Modeling and in situ observations around the Florida Keys coral reefs: potential applications of coastal altimetry

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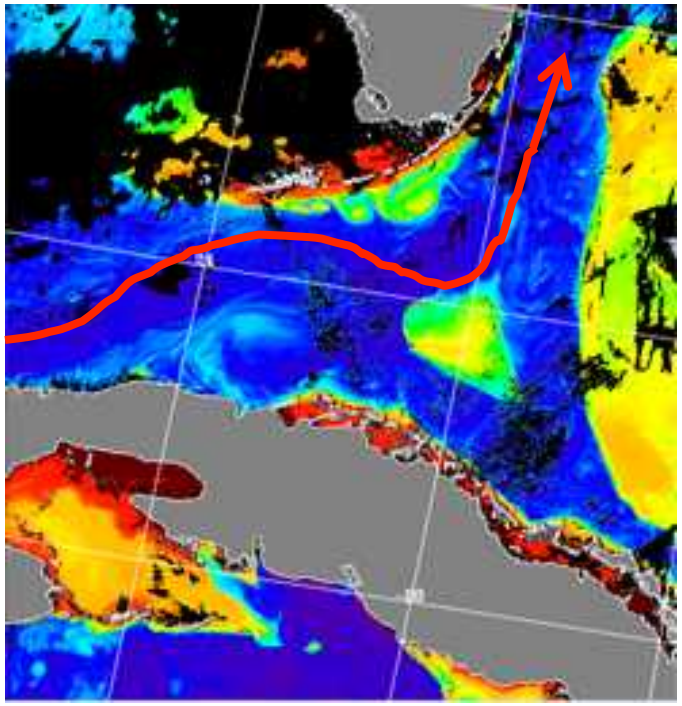
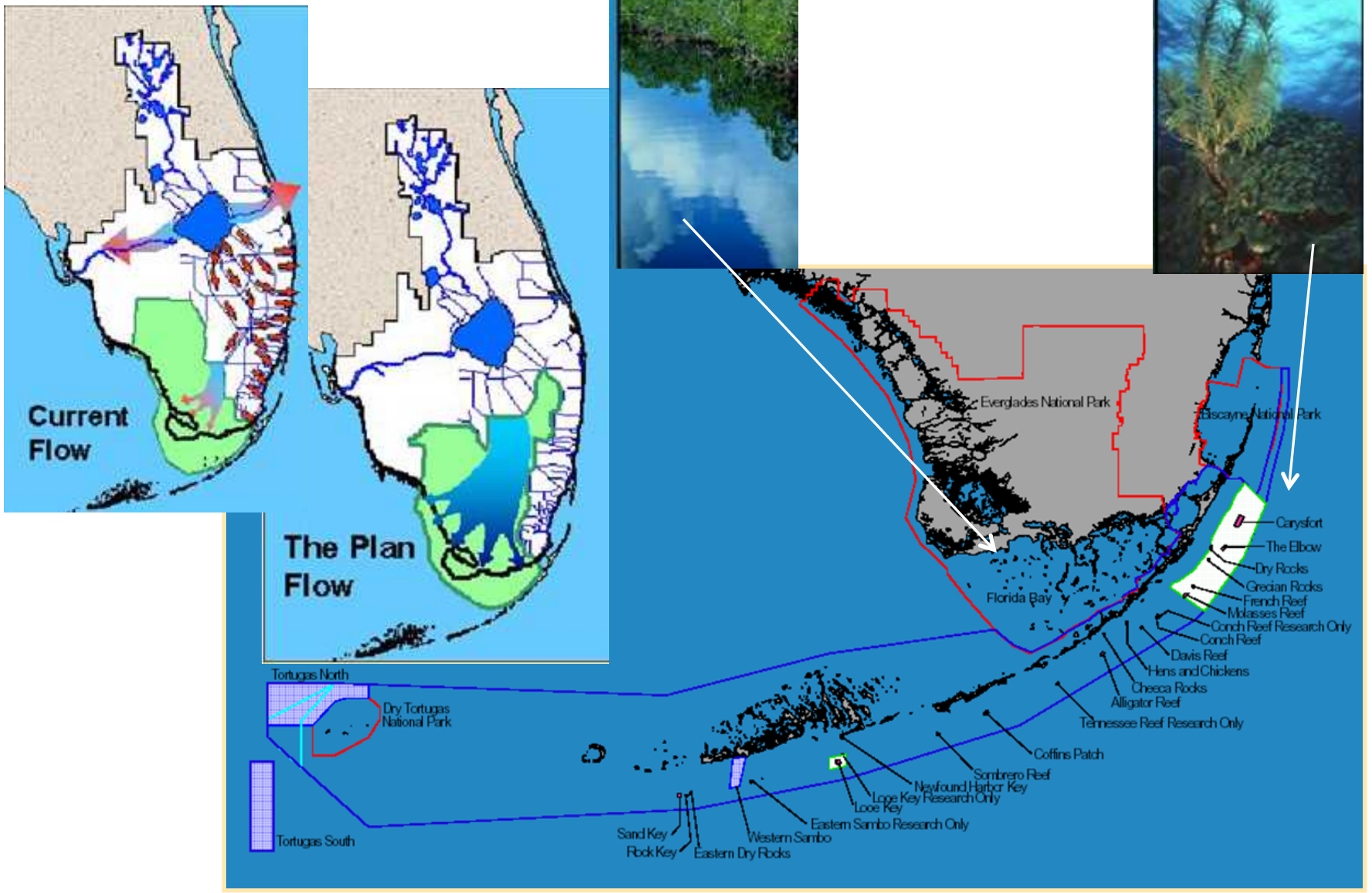


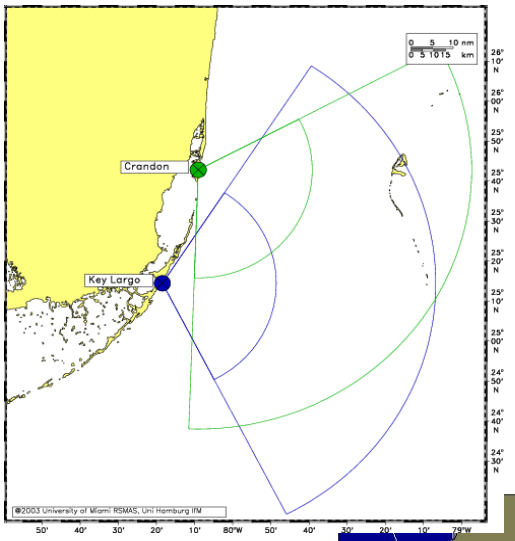
S. Florida coastal areas are subject to oceanic influence and hydrological changes

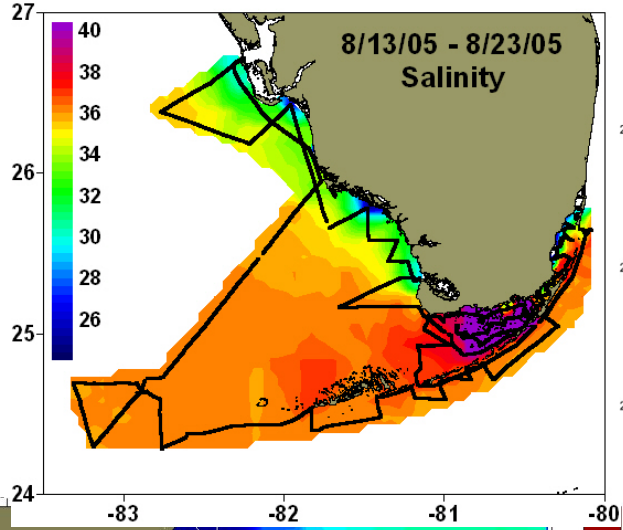


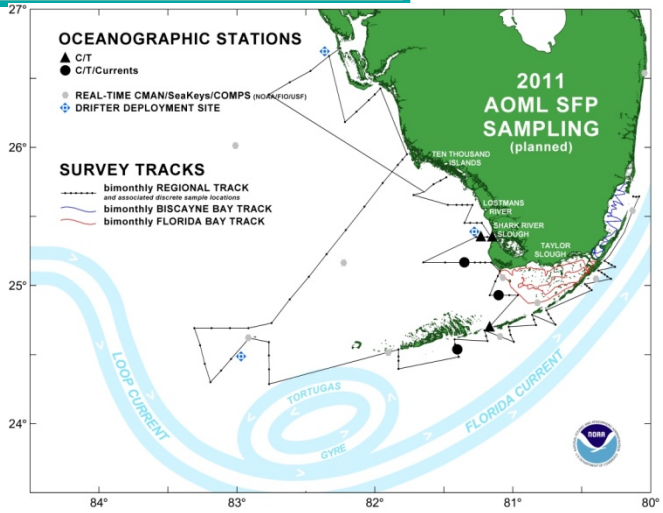
In-situ Data Coverage around the South Florida coastal seas

UM-RSMAS High freq. radar (WERA)

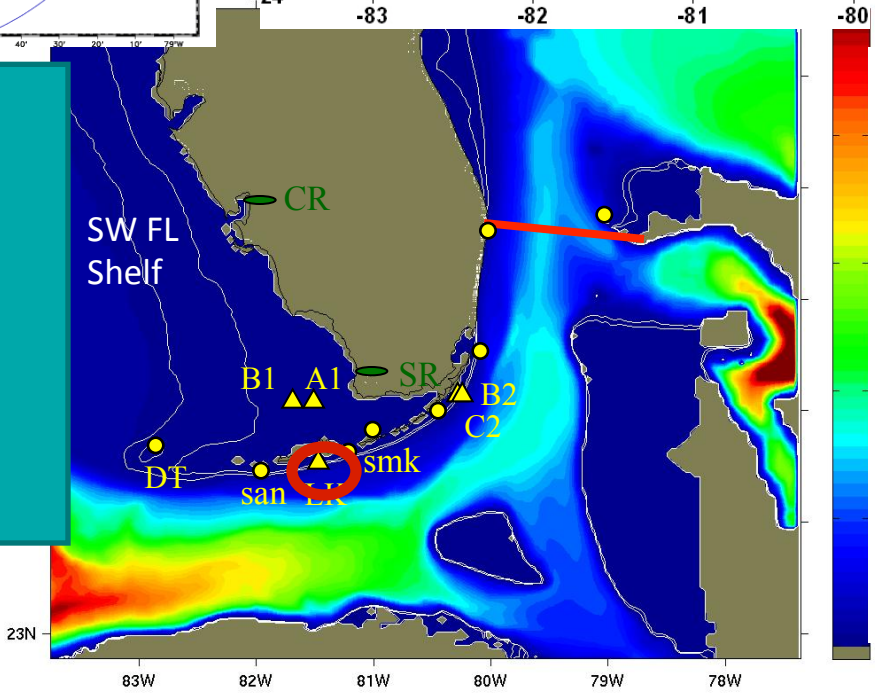
NOAA-AOML/UM-RSMAS monitoring

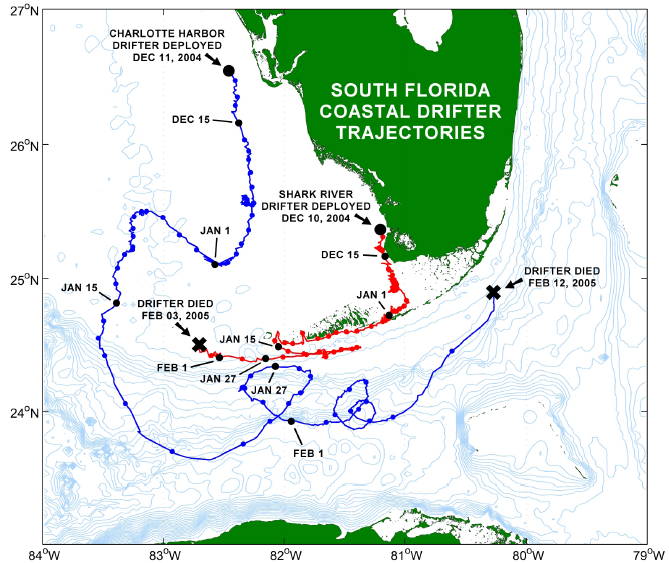






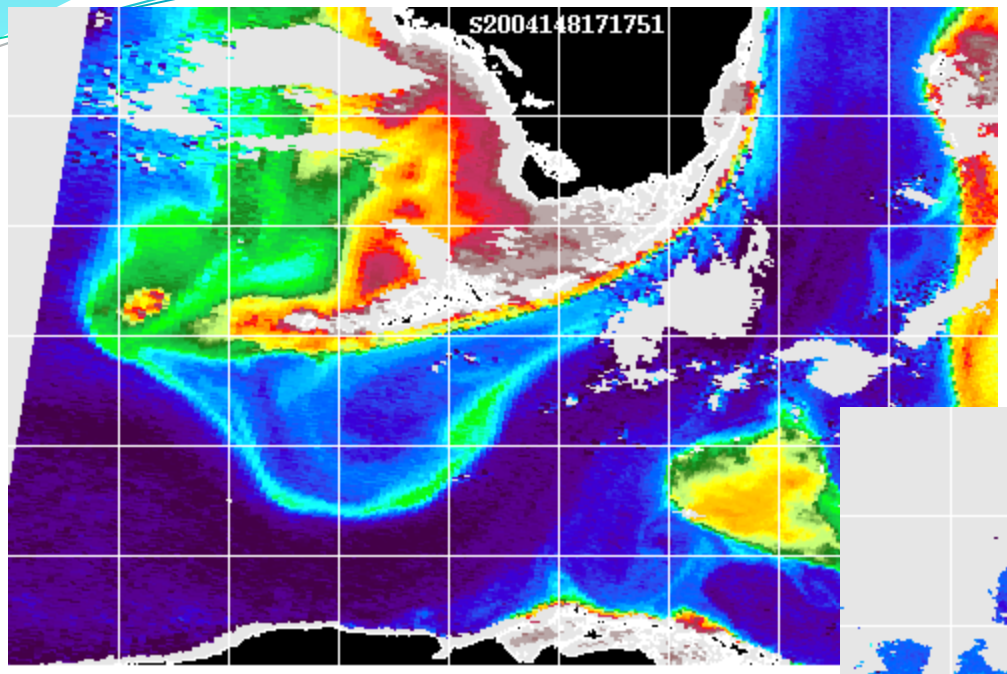
▲: moorings
●: c-man stations
DT: Dry Tortugas
LK: Looe Key
san: Sand Key
smk: Sombrero Key
SR: Sharker River
CR: Caloosahatchee River
▬: Cable

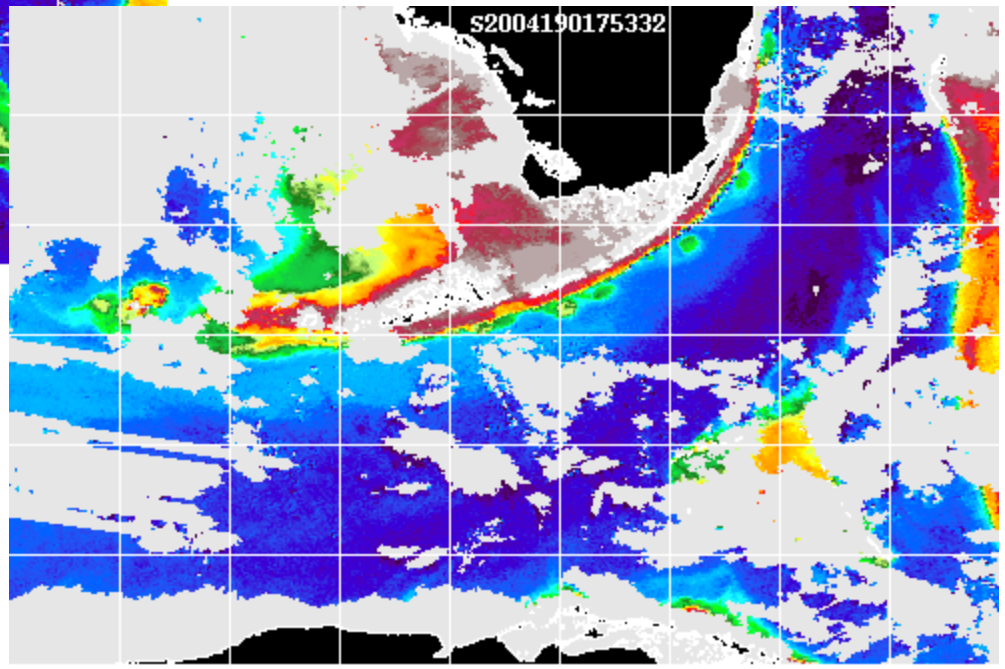




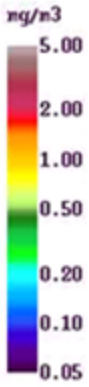
Ocean color data:

Mesoscale and submesoscale eddies along the Florida Keys

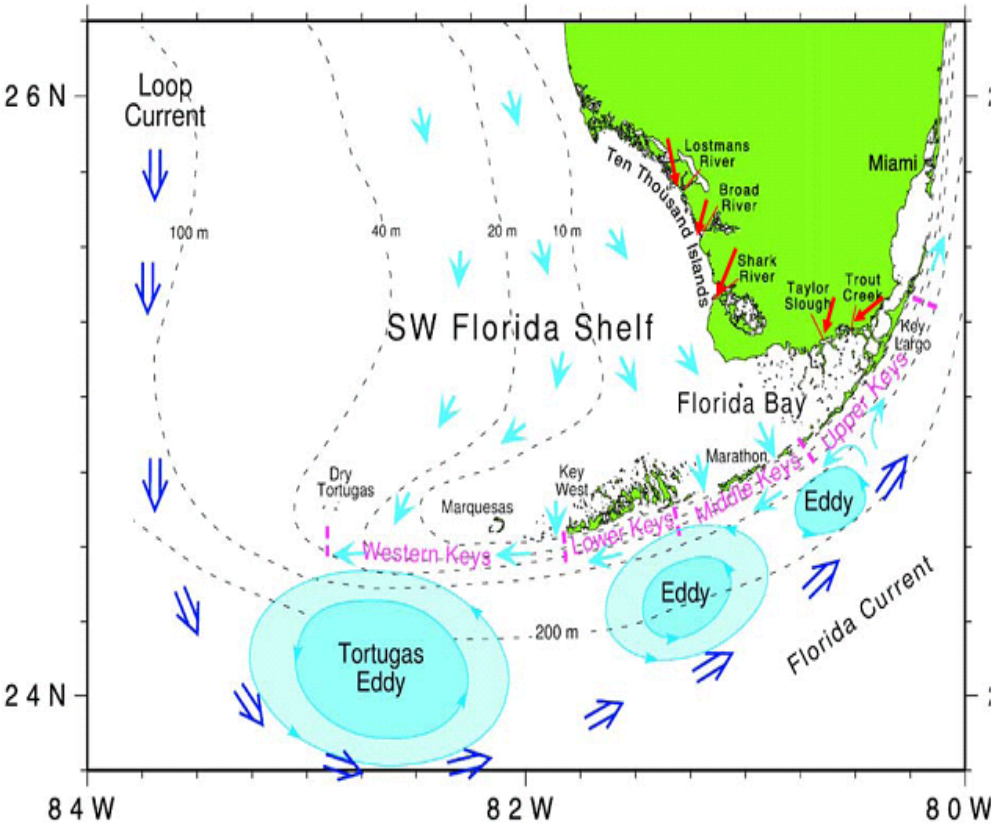




Provided by C. Hu (USF/IMARS)



Circulation highlights around South Florida



Adapted from Lee et al. (2002)

COMPLEX TOPOGRAPHY

- Broad SW Florida shelf
- Narrow Atlantic Florida Keys shelf
- Shallow Florida Bay
- Deep Straits of Florida

COMPLEX DYNAMICS

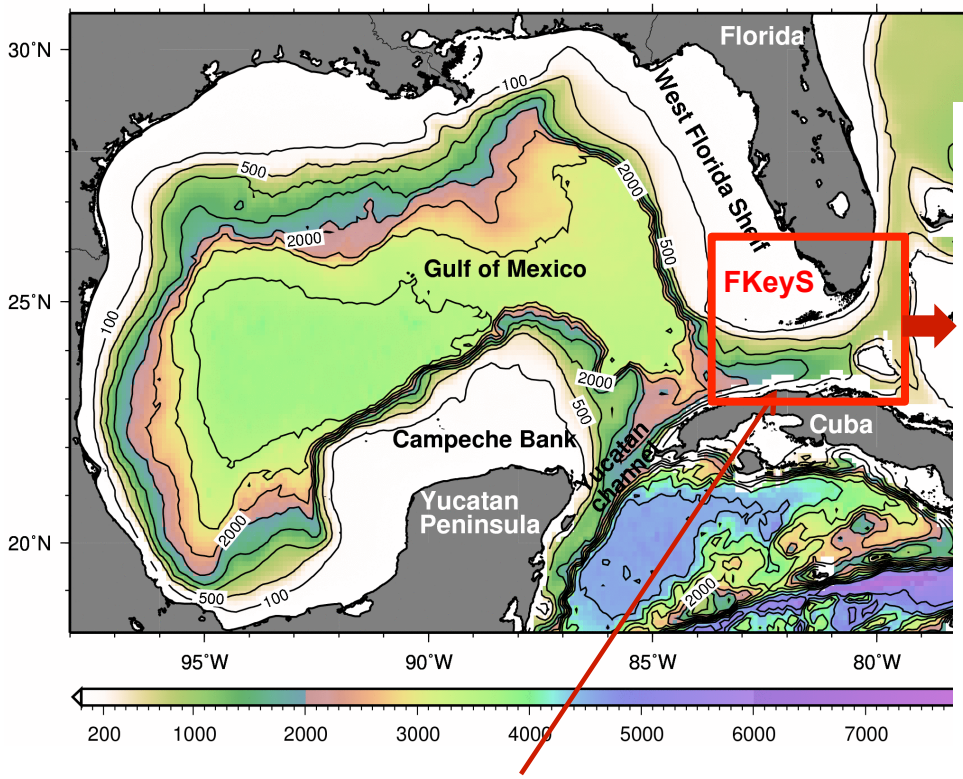
- Wind-driven shelf flows
- Buoyancy-driven shelf flows (river runoffs)
- Intense coastal to offshore interactions (Loop Current /Florida Current front and eddies)

Gulf of Mexico and South Florida numerical models

http://coastalmodeling.rsmas.miami.edu

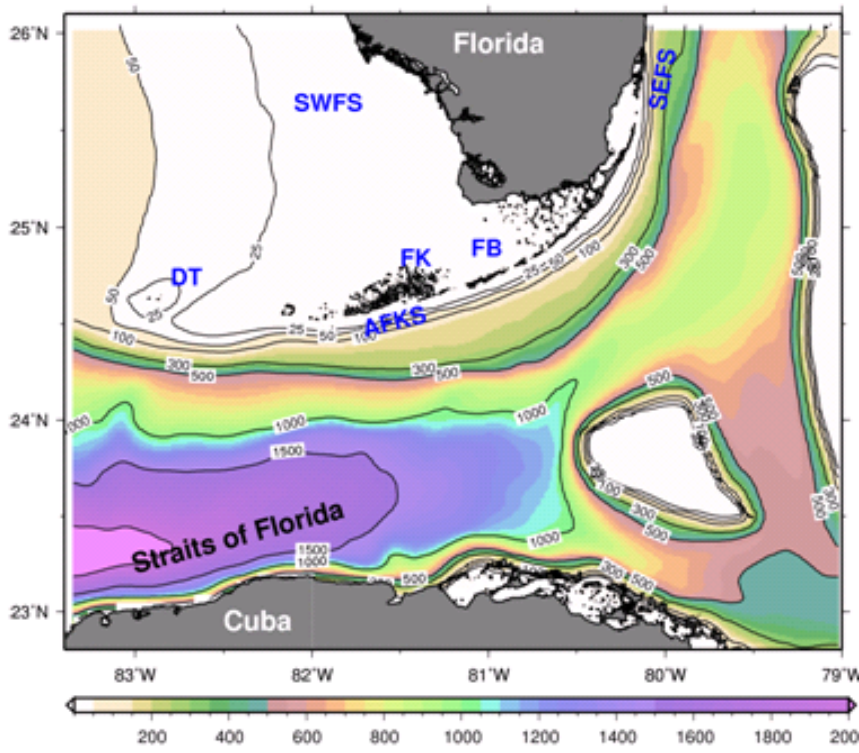
ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE

➢Prediction as a management tool



NESTED HIGH RESOLUTION MODEL
(now giving predictions in Real Time)

GULF OF MEXICO (GoM) HYCOM
➡Resolution ~ 3.6 km

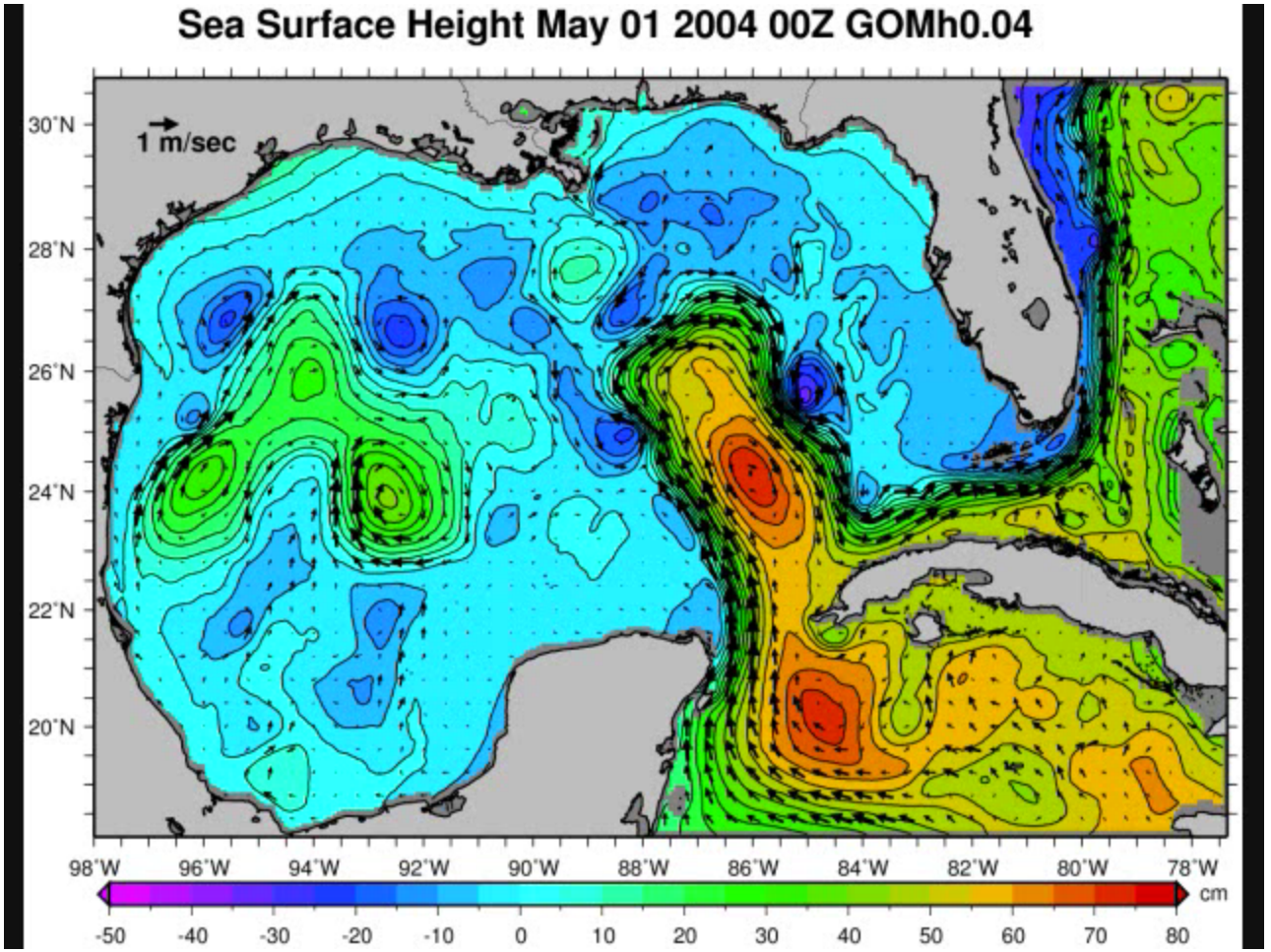


FLORIDA STRAITS , SOUTH FLORIDA and FLORIDA KEYS (FKeyS) - HYCOM

Resolution ~ 900 m

GoM-HYCOM 3.5 km simulations provided by P. Hogan and Ole-Martin Smedstad, NRL-SSC

Model animation of Sea Surface Height and Currents in the Gulf of Mexico

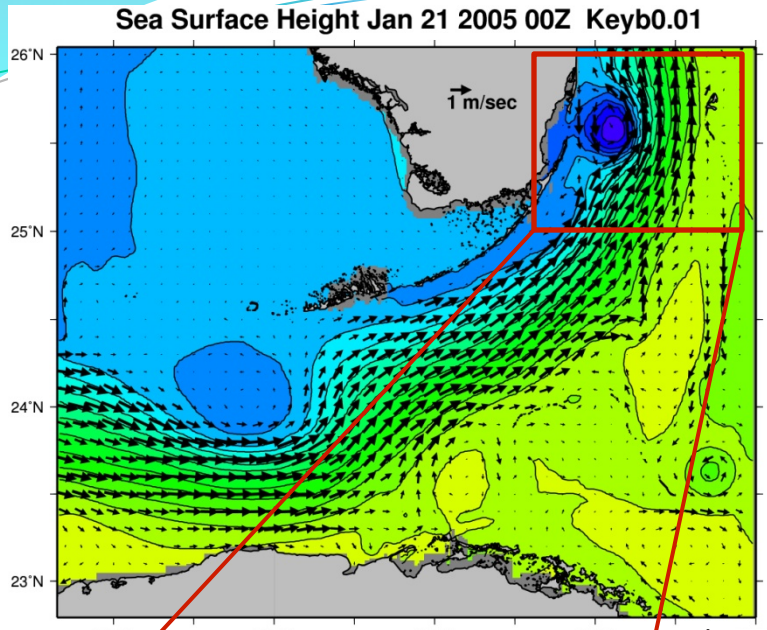


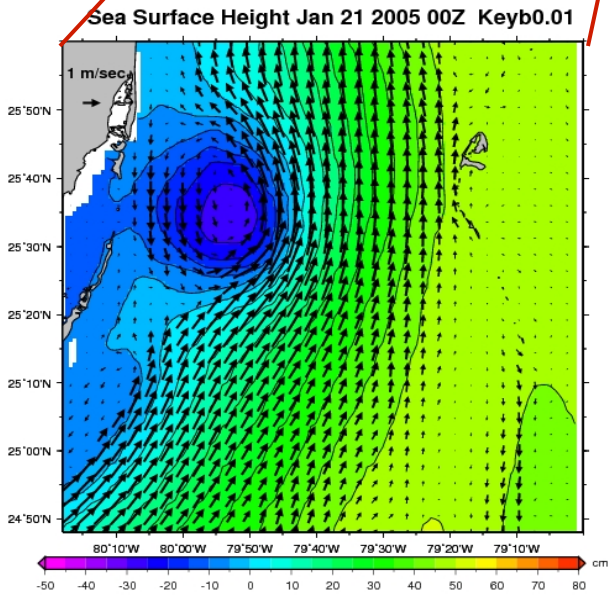
see external movie: GOMh0.04_expt_30.3_ssh_current_May04.wmv

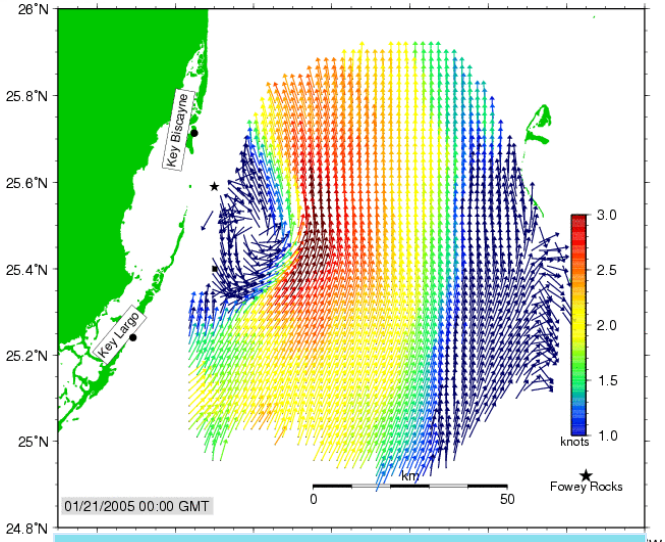
Evolution of eddies along the Florida Keys

- Synergy with the Florida Current meandering
- Implications for Gulf Stream evolution?

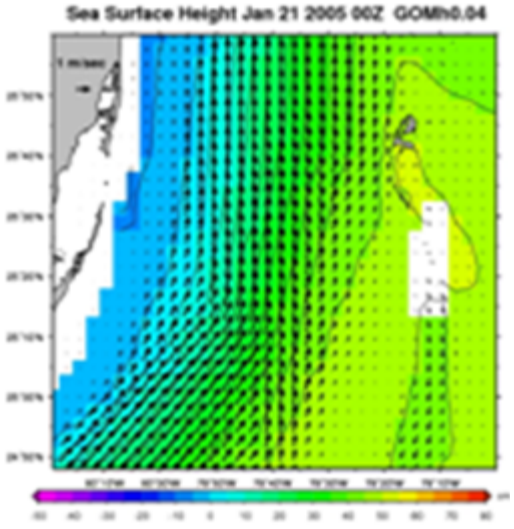
Jan 21, 2005





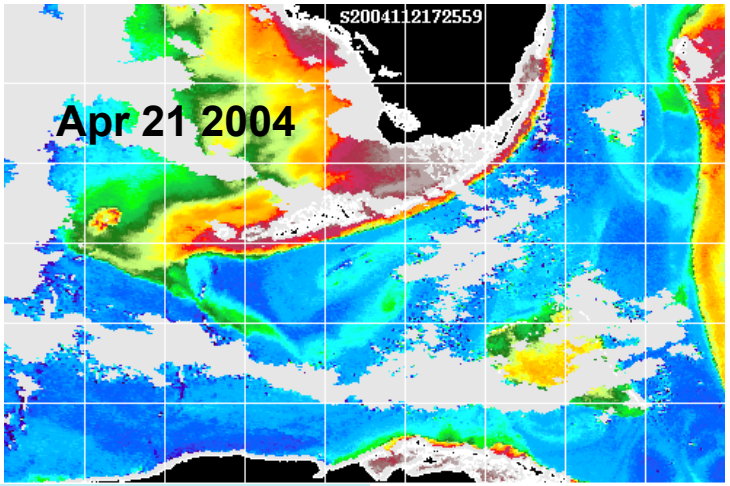


WERA data (N. Shay, RSMAS):

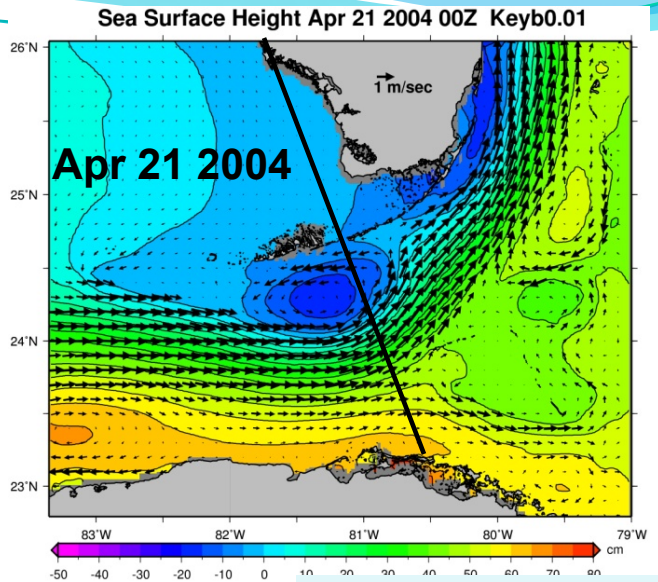


Regional GoM-HYCOM (eddy not resolved)

Influence of eddy properties on coastal circulation

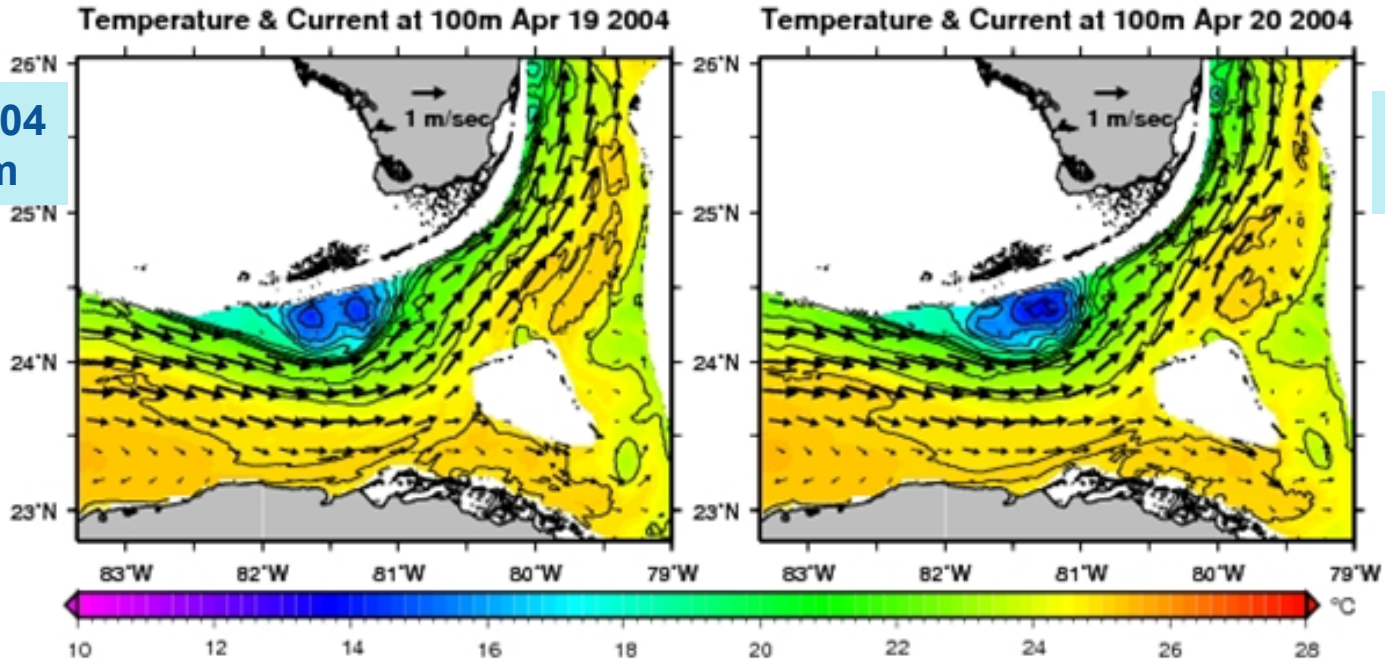


(provided by C. Hu, USF)



Kourafalou and Kang (2011)

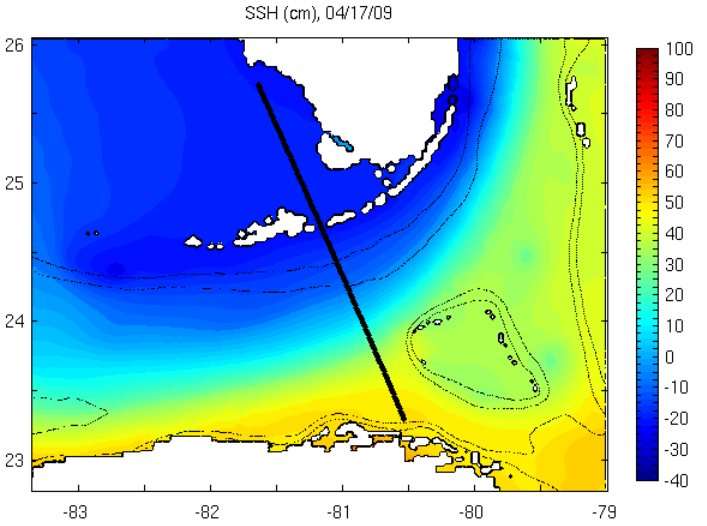
Apr 19 2004
T,V 100m



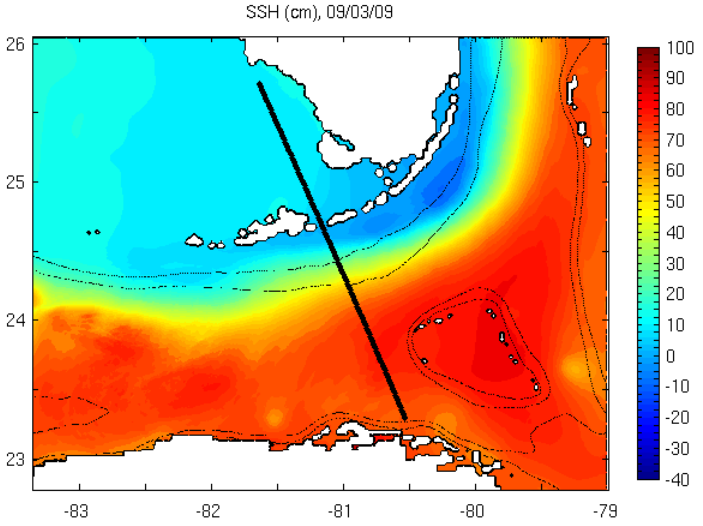
Apr 20 2004
T,V 100m

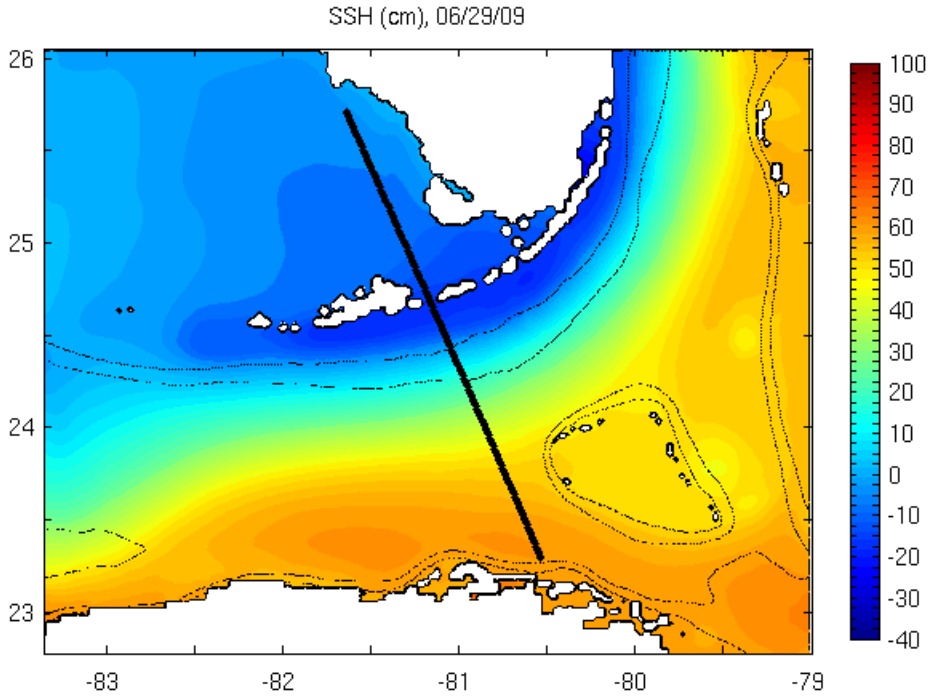
Eddy events within the Coastal Altimetry data set: 2009 study

APRIL 2009



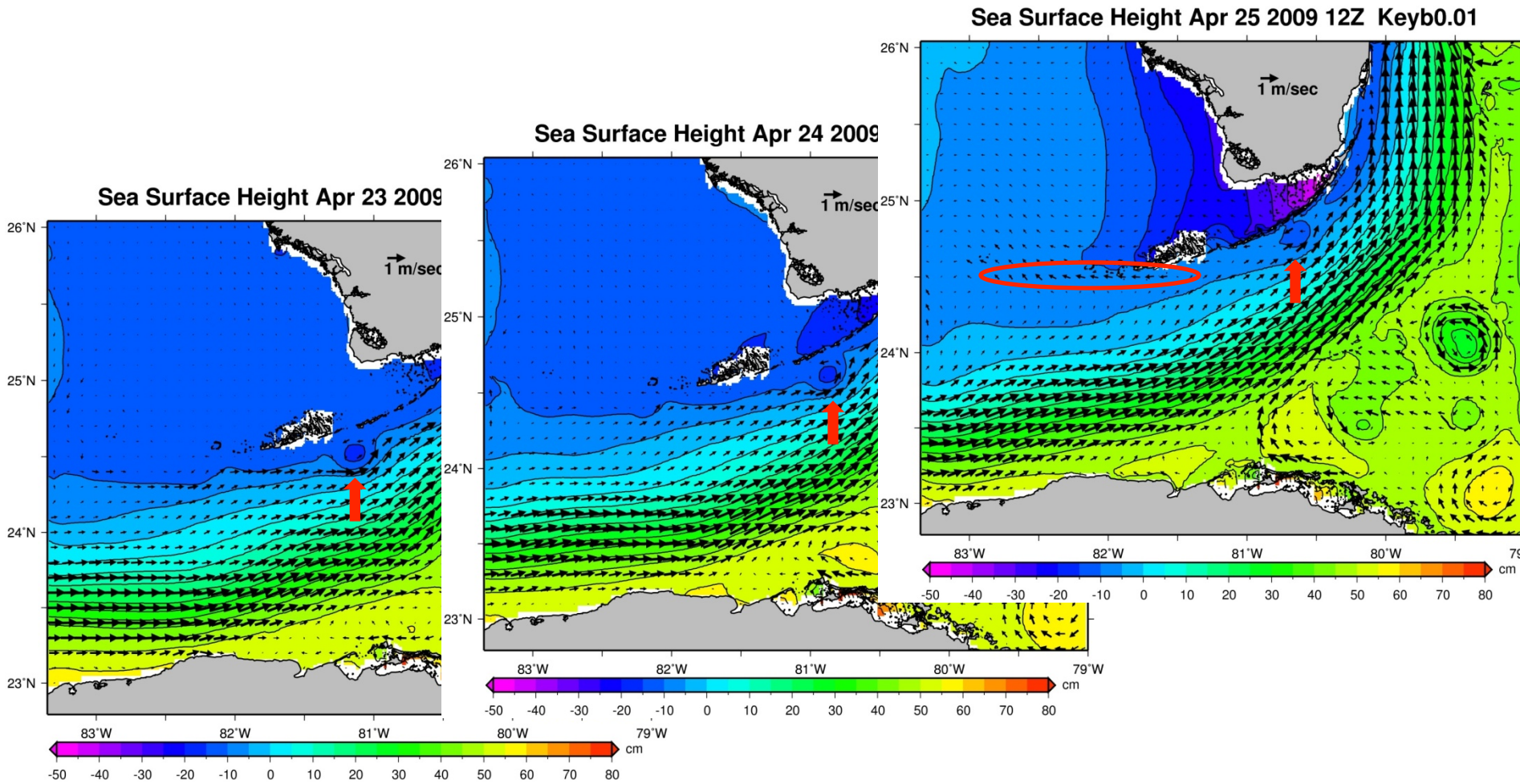
SEPTEMBER 2009



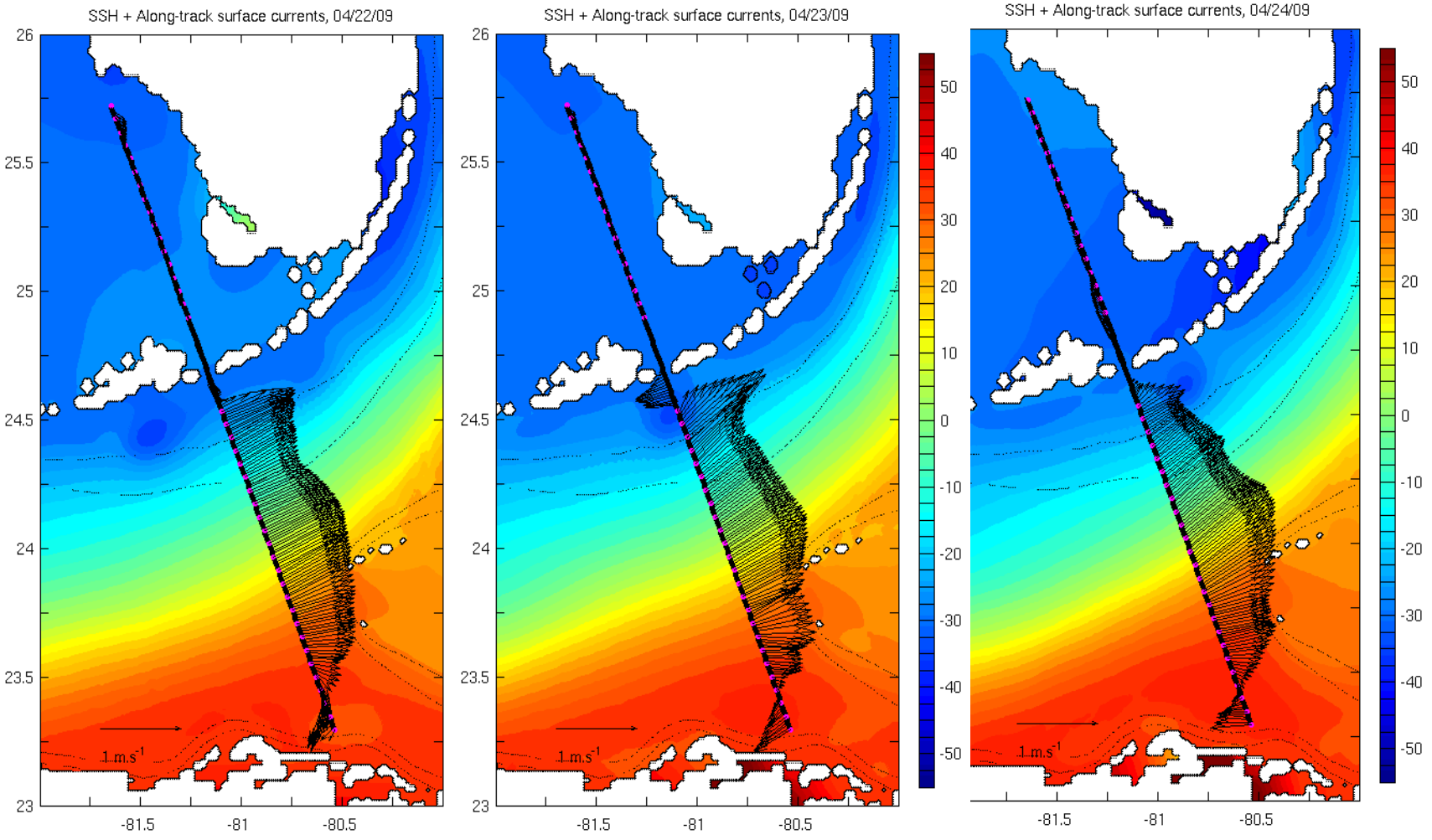


JULY-OCTOBER 2009

April 2009 eddy event: Sea Surface Height and near surface Currents



April 2009 eddy event: Sea Surface Height and along track sfc. Currents

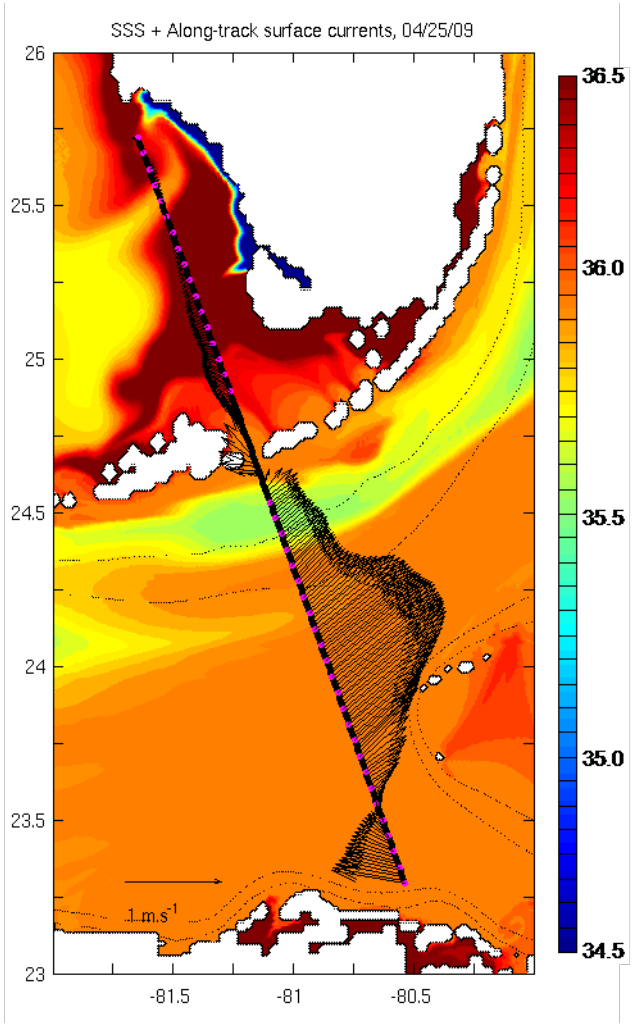


APRIL 22, 2009 | APRIL 23, 2009 | APRIL 24, 2009

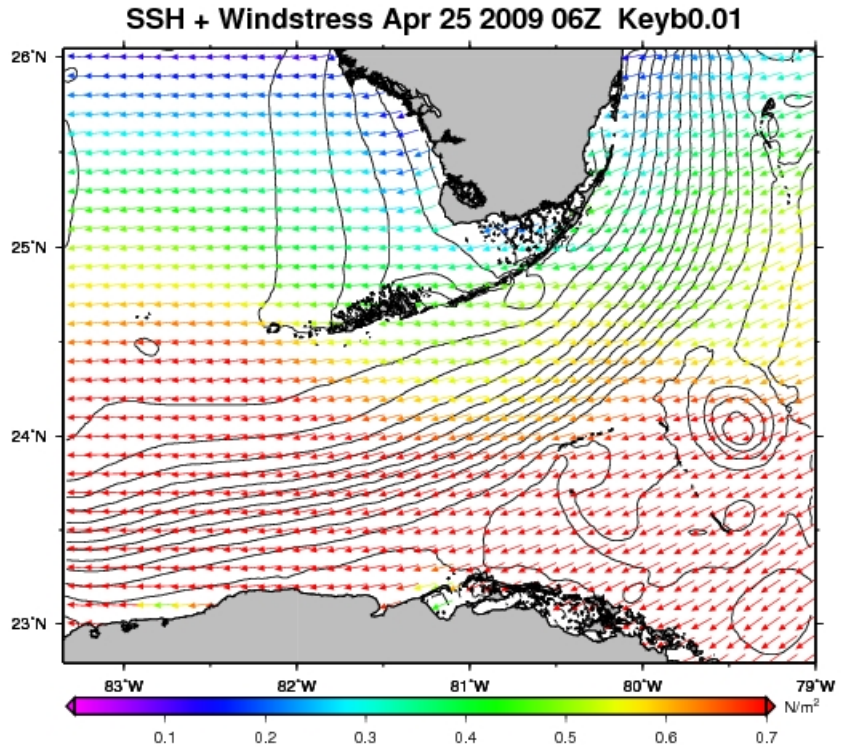
➢ *FKeyS-HYCOM model currents projected on track #243*
(not altimetry derived currents)

April 2009 eddy event: wind induced coastal transport

Sea Surface Salinity and along track sfc. Currents



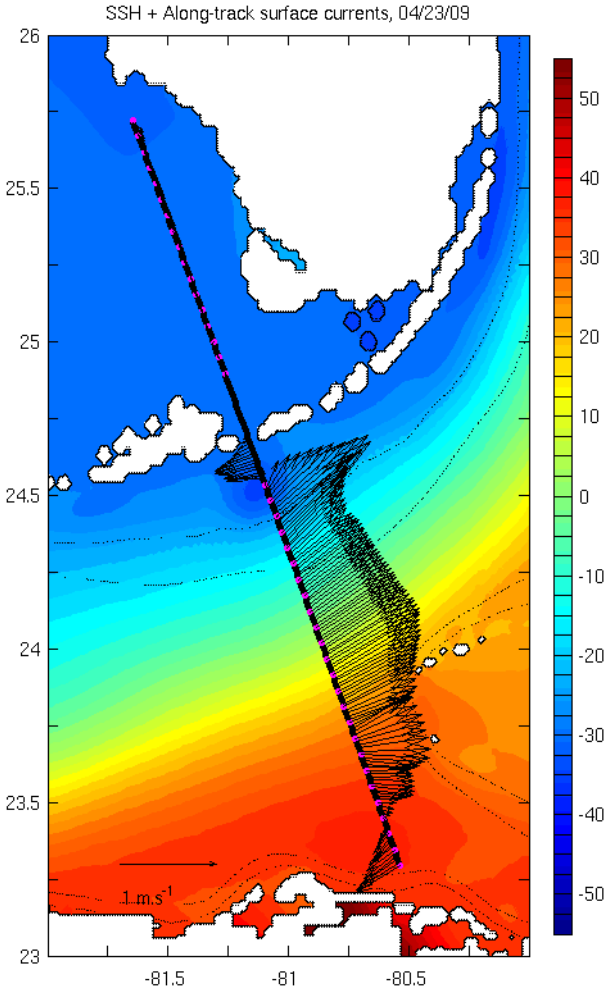
Sea Surface Height and Wind Stress



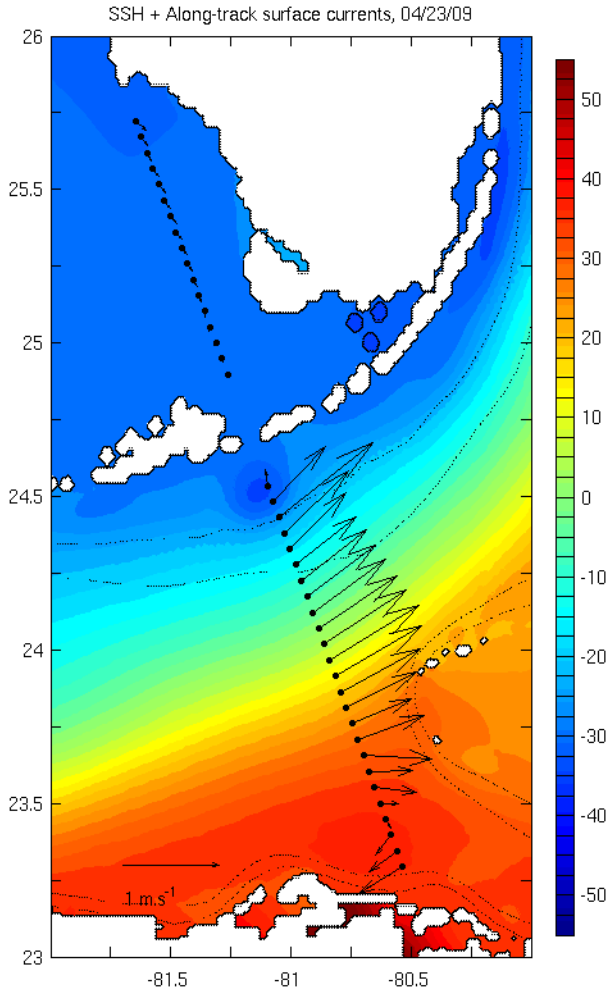
APRIL 25, 2009

Influence of resolution between Altimetry data sets

Coastal Altimetry data points



Standard Altimetry data points



Concluding remarks

The coastal seas around South Florida exhibit a topographically and dynamically complex environment that encompasses ecologically fragile, economically important coastal ecosystems, subject to anthropogenic influence and intense natural variability

Recent development of high resolution regional/nested models in the Gulf of Mexico and the Florida Straits has allowed unprecedented details in the evolution of the eddy field and the synergy with the meandering of the Florida Current

Coastal altimetry data for model evaluation/assimilation are a very promising tool in capturing details in mesoscale dynamics not permitted through standard altimetry.

Combining novel satellite products with available long term in situ data and high resolution modeling has the potential of a) improving the understanding of coastal to offshore interactions and the role of oceanic/rim currents on the connectivity of remote coastal ecosystems; b) advancing biogeochemical connectivity studies and guiding socioeconomic and policy issues related to local and regional ecosystem management

Oceanography before, and after, the advent of satellites

Walter Munk
Scripps Institution of Oceanography, La Jolla, California

Key note address, EXPO '98 ocean pavillon

If I were to choose a single phrase to characterize the first century of modern oceanography, it would be "a century of undersampling." The most profound effect of satellite oceanography has not been the resulting new sensor packages (and these have been remarkable), nor the global coverage, but rather that for the first time ocean processes were adequately sampled.

In the early 1970s, when the first oceanographic satellite—SeaSat—was being planned, we were living under the axiom that what is not done from ships is not oceanography. Upon hearing that satellite altimeters would measure dynamic heights, a well-known oceanographer replied, "If you gave it to me I wouldn't know what to do with it." Satellite altimetry is now an outstanding success story. Its contribution towards understanding ocean processes goes well beyond anything that had been imagined.

But even so, there is much value added by combining the space observations with "sea truth."

"Comparing In Situ Current Data with Current Anomalies Derived from the PISTACH Products: the Loop Current Case"
By Mathilde Cancet (Tue. 8:30 am)