An Overview of the Tampa Bay and West Florida Shelf Real-Time Coastal Ocean Monitoring Systems

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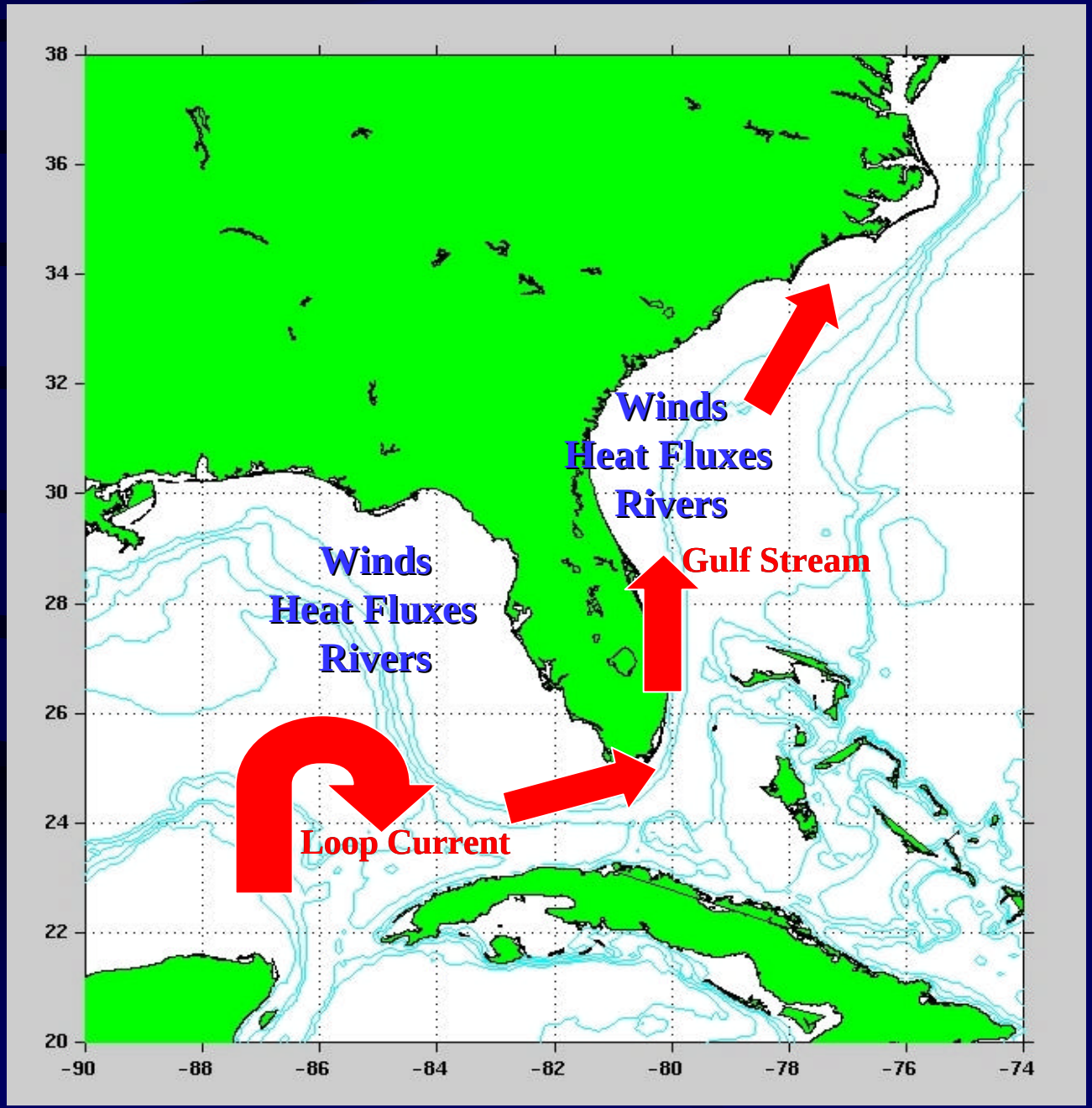
Research Vessel Technical Enhancement Committee
November 3, 2004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-76
-74
Winds
Heat Fluxes
Rivers
Gulf Stream
Winds
Heat Fluxes
Rivers
Loop Current

Overarching Scientific Question

What is the relative importance of local and deep-ocean forcing in determining shelf water properties?

where

Local forcing is defined as the shelf-wide inputs of momentum (by winds) and buoyancy (by surface heating and rivers)

and

Deep-ocean forcing is defined as the momentum and buoyancy input at the shelf break.

Approach

A Coordinated Program of:

1) *In-situ* Real-time Measurements:
(Sea level, Currents, Winds, Surface heat fluxes, Rivers, Temperature, Salinity, Nutrients, Primary productivity and other biological indicators)

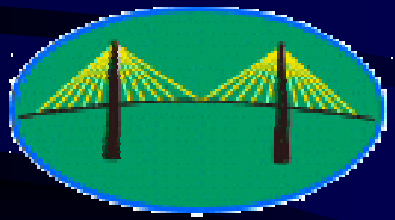
and

2) Model and Modeled Data Products:
(Ocean Circulation and Ecology)

West Florida Coast Real-Time Data Acquisition Systems

- Tampa Bay Physical Oceanographic Real-Time System (PORTS)
- Coastal Ocean Monitoring and Prediction System (COMPS)
- CODAR Surface Current Mapping System

Tampa Bay Physical Oceanographic Real-Time System (PORTS)



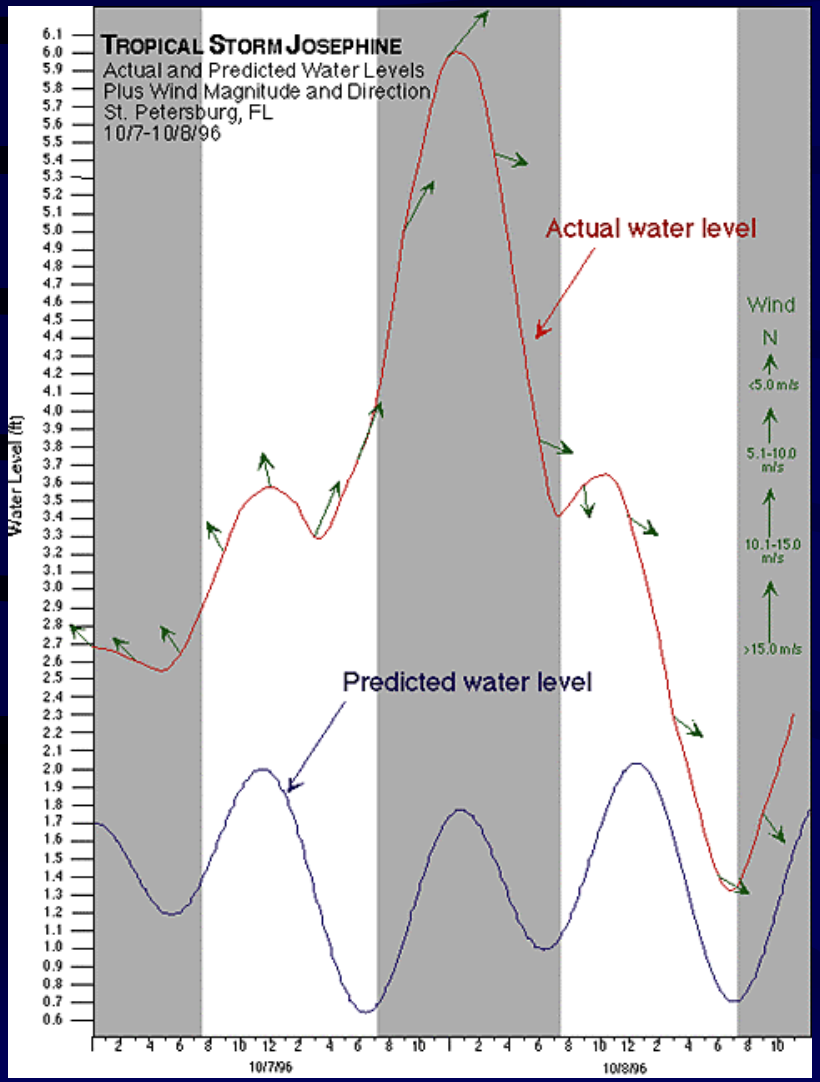
Tampa Bay P.O.R.T.S.

Physical Oceanographic Real-Time System

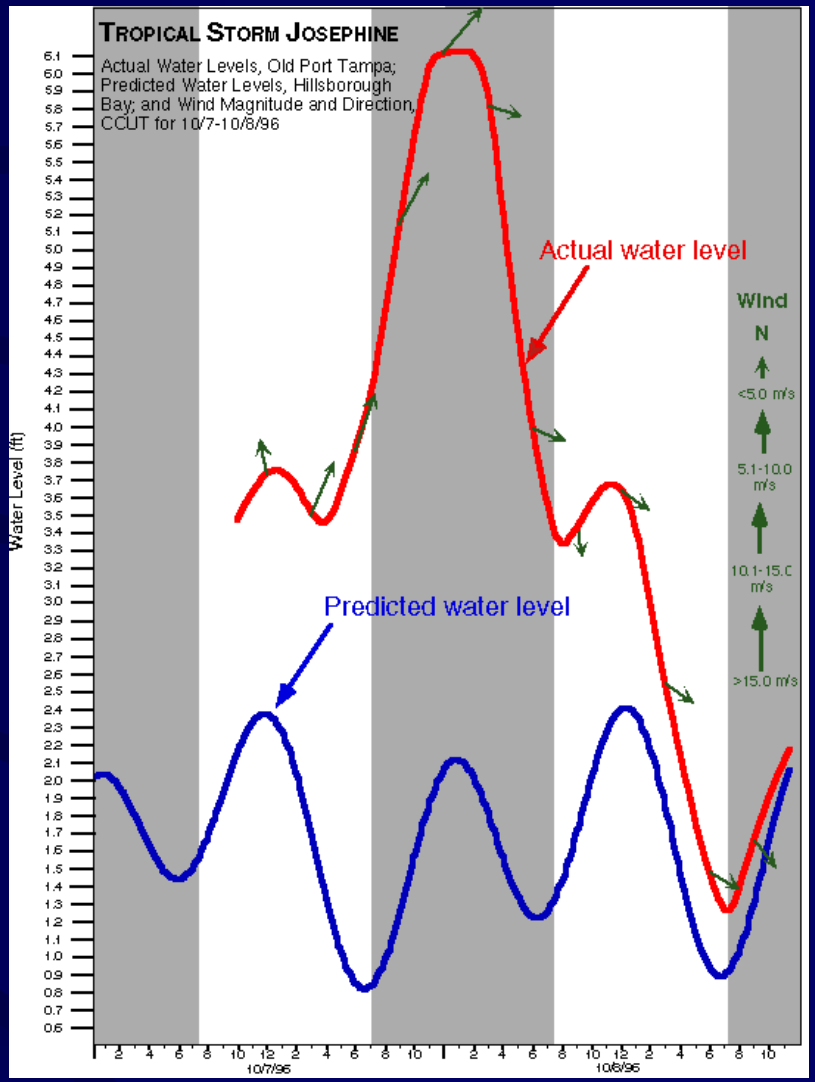
Why PORTS?

- Traditional tide tables provide information about astronomical tides and currents but do not include effects of wind, river flow, and other meteorological forces
- Non tidal forces in Tampa Bay can result in deviations from published tide predictions by up to 100 minutes and 2.5 feet
- Real-time measurements, enriched by nowcasts, were identified as critical requirements for safe navigation in Tampa Bay

Tropical Storm Josephine Water Levels



PORTS St. Petersburg Station



PORTS C-CUT Station

Tampa Bay PORTS

- Developed by National Ocean Service (NOS), NOAA in collaboration with the University of South Florida's College of Marine Science (USF/CMS) during 1990 and 1991

- Managed, operated, and maintained by The Greater Tampa Bay Marine Advisory Council-PORTS under a cooperative agreement with NOS and USF/CMS

- Receiving Station physically located USF/CMS St. Petersburg

PORTS Observing Array System

- At present, the Tampa Bay PORTS observing array system consists of 6 stations of varying equipment located within Tampa Bay

- Provides essential real-time information to improve navigational safety, hazardous material,oil spill prevention and response, search-and-rescue, and scientific research

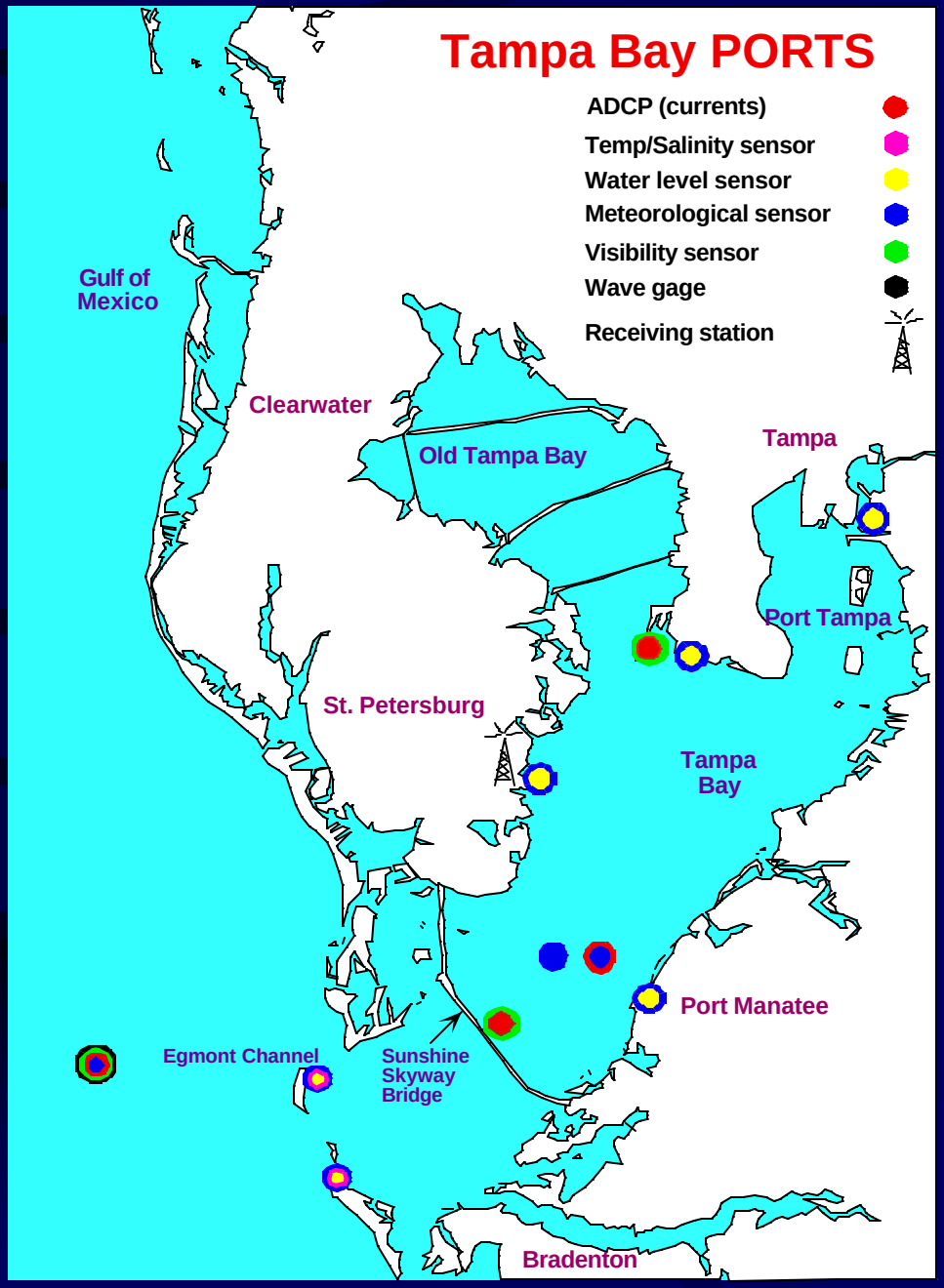


Figure 1 : Map of the Tampa Bay region showing the sensor complex that makes up the Physical Oceanographic Real-Time System (PORTS).

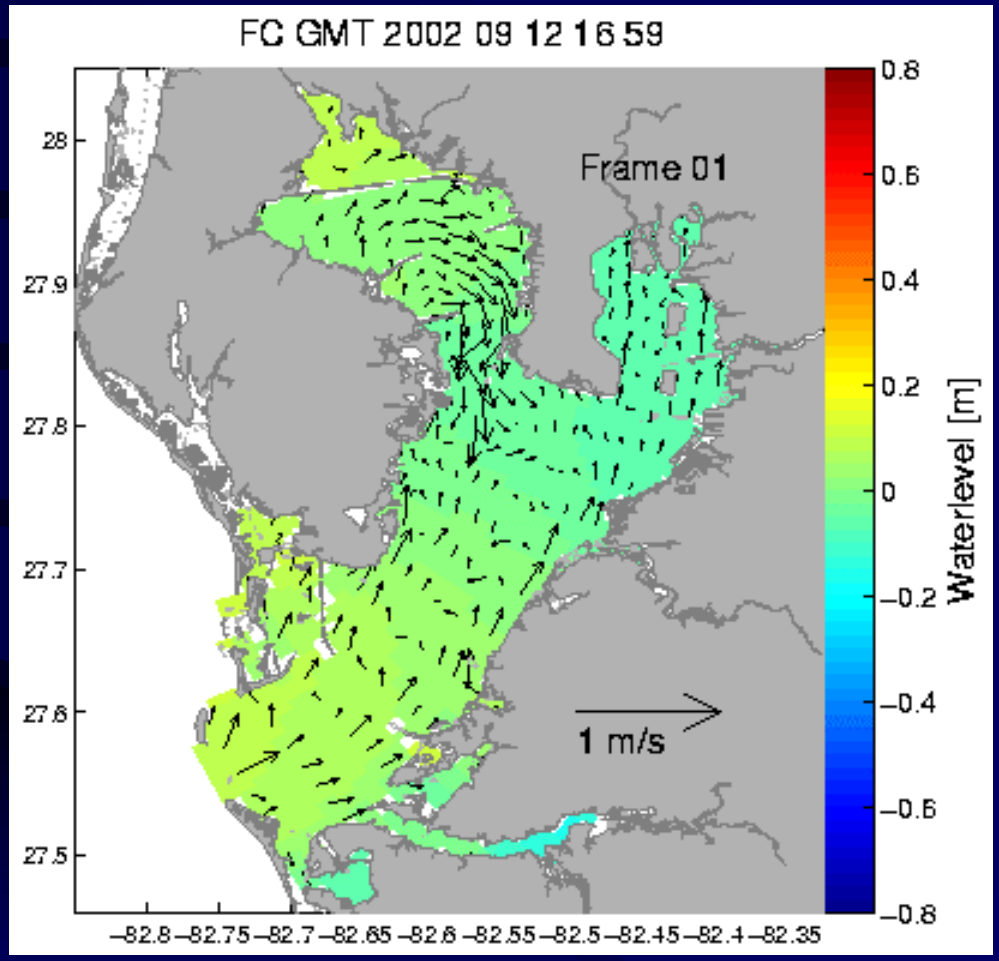
Tampa Bay PORTS

Operated in collaboration with NOAA/NOS/USF and local maritime interests

PORTS Air-Sea Interaction Stations

- Old Port Tampa - Water Level, Winds, Water Temperature, and Currents
- Port of Tampa - Water Level and Winds
- Port Manatee - Water Level, Winds, Water Temperature, and Currents
- St. Petersburg - Water Level and Winds
- Sunshine Skyway - Currents and Water Temperature
- C-Cut - Winds, Air Temperature, Pressure
- Egmont Key (COMPS) - Water Level, Winds, Conductivity, Water temperature
- Anna Maria (COMPS) - Water Level, Winds, Relative Humidity, Pressure

Tampa Bay Forecast Model Output

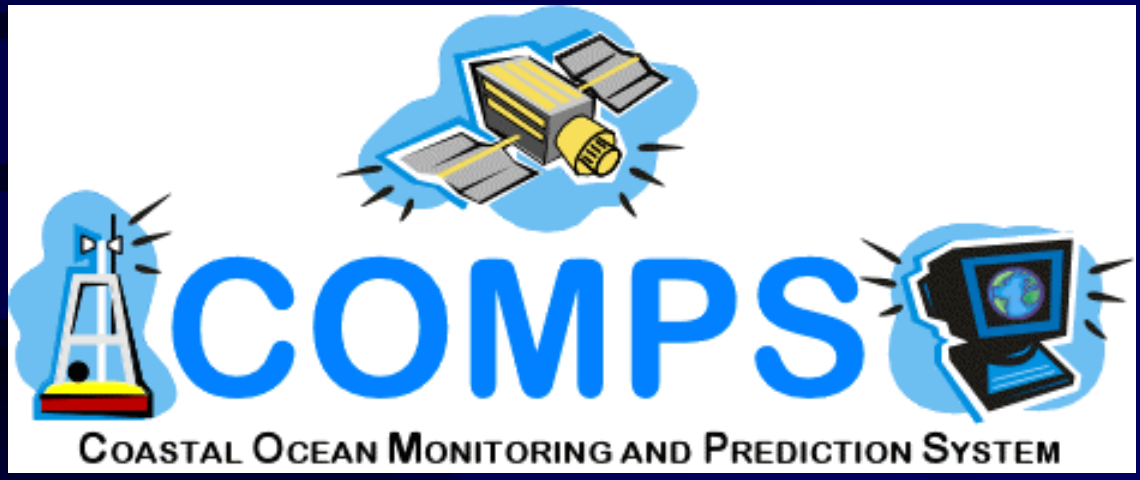


PORTS Data Dissemination

- Easy-to-use telephone voice data response system
- Packet Radio Transmission Equipment
- Modem dial-up

- World Wide Web (http://ompl.marine.usf.edu/PORTS/)
- Anonymous FTP (ftp://beach.marine.usf.edu/pub/ports)

Coastal Ocean Monitoring and Prediction System (COMPS)



Why COMPS?

- Florida is the US's 4th most populated state with 80% of the population living a coastal county
- Coastal Sea Level Response to Extra-Tropical and Tropical Storms result in wind forcing over entire Continental Shelf
- As a result, local Sea Level Response can be effected by both local and spatially distant storms, e.g.,

  - March 1993 Extra-Tropical "Storm of the Century's" unexpected 6-9 foot Storm Surge
  - October 1996 Tropical Storm Josephine, a modest spatially distant storm, that produced unpredicted flooding in the Tampa Bay Area
  - August 2004 Category 4 Hurricane Charley

COMPS Program Goal

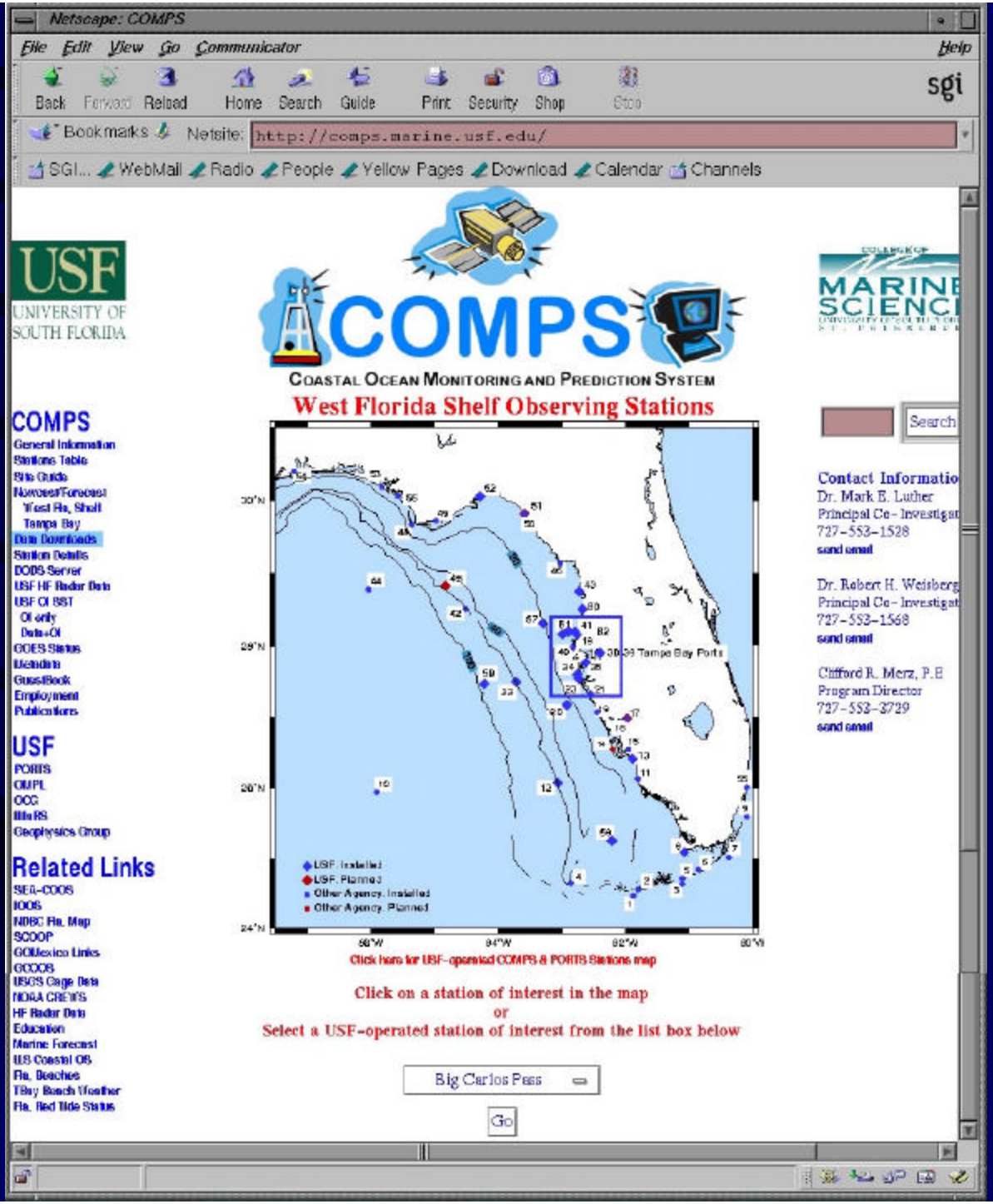
- The COMPS Program was implemented as a State of Florida legislative initiative in 1997 with continuing support to date. This support has been supplemented by other state and federal programs.

- COMPS Overall Program Goals are:
  - To provide real-time data for Emergency Management,
  - To improve description and understanding of relevant physical processes controlling shelf circulation, hydrography, and coastal flooding,
  - To Foster Continued Educational Outreach

COMPS Observing Array System

- Coupled with complementary funding from numerous sources, the COMPS observing array system has grown to 6 offshore buoys and 11 land based coastal stations located along the West Florida coast with more planned

- Designed to support a variety of operational and research efforts, including storm surge prediction, search and rescue efforts, sediment transport, red tide research (ECOHAB, MERHAB), Hyperspectral satellite remote sensing of Coastal Ocean Dynamics (HyCODE), the Southeast Atlantic Coastal Ocean Observing System (SEA-COOS), and the Southeast Coastal Ocean Observations Regional Association (SECOORA)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COASTAL OCEAN MONITORING AND PREDICTION SYSTEM
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GCOOS
USGS Cage Data
NOAA CREWS
HF Radar Data
Education
Marine Forecast
US Coastal OS
Fla. Beaches
TBay Beach Weather
Fla. Red Tide Status
30°N
29°N
28°N
24°N
88°W
84°W
82°W
80°W
USF-Installed
USF-Planned
Other Agency-Installed
Other Agency-Planned
Tampa Bay Ports
Click here for USF-operated COMPS & PORTS Stations map
Click on a station of interest in the map
or
Select a USF-operated station of interest from the list box below
Big Carlos Pass
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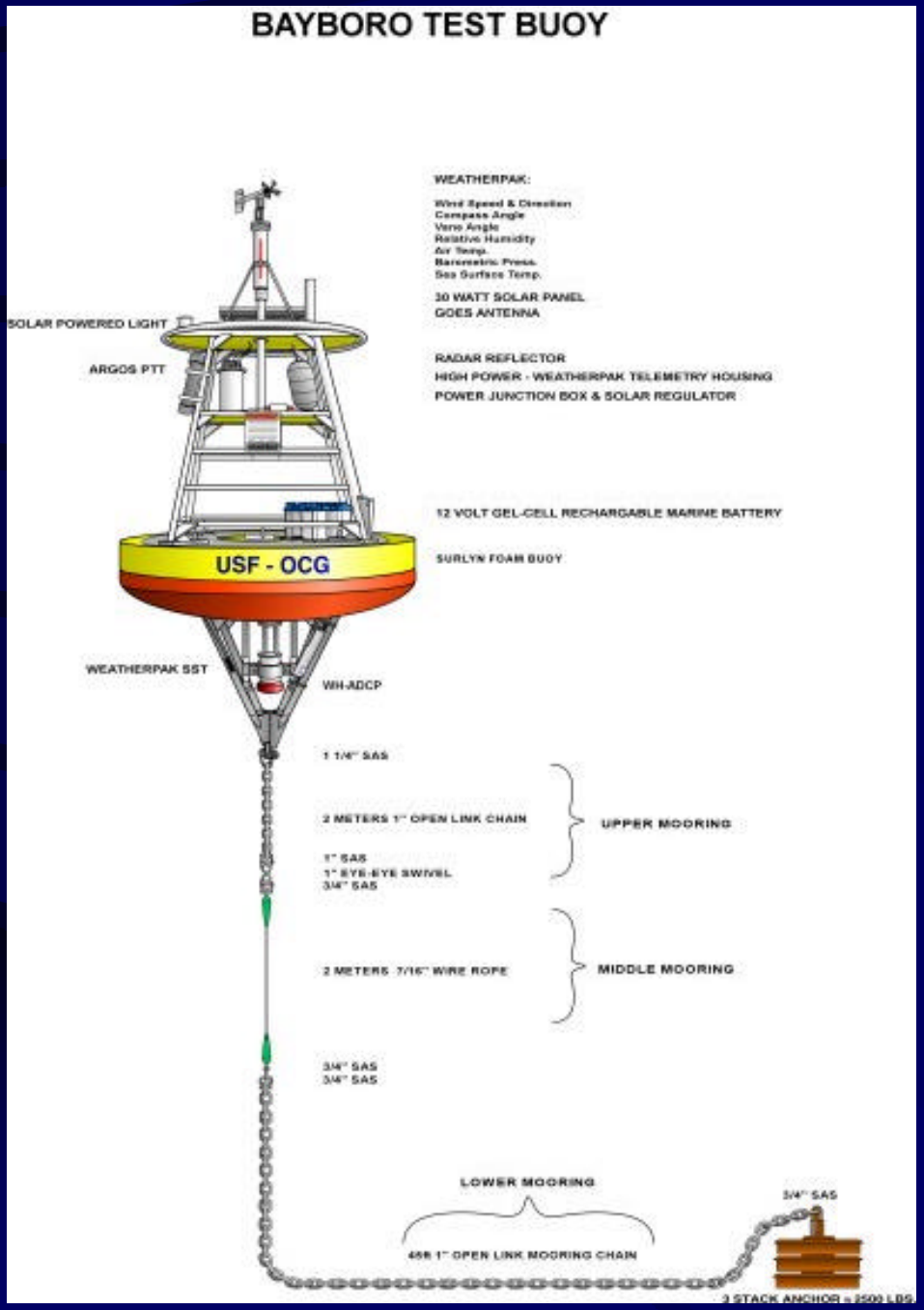
COMPS Real-time Air-Sea Interaction Buoy

- ATMOSPHERE MEASUREMENTS:
  - Wind speed & direction
  - Sea surface temperature
  - Air temperature
  - Relative humidity
  - Barometric pressure
  - Short & Long wave solar radiation
  - Precipitation
- OCEAN MEASUREMENTS: (surface and sub-surface)
  - Current speed (velocity) & direction
  - Temperature and Conductivity (salinity)
- DATA TELEMETRY:
  - Hourly NOAA GOES Satellite Transmissions and RF Radio Modems

COMPS Offshore Weather Buoy



COMPS/EMPATF/Pasco CMP4 Air-Sea Interface Buoy

COMPS--CMP4 - Microsoft Internet Explorer

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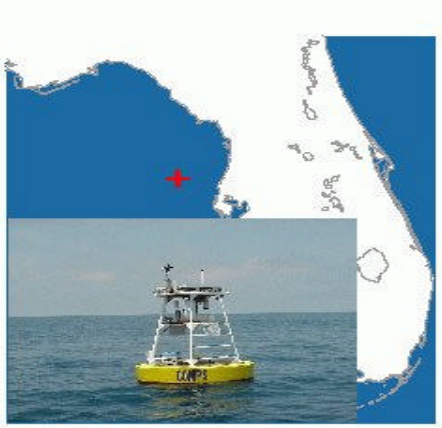
Address http://comps.marine.usf.edu/CMP4/index.shtml Go Links

COMPS Station

CMP4

University of South Florida USF

Station ID	CMP4	**Latitude**	28° 18.334' N
Station Type	Offshore Buoy	**Longitude**	83° 18.002' W
Responsible Agency		**USF**	



Site Notes Buoy is located at 28° 18.334' N (28.306 N), 83° 18.002' W (83.300 W) offshore of Hudson in a water depth of 21 meters. Data is hourly transmitted via the GOES satellite. Site funding is via a cooperative effort between the University of South Florida's/College of Marine Science's COMPS program, the Emergency Management Preparedness and Assistance Trust Fund, and the Pasco County Division of Emergency Management. This site became an operational COMPS offshore station on 4/24/2002.

The wind and current vector plots (24 hr and 5 days) are available on-line. Please click on plots link under Meteorological and Oceanographic Data (24 h and 5 - Days) to view the same. The current trajectories plots are available on-line. Please click on current trajectories link under 5 - Days Oceanographic data to view the same.

Meteorological Data

Date	09-27-02		09-27-02	09-27-02
Time	16:00:00		15:40:00	15:20:00
Wind Speed	8.51 ms^{-1}	16.53 knots	7.92 ms^{-1}	7.89 ms^{-1}
Wind Direction	150 ° True	150 ° True	133 ° True	168 ° True
Wind Gusts	9.3 ms^{-1}	18.07 knots	9.4 ms^{-1}	8.5 ms^{-1}
Air Temp	28.44 °C	83.19 °F	28.37 °C	28.41 °C
Sea Surface Temp	28.90 °C	84.02 °F	28.90 °C	28.90 °C
Barometric Pressure	1009.9 mbar	29.82 in Hg	1009.8 mbar	1009.8 mbar
Relative Humidity	75 %	75 %	78 %	78 %
Short Wave Radiation	636.40 W/m^2	636.40 W/m^2	690.00 W/m^2	594.70 W/m^2
Long Wave Radiation	421.40 W/m^2	421.40 W/m^2	420.20 W/m^2	429.00 W/m^2

ADCP Data

Date 09-27-02	Depth		Depth		Depth	
Time 15:00:00	4 m		12 m		17 m	
Current Speed	8.5 cms^{-1}	0.17 knots	7.1 cms^{-1}	0.14 knots	4.5 cms^{-1}	0.09 knots
Current Direction	21 ° True		45 ° True		63 ° True	

Temperature and Salinity Data

Date 09-27-02	Depth		Depth		Depth	
Time 14:20:00	5 m		10 m		15 m	
Temperature	28.88 °C	83.98 °F	28.88 °C	83.98 °F	28.88 °C	83.98 °F
Salinity	35.93 PSU		35.94 PSU		35.93 PSU	

Current, Direction, Temperature and Salinity depth profiles

Diagonostic Sensor Data
Sensor Data

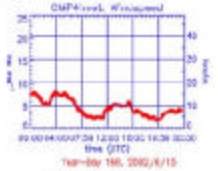
Past 24-hours Observations
Meteorological Data
Table: metric, imperial
Plots
Oceanographic Data
Table: Currents Temperature and Salinity
Plots: Currents Temperature and Salinity
Diagonostic Sensor Data
Table: Sensor Data
Plots

Past 5-days Observations
Meteorological Data
Plots
Oceanographic Data
Plots: Currents, Current Trajectories, Temperature and Salinity
Diagonostic Sensor Data
Plots

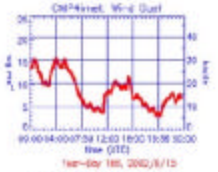
COMPS Station

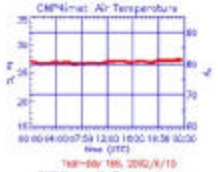
CMP4 Buoy: 24-hour Graphics

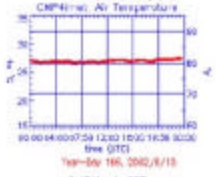
Preliminary data - not quality-controlled - use at your own risk - see disclaimer.
These graphics are being updated hourly.

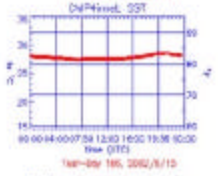


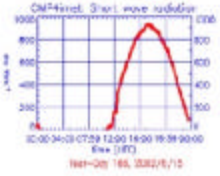
Wind Velocity Stick Plots

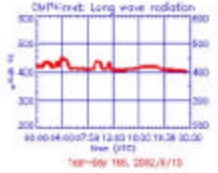












Periods of straight lines in otherwise rich data indicate breaks in data transmission.
Back to station page.

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COMPS Real-time Air-Sea Coastal Station

- ATMOSPHERE MEASUREMENTS:
  - Air temperature
  - Wind speed & direction
  - Relative humidity
  - Barometric pressure
  - Precipitation
- OCEAN MEASUREMENTS: (sub-surface)
  - Water Level (surveyed to NAVD 88 datum)
  - Temperature and Conductivity (salinity)
- DATA TELEMETRY:
  - Hourly NOAA GOES Satellite Transmissions and RF Radio Modems

COMPS/Lee County/EMPATF
Big Carlos Pass Coastal Station

Netscape: COMPS---Big Carlos Pass Gulf Park Coastal Station

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Bookmarks Location: http://comps1.marine.usf.edu/bcp/index.shtml

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COMPS Station

Big Carlos Pass

Station ID	BCP	**Latitude**	26° 24.269' N
Station Type	Shore based	**Longitude**	81° 52.26' W
Responsible Agency		**USF**	

Site notes The COMPS Big Carlos Pass Coastal Station is physically located at 26° 24.269' N (26.404 °N) and 81° 52.26' W (81.881° W), on the Big Carlos Pass Bridge between the cities of Fort Meyers Beach and Bonita Springs, Fl. Mounted on the bridge deck is an instrument tower housing: Wind Speed/Direction, Relative Humidity/Air Temperature, Barometric Pressure, and Precipitation sensors. Marine Instrumentation includes: Water Level, Temperature, and Salinity. Data is hourly transmitted via the GOES satellite as well as every 6 minutes via a direct radio link to the Lee County Office of Emergency Management. Site funding is via a cooperative effort between the University of South Florida's/College of Marine Science's COMPS program, the State of Florida's Emergency Management Preparedness and Assistance Trust Fund, the Lee County Office of Emergency Management, and the Florida Department of Environmental Protection. This site became an operational COMPS coastal station on 8/05/2004.

►Station photos

Latest Observations

Measurements are made every 6 minutes and are downloaded hourly via GOES satellite. Time reported is UTC (Coordinated Universal Time): subtract 5 hours for EST, subtract 4 hours for EDT.

Provisional data – not quality-controlled – use at your own risk – see disclaimer.

Meteorological and Marine Data

Local system date : 08-30-04, Year-Day 243		
Posted at time (UTC) : 18:55 (14:55 EDT)		
Data timestamp (UTC): Mon 30-Aug-2004 1754		
Water Level	0.669 m	2.19 ft
Barometric pressure	1016.0 mbar	30.00 in Hg
Air temperature	31.1°C	87.9°F
Relative humidity	62.9%	
Wind speed	3.5 ms^{-1}	6.8 knots
Wind Gusts	4.2 ms^{-1}	8.2 knots
Wind direction	231°True	
Water temperature	32.19°C	89.9 °F
Salinity	34.6	

Water level referenced unsurveyed datum.

Wind Direction is the compass angle from which the wind is blowing, referenced in degrees clockwise from true N (0=North, 90=East, 180=South, and 270=West).

Missing data represented by -99

Past 24-hours Observations

Meteorological and Marine Data

Table: metric, imperial

Plots

Past 5-Day Observations

Meteorological Marine Data

Plots

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Hurricane Charley Storm Track

Netscape: COMPS-BCP-5-Day Graphics

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Bookmarks Location: http://comps1.marine.usf.edu/bcp/charley.html

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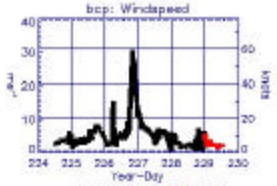
COMPS Station

Big Carlos Pass: Hurricane Charley Graphics

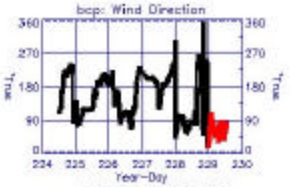
Provisional data – not quality-controlled – use at your own risk – see disclaimer.

bcp: Windspeed



Year-Day 229, 2004/8/16

bcp: Wind Direction



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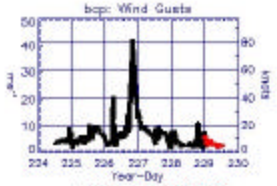
bcp: Wind Gusts



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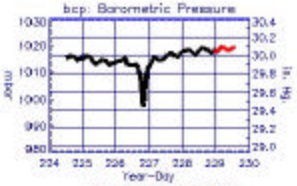
bcp: Barometric Pressure



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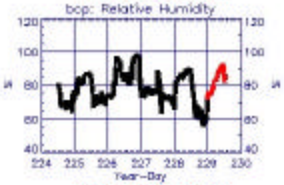
bcp: Relative Humidity



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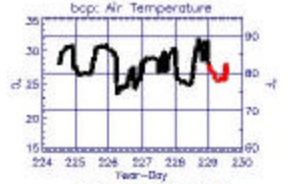
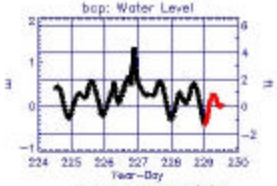
bcp: Air Temperature



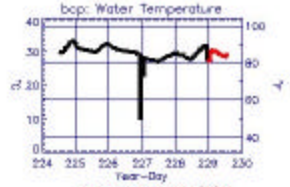
Year-Day 229, 2004/8/16

bcp: Water Level



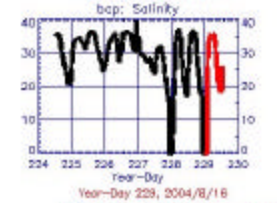
Year-Day 229, 2004/8/16

bcp: Water Temperature



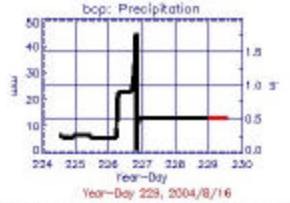
Year-Day 229, 2004/8/16

bcp: Salinity



Year-Day 229, 2004/8/16

bcp: Precipitation



Year-Day 229, 2004/8/16

USF COMPS Map — Station Table — Site Guide — COMPS Info — Guestbook

100%

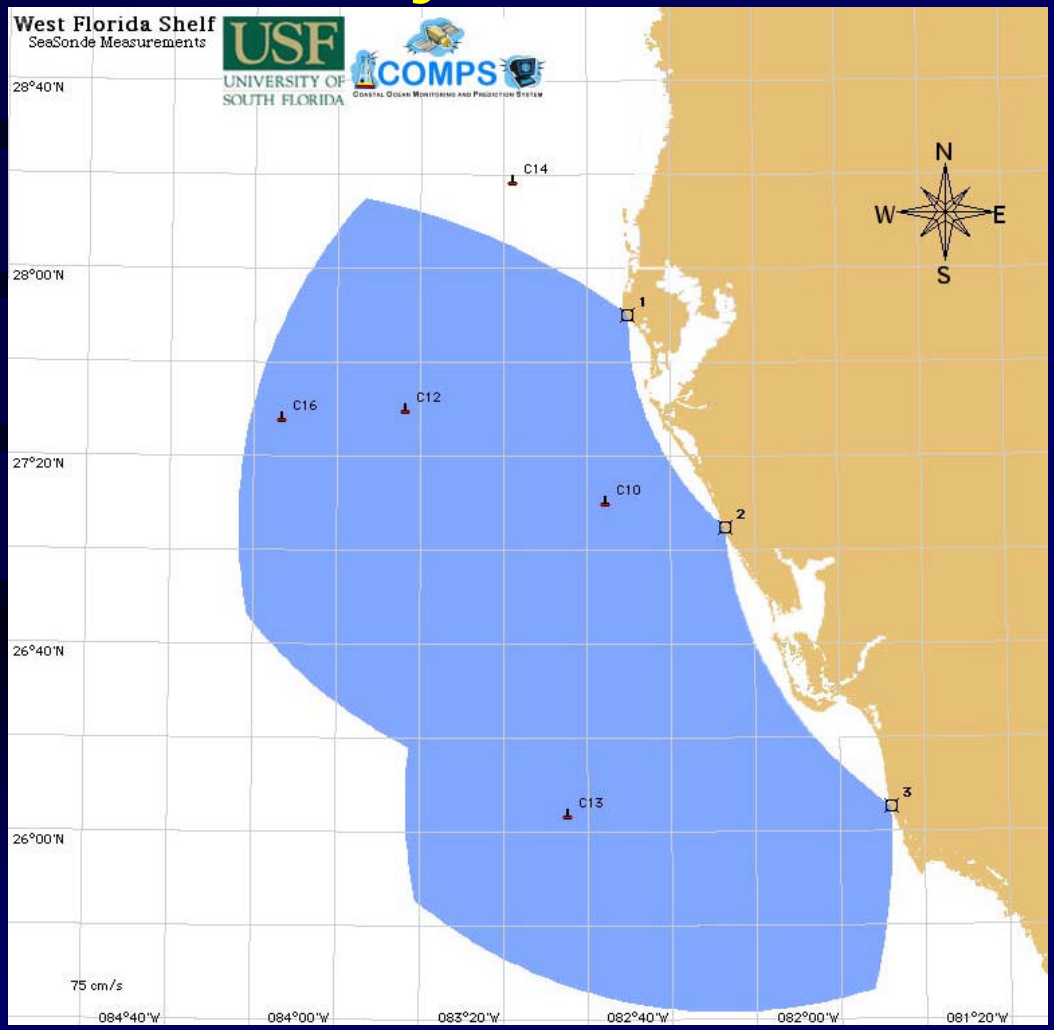
COMPS Data Dissemination

- Data and Model Products are disseminated in real-time to federal, state, local emergency management officials, and the general public via the internet at:
  (http://comps.marine.usf.edu)

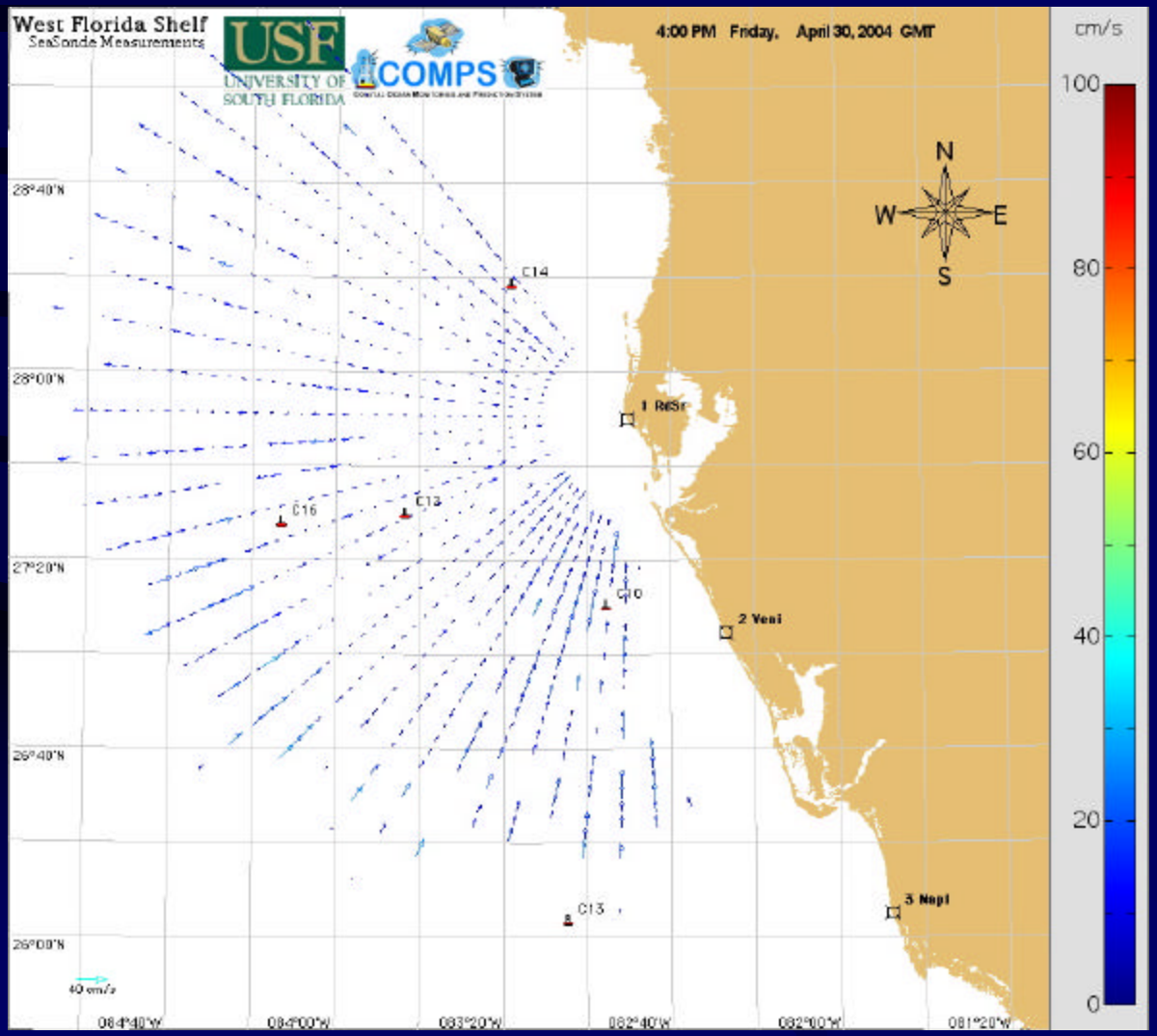
- Data is provided via FTP to NOAA/NDBC and the NWS West Florida Regional Forecast Office for ingestion into NWS/AWIPS (Advanced Weather Interactive Processing System) and for Post-Storm Analysis

- Data is provided directly to County Emergency Management Agencies via RF Spread Spectrum "Freewave" Radio Transceivers

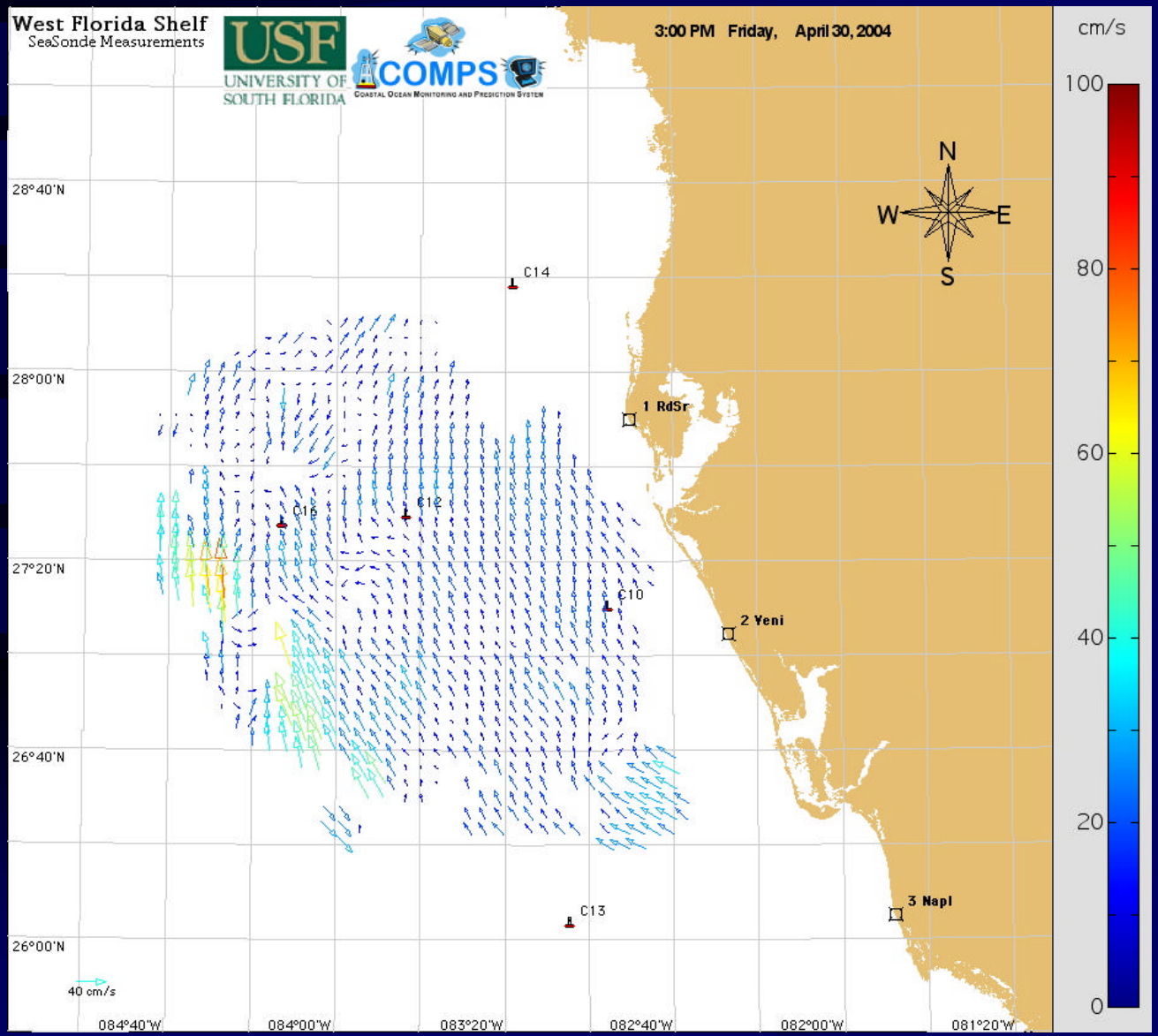
Coastal Ocean Dynamics Applications Radar (CODAR) Surface Current 2004 Velocity Vector Coverage



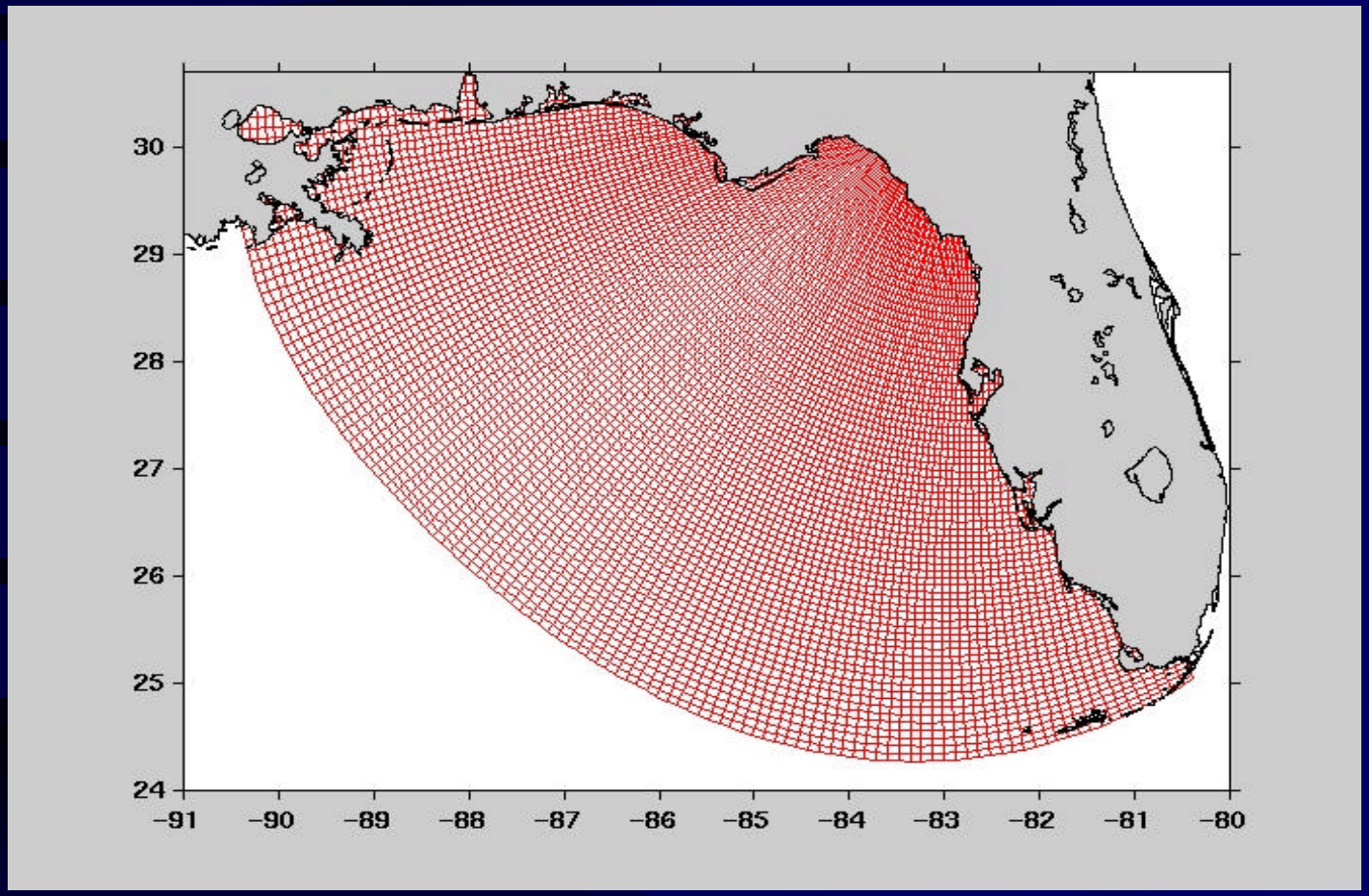
HF Radar Real-Time Radial Velocity Map
Redington Shores North Site



Measured Velocity Field - Sites 1 and 2

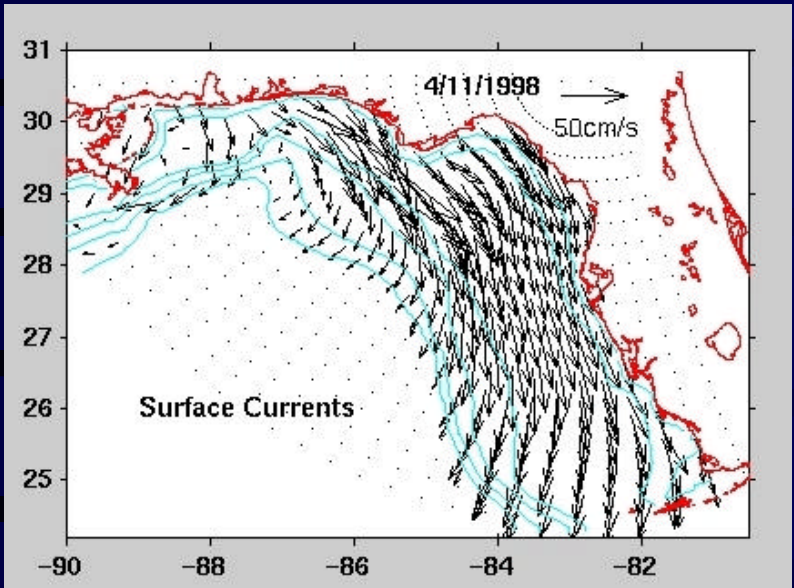


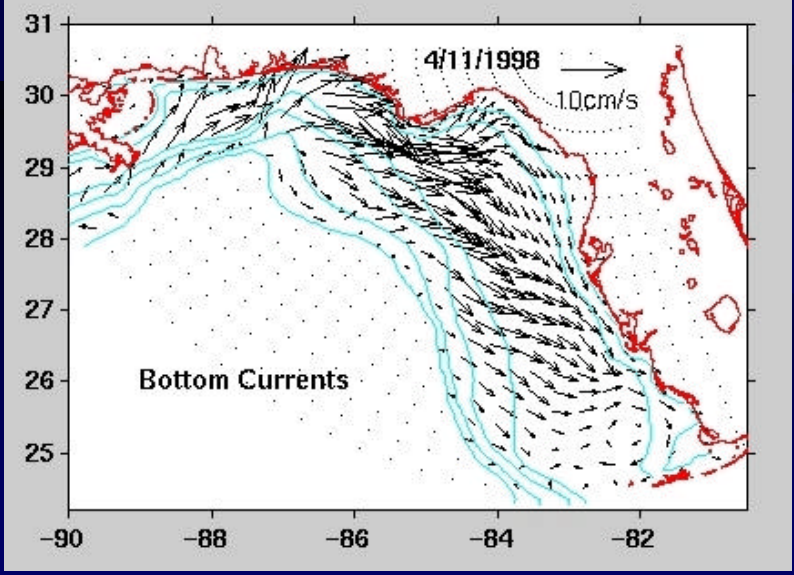
COMPS Model Grid



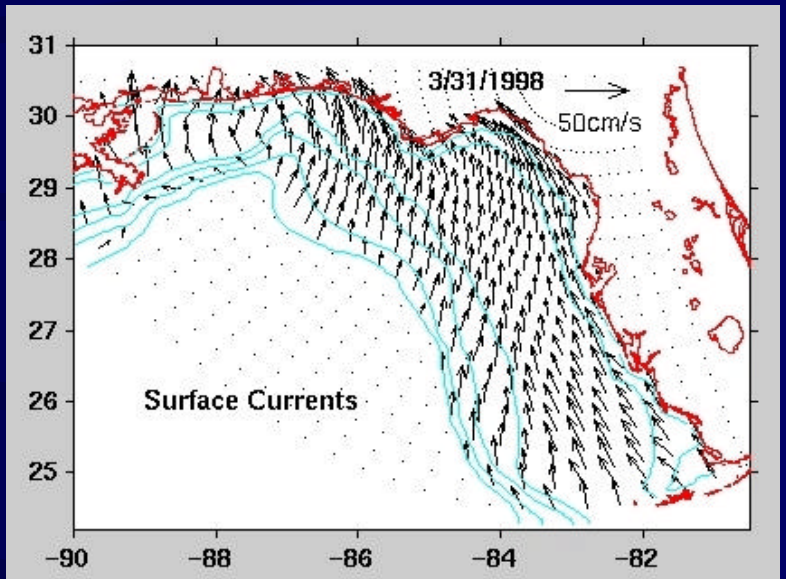
- **3-D primitive equation Princeton Ocean Model**
- **Resolution: < 2 km near the coast and ~ 6 km along the open boundary**
- **Forced by NOAA NCEP reanalysis wind, air pressure, surface heat fluxes and rivers**
- **Initialized by across-shelf hydrographic data.**

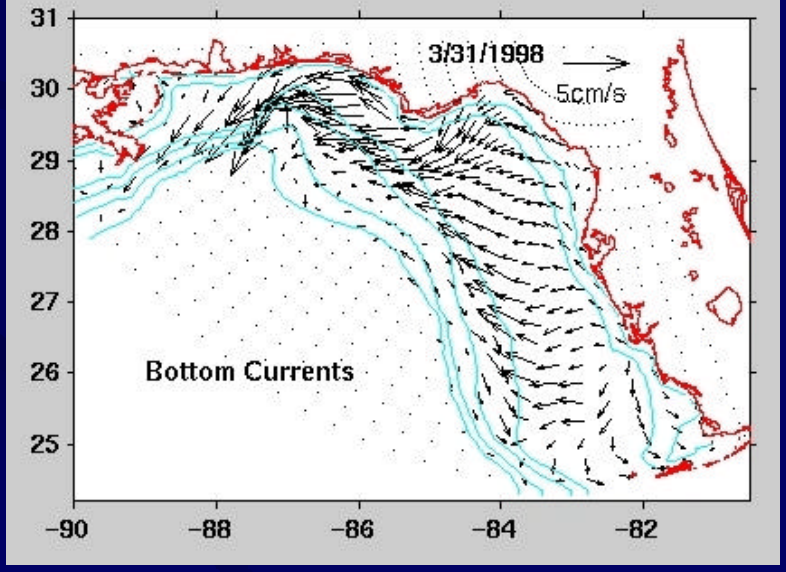
Upwelling Circulation



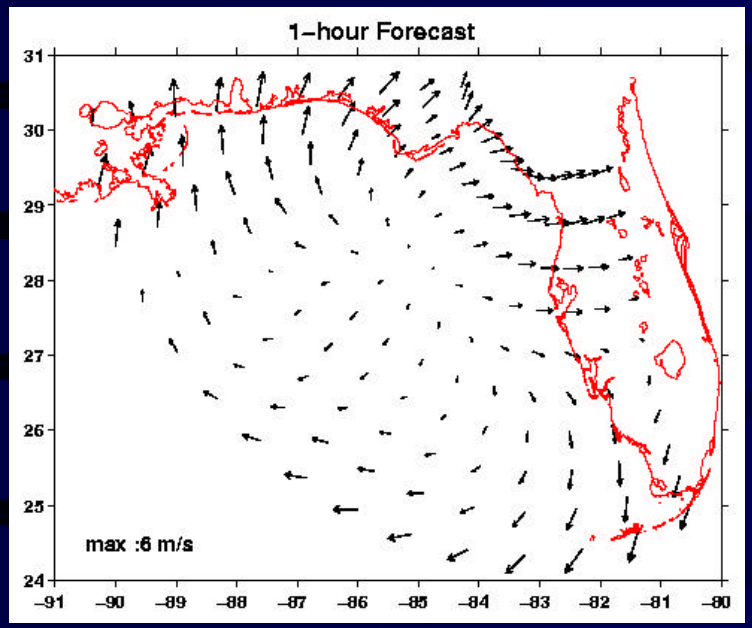


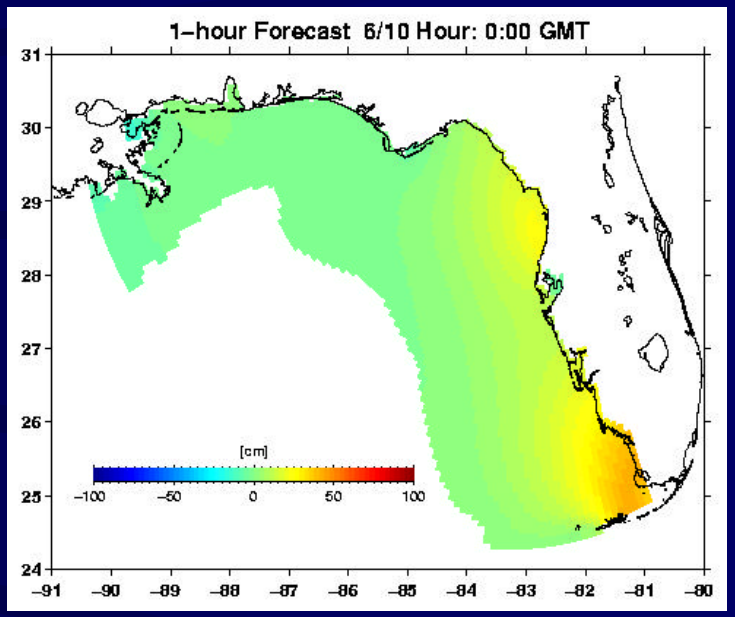
Downwelling Circulation

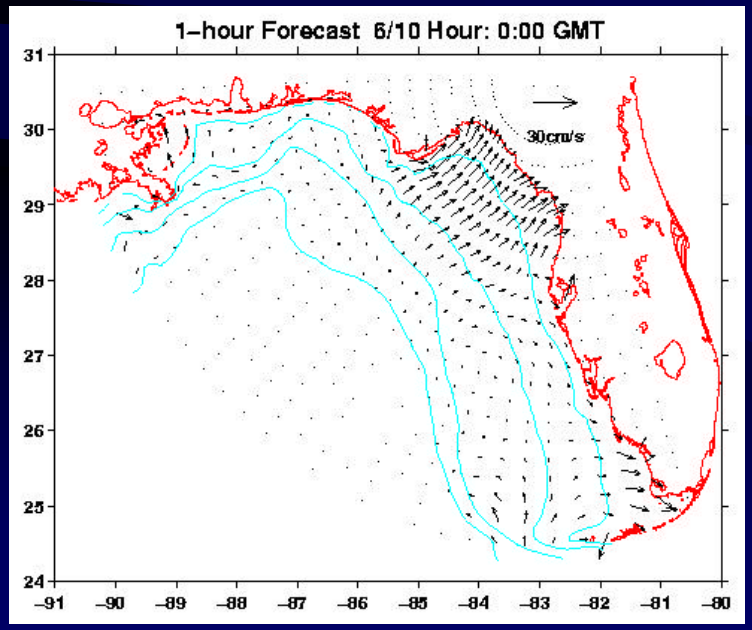


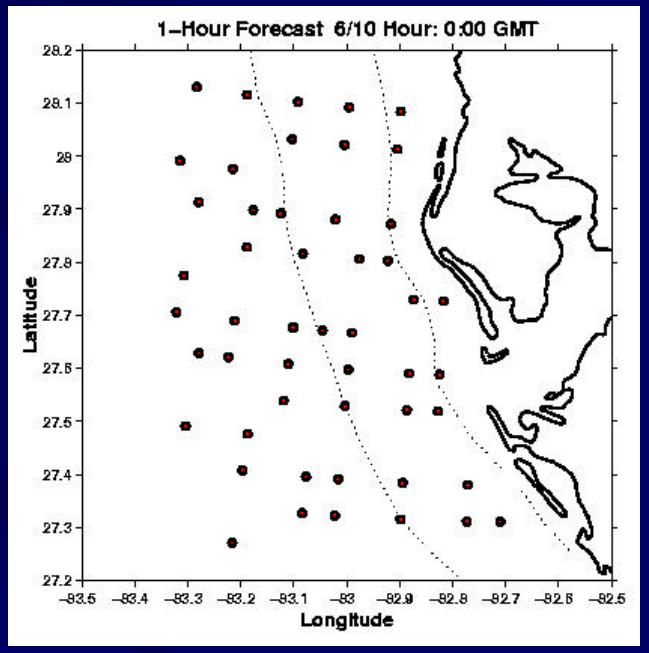


Model Products – 36 Hour Forecast



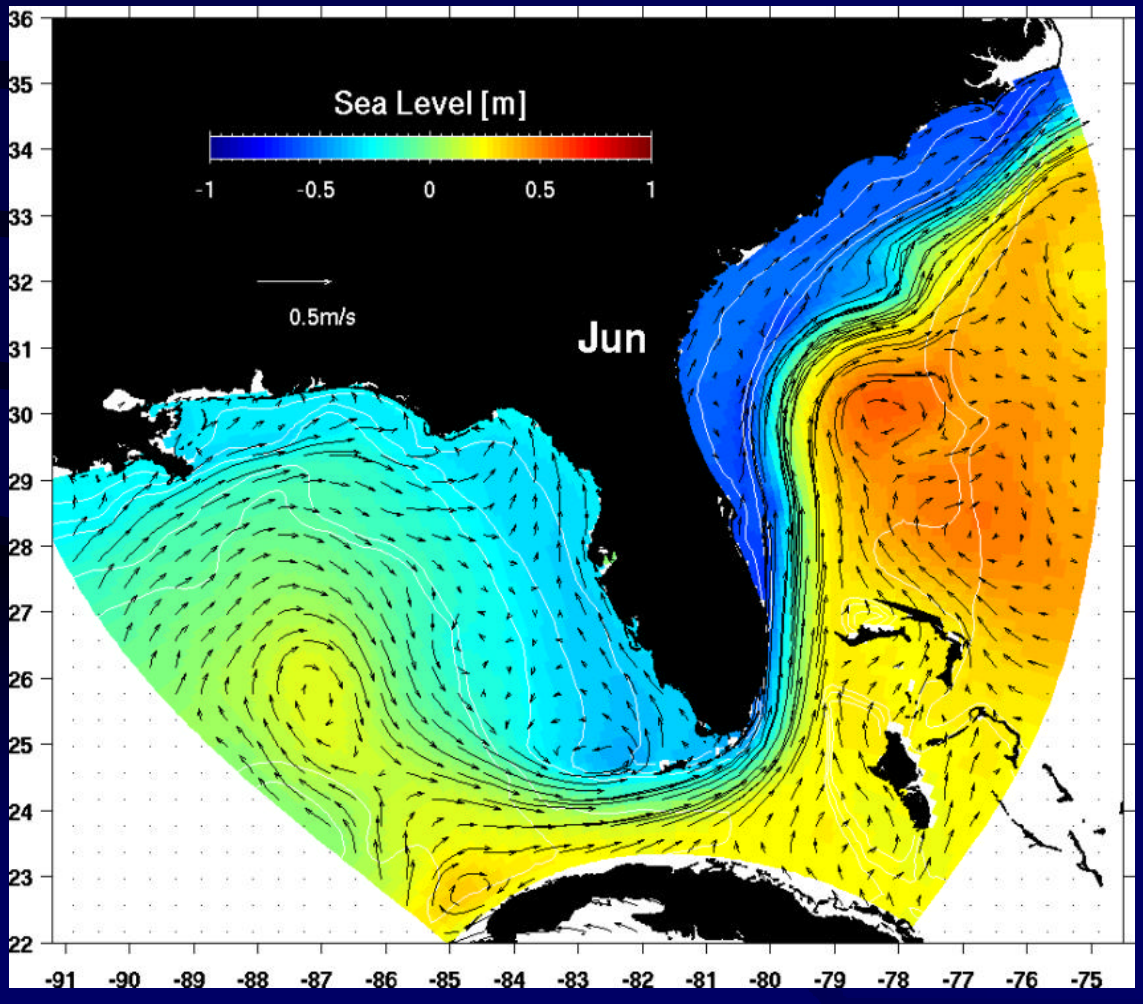






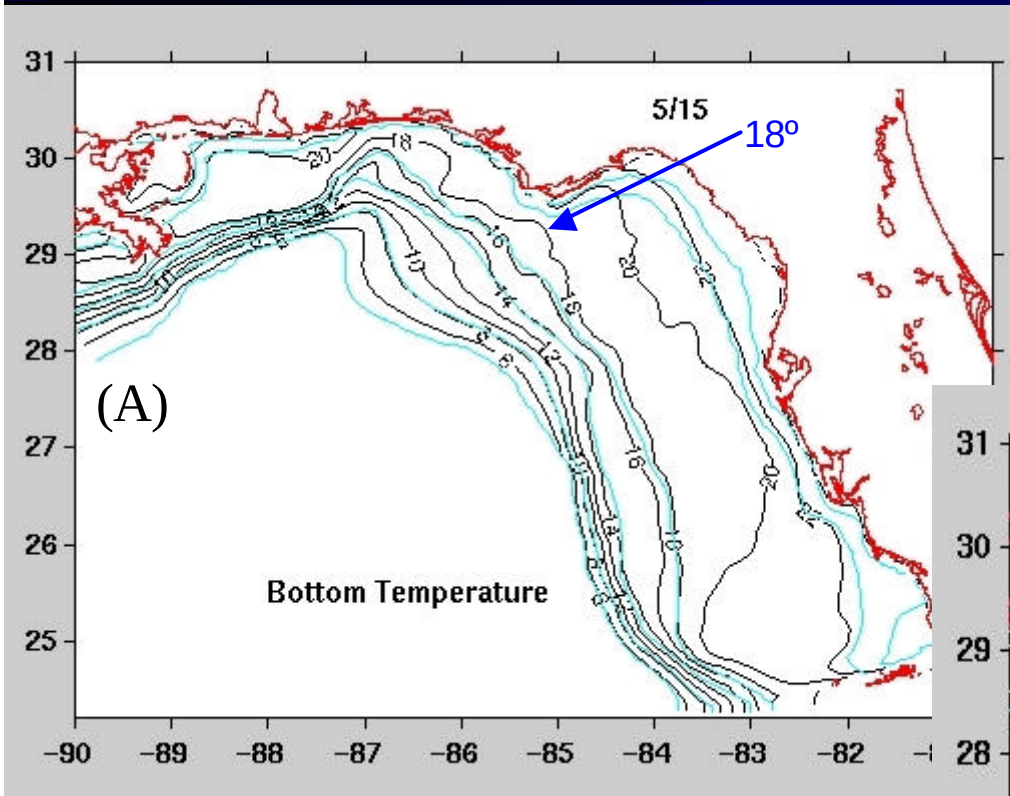
More Modeling

Regional ROMS (as below) and HYCOM applications are to better include the effects of the G of M Loop Current on the WFS, and to draw connections around the southeast US. Finally, coupled biological modeling is with J. Walsh.



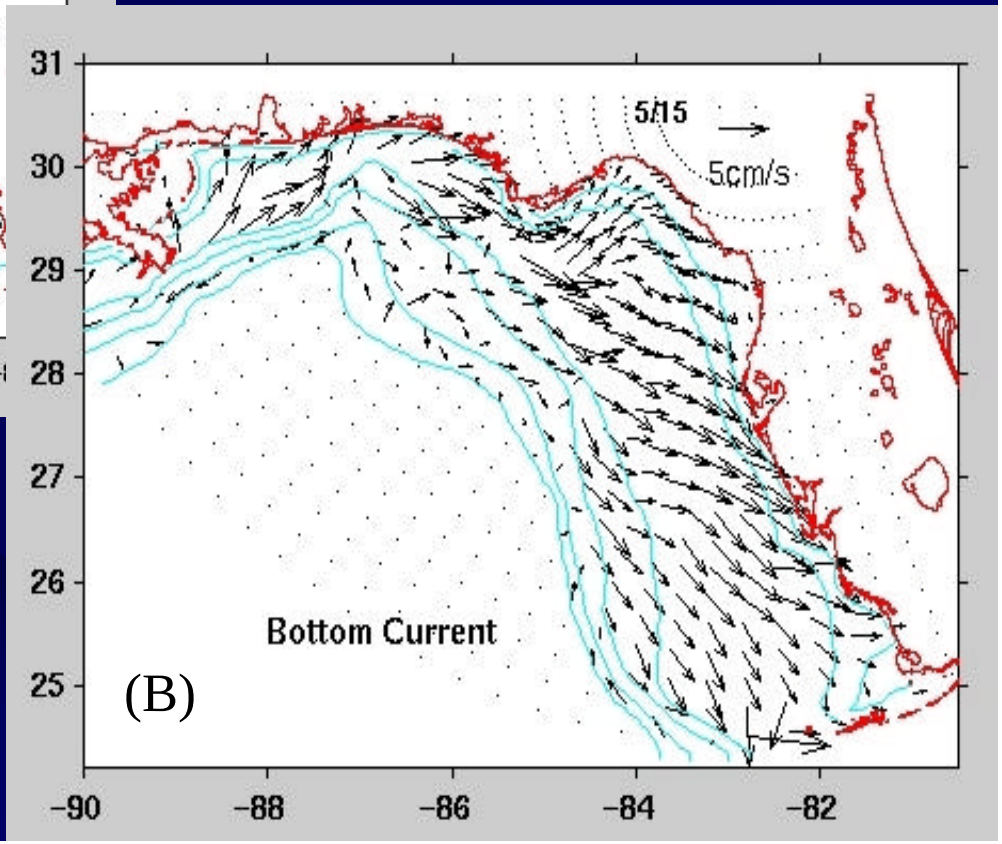
Explanation of anomalous 1998 “Cold Tongue” condition

see phys. and coupled phys./biol. model simulations by Weisberg and He (2003) and Walsh et al. (2003)



Modeled Upwelling Circulation

(A) Cold, nutrient-rich water upwells onto the shelf by the combined effects of local and LC forcing.



(B) Bottom Ekman layer currents then transport these waters towards the coast, contributing to the coastal primary productivity.

COMPS/WFS Collaborating Agencies

State of Florida

- Florida Department of Environmental Protection
- Florida Department of Emergency Management
- Florida Marine Research Institute
- Florida Institute of Oceanography
- Citrus, Pasco, Pinellas, Wakulla, Lee , and Monroe Counties
- City of Tarpon Springs
- South West Florida Water Management District

Federal

- Office of Naval Research
- National Weather Service
- National Oceanic and Atmospheric Administration
- United States Geological Survey
- Southeast Atlantic Coastal Ocean Observing System (SEA-COOS)
- Southeast Coastal Ocean Observations Regional Association (SECOORA)

CONCLUSION

- Since their inception, the PORTS and COMPS Programs have grown steadily in both size and constituent usage

- Through partnering efforts, they have forged “grass roots” Networks of Direct Maritime and Public Support as well as providing a Platform for Scientific and Educational Outreach Purposes

- Both the PORTS and COMPS Programs provide examples of the practical value of University Research

QUESTIONS?

THANK YOU!