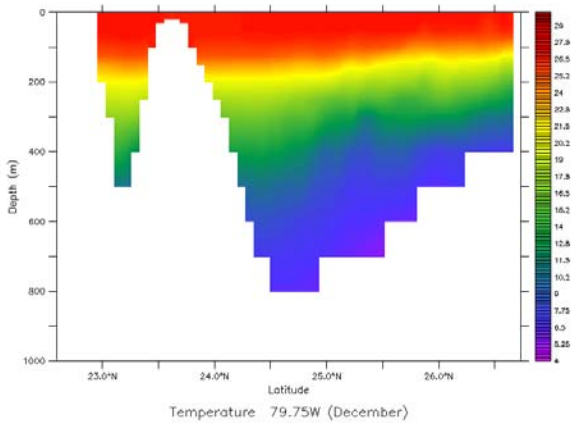


1/12 deg

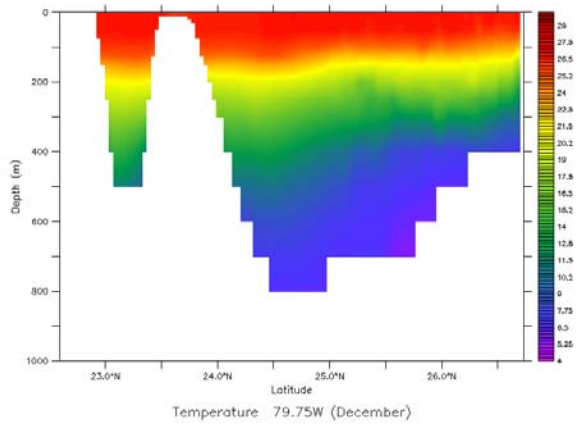


1/25 deg

DECEMBER

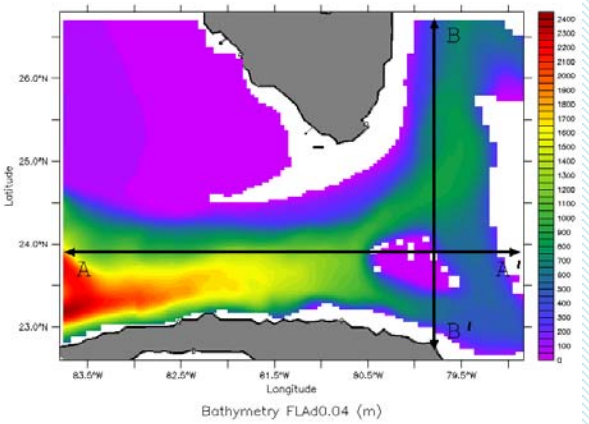


1/12 deg



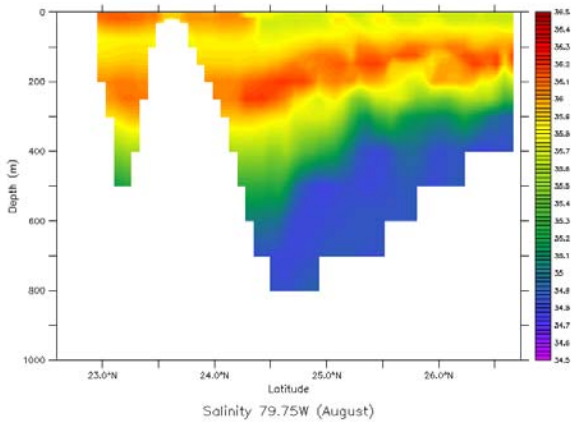
1/25 deg

SALINITY (Longitude 79.75W) – section B

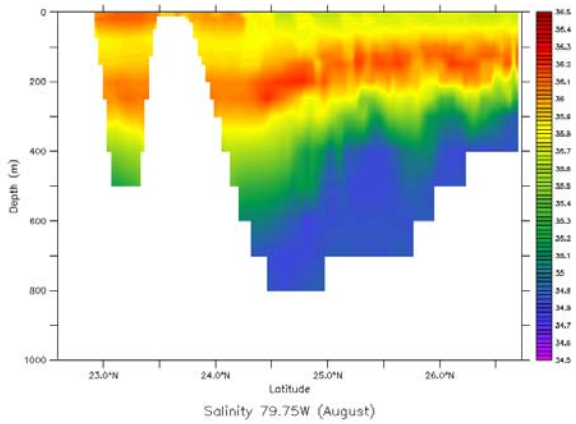


1/25 deg bathymetry

AUGUST



1/12 deg



1/25 deg

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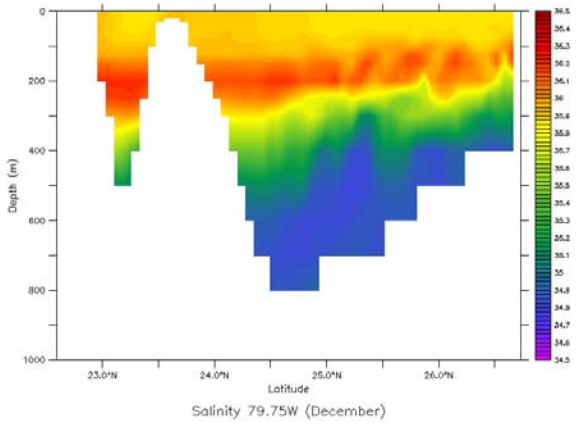
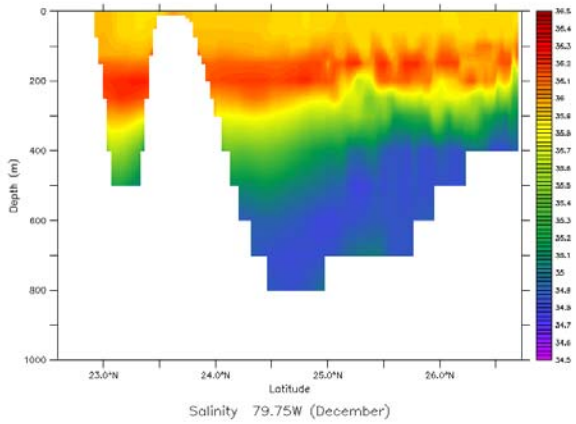


1/12 deg

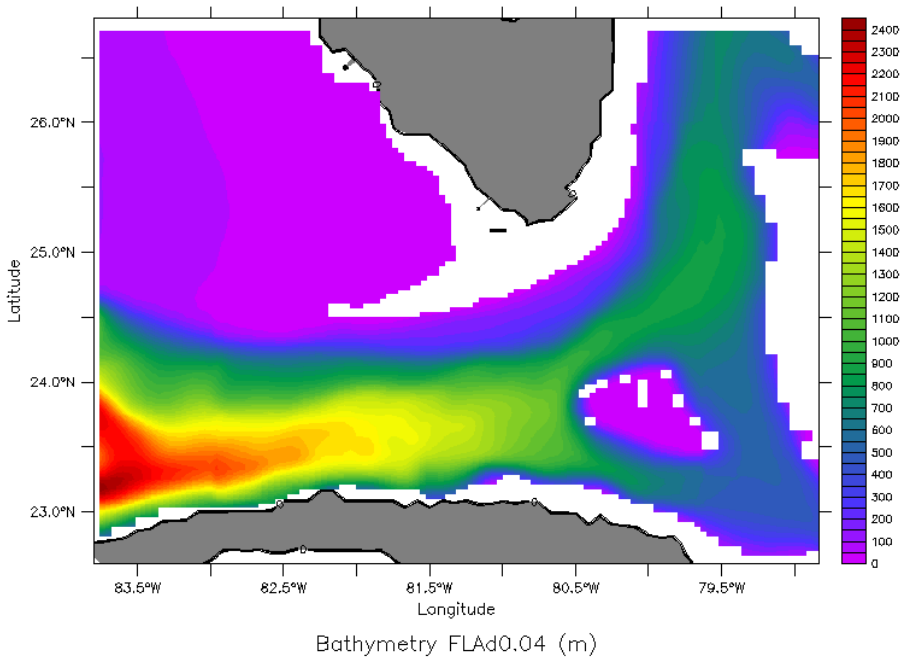


1/25 deg

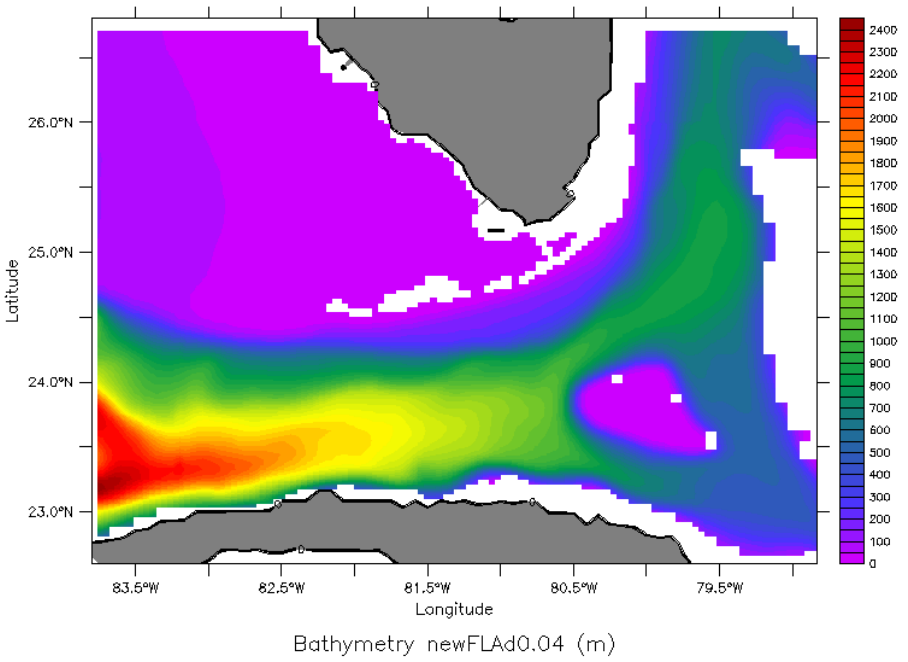
The simulation was repeated with upgraded bathymetry to better represent the shallow areas

This was done mainly as a HYCOM implementation exercise and in preparation for simulations with high frequency forcing – the current climatological forcing did not allow for noticeable changes in the computed flows

OLD BATHYMETRY



NEW BATHYMETRY

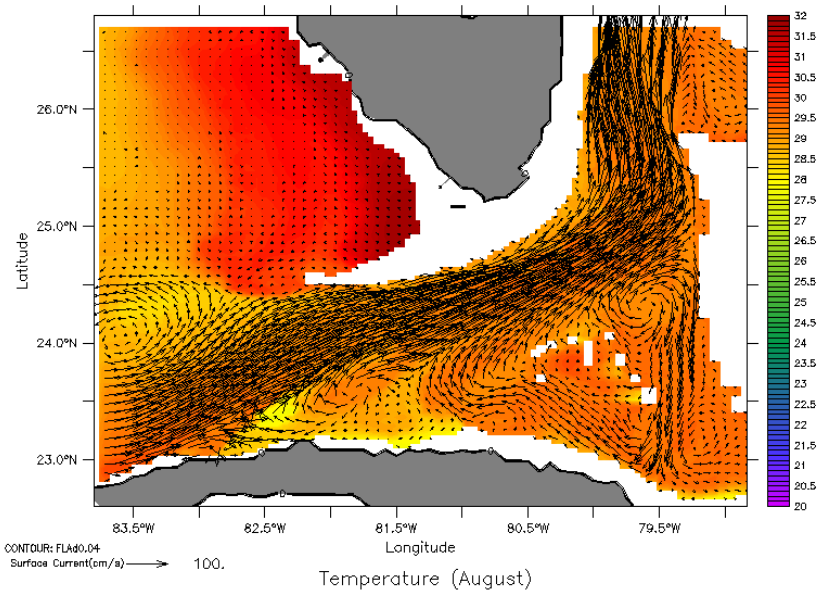


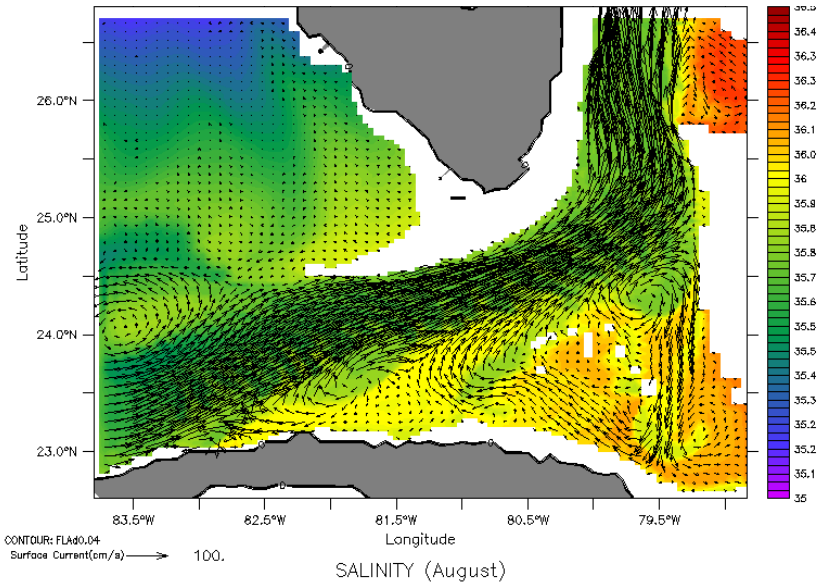
1/25 deg, Hmin=10m

1/25 deg, Hmin=5m

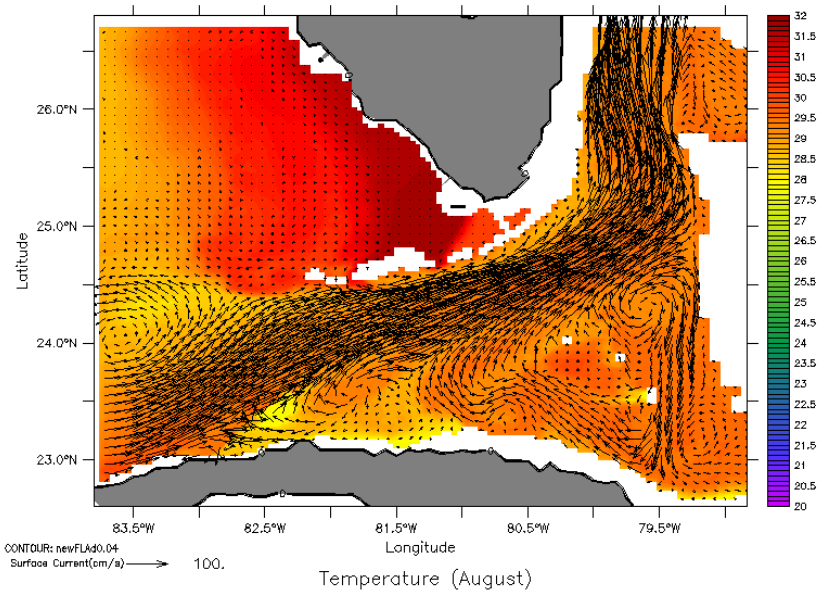
AUGUST

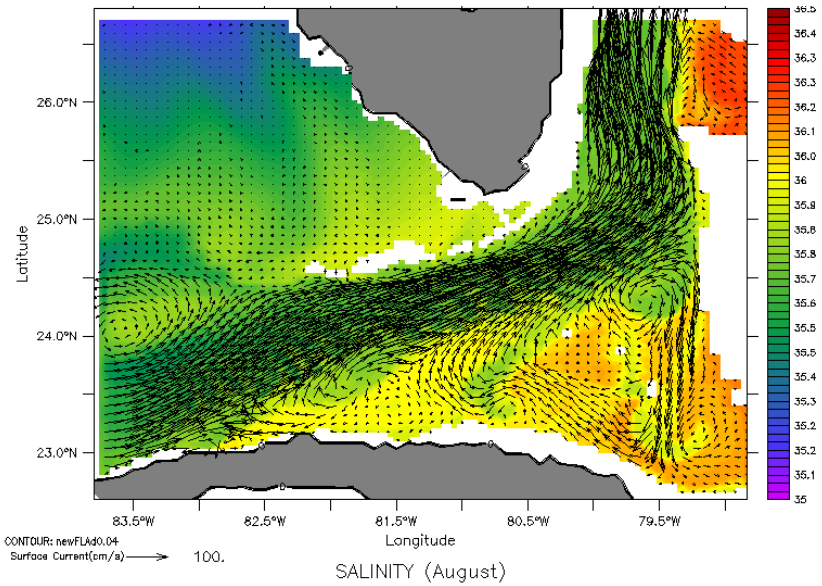
OLD BATHYMETRY





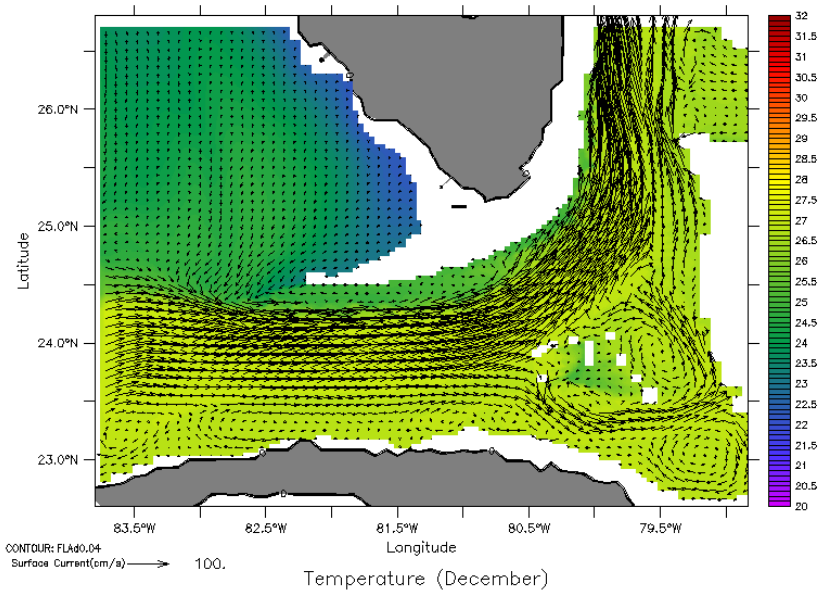
NEW BATHYMETRY

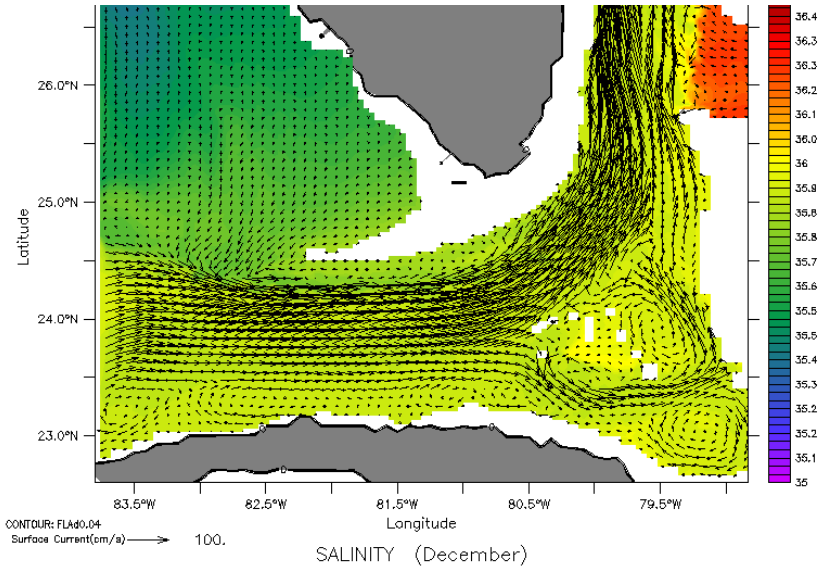




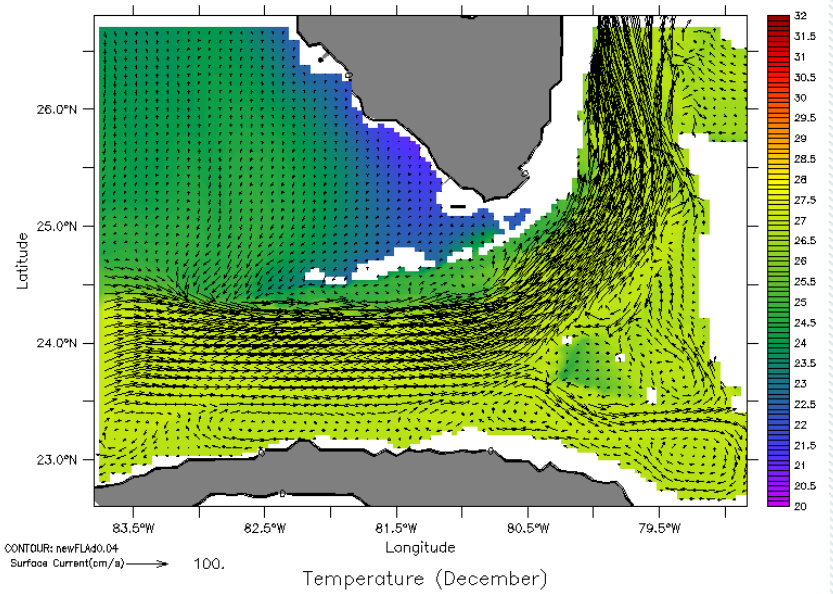
DECEMBER

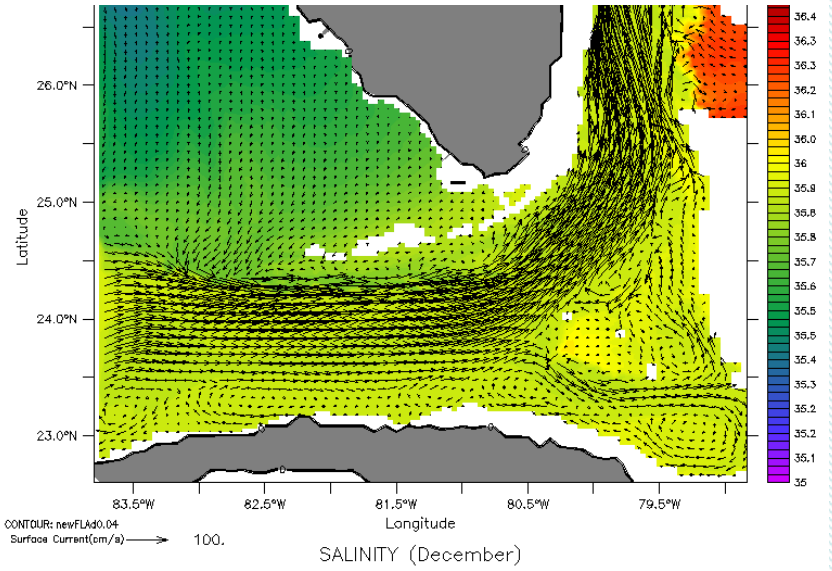
OLD BATHYMETRY





NEW BATHYMETRY





In summary:

- **The South Florida Regional Model is a coastal application of HYCOM in a region that requires a nested approach to address multiple spatial and temporal scales and strong coastal to large scale flow interactions**

- **The nesting seems successful, although more evaluation is under way**

- **Three 6-month simulations have been completed that employ changes in grid size and in bathymetry**

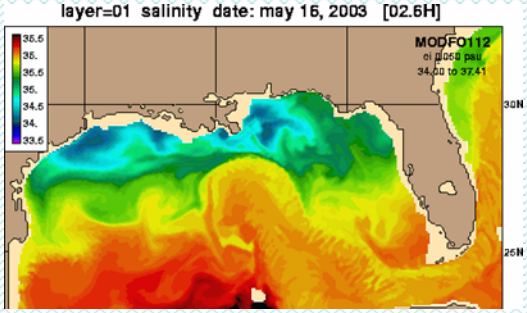
- **A simulation with Hmin= 3m is in progress and nesting within the IAS HYCOM will follow**

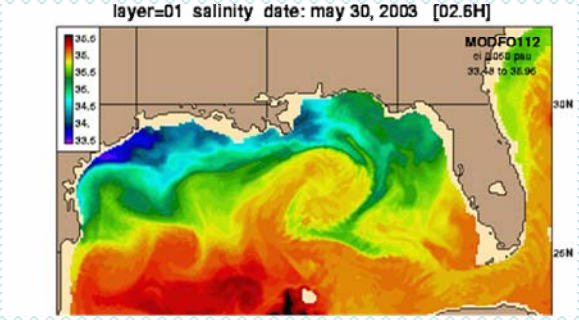
An example of the studies that will be performed with the South Florida Regional Model is the recent advection of Mississippi River waters toward the Florida keys, due to the northward position of the Loop Current (May-June 2003)

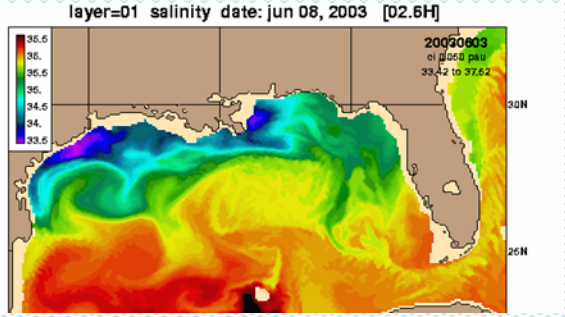
The event was successfully modeled by the NA HYCOM and was verified with parallel Florida Straits in situ salinity data (R/V W. Smith, June 2003) and ocean color satellite data

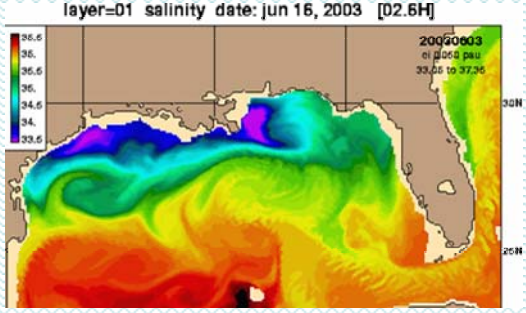
An “Alert” was issued to Florida Keys managers and posted on the NOAA Coral List website and on the HYCOM regional applications site:

http://hycom.rsmas.miami.edu/regional_sim.html

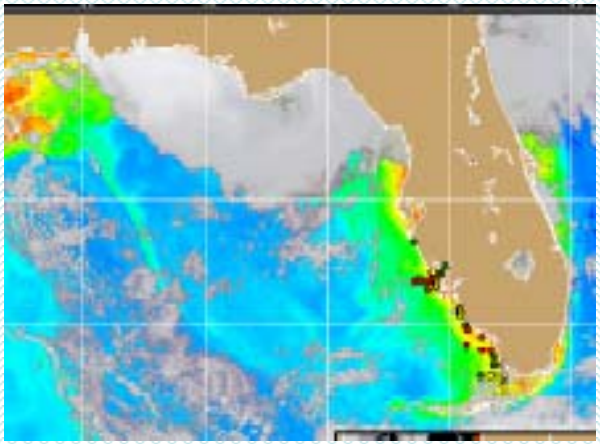




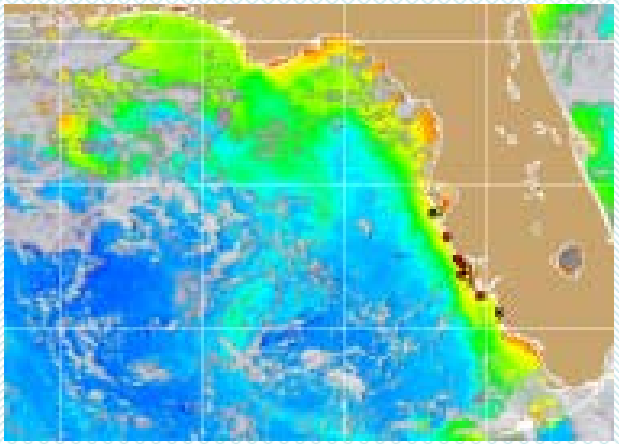




HYCOM model SSS http://hycom.rsmas.miami.edu/ocean_prediction.html

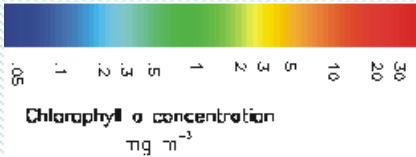


May 1, 2003



June 10, 2003

NOAA CoastWatch Harmful Algal Blooms (HAB) bulletin http://coastwatch.noaa.gov/hab/bulletins_ms.htm



This is an important phenomenon that has strong implications for the circulation and ecosystem dynamics in the South Florida coastal seas

It has been documented during the 1993 Mississippi River flood (*Ortner et al., 1995*) and was recently explored through SeaWifs data and Gulf of Mexico simulations with the 1/12 deg CUPOM* (*Toner et al. 2003*)

The most recent in situ data (R/V Walton Smith, August 2003) show that large quantities of low salinity waters still exist around the Dry Tortugas and the Florida Keys – a much longer "event" than ever documented before

*Univ. of Colorado POM version