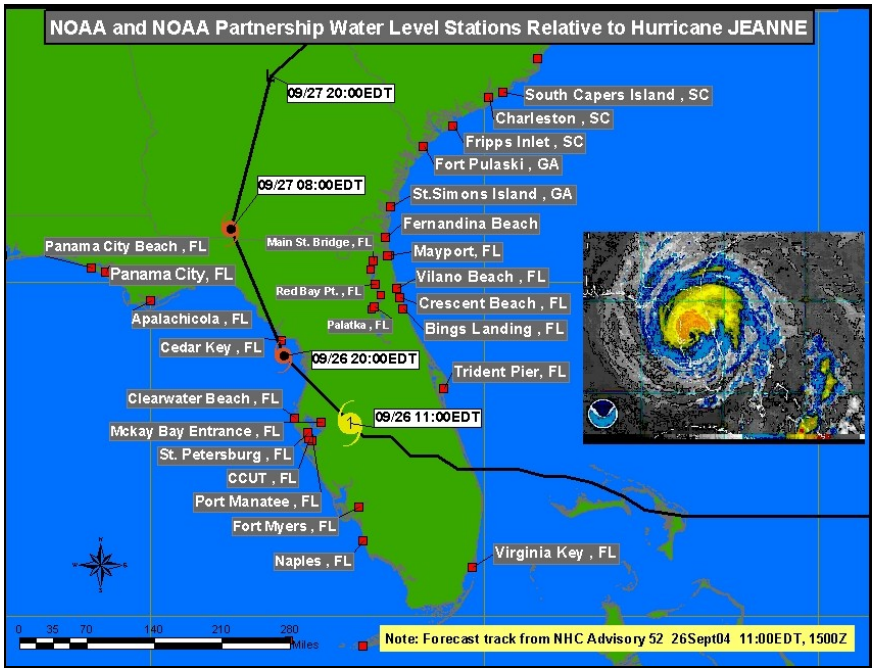
Hurricane jeanne
Preliminary Water Levels Report



Tide Gauges within the Path of Hurricane Jeanne

*For the purpose of timely release, data contained within this report have undergone "limited" NOS Quality Assurance/Control; however, the data have not yet undergone final verification. All data subject to NOS verification.

September 2004

noaa National Oceanic and Atmospheric Administration

U.S. Department of Commerce
National Ocean Service
Center for Operational Oceanographic Products and Services

SUMMARY

CO-OPS Tide Gauge Data for Hurricane Jeanne

NOAA's Center for Operational Oceanographic Products and Services (CO-OPS) maintains a network of tide gauges along the eastern United States coast line, the Caribbean, and the Gulf of Mexico. These tide gauges are actively monitored when storm events occur in the Atlantic. Data from the tide gauges that lie directly within the path of the storm can be triggered to appear in storm surge mode in real time on Tides Online (http://tidesonline.nos.noaa.gov). Storm surge is the observed water level minus the predicted water level referred to MLLW.

Hurricane Jeanne had two major stages of impact. First Jeanne made landfall on Hispaniola as Tropical Storm and then after meandering through the Atlantic for a few days she made landfall again as a Category 3 Hurricane on Florida's mainland. Hurricane Jeanne effected tide gauges in the Caribbean, Florida, Georgia, and South Carolina. Currently CO-OPS monitors 2 tide gauges in the Virgin Islands, 2 in Puerto Rico, 34 in Florida, 2 in Georgia, and 5 in South Carolina.

Hurricane Jeanne Storm Track and Progression

The initial advisory for the 11th tropical depression of the 2004 Hurricane season was issued at 1600 EDT/ 2000Z on Monday September 13, 2004. Tropical depression Jeanne was located at latitude16.0 N and longitude 60.4 W, 70 miles SE of Guadeloupe. At 1000 EDT/ 1400Z Tuesday September 14, 2004 Jeanne was upgraded to a Tropical Storm moving northeast through the Caribbean. Hurricane warnings for Puerto Rico and the Virgin Islands were issued at 1600 EDT/ 2000Z on Tuesday September 14, 2004.

On Wednesday September 15, 2004 1300 EDT/ 1700Z Jeanne made landfall over Puerto Rico as a strong Tropical Storm, 25 miles south southeast of San Juan, PR. The center of the storm was located at latitude 18.1 N and longitude 66.1 W. As Jeanne made landfall on Puerto Rico she dropped copious amounts of rain and induced severe flooding.

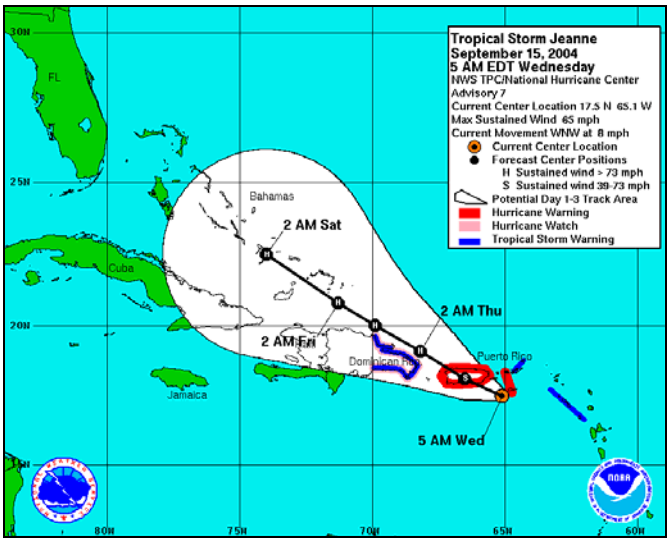


Figure 1. Predicted Path of Tropical Storm Jeanne, Wednesday September 15, 2004 @ 0500 EDT/0900Z.

Maximum Water Level and Storm Surge Values for CO-OPS Tide Gauge Stations in the Caribbean and Puerto Rico

There were four CO-OPS tide gauge stations in the Caribbean and Puerto Rico that were effected by Tropical Storm Jeanne: Lime Tree Bay, VI (Figures 4 & 5); Charlotte Amalie, VI (Figures 6 & 7); San Juan, PR (Figures 8 & 9); and Maqueyes, PR (Figures 10 & 11). As a tropical storm, Jeanne produced minimal amounts of storm surge in the Caribbean. However, each of the four CO-OPS tide gauge stations recorded elevated water levels. Table 1 lists the maximum observed water levels relative to station datum and MLLW. NAVD 88 and NGVD 29 values are not available for these stations. The maximum observed water levels above MLLW are further compared in Figure 2. A comparison of storm surge values for these CO-OPS stations within the path of Tropical Storm Jeanne are listed below in Table 2 & Figure 3. The greatest amount of surge was 0.378m (1.24ft) on 09-15-04 @ 10:30 GMT at Lime Tree Bay, VI. However, San Juan, PR had the highest observed maximum water level of 0.664m (2.18ft) above MLLW on 09-18-04 @ 15:48 GMT.

Maximum Observed Water Levels in the Caribbean and Puerto Rico

Table 1. Maximum Observed Water Levels Referred to MLLW. NAVD 88 and NGVD 29 values are not available for these stations.

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Station Name	Station ID	Latitude	Longitude	Date/Time GMT	Maximum Water Level above Station Datum (m)	Maximum Observed Water Level Above MLLW (m)
Lime Tree Bay, VI	9751401	17 41.8 N	64 45.2 N	09-15-04 10:30	10.970	0.581
Charlotte Amalie, VI	9751639	18 20.1N	64 55.2 N	09-21-04 20:00	2.024	0.423
San Juan, PR	9755371	18 27.5 N	66 7.0 N	09-18-04 15:48	1.696	0.664
Maqueyes, PR	9759110	17 58. 3 N	67 2.8 N	09-24-04 00:36	1.425	0.334

Maximum Observed Water Levels in the Caribbean and Puerto Rico during Hurricane Jeanne 12-Sept – 30 Sept 2004

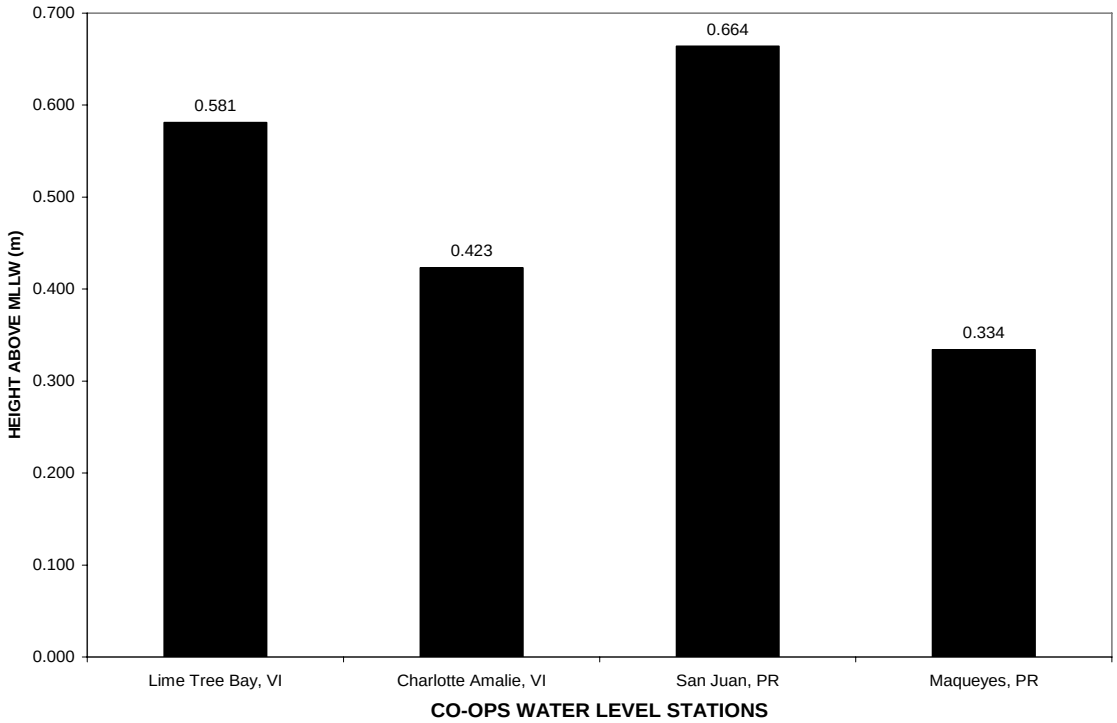

Figure 2. Comparison of Maximum Observed Water Levels above MLLW for CO-OPS stations in the Caribbean and Puerto Rico.

Maximum Observed Storm Surge in the Caribbean and Puerto Rico

Table 2. Maximum Observed Storm Surge for CO-OPS stations in the Caribbean and Puerto Rico.

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Station Name	Station ID	Latitude	Longitude	Date/Time GMT	Observed Water Level Above MLLW (m)	Predicted Water Level Above MLLW (m)	Maximum Surge (m)
Lime Tree Bay, VI	9751401	17 41.8 N	64 45.2 N	09-15-04 10:30	0.581	0.203	0.378
Charlotte Amalie, VI	9751639	18 20.1N	64 55.2 N	09-15-04 18:00	0.395	0.162	0.233
San Juan, PR	9755371	18 27.5 N	66 7.0 N	09-15-04 18:54	0.309	0.160	0.149
Maqueyes, PR	9759110	17 58. 3 N	67 2.8 N	09-16-04 06:30	0.288	0.161	0.127

Maximum Observed Storm Surge in the Caribbean and Puerto Rico during Hurricane Jeanne 12 Sept. – 30 Sept. 2004

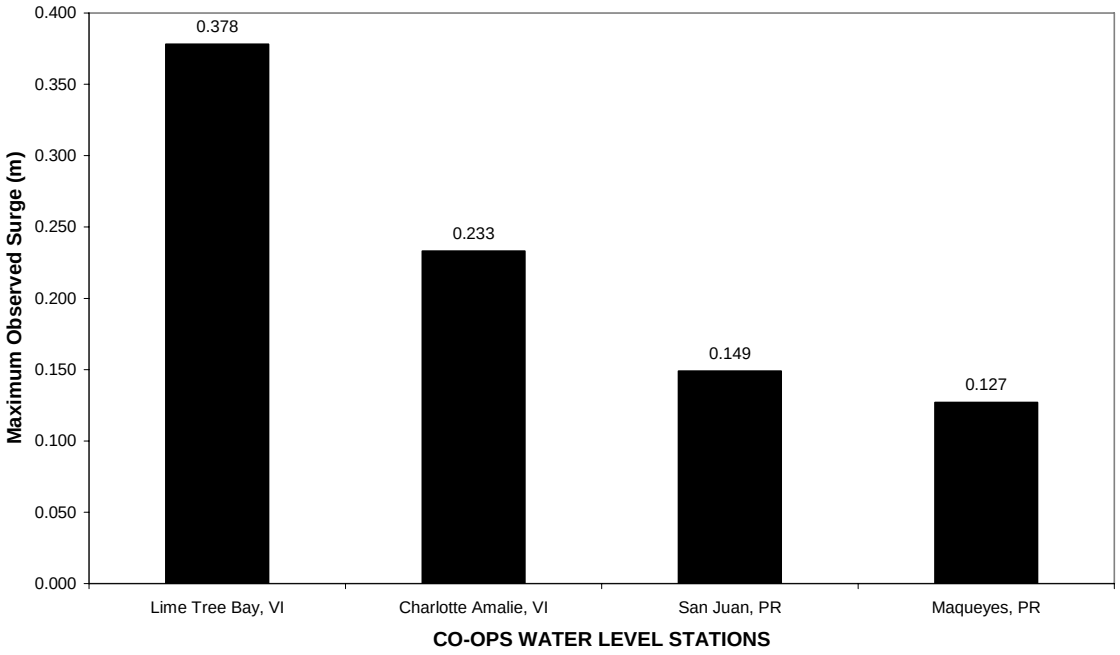

Figure 3. Comparison of Storm Surge values for CO-OPS Water Level Stations in the Caribbean and Puerto Rico.

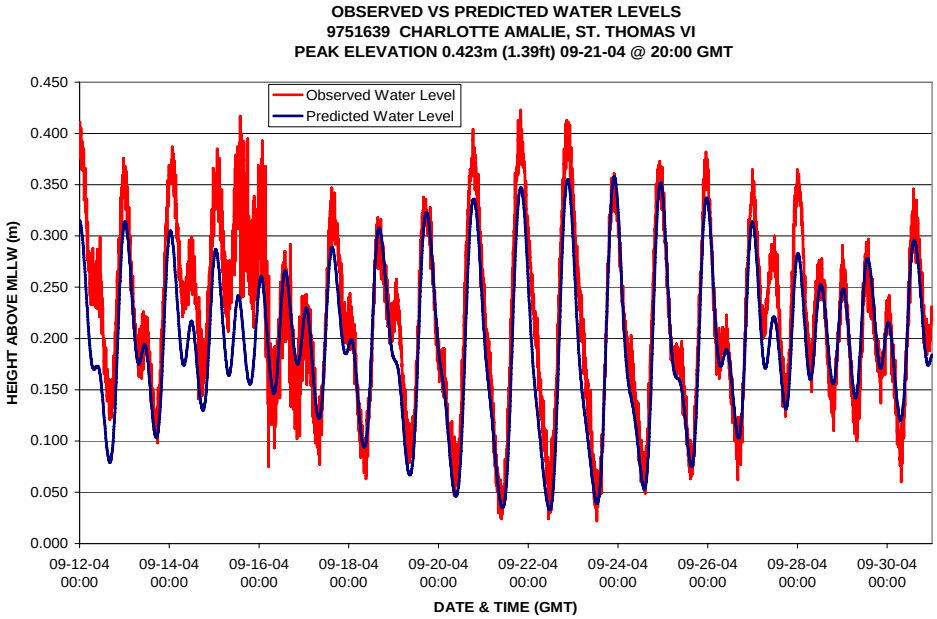

Figure 4. Observed vs. Predicted Water Levels for Charlotte Amalie, St. Thomas VI.

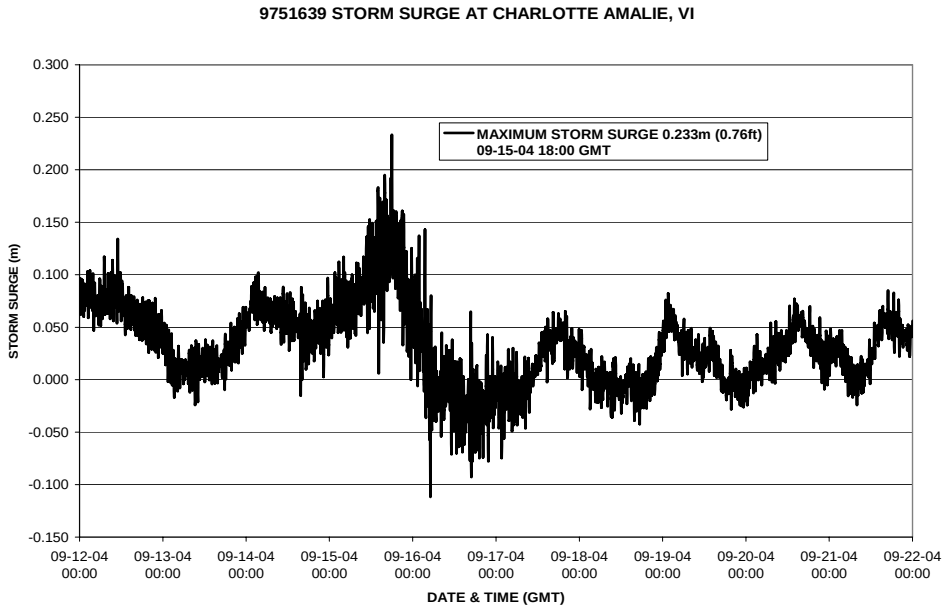

Figure 5. Storm Surge at Charlotte Amalie, St. ThomasVI.

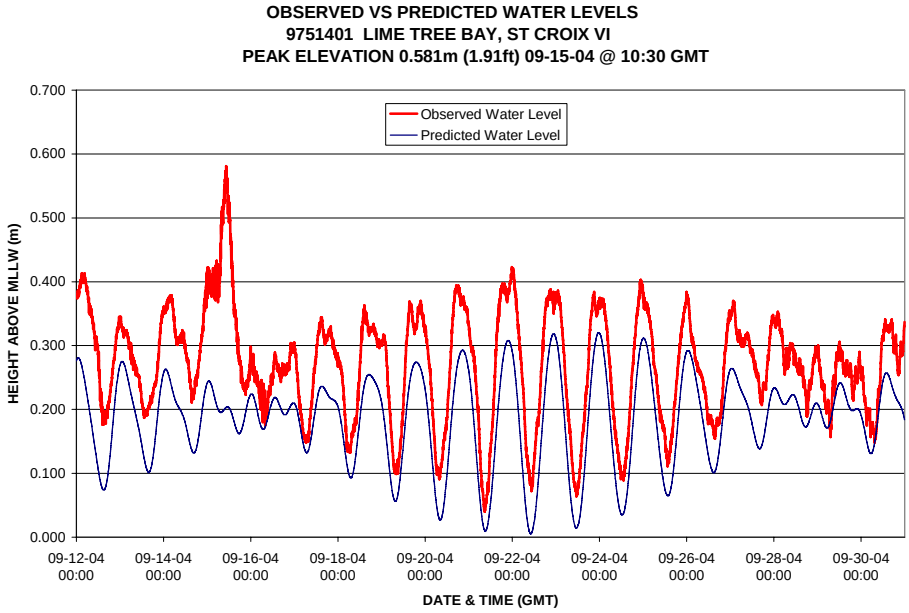

Figure 6. Observed vs Predicted Water Levels for Lime Tree Bay, St. Croix VI.

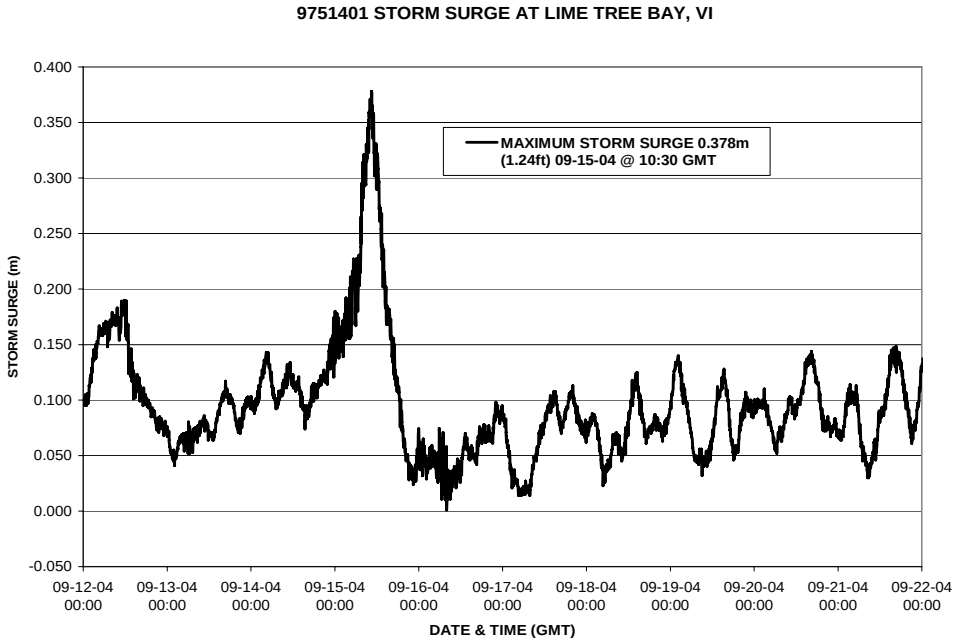

Figure 7. Storm Surge at Lime Tree Bay, St. Croix VI.

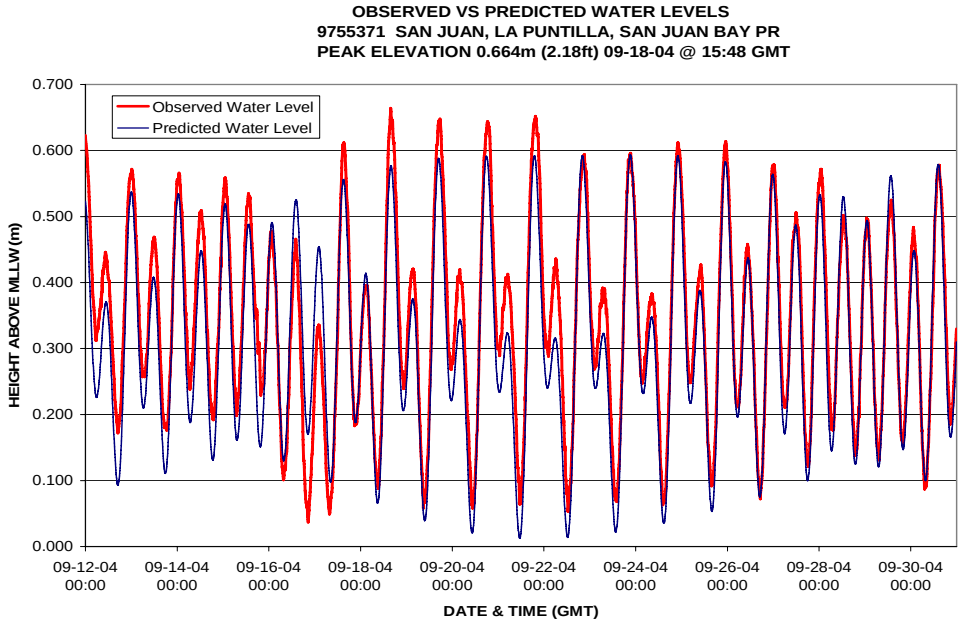

Figure 8. Observed vs. Predicted Water Levels for San Juan, La Puntillla, San Juan Bay PR.

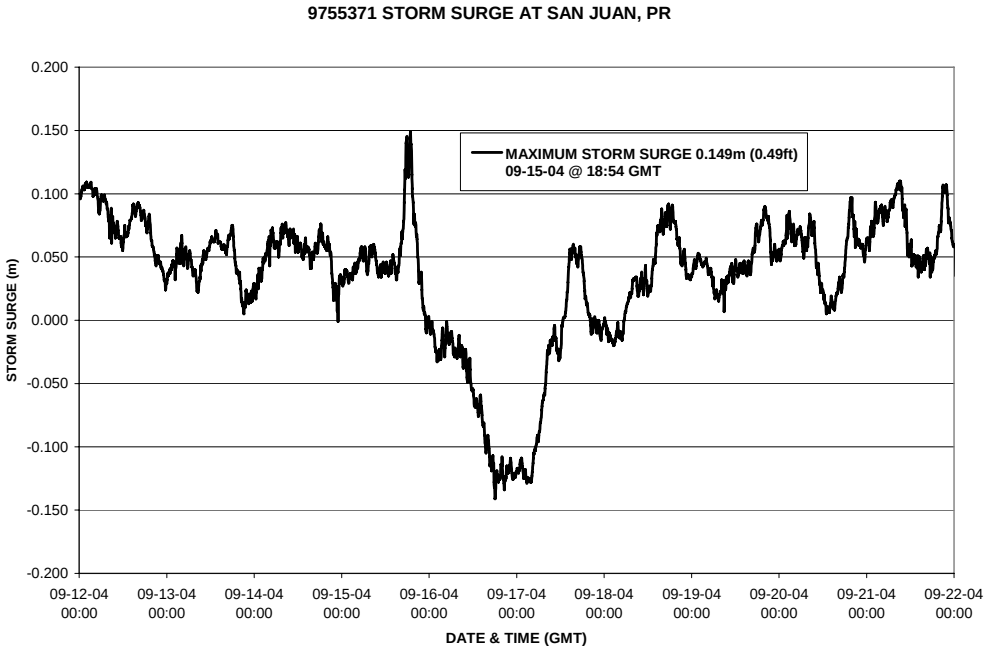

Figure 9. Storm Surge at San Juan, La Puntilla, San Juan Bay PR.

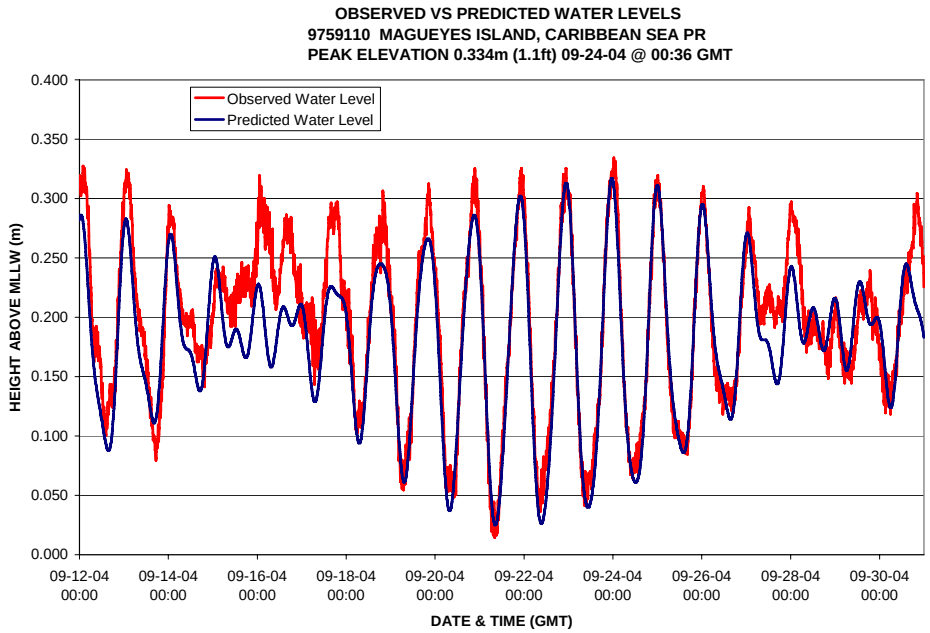

Figure 10. Observed vs. Predicted Water Levels for Magueyes Island, Caribbean Sea PR.

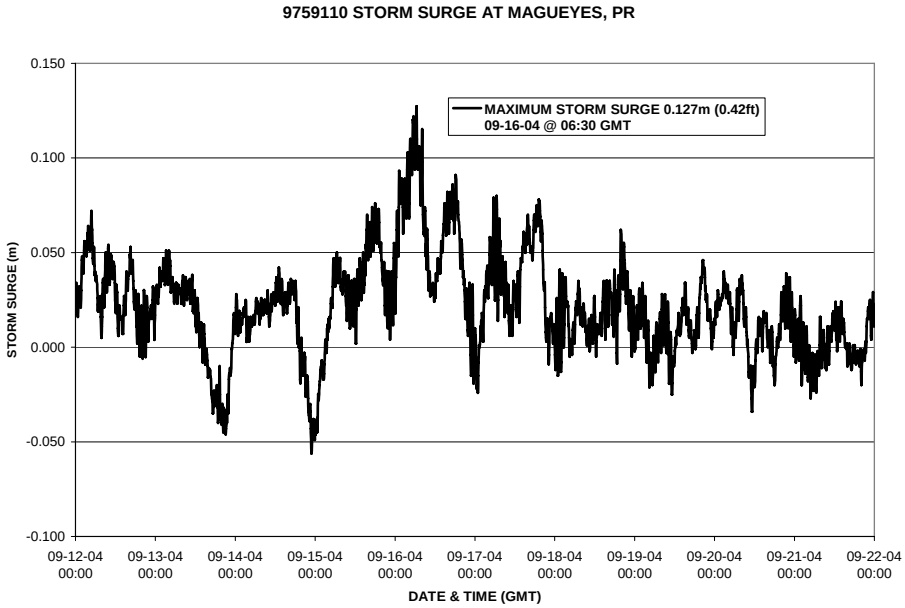

Figure 11. Storm Surge at Magueyes Island, Carribbean Sea PR.

After making landfall on Puerto Rico, Jeanne became the sixth hurricane of the 2004 season located near the eastern tip of Hispaniola and heading northeast over the Dominican Republic at 0700 EDT/1100Z Thursday September 16, 2004. However, by 1600 EDT/2000Z Jeanne was downgraded to a tropical storm over the Dominican Republic. On Friday September 17, 2004 1600 EDT/ 2000Z tropical storm warnings were discontinued and Jeanne was further downgraded to a tropical depression. The center of the depression was located just north of Hispaniola at latitude 20.2N and longitude 71.8 W.

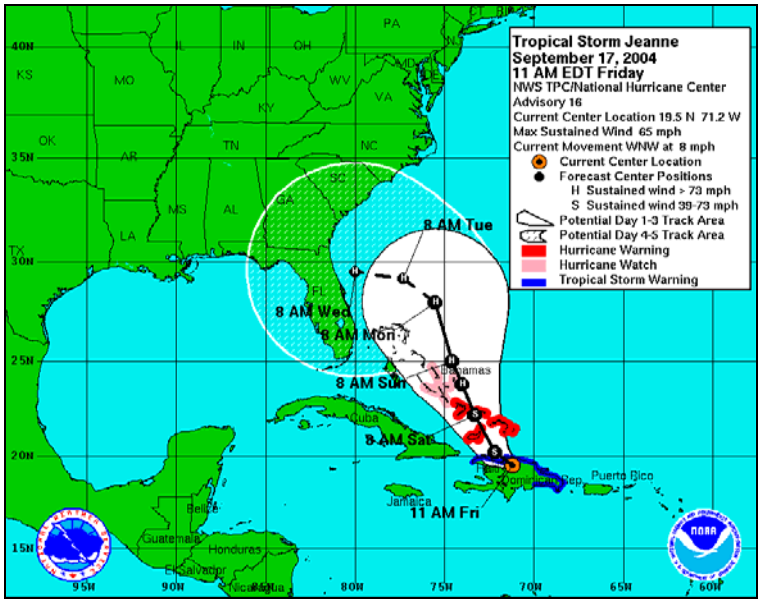

Figure 12. Projected Path of Tropical Storm Jeanne, Friday September 17, 2004 @ 1100 EDT/1500Z.

As Jeanne continued to move north northwest she regained intensity throughout Friday September 17, 2004 and was upgraded by 2200EDT/0200Z to a Tropical Storm with winds at 45mph. Tropical Storm Jeanne moved northward over the weekend and gained strength as she moved away from the Bahamas. By Monday September 20, 2004 Jeanne was well organized and had strengthened into a hurricane by 1700 EDT/2100Z. The center of the hurricane was found at latitude 27.4 N and longitude 71.2 W. Winds were at 85 mph and there was a central pressure of 983MB.

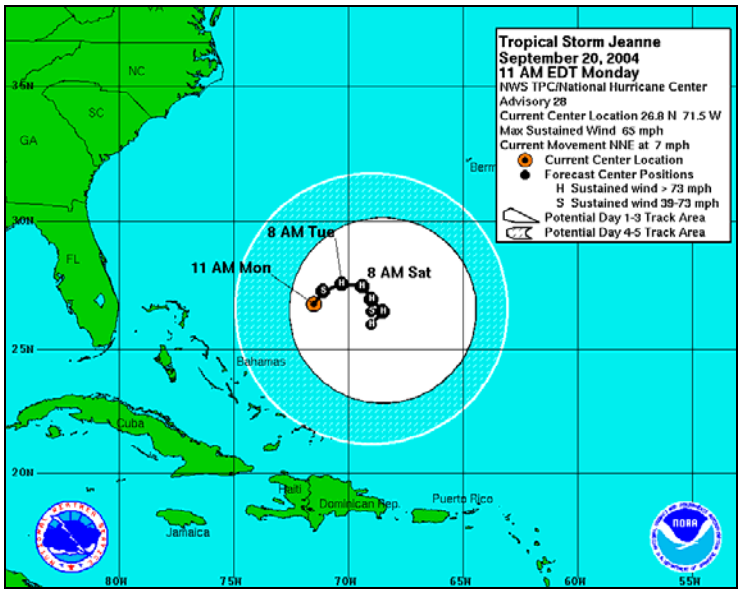

Figure 13. Projected Path of Tropical Storm Jeanne, Monday September 20, 2004 @1100 EDT/1500Z.

Jeanne continued to meander through the Bahamas on Tuesday September 21 and Wednesday September 22, 2004 causing hurricane watches for the surrounding areas. A hurricane watch remained in effect for the Central Bahamas on Thursday September 23, 2004.

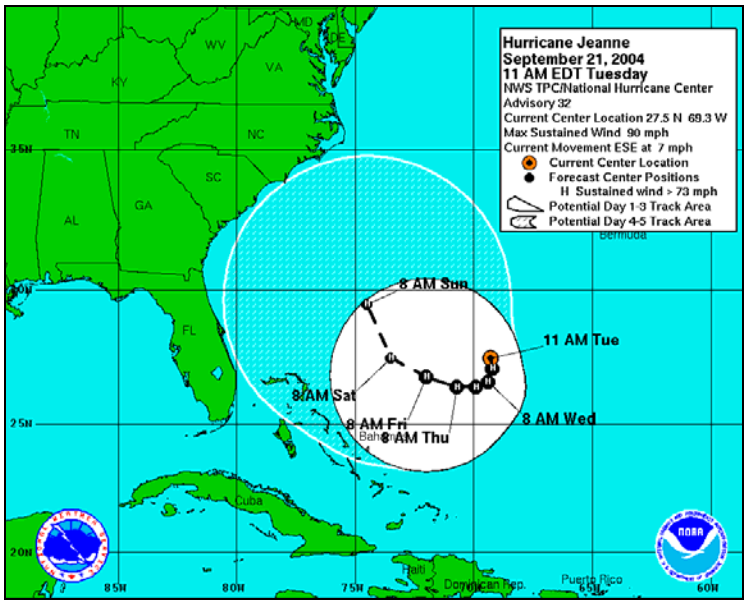

Figure 14. Projected Path of Hurricane Jeanne, Tuesday September 21, 2004 @ 1100 EDT/1500Z.

On Thursday September 23 at 1400 EDT/1800Z Jeanne was located at latitude 25.8 N and longitude 70.0 W moving west toward the eastern coast of Florida. By Friday September 24, 2004 Jeanne had become better organized was continuing to move westward. Hurricane warnings went into effect for Florida's eastern coast from Florida City to St. Augustine, while hurricane watches were issued for Northeast Florida and the Georgia Coasts. Jeanne became a dangerous Category 3 hurricane by 1100 EDT/1500z on Saturday September 25, 2004.

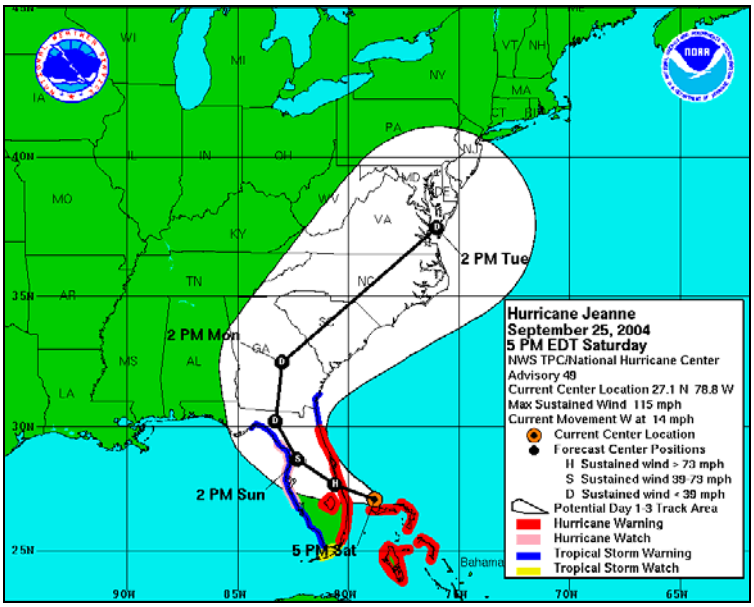

Figure 15. Projected Path of Hurricane Jeanne, Saturday September 25, 2004 @ 1700 EDT/2100Z.

Viciously hitting the Bahamas on Saturday September 25, 2004 Jeanne was centered at latitude 26.5 N and longitude 77.6 W, 155 miles southeast of the coast of Florida. Jeanne continued to attack the Bahamas throughout Saturday September 25, 2004. By 2300 EDT/0300Z the eye of the hurricane was beginning to move onto Florida's shore over Martin and St. Lucie's counties at latitude 27.2 N and longitude 80.0 W. Winds had increased to 115 mph with greater extending gusts. However, as Jeanne moved inland she began to weaken. By 0500 EDT/0900Z on Sunday September 26, 2004 Jeanne had downgraded to a Cat 2 Hurricane as she passed over Lake Okeechobee. Weakening throughout the day Jeanne was further reduced to a Tropical Storm by 1400 EDT/1800Z with winds at 70mph. At 2300 EDT/0300Z Sunday night (September 26) the Tropical Storm force winds struck the northeast Florida coasts. Winds had decreased to 50 mph and the eye of the storm was located at latitude 29.9 N and longitude 82.8 W.

On Monday September 27, 2004 Tropical Storm Jeanne was passing across Northern Florida and induced storm warnings for the eastern coast.

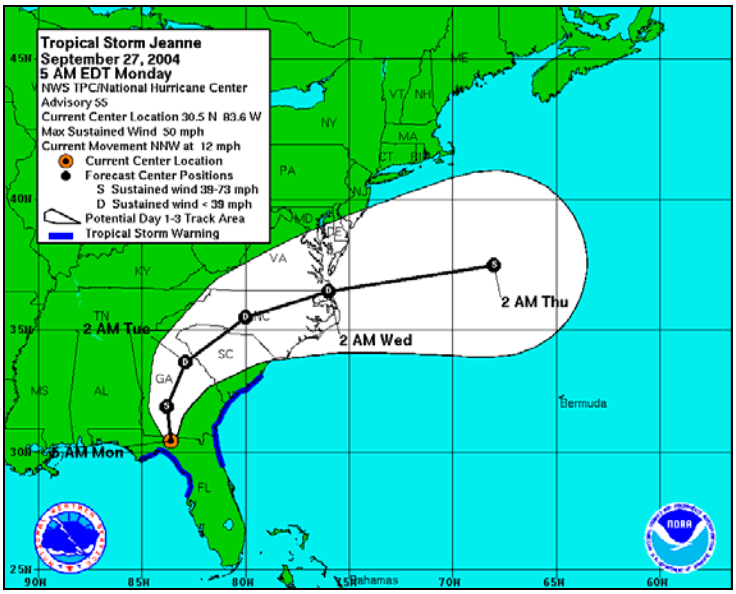

Figure 16. Projected Path of Tropical Storm Jeanne, Monday September 27, 2004 @ 0500 EDT/0900Z.

Jeanne weakened throughout the day and became a Tropical Depression by 1400 EDT/1800Z Monday September 27, 2004. The final advisory was issued at this time with Jeanne centered at longitude 32.2 N and latitude 83.7 W. The maximum sustained winds were at 30 mph and the minimum central pressure was 990MB.

Maximum Water Levels and Storm Surge Values for Florida, Georgia, & South Carolina

When Jeanne made landfall the second time as Category 3 Hurricane she affected the tides primarily in Florida and Georgia; however, elevated water levels were also seen in the Carolinas. There were fourteen tide gauges in Florida, one in Georgia, and three in South Carolina that experienced elevated water levels. The highest maximum observed water level above MLLW during Hurricane Jeanne was 2.884 m (9.46ft) on 09-27-04 @ 00:00 GMT at St. Simons Island, GA. Table 3 lists the eighteen tide gauges within Jeanne's path that recorded higher than normal water levels. These water levels are referred to station datum, MLLW, NAVD 88, and NGVD 29. Figure 17 further compares the observed maximum water levels for these stations above MLLW. Panama City Beach, FL (Figure 33); Panama City, FL (Figure 32); Apalachicola, FL (Figure 29); and Cedar Key, FL (Figure 25); which are all located in the Gulf of Mexico, experienced receded water levels.

Trident Pier (FL), Main Street Bridge (FL), Fernandina Beach (FL), Cedar Key (FL) and St. Simons (GA) all recorded storm surge over a 1m. The tide gauge at Cedar Key, FL recorded the highest storm surge of 1.631m (5.35ft) on 09-27-04 @ 10:48 GMT. In addition Cedar Key, FL also recorded the greatest maximum low of -0.750m (-2.46ft) on 09-26-04 @ 22:00 GMT. Table 4 and Figure 18 compare the maximum storm surge values above MLLW for these CO-OPS stations within the path of Hurricane Jeanne.

Maximum Observed Water Levels

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Station Name	Station ID	Latitude	Longitude	Date/Time GMT	Maximum Water Level above Station Datum (m)	Maximum Observed Water Level Above MLLW (m)	Maximum Observed Water Level Above NAVD88 (m)	Maximum Observed Water Level Above NGVD 29 (m)
Virginia Key, FL	8723214	25 43.9 N	80 9.7 W	09-26-04 11:36	4.168	1.078	0.470	NA
Naples, FL	8725110	26 7.8 N	81 48.4 W	09-26-04 13:36	2.134	1.481	0.785	1.172
Fort Myers, FL	8725520	26 38.8 N	81 52.3 W	09-26-04 19:12	2.489	1.160	0.842	1.200
Clearwater Beach, FL	8726724	27 58.7 N	82 49.9 W	09-26-04 15:48	1.697	1.178	0.633	0.896
Trident Pier, FL	8721604	28 24. 9N	80 35.6 W	09-30-04 23:54	6.252	0.825	NA	NA
Cedar Key, FL **	8727520	29 8.1 N	83 1.9 W	09-27-04 07:30	2.437	1.887	1.200	1.411
Palatka, FL	8720774	29 38.6 N	81 37.6 W	09-26-04 20:42	1.013	1.267	NA	NA
Apalachicola, FL **	8728690	29 43.6 N	84 58.9 W	09-23-04 14:24	2.020	0.713	0.481	0.654
Red Bay Point, FL	8720503	29 58.7 N	81 37.7 W	09-27-04 05:24	1.025	1.251	1.023	1.333
Panama City, FL **	8729108	30 9.1 N	85 40.0 W	09-23-04 09:54	1.684	0.665	0.495	0.639
Panama City Beach, FL **	8729210	30 12.8 N	85 52.7 W	09-23-04 09:06	8.924	0.683	NA	NA
Main Street Bridge, FL	8720226	30 19.2 N	81 39.5 W	09-27-04 03:24	1.237	1.653	NA	NA
Bar Pilots Dock, FL	8720218	30 23.8 N	81 25.8 W	09-27-04 00:36	5.063	2.306	NA	NA
Fernandina Beach, FL	8720030	30 40.3 N	81 27.9 W	09-27-04 01:06	3.363	2.845	1.680	NA
St. Simons Island, GA	8677344	31 7.9 N	81 23.8 W	09-27-04 00:00	3.413	2.884	1.607	NA
Fripps Inlet, SC	8668498	32 20.4 N	80 27.9 W	09-26-04 23:54	8.360	2.574	1.428	1.710
Charleston, SC	8665530	32 46.9 N	79 55.5 W	09-28-04 00:24	3.042	2.199	1.242	1.541
South Capers Island, SC	8664941	32 51.4 N	79 42.4 W	09-28-04 00:24	3.049	2.170	1.959	2.259

**** Stations that experienced receded water levels due to Hurricane Jeanne.**

Table 3. Maximum Observed Water Levels referred to Station datum, MLLW, NAVD 88, NGVD 29.

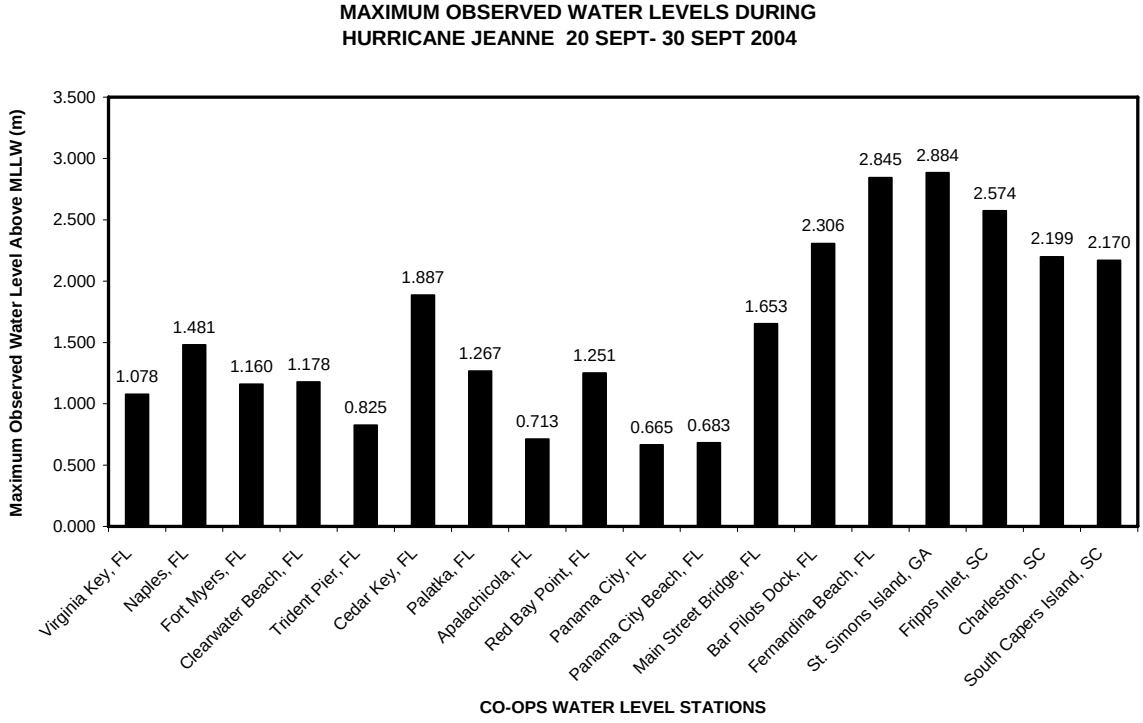

Figure 17. Maximum Observed Water Levels relative to MLLW for CO-OPS tide gauges during Hurricane Jeanne.

Maximum Observed Storm Surge

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Station Name	Station ID	Latitude	Longitude	Date/Time GMT	Observed Water Level Above MLLW (m)	Predicted Water Level Above MLLW (m)	Maximum Surge (m)
Virginia Key, FL	8723214	25 43.9 N	80 9.7 W	09-26-04 09:42	0.890	0.606	0.284
Naples, FL	8725110	26 7.8 N	81 48.4 W	09-26-04 12:54	1.391	0.824	0.567
Fort Myers, FL	8725520	26 38.8 N	81 52.3 W	09-26-04 19:12	1.160	0.483	0.677
Clearwater Beach, FL	8726724	27 58.7 N	82 49.9 W	09-26-04 20:42	0.844	0.129	0.715
Cedar Key, FL	8727520	29 8.1 N	83 1.9 W	09-27-04 10:48	1.884	0.253	1.631
Trident Pier, FL	8721604	28 24. 9N	80 35.6 W	09-26-04 06:18	1.667	0.385	1.282
Palatka, FL	8720774	29 38.6 N	81 37.6 W	09-26-04 23:36	1.174	0.278	0.896
Apalachicola, FL	8728690	29 43.6 N	84 58.9 W	09-23-04 02:42	0.488	0.298	0.19
Red Bay Point, FL	8720503	29 58.7 N	81 37.7 W	09-27-04 10:48	1.003	0.008	0.995
Panama City, FL	8729108	30 9.1 N	85 40.0 W	09-23-04 01:36	0.281	0.186	0.095
Panama City Beach, FL	8729210	30 12.8 N	85 52.7 W	09-23-04 13:36	0.511	0.455	0.056
Main Street Bridge, FL	8720226	30 19.2 N	81 39.5 W	09-27-04 07:06	1.314	0.027	1.287
Bar Pilots Dock, FL	8720218	30 23.8 N	81 25.8 W	09-27-04 03:00	1.754	0.872	0.882
Fernandina Beach, FL	8720030	30 40.3 N	81 27.9 W	09-27-04 04:24	1.669	0.454	1.215
St. Simons Island, GA	8677344	31 7.9 N	81 23.8 W	09-27-04 04:18	1.64	0.574	1.066
Fripps Inlet, SC	8668498	32 20.4 N	80 27.9 W	09-26-04 15:00	1.082	0.518	0.564
Charleston, SC	8665530	32 46.9 N	79 55.5 W	09-21-04 09:24	1.021	0.558	0.463
South Capers Island, SC	8664941	32 51.4 N	79 42.4 W	09-20-04 21:30	1.056	0.573	0.483

Table 4. Storm Surge values for CO-OPS tide gauges within the path of Hurricane Jeanne.

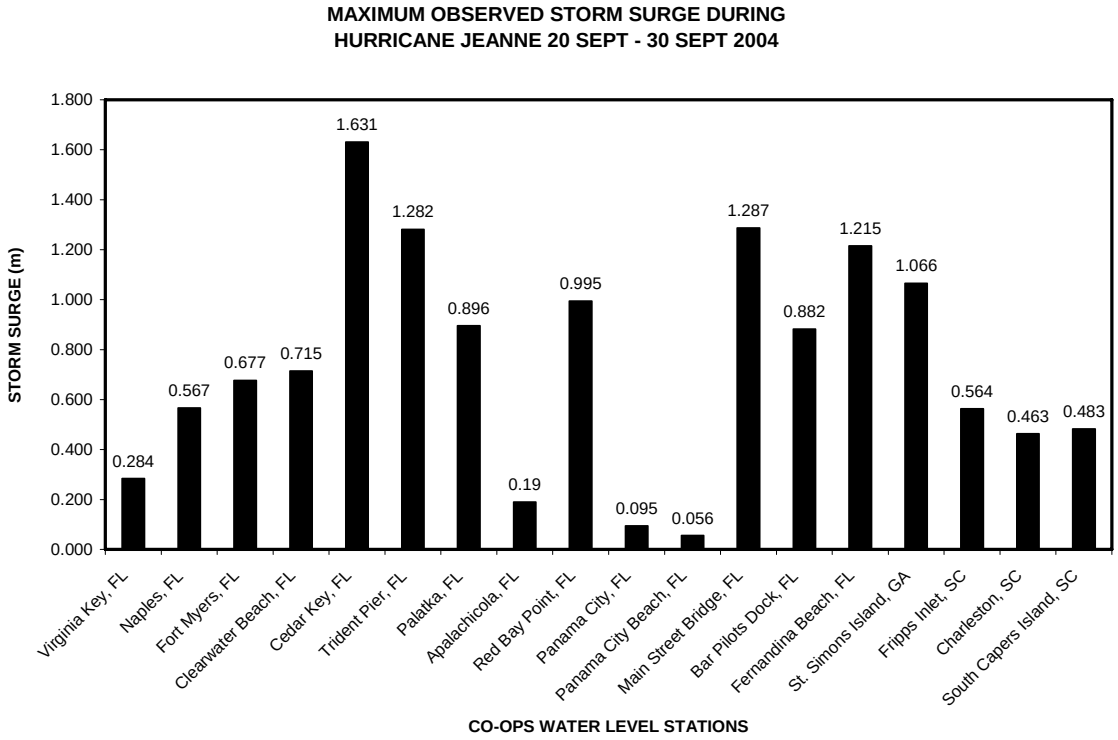

Figure 18. Maximum Observed Storm Surge for CO-OPS water level stations within the path of Hurricane Jeanne.

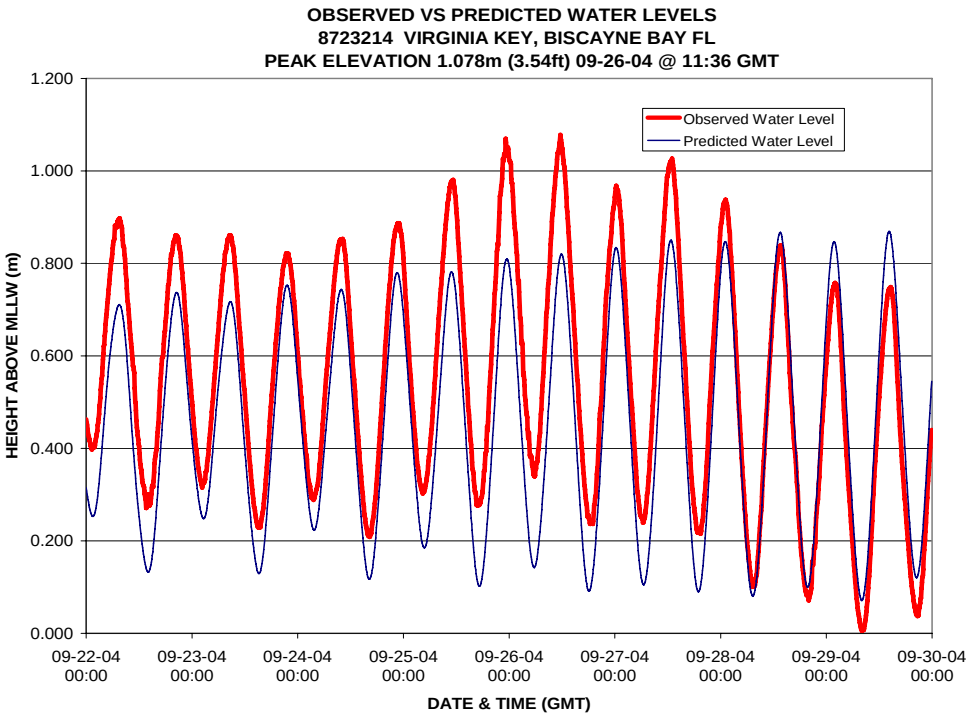

Figure 19. Observed vs. Predicted Water Levels for Virginia Key, Biscane Bay FL.

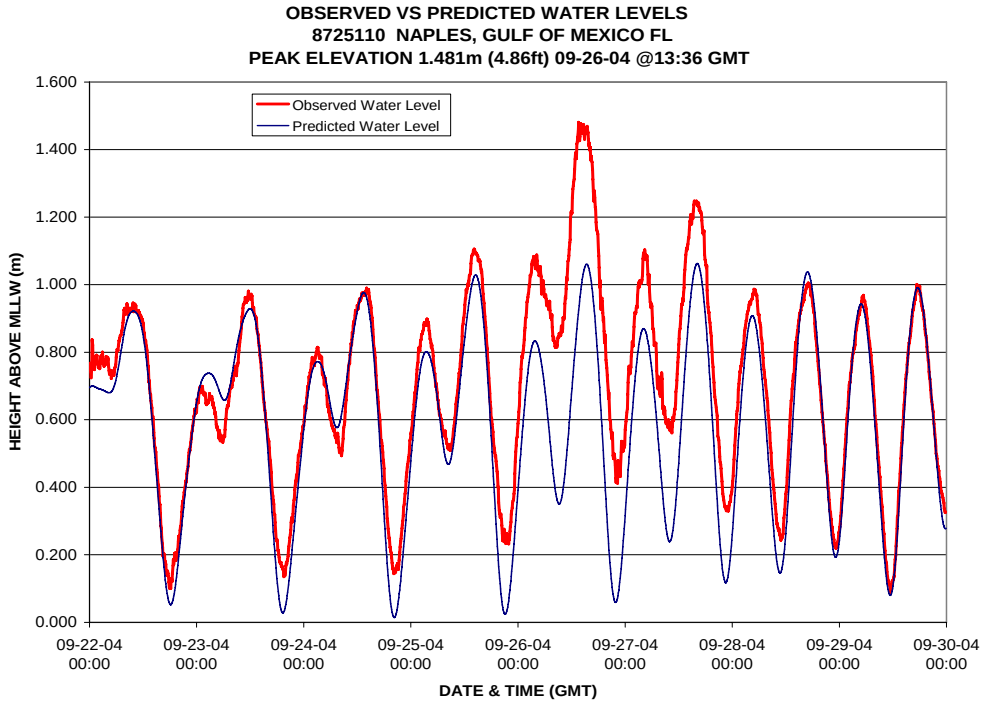

Figure 20. Observed vs. Predicted Water Levels for Naples, GOM FL.

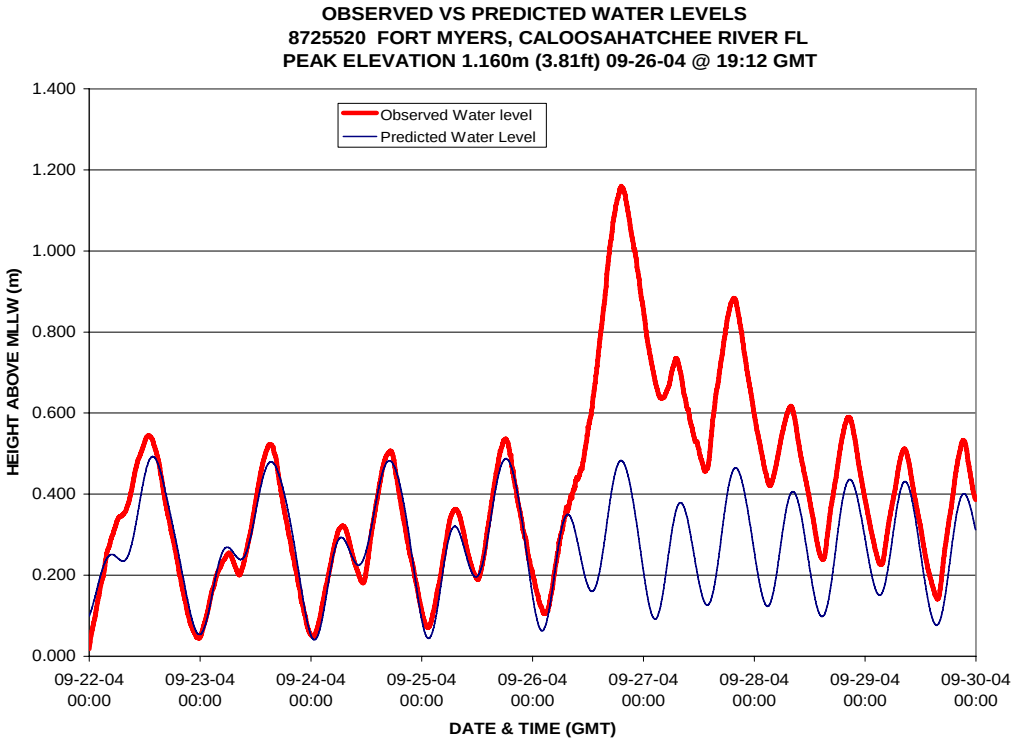

Figure 21. Observed vs. Predicted Water Levels for Fort Myers, Caloosahatchee FL.

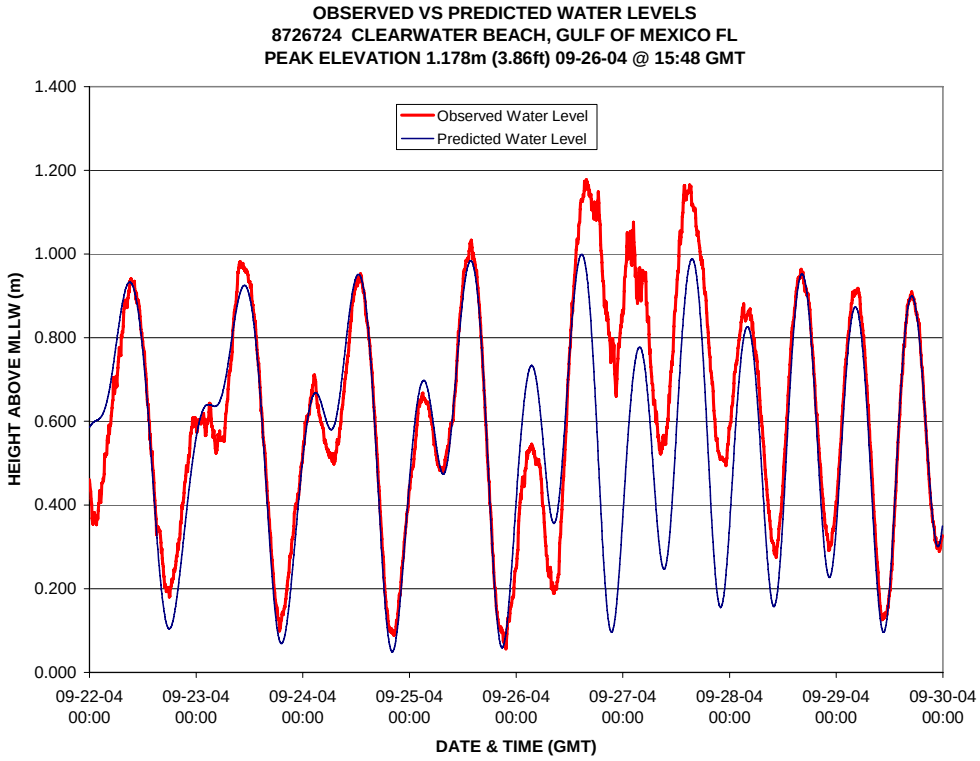

Figure 22. Observed vs. Predicted Water Levels for Clearwater Beach, GOM FL.

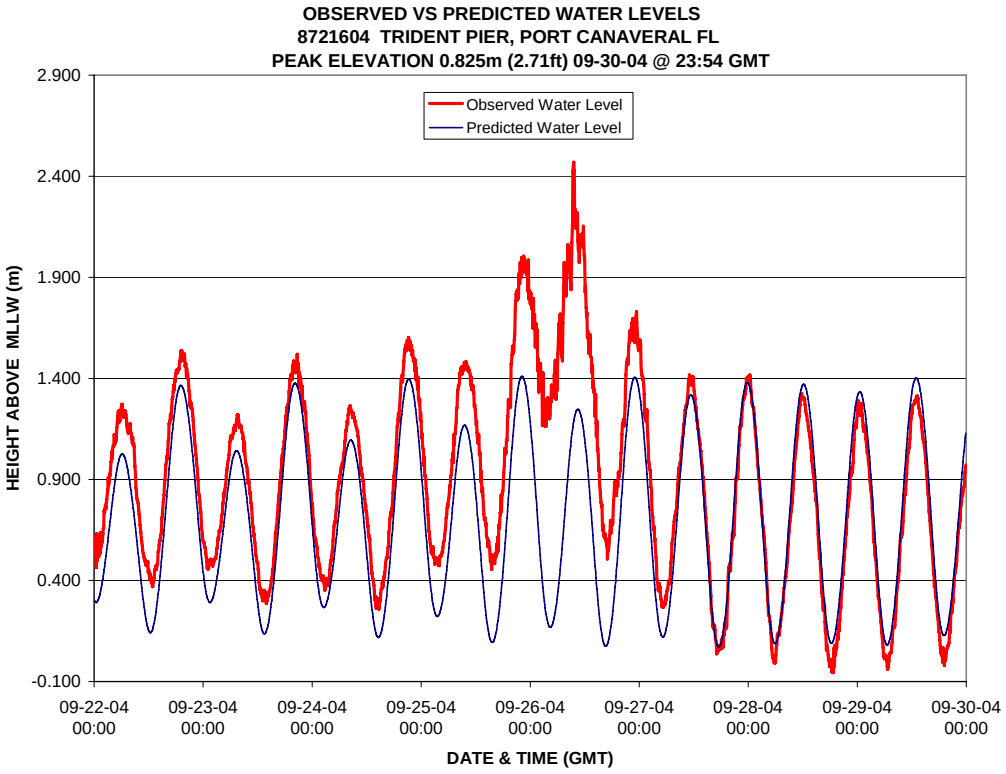

Figure 23. Observed vs. Predicted Water Levels for Trident Pier, Port Canaveral FL.

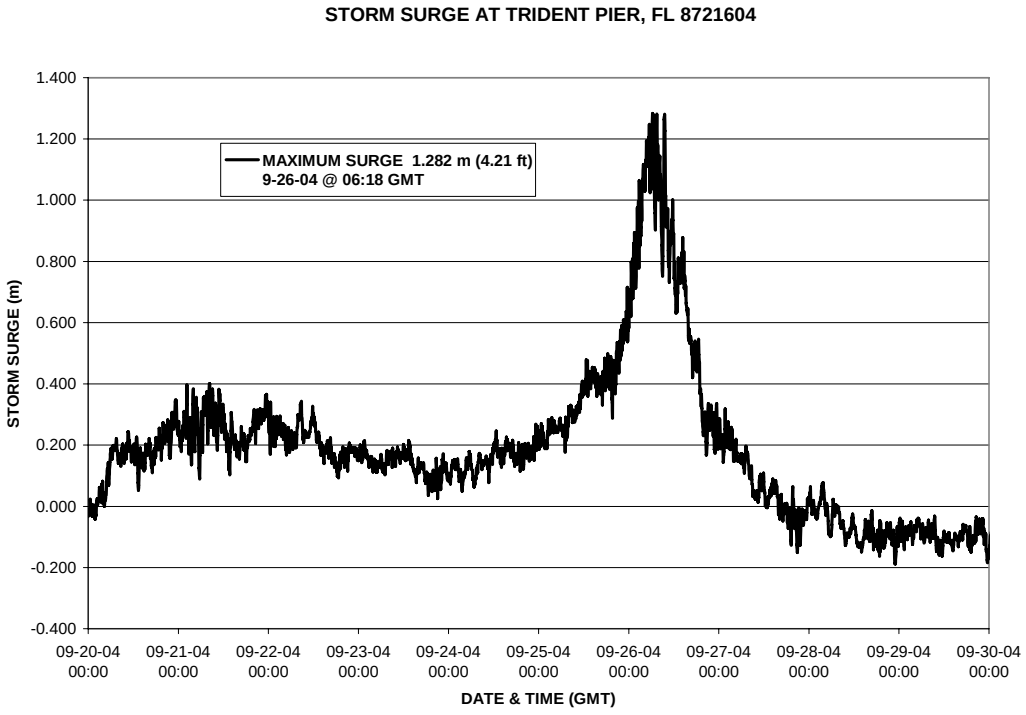

Figure 24. Storm Surge at Trident Pier, Port Canaveral FL.

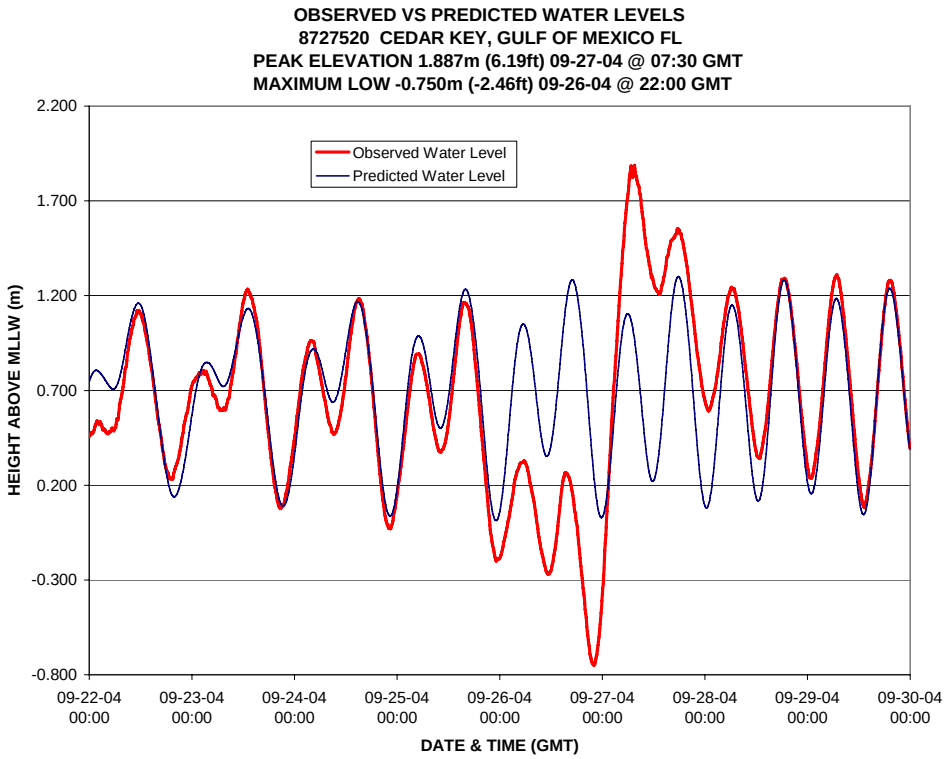

Figure 25. Observed vs. Predicted Water Levels for Cedar Key, GOM FL.

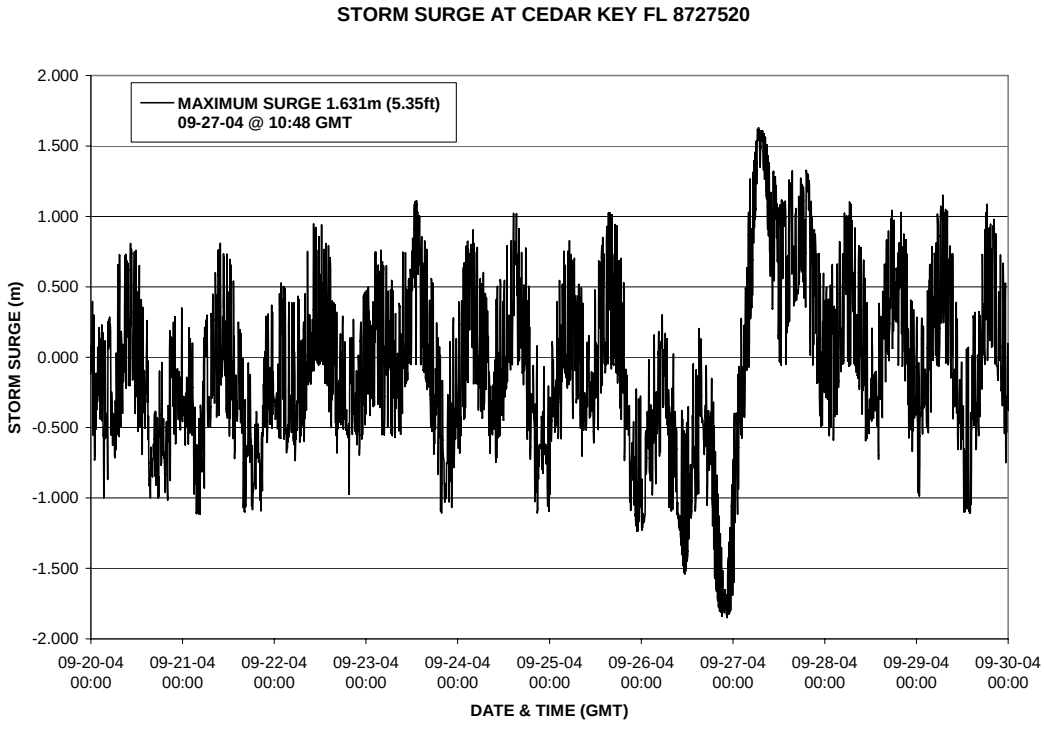

Figure 26. Storm Surge at Cedar Key, GOM FL.

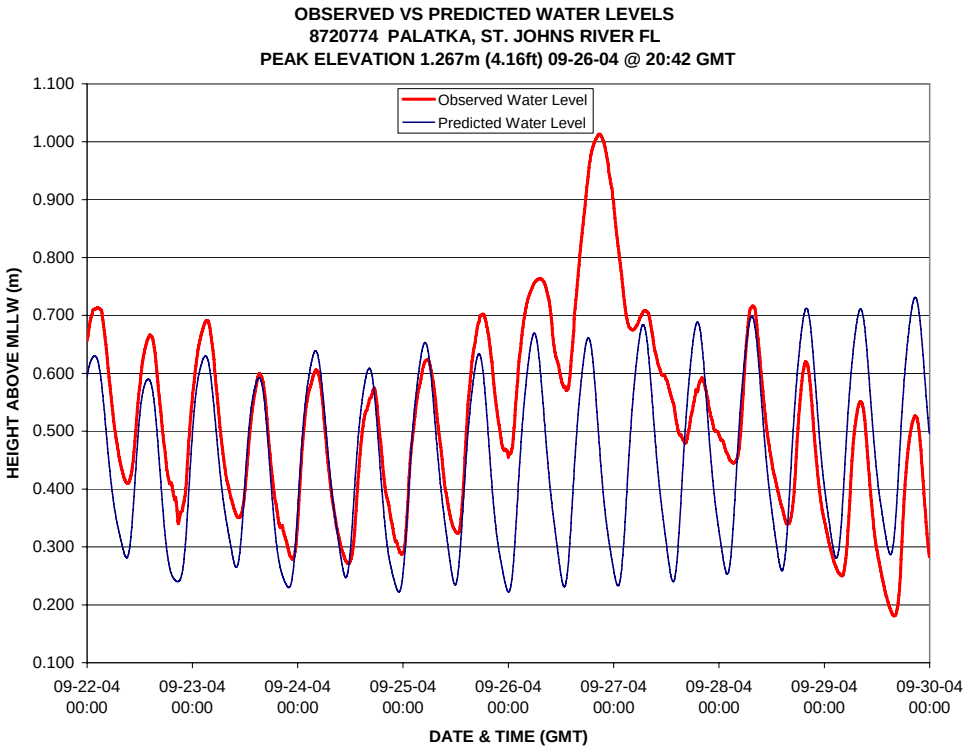

Figure 27. Observed vs. Predicted Water Levels for Palatka, St. Johns River FL.

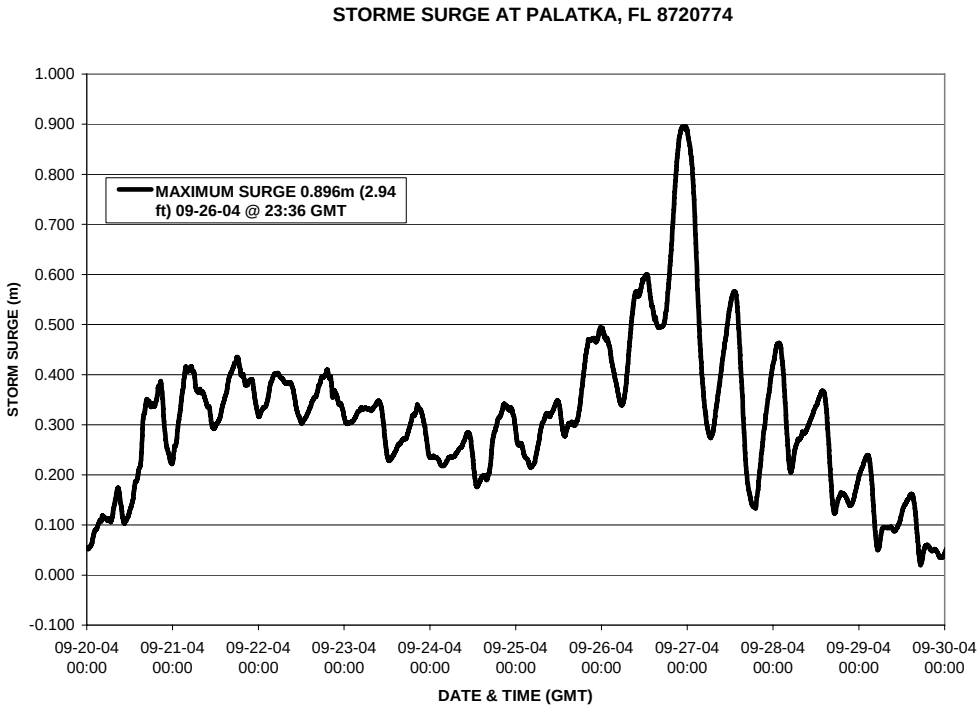

Figure 28. Storm Surge at Palatka, St. Johns River FL.

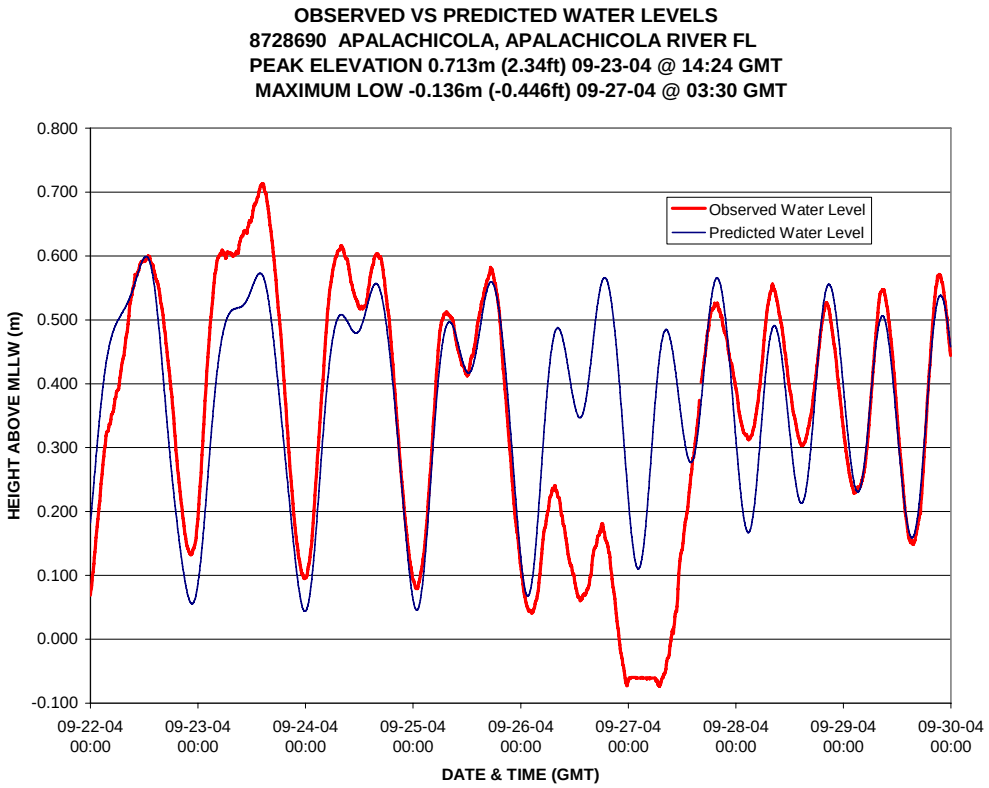

Figure 29. Observed vs. Predicted Water Levels for Apalachicola, FL.

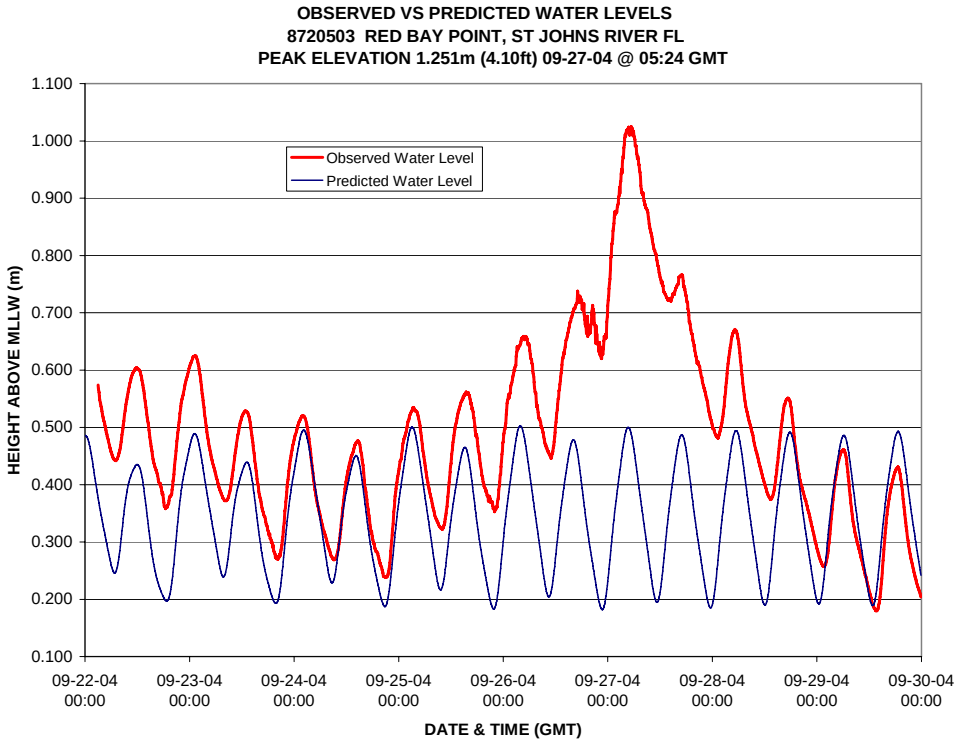

Figure 30. Observed vs. Predicted Water Levels for Red Bay Point, St. Johns River FL.

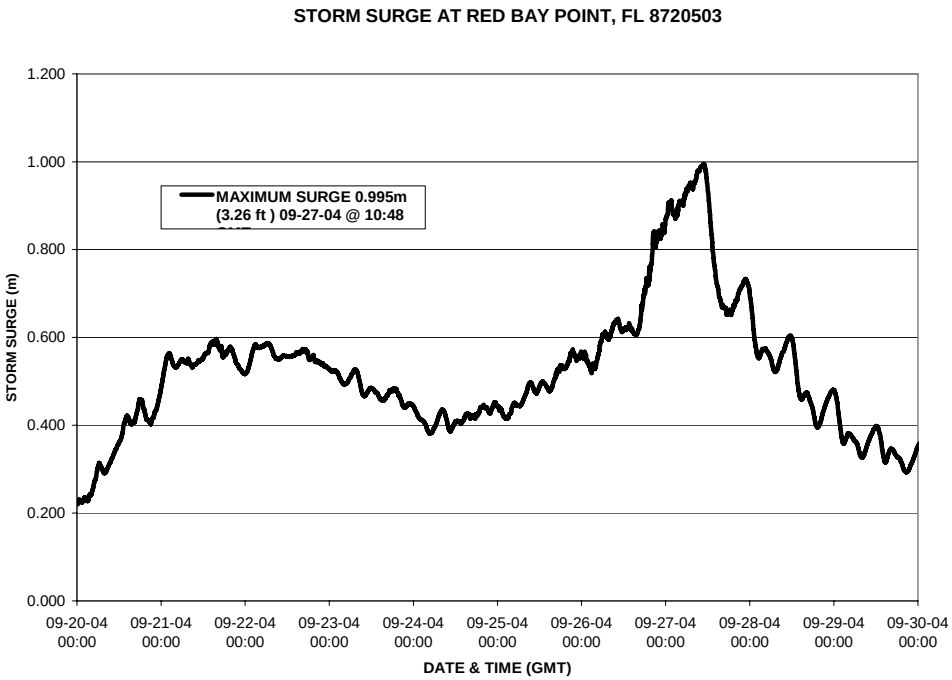

Figure 31. Storm Surge at Red Bay Point, St. Johns River FL.

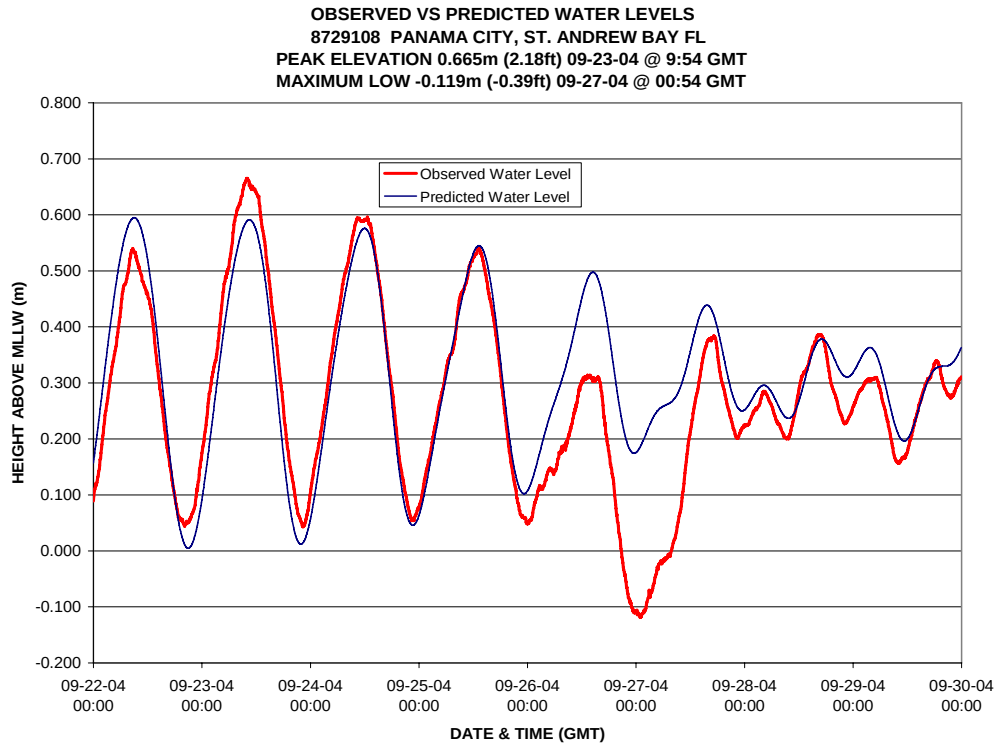

Figure 32. Observed vs. Predicted Water Levels at Panama City, St. Andrew Bay FL.

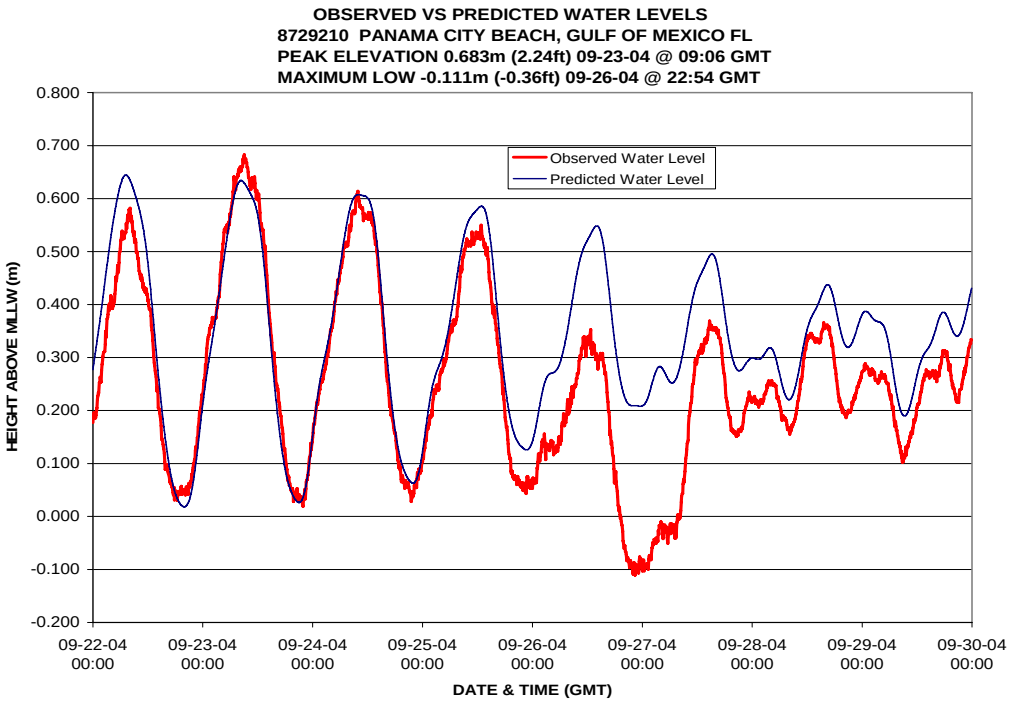

Figure 33. Observed vs. Predicted Water Levels for Panama City Beach, GOM FL.

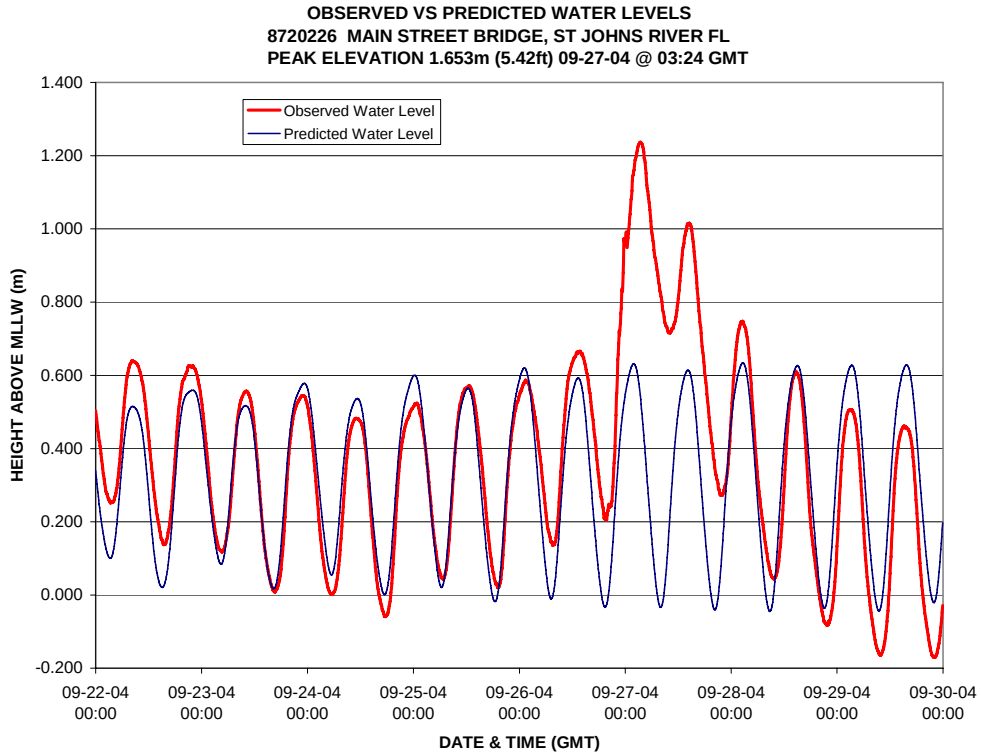

Figure 34. Observed vs. Predicted Water Levels for Main Street Bridge, St. Johns River FL.

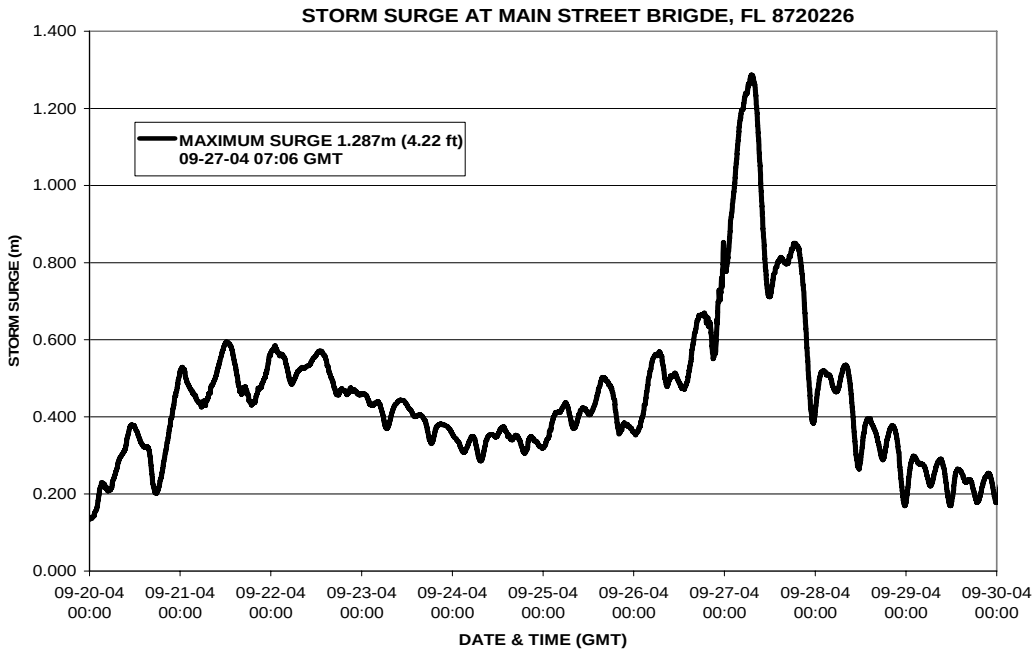

Figure 35. Storm Surge at Main Street Bridge, St. Johns River FL.

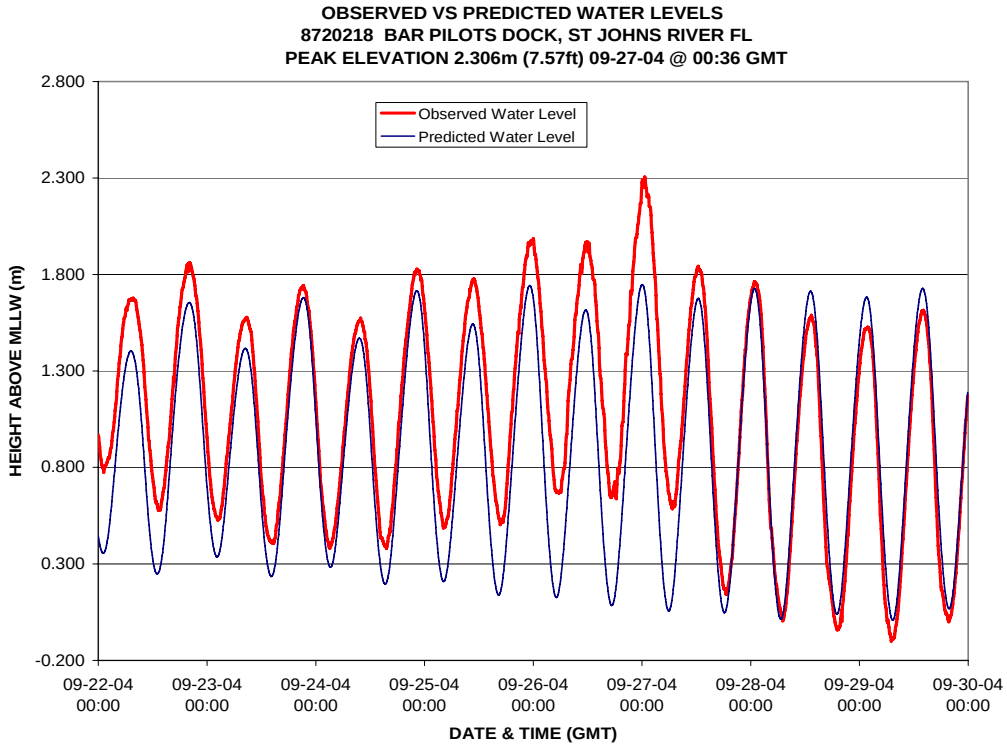

Figure 36. Observed vs. Predicted Water Levels for Bar Pilots Dock, St. Johns River FL.

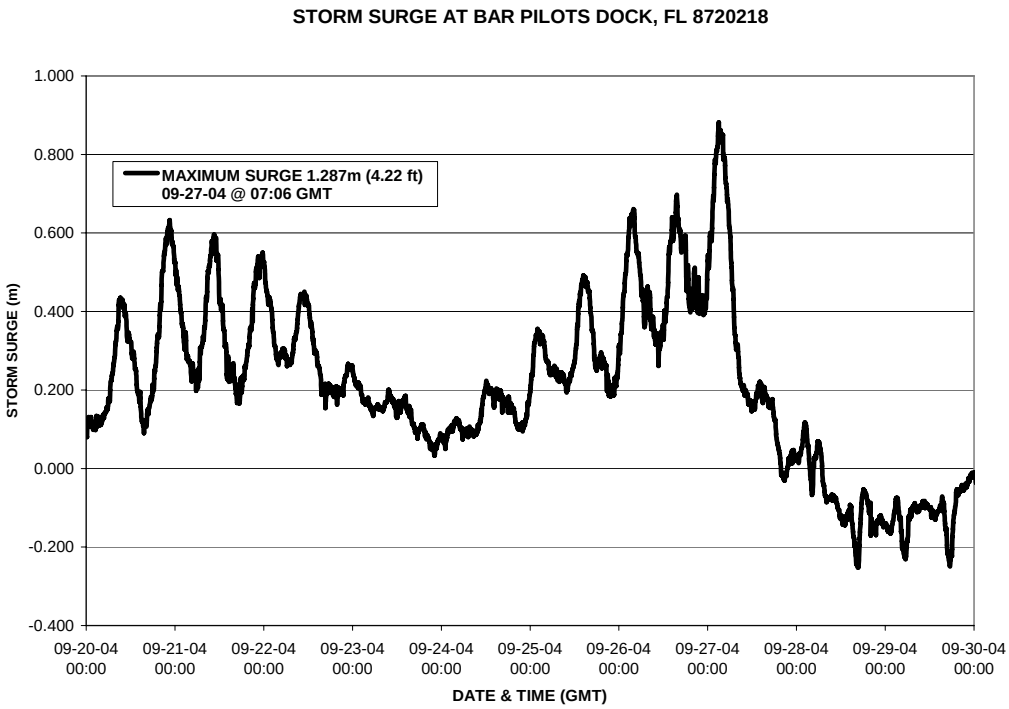

Figure 37. Storm Surge at Bar Pilots Dock, FL.

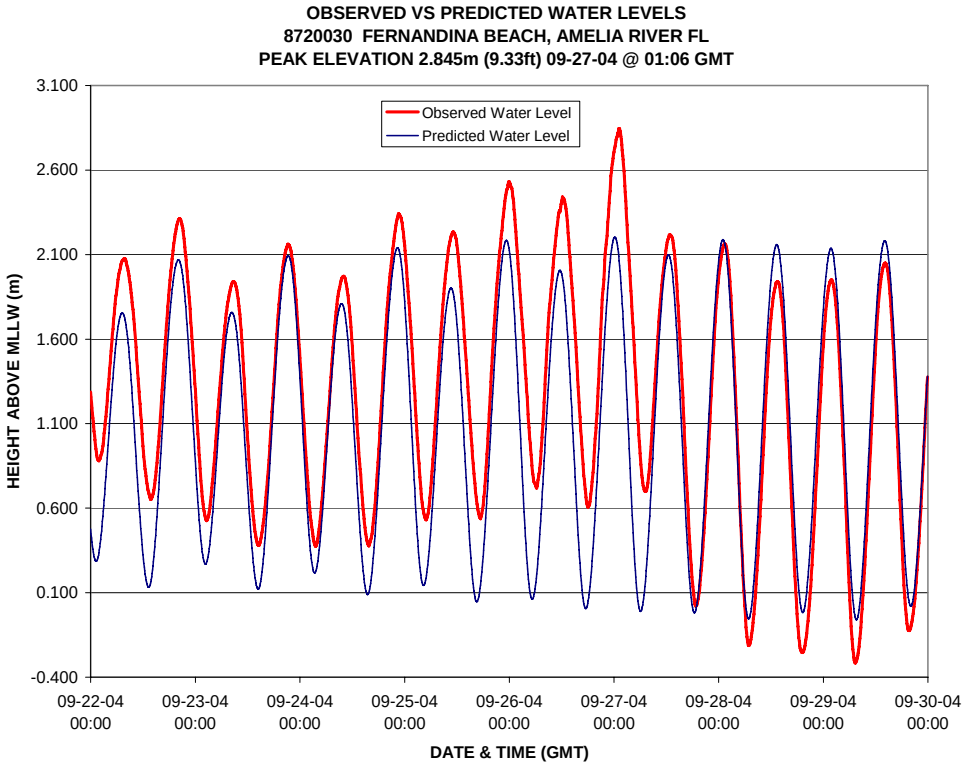

Figure 38. Observed vs. Predicted Water Levels for Fernandina Beach Amelia River FL.

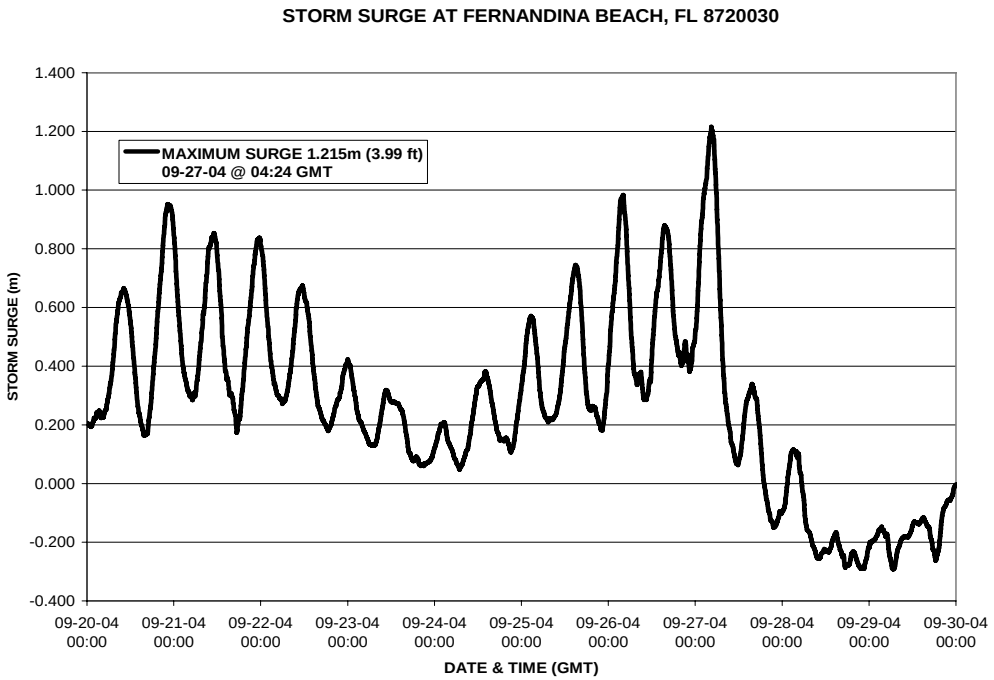

Figure 39. Storm Surge at Fernandina Beach, Amelia River FL.

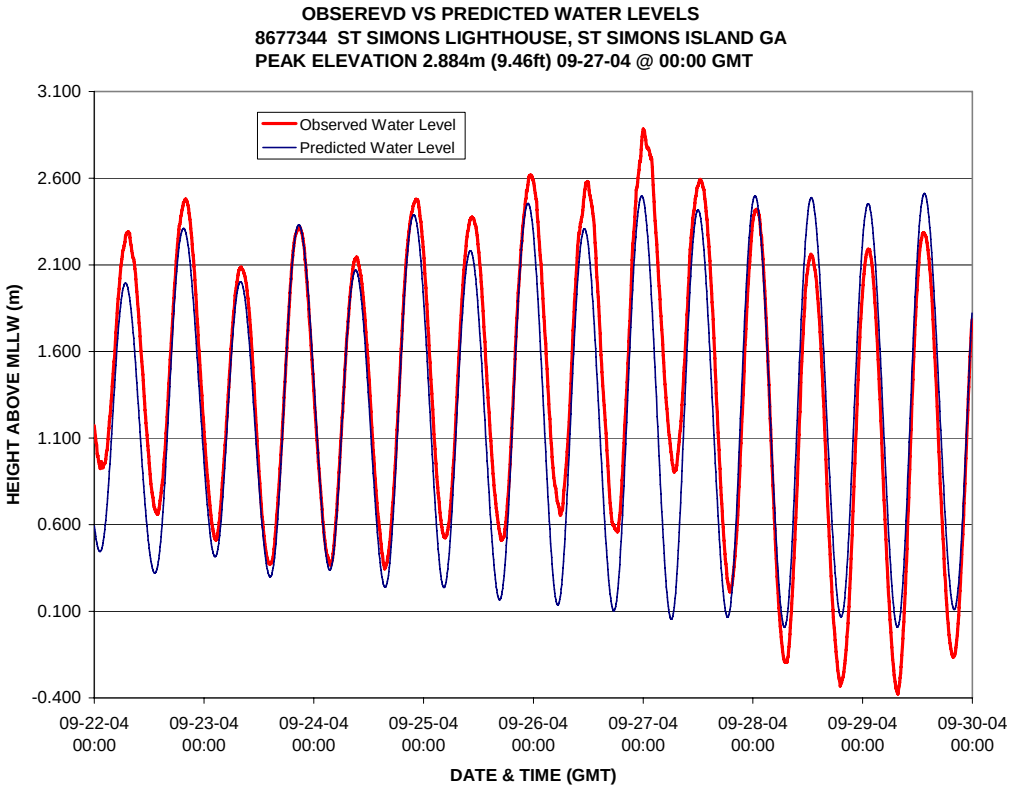

Figure 40. Observed vs. Predicted Water Levels for St. Simons Lighthouse, GA.

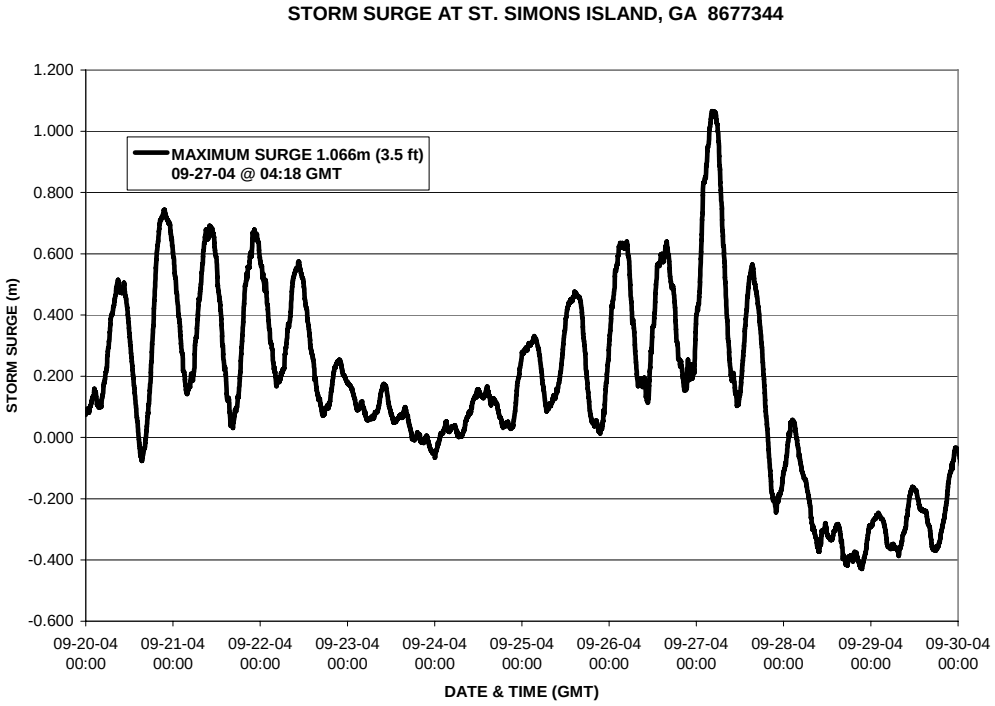

Figure 41. Storm Surge at St. Simons Island, GA.

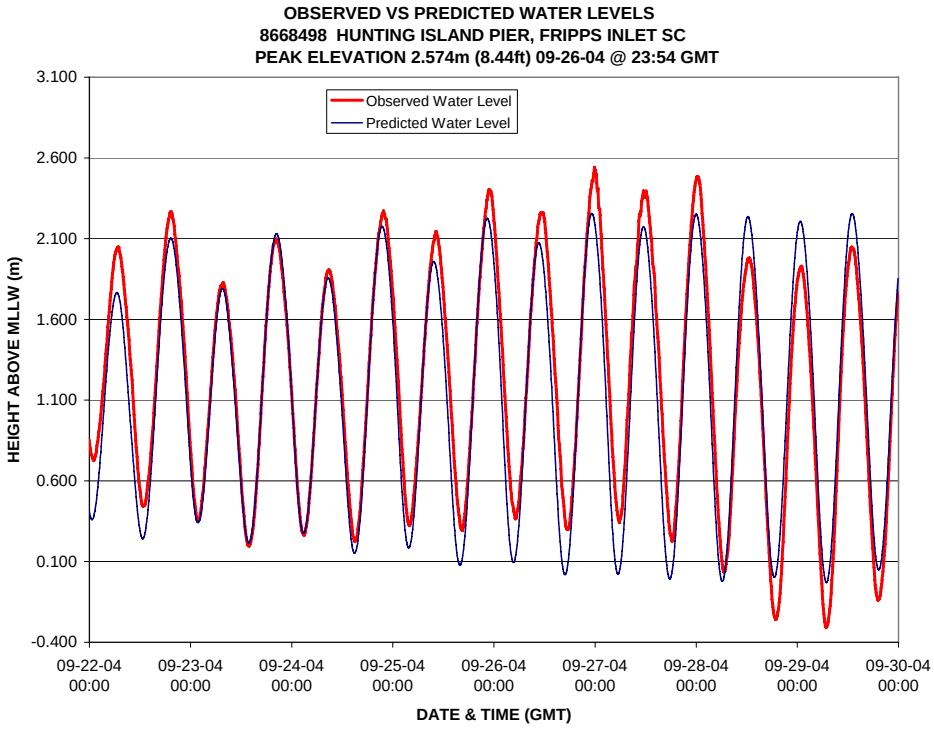

Figure 42. Observed vs. Predicted Water Levels for Huntington Island Pier, Fripps Inlet SC.

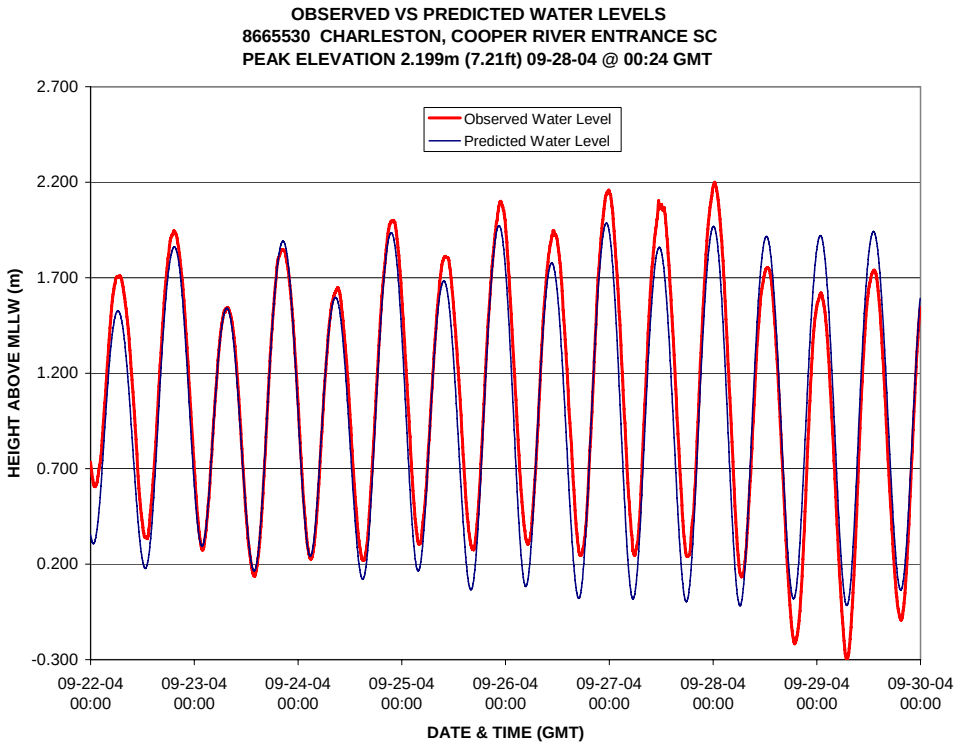

Figure 43. Observed vs. Predicted Water Levels for Charleston, Cooper River Entrance SC.

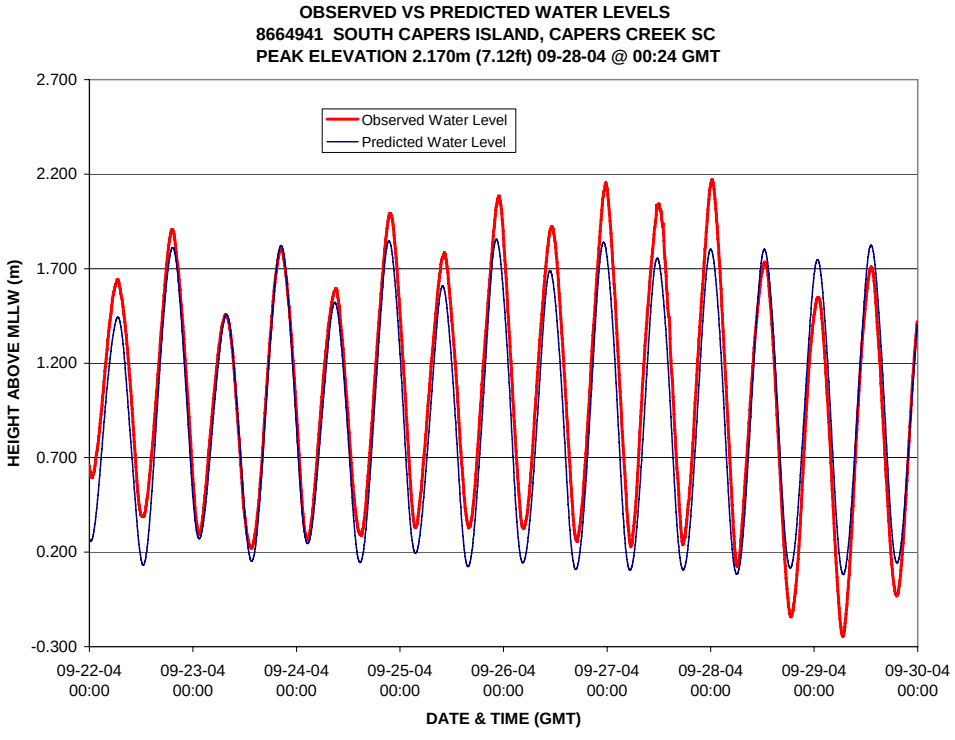

Figure 44. Observed vs. Predicted Water Levels for South Capers Island, Capers Creek SC.

Appendix 2

Excerpt From:

Tide and Current Glossary, NOAA National Ocean Service, Silver Spring, MD, 2000.

tide: The periodic rise and fall of a body of water resulting from gravitational interactions between Sun, Moon, and Earth. The vertical component of the particulate motion of a tidal wave. Although the accompanying horizontal movement of the water is part of the same phenomenon, it is preferable to designate this motion as tidal current. Same as astronomic tide.

tide (water level) gauge: An instrument for measuring the rise and fall of the tide (water level).

storm tide: As used by the National Weather Service, NOAA, the sum of the storm surge and astronomic tide. See storm surge and tide.

storm surge: The local change in the elevation of the ocean along a shore due to a storm. The storm surge is measured by subtracting the astronomic tidal elevation from the total elevation. It typically has a duration of a few hours. Since wind generated waves ride on top of the storm surge (and are not included in the definition), the total instantaneous elevation may greatly exceed the predicted storm surge plus astronomic tide. It is potentially catastrophic, especially on low lying coasts with gently sloping offshore topography. See storm tide.

National Water Level Observation Network (NWLON): The network of tide and water level stations operated by the National Ocean Service along the marine and Great Lakes coasts and islands of the United States.

datum (vertical): For marine applications, a base elevation used as a reference from which to reckon heights or depths. It is called a tidal datum when defined in terms of a certain phase of the tide. Tidal datums are local datums and should not be extended into areas which have differing hydrographic characteristics without substantiating measurements. In order that they may be recovered when needed, such datums are referenced to fixed points known as bench marks. See chart datum and bench marks.

chart datum: The datum to which soundings on a chart are referred. It is usually taken to correspond to a low-water elevation, and its depression below mean sea level is represented by the symbol Z_0. Since 1980, chart datum has been implemented to mean lower low water for all marine waters of the United States, its territories, Commonwealth of Puerto Rico, and Trust Territory of the Pacific Islands. See datum and National Tidal Datum Convention of 1980.

geodetic datum: See National Geodetic Vertical Datum of 1929 (NGVD 1929) and North American Vertical Datum of 1988 (NAVD 1988).

Mean Lower Low Water (MLLW): A tidal datum. The average of the lower low water height of each tidal day observed over the National Tidal Datum Epoch. See National Tidal Datum Epoch. For stations with shorter series, comparison of simultaneous observations with a control tide station is made in order to derive the equivalent datum of the National Tidal Datum Epoch.

National Tidal Datum Epoch: The specific l9-year period adopted by the National Ocean Service as the official time segment over which tide observations are taken and reduced to obtain mean values (e.g., mean lower low water, etc.) for tidal datums. It is necessary for standardization because of periodic and apparent secular trends in sea level. The present National Tidal Datum Epoch is 1960 through 1978. It is reviewed annually for possible revision and must be actively considered for revision every 25 years.

National Tidal Datum Convention of 1980: Effective November 28, 1980, the Convention: (1) establishes one uniform, continuous tidal datum system for all marine waters of the United States, its territories, Commonwealth of Puerto Rico, and Trust Territory of the Pacific Islands, for the first time in history; (2) provides a tidal datum system independent of computations based on type of tide; (3) lowers chart datum from mean low water to mean lower low water along the Atlantic coast of the United States; (4) updates the National Tidal Datum Epoch from 1941 through 1959, to 1960 through 1978; (5) changes the name Gulf Coast Low Water Datum to mean lower low water; (6) introduces the tidal datum of mean higher high water in areas of predominantly diurnal tides; and (7) lowers mean high water in areas of predominantly diurnal tides. See chart datum.

National Geodetic Vertical Datum of 1929 [NGVD 1929]: A fixed reference adopted as a standard geodetic datum for elevations determined by leveling. The datum was derived for surveys from a general adjustment of the first-order leveling nets of both the United States and Canada. In the adjustment, mean sea level was held fixed as observed at 21 tide stations in the United States and 5 in Canada. The year indicates the time of the general adjustment. A synonym for Sea-level Datum of 1929. The geodetic datum is fixed and does not take into account the changing stands of sea level. Because there are many variables affecting sea level, and because the geodetic datum represents a best fit over a broad area, the relationship between the geodetic datum and local mean sea level is not consistent from one location to another in either time or space. For this reason, the National Geodetic Vertical Datum should not be confused with mean sea level. See North American Vertical Datum of 1988 (NAVD 1988).

North American Vertical Datum of 1988 [NAVD 1988]: A fixed reference for elevations determined by geodetic leveling. The datum was derived from a general adjustment of the first-order terrestrial leveling nets of the United States, Canada, and Mexico. In the adjustment, only the height of the primary tidal bench mark, referenced to the International Great Lakes Datum of 1985 (IGLD 1985) local mean sea level height

value, at Father Point, Rimouski, Quebec, Canada was held fixed, thus providing minimum constraint. NAVD 1988 and IGLD 1985 are identical. However, NAVD 1988 bench mark values are given in Helmert orthometric height units while IGLD 1985 values are in dynamic heights. See International Great Lakes Datum of 1985, National Geodetic Vertical Datum of 1929, and geopotential difference.

bench mark (BM): A fixed physical object or mark used as reference for a horizontal or vertical datum. A tidal bench mark is one near a tide station to which the tide staff and tidal datums are referred. A primary bench mark is the principal mark of a group of tidal bench marks to which the tide staff and tidal datums are referred.

For further information on tides, tidal predictions, tidal datums and related publications, contact:

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