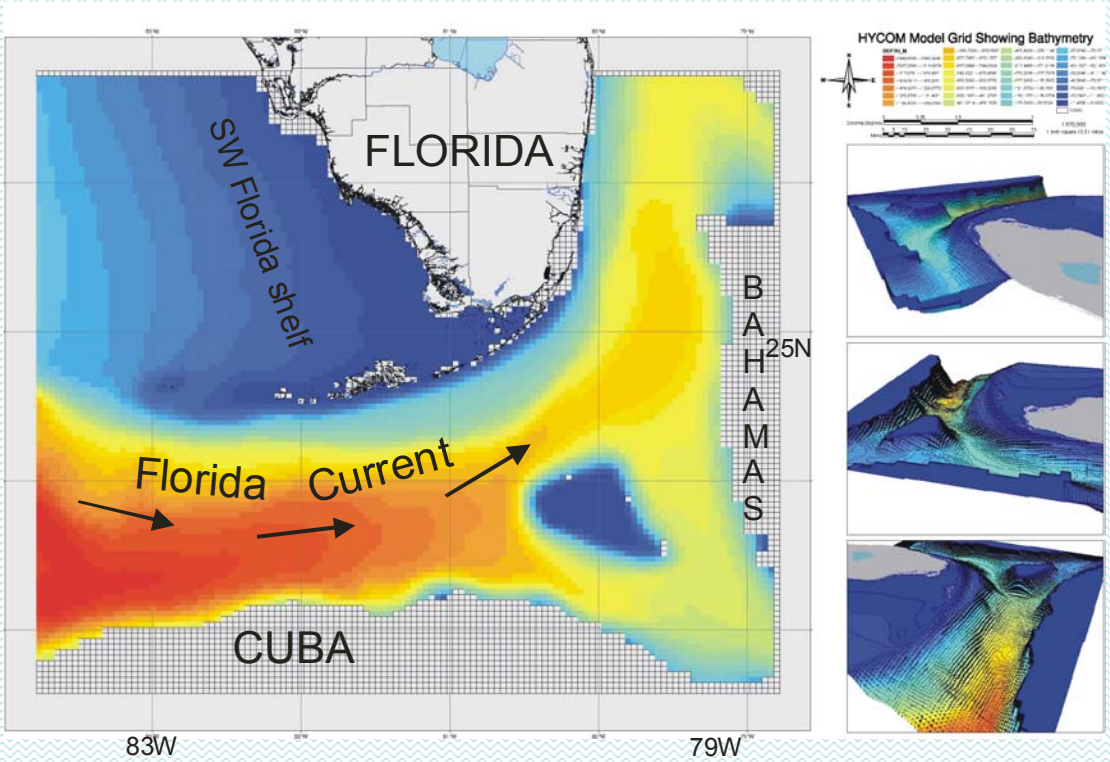
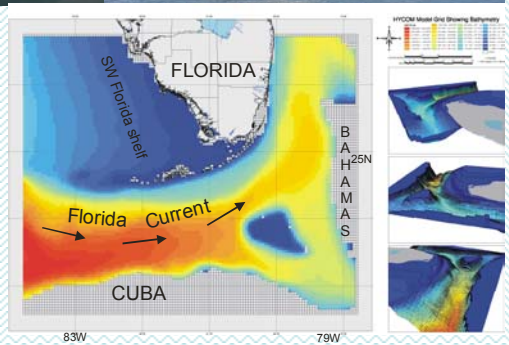
Inter-annual simulation with the SoFLA-HYCOM

(South Florida HYCOM)

Villy Kourafalou, Roland Balotro (UM / RSMAS)
and Alan Wallcraft (NRL/SSC)

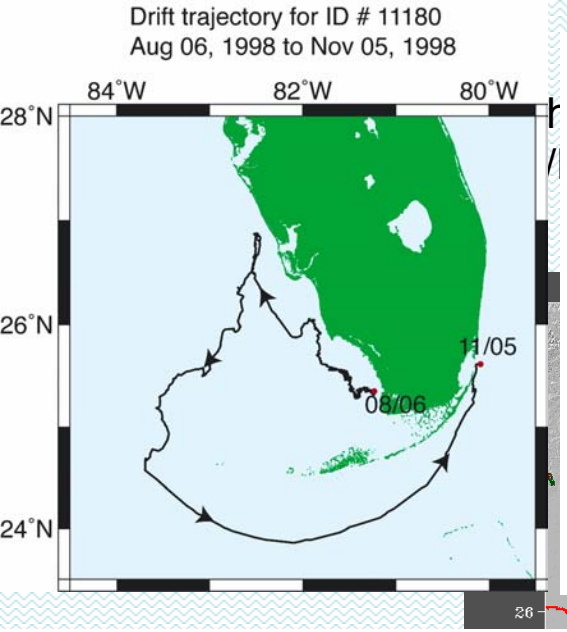


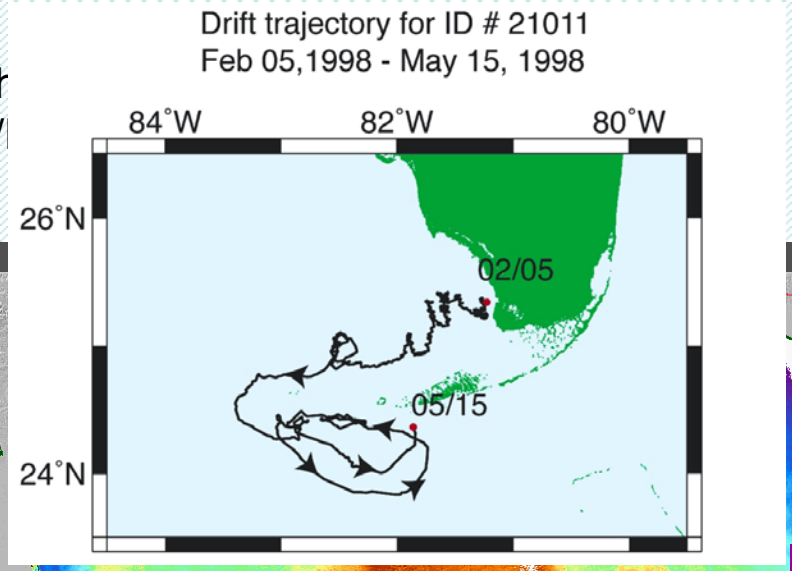
South Florida Ecosystem Research and Monitoring Program

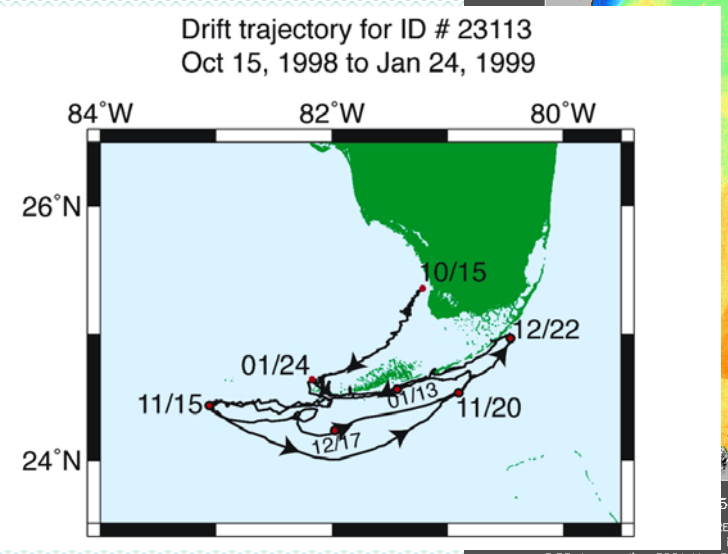


- **Process Studies** — **T. Lee**
- **Interdisciplinary Sustained Observations** — **P. Ortner**
- **Realtime Event Detection** — **E. Johns**
- **Modeling** — **V. Kourafalou**

NOAA NOS/NCCOS, OAR/AOML, NMFS/SEFSC & SFWMD







SoFLA-HYCOM

Satellite Sea Surface Temperature March 23, 2001

RSMAS
ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE
UNIVERSITY OF MIAMI

Regional model for South Florida seas: SoFLA-HYCOM (South Florida Hybrid Coordinate Ocean Model)

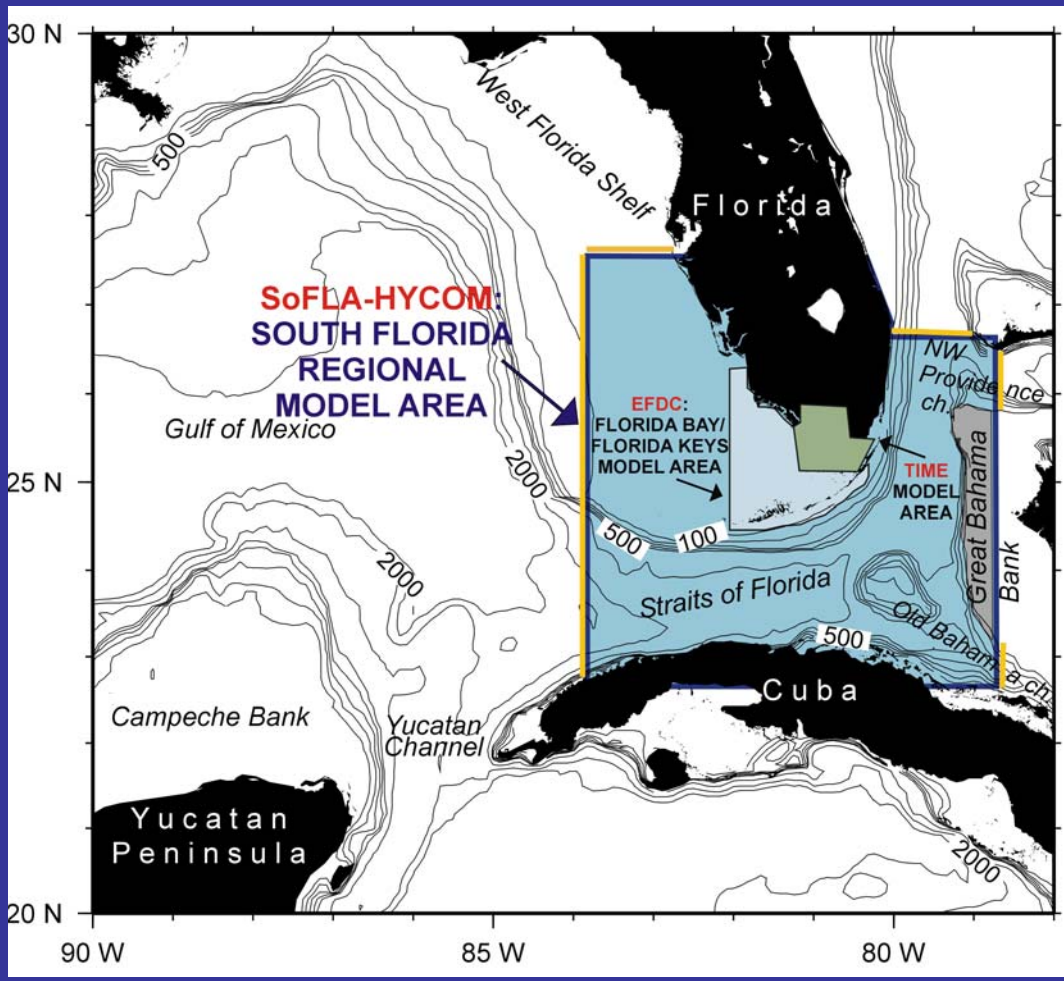
http://hycom.rsmas.miami.edu/overview/SoFLA_HYCOM.pdf

A multi-nested modeling approach in support of the Everglades Restoration Project:

SOFLA-HYCOM has been approved by the FBFKFS Interagency Modeling Panel as the South Florida Regional Model that provides boundary conditions to the embedded Florida Bay and Florida Keys model (EFDC model developed by the SFWMD) which receives freshwater inflows by the TIME model (USGS).

SoFLA-HYCOM capabilities:

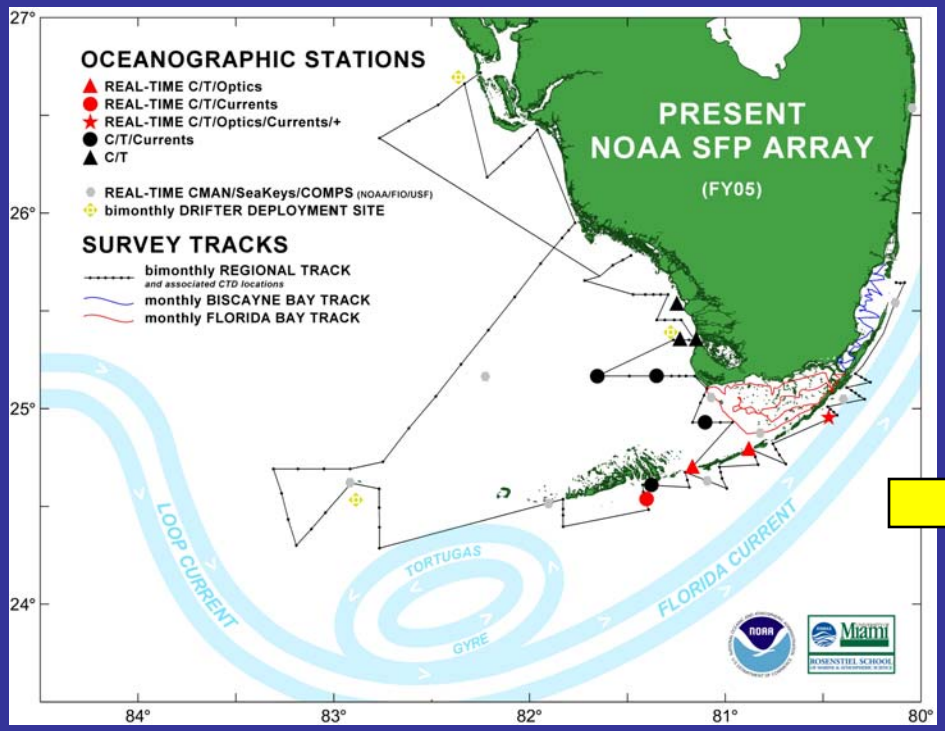
- Hydrodynamics (current)
- Larval transport (emerging)
- Nutrient transport (emerging)

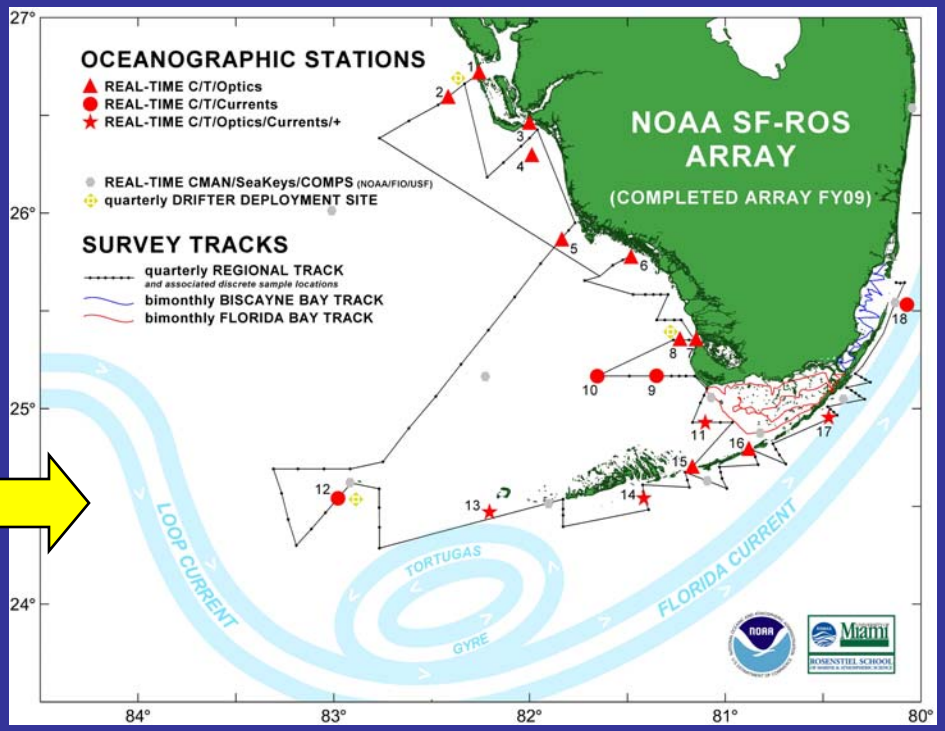


Nested boundaries

Observational Support for the Regional South Florida SoFla-HYCOM model and for FKNMS and NMFS Concerns

Evolution to Sustained Operations: From Ships to Models & Real-time Data Assimilation



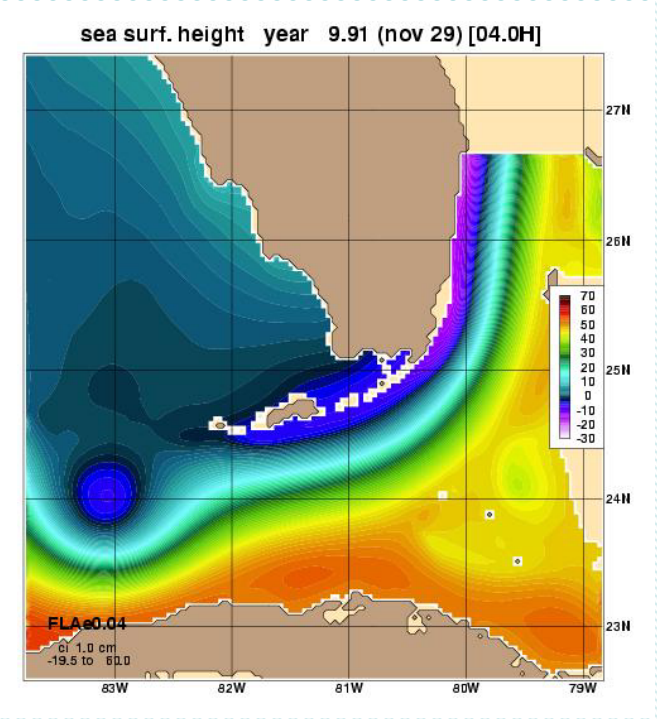


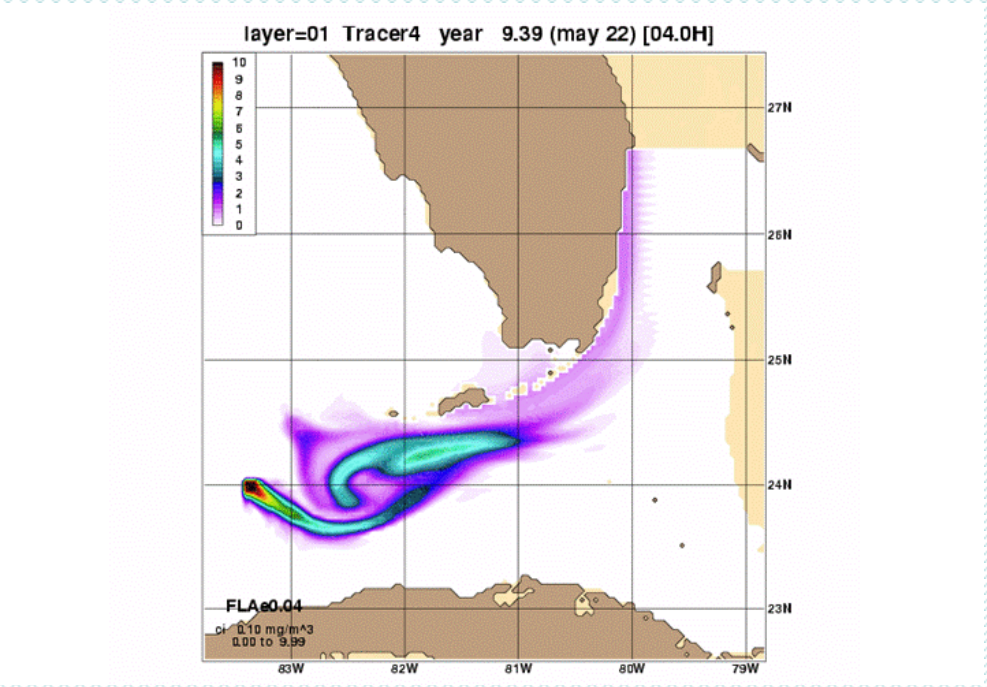
A long term data set of interdisciplinary shipboard observations, moored arrays and drifters (left) is currently in use by the SoFLA-HYCOM model for validation;
The observational activities are evolving into an expanded near real-time array (right), in support of emerging data assimilative modeling activities and operational capabilities.

Previous simulations:
Climatological forcing and process oriented

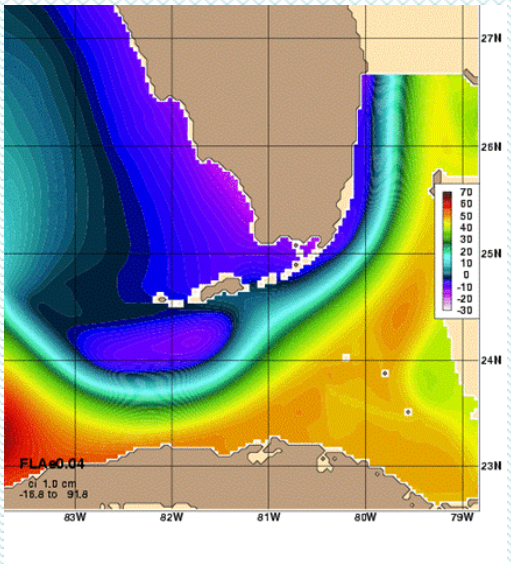
BC's from Tammy Townsend

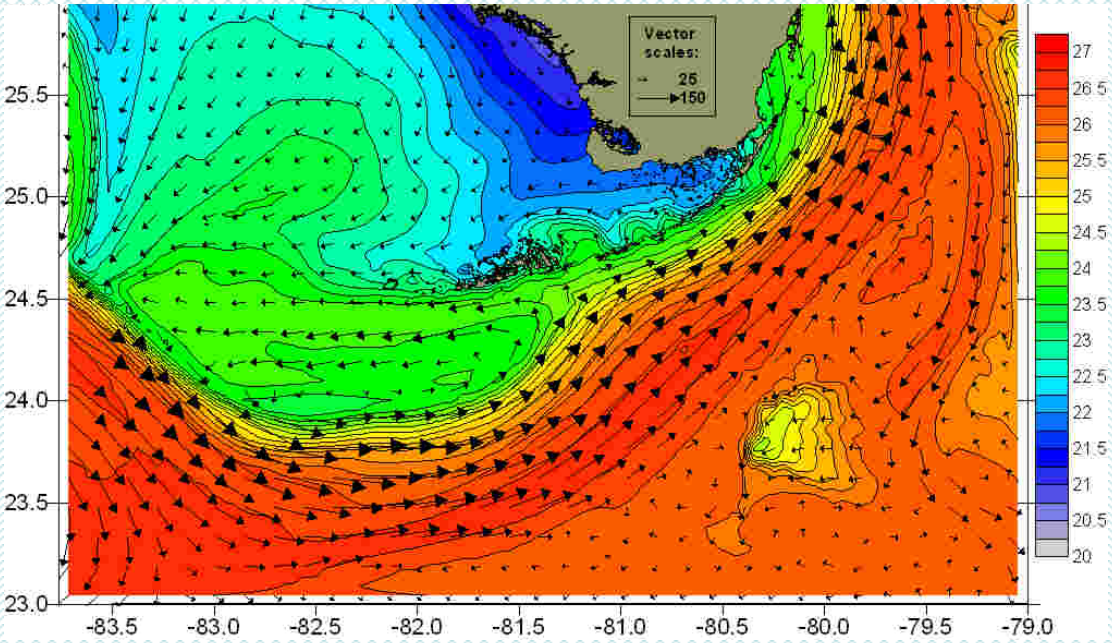
Eddy passages





Eddy elongation in Straits of Florida



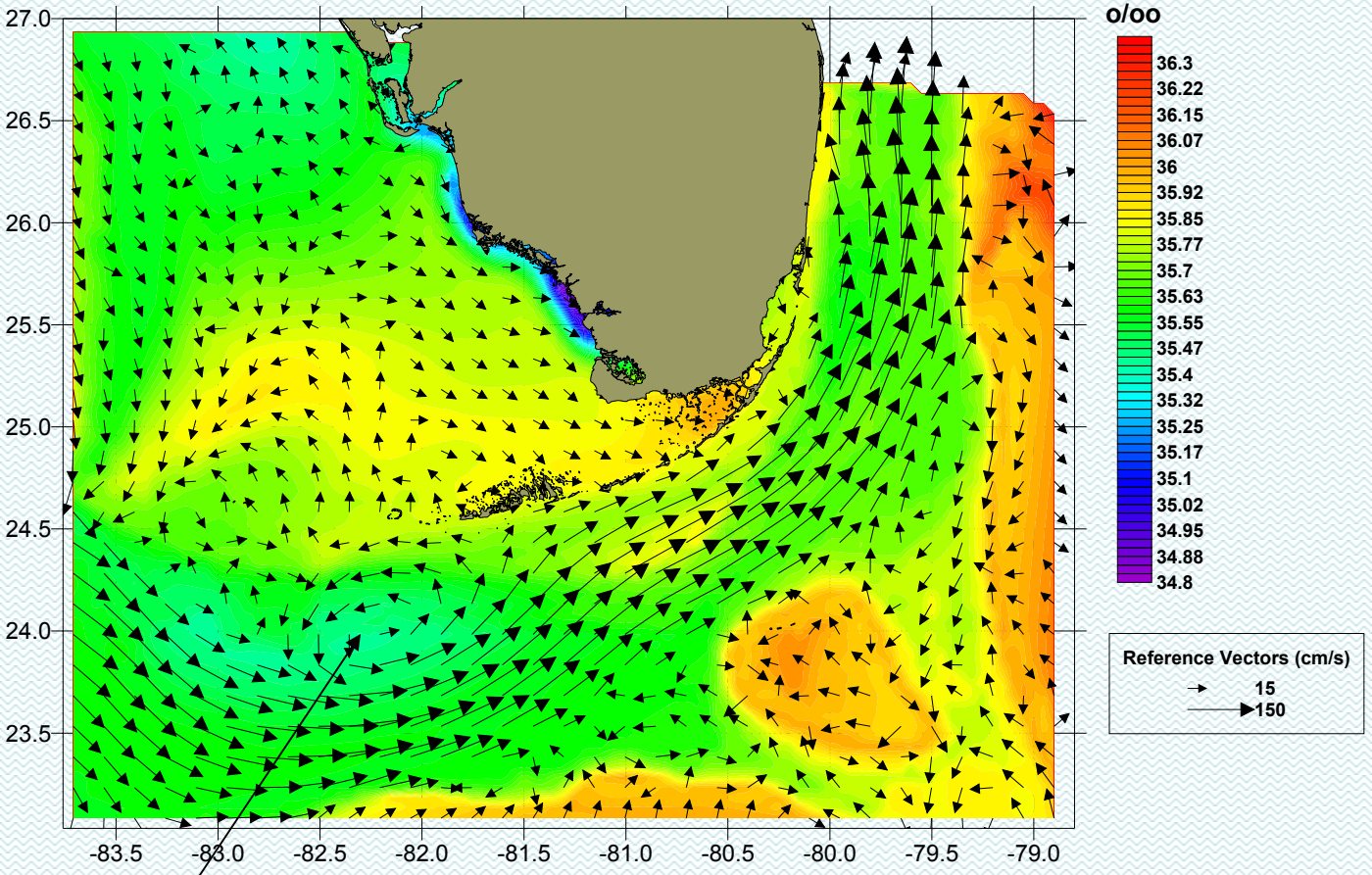


Sea surface height **Temperature and velocity (sfc)**

★ **Implications for larval recruitment in Florida Bay and the Florida Keys**

Sponaugle, S., T.N. Lee, V.H. Kourafalou and D. Pinkard, 2005. Florida current frontal eddies and the settlement of coral reef fishes. *Limnology and Oceanography*, 50: 1033-1048.

Surface salinity and currents (dry season)



improved river parameterization and line river source along Ten Thousand Islands

Low salinity water of Mississippi origin

★ Influence of remote sources of low salinity can alter regional distributions even in the dry season

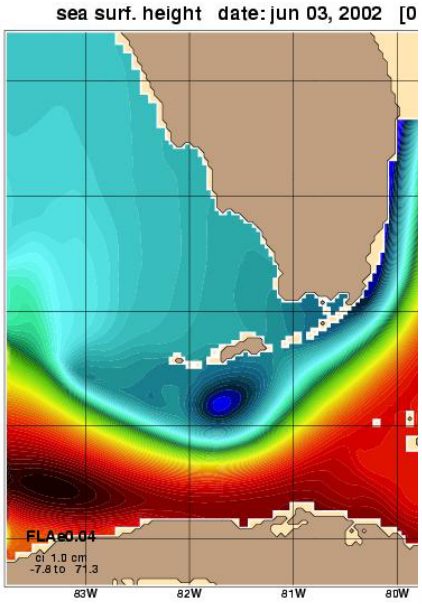
Inter-annual simulation

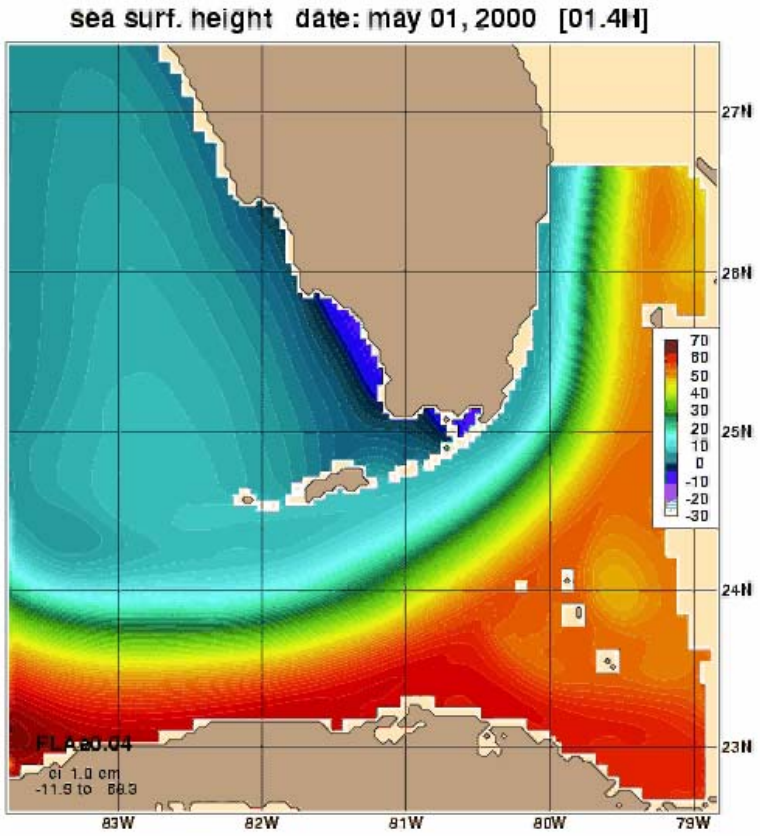
SoFLA-HYCOM

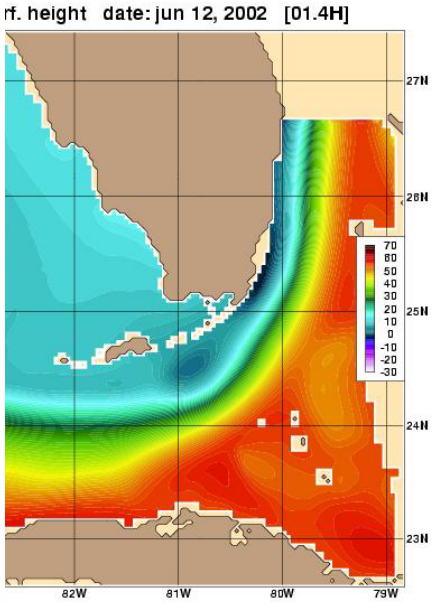
Regional FLAe0.04 model

- Domain is nested within ATLd0.08
- Simulation from Sept 1999 to Dec. 2002 with NOGAPS and daily rivers from hydrological model
  (Nsmooth = 5, thkriv = 5m, epmass =1)
- Free running - no data assimilation
- HYCOM version 2.1.27

Ye es







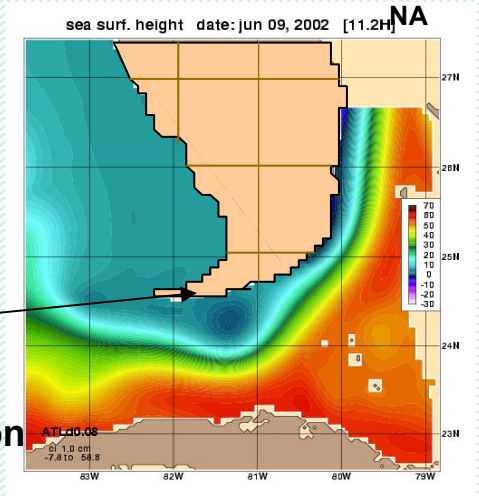
- The model sir ages along the Loop Current/
- The eddies pr aterial and nutrients betw s.

North Atlantic-HYCOM to SoFLA-HYCOM comparison

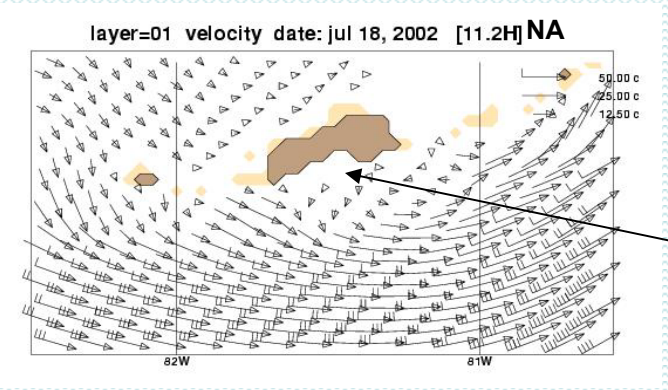
June 9, 2002 (eddy)

July 18, 2002 (no eddy)

North Atlantic

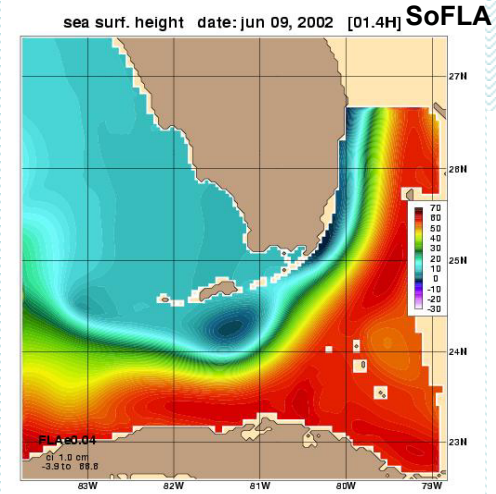


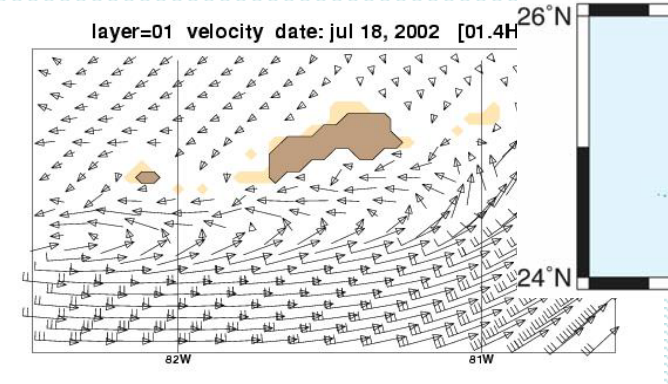
No coastal Topography, no eddy elongation

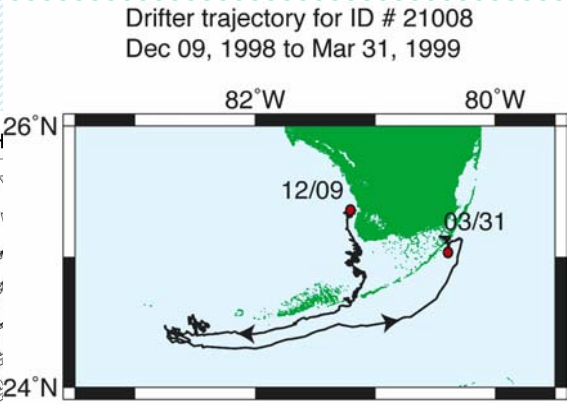


No wind-driven coastal current

SoFLA

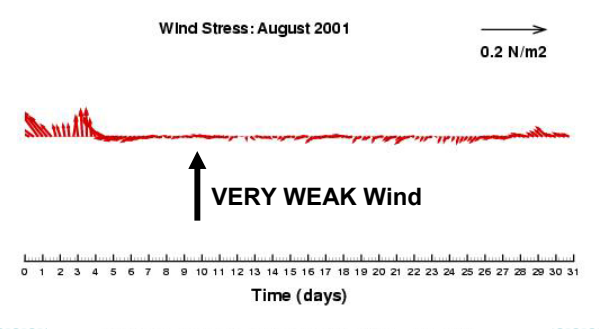


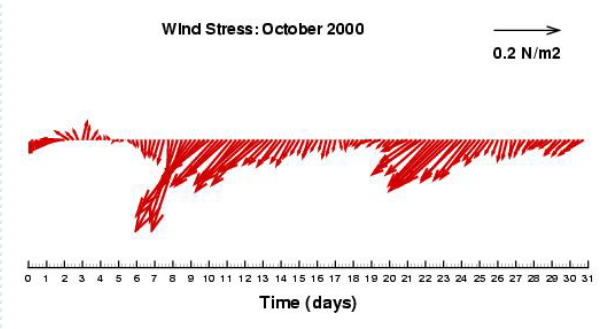


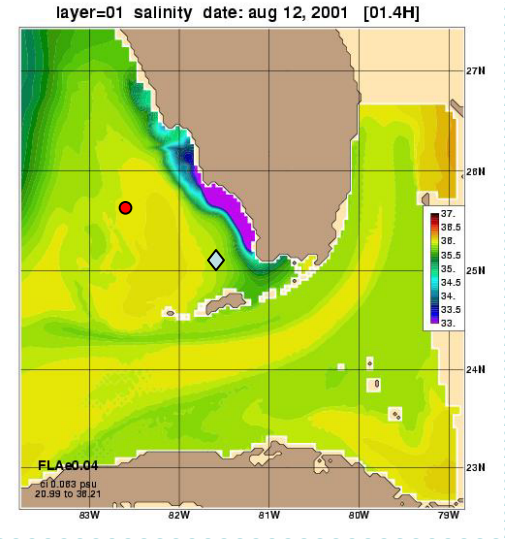


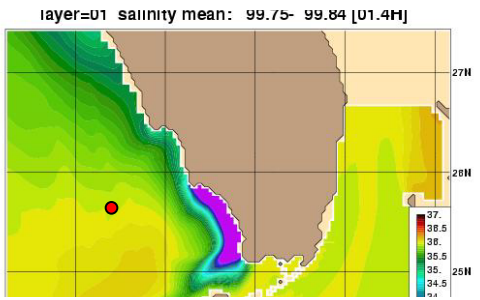
Seasonal and inter-annual variability in salinity and river effects

Buoyancy and wind driven flows

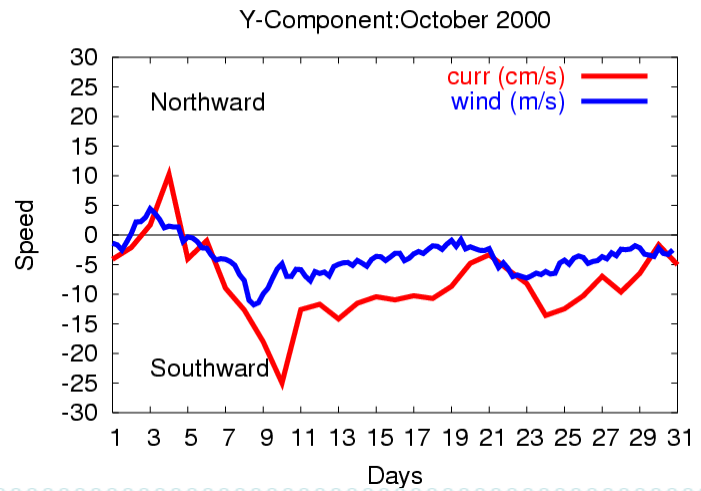




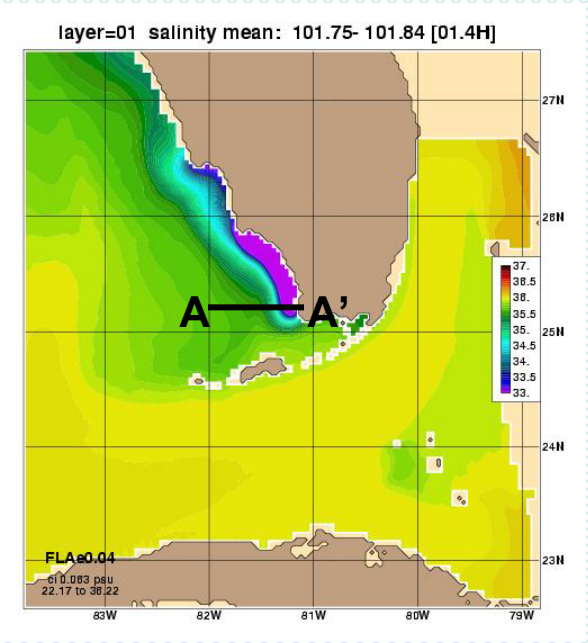


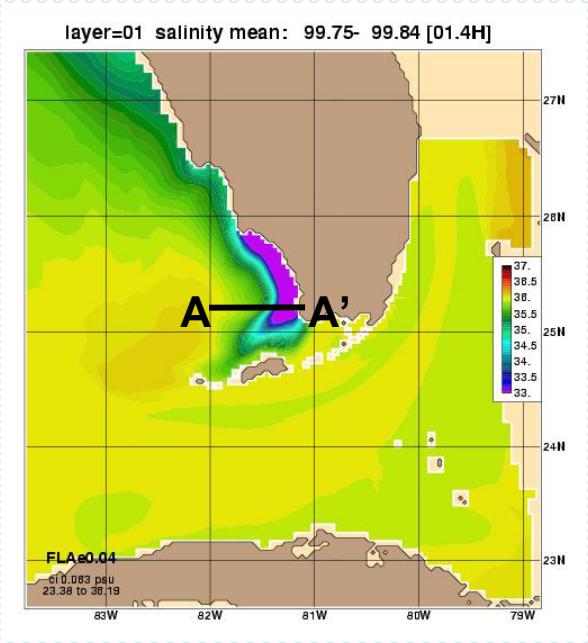


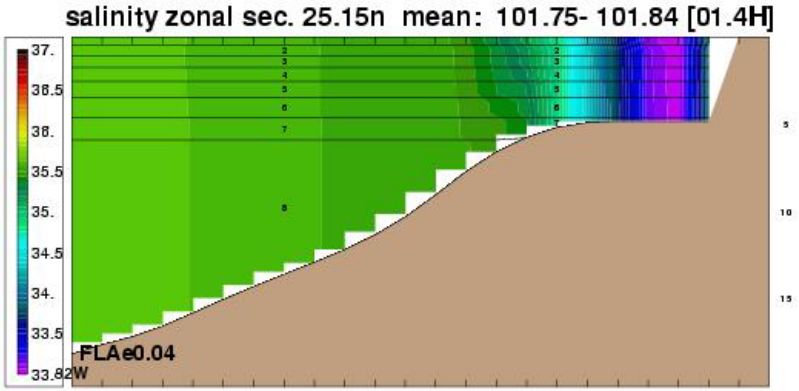
◊ Mooring B location

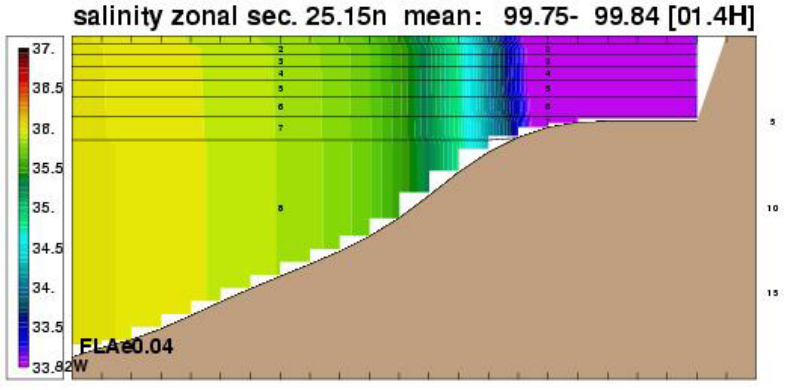


Vertical salinity profiles



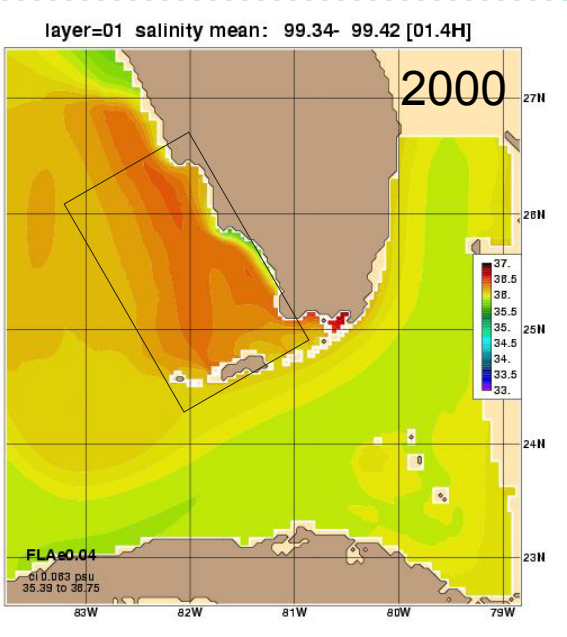


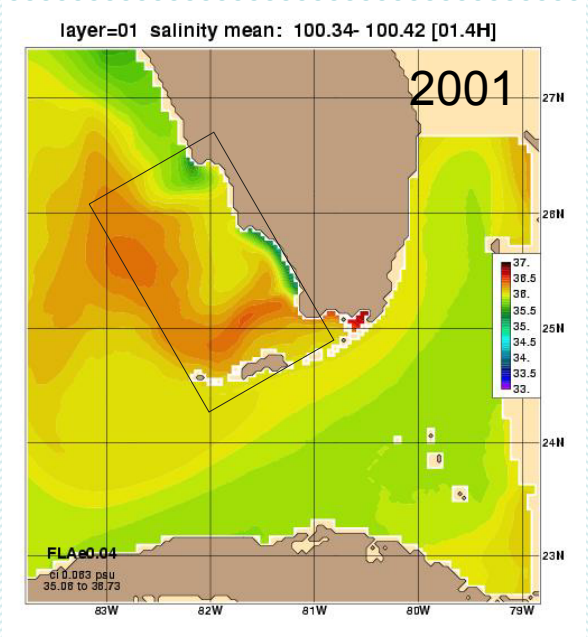


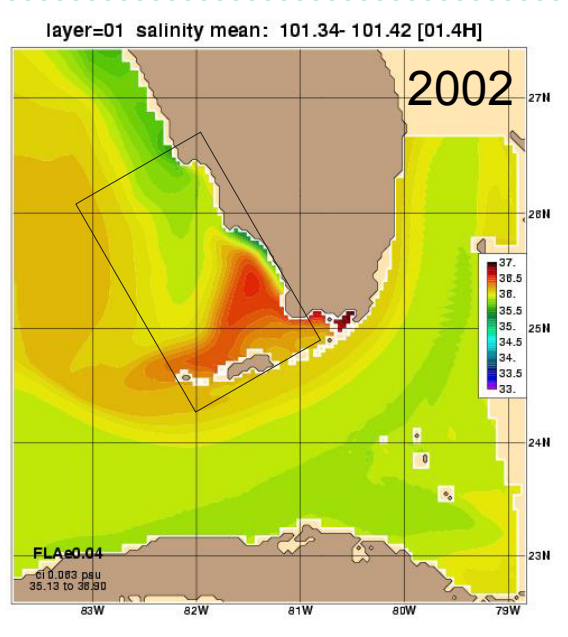


Model to data comparison: salinity

Inter-annual Variability: Dry Season (May)



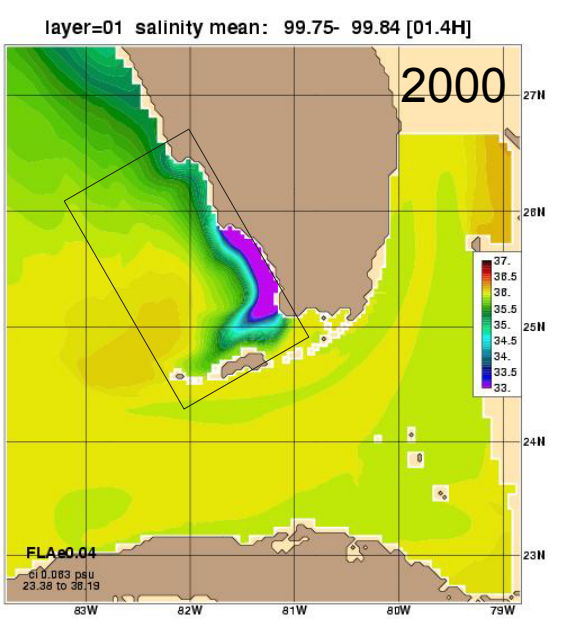


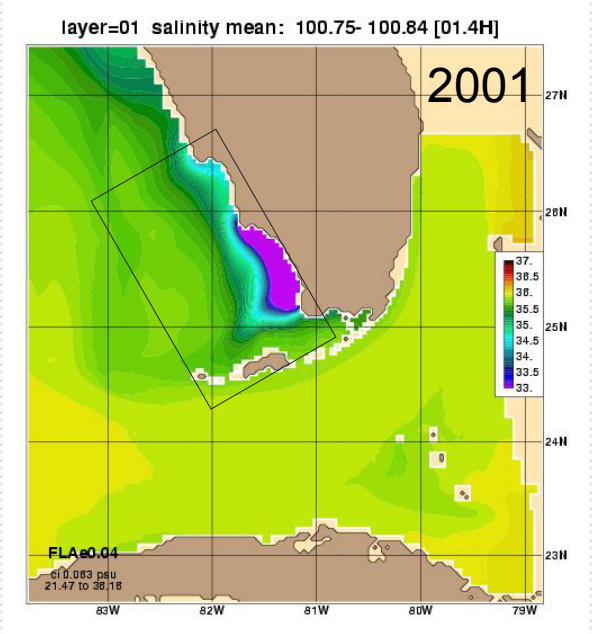


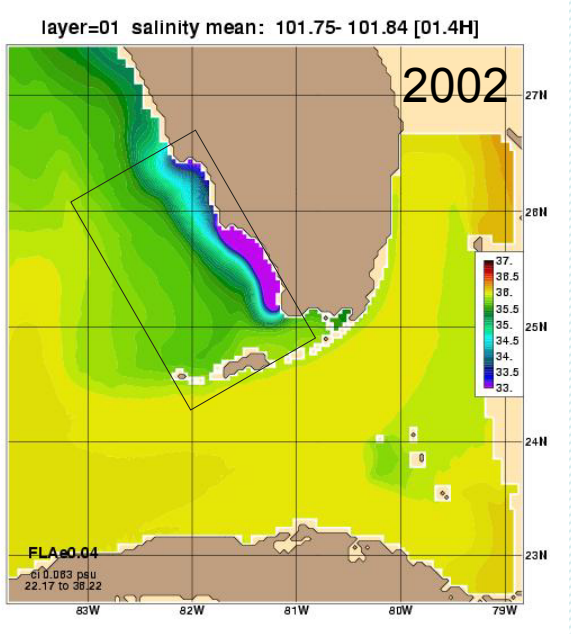
The peak of the dry season is around April-May.

Year 2000 is the most “dry”.

Inter-annual Variability: Wet Season (October)

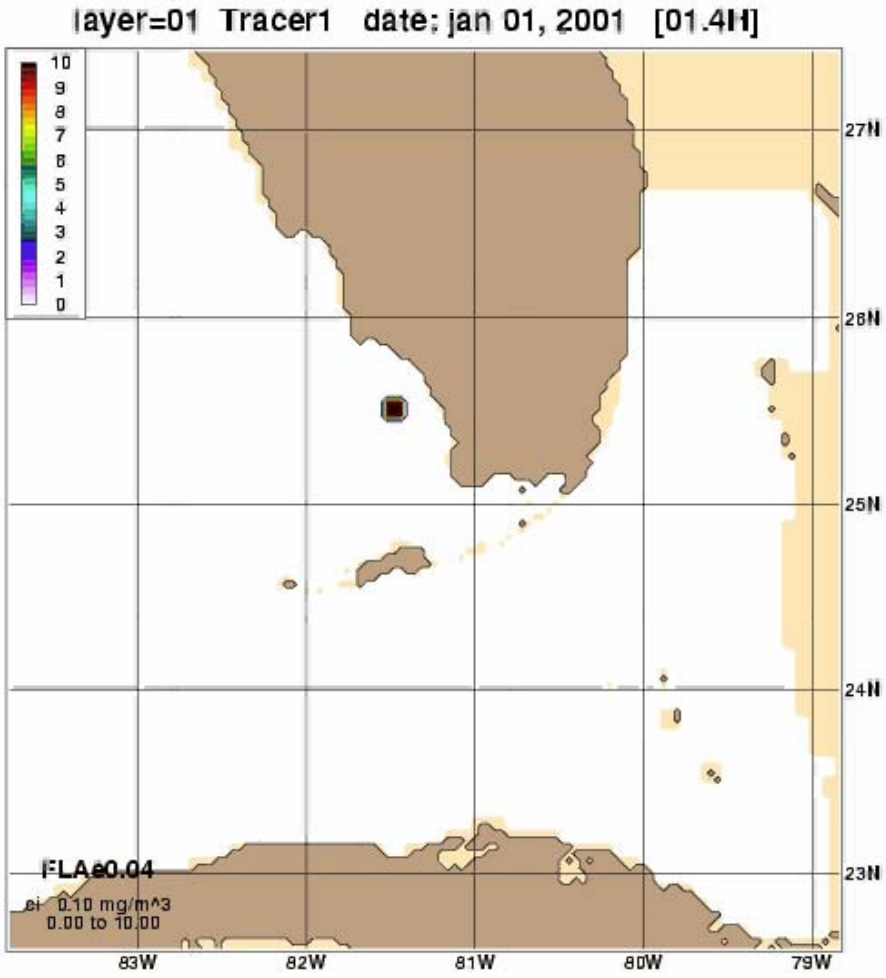






The peak of the wet season is around September-October (increased precipitation and increased river runoff)

Year 2002 is the most “wet”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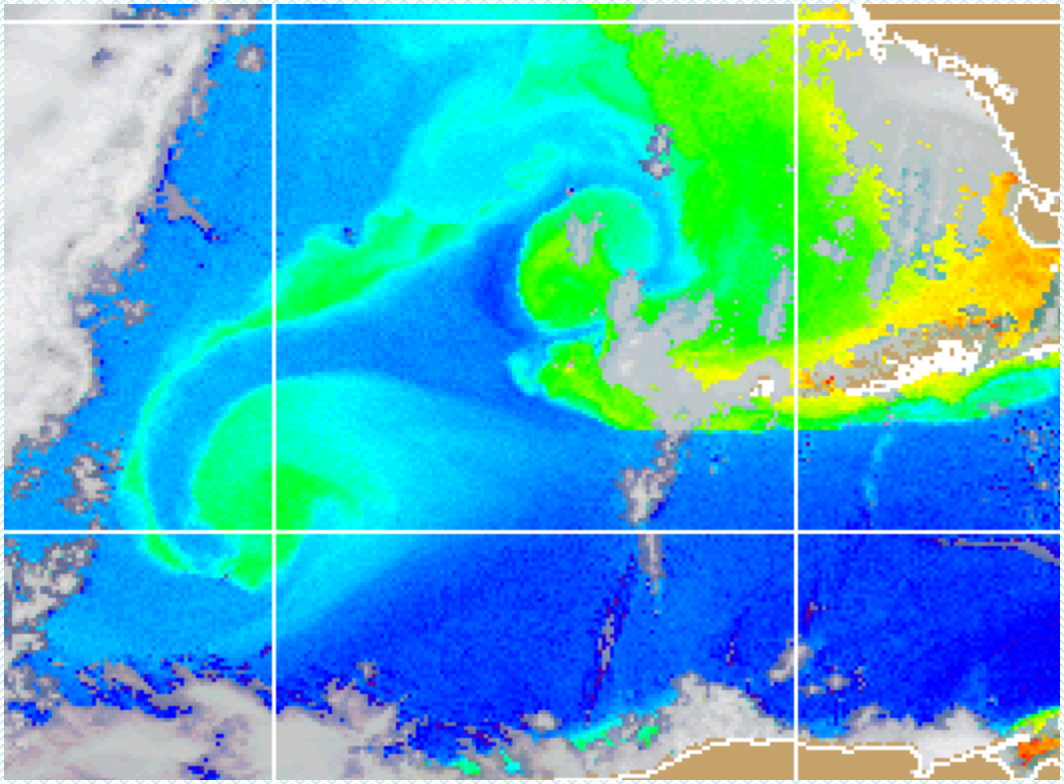
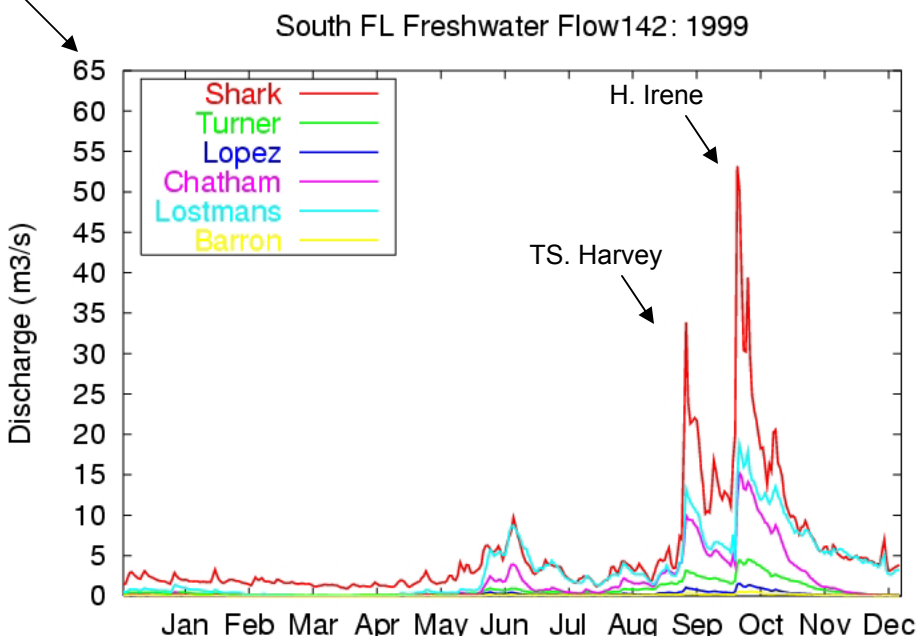
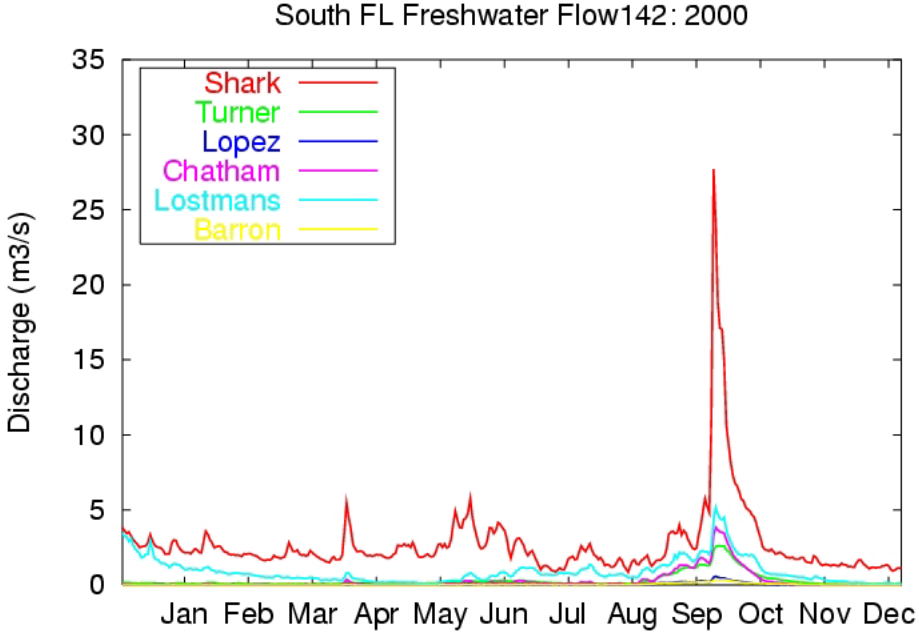


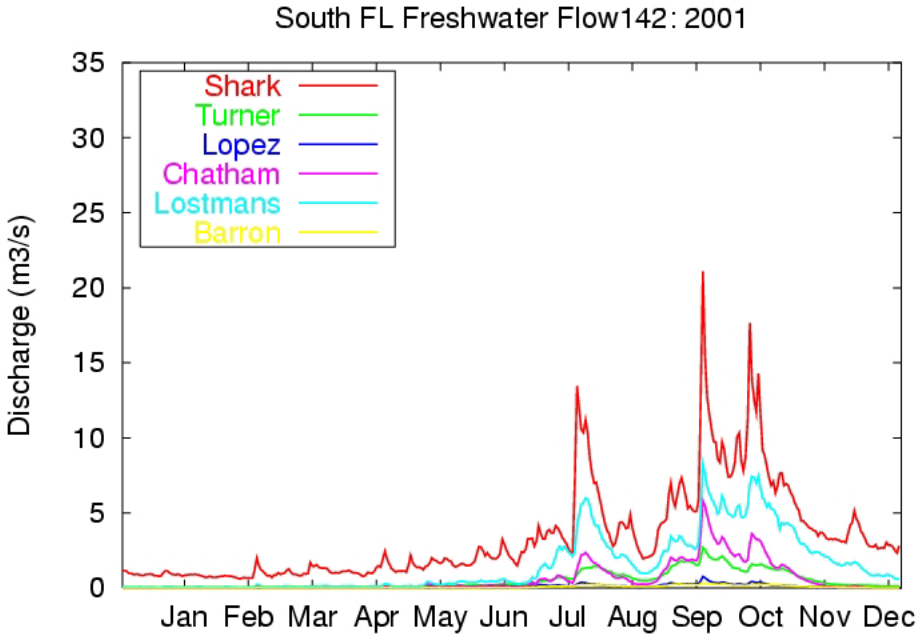
Offshore advection of high chlorophyll waters
from the SW Fla shelf and entrainment in Tortugas eddy

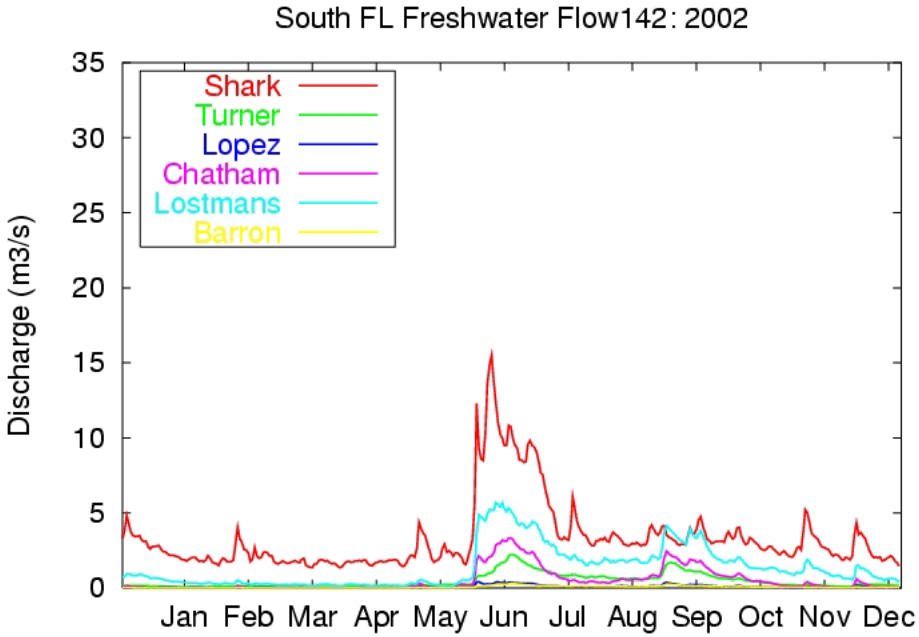
Flows from TIME model

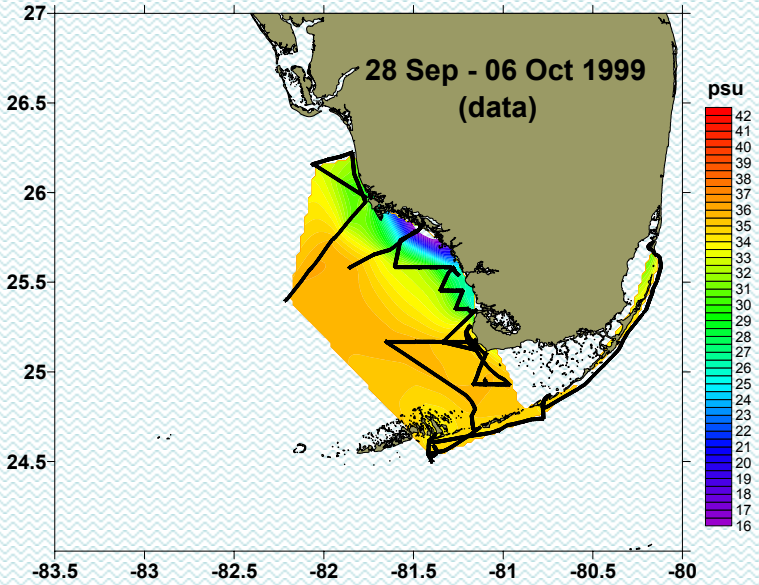
different scale

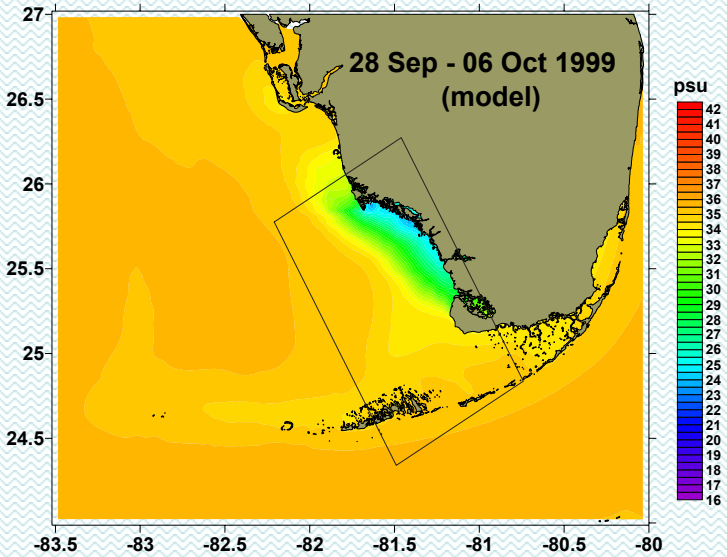






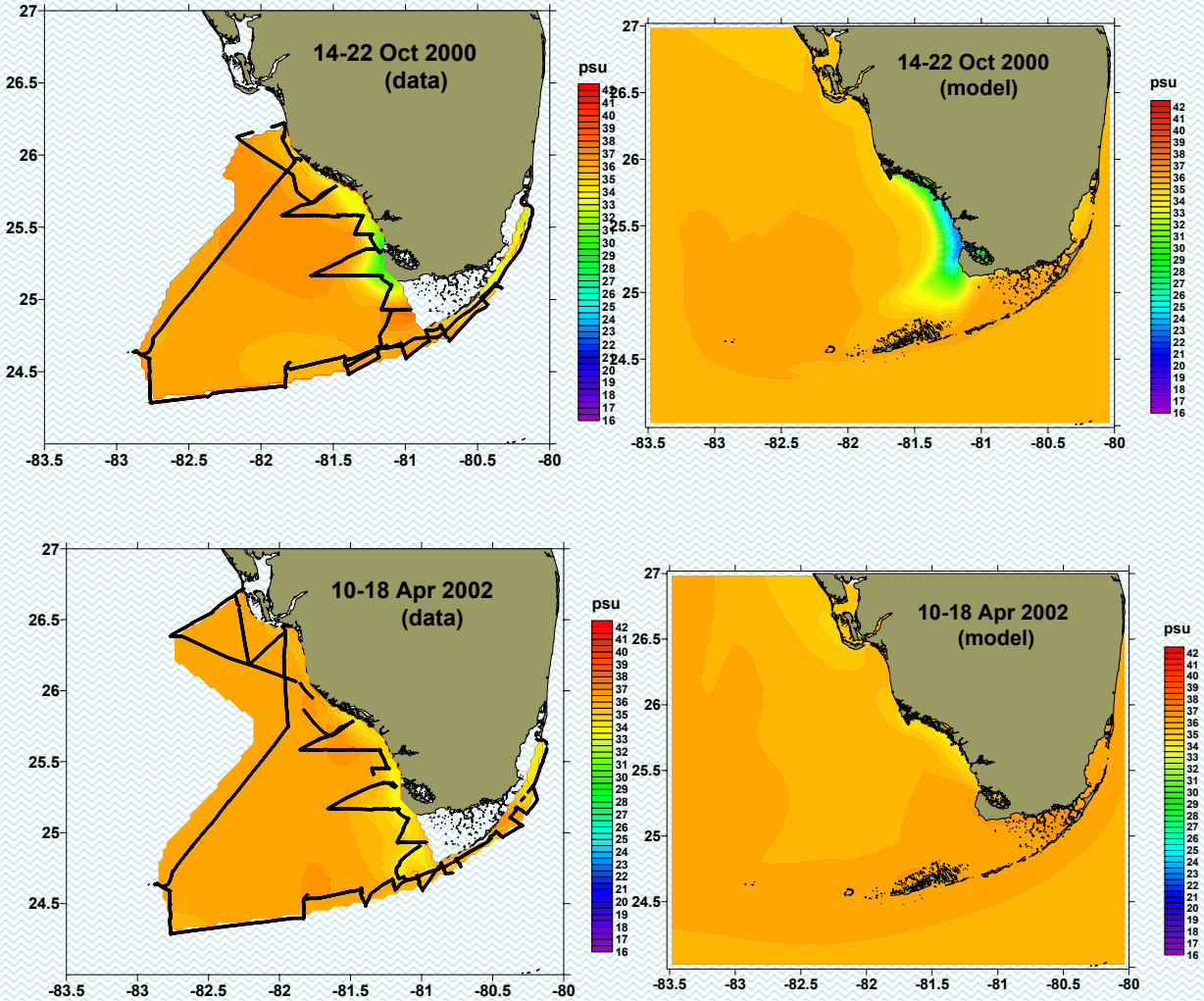






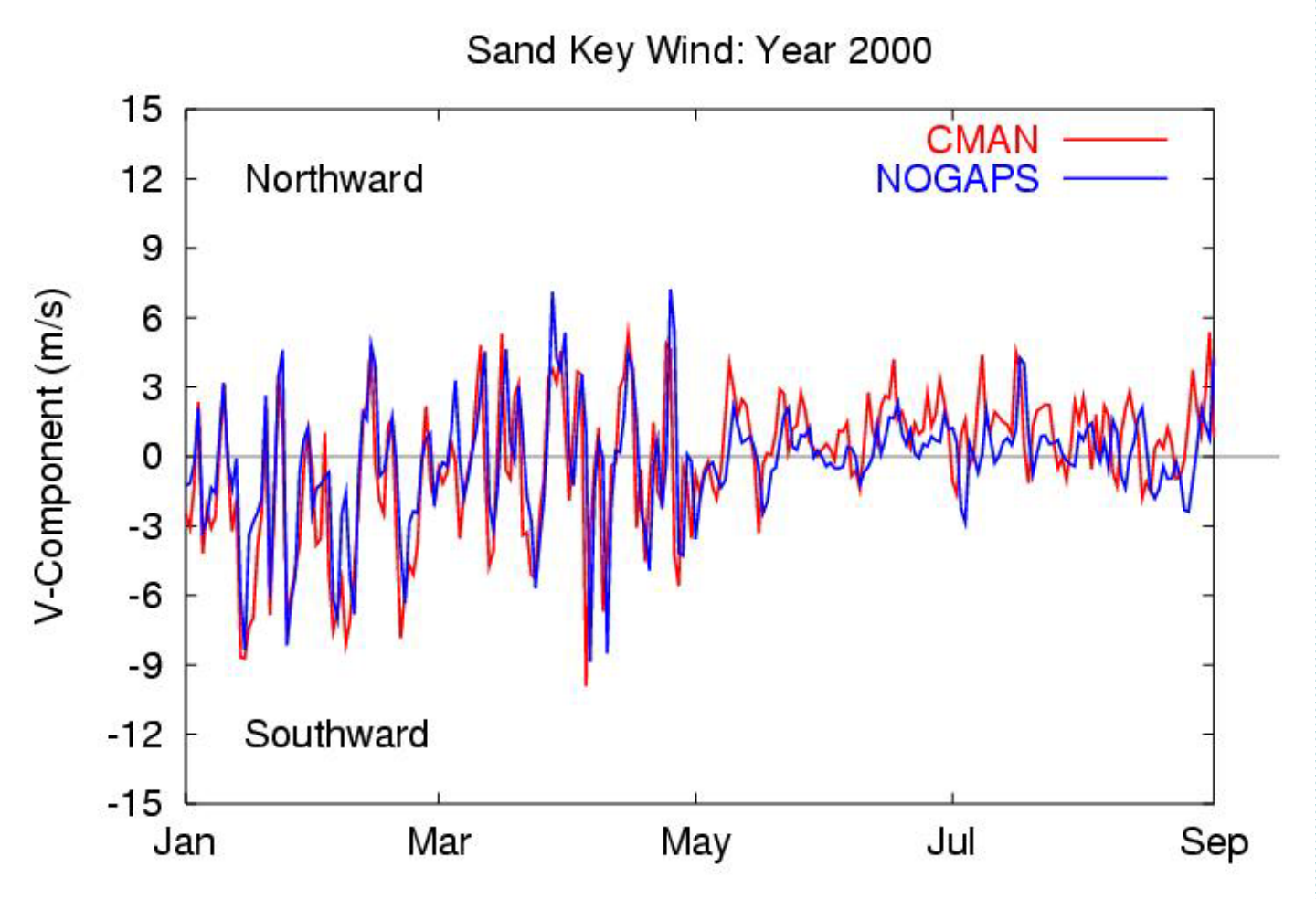
Lowest coastal salinity / no effect on FBay

Comparison with Observations: Salinity

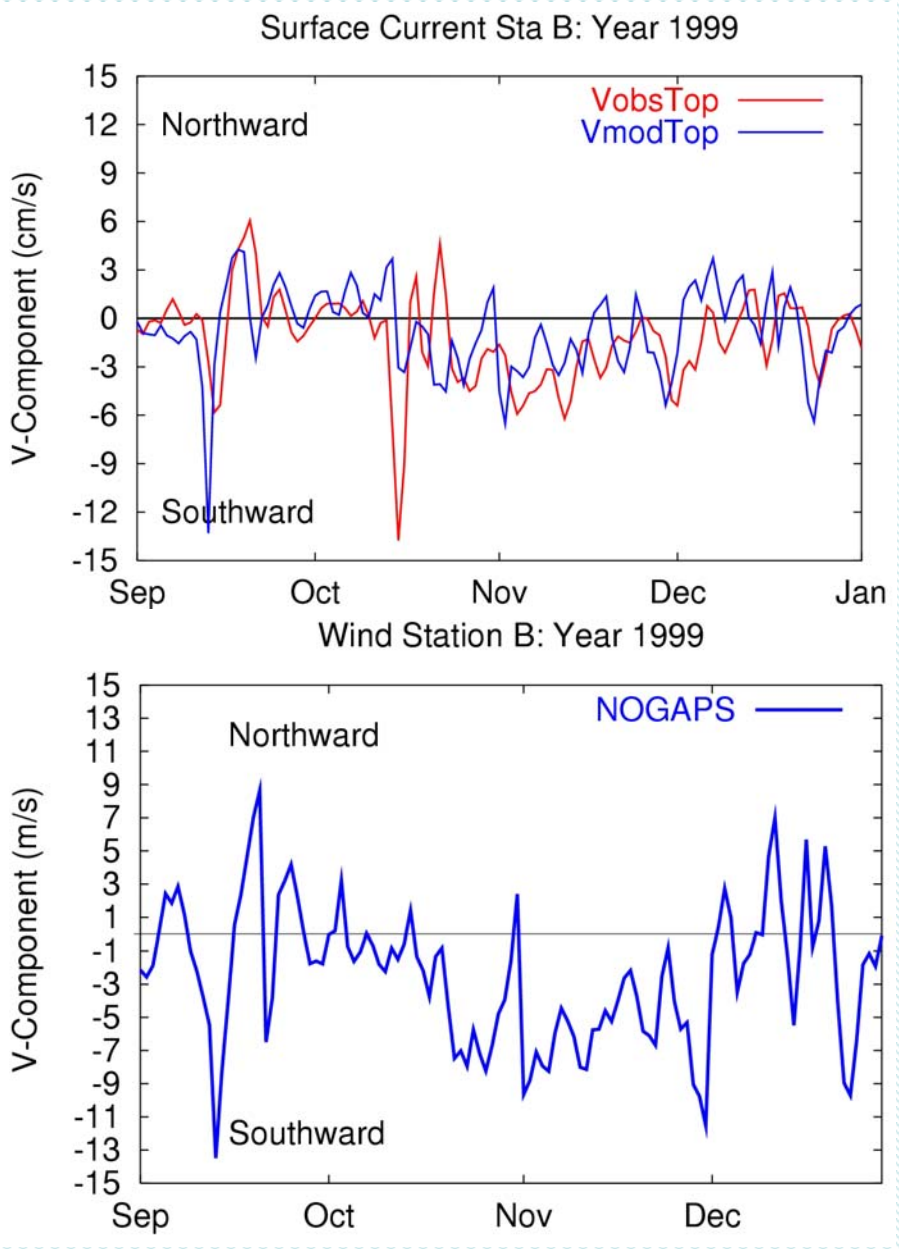


Model to data comparison: currents

Forcing evaluation: NOGAPS vs CMAN wind comparison

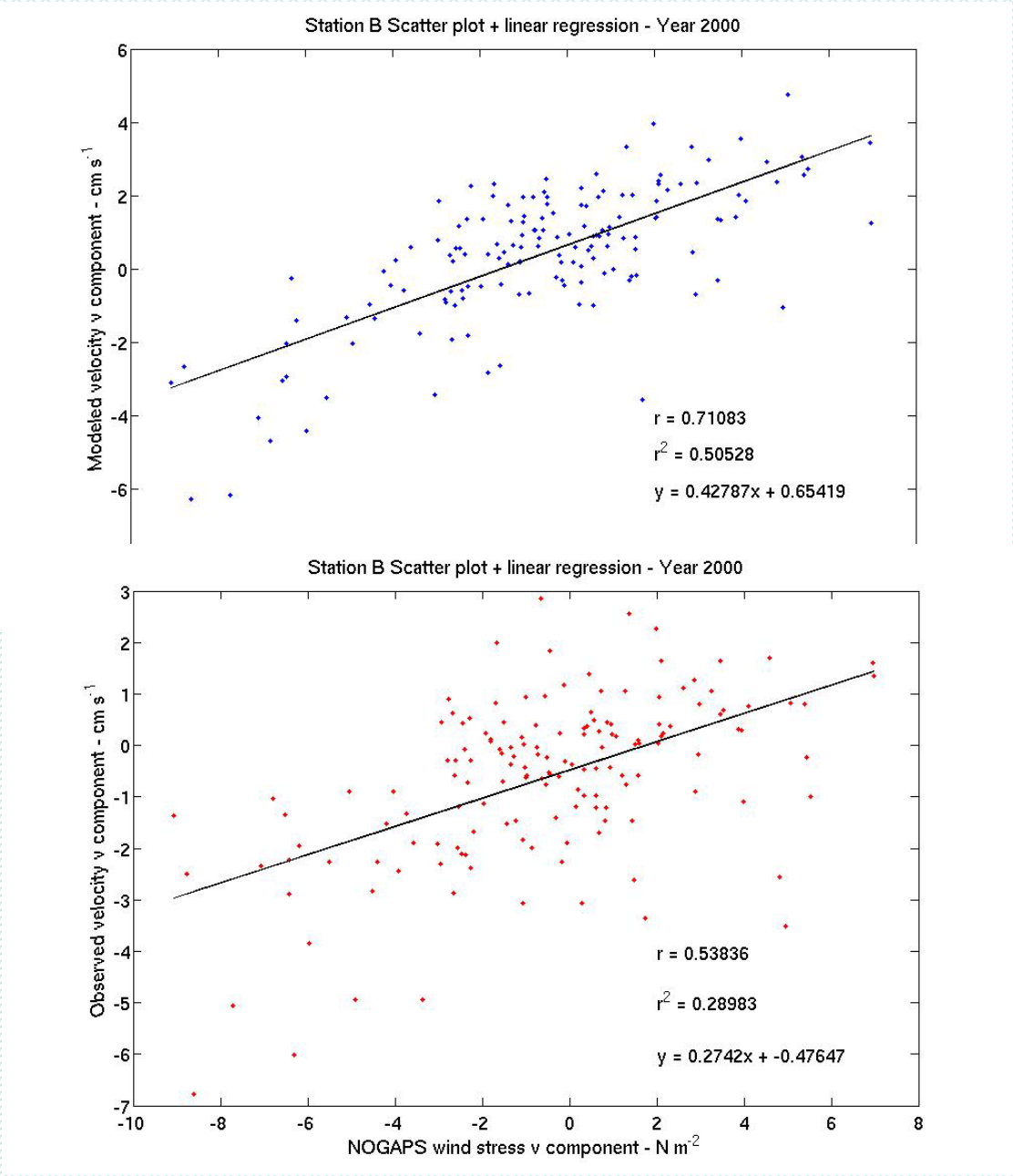


Comparison with Observations: V-Current (mooring B)



Statistical Comparison
of model vs data time series
is in progress
(Rafael Schiller/RSMAS)

Regression of
V- current and
v-wind
components



Station B

Daily Values
Current v component

	Modeled – Top Layer (P_i)	Observed – Top layer (O_i)
Mean	-1.0497 cm s^{-1}	-1.0273 cm s^{-1}
Standard Deviation	2.1603	1.8383
R	0.6828	
R^2	0.4663	
Slope (b)	0.8025	
Intercept (a)	0.7747	
RMSE	1.8885 cm s^{-1}	
SRMSE	1.0426 cm s^{-1}	
URMSE	1.5746 cm s^{-1}	

Root Mean Square Error

$$RMSE = \left[N^{-1} \sum_{i=1}^{N} (P_i - O_i)^2 \right]^{0.5}$$

Systematic Root Mean Square Error

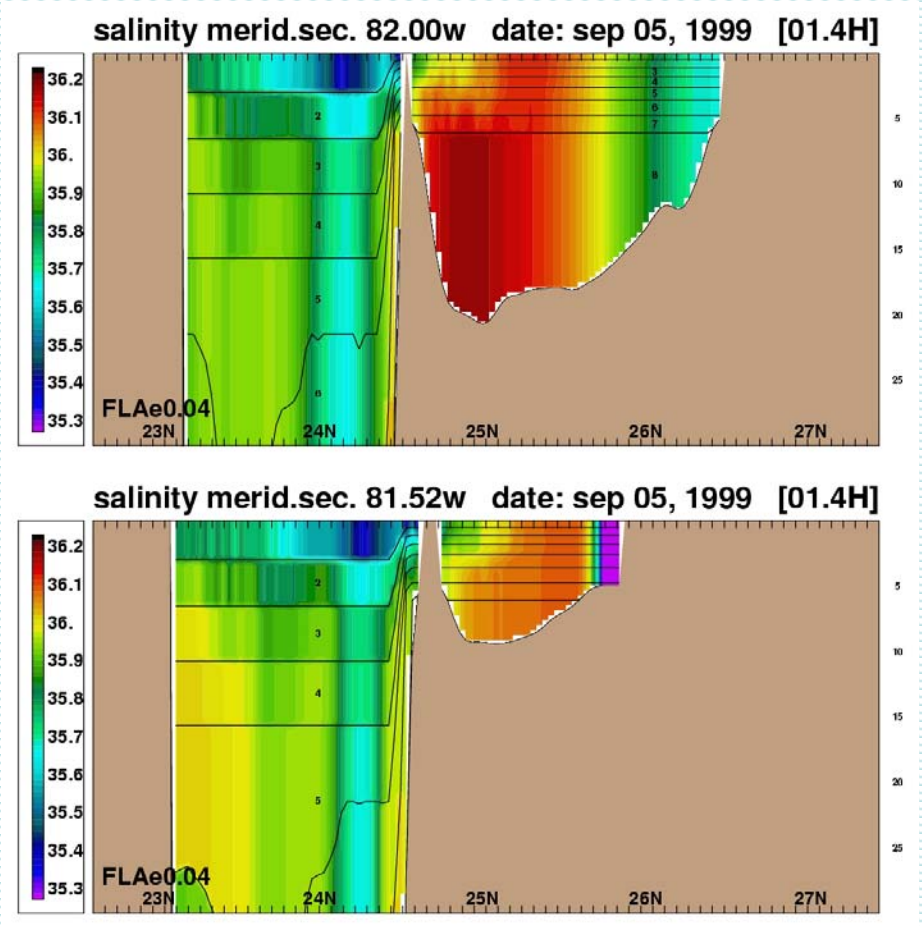
$$SRMSE = \left[N^{-1} \sum_{i=1}^{N} \left(\hat{P}_i - O_i \right)^2 \right]^{0.5}$$

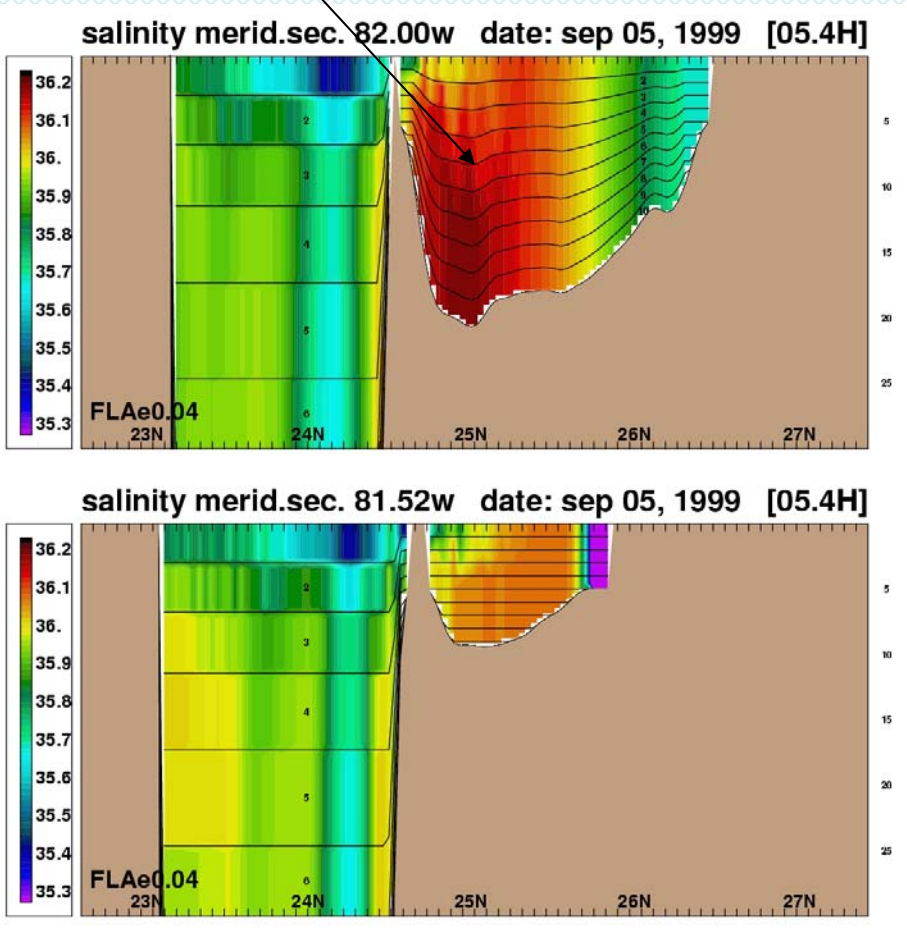
$$\hat{P}_i = a + bO_i$$

Unsystematic Root Mean Square Error

$$URMSE = \left[N^{-1} \sum_{i=1}^{N} \left(P_i - \hat{P}_i \right)^2 \right]^{0.5}$$

Increased vertical resolution on SW Fla shelf

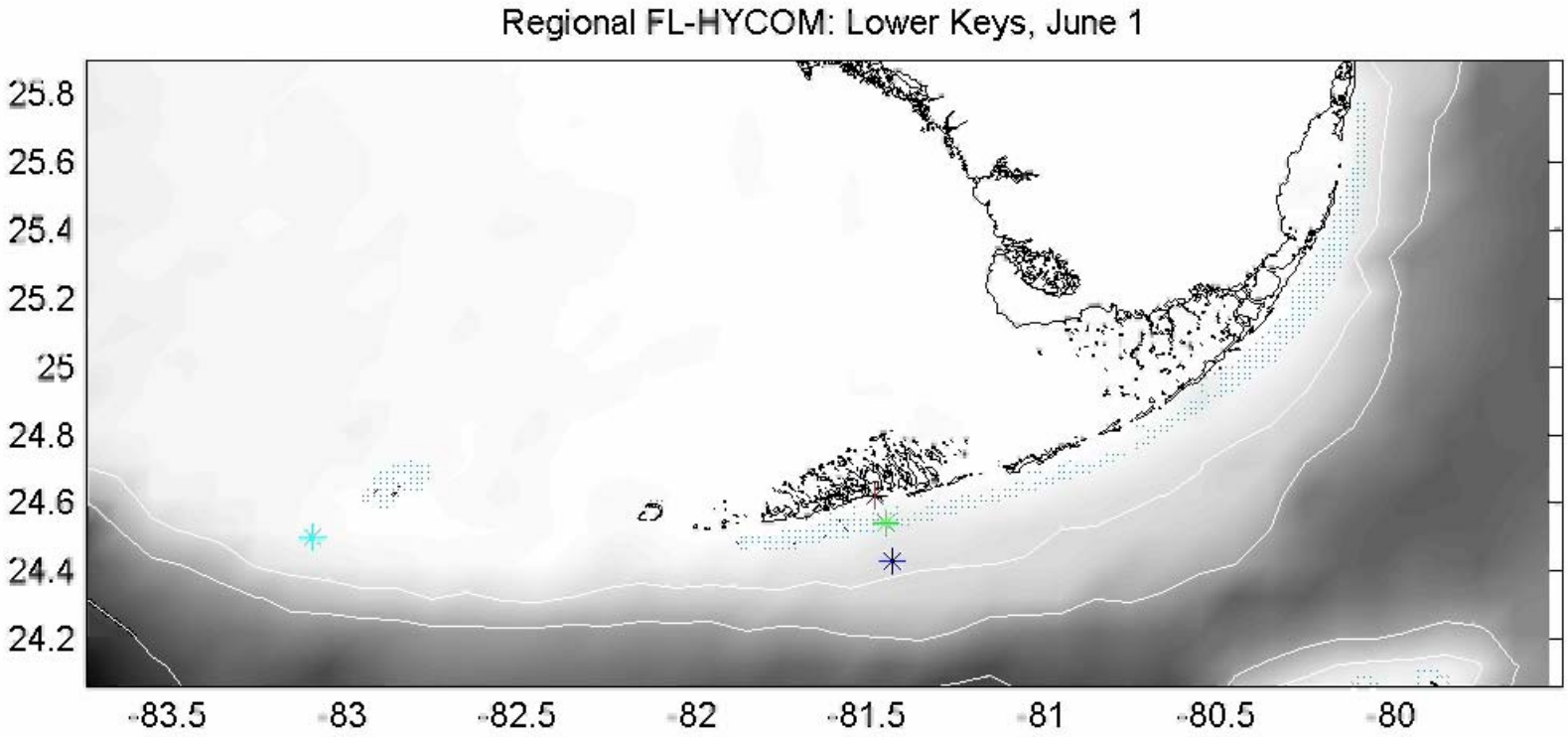




19 vertical layers

25 vertical layers

Larval particle transport (animation)



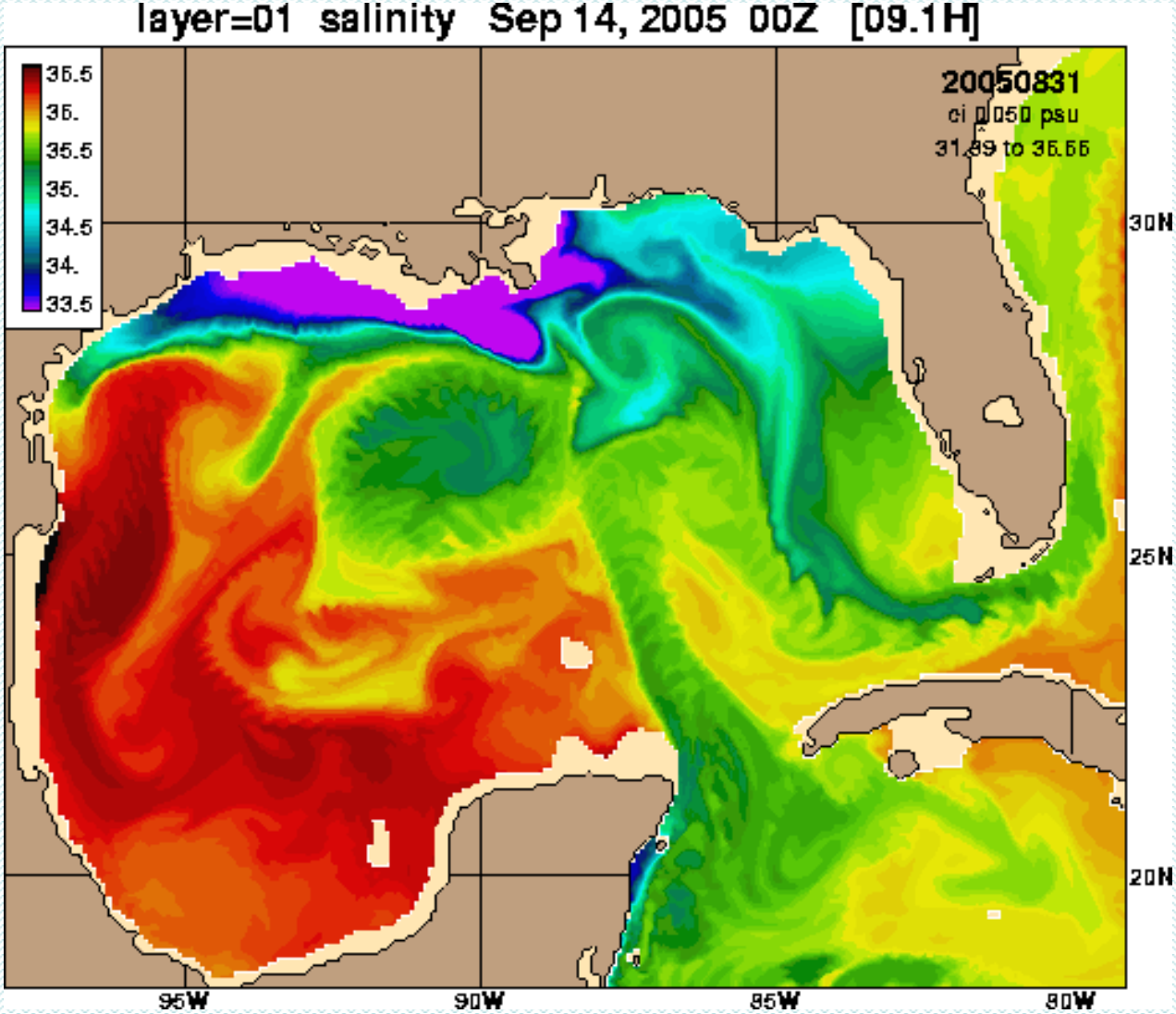
Lagrangian transport model from Claire Paris (UM/RSMAS)

FUTURE OUTLOOK:

"HYCOM Coastal Ocean Hindcasts and Predictions:
Impact of nesting in HYCOM GODAE Assimilative hindcasts"
(funded by NOPP)

SoFLA $1/50^0$ nest in $1/25^0$ GoM
B.C.'s from free running GoM
B.C.'s from GoM with NCODA assimilation scheme
(use South Florida near real-time mooring array)
High resolution nest around the WERA radar region (upper Fla Keys)

Effects of Mississippi River low salinity / high nutrient waters in the FKeys/FBay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35.5
35.
35.5
35.
34.5
34.
33.5
20050831
ci 0.050 psu
31.89 to 35.66
30N
25N
20N
95W
90W
85W
80W