Inter-Annual Simulations with SoFLA-HYCOM and Comparison to in-situ Data

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In Collaboration with

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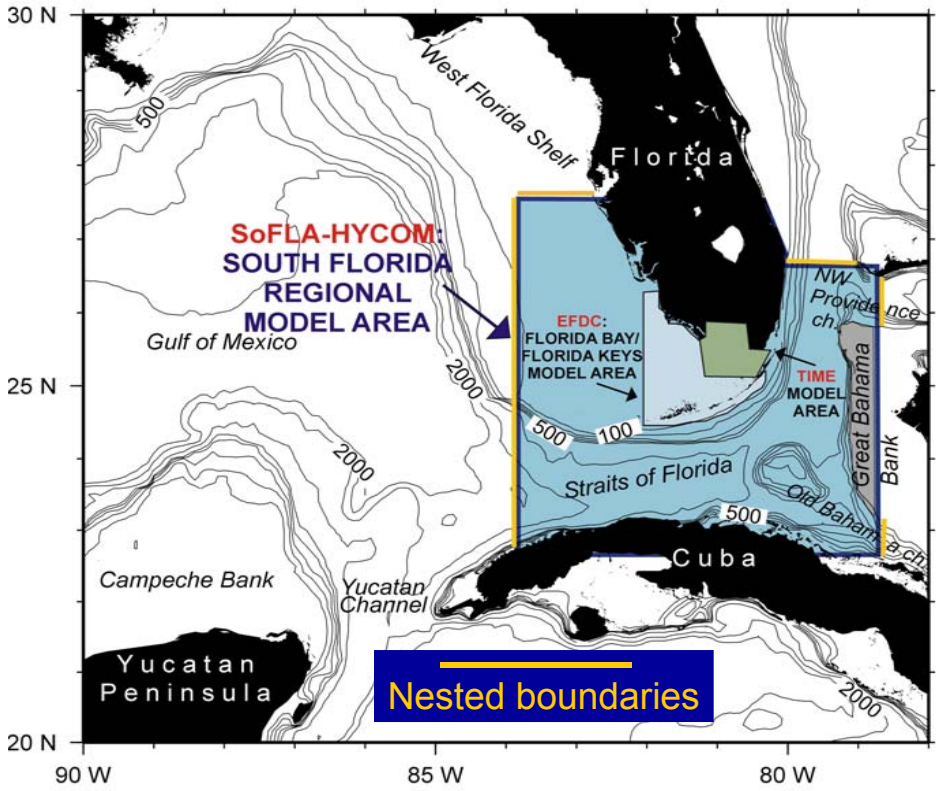
SoFLA-HYCOM

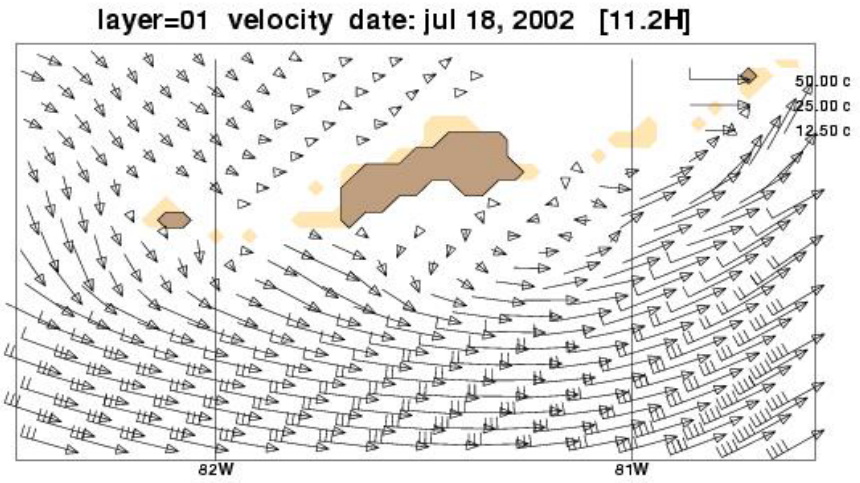
Regional FLAe0.04 model

- HYCOM version 2.1.27
- Domain (83.76W-78.8W; 22.59N-27.45N) is nested within N.ATLd0.08 (1/12º)
- Simulation from Sept 1999 to Dec. 2002 with NOGAPS and daily rivers from a hydrological model
- Free running - no data assimilation
- Improved local topography with 5 m minimum water depth



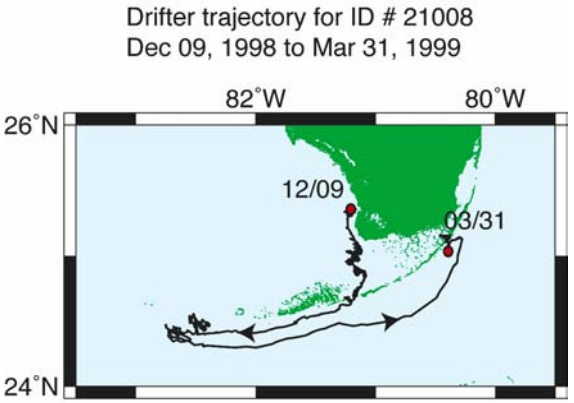
The goals are to examine the capability of HYCOM in simulating coastal currents on the SW FL Shelf and to provide boundary conditions to the FL Bay/KEYS models.

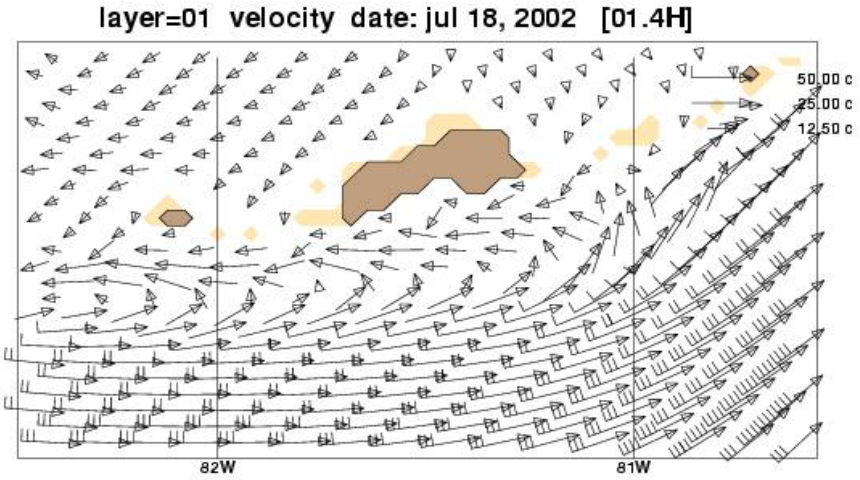
Coastal features in nested model



NA-HYCOM

No wind-driven coastal current



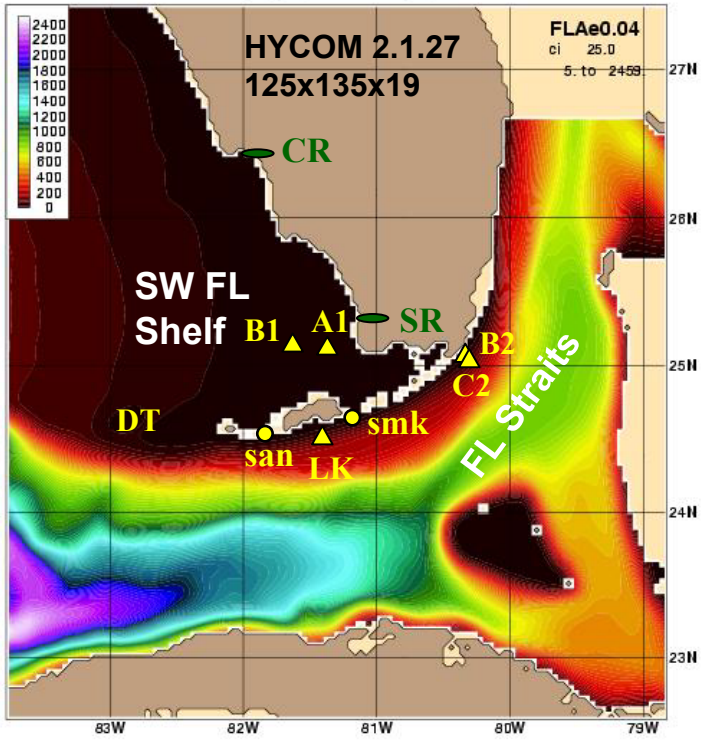


SoFLA-HYCOM

Improved topography & horizontal resolution

→ better wind-driven coastal current.

Geographic Locations of Data and Model Points

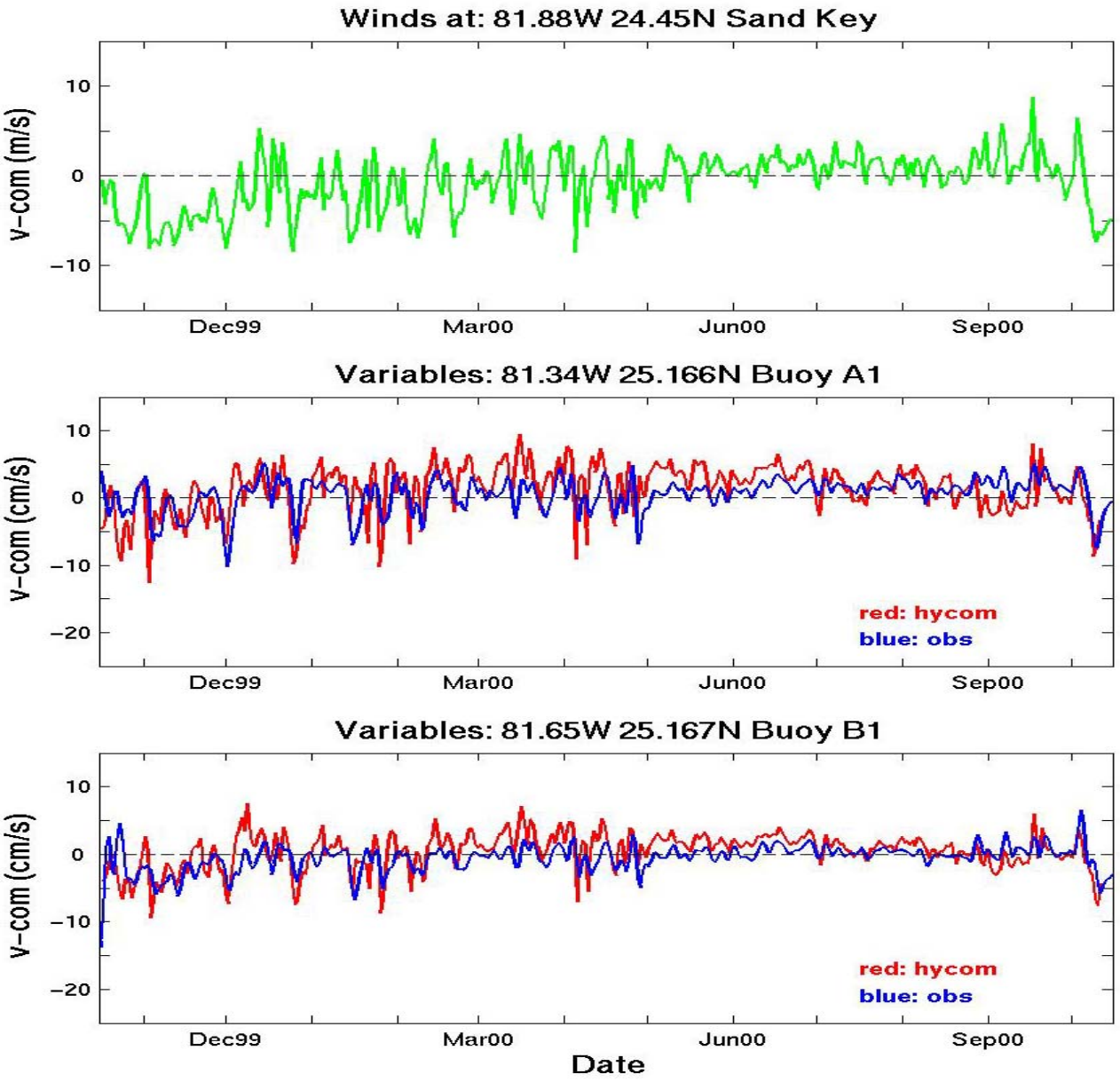


▲: moorings; ●: c-man
DT: Dry Tortugas; LK: Looe Key;
san: Sand Key; smk: Sombrero Key;
SR: Sharker River
CR: Caloosahatchee River.

Station ID	type	Lon (°w)	Lat (°N)	Water Depth (m)	Model Depth (m)*
A1	buoy	81.336	25.1657	6.4	5.36
B1	buoy	81.653	25.1672	11.58	13.34
B2	buoy	80.355	25.093	7.0	14.798
C2	buoy	80.318	25.073	21.8	31.18
LK	buoy	81.40	24.542	24	56.8
san	C-MAN	81.88	24.45		
smk	C-MAN	81.11	24.63		
mlr	C-MAN	80.38	25.01		

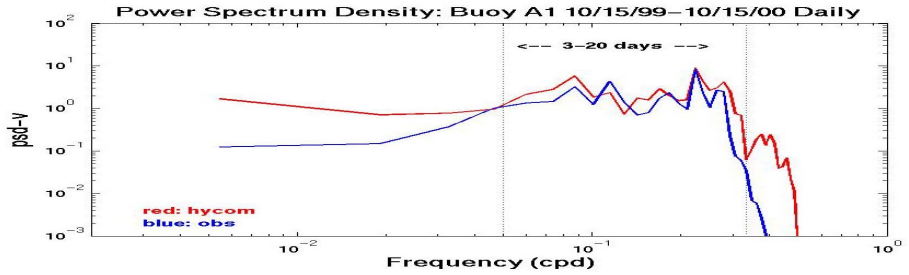
*: Model point is the closest model point to the data point but may not be collocated with data points.

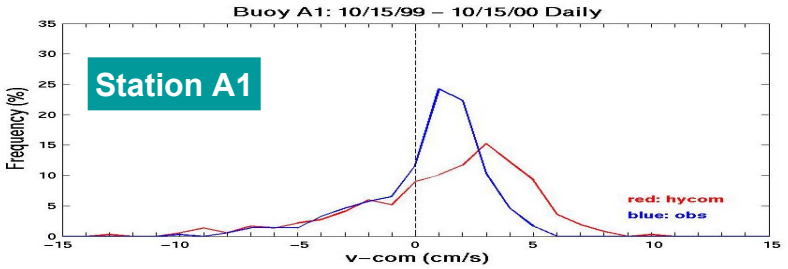
Model-Data Comparison: Time Series

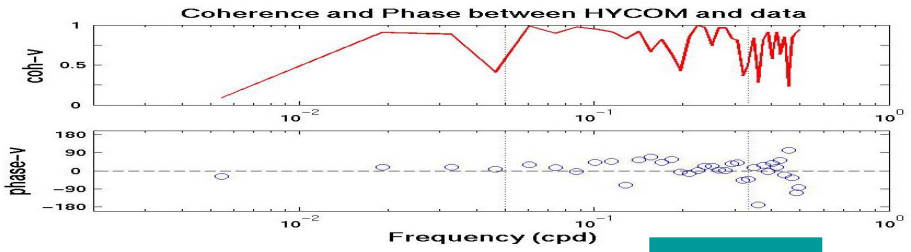


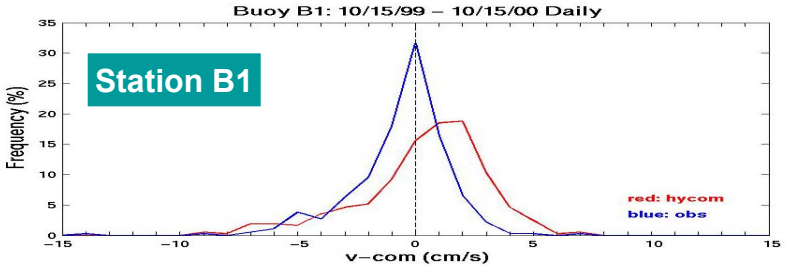
- **Currents on the SW FL shelf are largely wind-driven**
- **In response to atmospheric forcing, the currents (both model and observations) display more fluctuations during winter season (November – May) than during summer season (June – October).**

Model-Data Comparison: Statistics

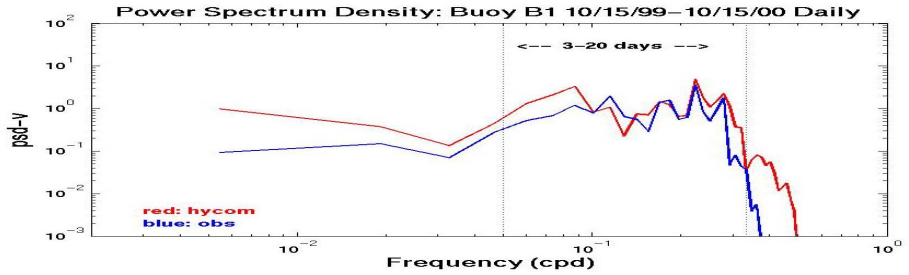


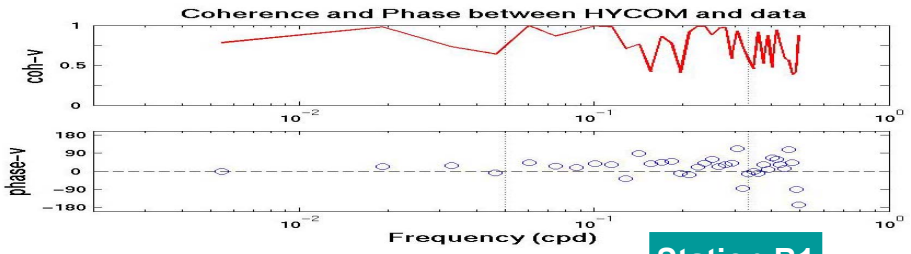






Station A1



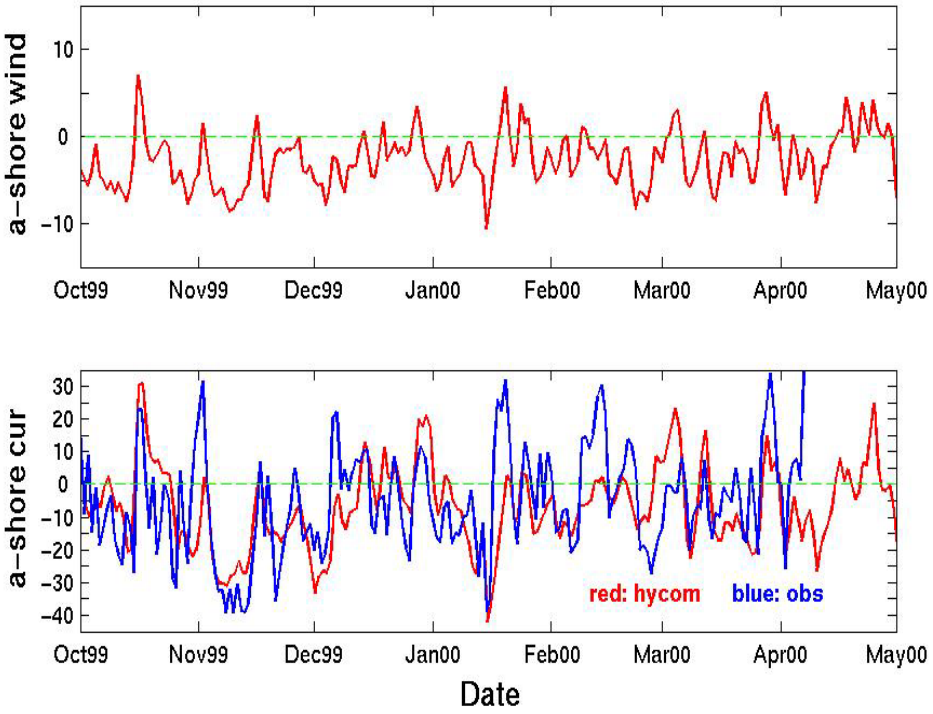


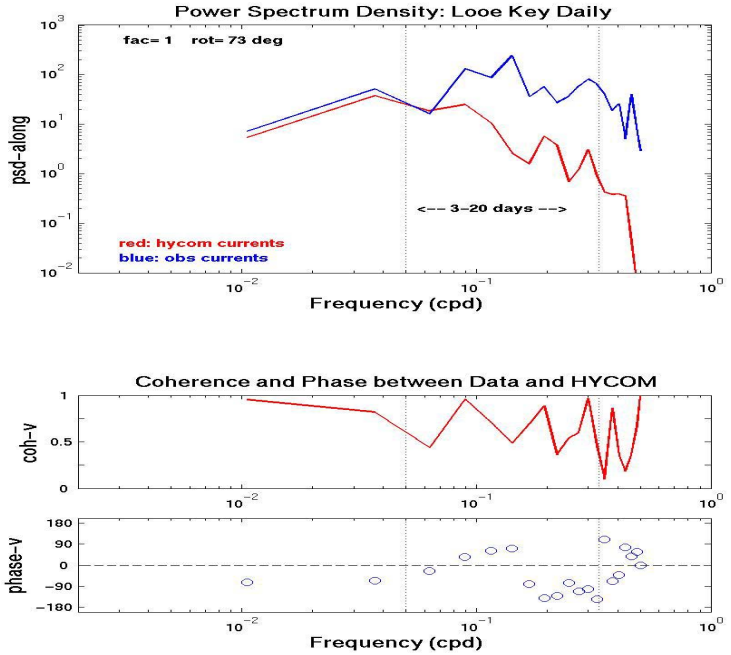
Station B1

- Energy peaks are in phase over all
- No obvious phase bias between model and data at these two locations
- The maximum cross-correlations occur at the zero lag which are above 99% significant level for both locations
- The model current distribution has a positive bias in both Station A1 and B1 than observations for the period.

C-MAN Winds at Sombrero and Currents at Looe Key

10/99 – 4/00 73° rotation





The similar results are found for B2 and C2 buoy stations at the Upper Keys.

Model currents have energy comparable to observations in low-frequency band but less energetic for the synoptic bands → other factors rather than winds play important role.

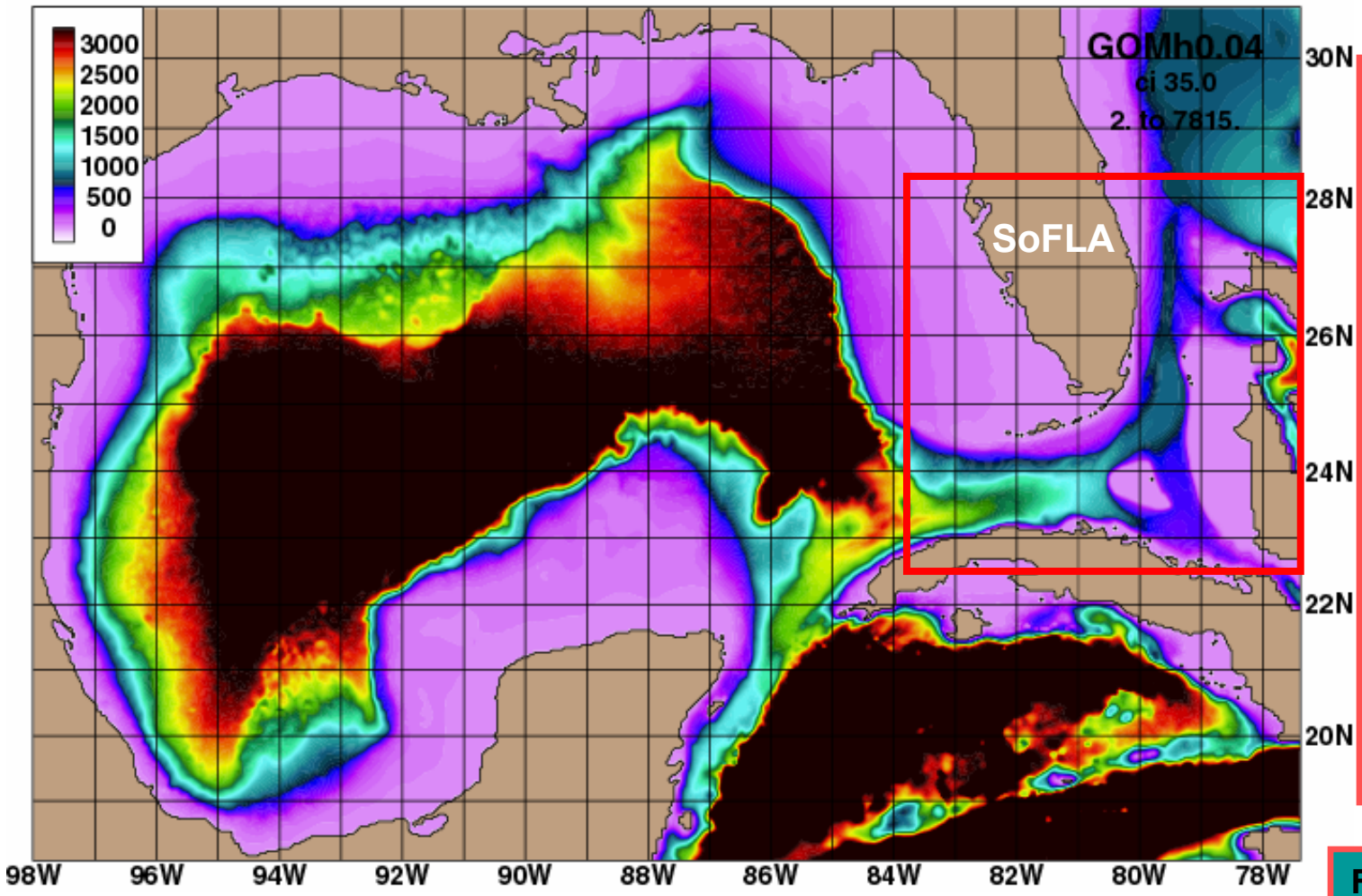
Conclusion on Data-Model Comparison

• The model currents on the SW Florida Shelf are in good agreement statistically with the observations. No phase between the two are found. However, the model currents have a positive bias in magnitude.

• Model currents compare better with the observations on the SW Florida Shelf than along the Straits.

New SoFLA-HYCOM (FLAh0.04)
Nested with New GOM-HYCOM (GOMh0.04)

GOM-HYCOM: GOMh0.04 Bathymetry



FLAh0.04

HYCOM 2.1.35

1/25° resolution:

idm=161

jdm=163

kdm=20

83.76°W–77.36°W

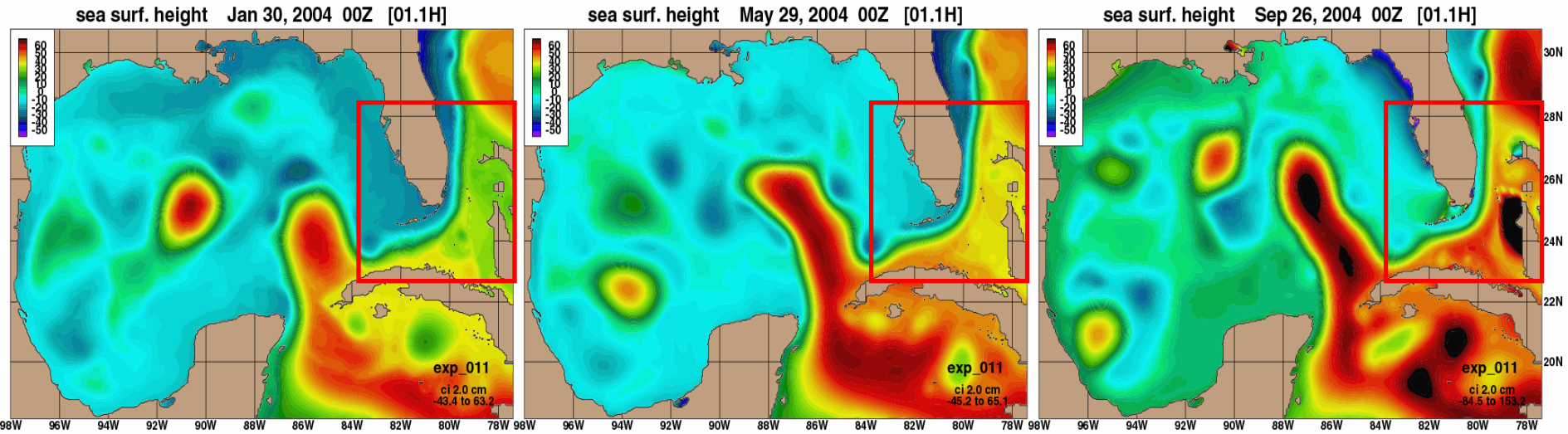
22.78°N–28.61°N

2 m minimum water depth

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

FLAh0.04 shares the same grid with GOMh0.04 within the SoFLA domain

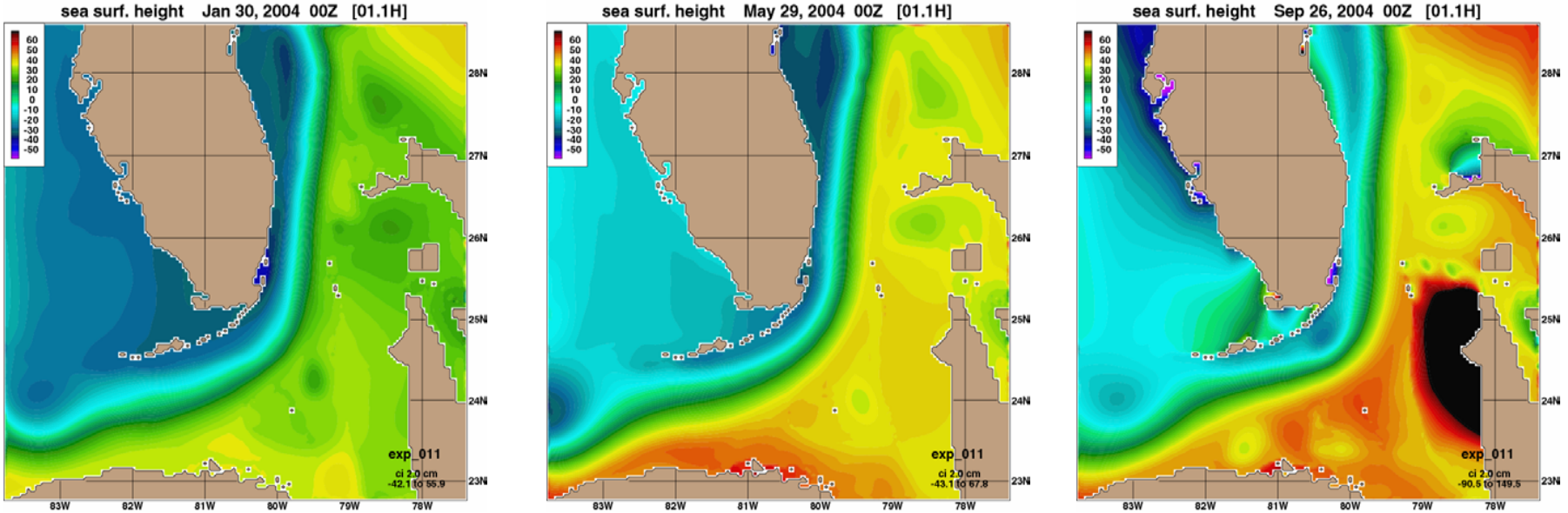
New GOM Domain: GOMh0.04/FLAh0.04 SSH Expt_01.1



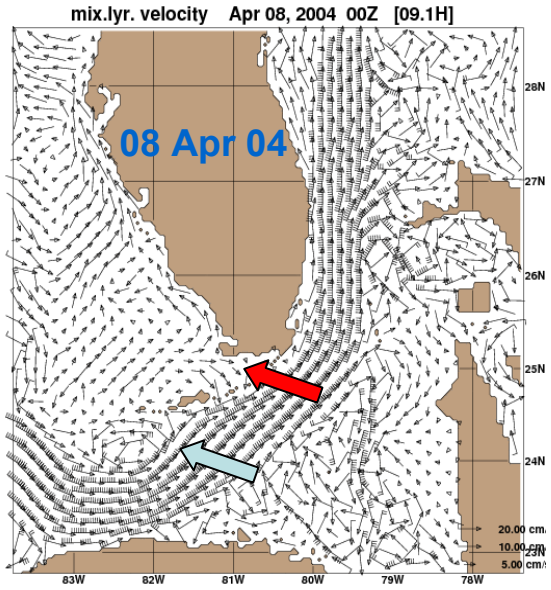
30 Jan 04

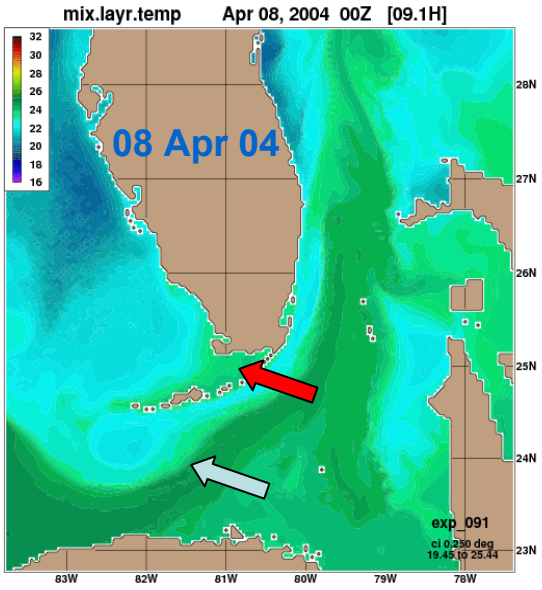
29 May 04

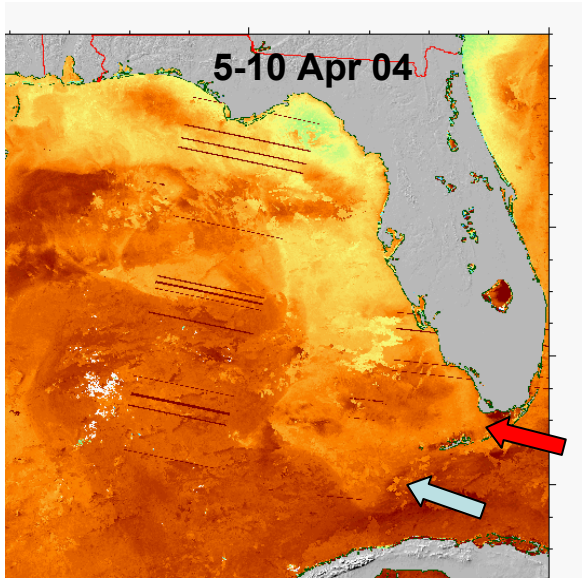
26 Sep 04

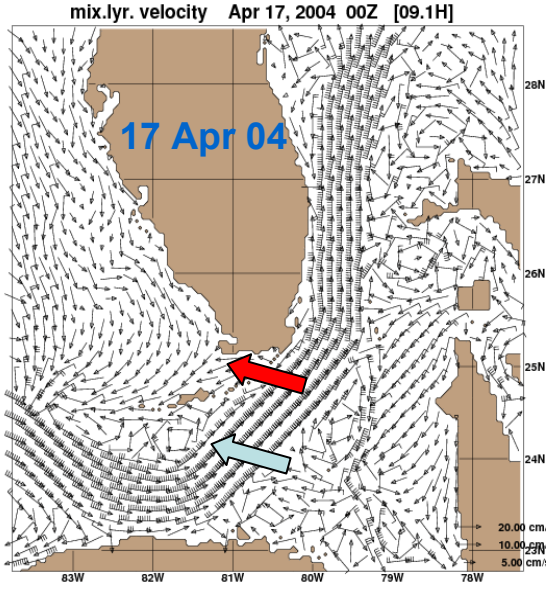


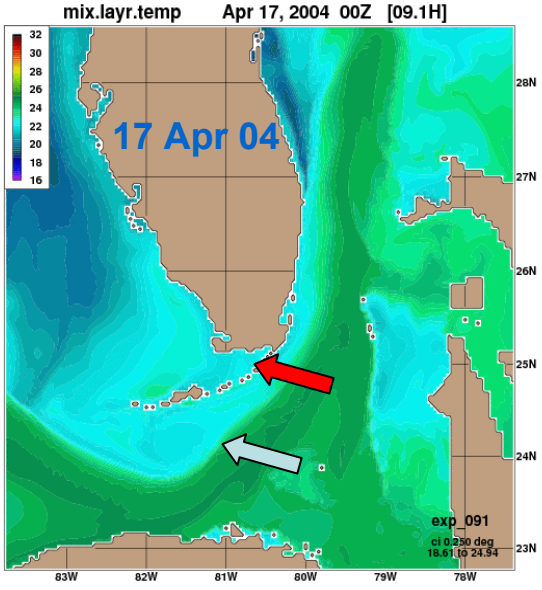
New SoFLA Domain: FLAh0.04 Coastal Currents on SW FL Shelf

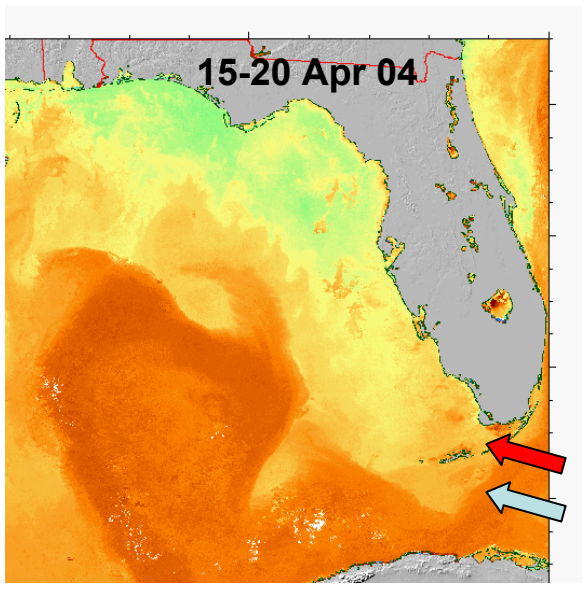












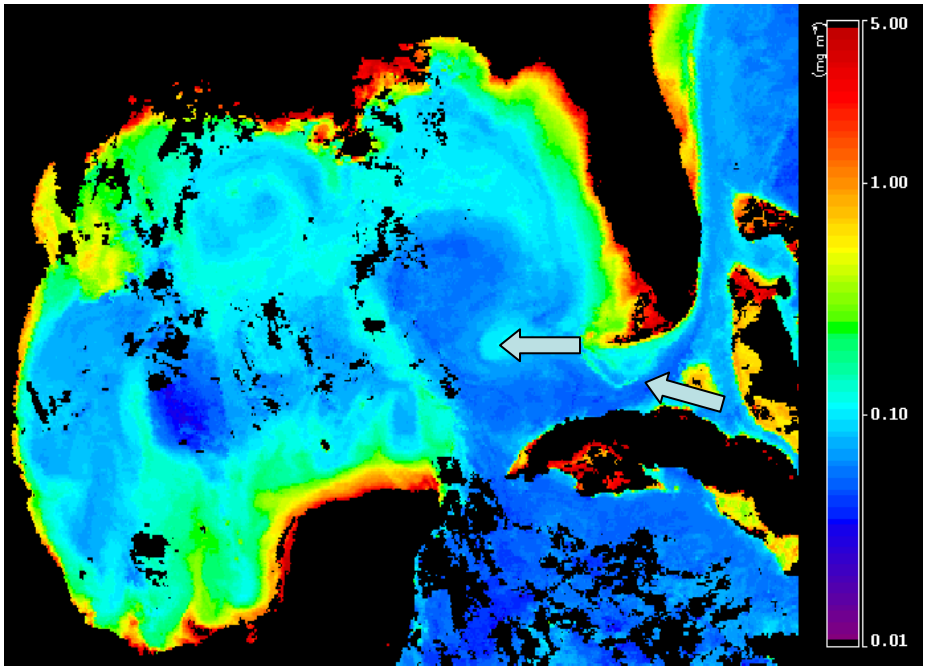
Model Surface Currents

Model SST

Observed SST: JHU

Impact of different nested fields: Free verse NCODA run

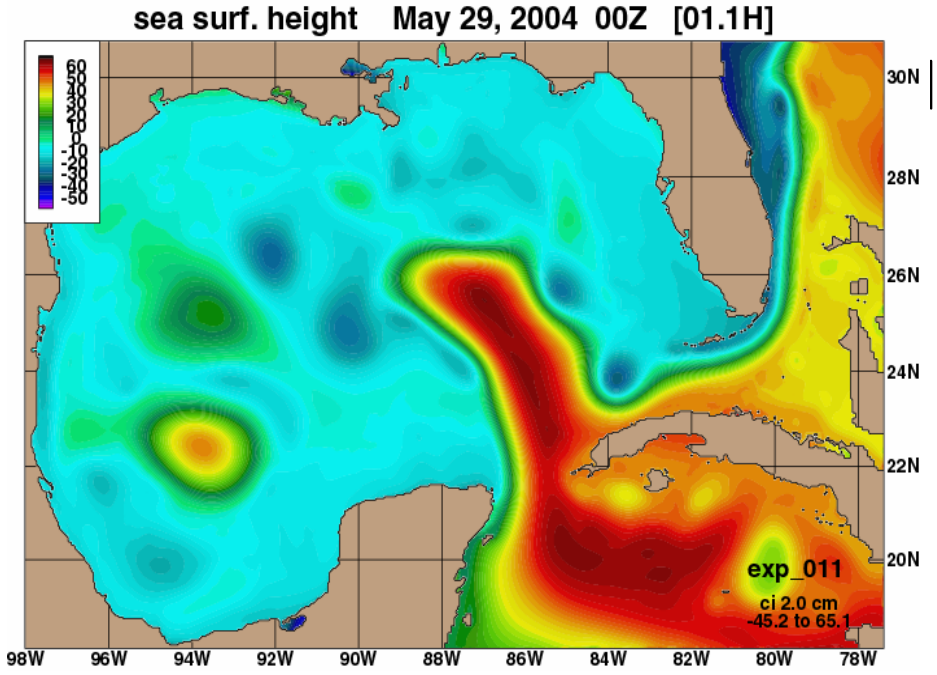
7-days, 5/24-31/2004,
Aqua-chla
Provided by
Viva Banzon, RSMAS
Satellite group

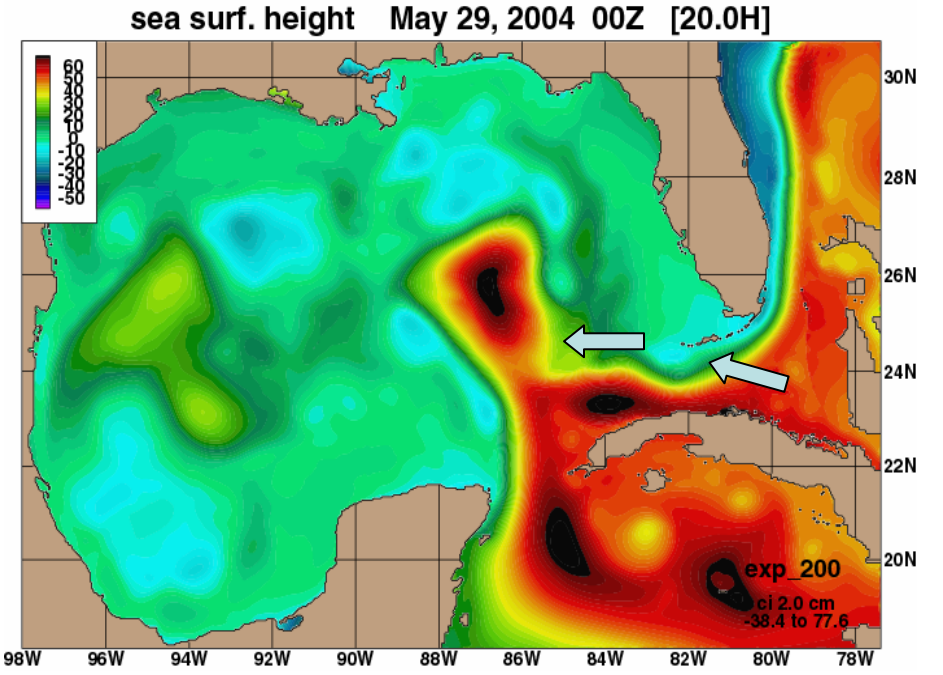


Noticeable improvement on positions of Loop Current and eddies

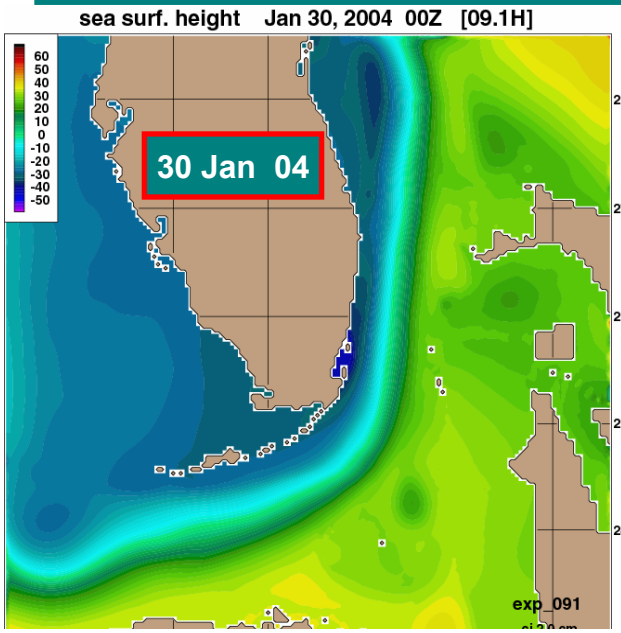
Free: Pat Hogan

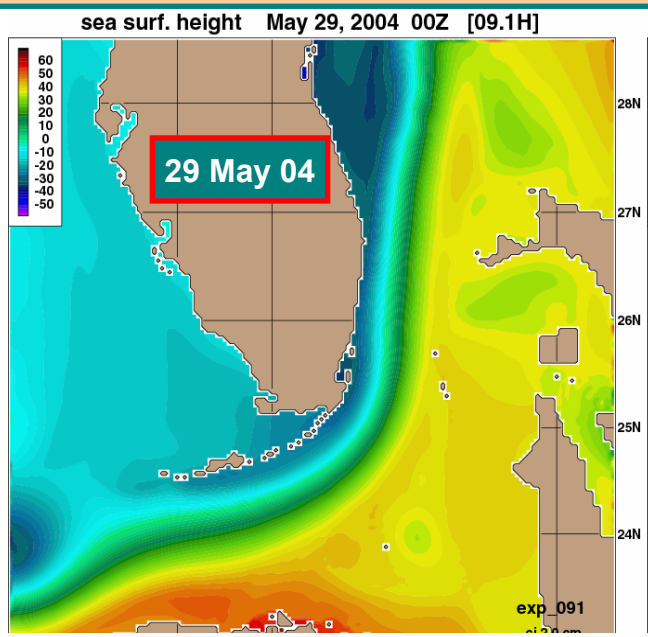
NCODA: Ole Martin

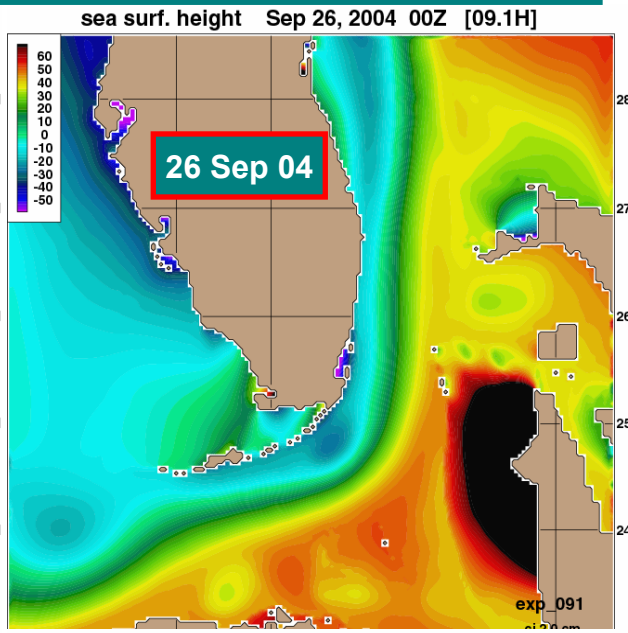


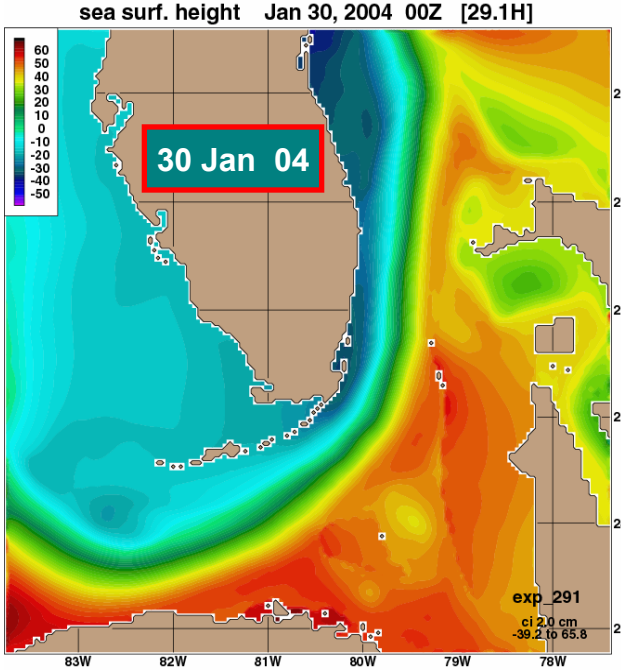


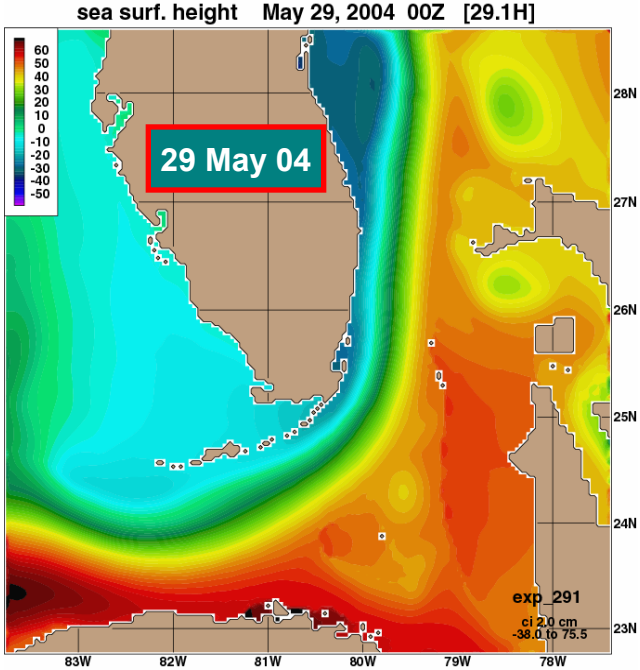
SoFLA-HYCOM: FLAh0.04 SSH Free (top) NCODA (bottom)

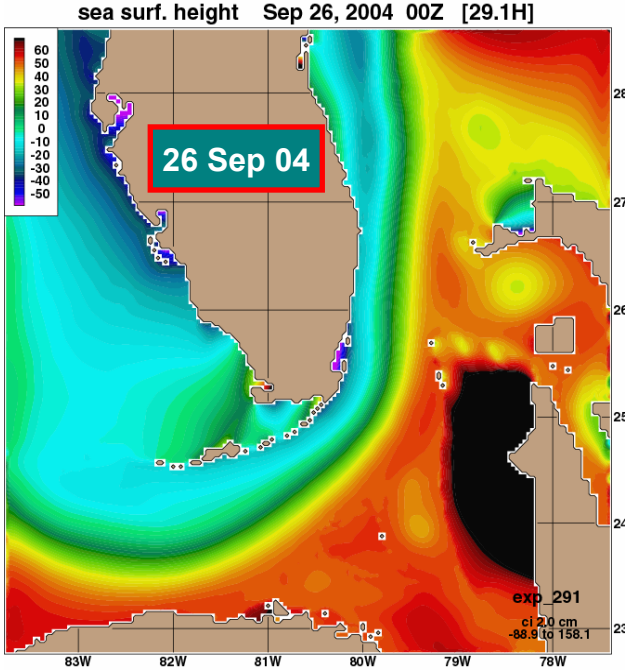








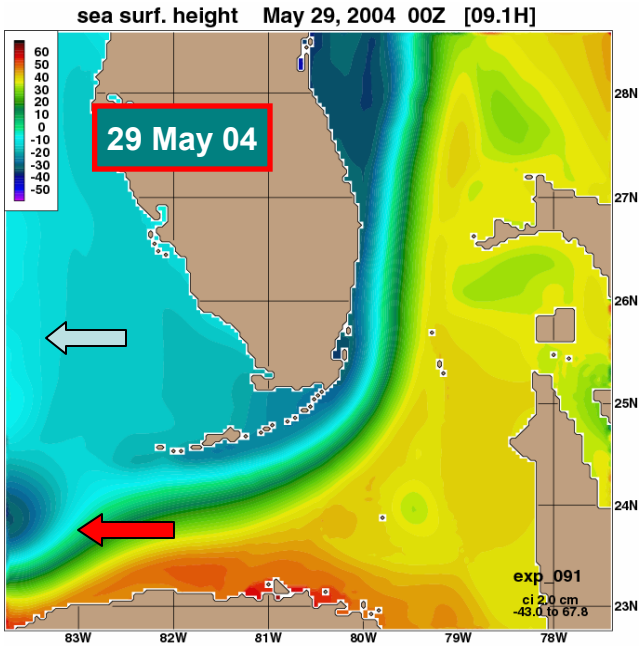


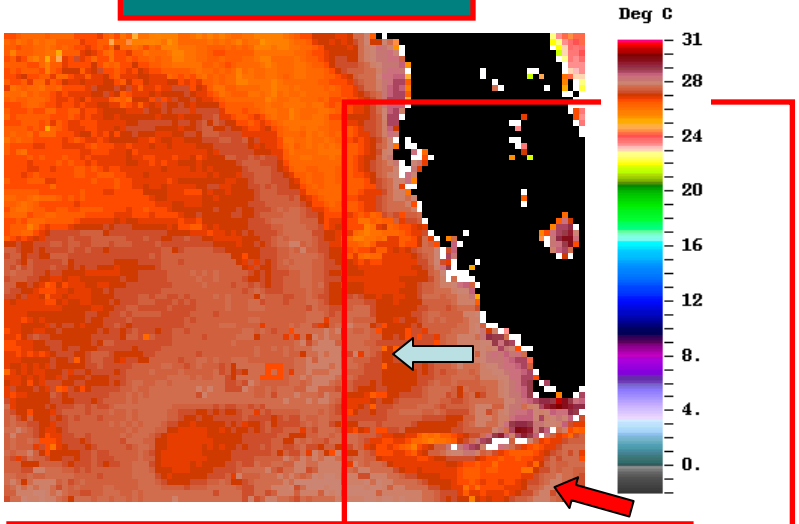


FLAh0.04 SSH

Observations

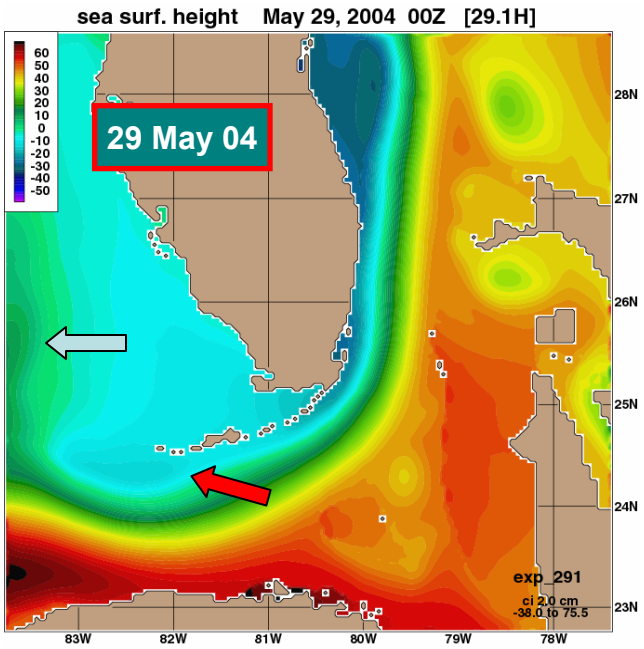
Free

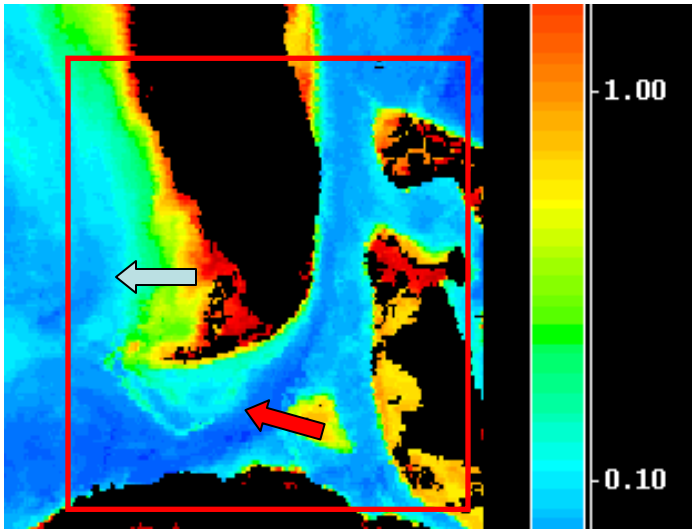




3-days, 5/28-30/2004, SST composite
(http://imars.usf.edu)

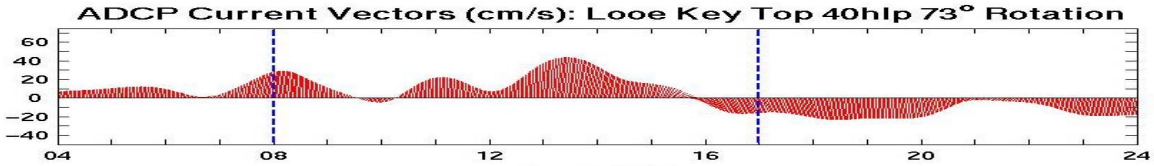
NCODA



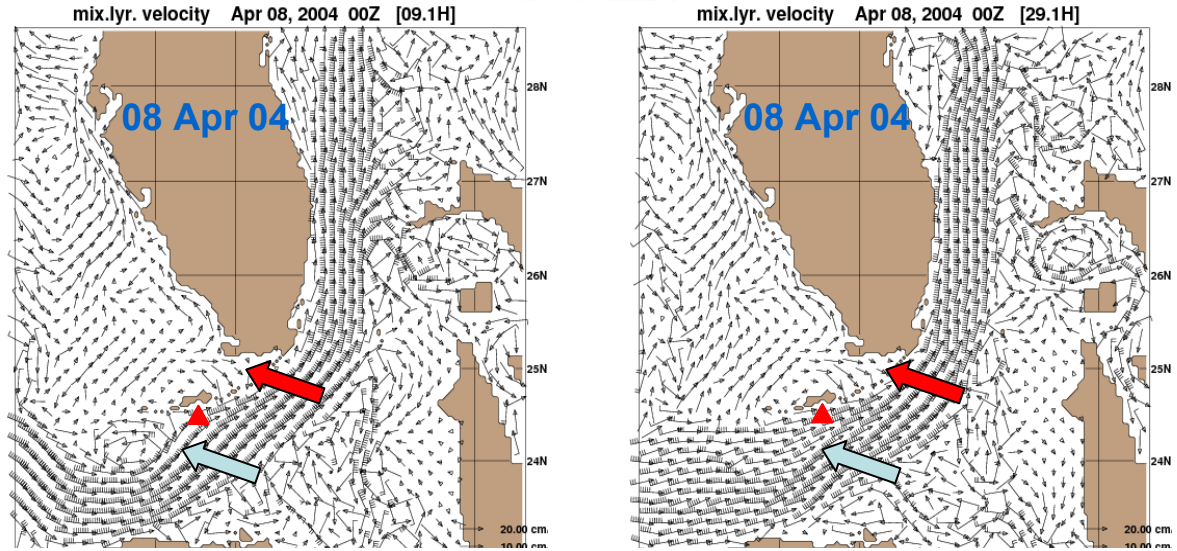


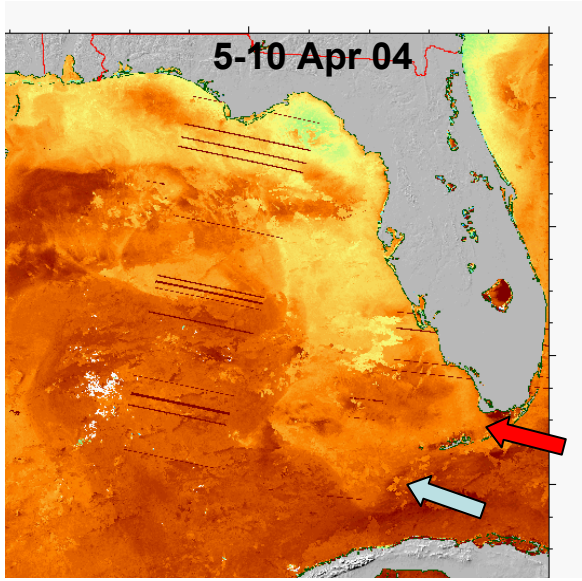
Better positions of Loop Current and eddy.

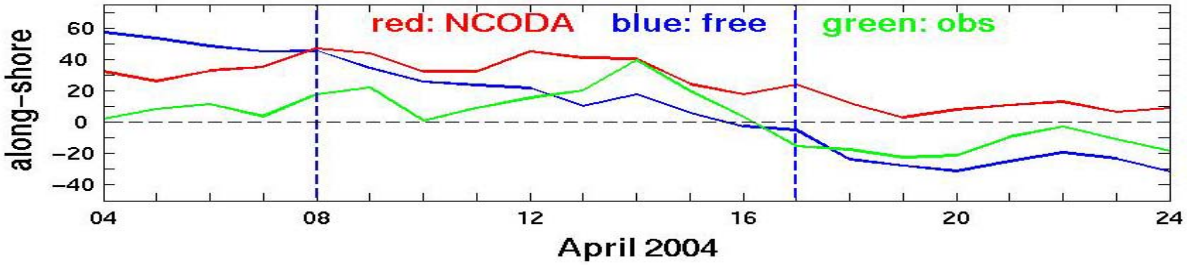
7-days, 5/24-31/2004, Aqua-chla
Viva Banzon, RSMAS Satellite group

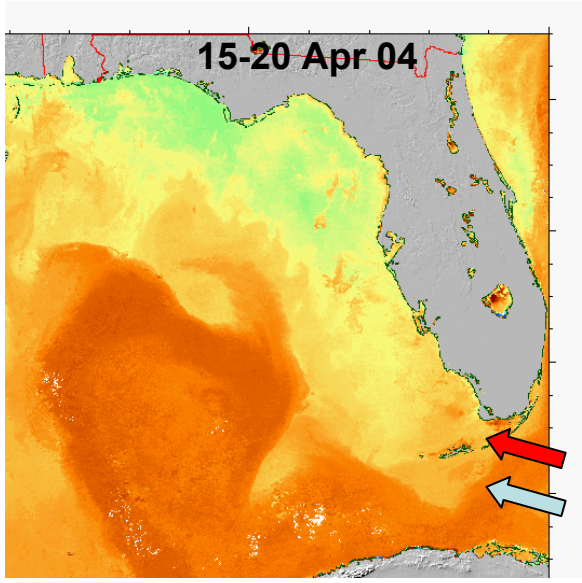


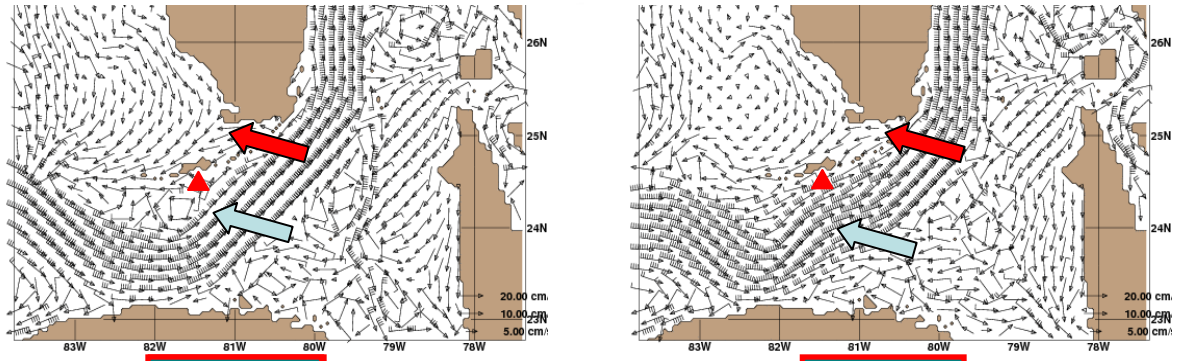
Data from Ryan Smith, NOAA











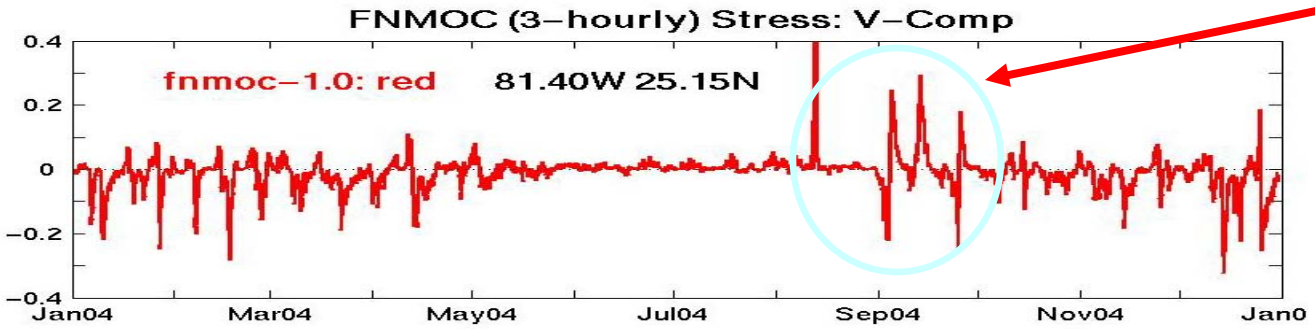
Free run

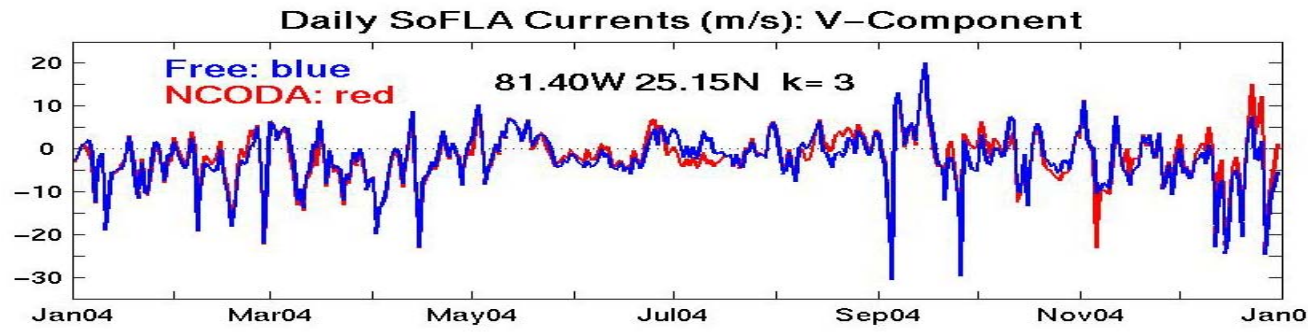
NCODA

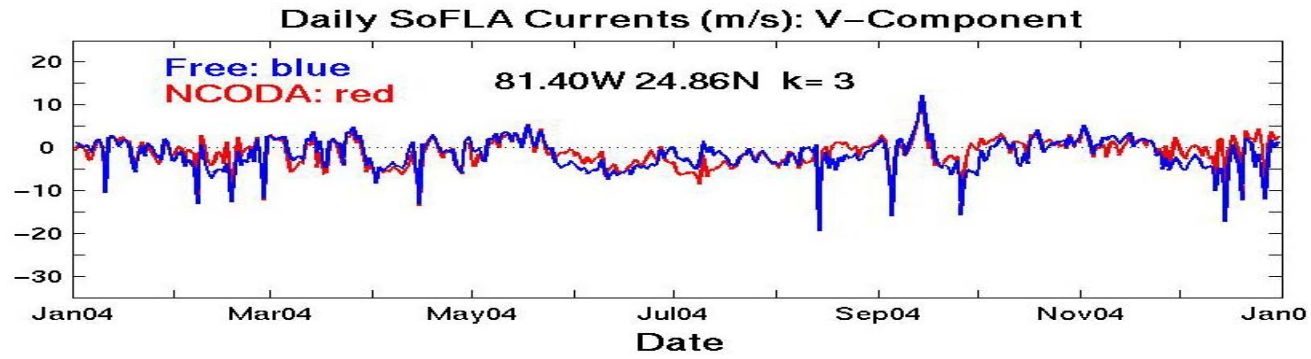
Observed SST: JHU

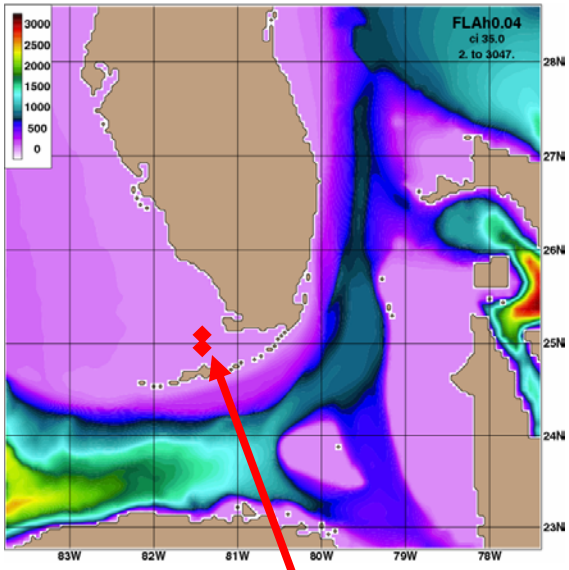
FLAh0.04 Time Series on SW FL Shelf V-Comp

Extreme wind events



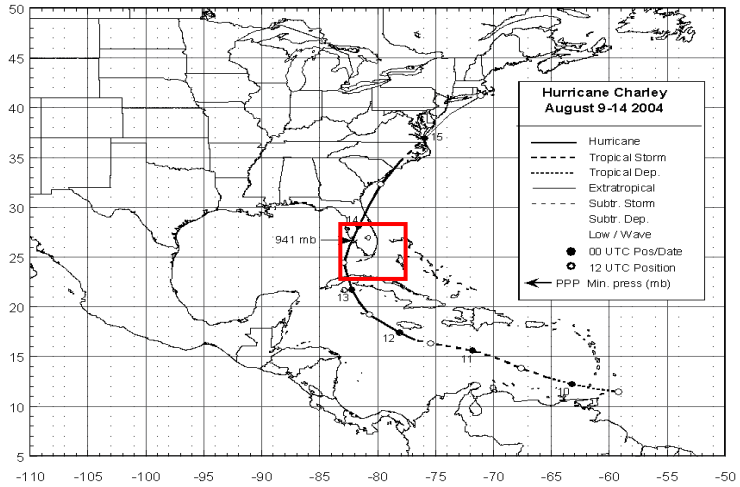




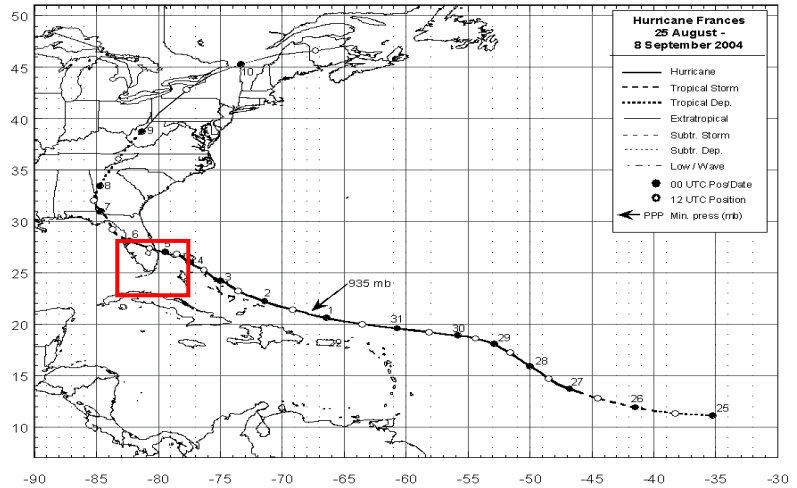


81.4W, 25.15N & 24.86N

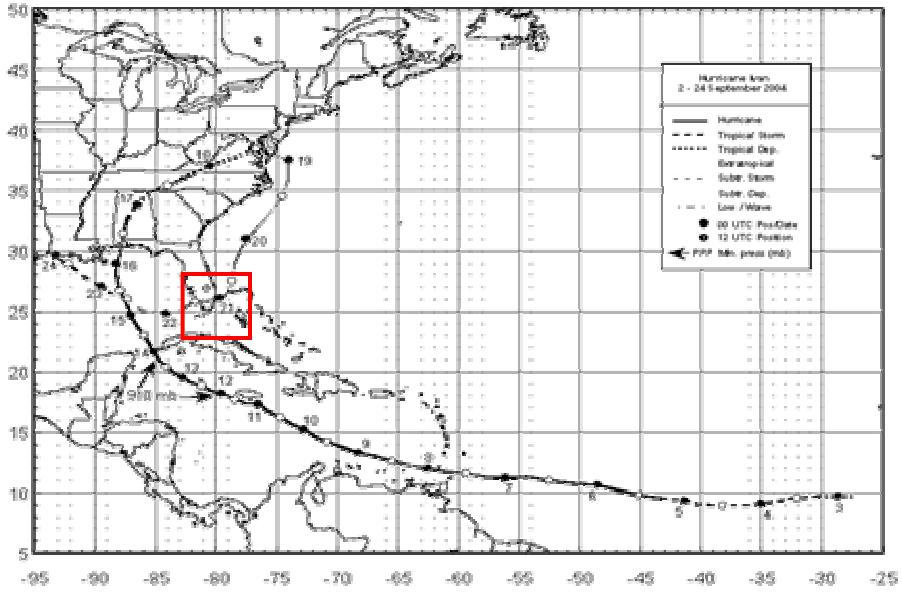
Hurricane Charley: 9 – 14 August 2004



Hurricane France: 25 August – 8 September 2004

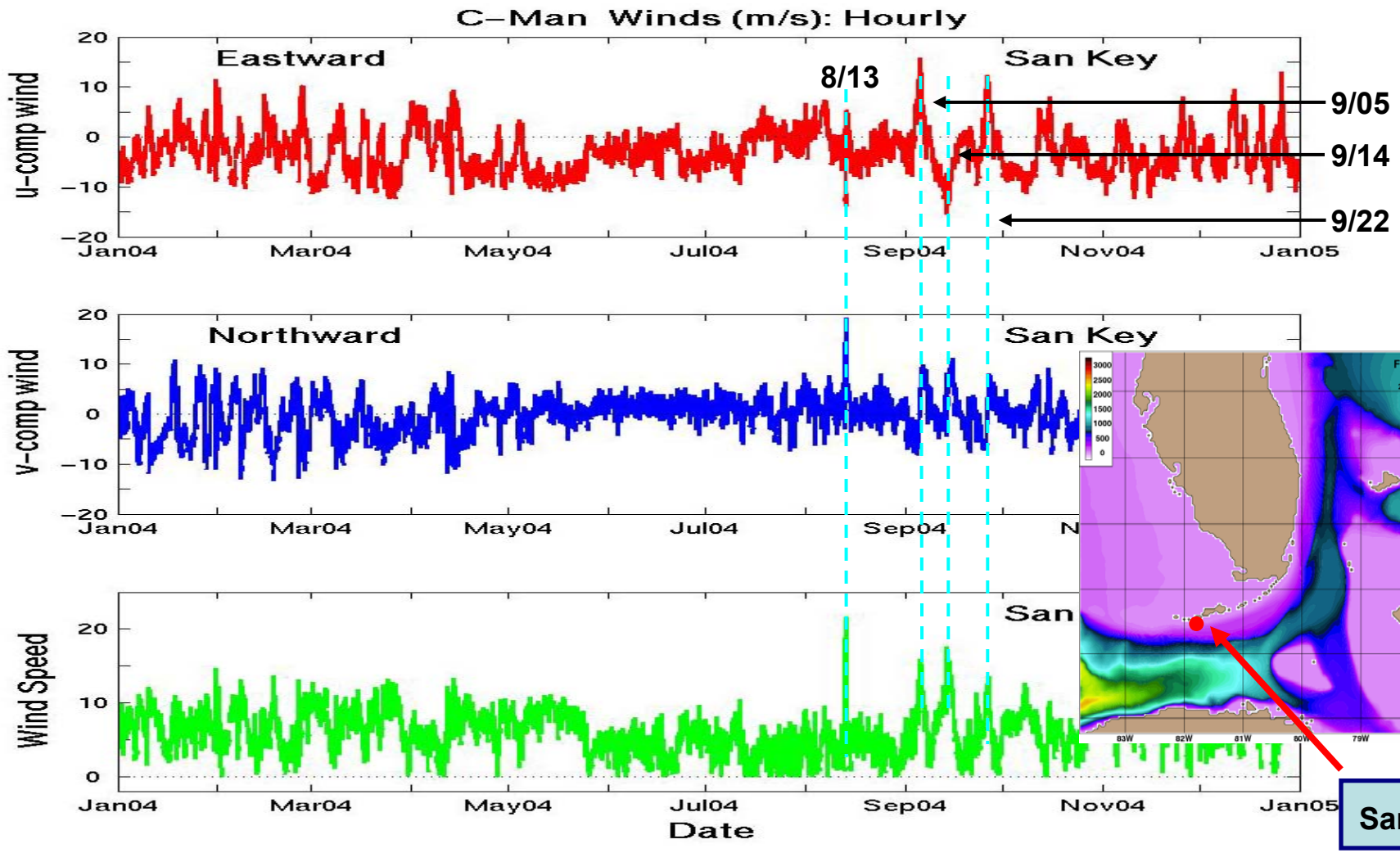


Hurricane Ivan: 2 – 24 September 2004



Best hurricane tracks
From nhc.noaa.gov

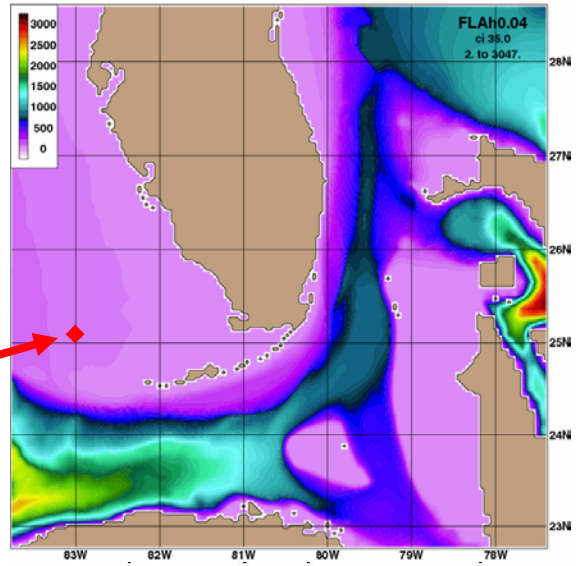
2004 C-MAN Winds Sand Key at 81.88W 24.46N Hourly



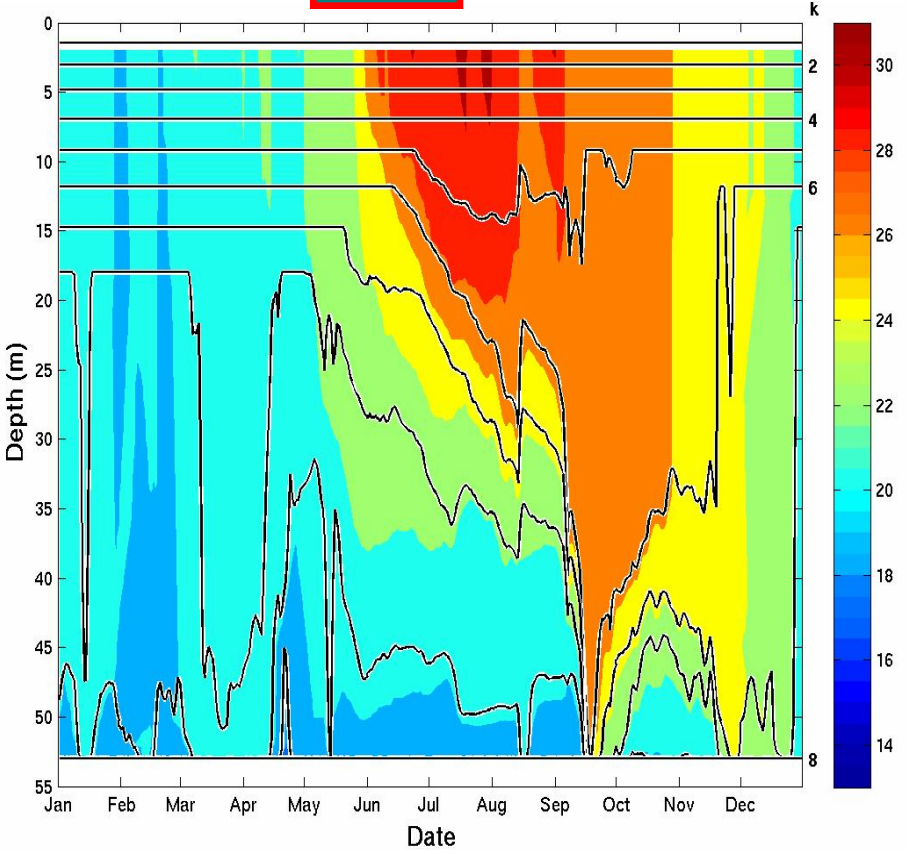
Charley: 9-14 Aug (13-14); **Frances:** 25 Aug – 8 Sep (5-6) ; **Ivan:** 2 – 24 Sep (14-15; 21-22). The SoFLA domain is affected during the days inside the parentheses.

FLAh0.04
Temperature 2004

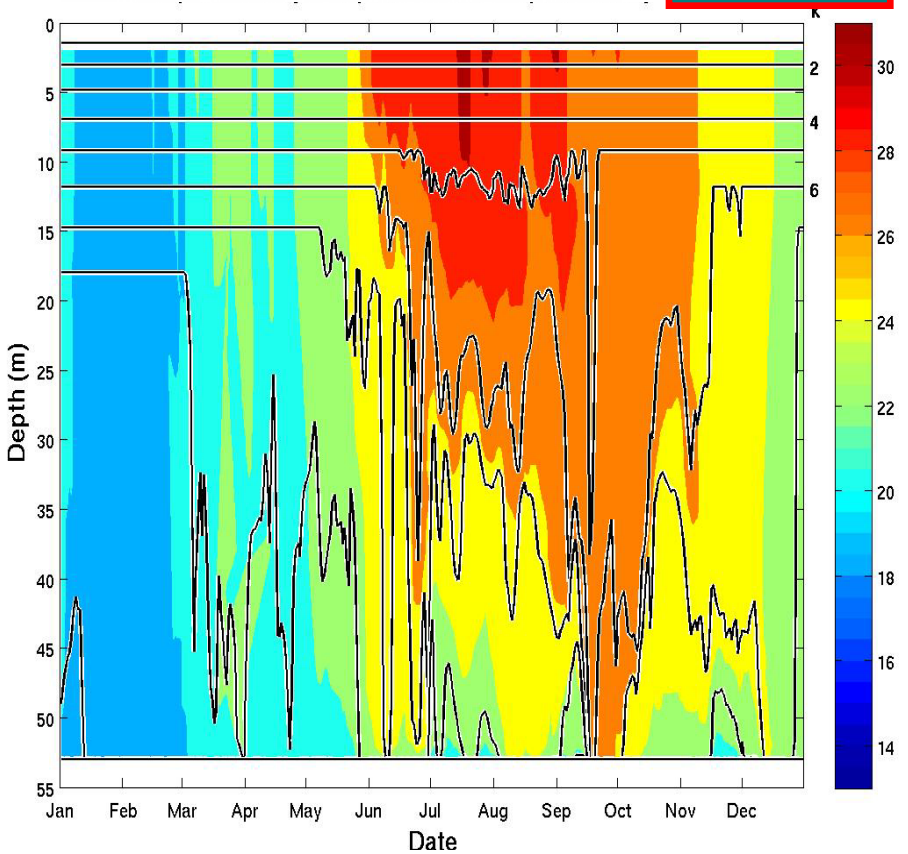
83W
25.15N



Free



NCODA



Conclusions on New SoFLA (FLAh0.04) Domain

- **The nesting between FLAh0.04 and GOMh0.04 works well**

- **The NCODA run shows very promising signs in improving the positions of the Loop Currents and eddies along the FL Straits and magnitudes of currents on the SW FL Shelf**

Future Work with New SoFLA Domain

- **In-depth analysis of impact of data assimilations to event simulations such as eddy-passages and hurricanes**
- **Impact of daily fresh water flux associated with river discharges**
- **Comparison to observations**
- **High resolution domain (1/50^{o})**
- **High resolution atmospheric forcing**
- **Impact of tides**

END