

# **Ocean Currents of the Eastern Gulf of Mexico**

**Robert H. Weisberg**

*Distinguished University Professor  
Professor of Physical Oceanography  
College of Marine Science  
University of South Florida*

*and*

**Lianyuan Zheng and Yonggang Liu**

**TBRPC Meeting  
October 12, 2009**

# **Physical Oceanography**

**The study of the ocean circulation, how the water moves and how the ocean and atmosphere interact.**

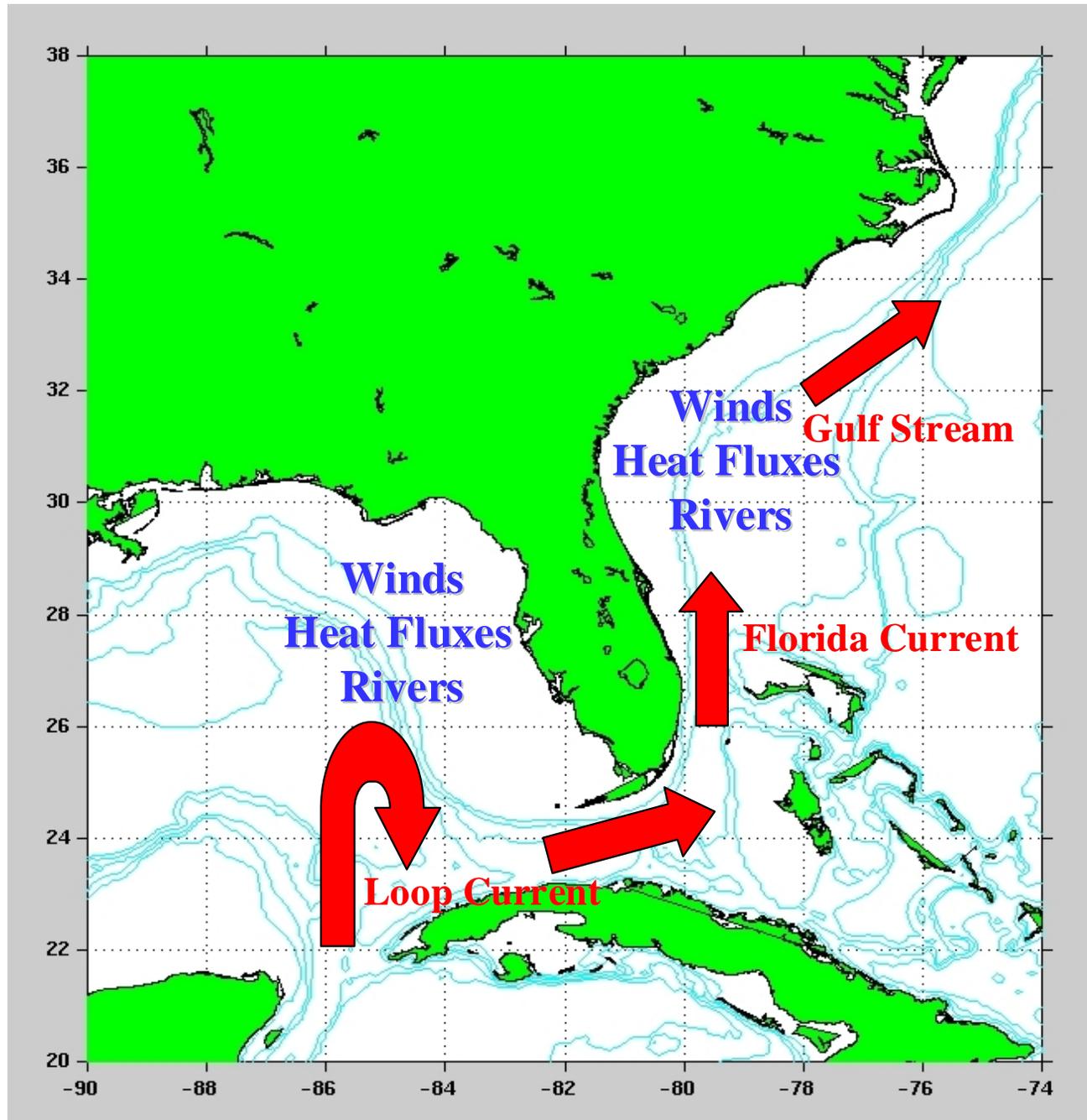
## **Large-scale, Deep-Ocean Circulation**

**The Gulf of Mexico Loop Current, Florida Current, Gulf Stream system.**

## **West Florida Continental Shelf Circulation**

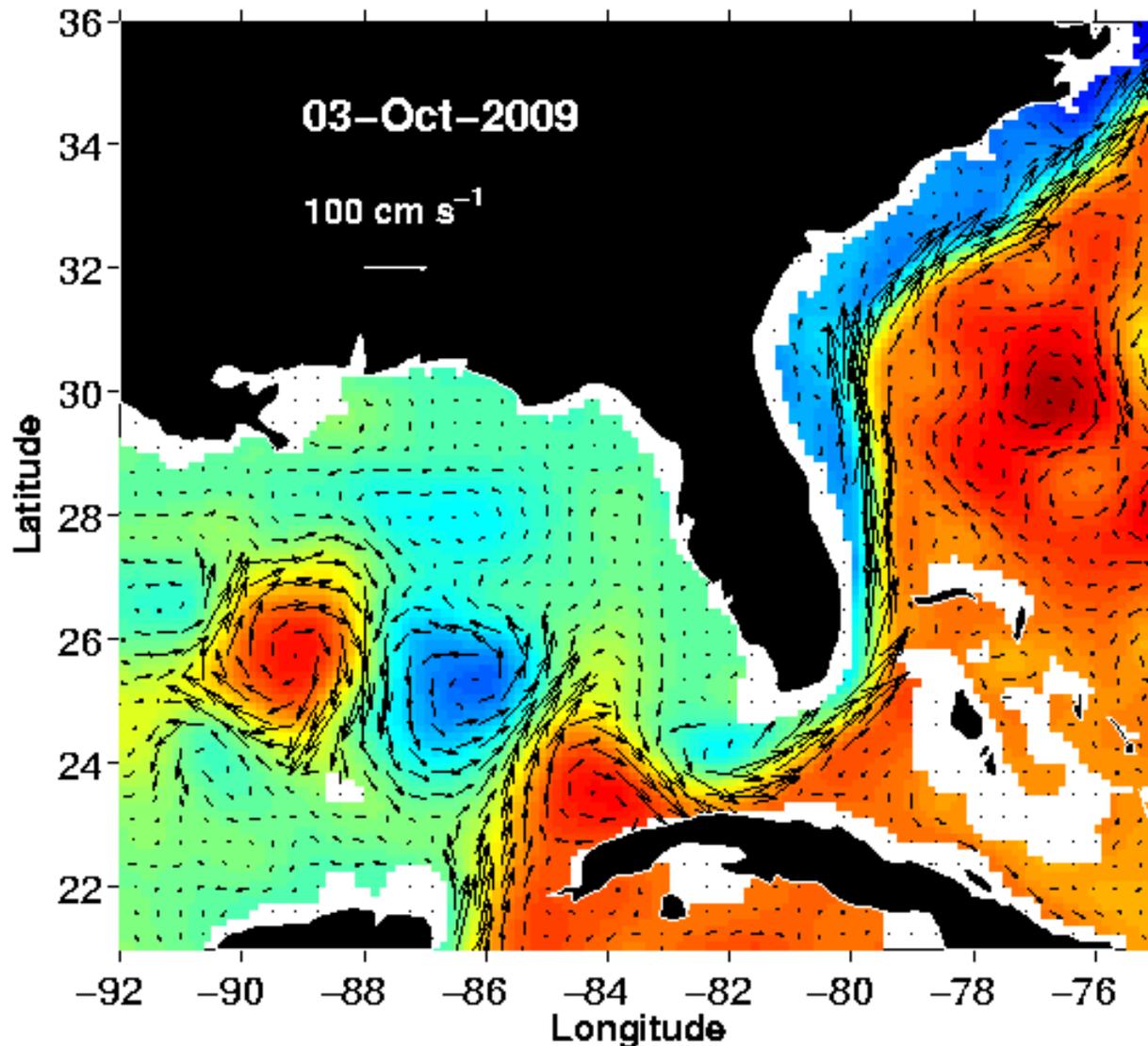
**The local, shallow water circulation driven by winds and surface heating/cooling.**

# The large-scale, deep-ocean circulation (red arrows) around Florida.



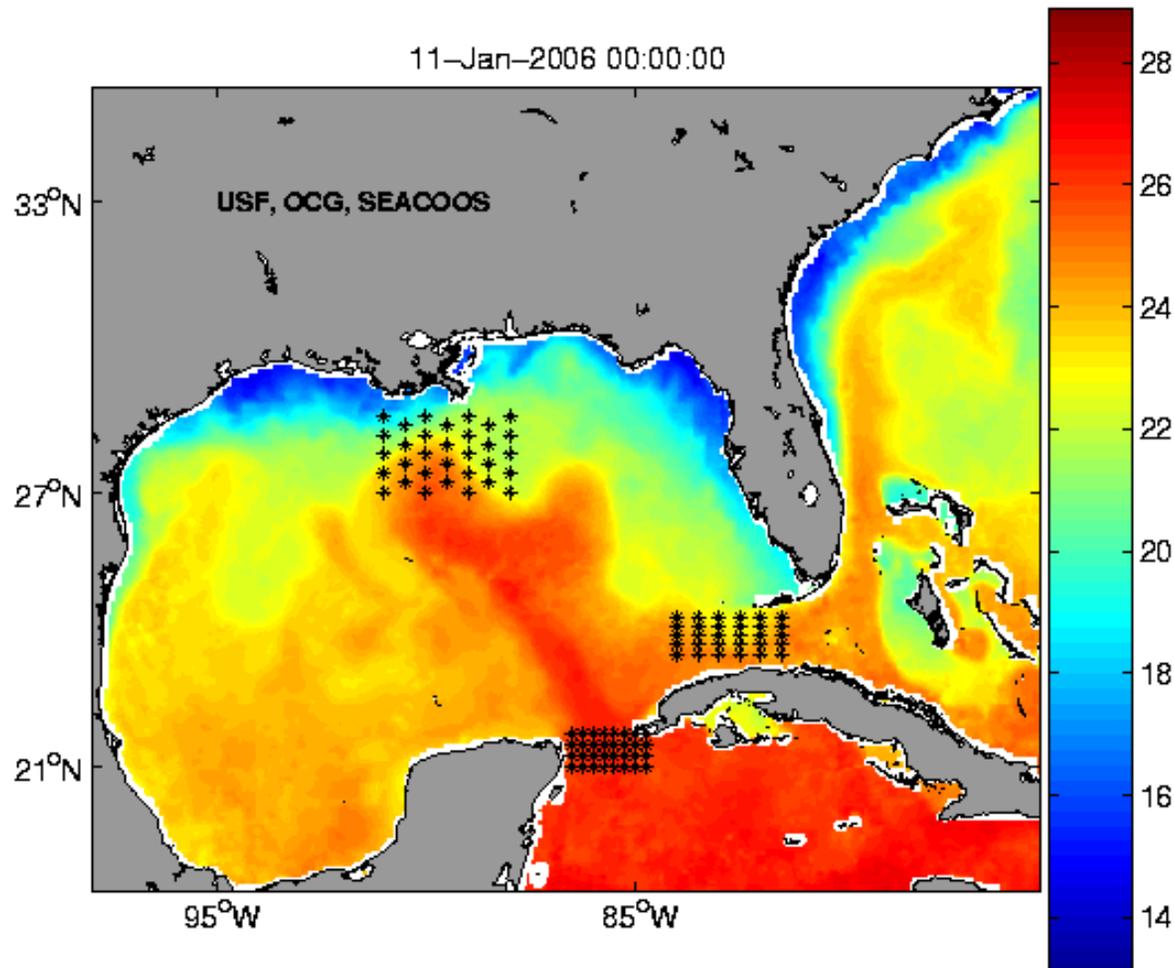
# Sea surface currents (arrows) superimposed on sea surface height (with **red** indicating high and **blue** low).

The height is obtained by satellite altimetry, and the currents are calculated using the geostrophic approximation, wherein the currents tend to flow along lines of constant pressure (height).

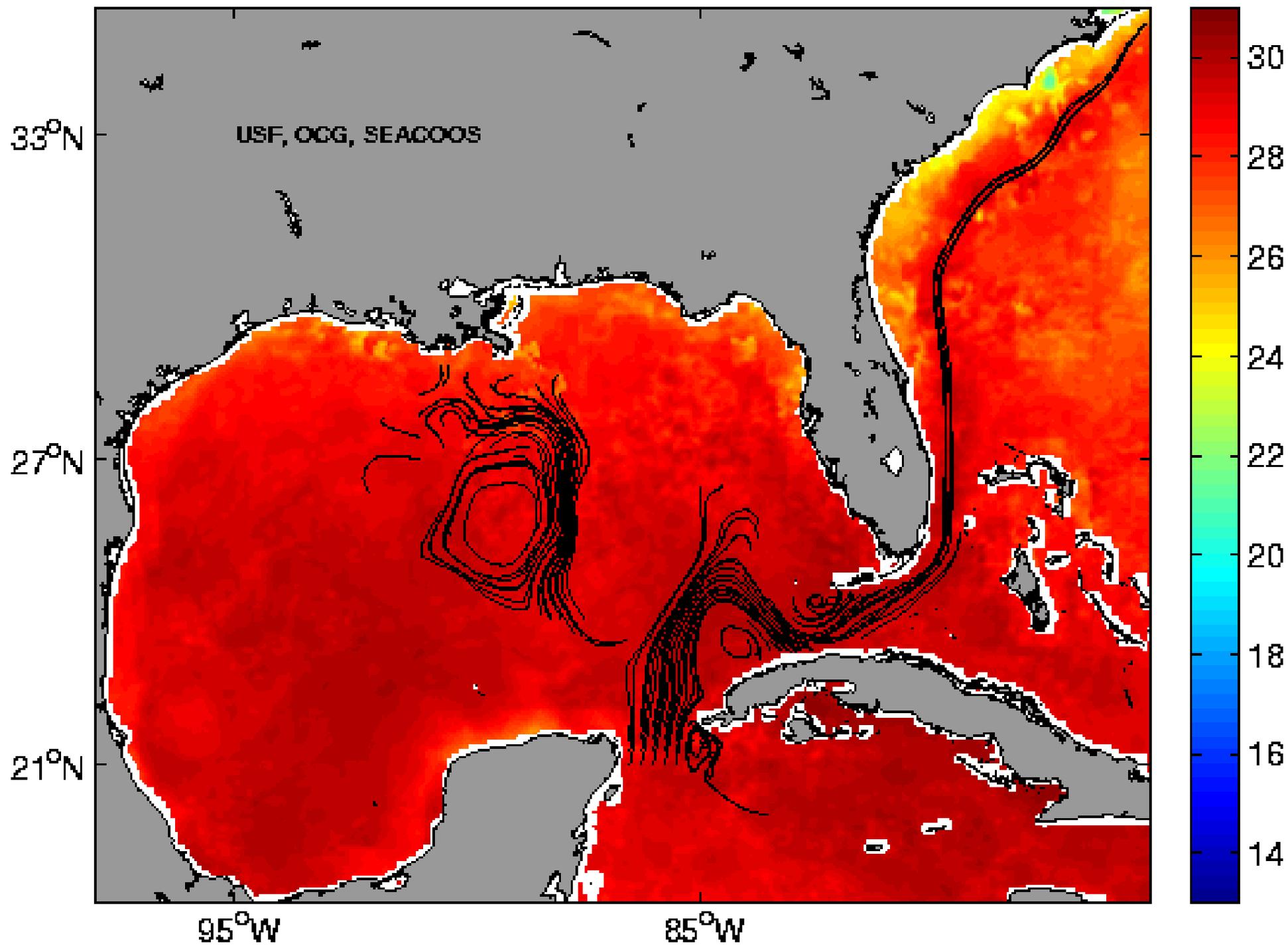


# Particle Trajectories for Multiple Launch Sites Superimposed on a Sea Surface Temperature Analysis

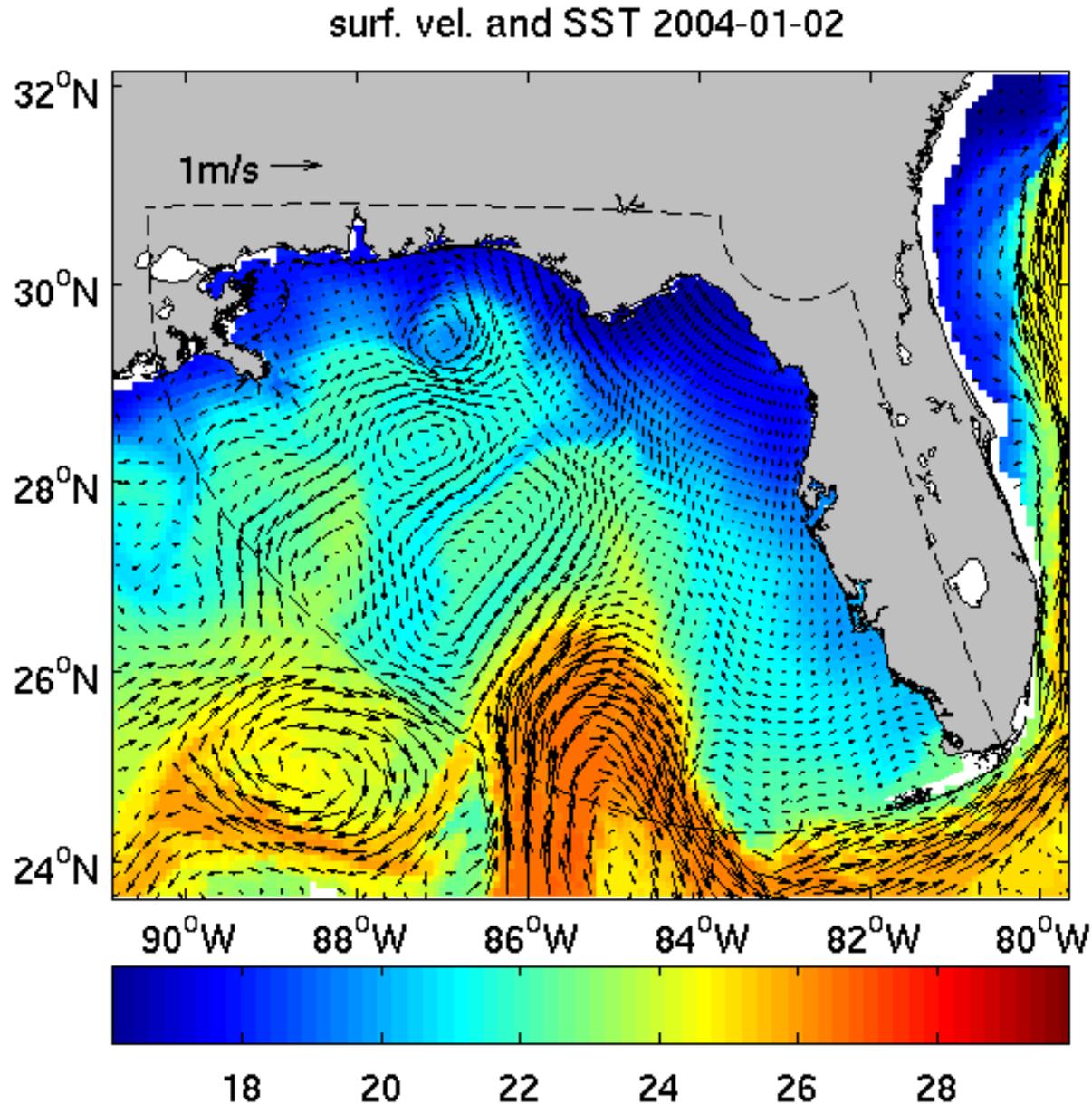
A one week hindcast and a one week forecast are updated weekly, in this case for 1/11-1/25/06 and calculated on 1/18/06. We use geostrophic currents analyzed from SSH integrated in time and apace.



10-Oct-2009 12:00:00

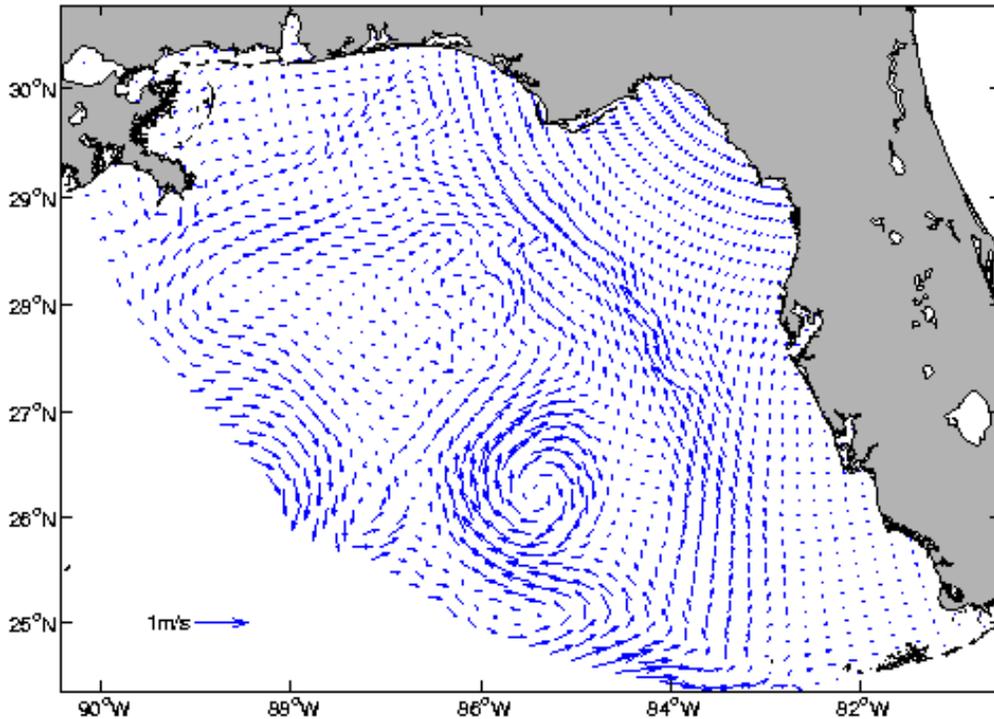


**Model simulation of the eastern GofM circulation driven by both the LC/FC/GS system and local winds and heat flux.  
Shown are surface  $\underline{V}$  superimposed on SST.**

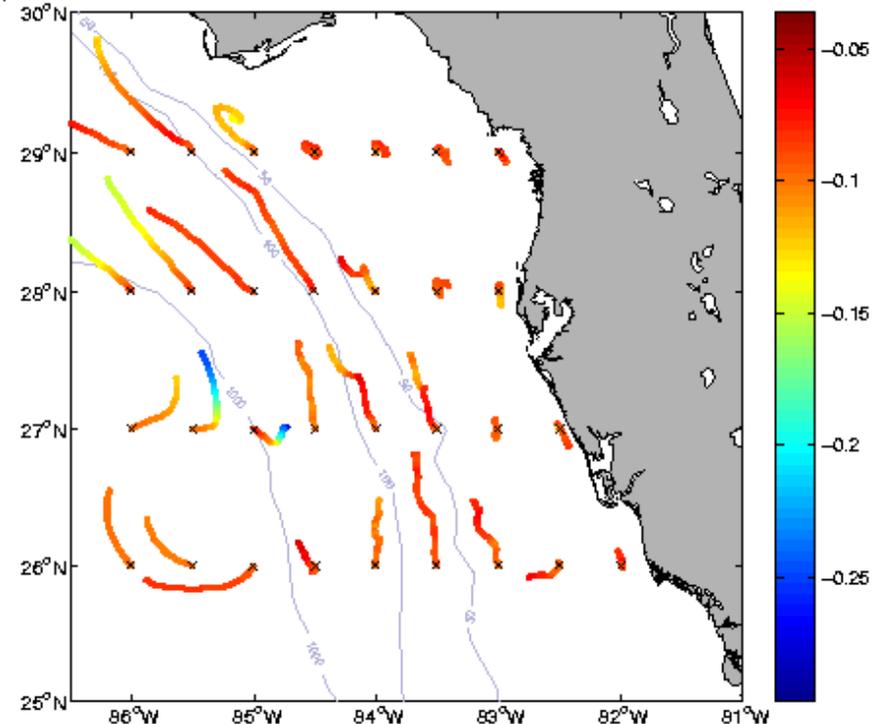


# CMS-USF WFS Nowcast/Forecast Model

velocity vectors at 0 m, date 2009-10-07



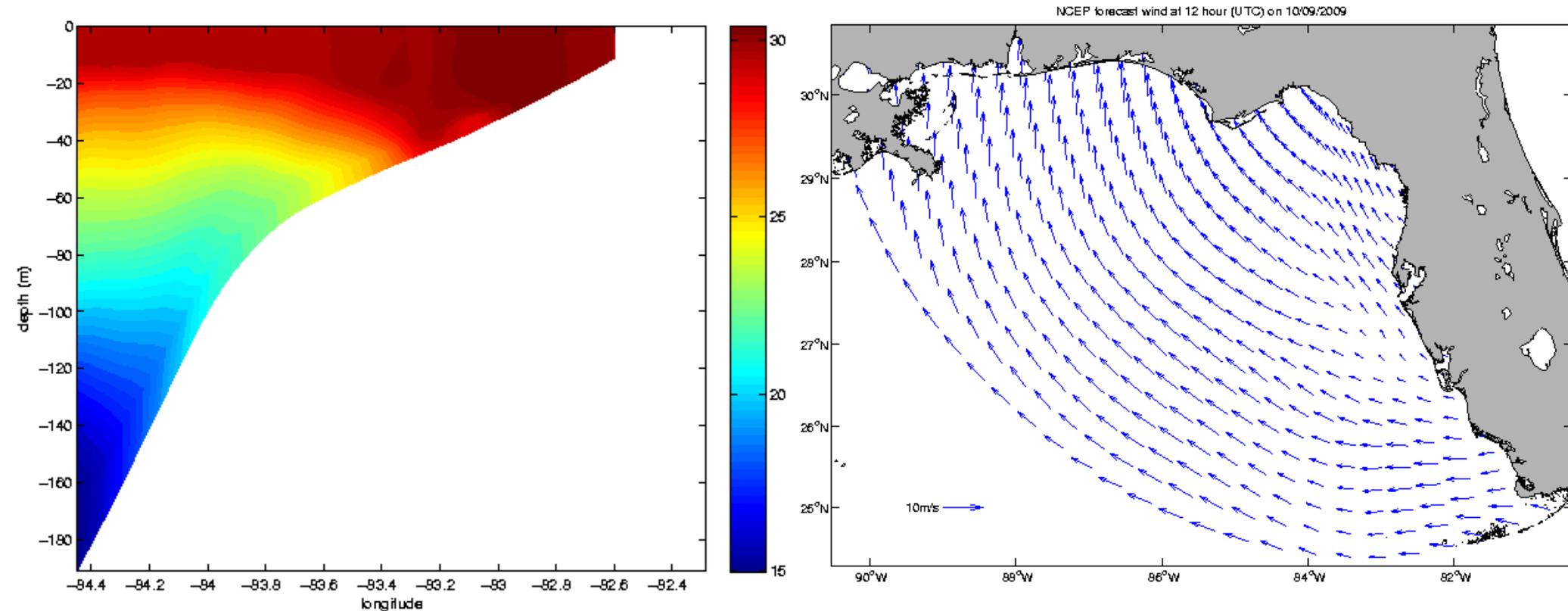
Color represents sigma-layer. Trajectory from 2009-10-07 to 2009-10-11



**Updated daily, we run a one day hindcast followed by a 3.5 day forecast.  
Results at different levels may be retrieved and plotted interactively.**

<http://ocgweb.marine.usf.edu>

# CMS-USF WFS Nowcast/Forecast Model

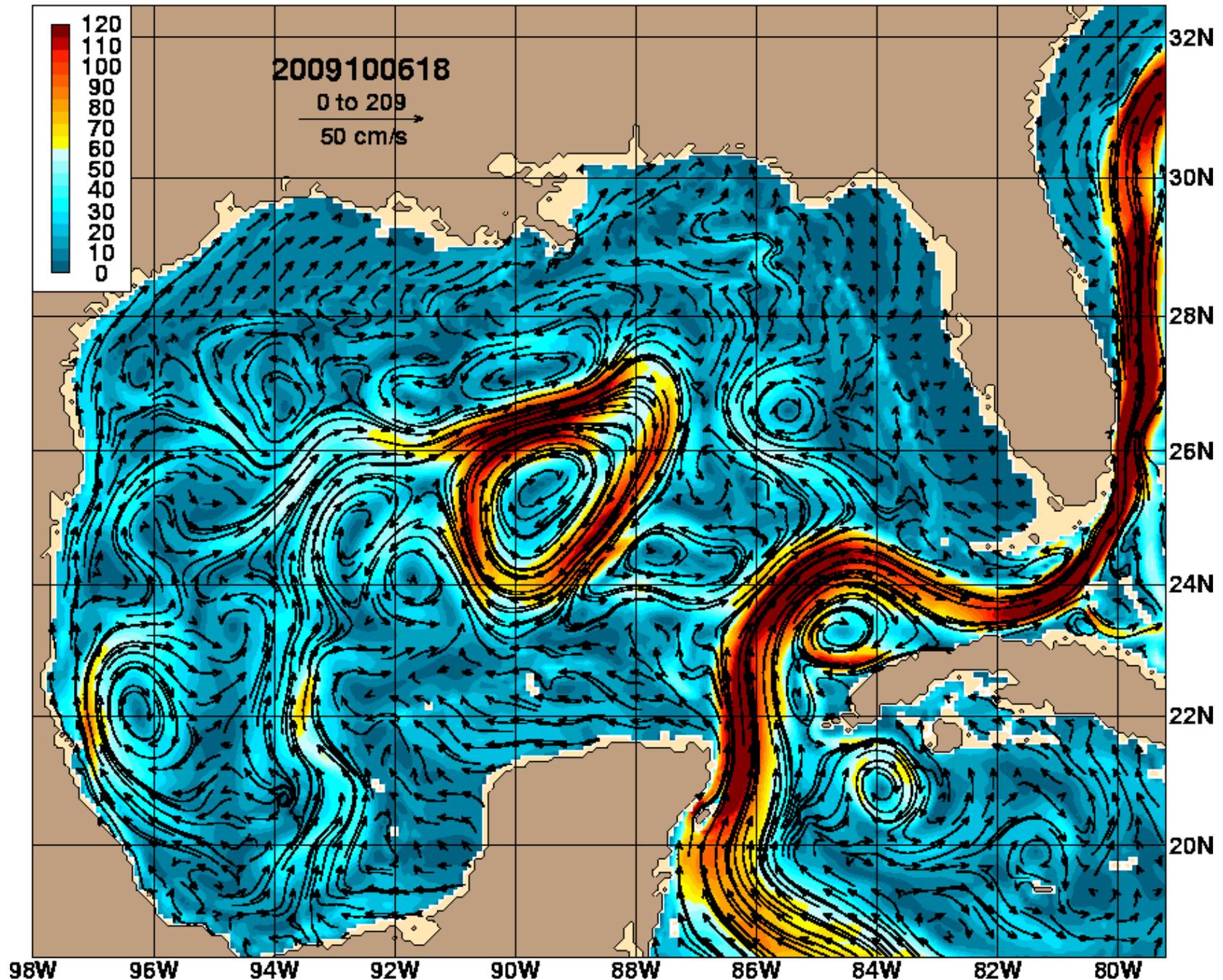


**Updated daily, we run a one day hindcast followed by a 3.5 day forecast.  
Results at different levels may be retrieved and plotted interactively.**

**<http://ocgweb.marine.usf.edu>**

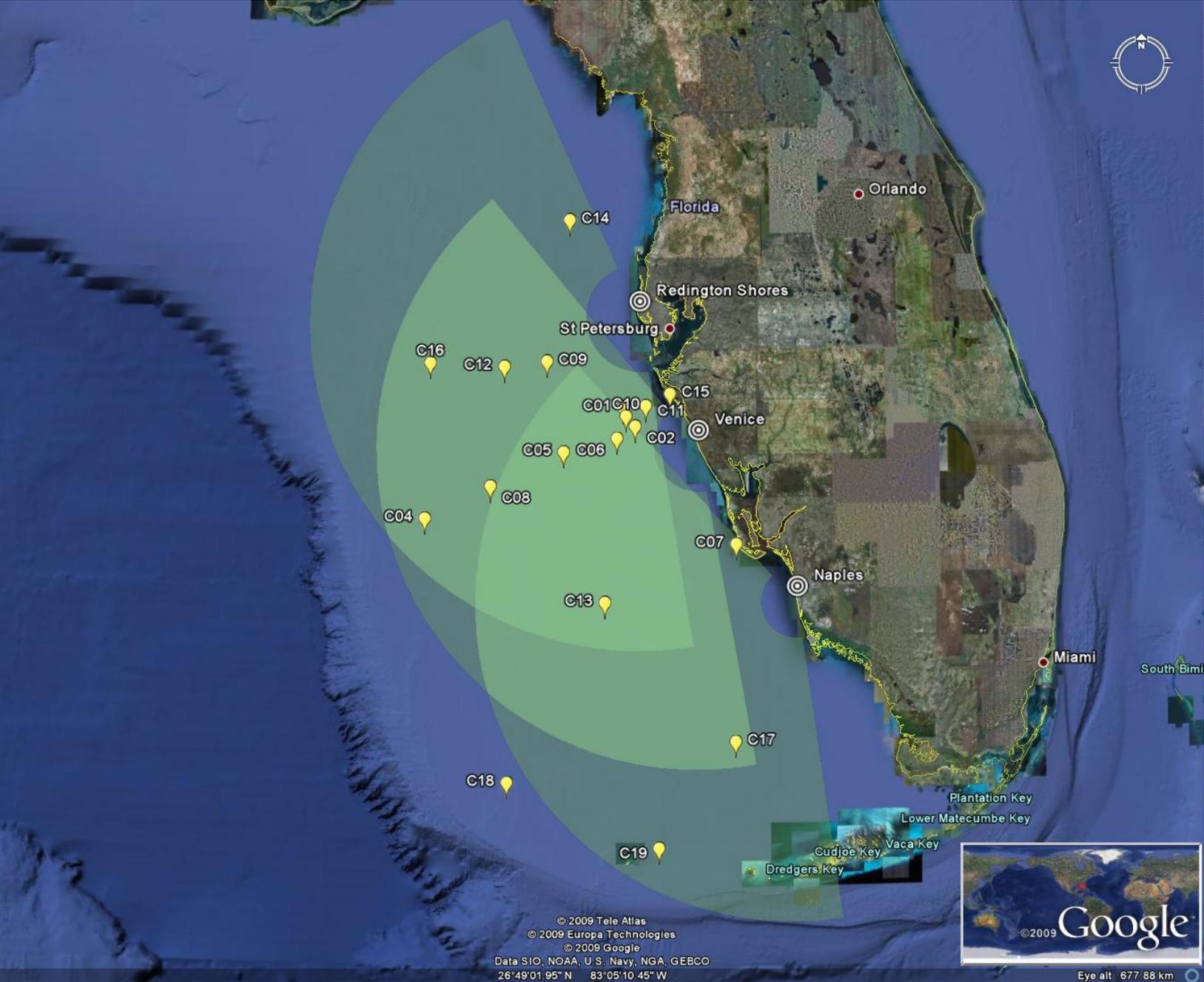
# Results from the NRL HYCOM

Speed/currents layer 1 date: Oct 10, 2009 00Z 90.8



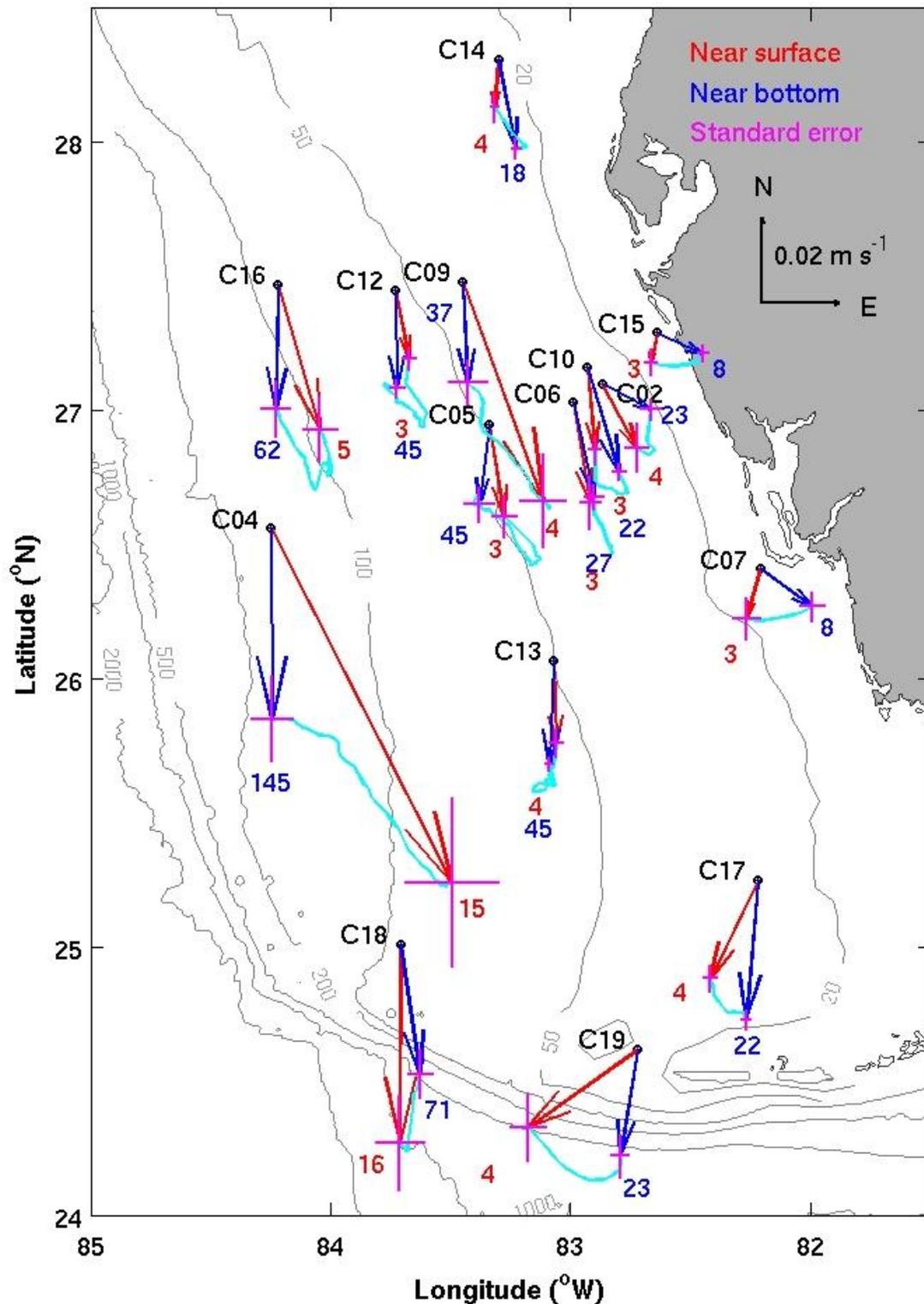
# **The Coastal Ocean of the West Florida Continental Shelf.**

# West Florida Shelf Observations



**Buoys,  
HF-radar,  
Profilers,  
Gliders**

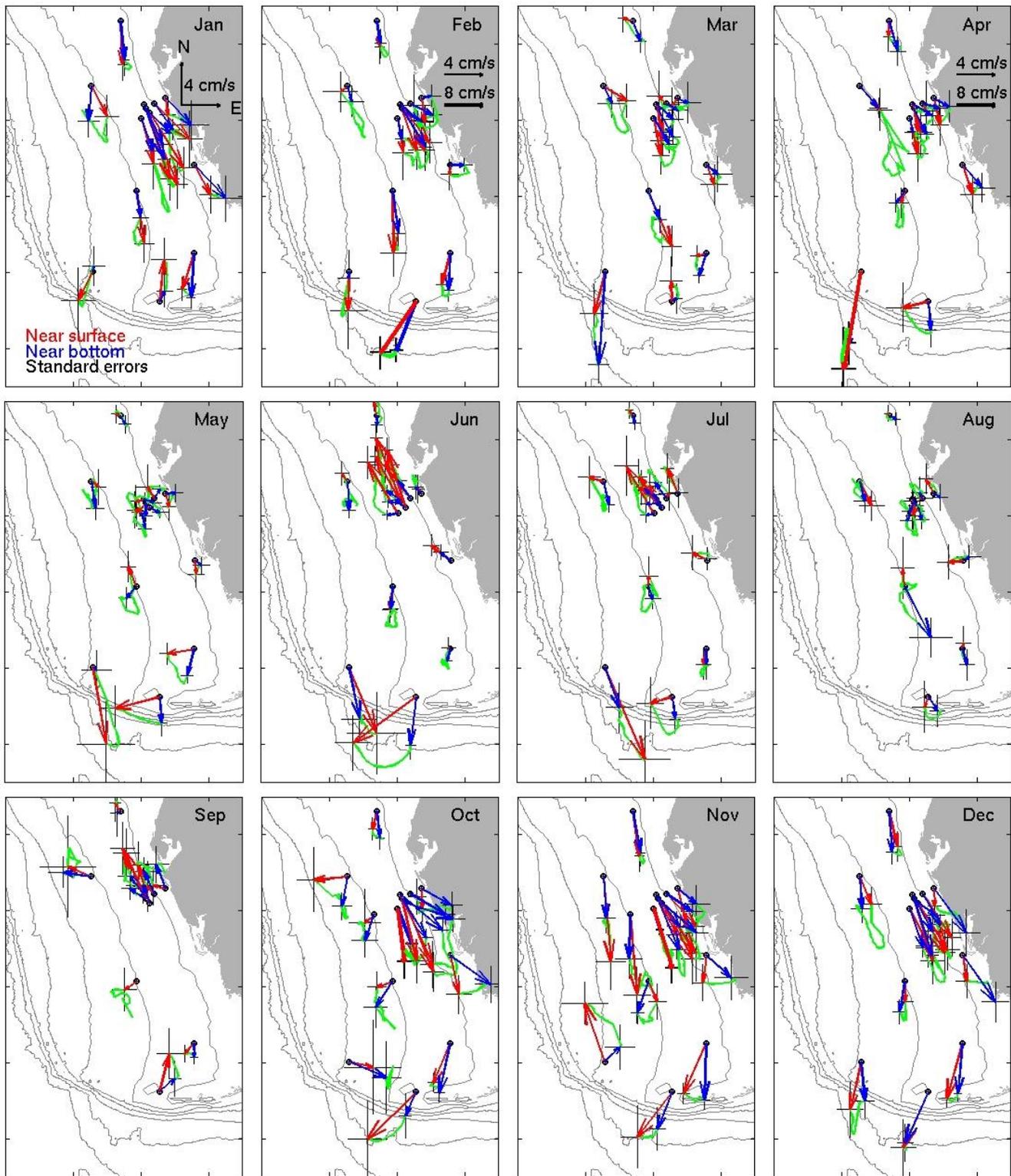




## The Long-Term Mean:

The mean flow is southward and upwelling over the inner half of the inner shelf.

The flow tends is southward and downwelling from the outer half of the inner shelf to the shelf break

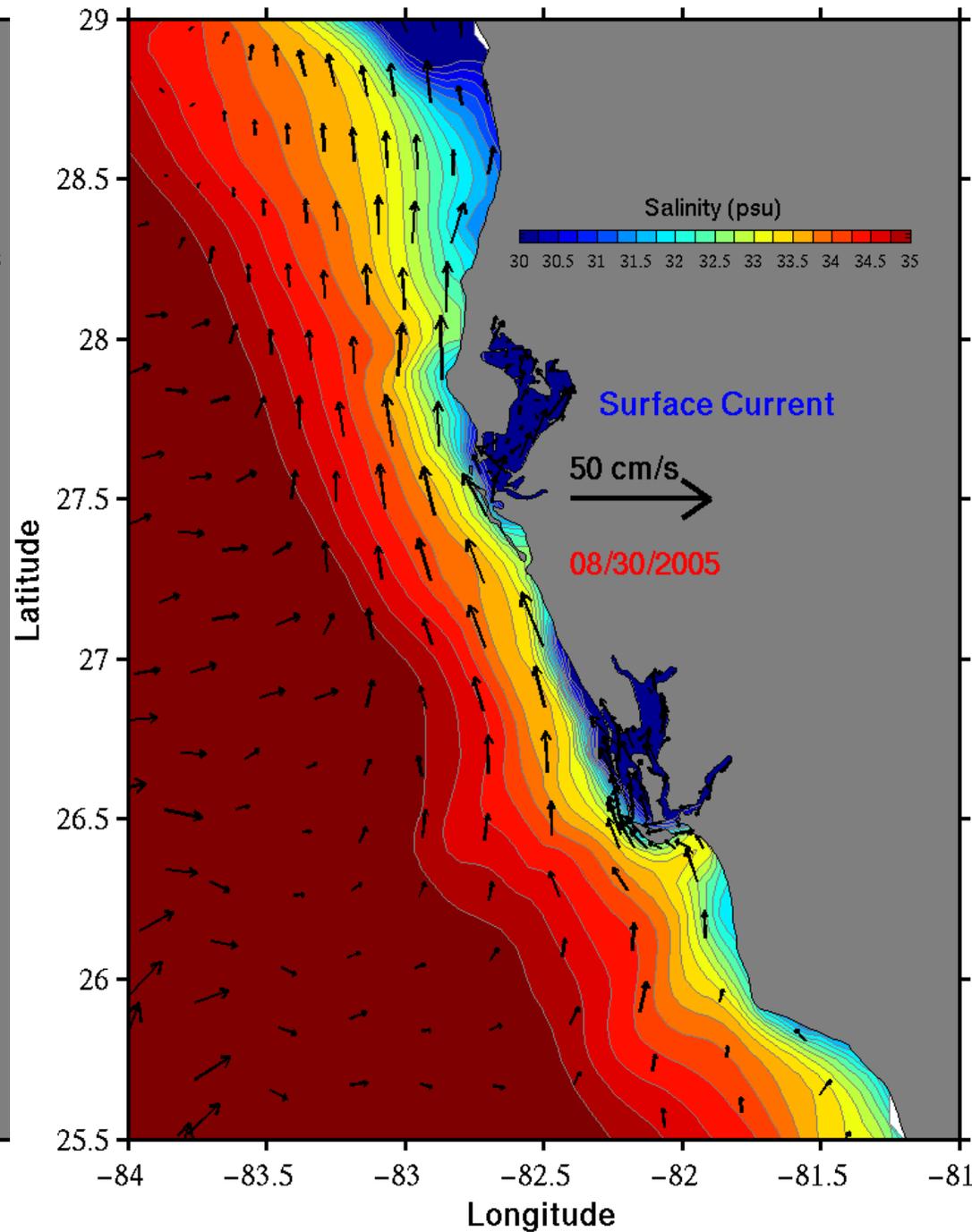
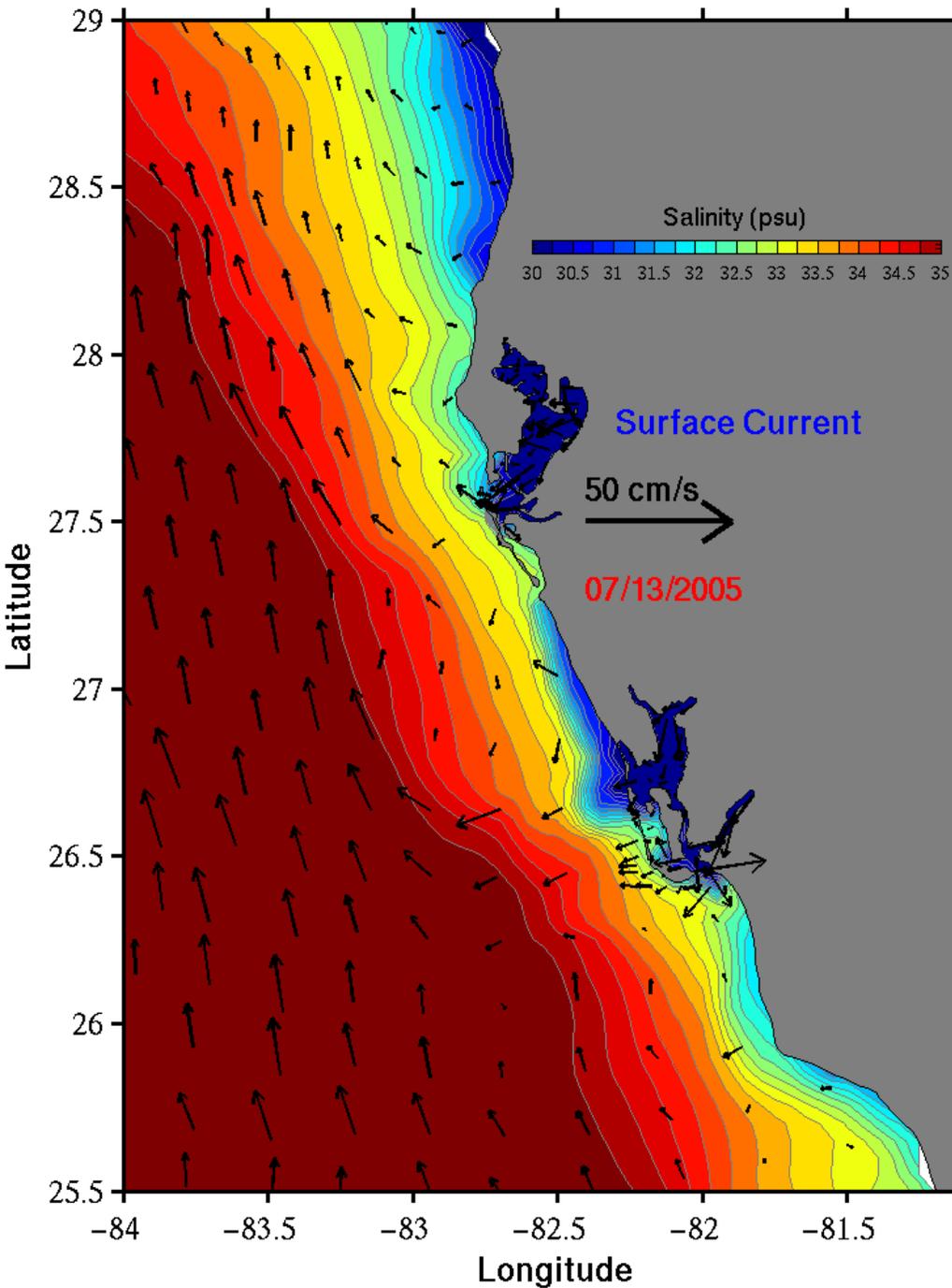


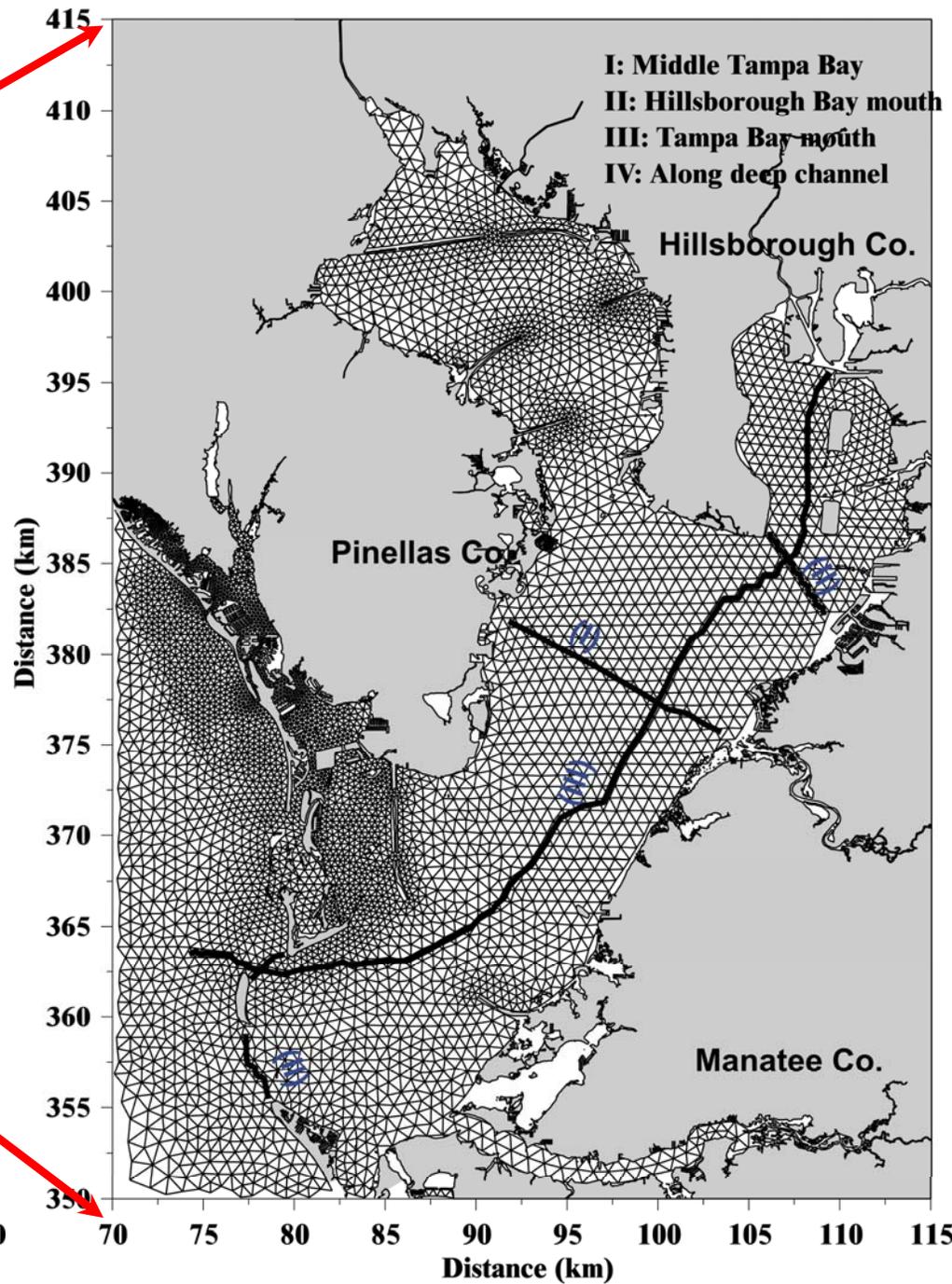
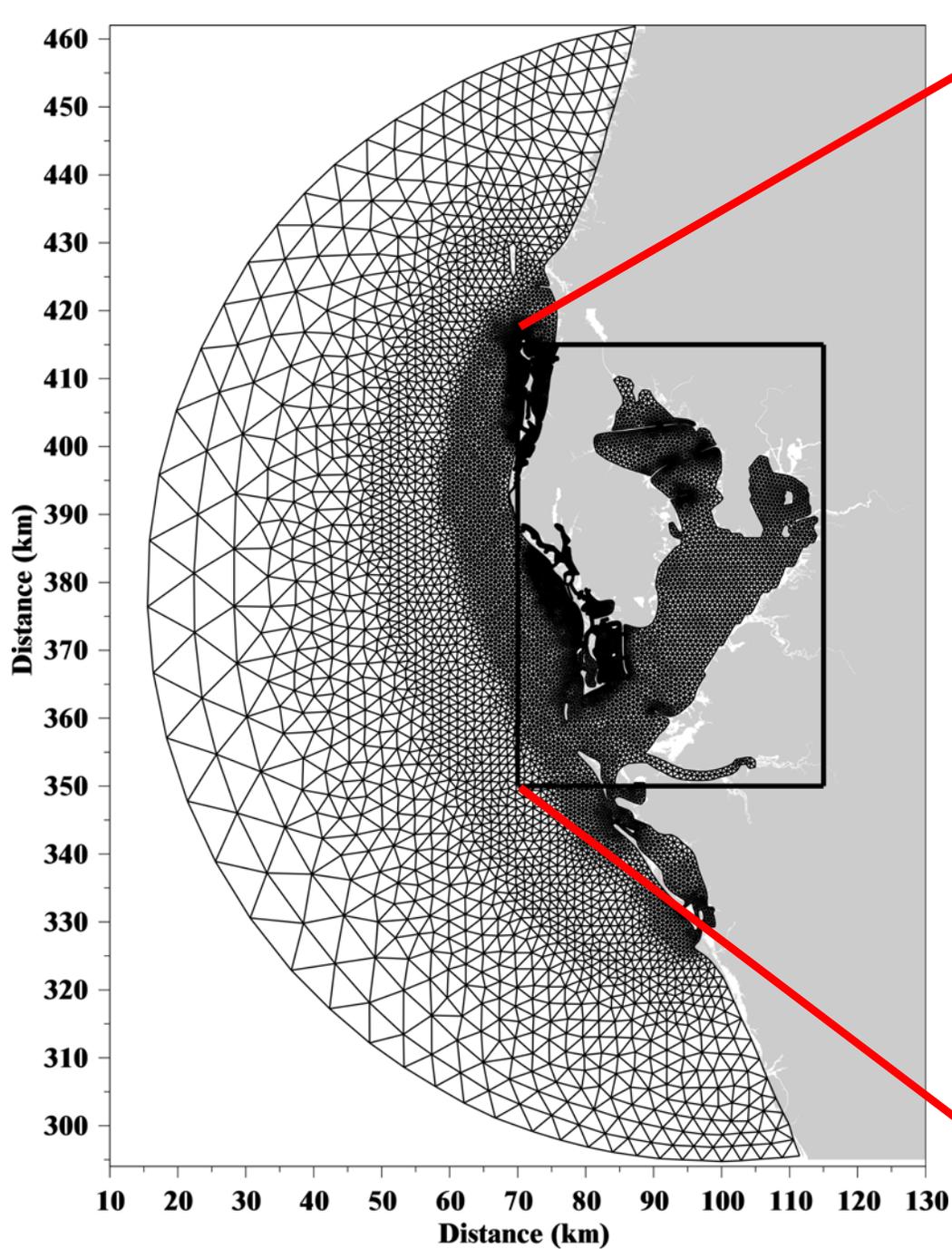
## The Seasonal variability:

**Fall – Spring:** The flow tends to be southward and upwelling.

**Summer:** The flow tends to be northward and downwelling

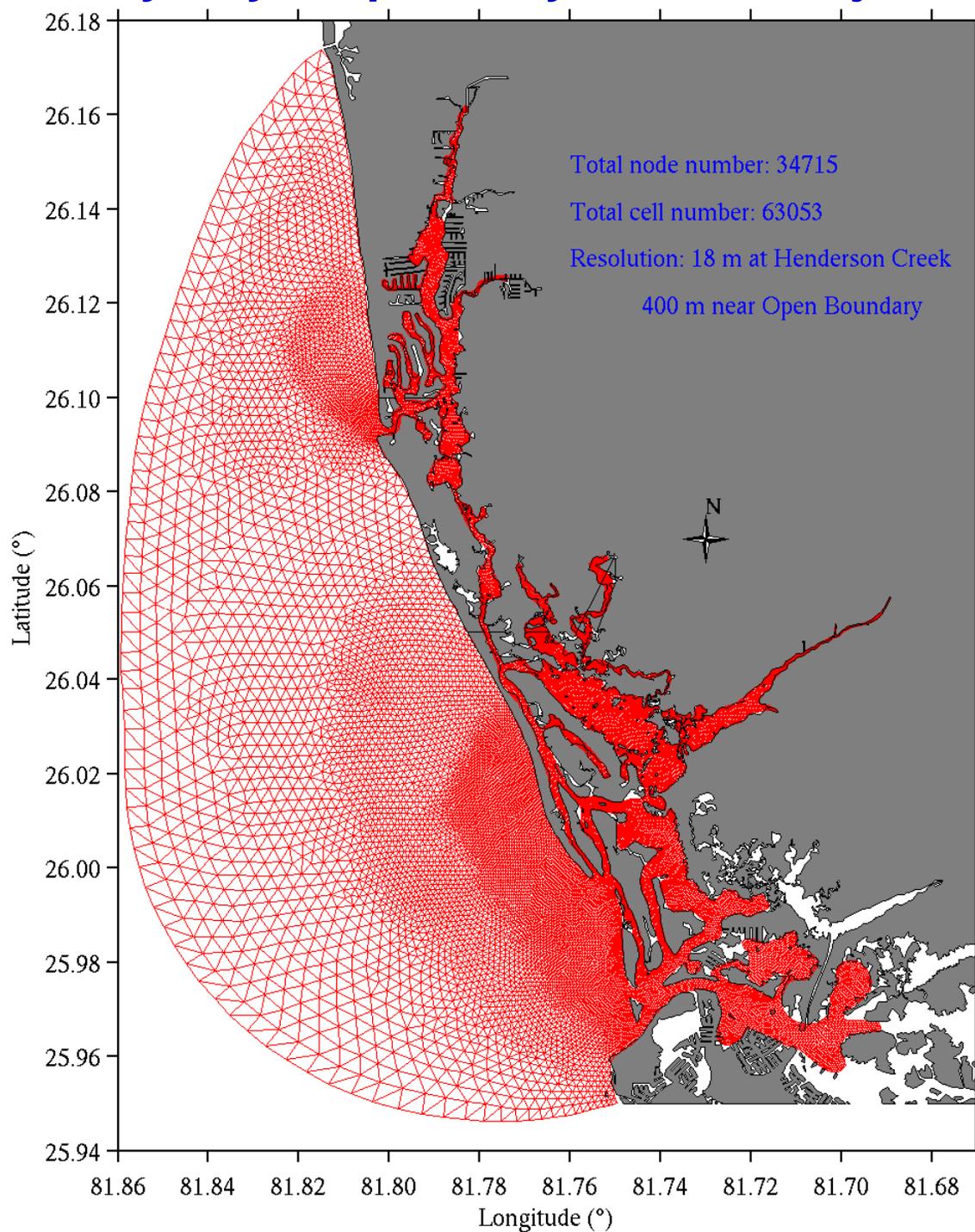
# Examples of advection of CH waters toward TB by strong downwelling circulations (H. Dennis and Katrina)



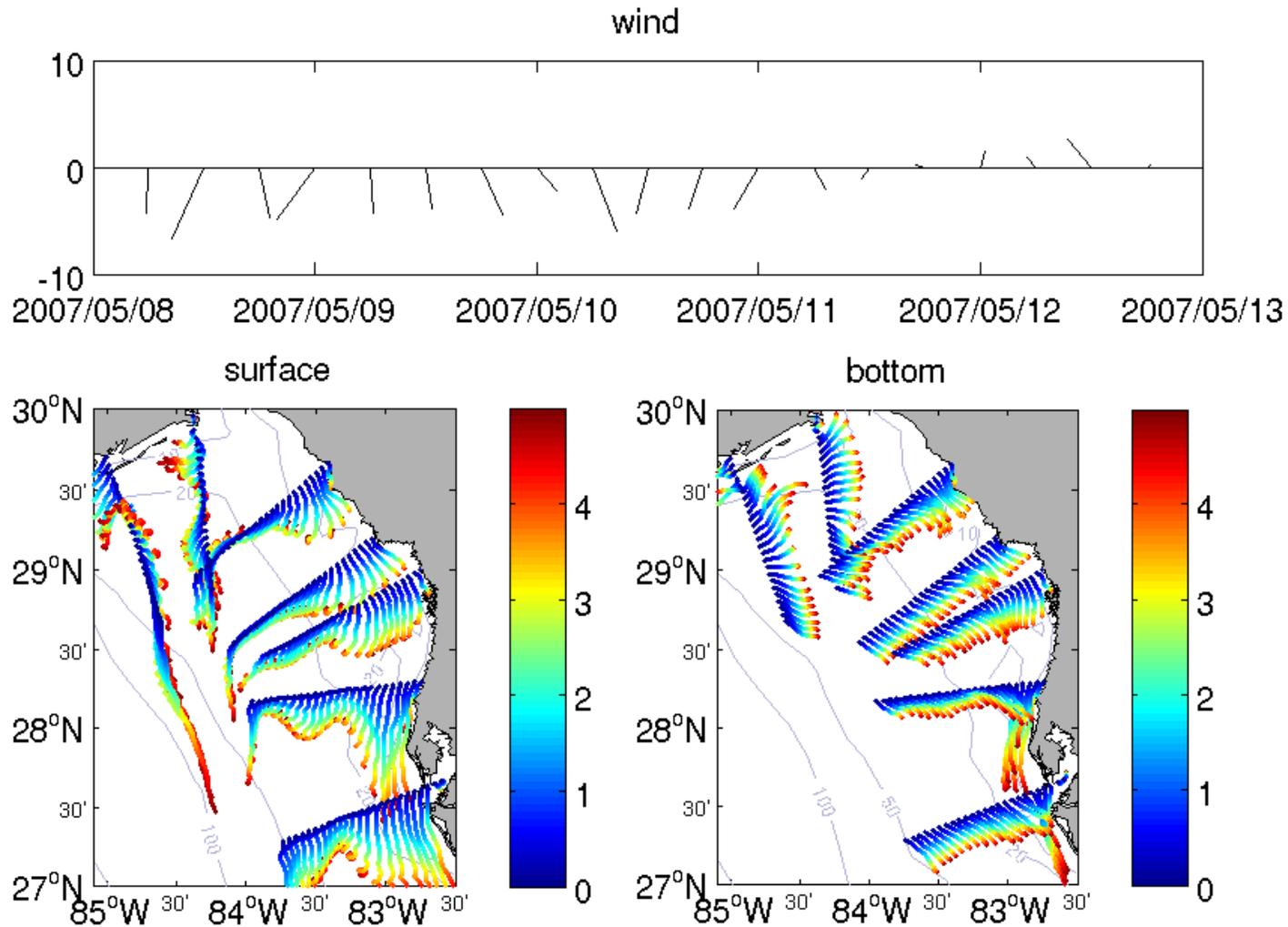


# The Model Grid

(including Rookery Bay, Naples Bay, and the adjacent Gulf of Mexico)



# Examples of surface and bottom trajectories over a five day period for which the winds were upwelling favorable.



**Particles were released in across shelf transects at 5 km intervals in the WFS N/F model and tracked for 5 days (from a report to the FDOH).**

# Summary

- 1. The eastern G of M deep-ocean circulation consists of the LC/FC/GS system, which is always present. Materials entrained in the LC can quickly flow through the Florida Straits in proximity to the Florida Keys and the east coast.**
- 2. The WFS circulation is driven mainly by winds and surface heating. The currents have well defined means and a seasonal cycle and these are fully 3-D, with the near bottom circulation accounting for the across shelf transport of nutrients from the deep-ocean.**
- 3. An understanding the shelf ecology must begin with an understanding on how the currents distribute water properties (nutrients, fish larvae, pollutants, etc.). The same infrastructure (observations and models) are required for all coastal ocean matters of societal concern.**
- 4. Given the shelf width and the nature of the currents, arbitrary distances from land are not in themselves sufficient indicators of environmental safety.**
- 5. Please don't take these observations/models for granted. They did not appear overnight, and they cannot remain without sustenance.**