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

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In Collaboration with

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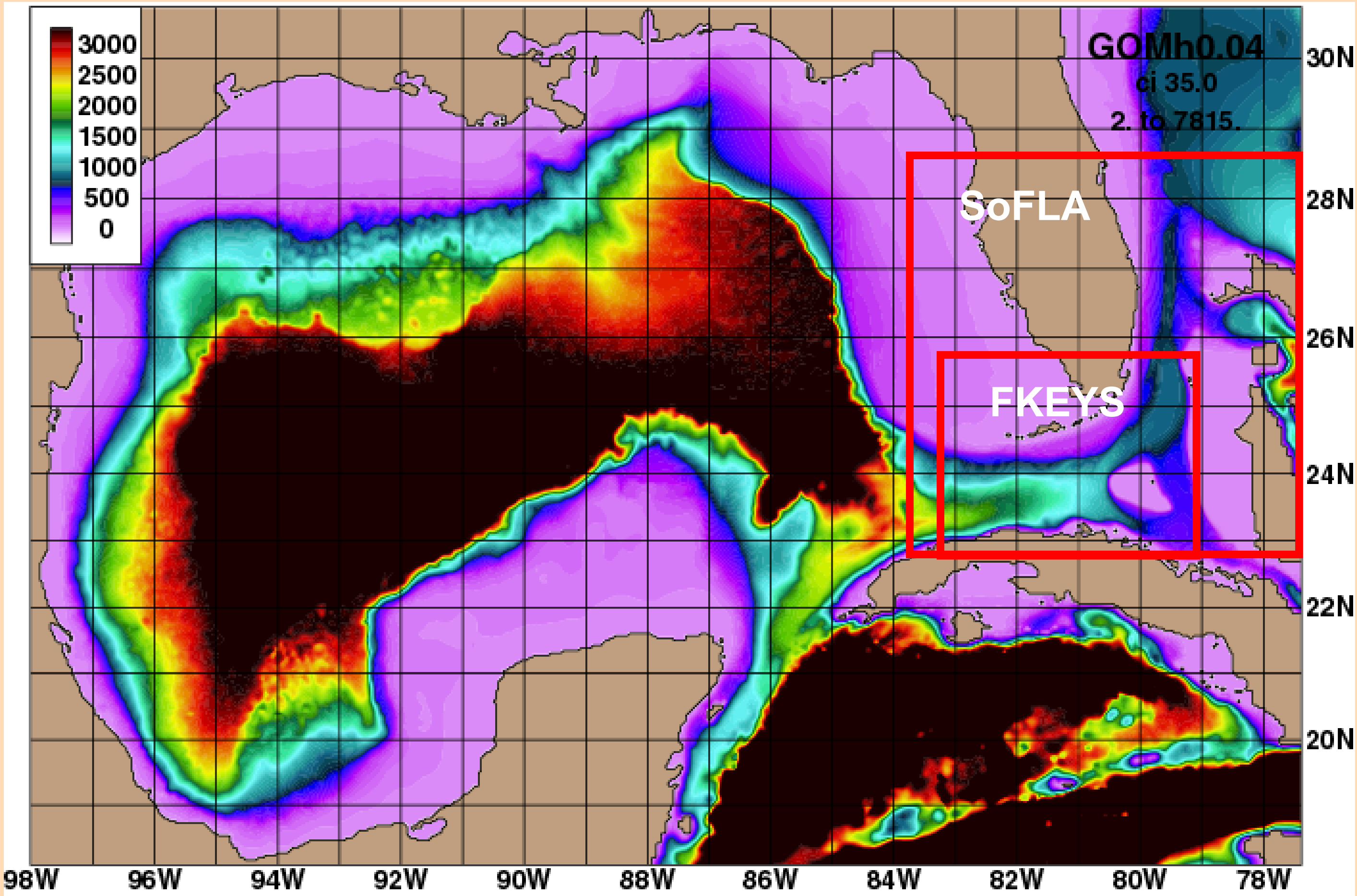
Bob Weisberg *(USF)*
Peter Ortner, Libby Johns *(NOAA-AOML)*

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

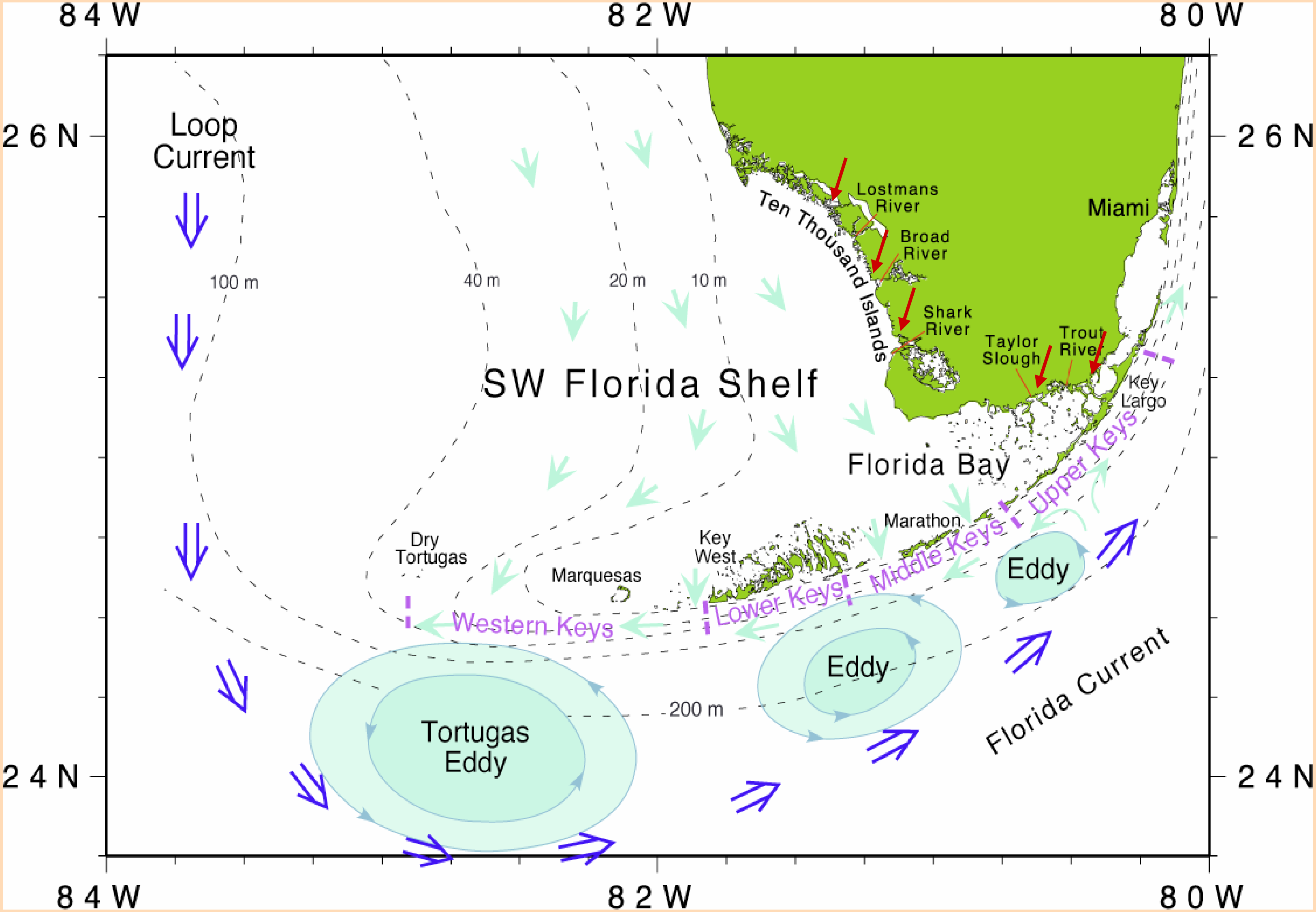
83.36°W–79.00°W

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

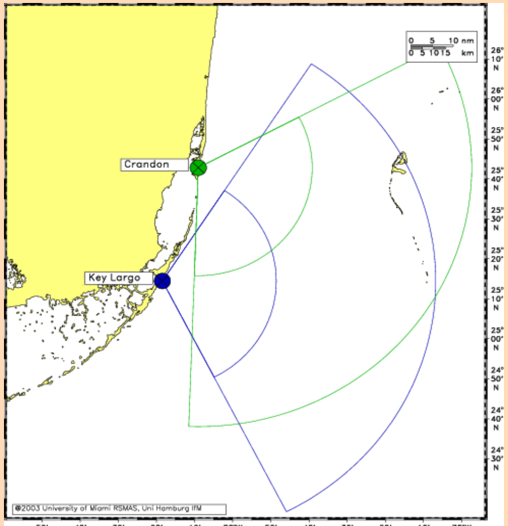
The complex South Florida coastal system



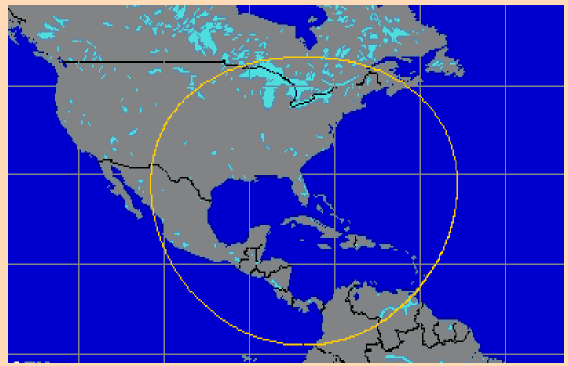
Lee et al., 2002

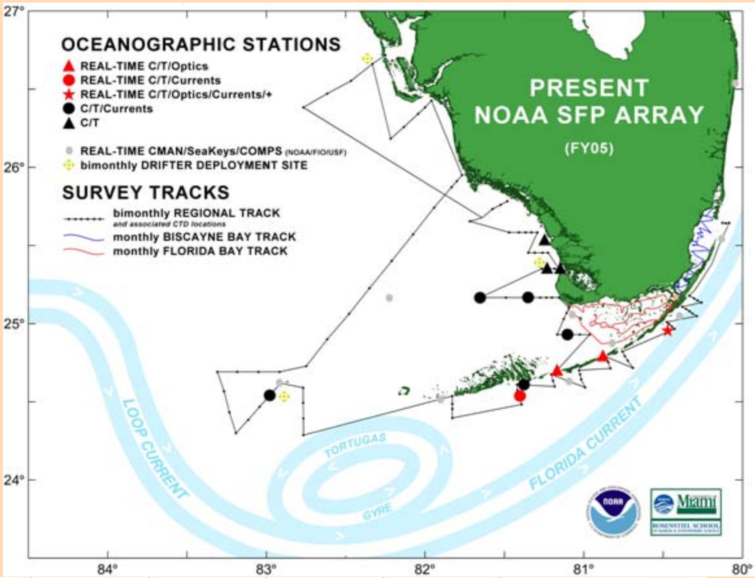
Local Observational Data Coverage in the SoFLA Domain

WERA coverage

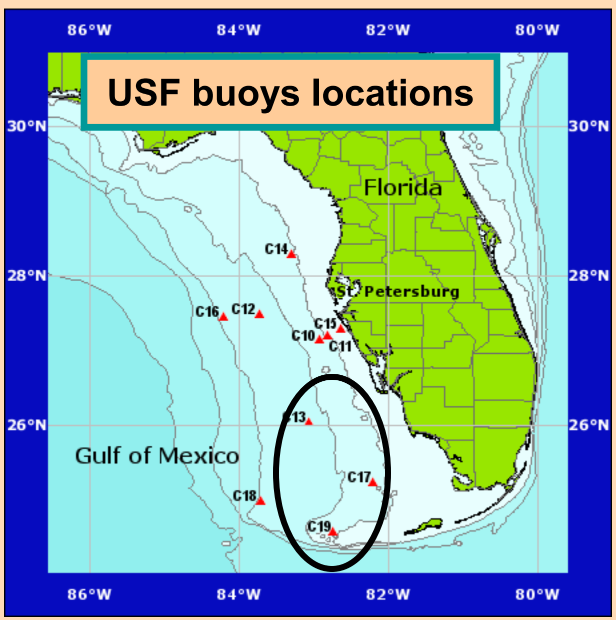


CSTAR coverage

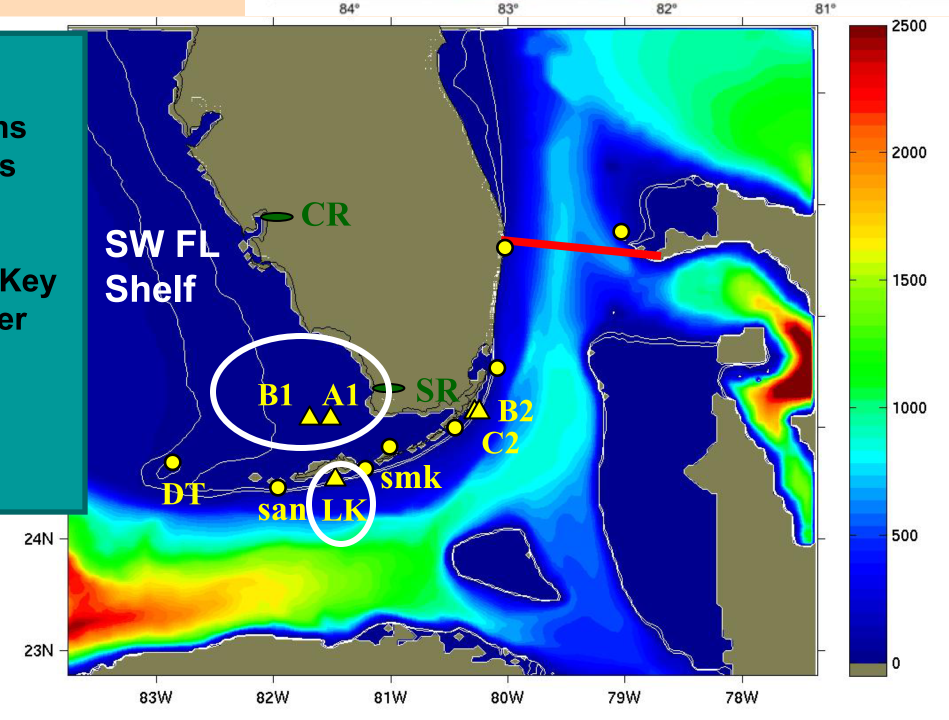




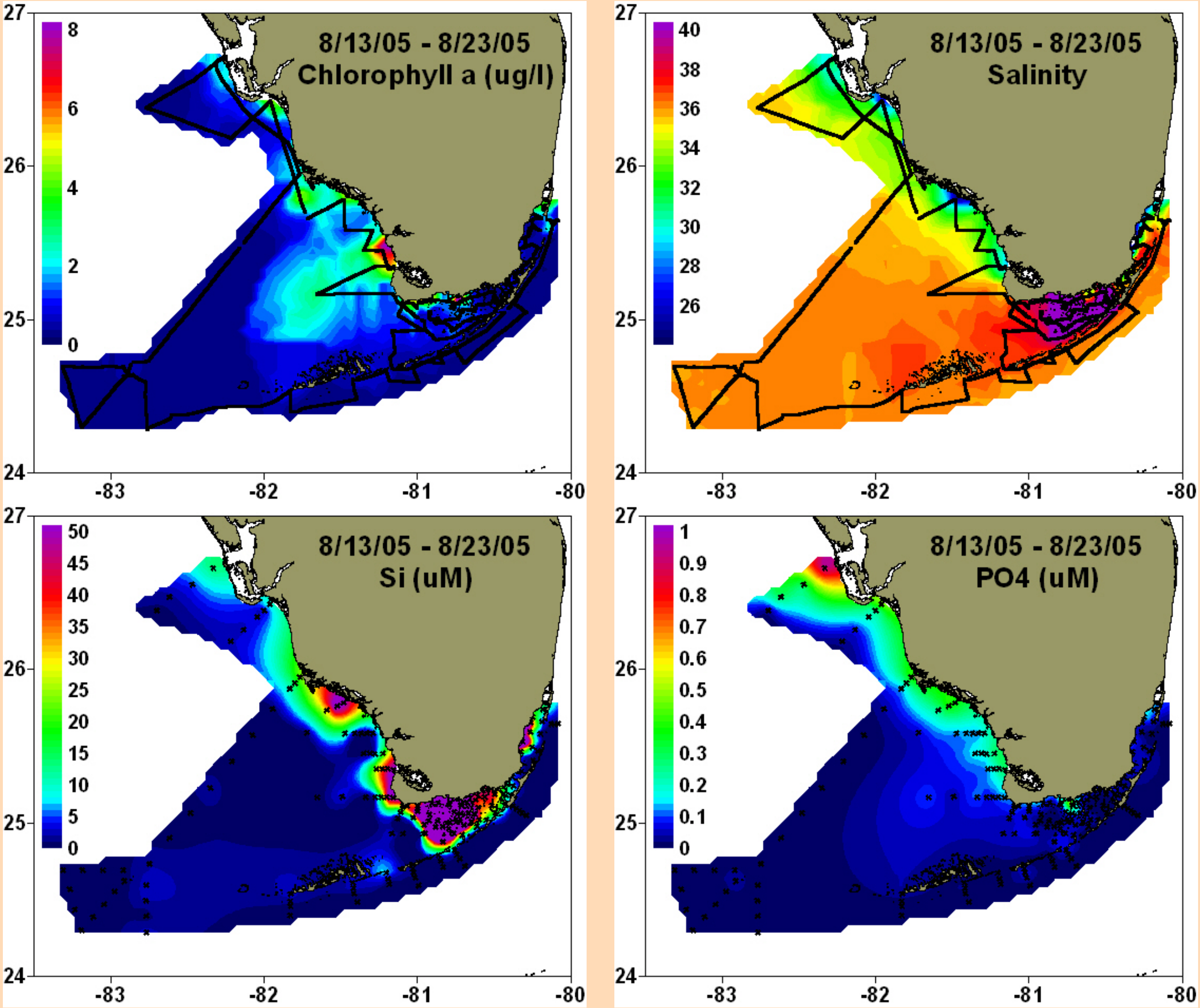
USF buoys locations



▲ : 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

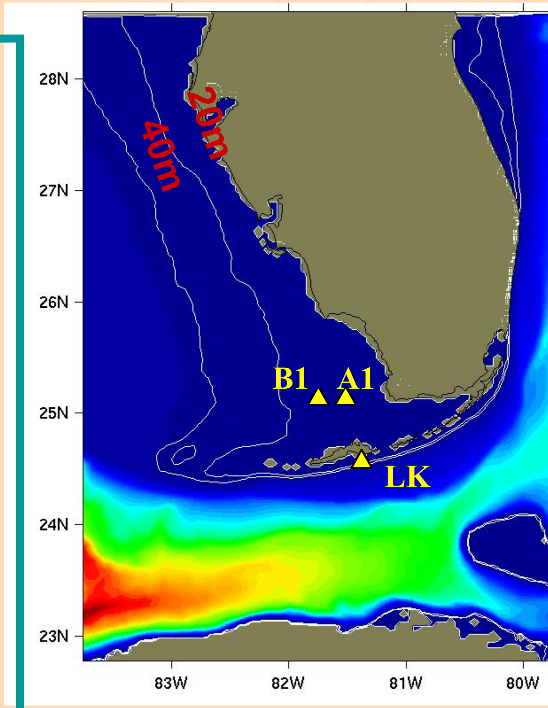


SoFLA-HYCOM: FLAh0.04 Run Numbers and Attributes

RunID	Layers	Atm. Forcing	Nesting BC	Simulation period
09.1	20	fnmoc-1.0	Free GOMh0.04	2004, 2005
29.1	20	fnmoc-1.0	NCODA GOMh0.04	2004, 2005
39.1	20	fnmoc-1.0	ATLd0.08	2004
07.1	20	coamps 27km	Free GOMh0.04	2004
27.1	20	coamps 27km	NCODA GOMh0.04	2004, 2005
04.1	20	Fnmoc-0.50	Free GOMh0.04	2004
02.1	26	Fnmoc-1.0	Free GOMh0.04	2004
01.5	26	coamps 27km	Free GOMh0.04	2004,2005
02.5	26	coamps 27km	NCODA GOMh0.04	2004,2005
03.5	26	coamps 27km	ATLd0.08	2004,2005

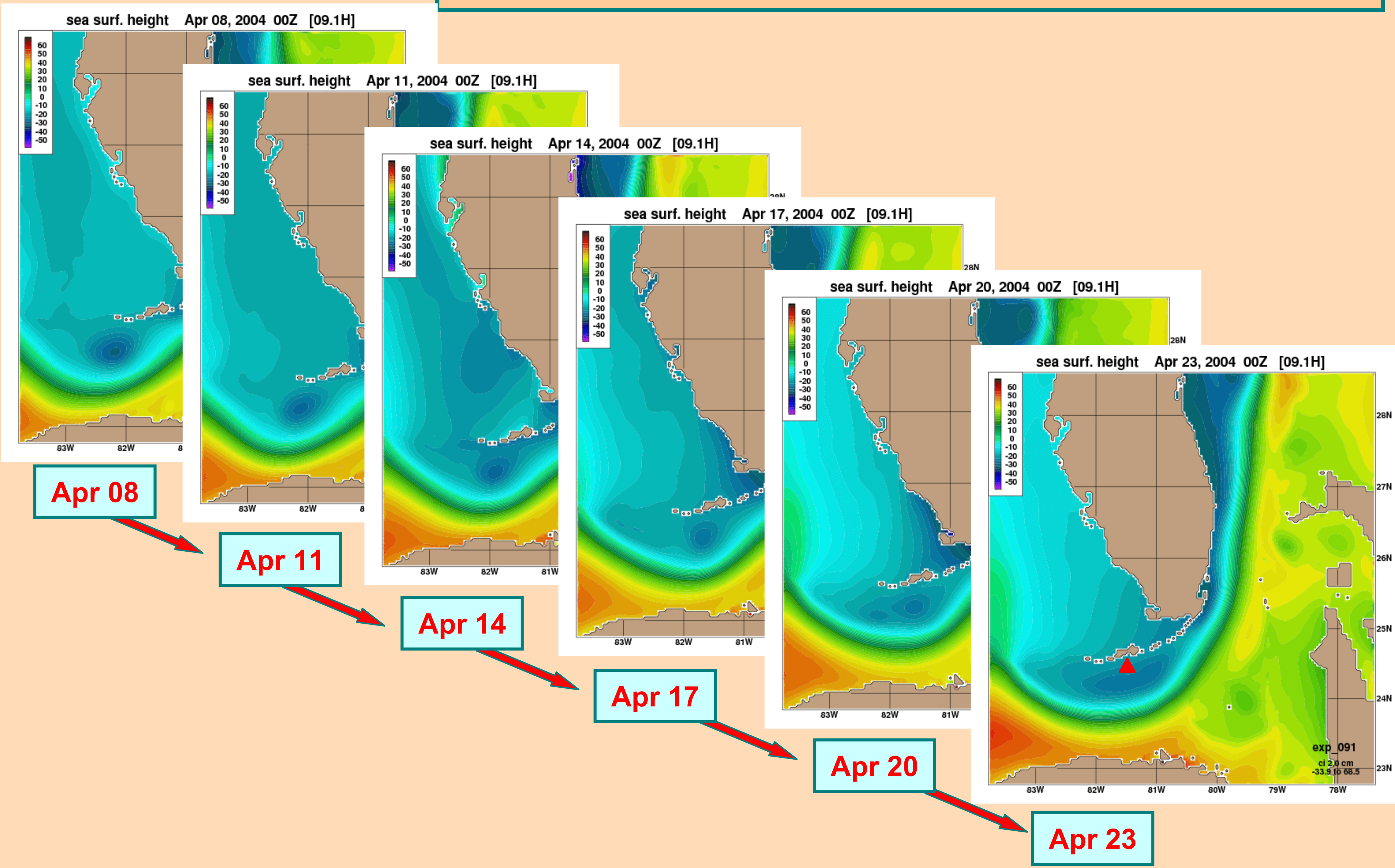
HYCOM v. 2.1.34, 2.1.35

Model-Data Comparison: inner shelf

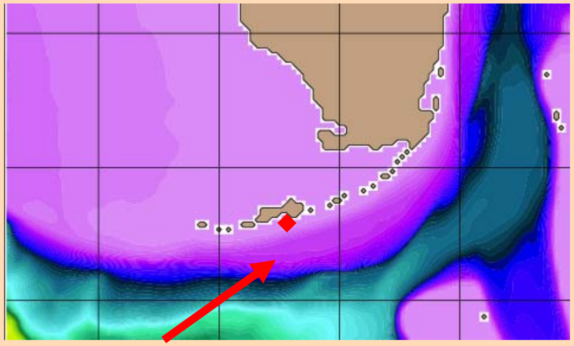


- Energy peaks are in phase over all
- For the SW Florida shelf shallow moorings (#A1 and #B1):
  - No obvious phase bias between model and data
  - The maximum cross-correlations occur at the zero lag which are above the 99% significance level
  - Model currents larger in amplitude
  - Wind-driven circulation 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

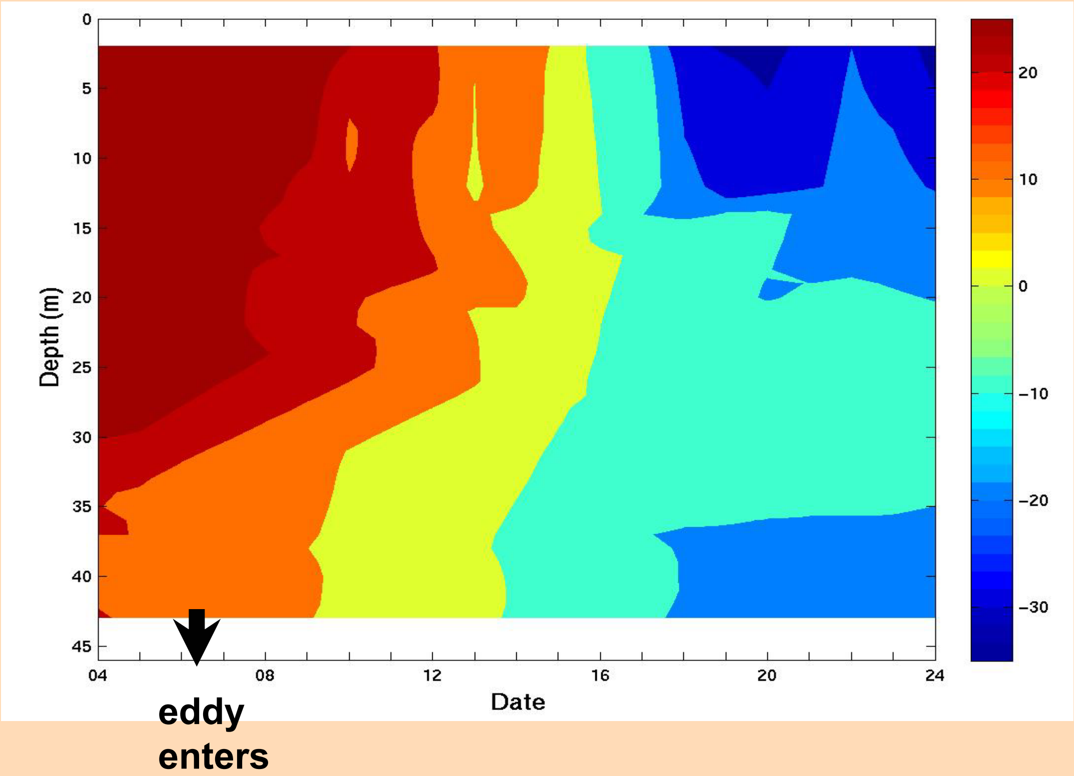
Simulation of coastal to offshore interactions during an eddy passage April 2004



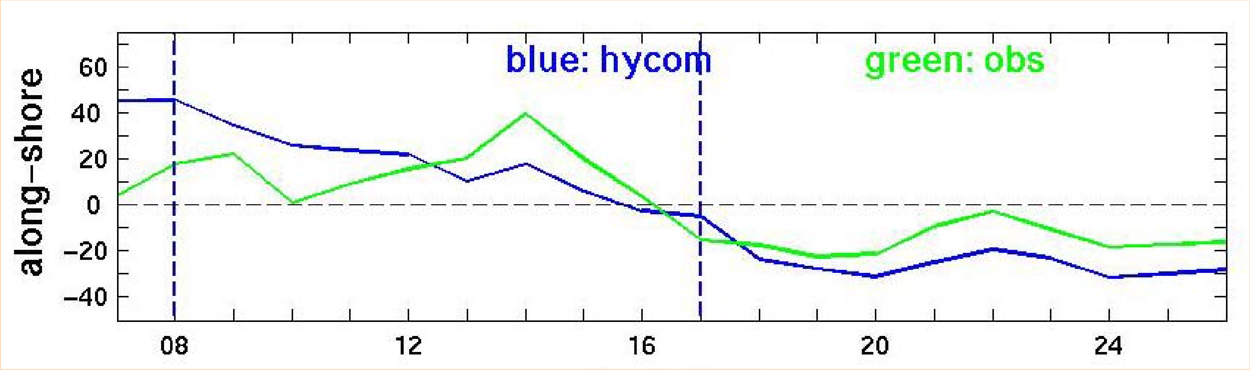
Along-Shore Current reversal at Looe Key during the eddy passage



81.4W, 24.65N



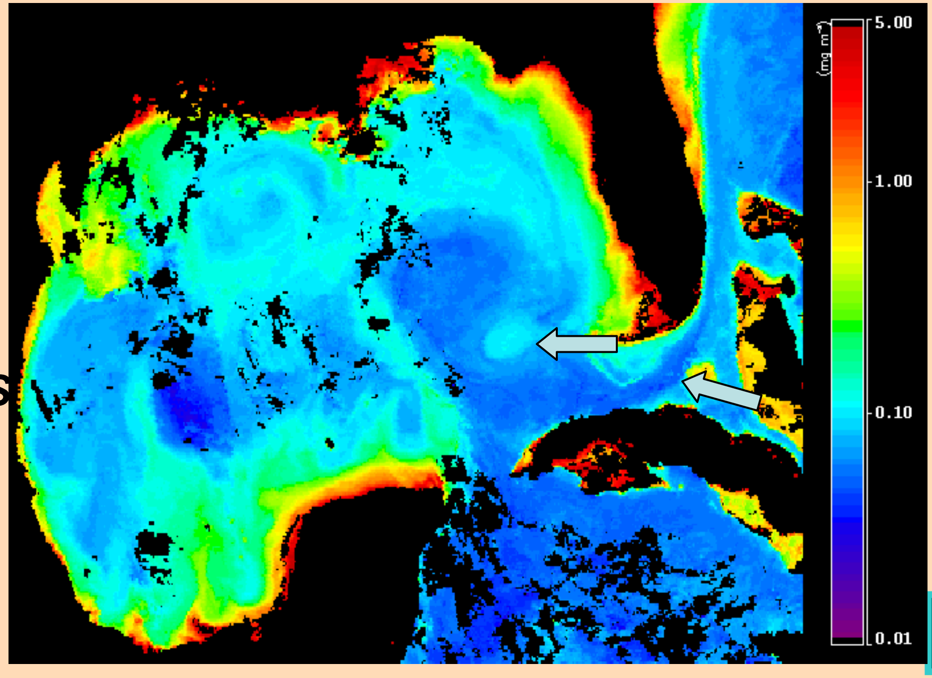
Model to Data comparison



April 2004

•40 HLP data (rot. 73 deg.) prepared by Ryan Smith, NOAA/AOML

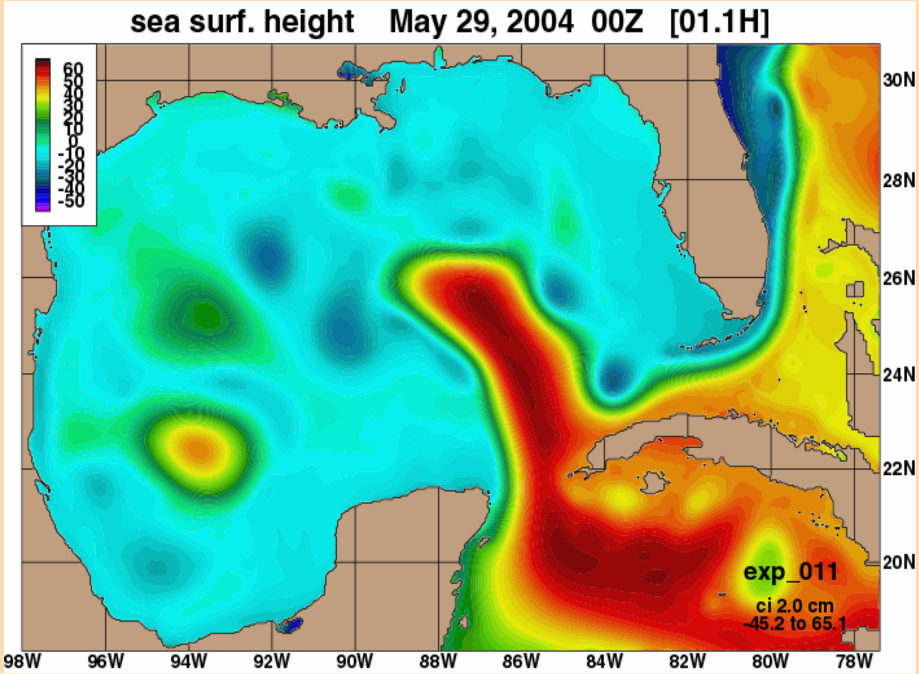
7-days, 5/24-31/2004,
Aqua-chla
Provided by
Viva Banzon, RSMAS
Satellite group

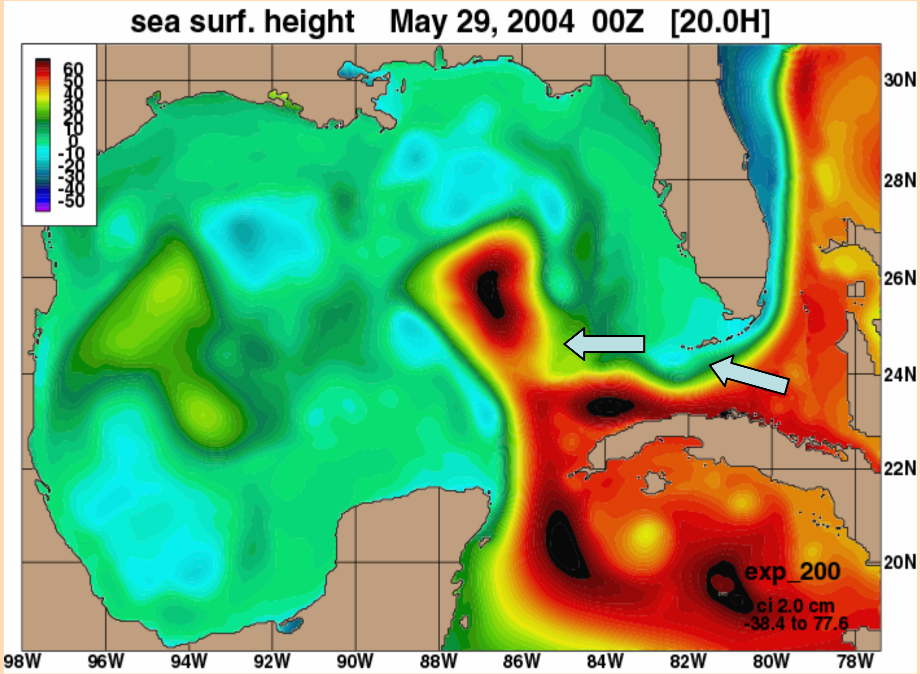


Noticeable improvement on positions of Loop Current and eddies

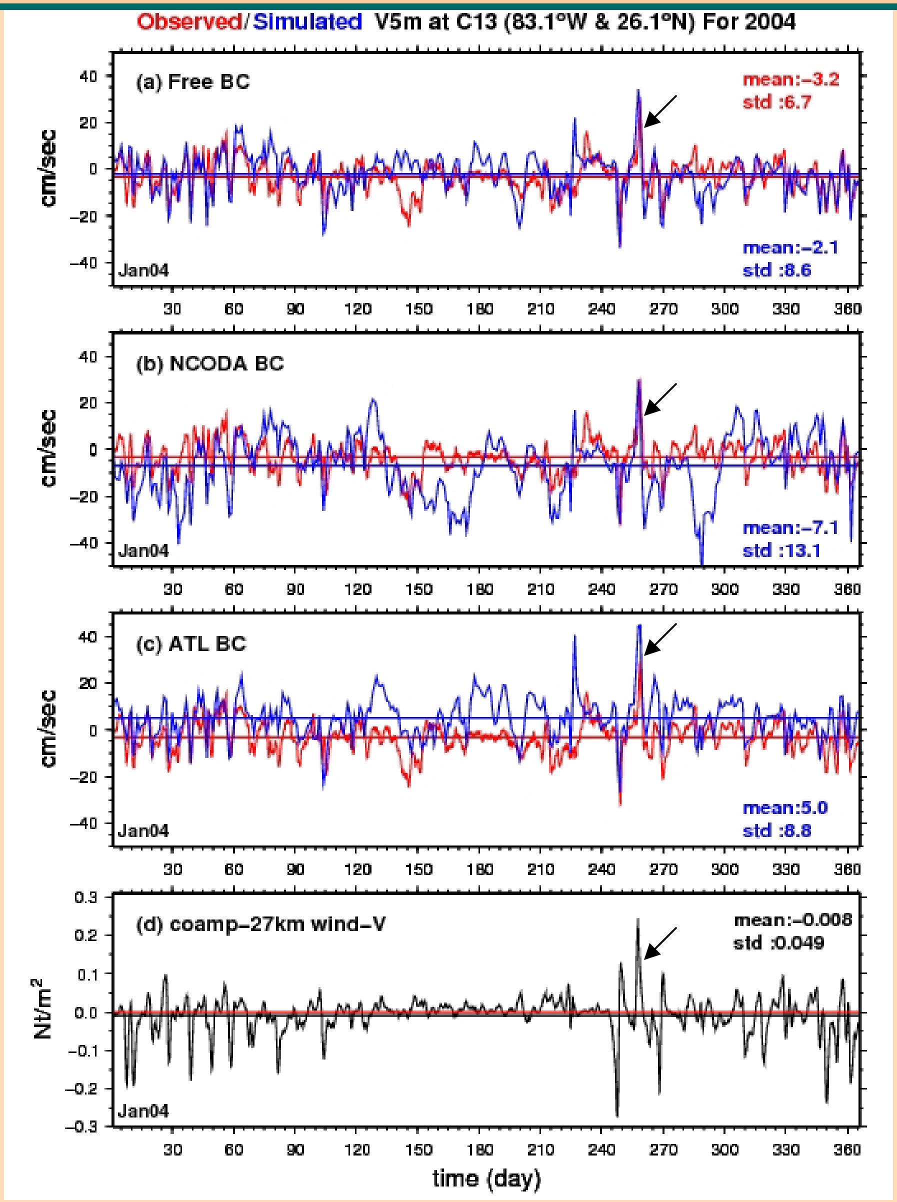
Free: Pat Hogan

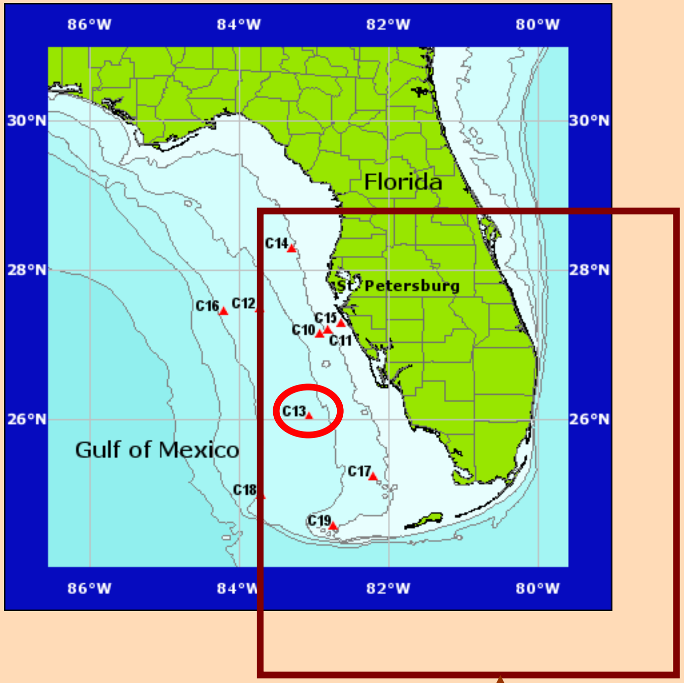
NCODA: O-M. Smedstadt





Model-Data Comparison: #C13 (COAMPS 27 km winds)



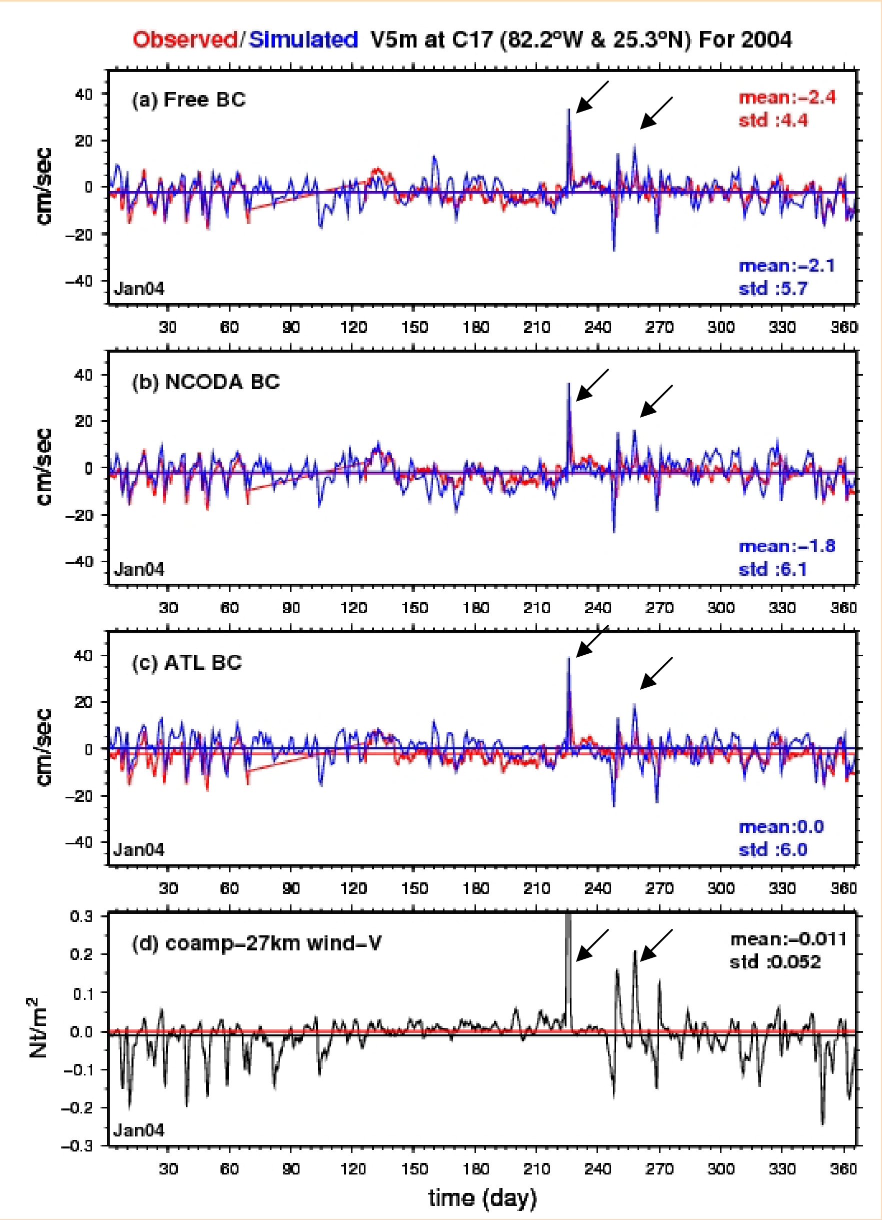


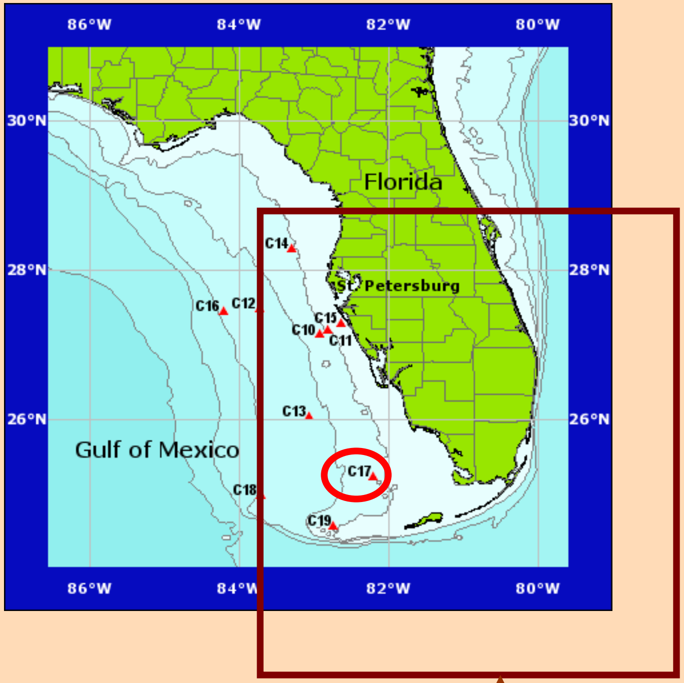
SoFLA-HYCOM

"Floats" code by G. Halliwell

3-hourly winds & hourly mooring data
=> Daily filtering

Model-Data Comparison: #C17 (COAMPS 27 km winds)

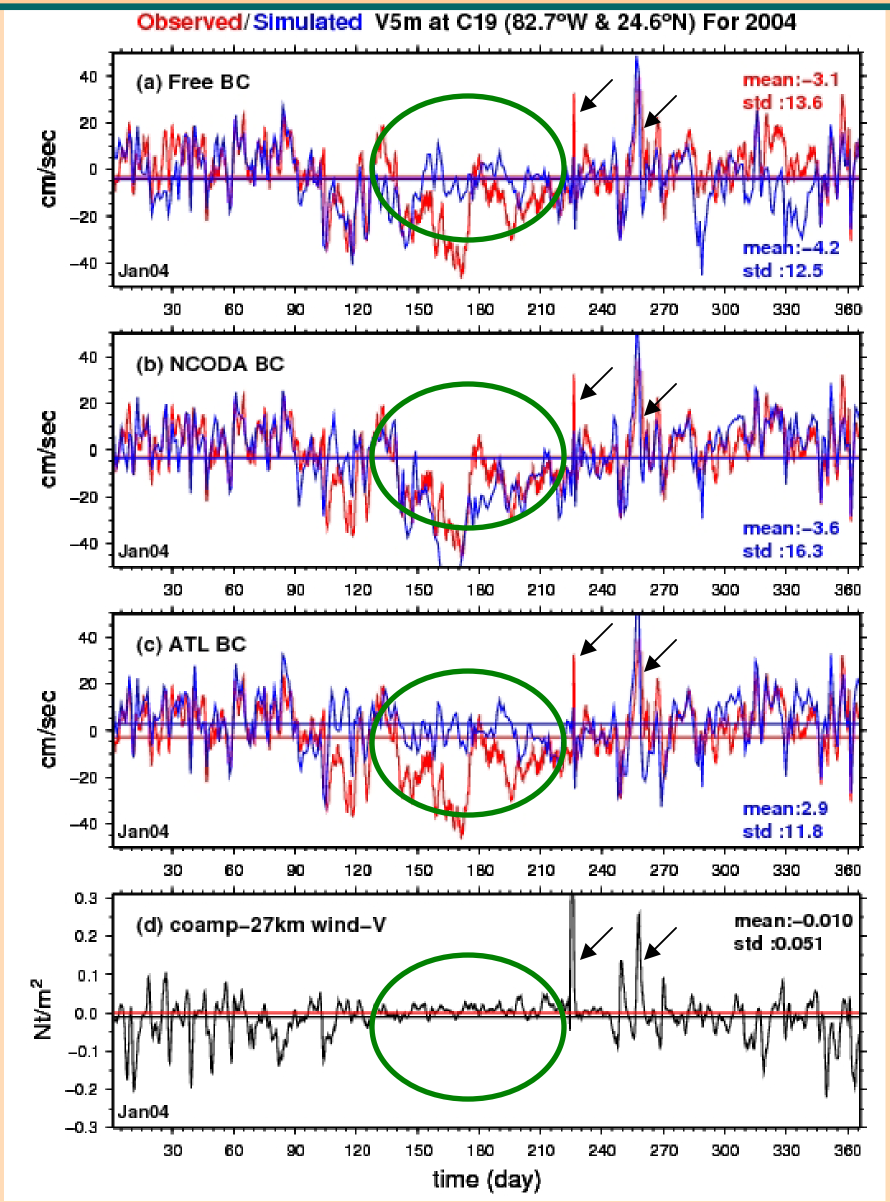


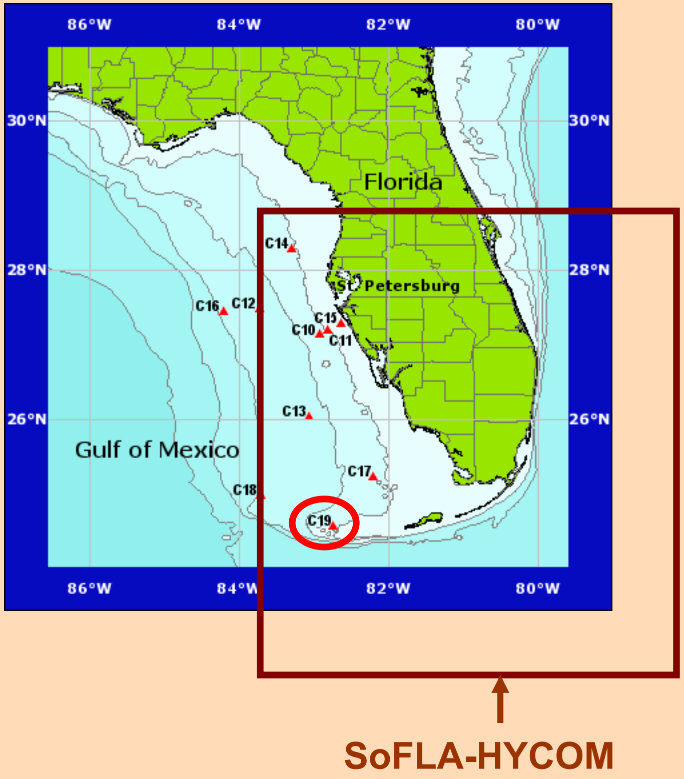


SoFLA-HYCOM

3-hourly winds & hourly mooring data
=> Daily filtering

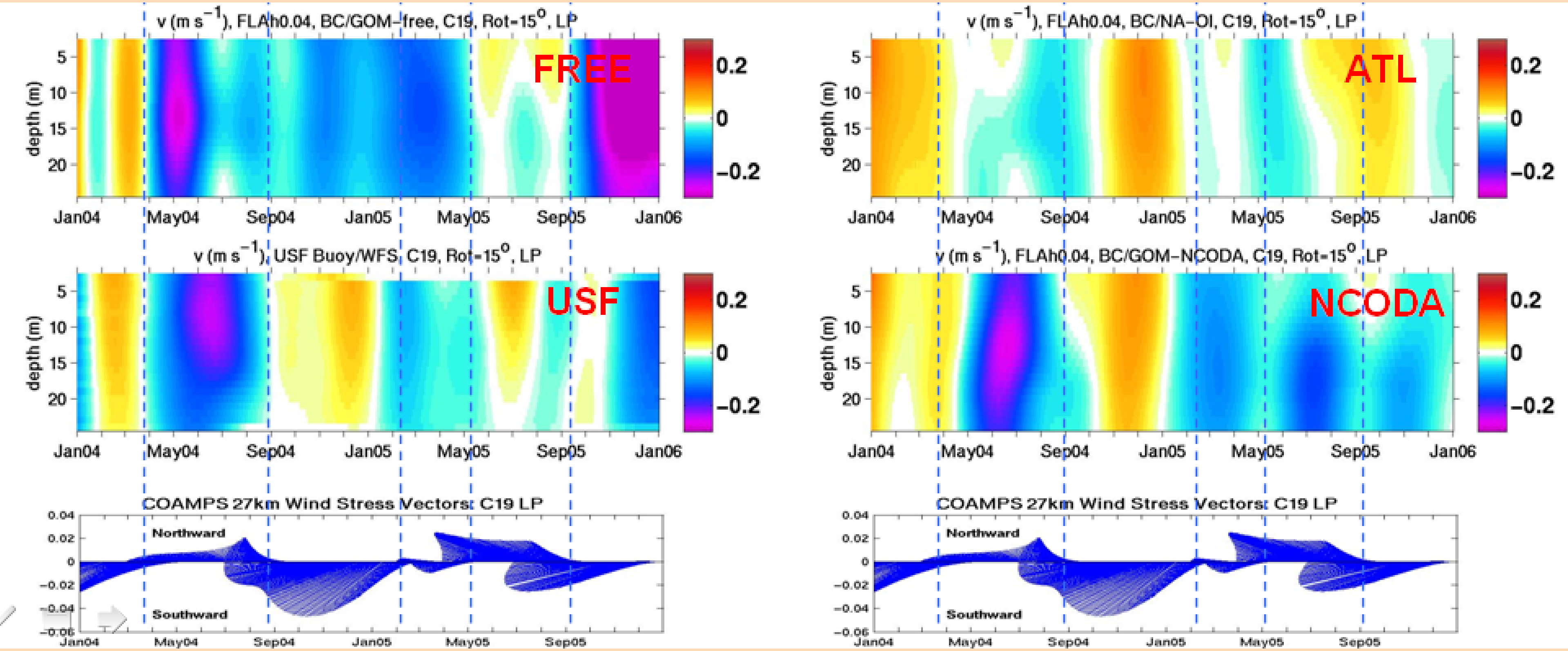
Model-Data Comparison: #C19 (COAMPS 27 km winds)



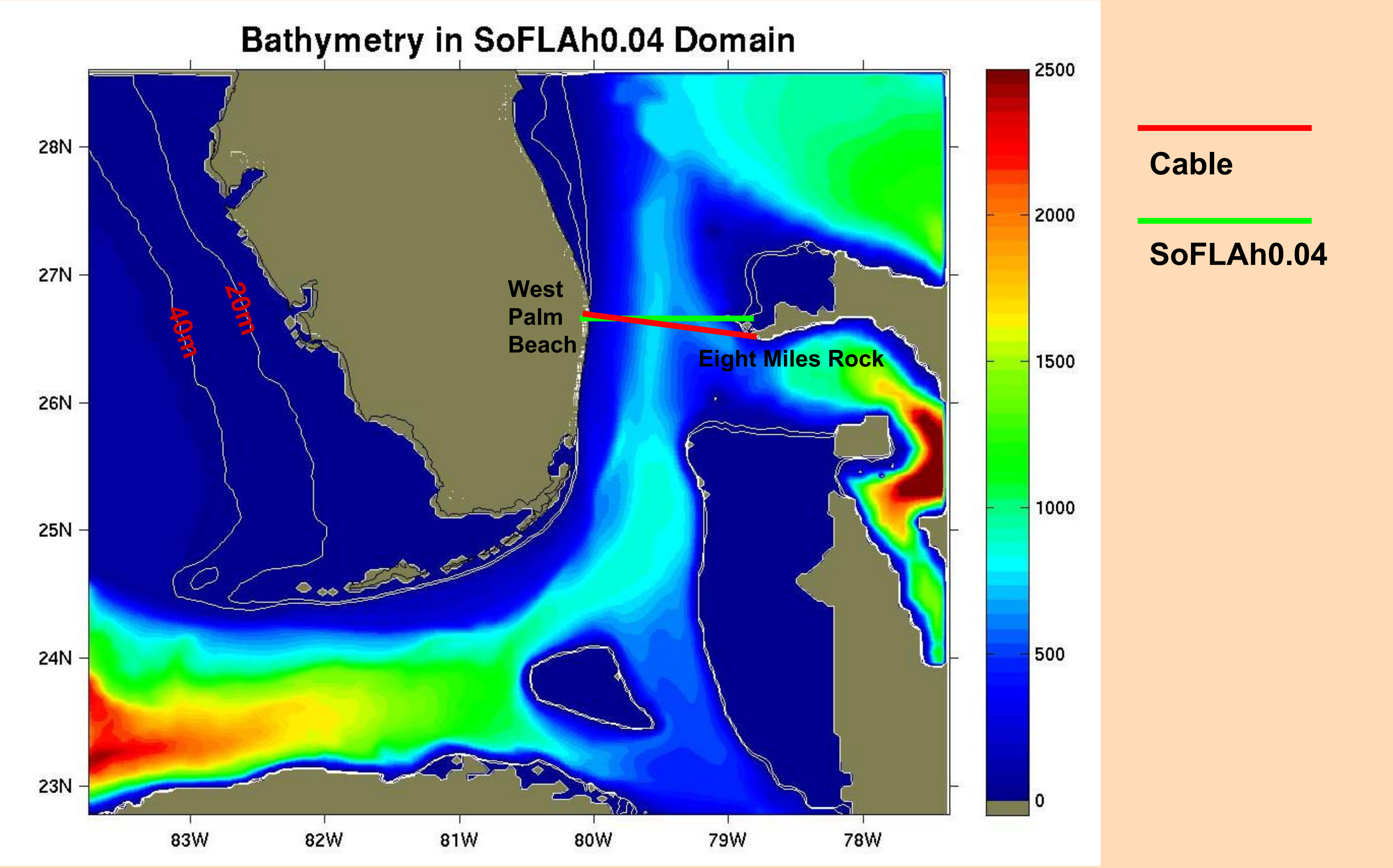


3-hourly winds & hourly mooring data
=> Daily filtering

Vertical-Time Section: FLAh0.04 C19 01/01/04-12/31/05 LP Rot=15°



Locations of the Cable and Model Sections



Statistic Characteristics: SoFLAh0.04

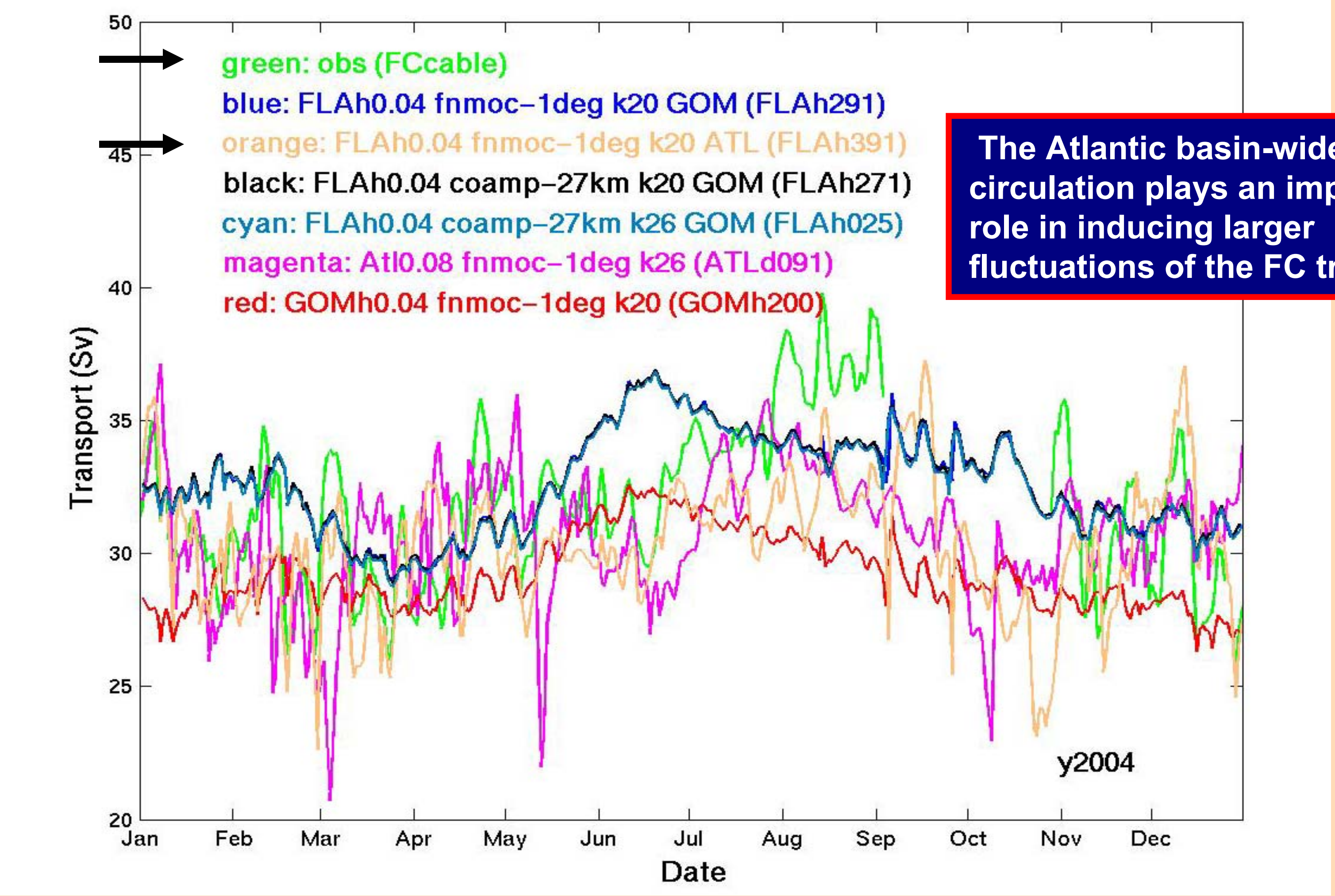
Florida Current Transport: 2004 and 2005

	Free	NCODA	Cable	Free	NCODA	Cable
Mean	31.85	32.46	31.81	32.02	32.62	31.38
STD	1.89	1.96	3.00	1.66	1.88	3.37
	Year 2004			Year 2005		

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

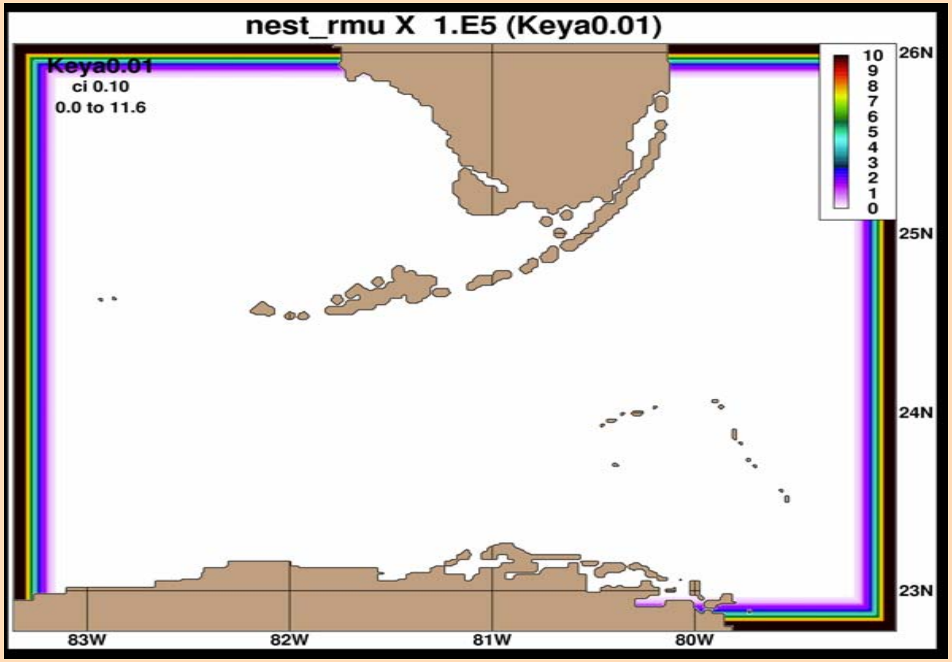


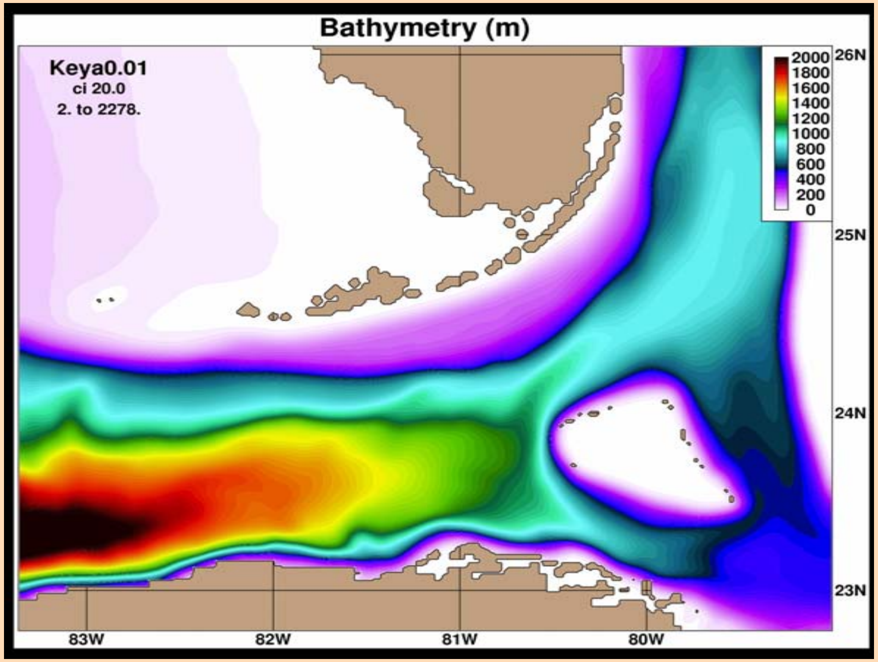
The Atlantic basin-wide circulation plays an important role in inducing larger fluctuations of the FC transport

FC transport at 27ºN 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





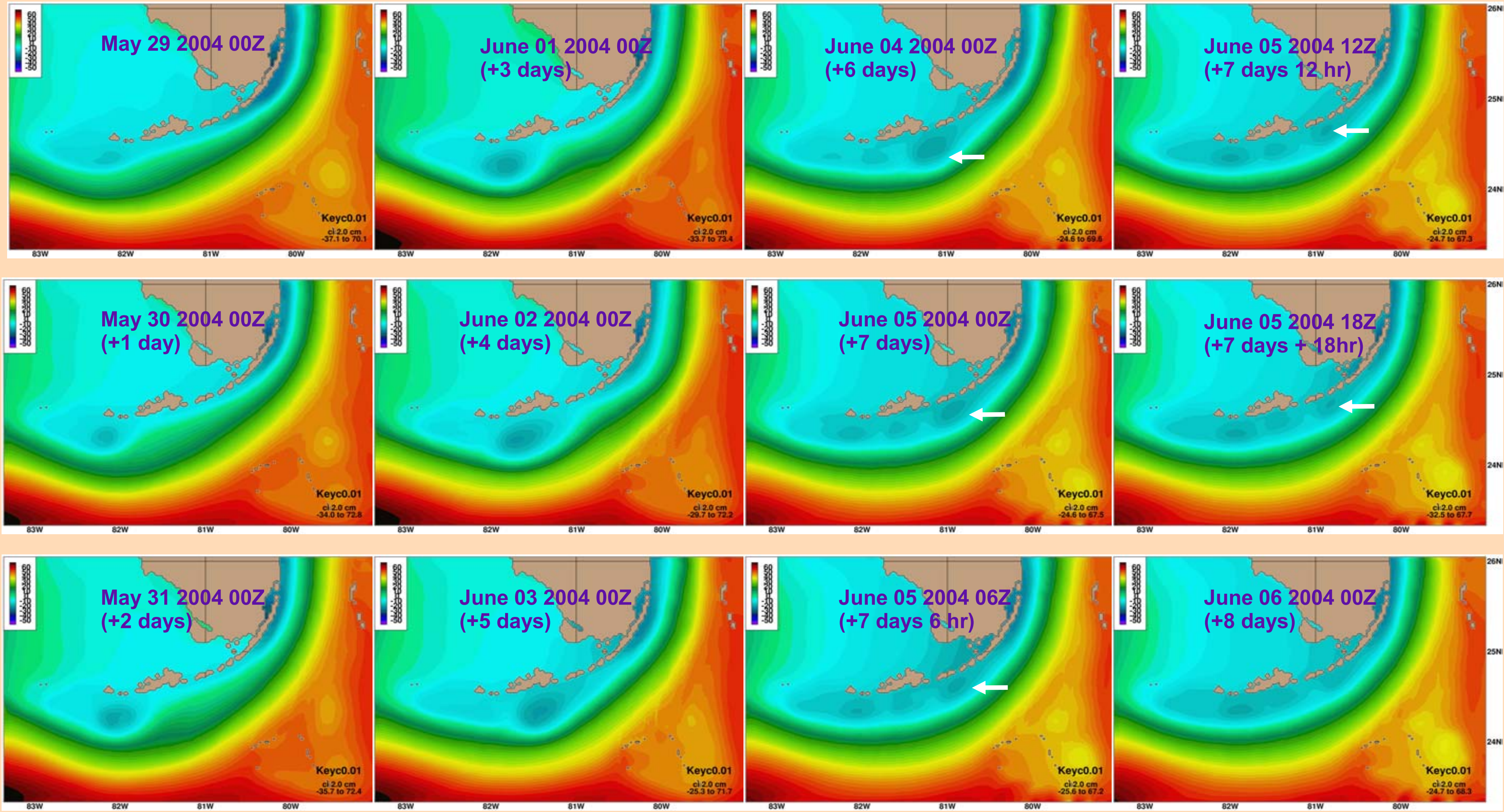
20 grids relaxation zone along boundaries
E-folding scale of 0.1 to 5-days
in a relaxation zone
Daily updating for barotrophic &
baroclinic BCs

NRL_DBDB2 with

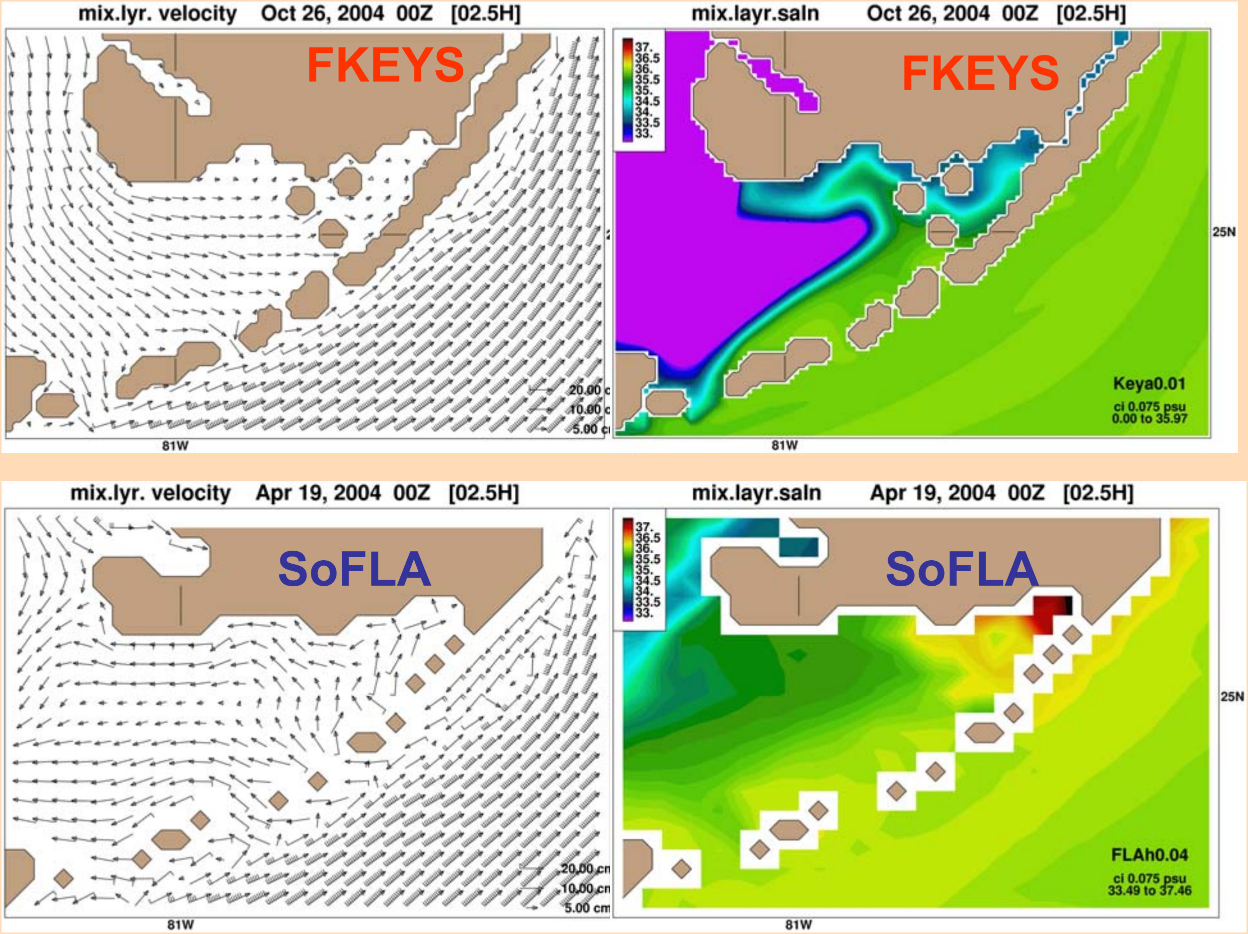
2m minimum water depth

More realistic passages between Keys

FKEYS-HYCOM SSH:
mesoscale and submesoscale eddy activity



FKEYS vs. SoFLA
Near sfc currents and salinity

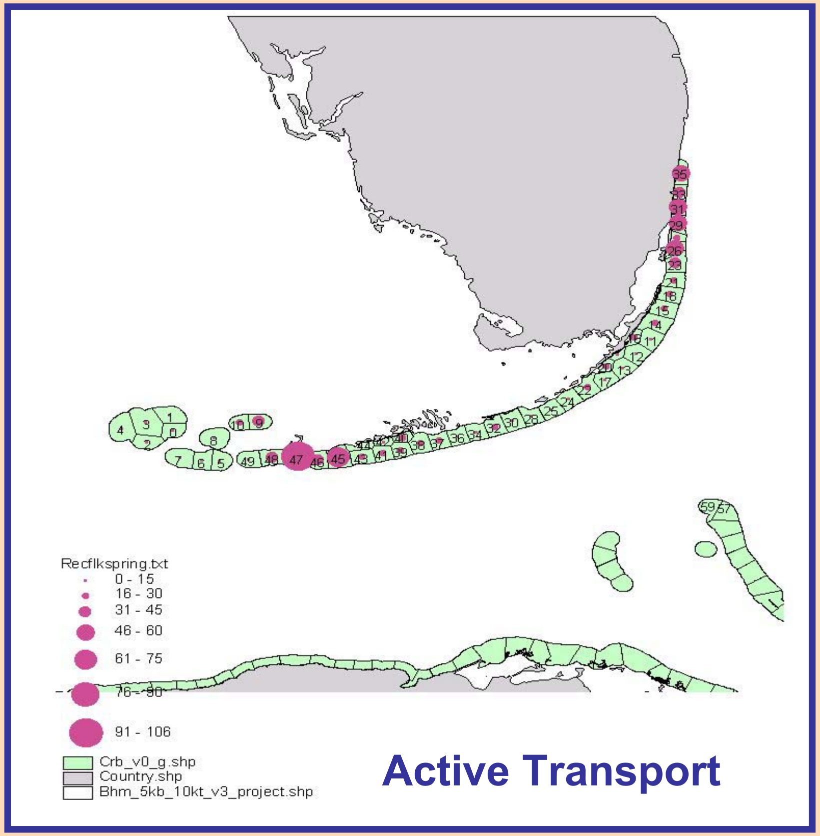


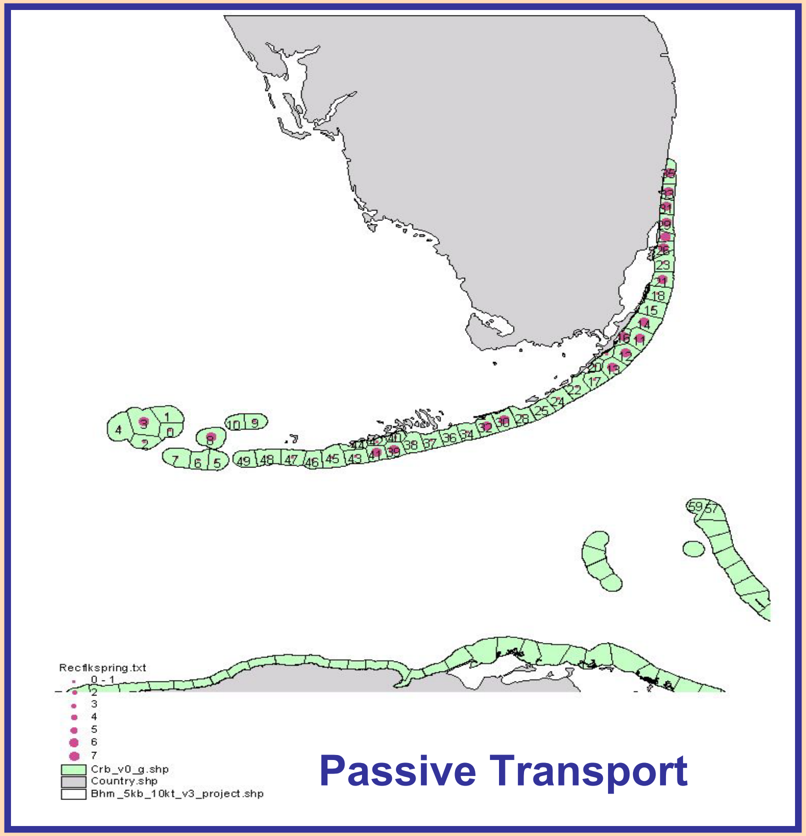
Future Work

- 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 1/12º NAT-HYCOM
Will be done with 1/100º FKEYS-HYCOM





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

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 1/12º NAT-HYCOM

Paris et. al (in prep.)

Regional HYCOM modeling at UM/RSMAS