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
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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)
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). 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 in 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 affected 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).
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 Station

CMP4

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.

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<tr>
<th>Meteorological Data</th>
<th>Date: 09-27-02</th>
<th>Date: 09-27-02</th>
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<td>Wind Gusts</td>
<td>9.3 ms⁻¹</td>
<td>18.07 knots</td>
<td>9.4 ms⁻¹</td>
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<td>Air Temp</td>
<td>28.44 °C</td>
<td>83.19 °F</td>
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<td>Sea Surface Temp</td>
<td>28.90 °C</td>
<td>84.02 °F</td>
<td>28.90 °C</td>
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<td>Barometric Pressure</td>
<td>1009.9 mbar</td>
<td>29.82 in Hg</td>
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<td>Relative Humidity</td>
<td>75%</td>
<td>75%</td>
<td>78%</td>
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<td>Short Wave Radiation</td>
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<td>636.40 W/m²</td>
<td>690.00 W/m²</td>
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<td>Long Wave Radiation</td>
<td>421.40 W/m²</td>
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<td>420.20 W/m²</td>
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<td>4 m</td>
<td>12 m</td>
<td>17 m</td>
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<tr>
<td>Time</td>
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<td>Current Speed</td>
<td>8.5 ms⁻¹</td>
<td>0.17 knots</td>
<td>7.1 ms⁻¹</td>
<td>0.14 knots</td>
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<td>Current Direction</td>
<td>21° True</td>
<td>45° True</td>
<td>62° True</td>
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</table>
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
**COMPS Station**

**Big Carlos Pass**

<table>
<thead>
<tr>
<th>Station ID</th>
<th>DBP</th>
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<tbody>
<tr>
<td>Latitude</td>
<td>26° 24.209' N</td>
</tr>
<tr>
<td>Longitude</td>
<td>81° 52.000' W</td>
</tr>
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</table>

**Responsibility Agency**

**Site Notes**
The COMPS Big Carlos Pass Coastal Station is physically located at 26° 24.209' N and 81° 52.000' W, off the Big Carlos Pass Bridge between the cities of Fort Myers Beach and Bonita Springs, FL. Mounted on the bridge deck is a black-canopy, white-air intake shelter with temperature and humidity sensors, an acoustic wave detector, an anemometer, and pressure sensors. Data is transmitted via GOES satellite. The site is operated by the Florida Department of Environmental Protection.

**Latest Observations**

Measurements are made every 6 minutes and are downloaded hourly via GOES satellite. Time reported in UTC (Coordinated Universal Time; subtract 4 hours for EST; subtract 5 hours for EDT). Data are not quality-controlled, unless noted otherwise.

### Meteorological and Marine Data

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<td>Barometric pressure</td>
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<tr>
<td>Air temperature</td>
<td>31.1°C</td>
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<tr>
<td>Relative humidity</td>
<td>62.6%</td>
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<tr>
<td>Wind speed</td>
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<td>Wind gusts</td>
<td>45 m/s</td>
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<tr>
<td>Wind direction</td>
<td>216°</td>
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<tr>
<td>Water temperature</td>
<td>22.1°C</td>
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<tr>
<td>Salinity</td>
<td>24.7</td>
</tr>
</tbody>
</table>

Water level referenced unmeasured 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 --

### Past 24-hour Observations

<table>
<thead>
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<th>Metric</th>
<th>Imperial</th>
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<tr>
<td>Wind speed</td>
<td>23 m/s</td>
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<tr>
<td>Wind gusts</td>
<td>45 m/s</td>
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<tr>
<td>Water temp</td>
<td>22.1°C</td>
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</table>

### Past 5-Day Observations

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<td>Barometric</td>
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<td>Air temp</td>
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<tr>
<td>Relative hu.</td>
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<tr>
<td>Wind speed</td>
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<tr>
<td>Wind gusts</td>
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</tr>
<tr>
<td>Wind direction</td>
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</tr>
<tr>
<td>Water temp</td>
<td></td>
</tr>
<tr>
<td>Salinity</td>
<td></td>
</tr>
</tbody>
</table>
COMPS Station
Big Carlos Pass: Hurricane Charley Graphics

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

- bcp: Windspeed
- bcp: Wind Direction
- bcp: Wind Gusts
- bcp: Barometric Pressure
- bcp: Relative Humidity
- bcp: Wet Temperature
- bcp: Water Level
- bcp: Water Temperature
- bcp: Salinity
- bcp: Precipitation

USF
COMPS Map — Station Menu — Site Guide — COMPS Info — Guestbook
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
• 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.
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.
Explaination 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.

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)
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!