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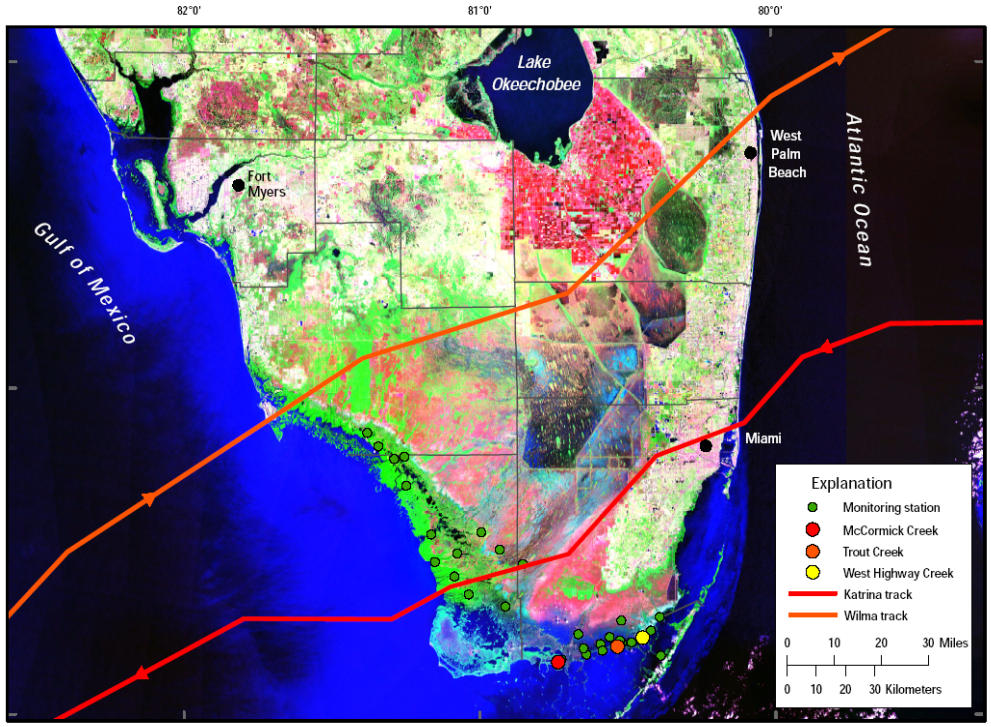
Northeastern Florida Bay Estuarine Creek Response during the 2004-05 Hurricane Seasons

Five hurricanes impacted south Florida during the 2004 and 2005 hurricane seasons: Charley, Frances, and Jeanne in 2004, and Katrina and Wilma in 2005. Data collection during such storms is an important component of hydrodynamic modeling, disaster management, and storm prediction. In Northeastern Florida Bay, the U.S. Geological Survey (USGS) coastal monitoring network recorded the extreme hydrologic conditions created by these hurricanes. Following the storms, USGS personnel measured flows using acoustic Doppler current profilers (ADCP's) and recorded high water debris marks at all of the stations.

The coastal monitoring network consists of 29 hydrologic monitoring stations that measure water level, discharge, salinity, and temperature. Thirteen stations measure stream velocity, which is then used to calculate creek discharge at 15-minute intervals. The remaining station measures stage, salinity, and temperature only. For the stations which measure stream velocity, a linear regression is used to relate mean measured velocity measurements (from a boat mounted ADCP) to velocity measurements obtained from an acoustic Doppler velocity meter deployed permanently on the channel bank. Creek discharge is then estimated by calculating the cross-sectional area of the creek, dictated by stage values, and multiplying the area by the rated velocity determined from the velocity regression.

Time series data from three of the monitoring stations were graphically compared to analyze hydrologic trends and similarities during periods of high wind and storm surge. Analysis of all measured and calculated data collected during these storm events correlate well between sites. The timing and magnitude of the observed peak storm surge was dependent upon the path of the storm (as it approached the coast) in relation to the geographic location and orientation of the estuary. Discharge and salinity trends showed clear differences between the two years in the amount of time required for the system to return to "typical" conditions for that time of year. Water retention from storm surges was dependent on wetland conditions carried over from the dry season, rainfall, and water management practices.



A.

Total discharges into northeast Florida Bay for McCormick Creek, Trout Creek, and West Highway Creek, 1996-2005.
In figure 3. 2004 was the lowest output of freshwater for this system due to a dry year partially due to a lack of hurricane activity directly over the study area. In 2005, the highest flows were recorded due primarily to the occurrences of Hurricanes Katrina and Wilma that passed directly over the study area.

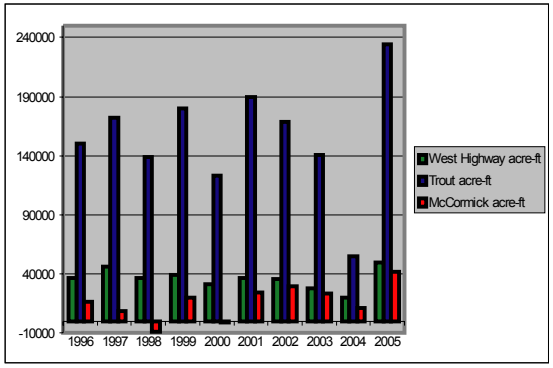


Figure 3. Total annual discharge from McCormick Creek, Trout Creek, and West Highway Creek into Northeastern Florida Bay.

Salinity Response to Hurricanes

As a result of storm surge from Hurricane Wilma, McCormick Creek salinity levels remained above pre-storm conditions for the remainder of the wet season and into the dry season during 2005. To the north of McCormick Creek lies a system of upstream lakes which have only one conduit with which to drain water to Florida Bay. During Hurricane Wilma, surge pushed saline water from the bay over the naturally occurring embankment which McCormick Creek cuts through. This saline water from the surge was then stored in the upstream lakes with no means of drainage except through McCormick Creek. Consequently outflow from McCormick Creek while significant was still more saline then pre-Wilma conditions due to the salt content stored in the lakes above it from surge and as a result of evapotransporation. Trout and West Highway Creeks both were able to regain their pre-storm salinity conditions after Hurricane Wilma due to a higher drainage capability and possibly due to upstream water-management practices (Fig. 4).

Water Level Response to Hurricanes

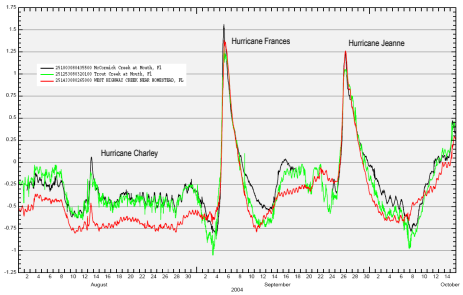


Figure 2A. Fifteen minute stage values from August through October 2004 at McCormick Creek, Trout Creek, and West Highway Creek.

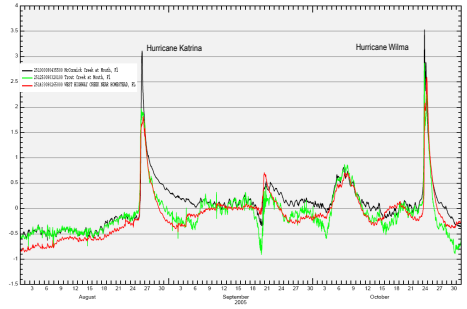
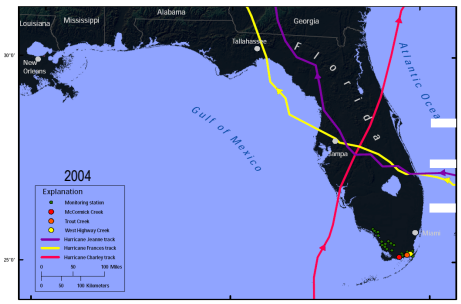


Figure 2B. Fifteen minute stage values from August through October 2004 at McCormick Creek, Trout Creek, and West Highway Creek.

B.



C.

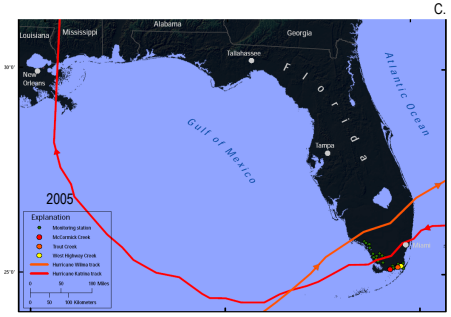


Figure 1A-C. Above. Hurricanes Katrina and Wilma tracks shown as they crossed the USGS coastal studies network of monitoring stations.

Salinity Response to Hurricanes

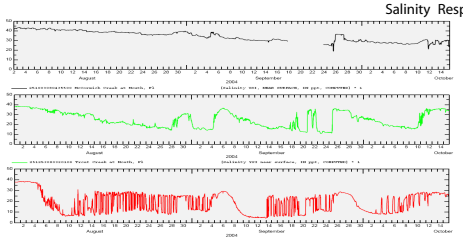


Figure 4A. Fifteen minute interval salinities from August through October 2004 at McCormick Creek, Trout Creek, and West Highway Creek.

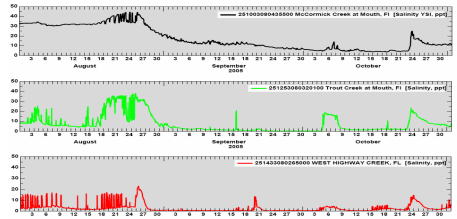


Figure 4B. Fifteen minute interval salinities from August through October 2004 at McCormick Creek, Trout Creek, and West Highway Creek.

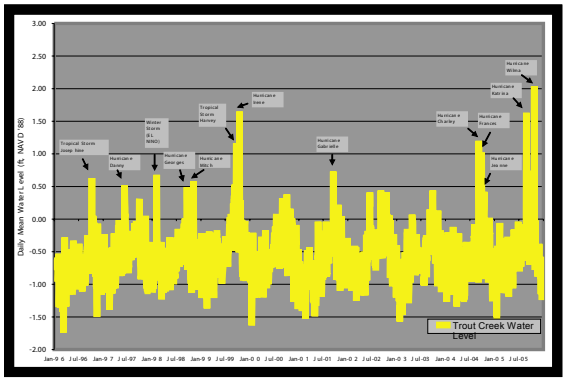


Figure 5. Trout Creek water level response during previous hurricanes.

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