# Evaluation of the effects of Boundary Conditions and Atmospheric Forcing in the SoFLA-HYCOM domain


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*UM/RSMAS*

**In Collaboration with**

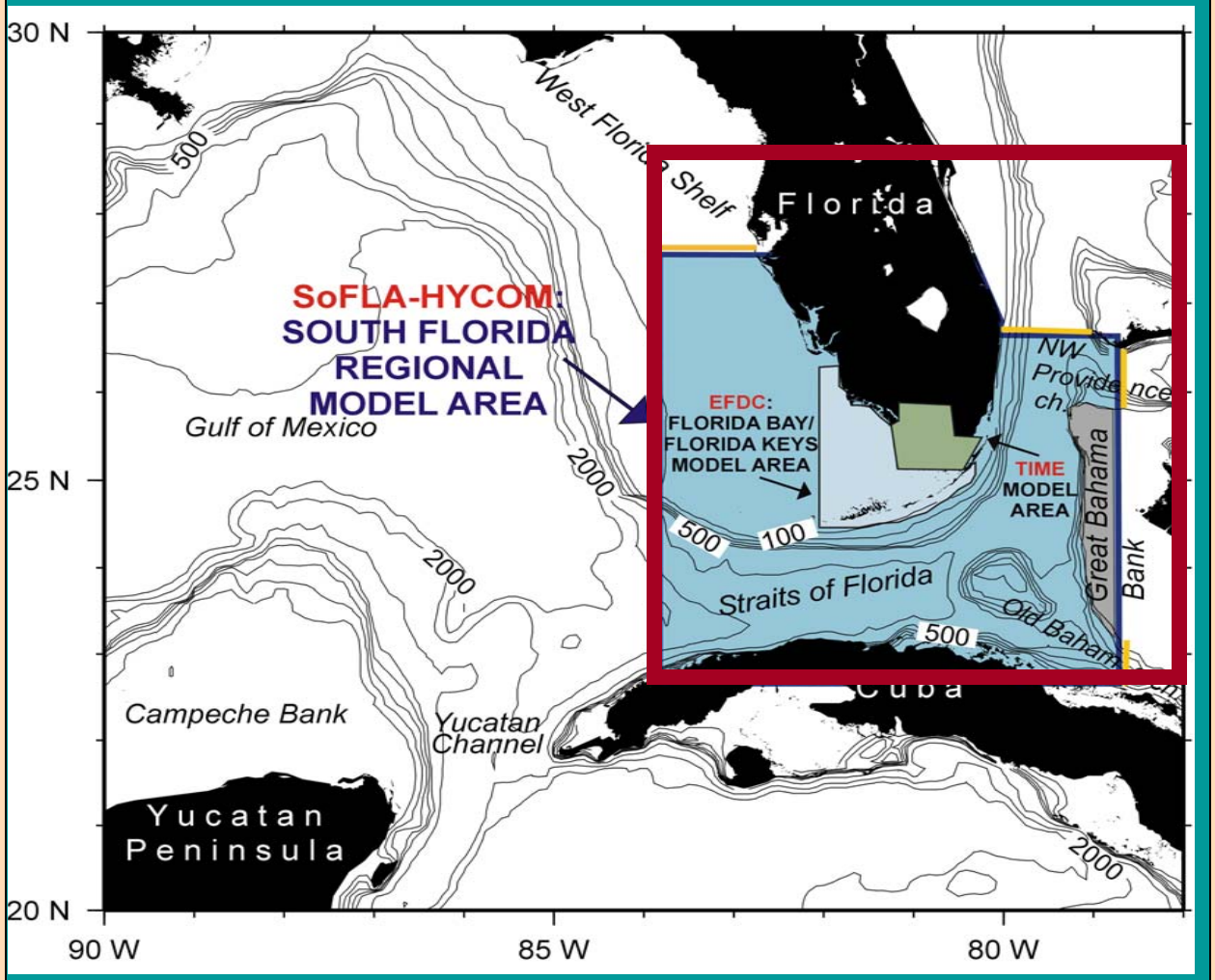
**Pat Hogan, Ole Martin Smedstad and Alan Walcraft *(NRLSSC)***
**Julie Pullen *(NRLMRY)***



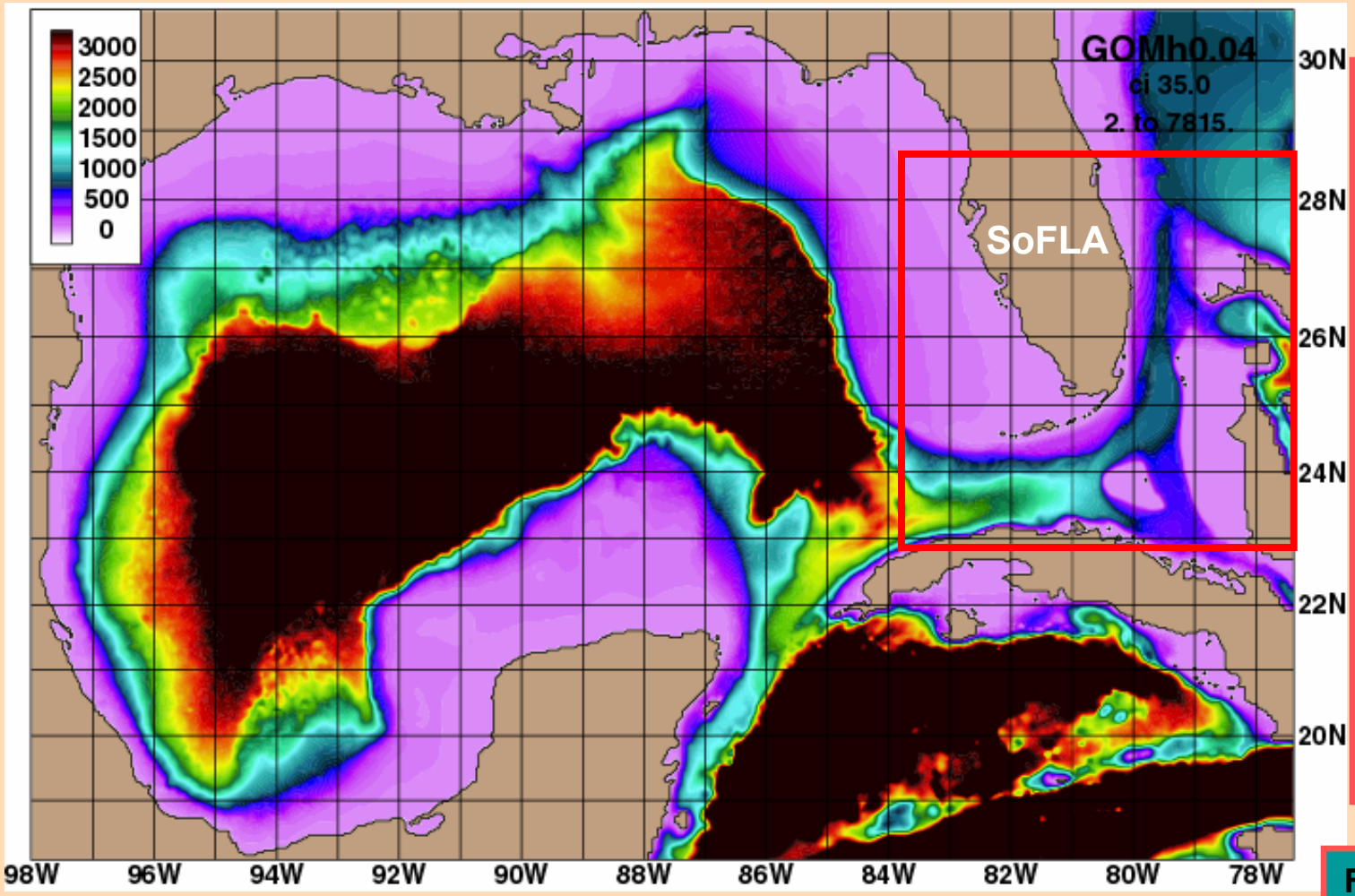

# Regional model for South Florida seas: SoFLA-HYCOM

## (South Florida Hybrid Coordinate Ocean Model)

- **A multi-nested modeling approach in support of the Comprehensive Everglades Restoration Project (funded by NOAA)**
- **Evaluation of nested simulation strategies in terms of boundary conditions, data assimilation and forcing (funded by ONR-NOPP)**
- **Coupled to a biological Lagrangian model of larval transport to study connectivity and coral reef fish recruitment in the Florida Keys (funded by NSF)**



# 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**

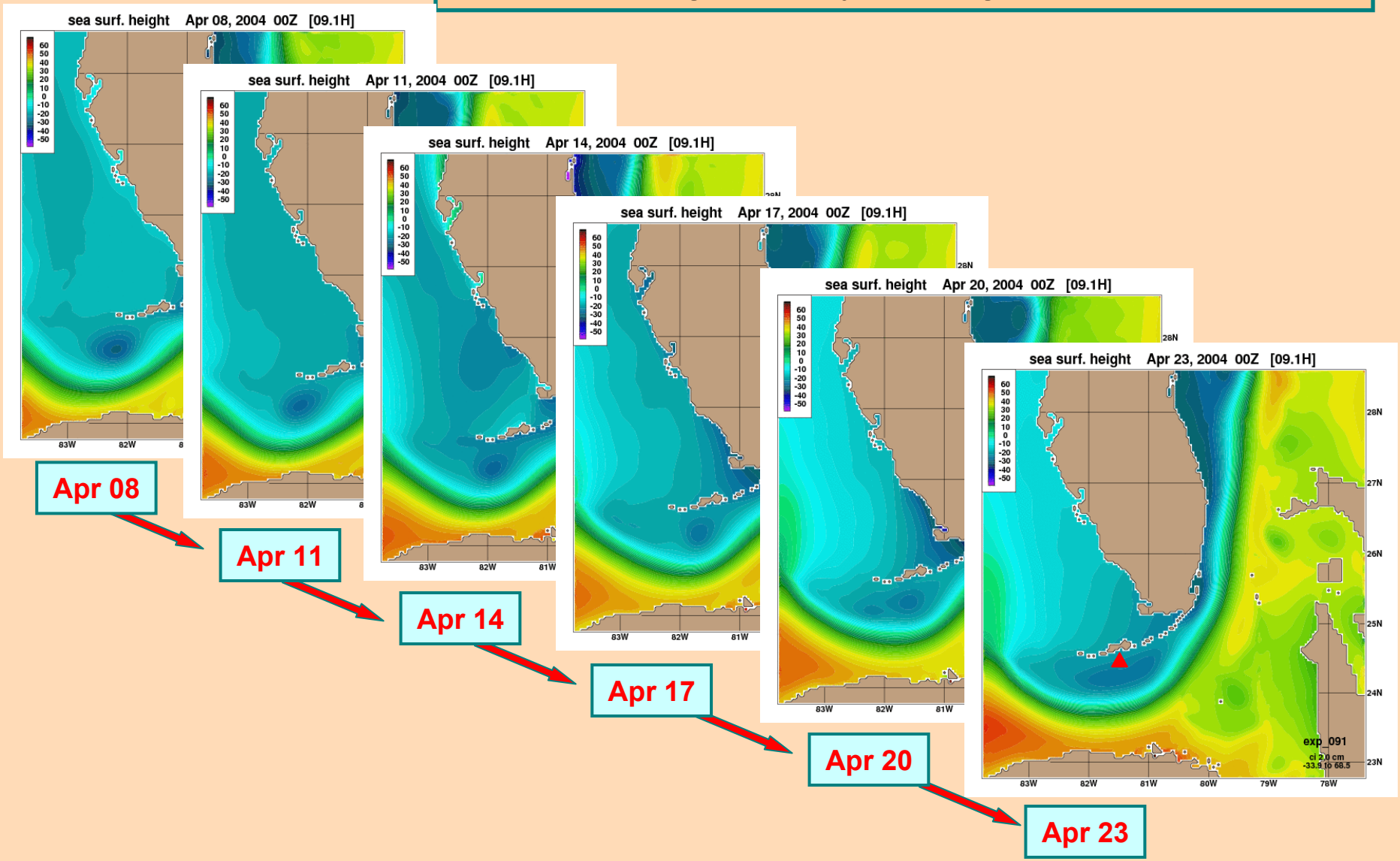
**GOMh0.04 1/25° resolution: Idm=517 jdm=349 kdm=20; 98°W-77.36°W; 18.90°N–30.71°N; 2 m minimum water depth**

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

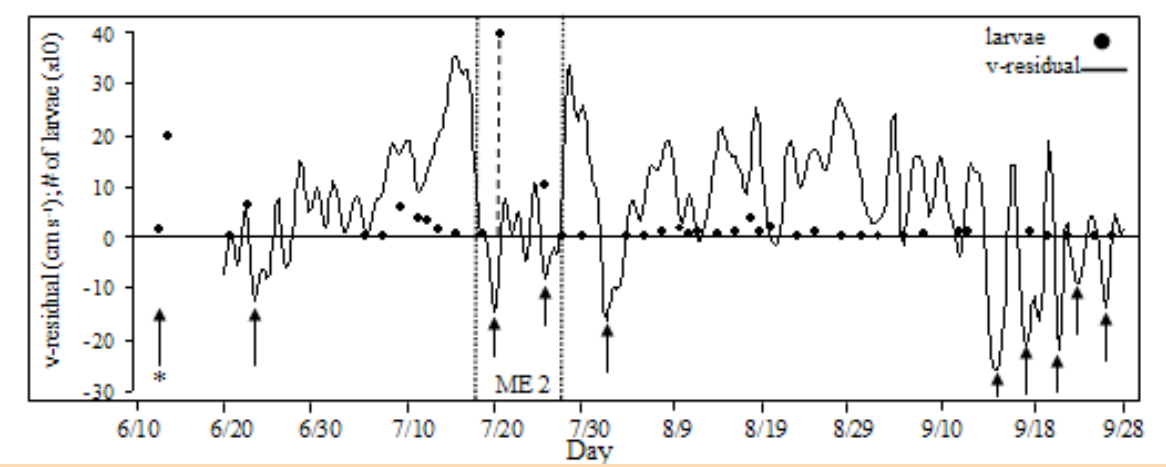
# SoFLA-HYCOM: FLAh0.04 Run Numbers and Attributes

| RunID | Layers | Rivers | Forcing | Nesting BC | Date |
|---|---|---|---|---|---|
| 01.1 | 20 | Same as free GOMh0.04 | fnmoc-1.0 | Free GOMh0.04 | 2004 |
| 06.4 | 20 | Merging 01.1 with FLAe06.4: Rivers_X5 | fnmoc-1.0 | Free GOMh0.04 | 2004 |
| 09.1 | 20 | Rivers_X9 | fnmoc-1.0 | Free GOMh0.04 | 2004, 2005 |
| 09.2 | 20 | Rivers_X9X5 | fnmoc-1.0 | Free GOMh0.04 | April and May, 2004 |
| 29.1 | 20 | Rivers_X9 | fnmoc-1.0 | NCODA GOMh0.04 | 2004, 2005 |
| 39.1 | 20 | Rivers_X9 | fnmoc-1.0 | ATLd0.08 | 2004 |
| 07.1 | 20 | Rivers_X9 | coamps 27km | Free GOMh0.04 | Jan-Sep, 2004? |
| 27.1 | 20 | Rivers_X9 | coamps 27km | NCODA GOMh0.04 | 2004, 2005 |
| 04.1 | 20 | Rivers_X9 | Fnmoc-0.50 | Free GOMh0.04 | 2004 |
| 02.1 | 26 | Same as free GOMh0.04 | Fnmoc-1.0 | Free GOMh0.04 | Jan, 2004 |
| 01.5 | 26 | Rivers_X9 | coamps 27km | Free GOMh0.04 | 2004,2005 |
| 02.5 | 26 | Rivers_X9 | coamps 27km | NCODA GOMh0.04 | 2004,2005 |
| 03.5 | 26 | Rivers_X9 | coamps 27km | ATLd0.08 | 2004,2005 |

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

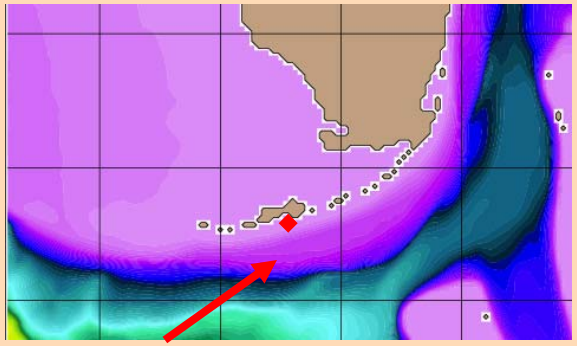


# Alongshore current and larval counts during an eddy passage (2001 data)

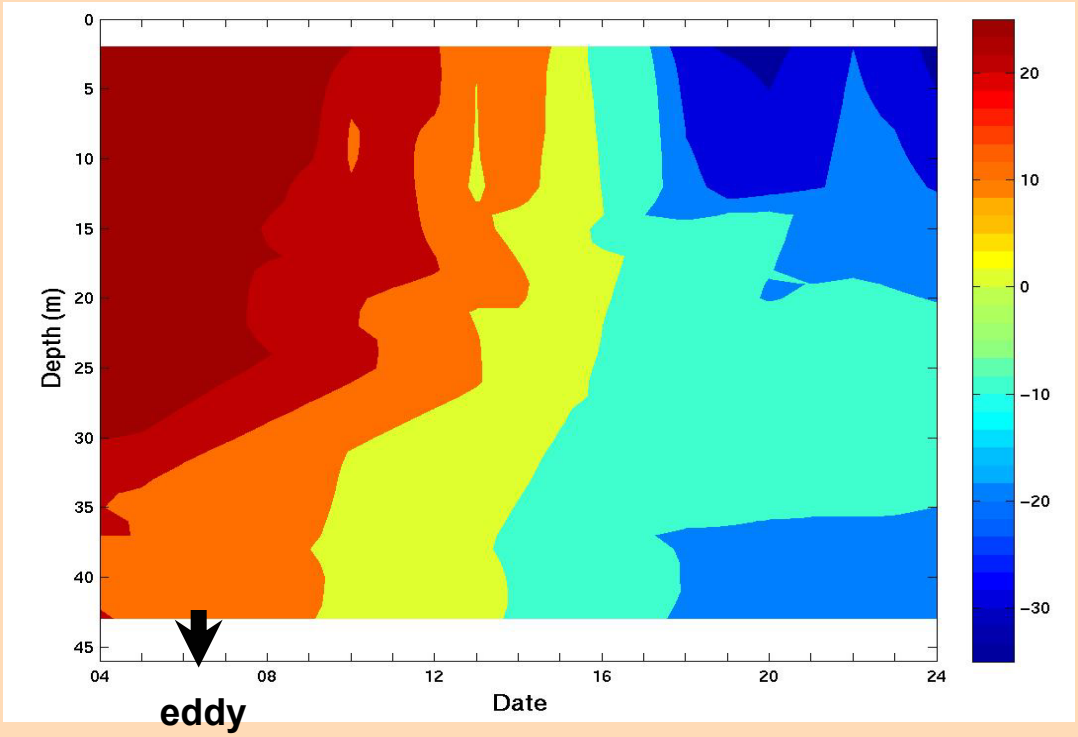



***Sponaugle et al., 2005***

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

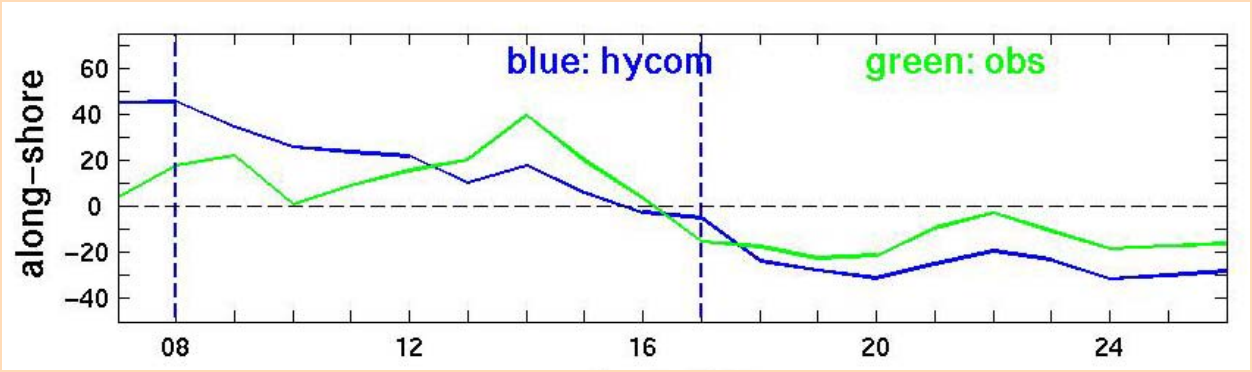


**81.4W, 24.65N**




**eddy enters**

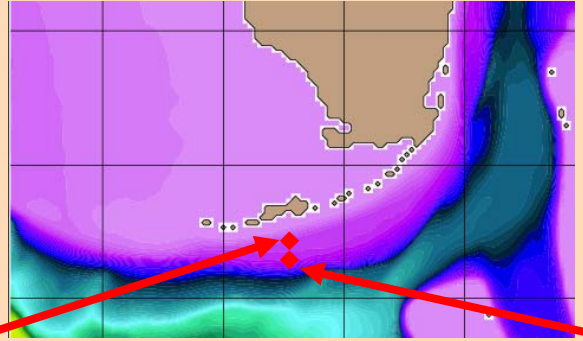
## Model to Data comparison




**April 2004**

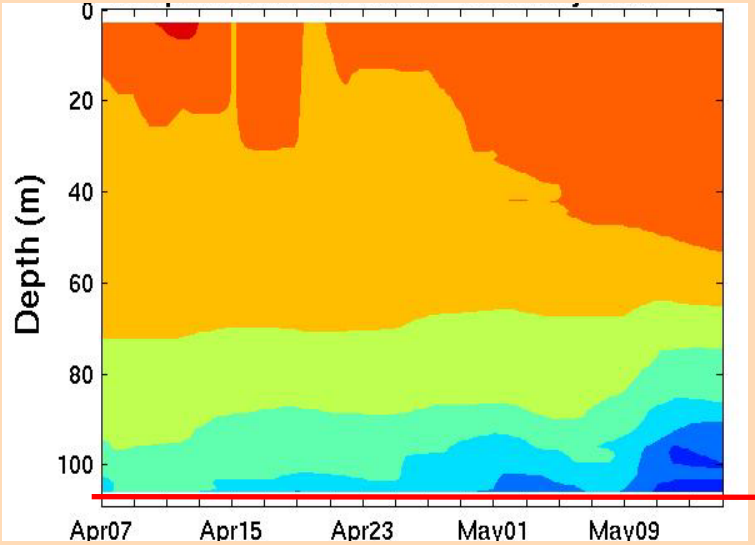
*•40 HLP data (rot. 73 deg.) prepared by*
*Ryan Smith, NOAA/AOML*

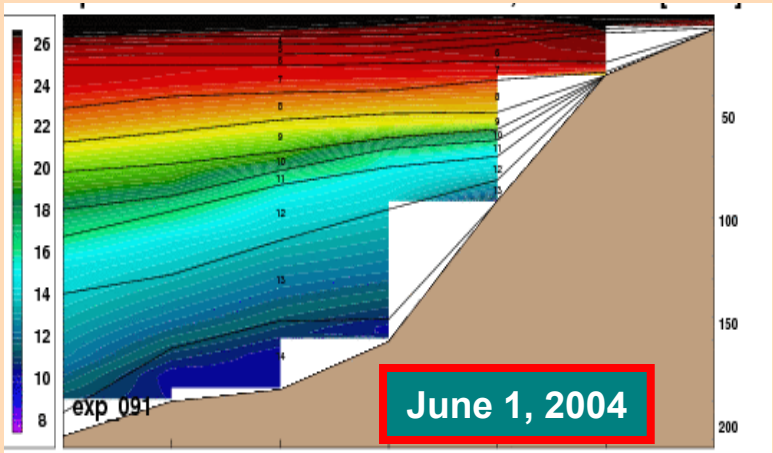
Eddy “signal” at different depths: Temperature cross-sections at Looe Key

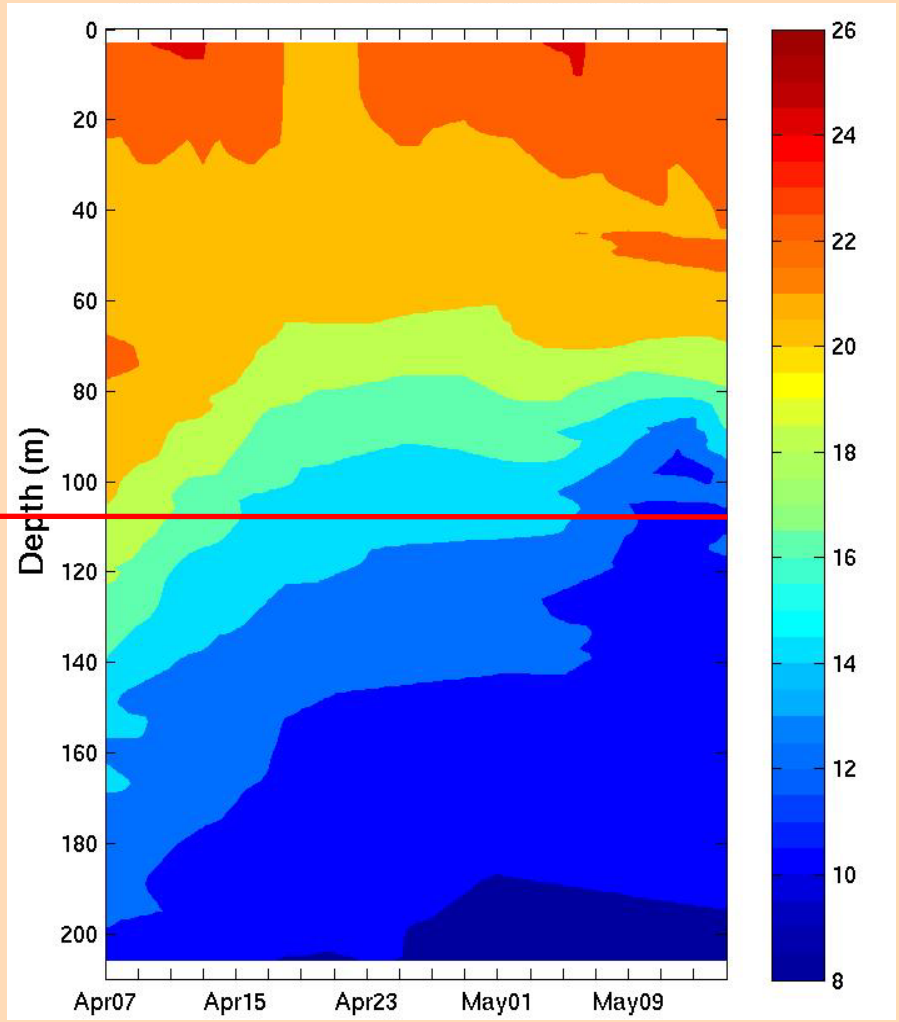


81.4W, 24.5N

81.4W, 24.35N

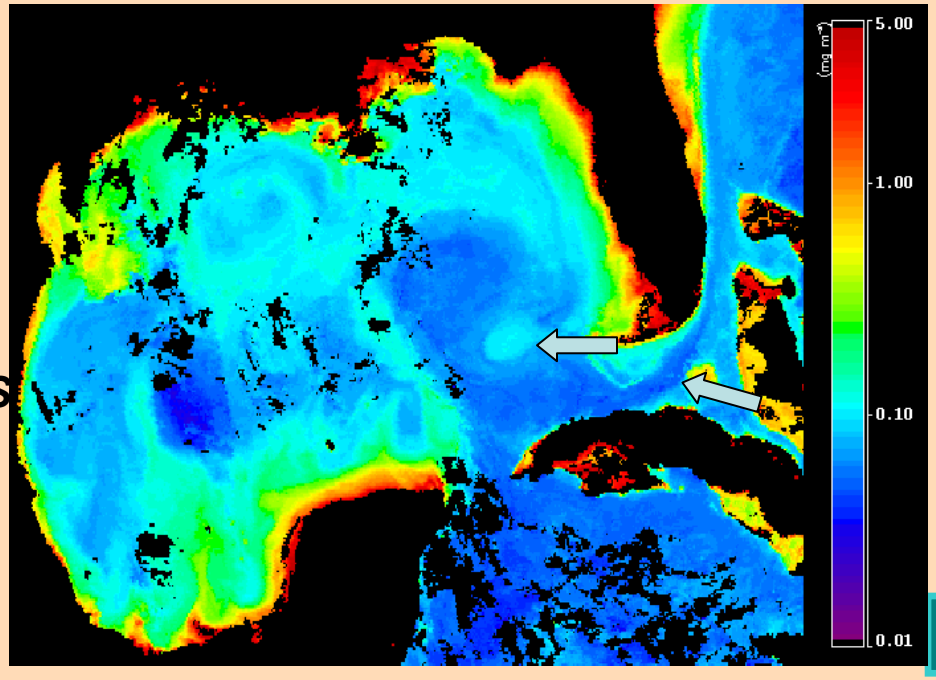


# Assimilation effects through Boundary Conditions

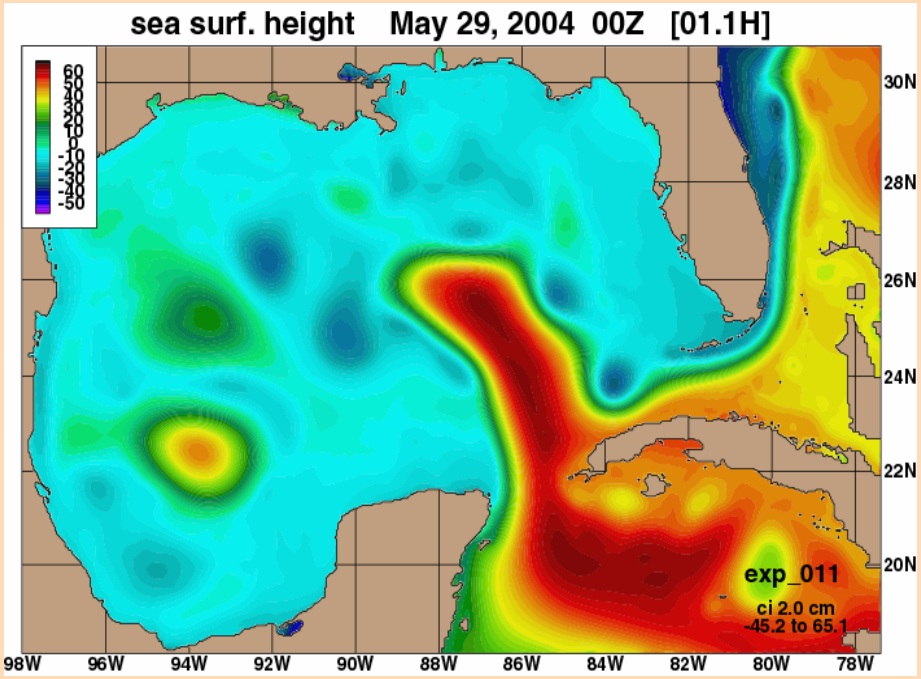
*7-days, 5/24-31/2004,*
*Aqua-chla*
*Provided by*
*Viva Banzon, RSMAS*
*Satellite group*

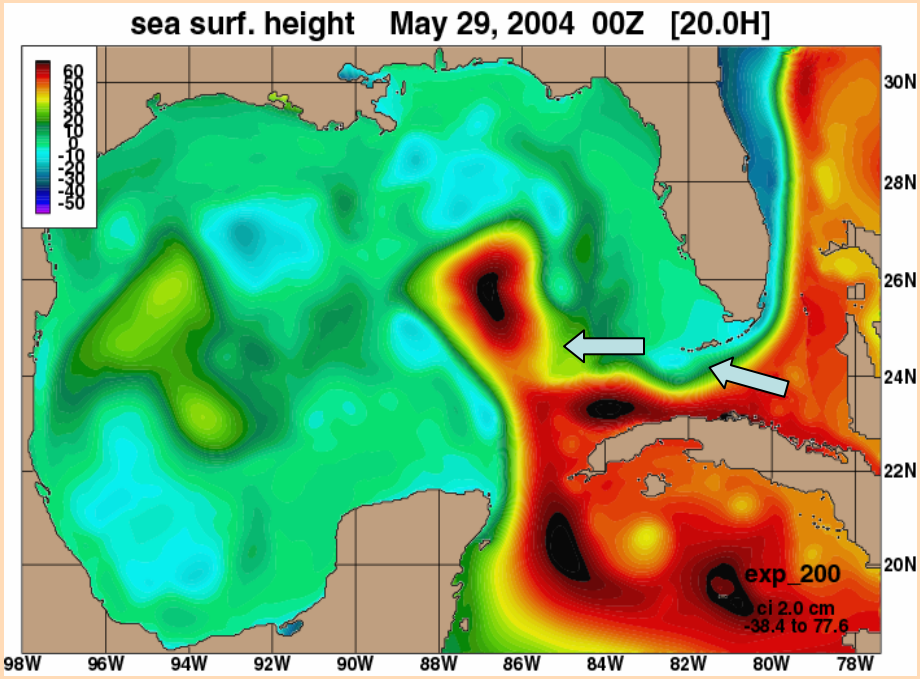



**Noticeable improvement on positions of Loop Current and eddies**

**Free: Pat Hogan**

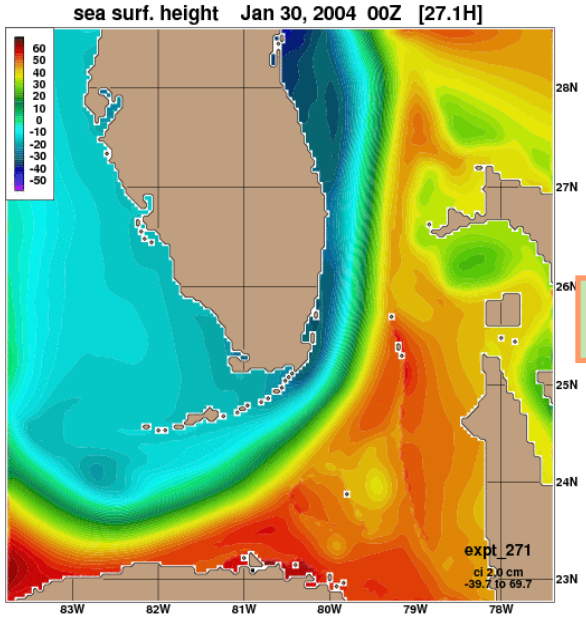
**NCODA: O-M. Smedstadt**

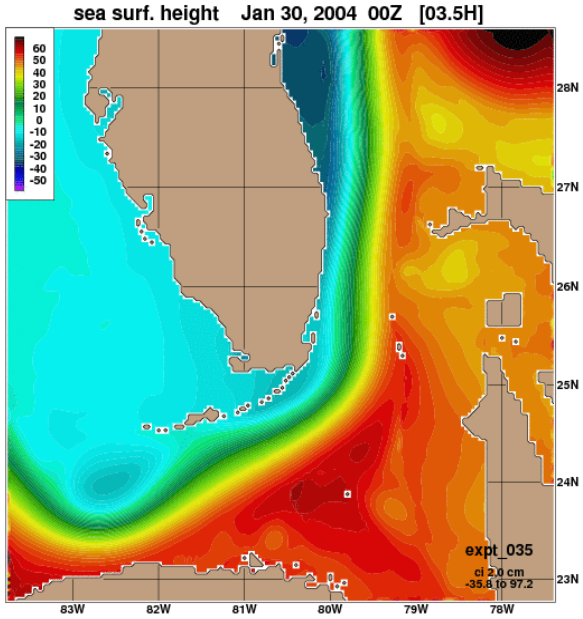


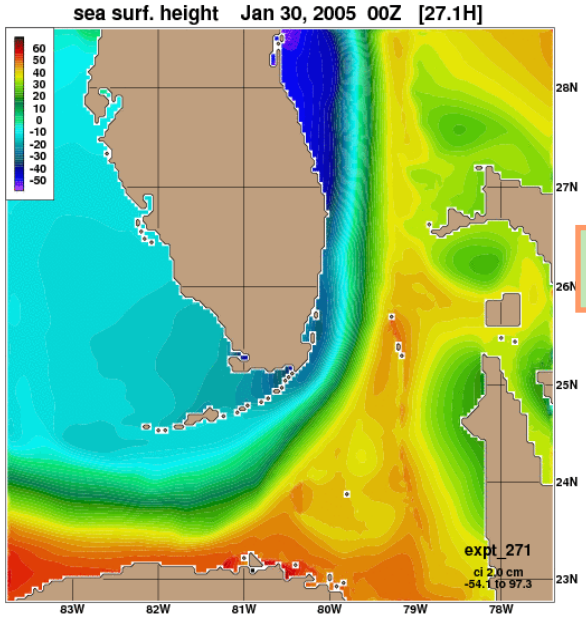
# NCODA GOMh0.04 Nesting

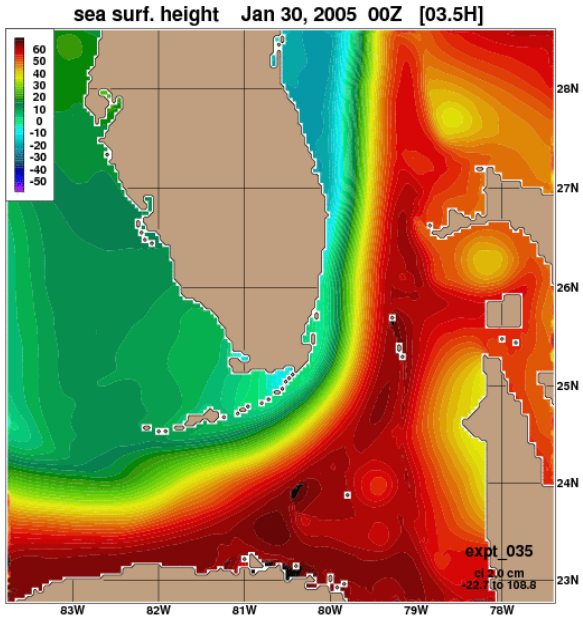
# OI NATL0.08 Nesting




**Jan 30, 2004**



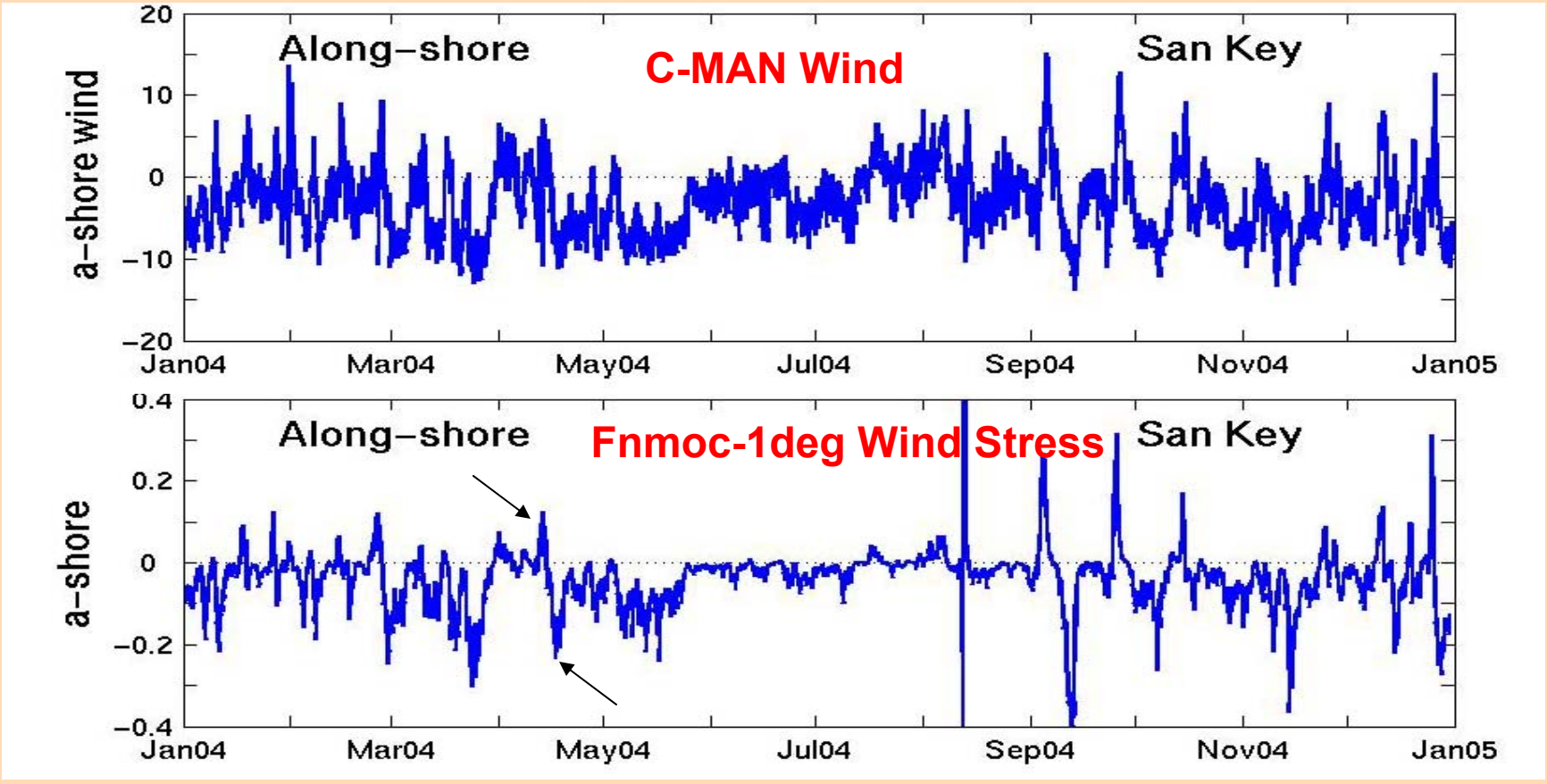



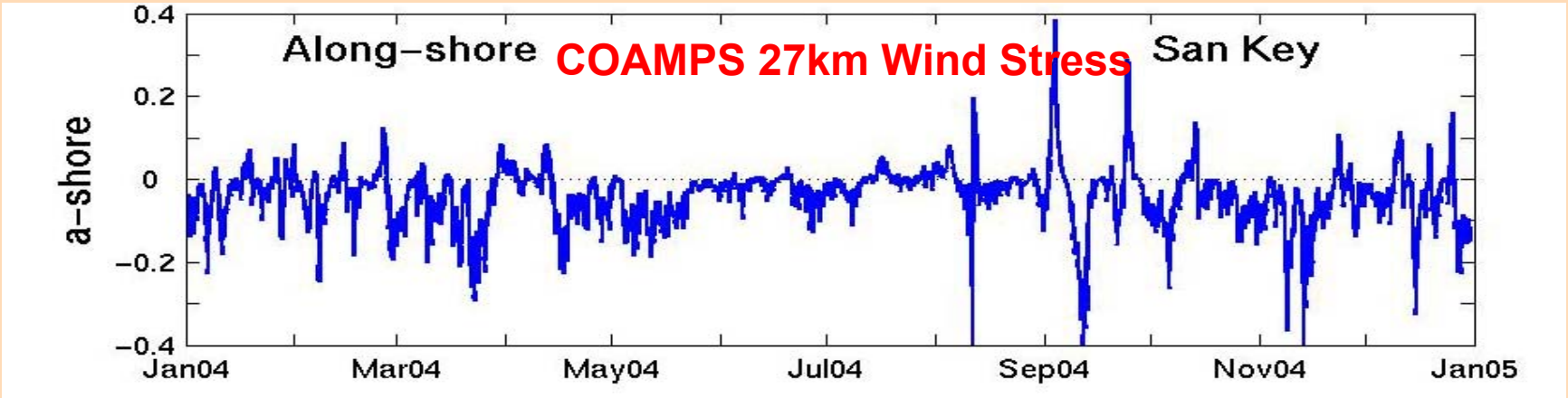

**Jan 30, 2005**

# Impact of Atmospheric Forcing Resolution

(NCODA BC's)

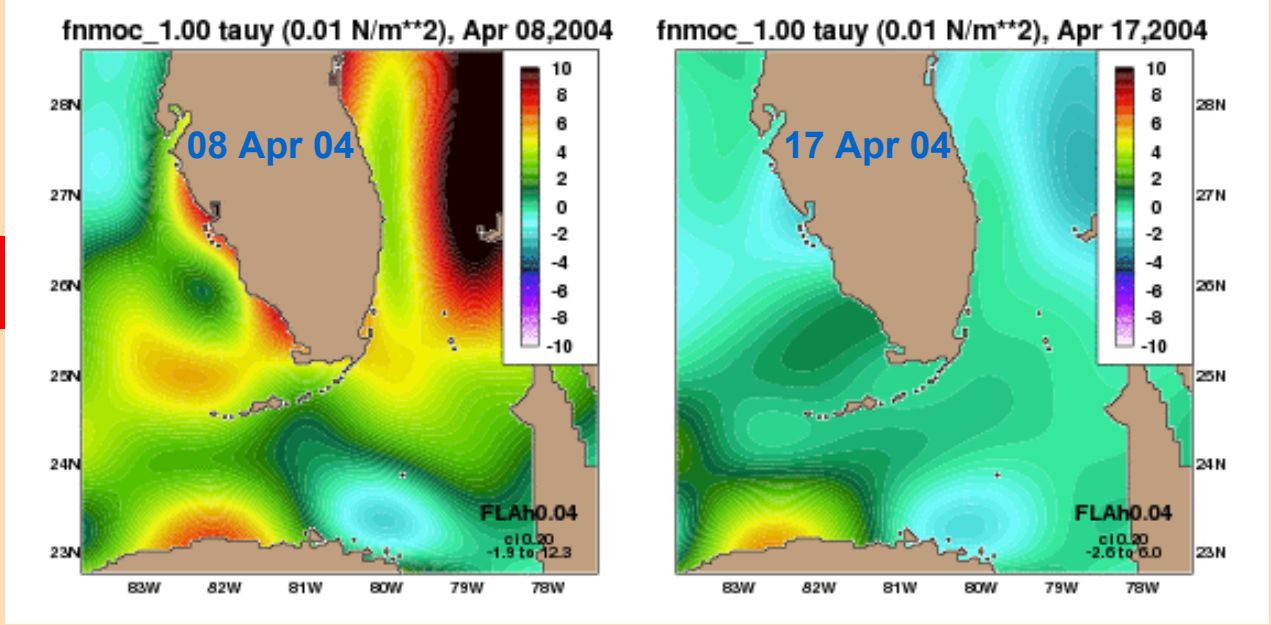
# Winds & Stress: Sand Key 81.88W 24.46N 2004 rot=73°



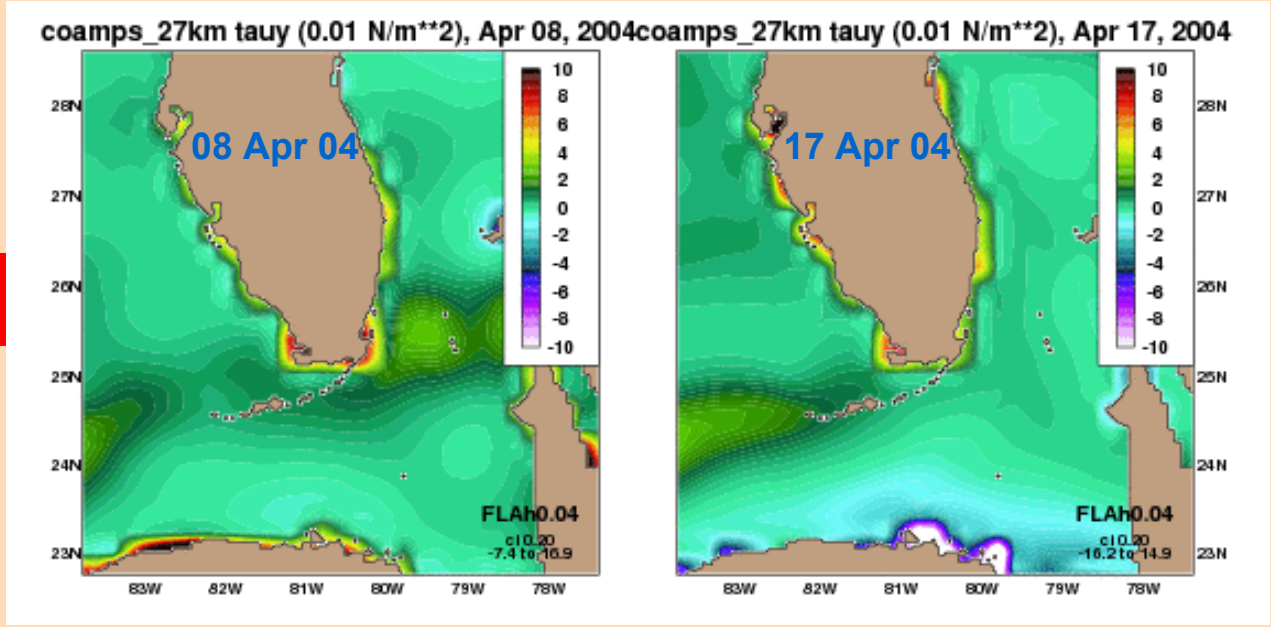



# SoFLA-HYCOM: FLAh0.04 Tau-y

**fnmoc 1-degree**



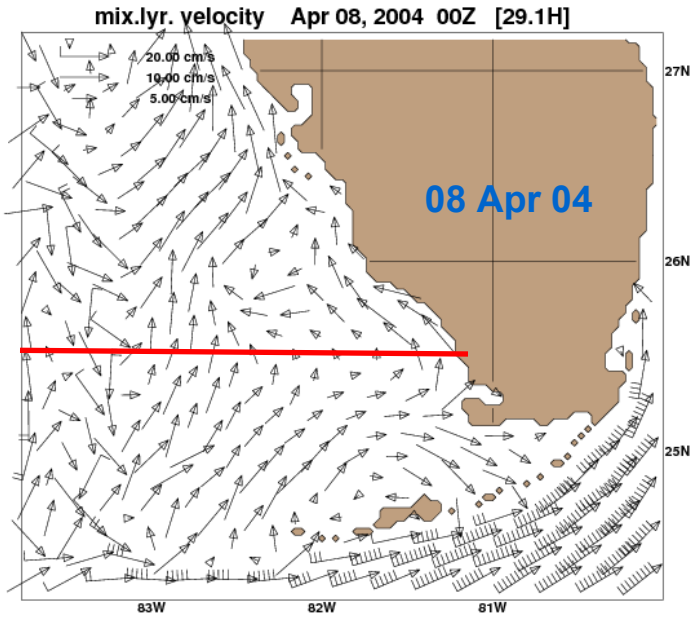

**Coamps 27 km**

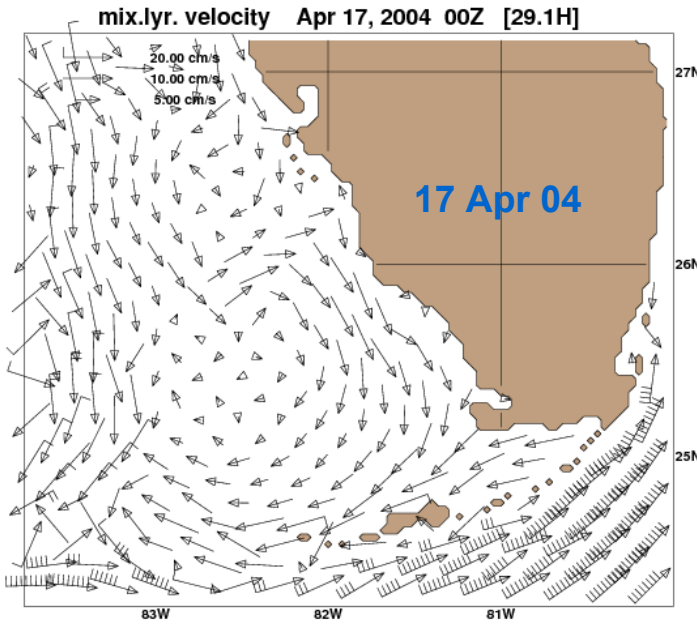


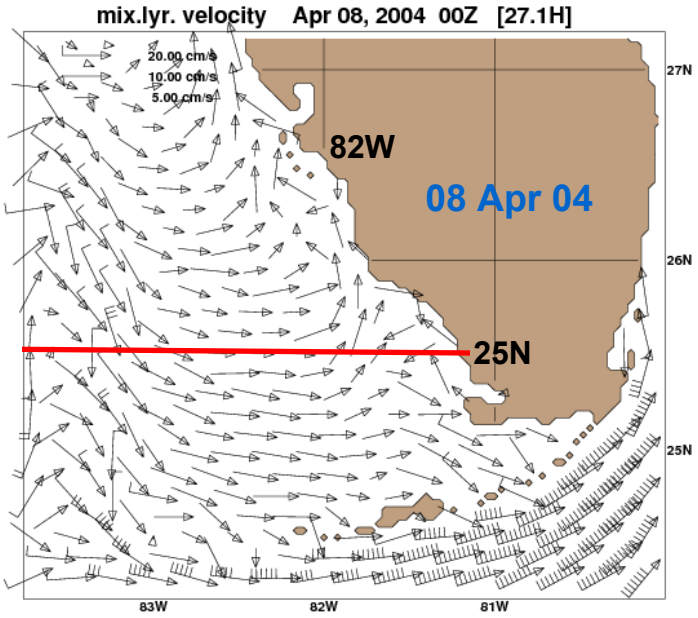
fnmoc 1-degree

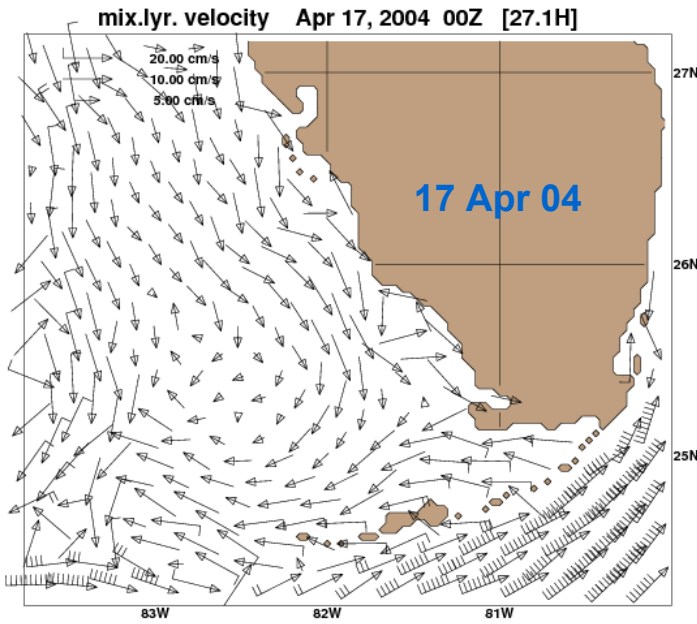
**SoFLA-HYCOM:**
**FLAh0.04 SVEL**
**West FL Shelf**

Coamps 27 km



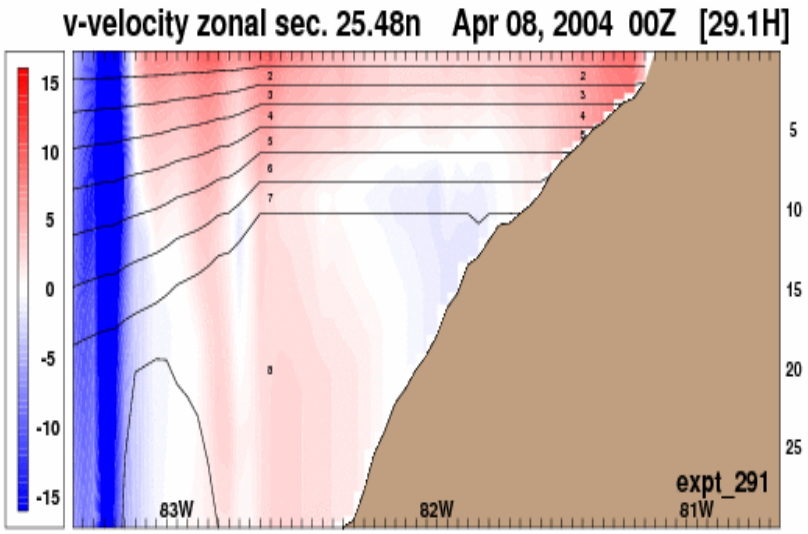



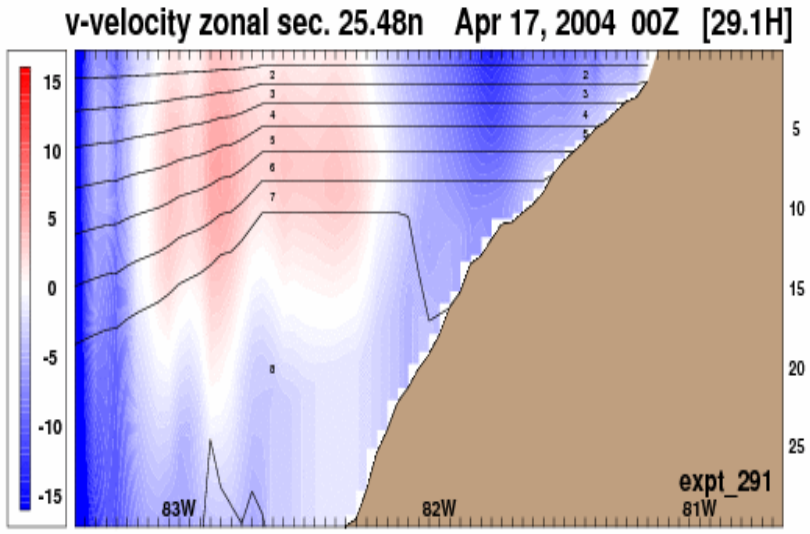



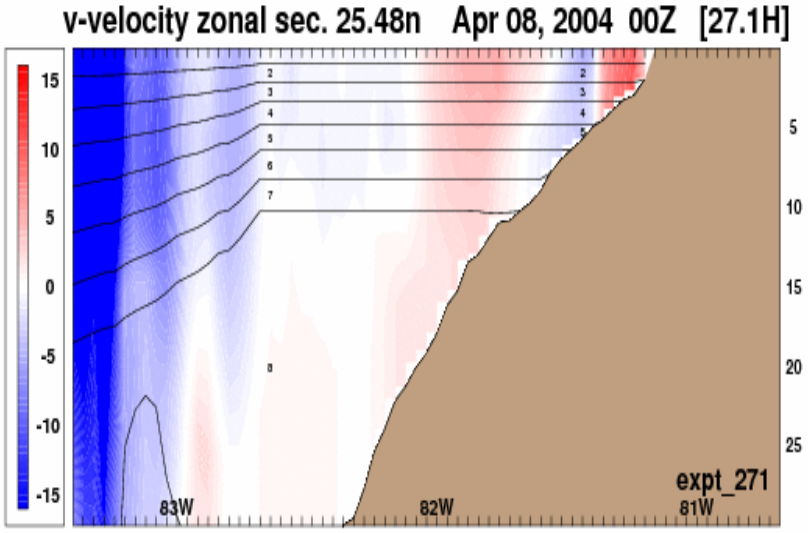
# SoFLA-HYCOM: FLAh0.04 25°N v-Comp

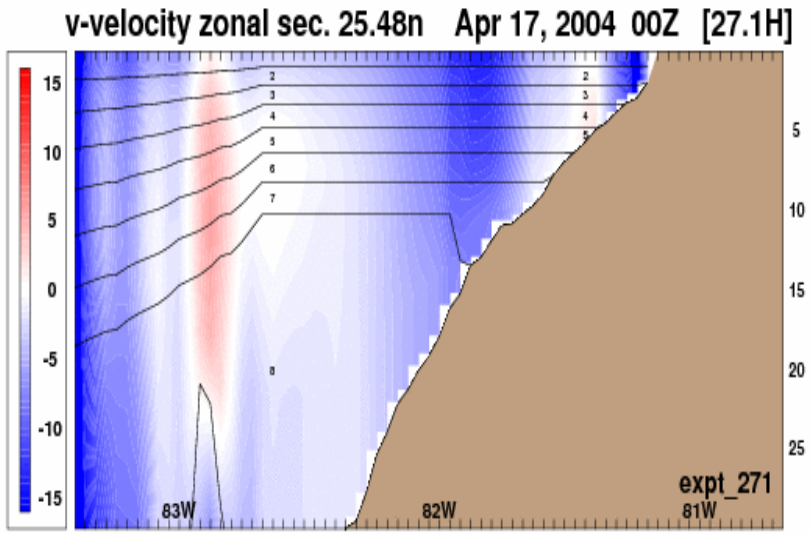
fnmoc 1degree




Coamps 27km

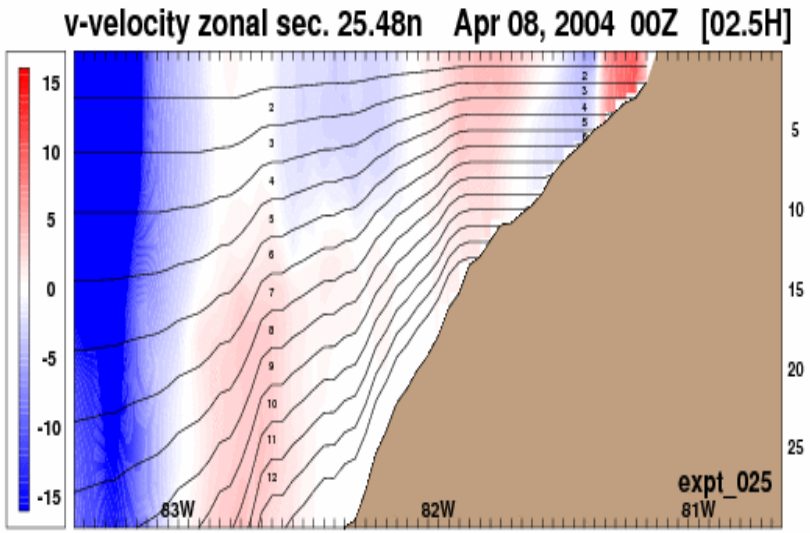


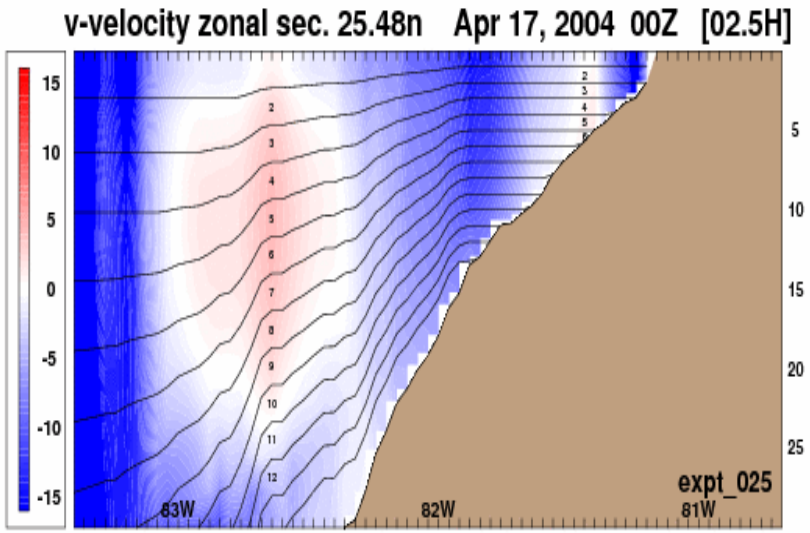



# Impact of
# Vertical Model Resolution
(coamps 27 km atmospheric forcing)

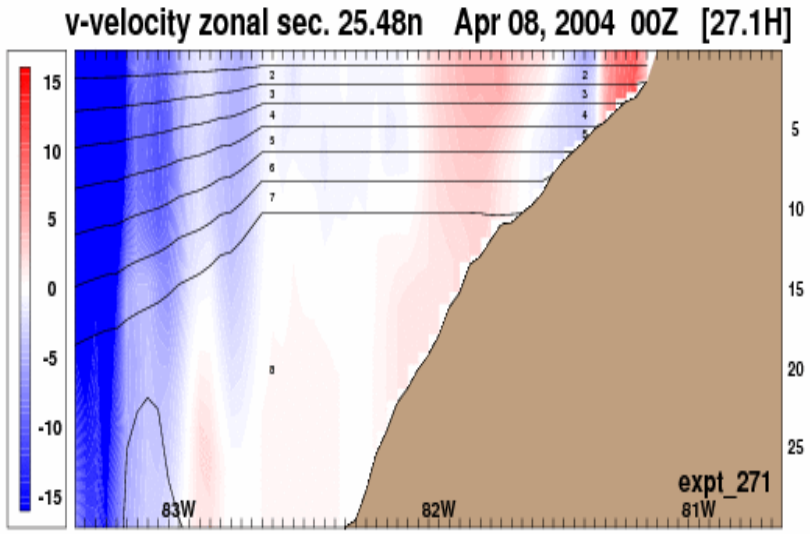
# SoFLA-HYCOM: FLAh0.04 25°N v-Comp

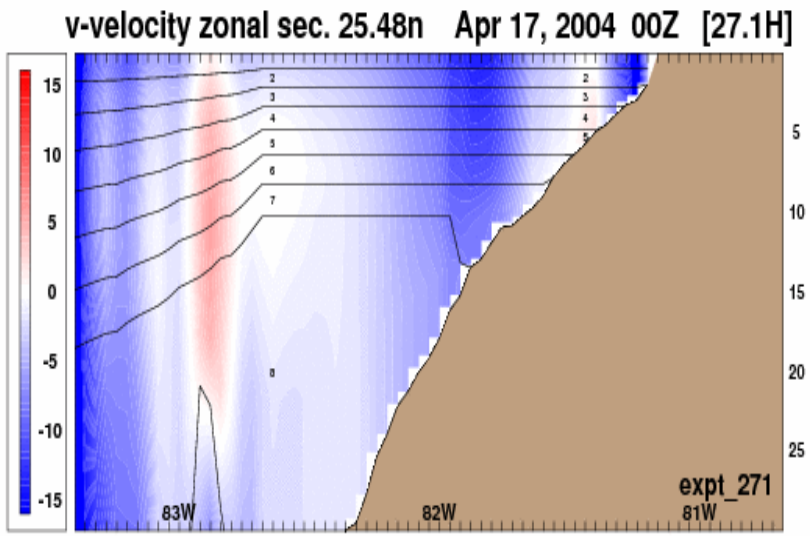
k26



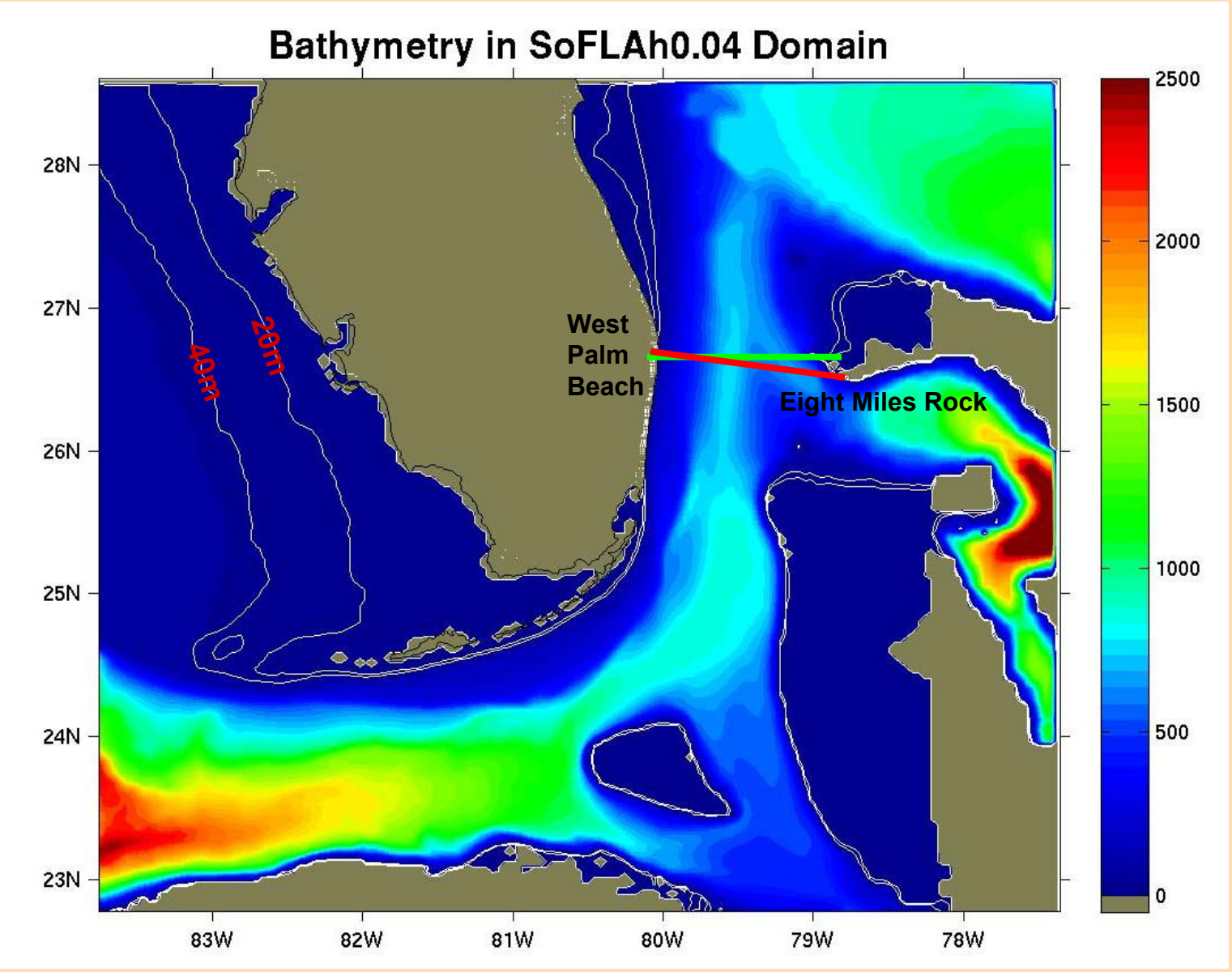

k20



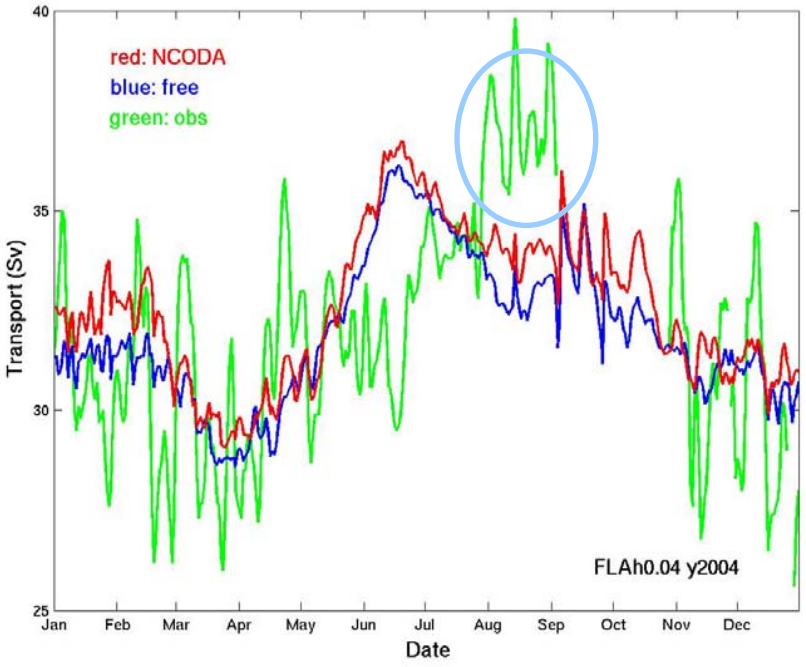



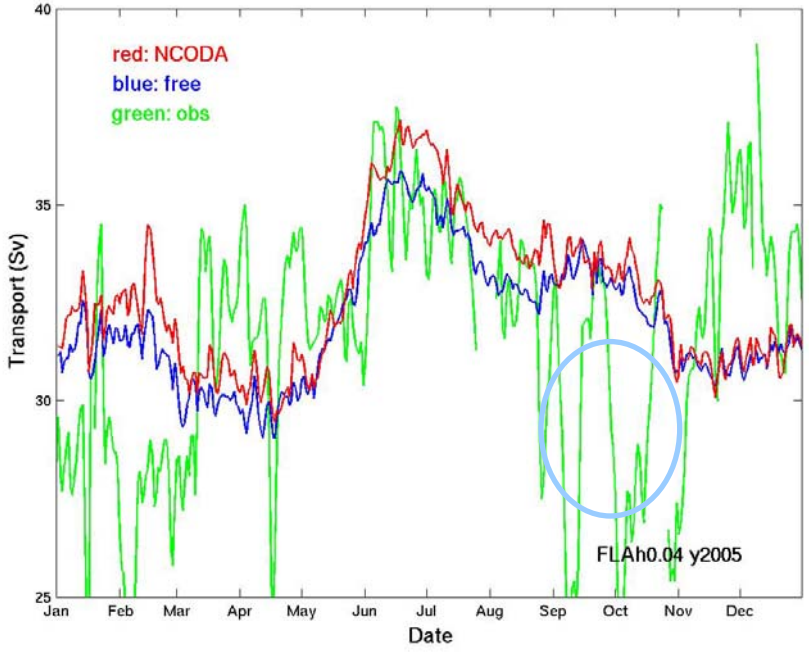
# Florida Current Transport

# Locations of the Cable and Model Sections



# SOFLA-HYCOM: FC Transport at 26.7N




Daily Mean 2004

Daily Mean 2005

## Statistic Characteristics: SoFLAh0.04

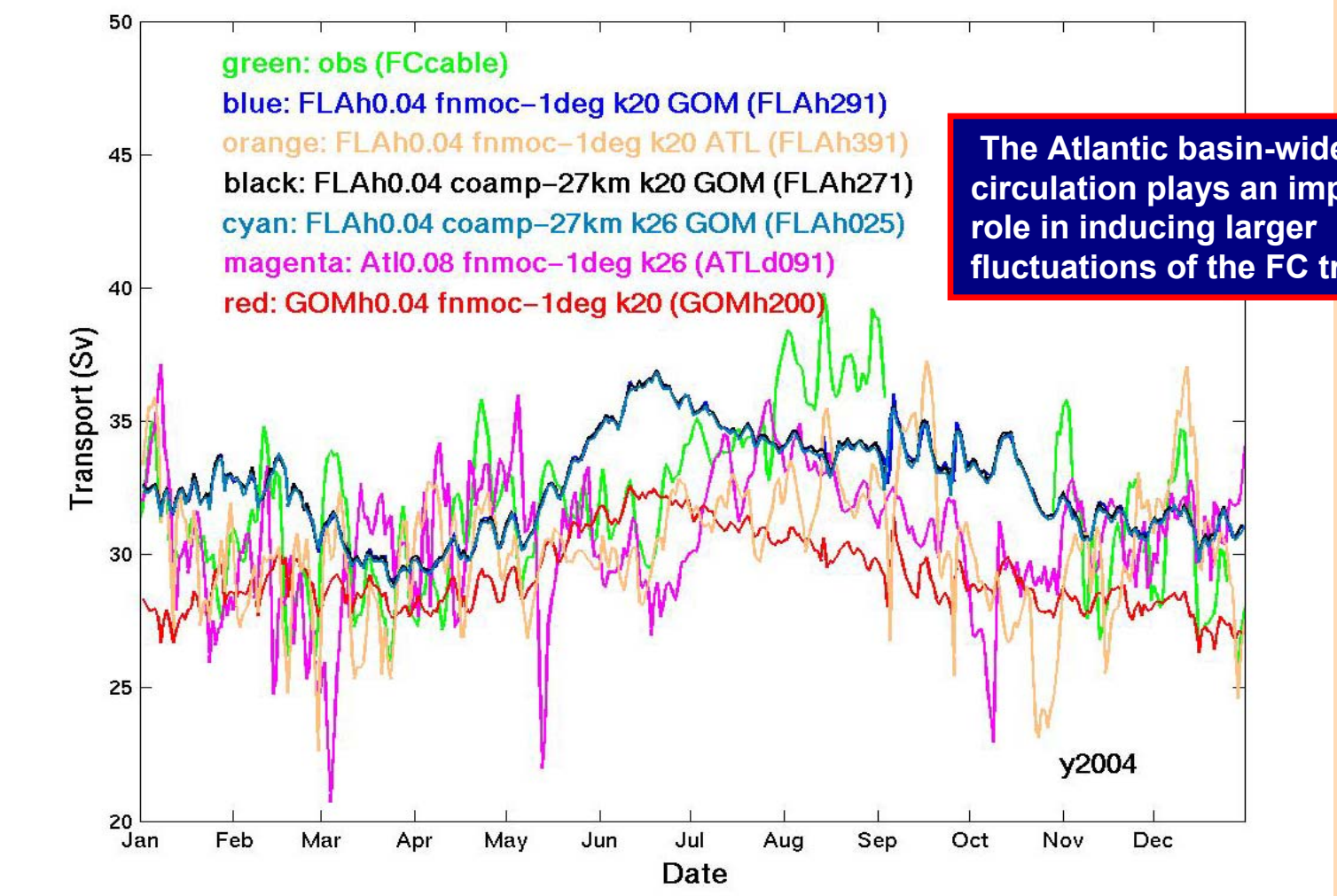
### Florida Current Transport: 2004 and 2005

| | 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

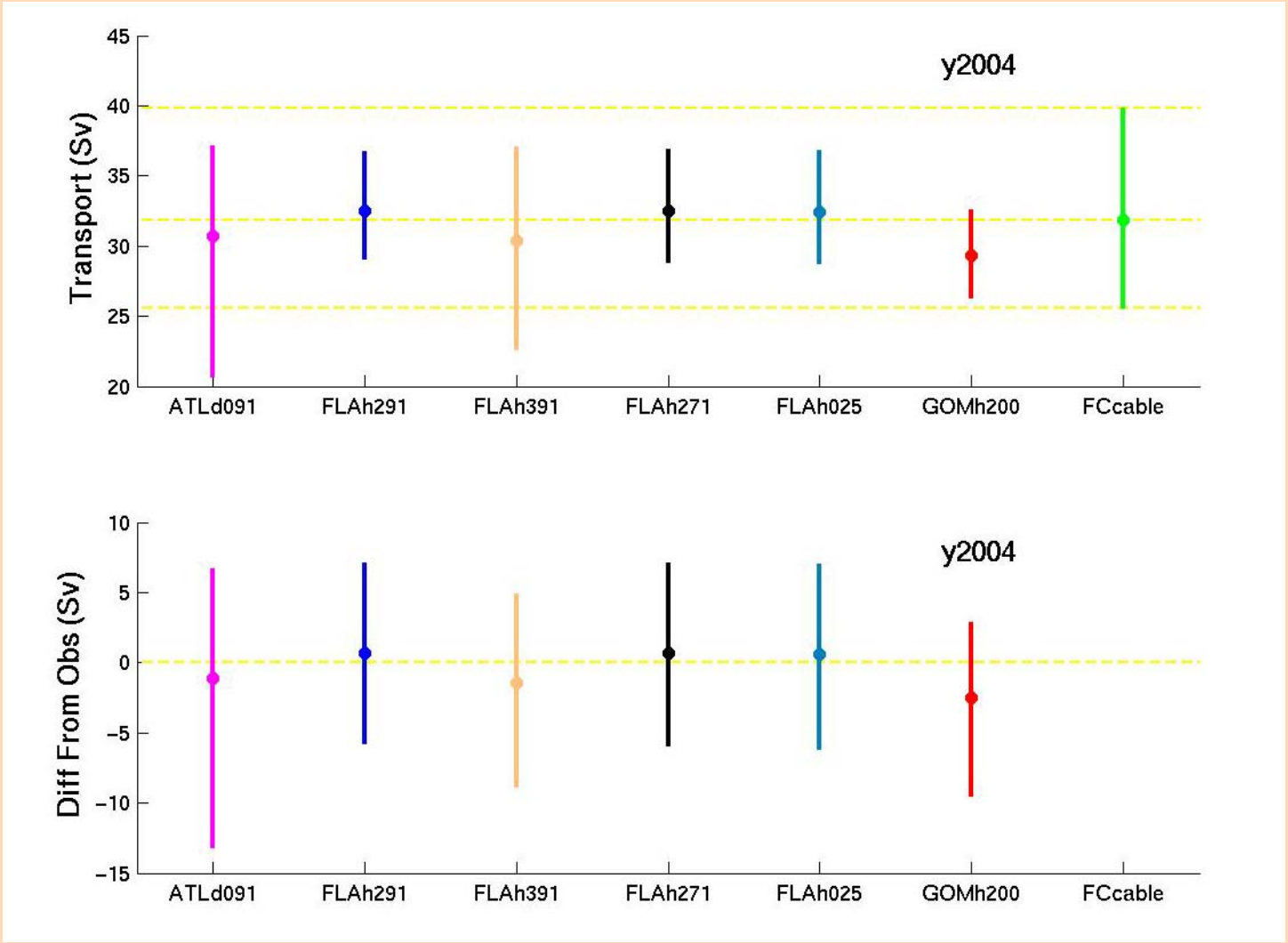



The Atlantic basin-wide circulation plays an important role in inducing larger fluctuations of the FC transport

FC transport at 27°N 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.*

# Cable and HYCOM: FC Transport at 26.7N Statistics



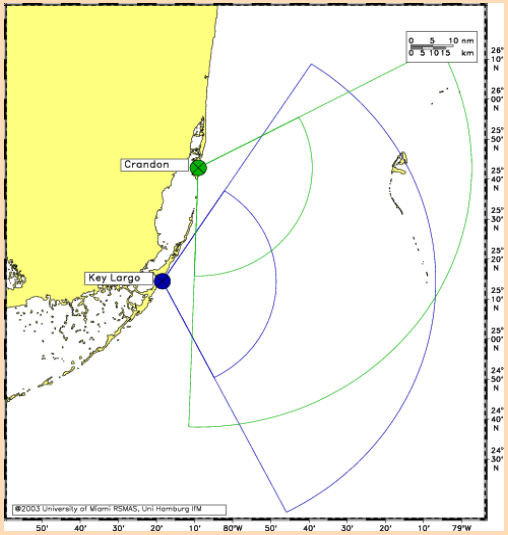

**The dots denote the means and the bars denote the range of values: from the minimum to maximum.**

# Future Work

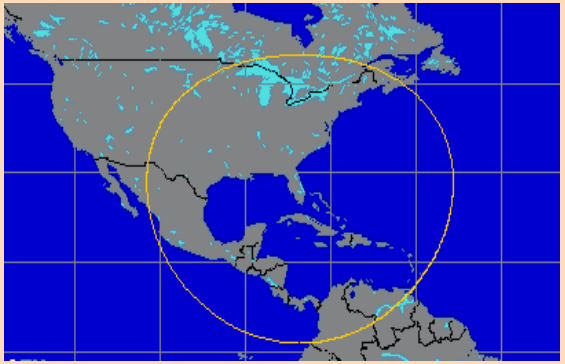
- Simulation nested in GoM with NAT BC's
- Tides
- Comparison to in-situ data
- Simulations in support of nested FKEYS and coupled BOLTS models

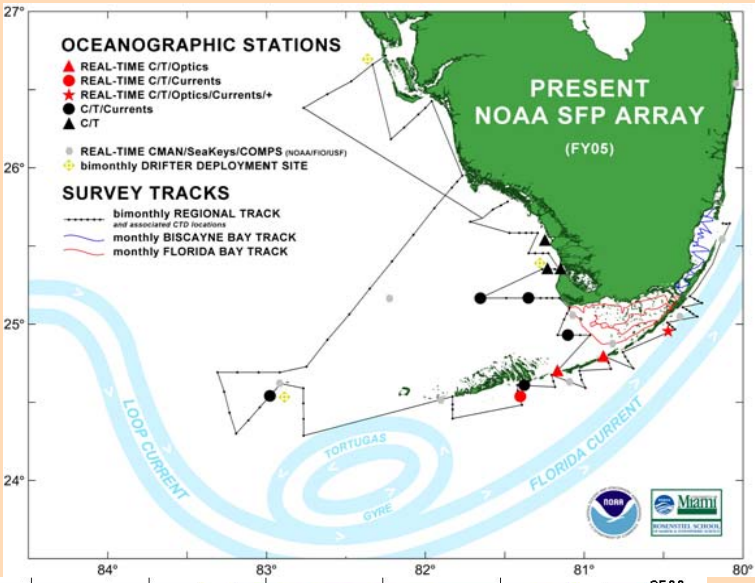
# Local Observational Data Coverage in the SoFLA Domain

## WERA coverage

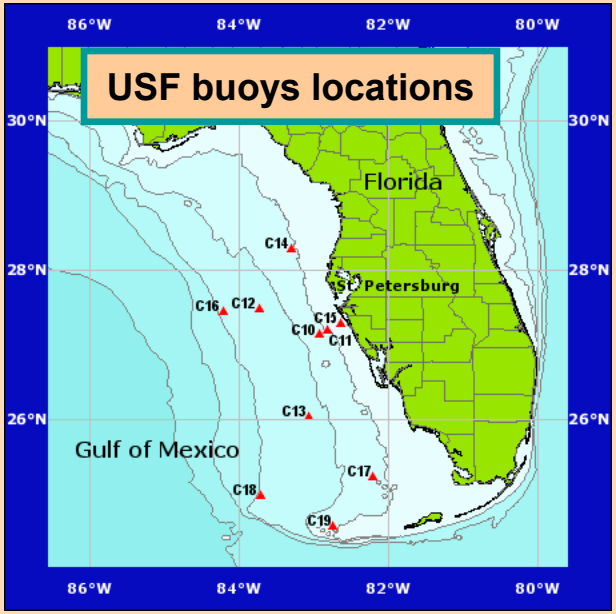



## CSTAR coverage






## 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