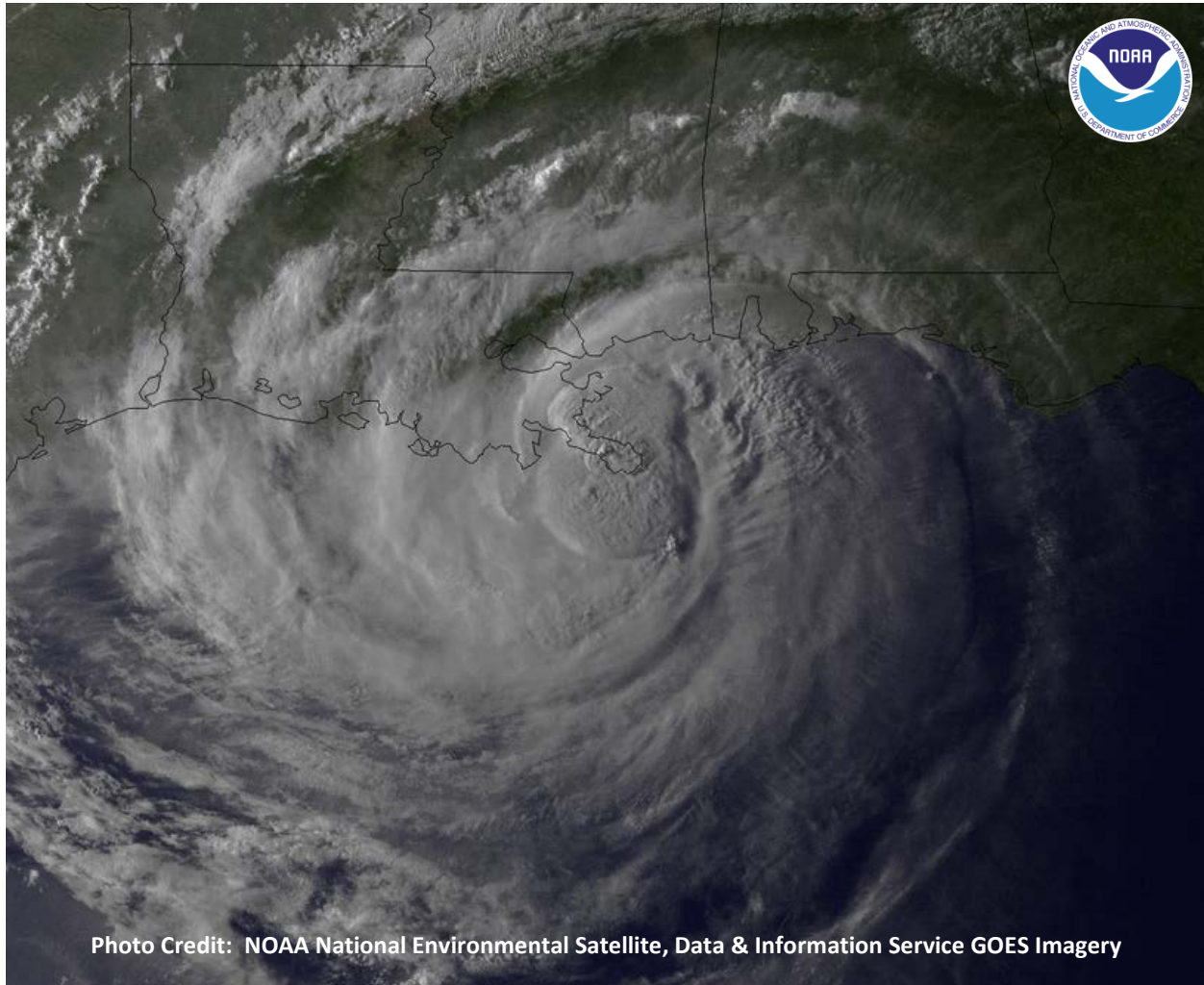


## HURRICANE ISAAC



Silver Spring, Maryland  
October 14, 2012

**noaa** National Oceanic and Atmospheric Administration

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U.S. DEPARTMENT OF COMMERCE  
National Ocean Service  
Center for Operational Oceanographic Products and Services

## **HURRICANE ISAAC**

**Paul Fanelli, David Wolcott  
October 14, 2012**

**noaa** National Oceanic and Atmospheric Administration

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## Overview

The National Oceanic and Atmospheric Administration (NOAA) Center for Operational Oceanographic Products and Services (CO-OPS) maintains a network of oceanographic and meteorological stations along the United States coastlines and Great Lakes to monitor water levels, winds (speed, direction and gusts), barometric pressure, and air/water temperature. CO-OPS also operates stations in partnership with the National Estuarine Research Reserve (NERR) and the Puerto Rico Seismic Network (PRSN). This report documents the elevated water levels, high winds and reduced barometric pressures recorded at stations along the coast of Puerto Rico and the U.S. Virgin Islands as well as the Gulf coast of the U.S. from Florida to Louisiana during Hurricane Isaac.

Station information and locations are contained in Figures 1 & 2a-2c and Appendices 1 & 2. Tidal stations are referenced to the standard chart datum of Mean Lower Low Water (MLLW), based on the National Tidal Datum Epoch 1983-2001 (Appendix 3). In addition, at several locations along the Gulf Coast of the U.S., water levels are provided relative to a geodetic reference datum, the North American Vertical Datum of 1988 (NAVD88), to assist in relating water levels to coastal inundation estimates.

Table 1 provides storm tide elevations and predicted tide elevations for stations affected by Hurricane Isaac by geographic region. Where available, water level elevations relative to NAVD88 are also presented, along with the residuals at the time of the maximum storm tides. Maximum storm surge levels are summarized in Table 3, ranked by amplitude. Storm tides are the maximum water level elevations during a storm passage. Residuals are the elevation differences between observed and predicted tides. Storm surge is the residual caused directly by the storm during its passage. Table 2 provides maximum wind speeds, wind gusts, and minimum barometric pressures observed at the stations during Hurricane Isaac.

In addition, the report highlights stations which have exceeded historical recorded maximum water levels as a result of Isaac (Figure 3). The historical recorded maximum water levels are the maximum water elevation measured by a water level station with a continuous time series throughout a high tide cycle for the entire historical period. A complete cycle is required to calculate the maximum tide elevation, applying a best fit curve to the observations. These historical records may not have included the highest water levels measured at a station during an event if a complete high tide cycle was not measured due to station/sensor damage (Appendix 3).

Individual time series graphs are provided for each station (Figures 4 – 54). For comparison and context, the historical recorded maximum water levels are displayed on the graphs, where available. The Highest Astronomical Tide (HAT) datum is also displayed to illustrate the elevation of the highest predicted astronomical tide expected to occur at a specific tide station over the 1983-2001 National Tidal Datum Epoch.

## Summary

Isaac initially formed as a tropical depression, about 715 miles east of the Leeward Islands on August 21<sup>st</sup> 2012. For several days, Isaac followed a westward track, which carried the storm about 150 miles to the south of Puerto Rico and the U.S. Virgin Islands as a weak tropical storm, resulting in a minor storm surge across the region. After passing to the south of Puerto Rico, Isaac turned and began taking a more west-north-westerly (WNW) track, crossing Haiti and far eastern Cuba on August 24-25<sup>th</sup>. Isaac continued on a WNW track between Cuba and the Bahamas and passed just to the west of the Florida Keys on August 26<sup>th</sup> as a stronger tropical storm with winds of 60 mph. Isaac moved across the Gulf of Mexico over the next couple of days; however the cyclone remained a tropical storm until August 28<sup>th</sup> 18:00 GMT when it reached hurricane strength, located roughly 75 miles southeast of the Louisiana coast. Isaac made an initial landfall in extreme southeastern Louisiana near the mouth of the Mississippi River on August 29<sup>th</sup> 00:00 GMT as a category 1 hurricane with winds of 80 mph. Moving westward along the Louisiana coast, Isaac briefly emerged over water again before making a final landfall near Port Fourchon, LA on August 29<sup>th</sup> 07:15 GMT with winds still at 80 mph. After making landfall, Isaac turned towards the north and began to weaken, first to a tropical storm on August 29, 2012 19:00 GMT and to a tropical depression on August 30<sup>th</sup> 21:00 GMT, with the center of the cyclone located near the Louisiana-Arkansas border.

As Isaac passed to the south of Puerto Rico and the U.S. Virgin Islands, the maximum storm tide measured was 0.760 m (2.49 ft) above Mean Lower Low Water (MLLW) at Arecibo, PR on August 23 17:00 GMT. The maximum storm surge recorded was 0.376 m (1.23 ft) at Mayaguez, PR on August 24, 23:06 GMT. Maximum storm surge/residuals along the coast of Puerto Rico and the U.S. Virgin Islands ranged from 0.22 to 0.38 m (0.7 to 1.2 ft) during Isaac. It should be noted that water levels across the U.S. Virgin Islands and Puerto Rico had been elevated by up to 0.5 feet above tidal predictions in the months leading up to Isaac and water levels referenced in this report include this pre-existing regional seasonal high sea-level anomaly along with effects from Isaac.

Along the U.S. coast from southeastern Florida to Louisiana, a noticeable storm surge was observed due to Isaac. Maximum storm surge/residuals along the Florida coast ranged from 0.27 to 1.06 m (0.9 to 3.5 ft) with the highest storm surge observed along the Florida Panhandle. Along the Alabama coast, including Mobile Bay, maximum storm surge/residuals ranged between 0.90 and 1.41 m (3.0 and 4.6 ft). From Mississippi to eastern Louisiana, maximum storm surge/residuals ranged from 1.20 to 3.36 m (3.9 to 11.0 ft). Storm surge/residuals along the Louisiana coast to the west of landfall generally reached 0.64 to 0.67 m (2.1 to 2.2 ft). The highest storm surge/residual measured along the Gulf coast of the U.S. was 3.364 m (11.04 ft) at Shell Beach, LA. The highest storm tide measured along the Gulf coast also occurred at Shell Beach, LA and measured 3.359 m (11.02 ft) above MLLW. These both occurred on August 29 05:36 GMT, about an hour and a half prior to final landfall. Noticeable negative storm surge/residuals due to prevailing offshore wind directions were also measured at stations in Louisiana located to the west of the storm track as the storm made landfall. For instance a negative storm surge of -0.362m (-1.19ft.) below MLLW was observed at LAWMA, LA and -0.626m (-2.05 ft.) below MLLW was observed at Freshwater Canal Locks, LA.

The highest wind speed recorded at CO-OPS and partnership stations, corresponding to the transit of Isaac to the south of Puerto Rico was 34.0 knots (39.1 mph) at Barbuda on August 23, 09:42 GMT. The highest wind gust of 46.7 kts (53.7 mph) occurred at Christiansted Harbor, St Croix, VI on August 22, 08:54 GMT. The minimum barometric pressure recorded as the storm passed south of Puerto Rico was 1005.5 mb at Lime Tree Bay, VI on August 23, 08:48 GMT. At CO-OPS and partnership stations along the Gulf coast of the U.S., the highest wind speed and gust recorded both occurred at Pilots Station East, SW Pass, LA with a speed of 64.5 knots (74.2 mph) measured on August 29, 05:06 GMT and a gust of 82.0 kts (94.4 mph) measured on August 29, 06:24 GMT. The minimum barometric

pressure recorded along the Gulf coast of the U.S. was 969.8 mb, also at Pilots Station East, SW Pass, LA on August 29, 02:18 GMT.

More information, data and storm reports can be found at the CO-OPS website, <http://tidesandcurrents.noaa.gov>. Storm reports are located under the Publications section of the webpage.

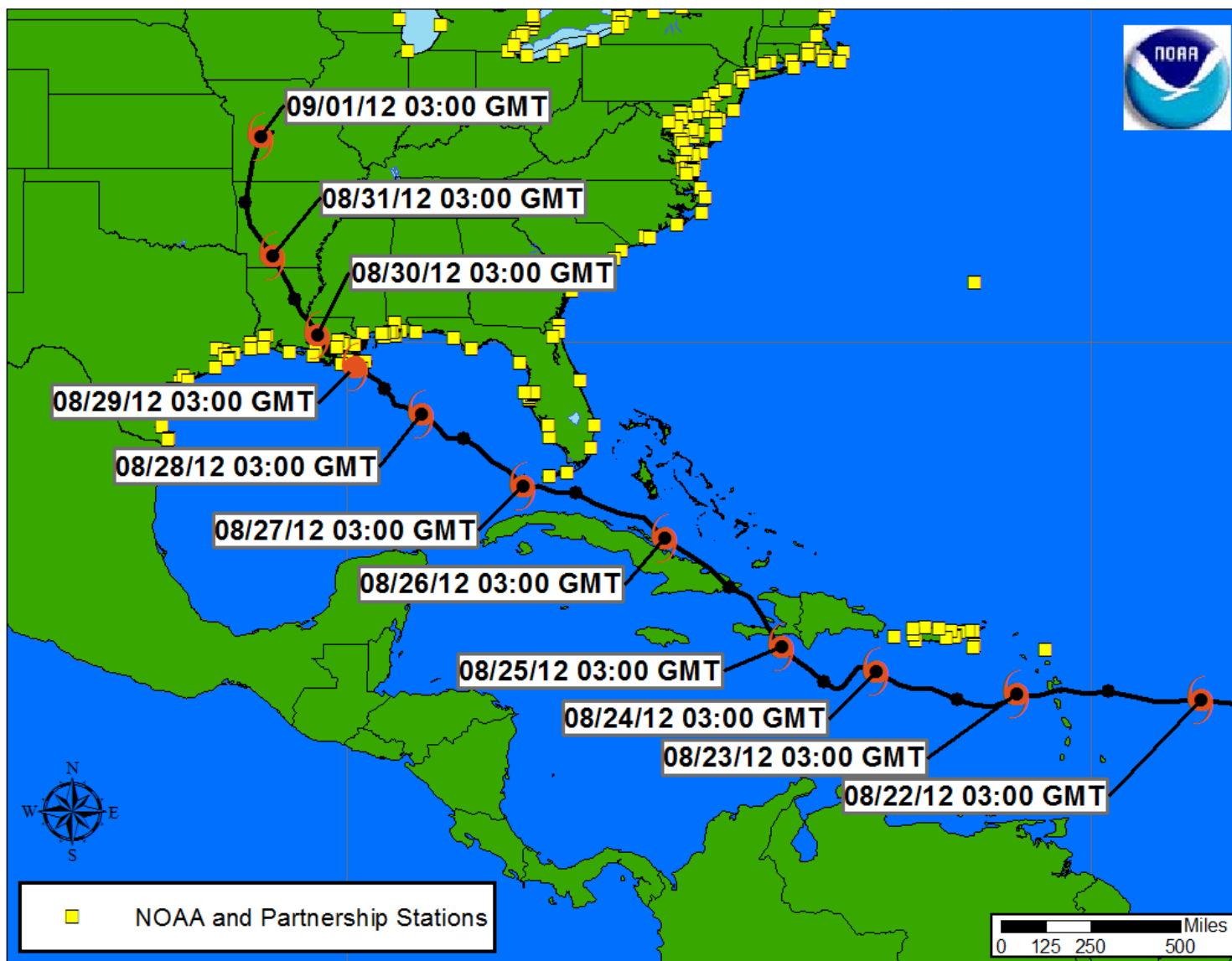
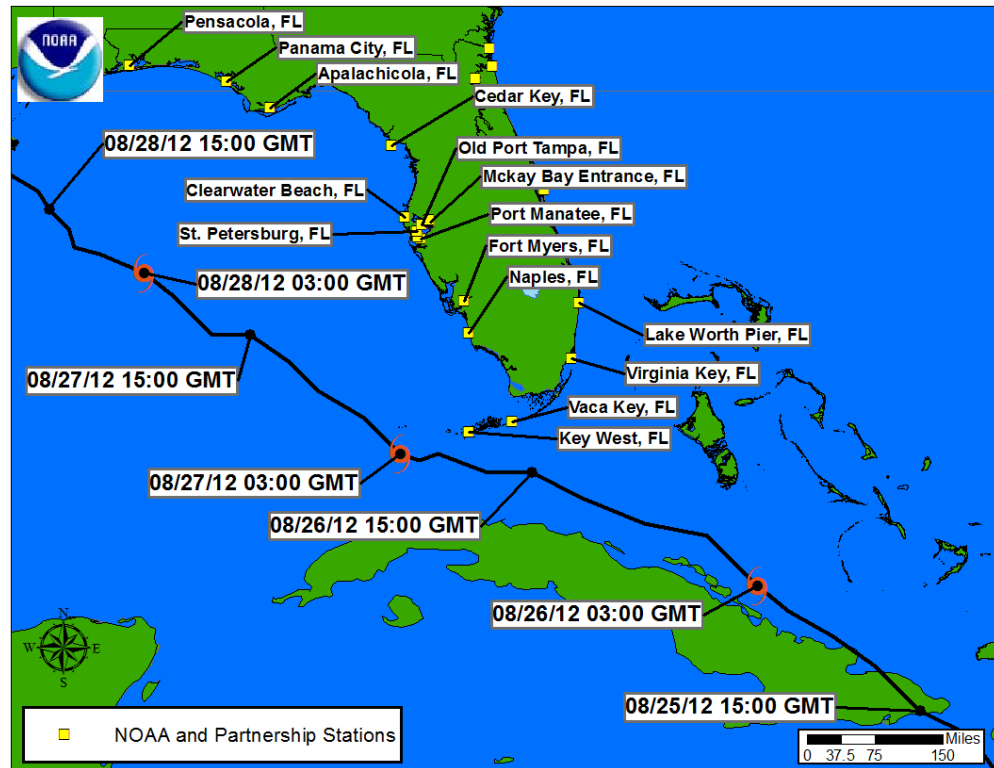
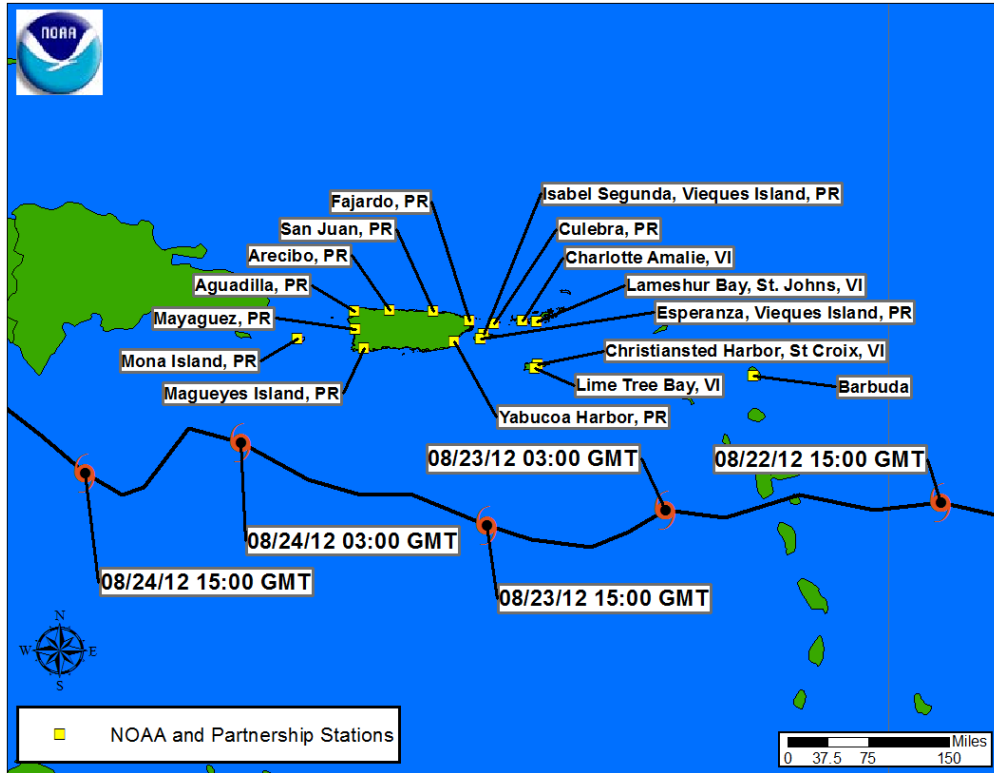


Figure 1: NOAA and Partnership stations relative to the Hurricane Isaac storm track (track information courtesy of the NOAA National Hurricane Center).



Figures 2a and 2b: NOAA and Partnership stations located along the coast of a) Puerto Rico, the U.S. Virgin Islands and Barbuda and b) Florida, relative to the Hurricane Isaac storm track (track information courtesy of the NOAA National Hurricane Center).

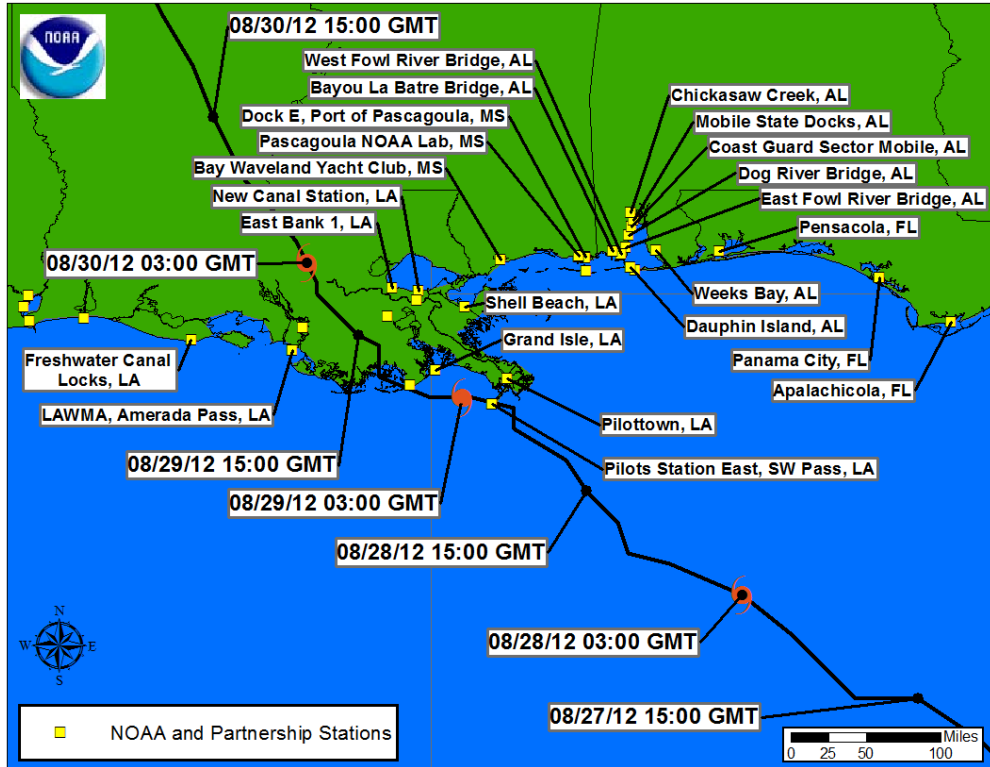


Figure 2c: NOAA and Partnership stations located along the Gulf Coast from Florida to Louisiana, relative to the Hurricane Isaac storm track (track information courtesy of the NOAA National Hurricane Center).



Table 1a: Maximum recorded water levels in geographic order for Hurricane Isaac, August 2012. Referenced to MLLW and NAVD88 (or PRVD02) where available. Storm Tide includes both tidal and meteorological forces and storm surge represents the observed water level (storm tide) minus predicted astronomical tide. Stations where the historical maximum water level was exceeded are highlighted in gray.

Station Name	Station ID	Date & Time GMT	Storm Tide	Predicted	Storm Surge/ Residual (m)	Storm Tide	Storm Tide	Predicted	Storm Surge/ Residual (ft)	Storm Tide
			(m, MLLW)	(m, NAVD88 or *PRVD02)		(ft, MLLW)	(ft, NAVD88 or *PRVD02)			
Barbuda	9761115	08/23/2012 01:42	0.590	0.168	0.422	n/a	1.94	0.55	1.39	n/a
Christiansted Harbor, St Croix, VI	9751364	08/23/2012 02:00	0.416	0.158	0.258	n/a	1.36	0.52	0.84	n/a
Lameshur Bay, St. John, VI	9751381	08/23/2012 17:06	0.502	0.261	0.241	n/a	1.65	0.86	0.79	n/a
Lime Tree Bay, VI	9751401	08/23/2012 21:42	0.459	0.243	0.216	n/a	1.51	0.80	0.71	n/a
Charlotte Amalie, VI	9751639	08/23/2012 19:18	0.535	0.281	0.254	n/a	1.76	0.92	0.84	n/a
Culebra, PR	9752235	08/23/2012 17:42	0.596	0.331	0.265	n/a	1.96	1.09	0.87	n/a
Isabel Segunda, Vieques Island, PR	9752619	08/23/2012 16:54	0.603	0.399	0.204	n/a	1.98	1.31	0.67	n/a
Esperanza, Vieques Island, PR	9752695	08/23/2012 20:24	0.502	0.195	0.307	n/a	1.65	0.64	1.01	n/a
Fajardo, PR	9753216	08/23/2012 17:00	0.706	0.497	0.209	n/a	2.32	1.63	0.69	n/a
Yabucoa Harbor, PR	9754228	08/23/2012 17:42	0.520	0.173	0.347	n/a	1.71	0.57	1.14	n/a
San Juan, PR	9755371	08/23/2012 17:30	0.681	0.537	0.144	*0.447	2.23	1.76	0.47	*1.47
Arecibo, PR	9757809	<b>08/23/2012 17:00</b>	<b>0.760</b>	0.550	0.210	n/a	<b>2.49</b>	1.80	0.69	n/a
Magueyes Island, PR	9759110	08/23/2012 23:54	0.557	0.236	0.321	n/a	1.83	0.77	1.06	n/a
<sup>2</sup> Mayaguez, PR	9759394	08/24/2012 18:18	0.670	0.327	0.343	n/a	2.20	1.07	1.13	n/a
<sup>2</sup> Aguadilla, PR	9759412	08/24/2012 18:06	0.725	0.442	0.283	*0.549	2.38	1.45	0.93	*1.80
Mona Island, PR	9759938	08/23/2012 22:00	0.540	0.247	0.293	n/a	1.77	0.81	0.96	n/a
Lake Worth Pier, FL	8722670	08/26/2012 20:36	1.194	0.984	0.210	0.446	3.92	3.23	0.69	1.46
Virginia Key, FL	8723214	08/26/2012 21:12	1.030	0.696	0.334	0.428	3.38	2.28	1.10	1.40
Vaca Key, FL	8723970	08/25/2012 10:24	0.574	0.341	0.233	0.167	1.88	1.12	0.76	0.55
Key West, FL	8724580	08/27/2012 10:54	0.890	0.644	0.246	0.352	2.92	2.11	0.81	1.16
Naples, FL	8725110	08/27/2012 14:12	1.493	0.943	0.550	0.797	4.90	3.09	1.81	2.61
Fort Myers, FL	8725520	08/27/2012 19:48	0.980	0.407	0.573	0.662	3.22	1.34	1.88	2.17
Port Manatee, FL	8726384	08/28/2012 04:12	1.110	0.486	0.624	0.639	3.64	1.59	2.05	2.10
St. Petersburg, FL	8726520	08/28/2012 04:42	1.189	0.487	0.702	n/a	3.90	1.60	2.30	n/a
Old Port Tampa, FL	8726607	08/28/2012 05:30	1.244	0.603	0.641	n/a	4.08	1.98	2.10	n/a
Mckay Bay Entrance, FL	8726667	08/28/2012 16:12	1.278	0.932	0.346	0.770	4.19	3.06	1.13	2.53
Clearwater Beach, FL	8726724	08/28/2012 01:54	1.346	0.610	0.736	0.807	4.42	2.00	2.42	2.65
Cedar Key, FL	8727520	08/28/2012 05:30	1.760	0.961	0.799	1.073	5.77	3.15	2.62	3.52

<sup>1</sup> Sensor reached physical limit on measurements and did not record a maximum value.

<sup>2</sup> Maximum recorded water level value exceeded historical maximum value.

Table 1b: Maximum recorded water levels in geographic order for Hurricane Isaac, August 2012. Referenced to MLLW and NAVD88 (or PRVD02) where available. Storm Tide includes both tidal and meteorological forces and storm surge represents the observed water level (storm tide) minus predicted astronomical tide. Stations where the historical maximum water level was exceeded are highlighted in gray.

Station Name	Station ID	Date & Time GMT	Storm Tide	Predicted	Storm Surge/ Residual (m)	Storm Tide	Storm Tide	Predicted	Storm Surge/ Residual (ft)	Storm Tide
			(m, MLLW)	(m, NAVD88 or *PRVD02)		(ft, MLLW)	(ft, NAVD88 or *PRVD02)			
Apalachicola, FL	8728690	08/28/2012 10:48	1.473	0.429	1.044	1.241	4.83	1.41	3.42	4.07
Panama City, FL	8729108	08/28/2012 14:48	1.278	0.515	0.763	1.108	4.19	1.69	2.50	3.64
Pensacola, FL	8729840	08/28/2012 17:42	1.227	0.420	0.807	1.129	4.02	1.38	2.64	3.70
<sup>2</sup> Weeks Bay, AL	8732828	08/29/2012 16:18	1.357	0.499	0.858	n/a	4.45	1.64	2.81	n/a
Dauphin Island, AL	8735180	08/29/2012 15:18	1.320	0.457	0.863	1.250	4.33	1.50	2.83	4.10
Dog River Bridge, AL	8735391	08/29/2012 17:36	1.605	0.515	1.090	n/a	5.27	1.69	3.58	n/a
East Fowl River Bridge, AL	8735523	08/29/2012 15:36	1.586	0.492	1.094	n/a	5.20	1.61	3.59	n/a
<sup>2</sup> Coast Guard Sector Mobile, AL	8736897	08/29/2012 17:00	1.771	0.468	1.303	n/a	5.81	1.54	4.27	n/a
<sup>2</sup> Mobile State Docks, AL	8737048	08/29/2012 18:54	1.614	0.443	1.171	1.540	5.30	1.45	3.85	5.05
Chickasaw Creek, AL	8737138	08/29/2012 19:18	1.567	0.385	1.182	n/a	5.14	1.26	3.88	n/a
West Fowl River Bridge, AL	8738043	08/29/2012 14:24	1.541	0.475	1.066	n/a	5.06	1.56	3.50	n/a
Bayou La Batre Bridge, AL	8739803	08/29/2012 13:12	1.734	0.525	1.209	n/a	5.69	1.72	3.97	n/a
Dock E, Port of Pascagoula, MS	8741041	08/29/2012 15:12	1.829	0.464	1.365	n/a	6.00	1.52	4.48	n/a
Pascagoula NOAA Lab, MS	8741533	08/29/2012 15:36	1.853	0.472	1.381	n/a	6.08	1.55	4.53	n/a
Bay Waveland Yacht Club, MS	8747437	08/29/2012 16:42	2.994	0.560	2.434	2.900	9.82	1.84	7.98	9.51
Pilottown, LA	8760721	08/29/2012 03:24	1.926	0.022	1.904	n/a	6.32	0.07	6.25	n/a
Pilots Station East, SW Pass, LA	8760922	08/29/2012 07:36	1.383	0.293	1.090	n/a	4.54	0.96	3.58	n/a
<sup>2</sup> Shell Beach, LA	8761305	<b>08/29/2012 05:36</b>	<b>3.359</b>	-0.005	3.364	n/a	<b>11.02</b>	-0.02	11.04	n/a
<sup>2</sup> Grand Isle, LA	8761724	08/29/2012 14:06	1.718	0.413	1.305	n/a	5.64	1.35	4.29	n/a
<sup>2</sup> New Canal Station, LA	8761927	08/30/2012 08:24	1.991	0.054	1.937	n/a	6.53	0.18	6.35	n/a
<sup>1,2</sup> East Bank 1, Norco, B. LaBranche, L	8762372	08/29/2012 10:18	2.033	0.026	2.007	n/a	6.67	0.09	6.58	n/a
LAWMA, Amerada Pass, LA	8764227	08/30/2012 19:30	1.054	0.389	0.665	n/a	3.46	1.28	2.18	n/a
Freshwater Canal Locks, LA	8766072	08/31/2012 18:54	1.189	0.545	0.644	n/a	3.90	1.79	2.11	n/a

<sup>1</sup> Sensor reached physical limit on measurements and did not record a maximum value.

<sup>2</sup> Maximum recorded water level value exceeded historical maximum value.

Table 2a: Maximum recorded wind speed, wind gusts and minimum barometric pressure in geographic order for Hurricane Isaac, August 2012.

Station Name	Station ID	Maximum Wind Speed			Maximum Wind Gusts			Minimum Atmospheric Pressure	
		Date & Time GMT	m/sec	knots	Date & Time GMT	m/sec	knots	Date & Time GMT	mbar
Barbuda	9761115	<b>08/23/2012 09:42</b>	<b>17.5</b>	<b>34.0</b>	08/23/2012 09:18	23.1	44.9	08/22/2012 23:36	1007.0
Christiansted Harbor, St Croix, VI	9751364	08/23/2012 23:06	9.7	18.9	<b>08/22/2012 08:54</b>	<b>24.0</b>	<b>46.7</b>	08/23/2012 08:36	1005.8
Lameshur Bay, St. John, VI	9751381	n/a	n/a	n/a	n/a	n/a	n/a	08/23/2012 08:48	1006.9
Lime Tree Bay, VI	9751401	08/24/2012 17:12	16.3	31.7	08/24/2012 05:18	19.8	38.5	08/23/2012 08:48	1005.5
Charlotte Amalie, VI	9751639	08/24/2012 18:24	7.8	15.2	08/23/2012 13:24	15.2	29.5	08/23/2012 08:36	1007.1
Culebra, PR	9752235	08/24/2012 17:54	9.2	17.9	08/23/2012 16:30	15.9	30.9	08/23/2012 09:42	1008.6
Isabel Segunda, Vieques Island, PR	9752619	08/23/2012 22:42	9.1	17.7	08/23/2012 15:00	15.9	30.9	n/a	n/a
Esperanza, Vieques Island, PR	9752695	08/24/2012 06:00	15.7	30.5	08/23/2012 17:36	19.1	37.1	08/23/2012 09:18	1007.5
Fajardo, PR	9753216	08/23/2012 17:06	13.2	25.7	08/23/2012 13:24	17.8	34.6	08/23/2012 09:06	1008.9
Yabucoa Harbor, PR	9754228	08/23/2012 20:24	15.1	29.4	08/23/2012 20:24	18.7	36.3	n/a	n/a
San Juan, PR	9755371	08/23/2012 11:42	14.0	27.2	08/23/2012 11:12	21.8	42.4	08/23/2012 18:06	1007.0
Arecibo, PR	9757809	08/23/2012 02:00	10.7	20.8	08/23/2012 12:54	15.1	29.4	08/23/2012 19:24	1009.9
Magueyes Island, PR	9759110	08/24/2012 01:30	9.2	17.9	08/24/2012 11:54	15.0	29.2	08/23/2012 18:54	1006.2
Mayaguez, PR	9759394	08/25/2012 02:12	9.8	19.0	08/25/2012 02:12	14.2	27.6	08/23/2012 19:06	1010.6
Aguadilla, PR	9759412	n/a	n/a	n/a	n/a	n/a	n/a	08/23/2012 19:42	1007.4
Mona Island, PR	9759938	n/a	n/a	n/a	n/a	n/a	n/a	08/23/2012 20:24	1006.7
Lake Worth Pier, FL	8722670	08/27/2012 05:54	20.2	39.3	08/26/2012 09:42	24.3	47.2	08/26/2012 23:18	1006.6
Virginia Key, FL	8723214	08/26/2012 17:42	20.4	39.7	08/26/2012 17:42	23.5	45.7	08/26/2012 17:42	1003.9
Vaca Key, FL	8723970	08/26/2012 15:36	15.1	29.4	08/25/2012 12:06	21.8	42.4	08/26/2012 19:54	1000.4
Key West, FL	8724580	08/27/2012 19:42	15.3	29.7	08/26/2012 17:06	17.7	34.4	08/26/2012 20:30	996.2
Naples, FL	8725110	08/27/2012 18:12	13.9	27.0	08/27/2012 15:54	18.6	36.2	08/27/2012 07:48	1004.0
Fort Myers, FL	8725520	08/27/2012 01:42	8.8	17.1	08/27/2012 18:36	14.3	27.8	08/27/2012 07:54	1004.0
Port Manatee, FL	8726384	n/a	n/a	n/a	n/a	n/a	n/a	08/27/2012 09:18	1005.4
St. Petersburg, FL	8726520	08/27/2012 19:18	14.0	27.3	08/27/2012 19:18	18.1	35.1	08/27/2012 21:30	1007.1
Old Port Tampa, FL	8726607	08/29/2012 16:00	12.1	23.5	08/28/2012 17:00	16.2	31.5	08/27/2012 09:18	1006.5
Mckay Bay Entrance, FL	8726667	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Clearwater Beach, FL	8726724	08/28/2012 19:54	12.8	24.9	08/27/2012 20:36	15.7	30.5	08/27/2012 19:42	1005.9
Cedar Key, FL	8727520	08/26/2012 20:42	15.2	29.5	08/26/2012 20:42	18.6	36.2	08/27/2012 21:00	1006.9

Table 2b: Maximum recorded wind speed, wind gusts and minimum barometric pressure in geographic order for Hurricane Isaac, August 2012.

Station Name	Station ID	Maximum Wind Speed			Maximum Wind Gusts			Minimum Atmospheric Pressure	
		Date & Time GMT	m/sec	knots	Date & Time GMT	m/sec	knots	Date & Time GMT	mbar
Apalachicola, FL	8728690	08/27/2012 19:48	12.6	24.5	08/27/2012 19:48	15.8	30.7	08/27/2012 22:30	1005.5
Panama City, FL	8729108	08/28/2012 16:18	12.1	23.5	08/30/2012 16:12	17.8	34.6	08/28/2012 07:24	1006.9
Pensacola, FL	8729840	08/28/2012 21:00	11.5	22.4	08/29/2012 18:00	21.0	40.8	08/28/2012 20:42	1004.6
Weeks Bay, AL	8732828	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Dauphin Island, AL	8735180	08/29/2012 05:48	23.2	45.1	08/28/2012 19:54	28.0	54.4	08/28/2012 21:48	1001.5
Dog River Bridge, AL	8735391	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
East Fowl River Bridge, AL	8735523	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Coast Guard Sector Mobile, AL	8736897	08/28/2012 19:42	16.2	31.5	08/29/2012 22:24	21.4	41.6	08/28/2012 20:36	1001.5
Mobile State Docks, AL	8737048	n/a	n/a	n/a	n/a	n/a	n/a	08/28/2012 20:42	1003.1
Chickasaw Creek, AL	8737138	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
West Fowl River Bridge, AL	8738043	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bayou La Batre Bridge, AL	8739803	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Dock E, Port of Pascagoula, MS	8741041	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Pascagoula NOAA Lab, MS	8741533	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bay Waveland Yacht Club, MS	8747437	08/29/2012 17:06	22.7	44.1	08/29/2012 15:36	29.8	57.9	08/29/2012 10:12	995.9
Pilottown, LA	8760721	08/29/2012 15:06	28.7	55.8	08/29/2012 04:54	35.3	68.6	08/28/2012 23:18	970.8
Pilots Station East, SW Pass, LA	8760922	<b>08/29/2012 05:06</b>	<b>33.2</b>	<b>64.5</b>	<b>08/29/2012 06:24</b>	<b>42.2</b>	<b>82.0</b>	<b>08/29/2012 02:18</b>	<b>969.8</b>
Shell Beach, LA	8761305	08/29/2012 03:24	28.6	55.5	08/29/2012 03:30	35.2	68.4	08/29/2012 09:18	987.8
Grand Isle, LA	8761724	08/29/2012 00:12	29.7	57.7	08/29/2012 00:12	37.9	73.7	08/29/2012 06:48	970.0
New Canal Station, LA	8761927	08/29/2012 08:36	27.4	53.3	08/29/2012 09:18	37.7	73.3	08/29/2012 14:18	983.4
East Bank 1, Norco, B. LaBranche, LA	8762372	08/29/2012 09:00	22.1	43.0	08/29/2012 07:12	32.8	63.8	08/29/2012 10:06	984.6
LAWMA, Amerada Pass, LA	8764227	08/29/2012 14:18	22.2	43.2	08/29/2012 14:24	28.3	55.0	08/29/2012 18:24	983.4
Freshwater Canal Locks, LA	8766072	n/a	n/a	n/a	n/a	n/a	n/a	08/29/2012 21:36	992.0

Table 3a: Maximum recorded storm surge/residual levels ranked by amplitude for Hurricane Isaac, August 2012. Storm Surge/Residual represents the observed water level (storm tide) minus predicted astronomical tide levels.

Station Name	Station ID	Date & Time GMT	Residual	
			in Meters	in Feet
<sup>2</sup> Shell Beach, LA	8761305	08/29/2012 05:36	3.364	11.04
Bay Waveland Yacht Club, MS	8747437	08/29/2012 14:24	2.438	8.00
<sup>1,2</sup> East Bank 1, Norco, B. LaBranche, LA	8762372	08/29/2012 10:18	2.007	6.58
<sup>2</sup> New Canal Station, LA	8761927	08/30/2012 08:24	1.937	6.35
Pilottown, LA	8760721	08/29/2012 00:12	1.924	6.31
<sup>2</sup> Coast Guard Sector Mobile, AL	8736897	08/29/2012 21:54	1.411	4.63
Pascagoula NOAA Lab, MS	8741533	08/29/2012 15:36	1.381	4.53
Dock E, Port of Pascagoula, MS	8741041	08/28/2012 23:36	1.378	4.52
<sup>2</sup> Grand Isle, LA	8761724	08/29/2012 14:06	1.305	4.28
Chickasaw Creek, AL	8737138	08/29/2012 22:24	1.302	4.27
Bayou La Batre Bridge, AL	8739803	08/29/2012 13:12	1.209	3.97
Pilots Station East, SW Pass, LA	8760922	08/29/2012 02:30	1.202	3.94
East Fowl River Bridge, AL	8735523	08/29/2012 04:48	1.198	3.93
<sup>2</sup> Mobile State Docks, AL	8737048	08/29/2012 18:54	1.171	3.84
Dog River Bridge, AL	8735391	08/29/2012 04:48	1.112	3.65
Dauphin Island, AL	8735180	08/28/2012 22:30	1.087	3.57
West Fowl River Bridge, AL	8738043	08/29/2012 14:24	1.066	3.50
Pensacola, FL	8729840	08/28/2012 21:06	1.058	3.47
Apalachicola, FL	8728690	08/28/2012 11:06	1.049	3.44
<sup>2</sup> Weeks Bay, AL	8732828	08/29/2012 21:54	0.902	2.96
Cedar Key, FL	8727520	08/28/2012 08:06	0.888	2.91
Mckay Bay Entrance, FL	8726667	08/27/2012 23:12	0.779	2.56
Old Port Tampa, FL	8726607	08/28/2012 01:18	0.771	2.53
Panama City, FL	8729108	08/28/2012 14:48	0.763	2.50
Clearwater Beach, FL	8726724	08/28/2012 01:24	0.761	2.50
St. Petersburg, FL	8726520	08/28/2012 01:00	0.756	2.48
Naples, FL	8725110	08/27/2012 19:54	0.725	2.38
Fort Myers, FL	8725520	08/28/2012 00:54	0.704	2.31
LAWMA, Amerada Pass, LA	8764227	08/30/2012 19:12	0.674	2.21

<sup>1</sup> Sensor reached physical limit on measurements and did not record a maximum value.

<sup>2</sup> Maximum recorded water level value exceeded historical maximum value.

Table 3b: Maximum recorded storm surge/residual levels ranked by amplitude for Hurricane Isaac, August 2012. Storm Surge/Residual represents the observed water level (storm tide) minus predicted astronomical tide levels.

Station Name	Station ID	Date & Time GMT	Residual	
			in Meters	in Feet
Port Manatee, FL	8726384	08/28/2012 01:24	0.656	2.15
Freshwater Canal Locks, LA	8766072	08/31/2012 18:54	0.644	2.11
Barbuda	9761115	08/23/2012 01:42	0.422	1.38
Virginia Key, FL	8723214	08/26/2012 19:36	0.402	1.32
<sup>2</sup> Mayaguez, PR	9759394	08/24/2012 23:06	0.376	1.23
Yabucoa Harbor, PR	9754228	08/23/2012 16:06	0.352	1.15
Key West, FL	8724580	08/27/2012 02:54	0.348	1.14
<sup>2</sup> Aguadilla, PR	9759412	08/24/2012 20:48	0.346	1.14
Esperanza, Vieques Island, PR	9752695	08/24/2012 01:00	0.323	1.06
Magueyes Island, PR	9759110	08/23/2012 23:54	0.321	1.05
Arecibo, PR	9757809	08/24/2012 23:54	0.298	0.98
Vaca Key, FL	8723970	08/26/2012 23:06	0.294	0.96
Mona Island, PR	9759938	08/23/2012 21:48	0.293	0.96
Culebra, PR	9752235	08/23/2012 02:00	0.285	0.94
Charlotte Amalie, VI	9751639	08/23/2012 15:12	0.282	0.93
Christiansted Harbor, St Croix, VI	9751364	08/23/2012 09:06	0.272	0.89
Lake Worth Pier, FL	8722670	08/26/2012 15:36	0.271	0.89
Fajardo, PR	9753216	08/23/2012 12:30	0.258	0.85
Lameshur Bay, St. John, VI	9751381	08/23/2012 16:00	0.251	0.82
Lime Tree Bay, VI	9751401	08/23/2012 09:48	0.251	0.82
Isabel Segunda, Vieques Island, PR	9752619	08/23/2012 09:18	0.240	0.79
San Juan, PR	9755371	08/23/2012 09:18	0.216	0.71

<sup>1</sup> Sensor reached physical limit on measurements and did not record a maximum value.

<sup>2</sup> Maximum recorded water level value exceeded historical maximum value.

**NOAA NOS Center for Operational Oceanographic Products & Services  
Station Comparison of Superseded Historical Maximum Water Levels  
with Hurricane Irene Maximum Storm Tide**

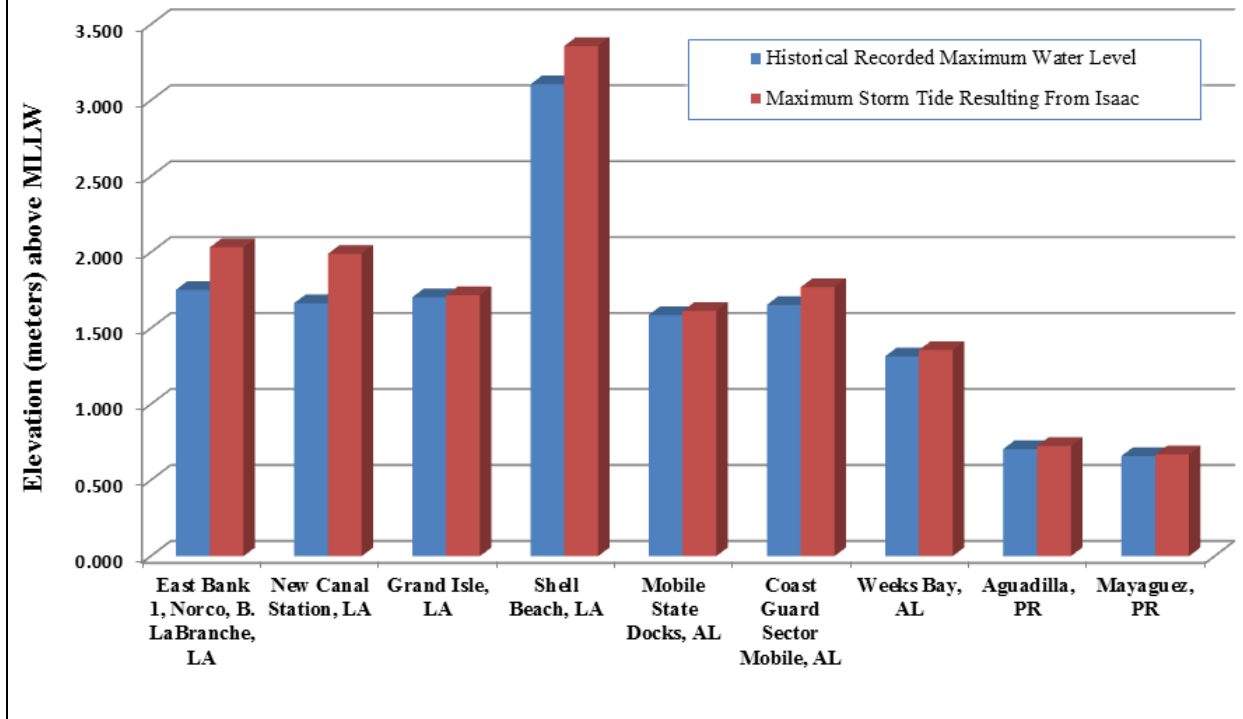


Figure 3: Stations that exceeded historical recorded maximum water levels during Hurricane Isaac.

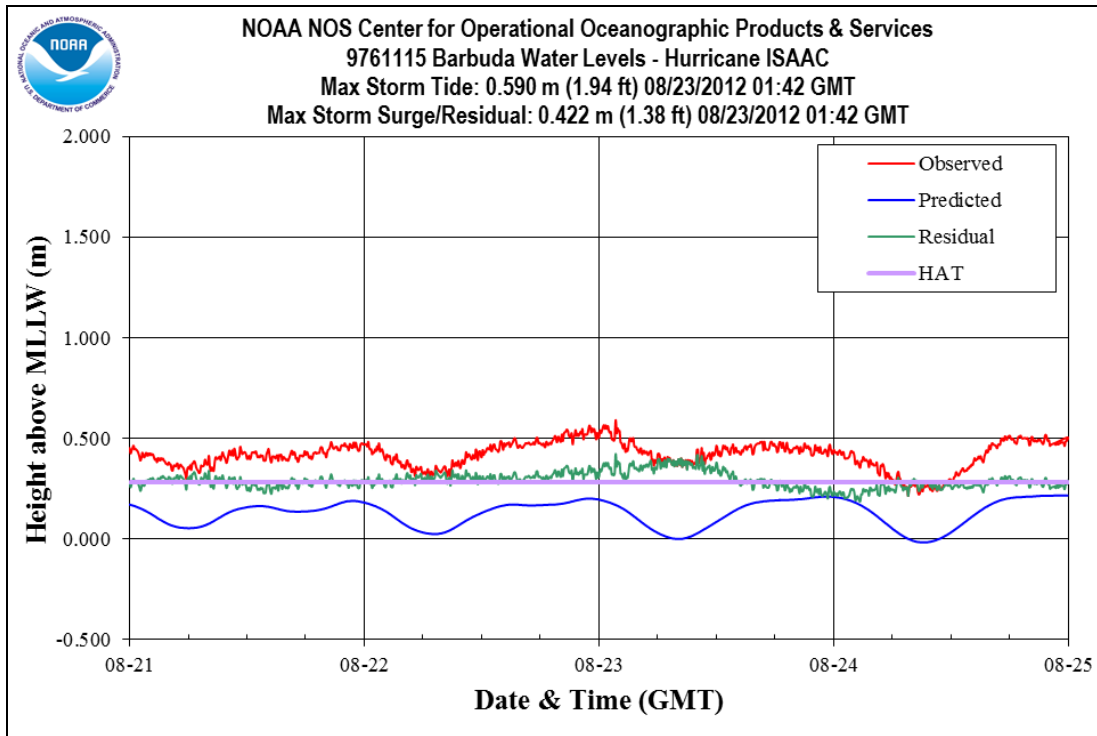


Figure 4: Water levels above Mean Lower Low Water (MLLW) at Barbuda. A line denoting Highest Astronomical Tide (HAT) is displayed.

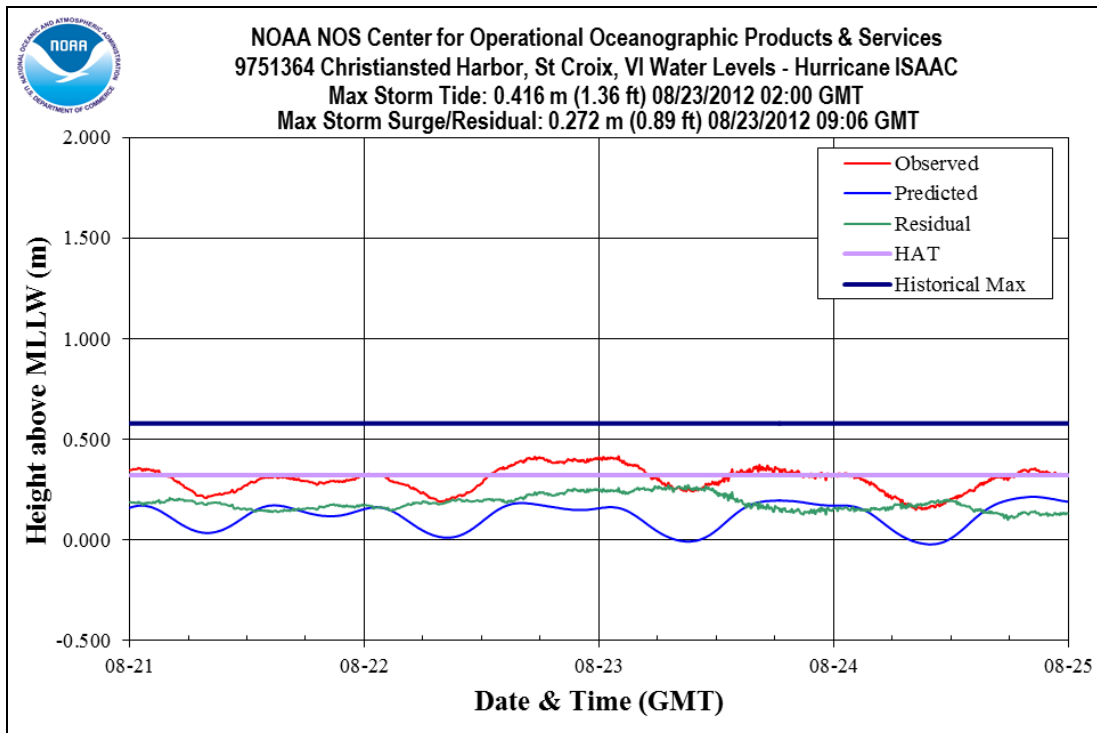


Figure 5: Water levels above Mean Lower Low Water (MLLW) at Christiansted Harbor, VI. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed.



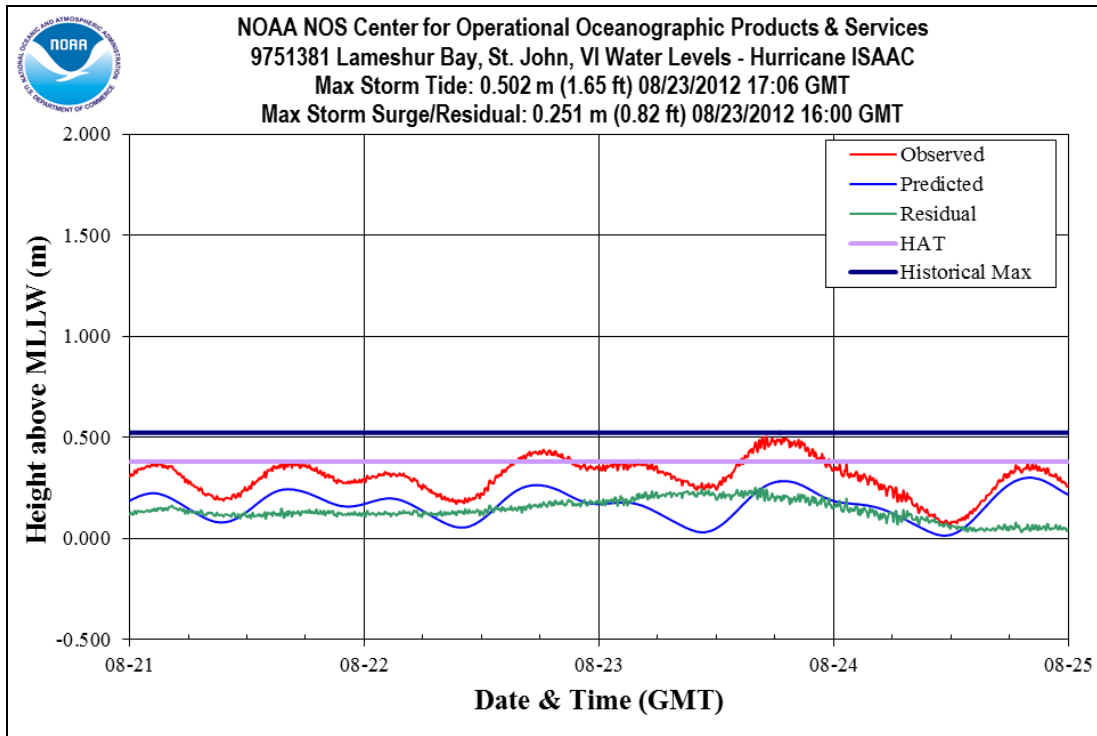


Figure 6: Water levels above Mean Lower Low Water (MLLW) at Lameshur Bay, VI. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed.

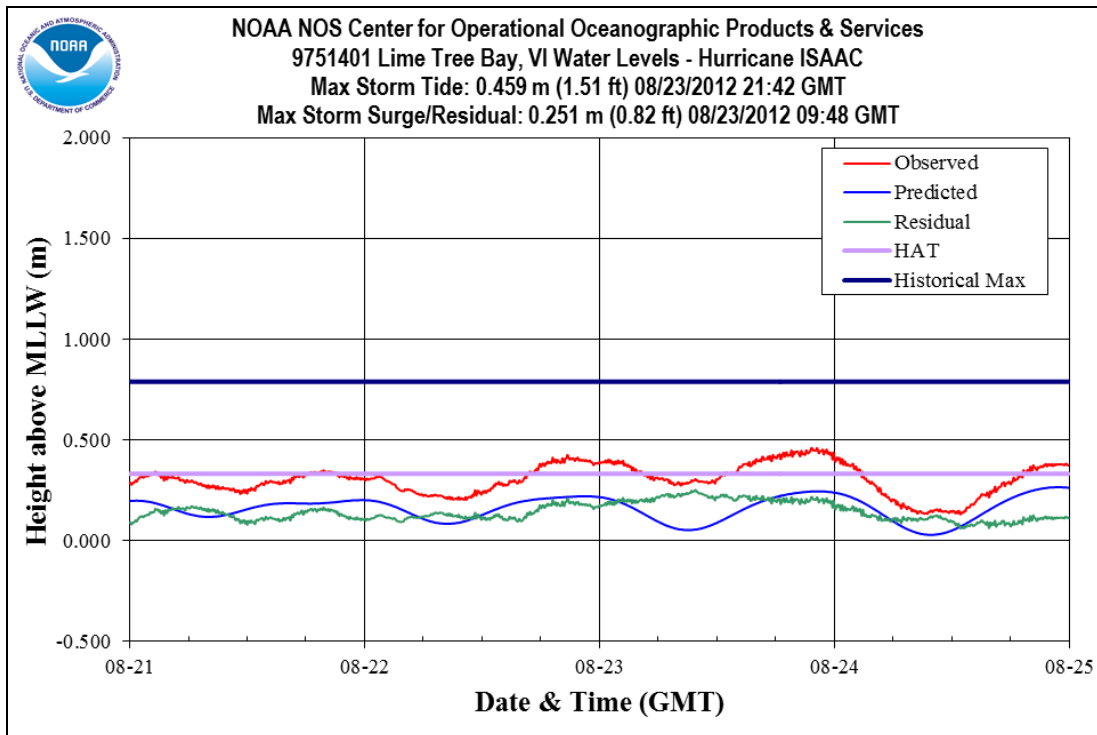


Figure 7: Water levels above Mean Lower Low Water (MLLW) at Lime Tree Bay, VI. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed.

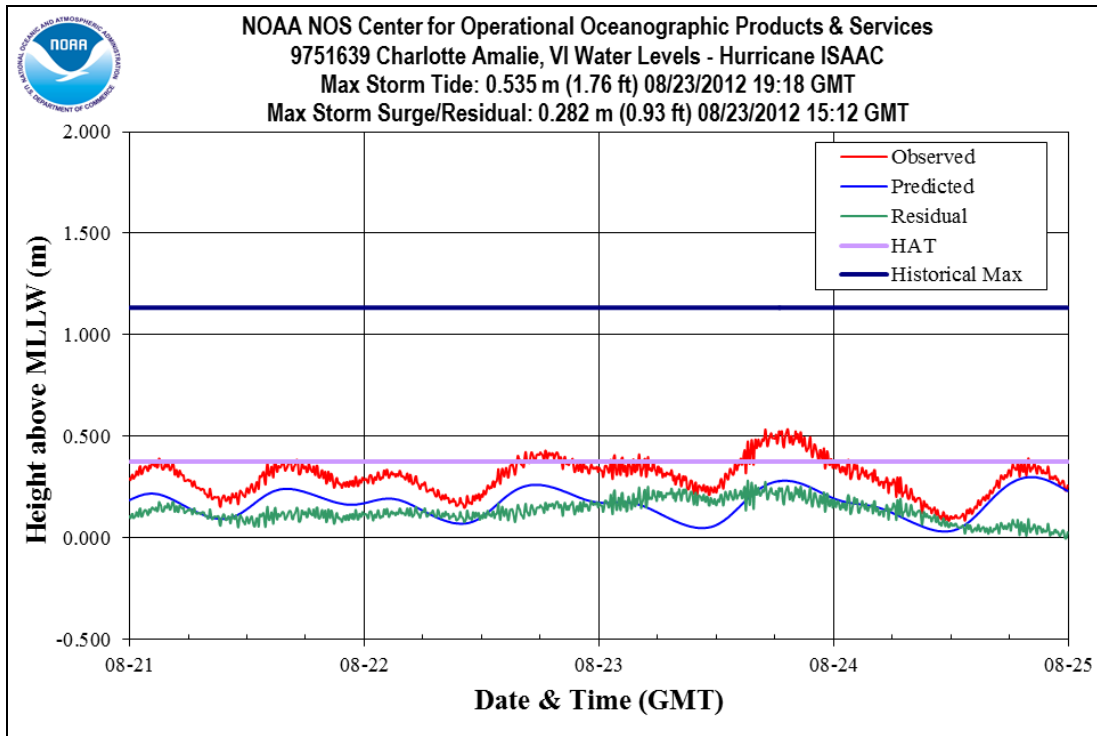


Figure 8: Water levels above Mean Lower Low Water (MLLW) at Charlotte Amalie, VI. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed.

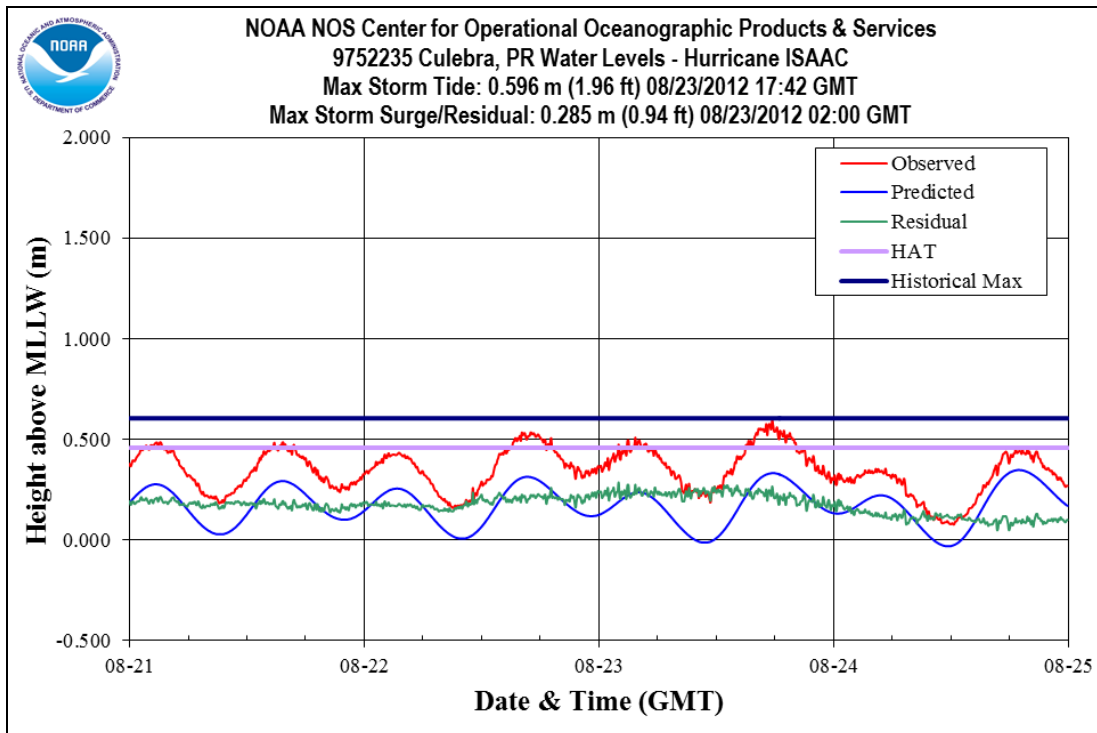


Figure 9: Water levels above Mean Lower Low Water (MLLW) at Culebra, PR. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed.

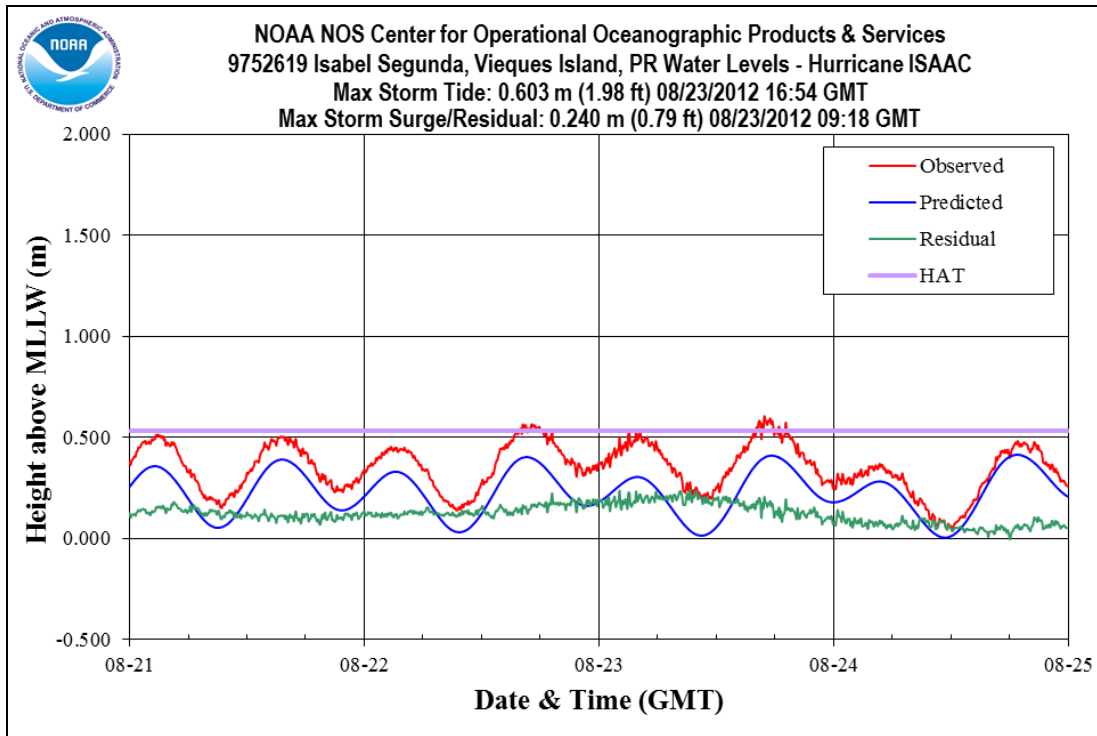


Figure 10: Water levels above Mean Lower Low Water (MLLW) at Isabel Segunda, Vieques Island, PR. A line denoting Highest Astronomical Tide (HAT) is displayed. These datums and any data referred to said datum are PROVISIONAL and subject to revision until they have been thoroughly reviewed and received final approval.

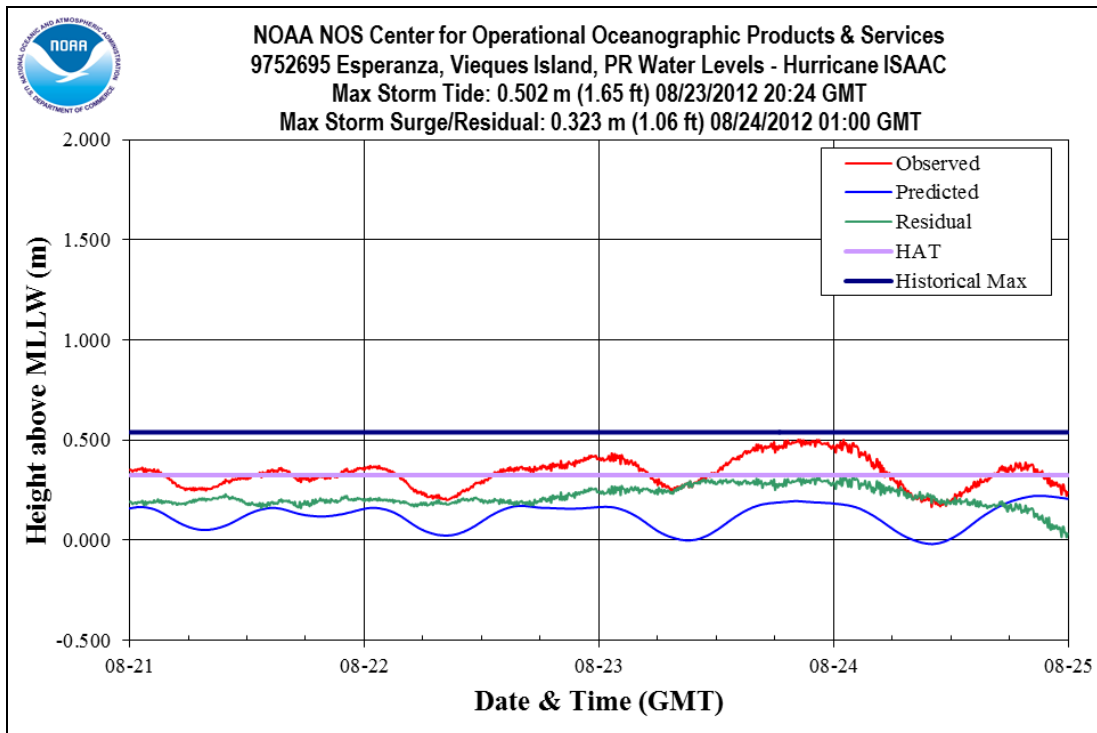


Figure 11: Water levels above Mean Lower Low Water (MLLW) at Esperanza, PR. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed.

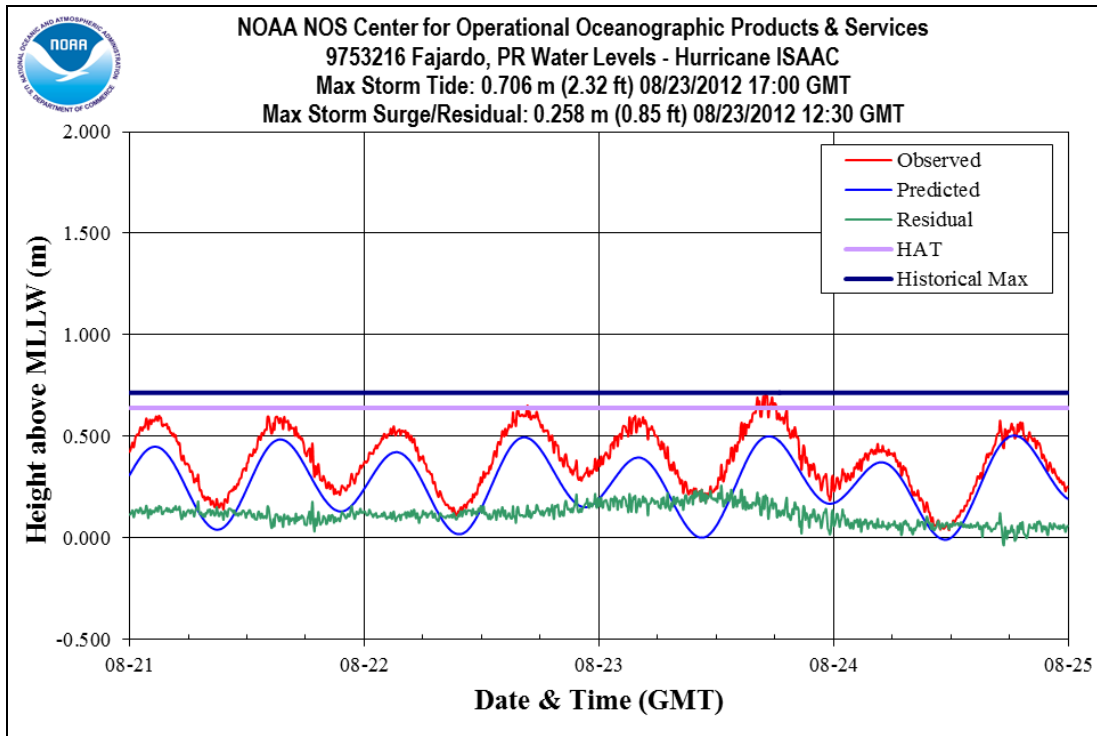


Figure 12: Water levels above Mean Lower Low Water (MLLW) at Fajardo, PR. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. These datums and any data referred to said datum are PROVISIONAL and subject to revision until they have been thoroughly reviewed and received final approval.

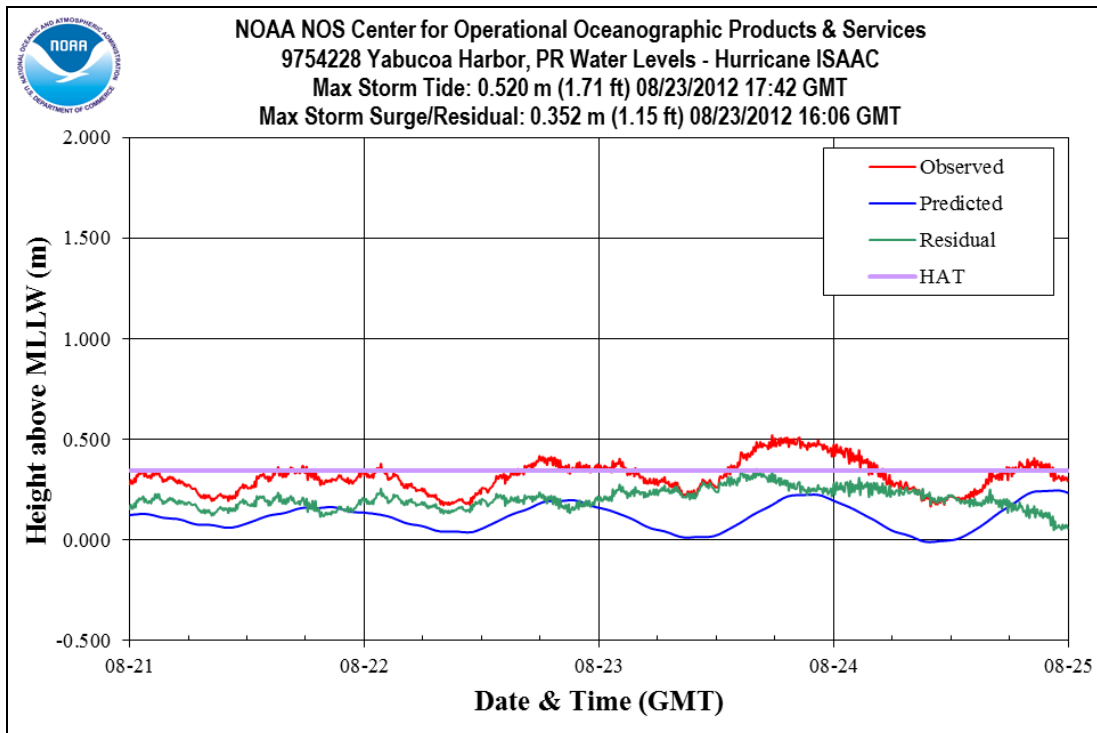


Figure 13: Water levels above Mean Lower Low Water (MLLW) at Yabucoa Harbor, PR. A line denoting Highest Astronomical Tide (HAT) is displayed. These datums and any data referred to said datum are PROVISIONAL and subject to revision until they have been thoroughly reviewed and received final approval.

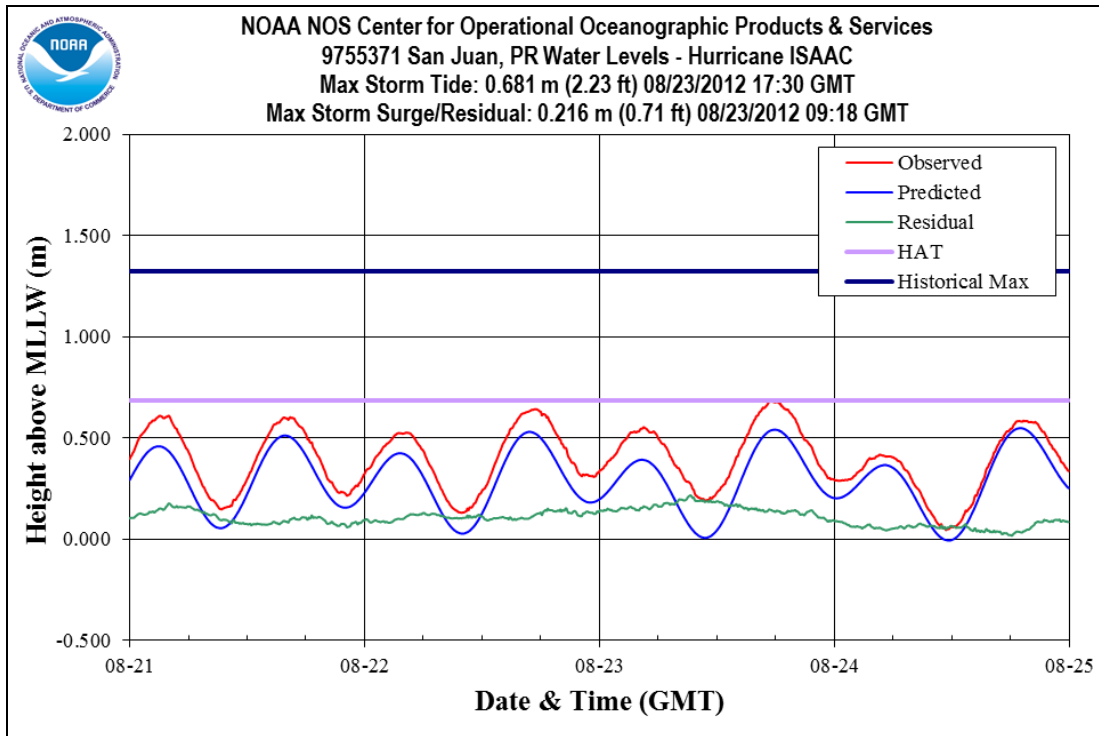


Figure 14: Water levels above Mean Lower Low Water (MLLW) at San Juan, PR. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed.

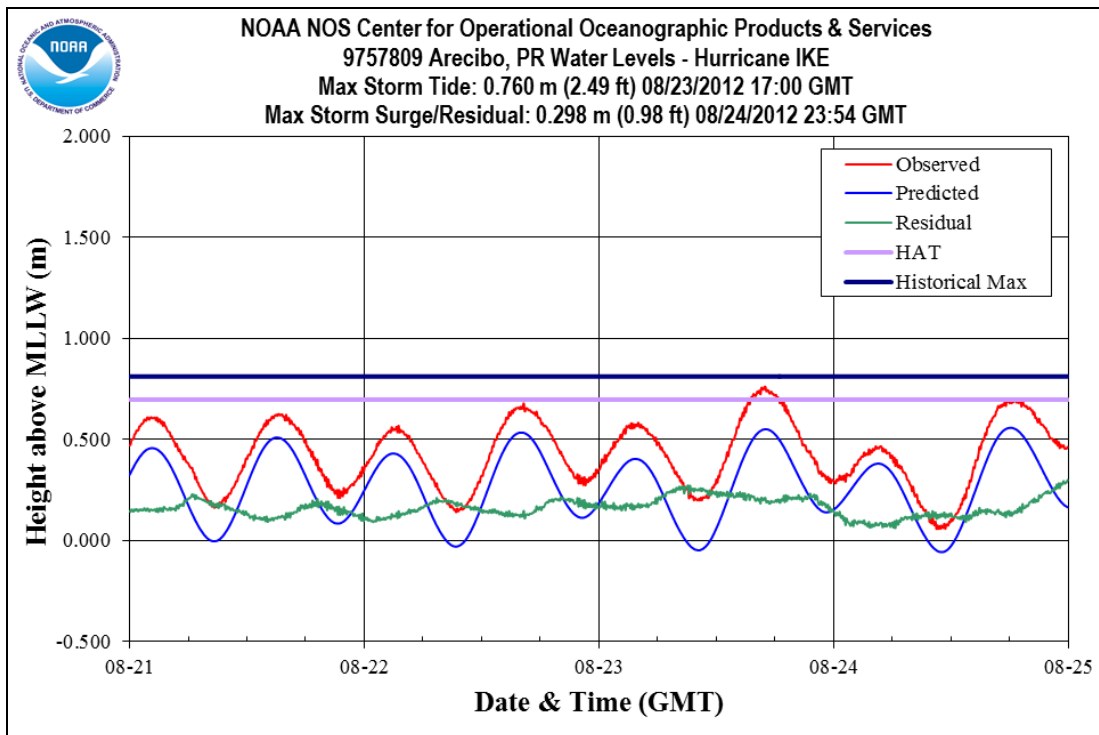


Figure 15: Water levels above Mean Lower Low Water (MLLW) at Arecibo, PR. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. These datums and any data referred to said datum are PROVISIONAL and subject to revision until they have been thoroughly reviewed and received final approval.

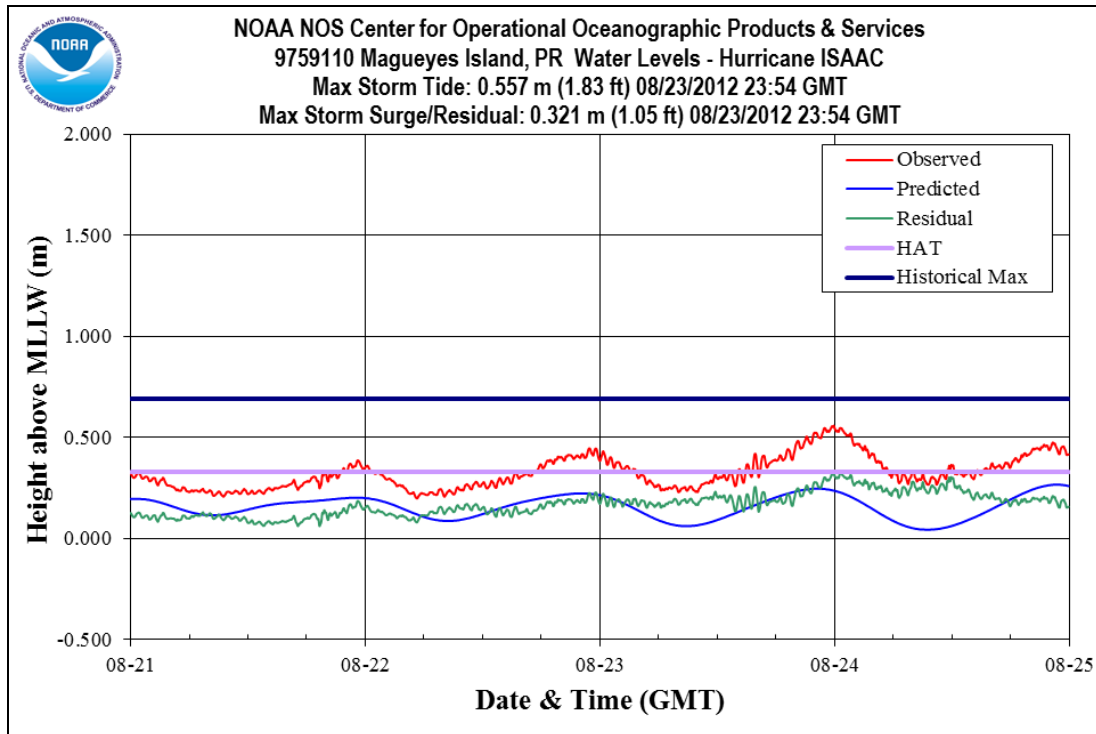


Figure 16: Water levels above Mean Lower Low Water (MLLW) at Magueyes, PR. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed.

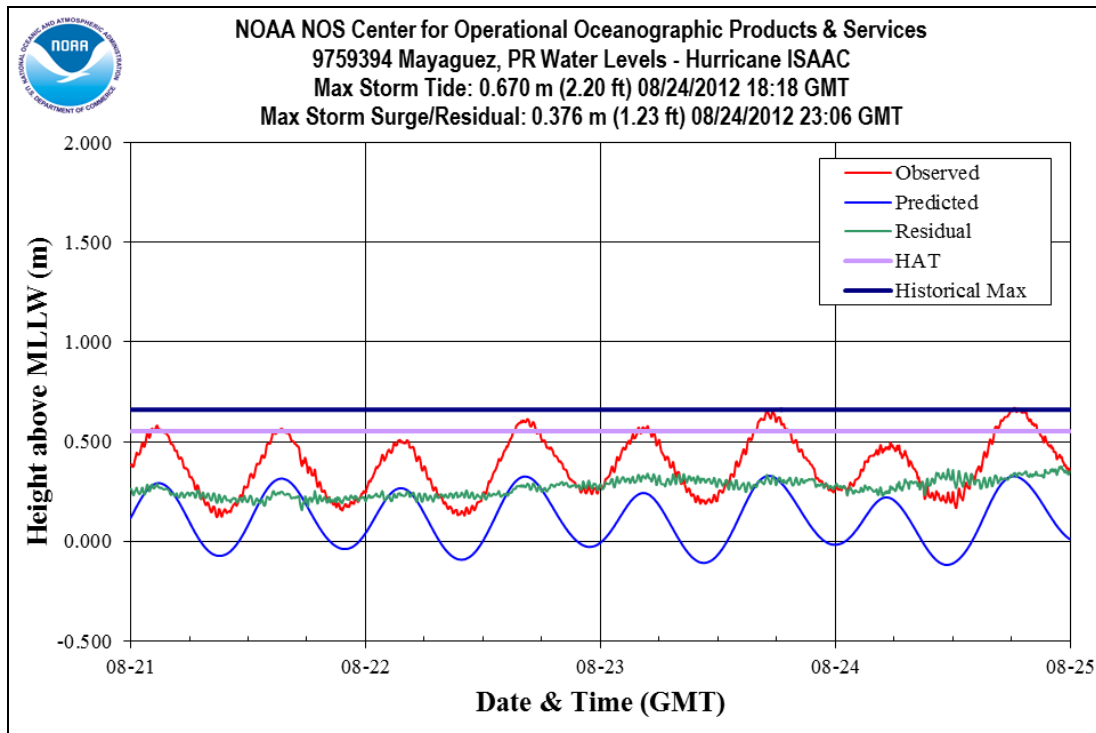


Figure 17: Water levels above Mean Lower Low Water (MLLW) at Mayaguez, PR. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane. These datums and any data referred to said datum are PROVISIONAL and subject to revision until they have been thoroughly reviewed and received final approval.

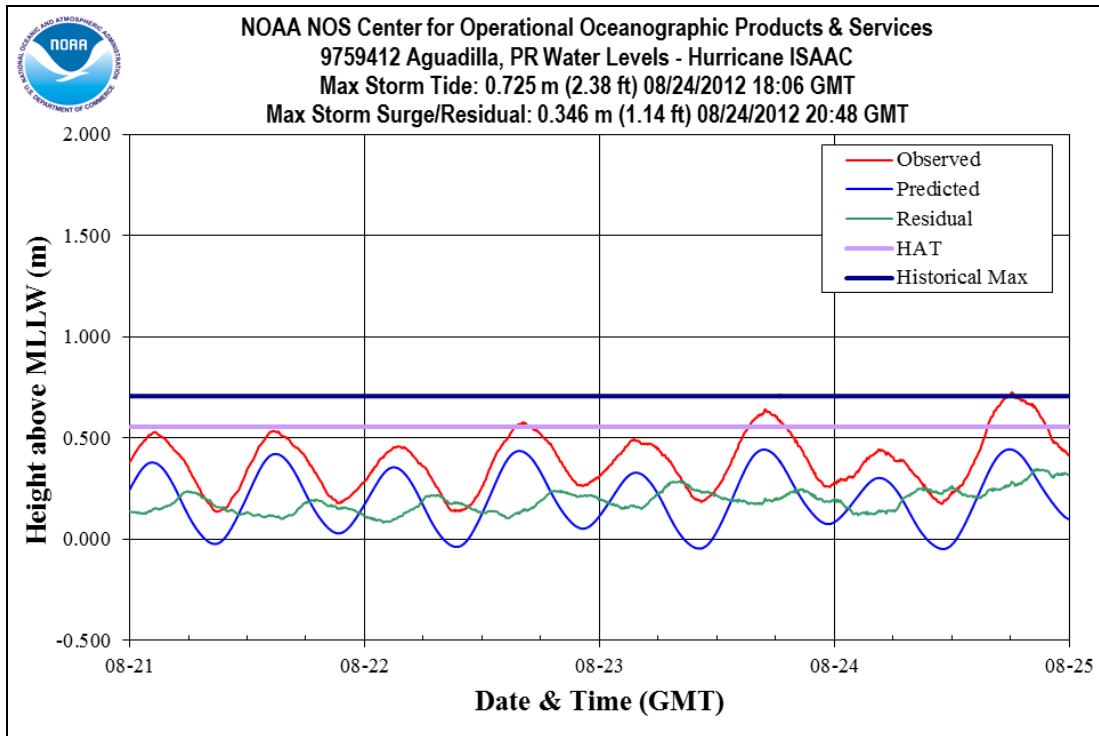


Figure 18: Water levels above Mean Lower Low Water (MLLW) at Aguadilla, PR. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

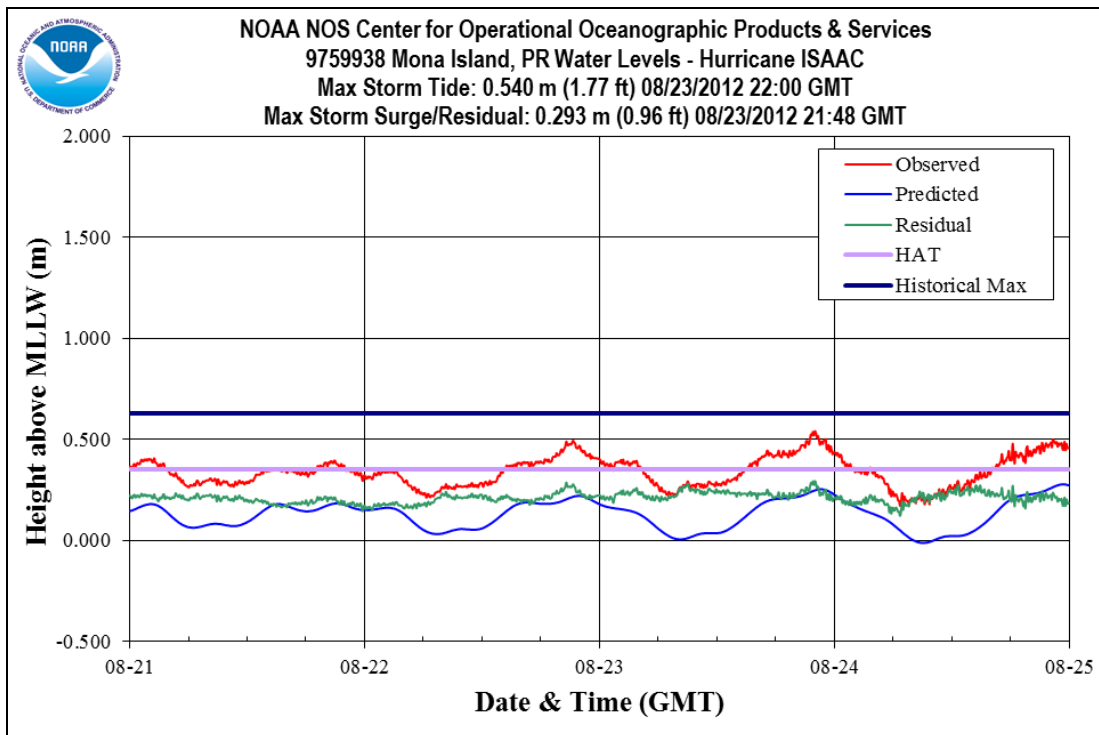


Figure 19: Water levels above Mean Lower Low Water (MLLW) at Mona Island, PR. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed.

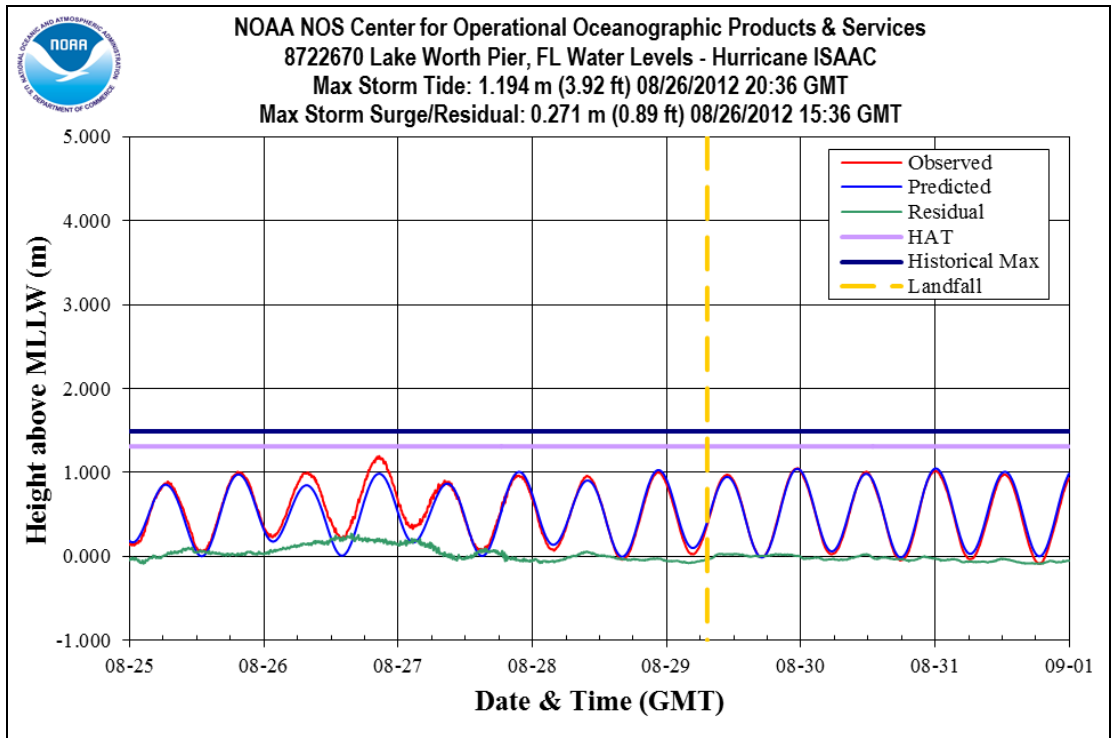


Figure 20: Water levels above Mean Lower Low Water (MLLW) at Lake Worth Pier, FL. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

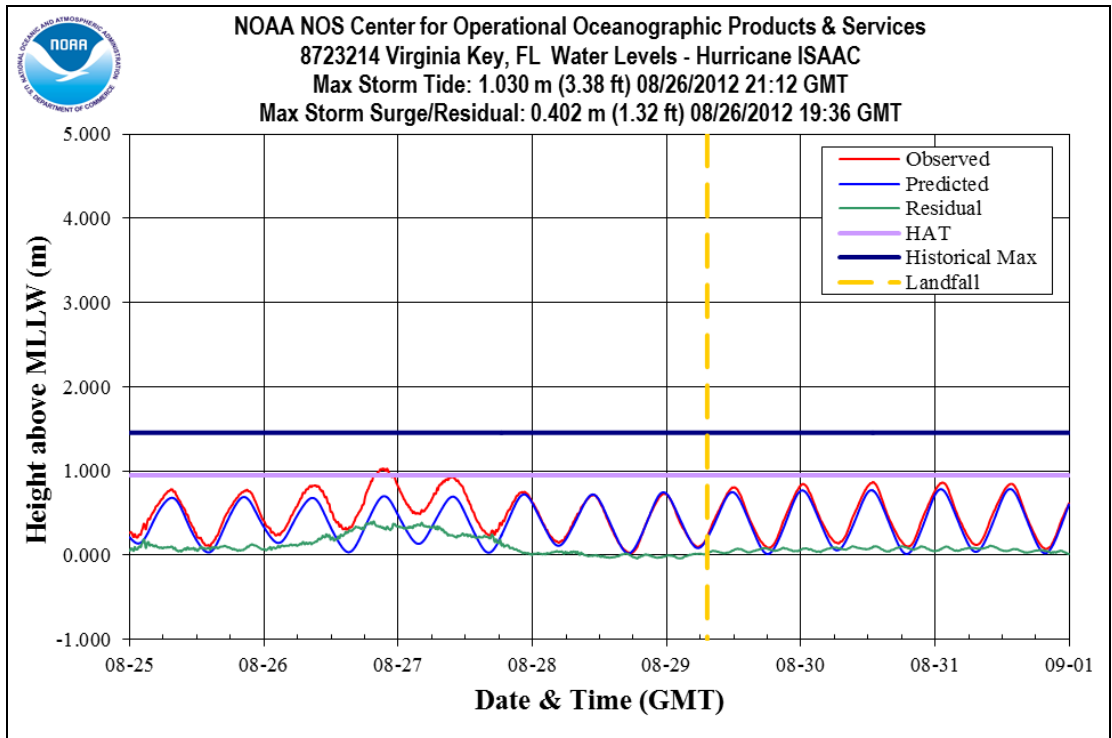


Figure 21: Water levels above Mean Lower Low Water (MLLW) at Virginia Key, FL. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.



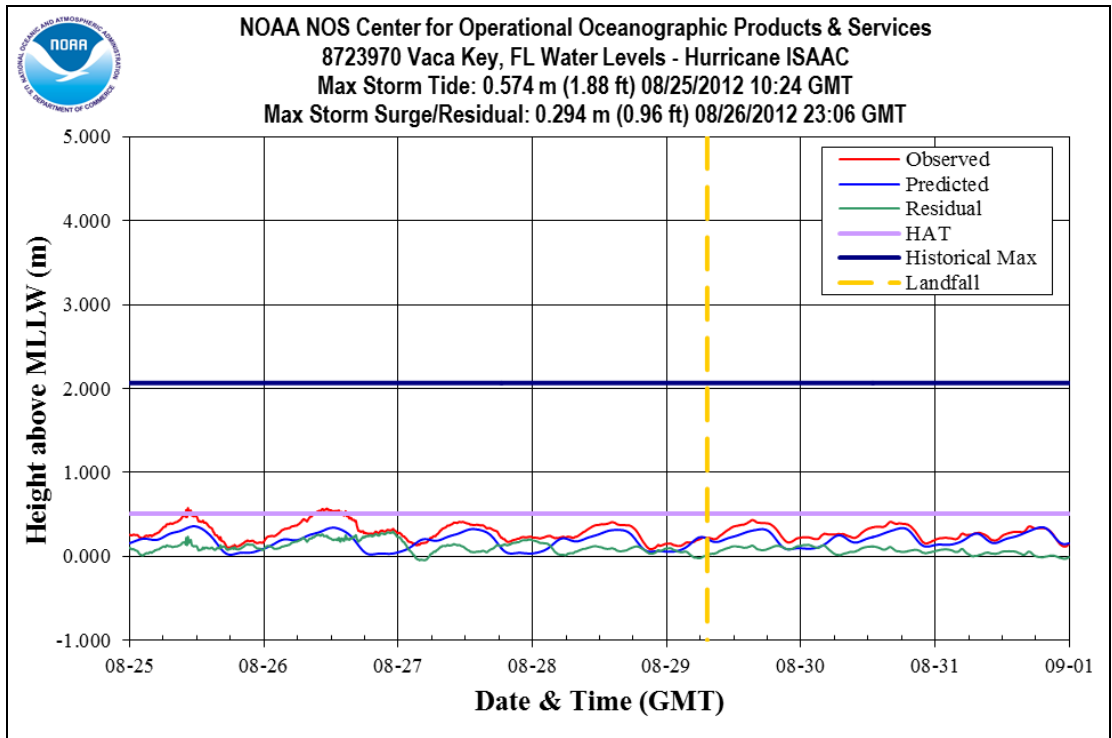


Figure 22: Water levels above Mean Lower Low Water (MLLW) at Vaca Key, FL. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

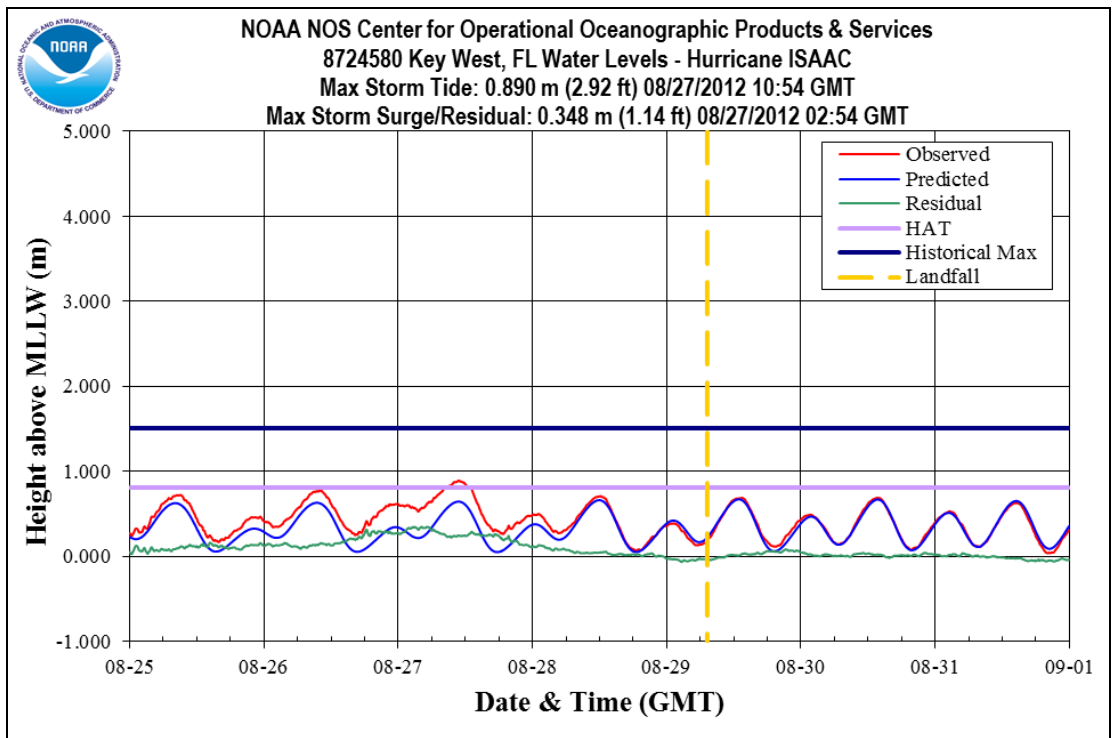


Figure 23: Water levels above Mean Lower Low Water (MLLW) at Key West, FL. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

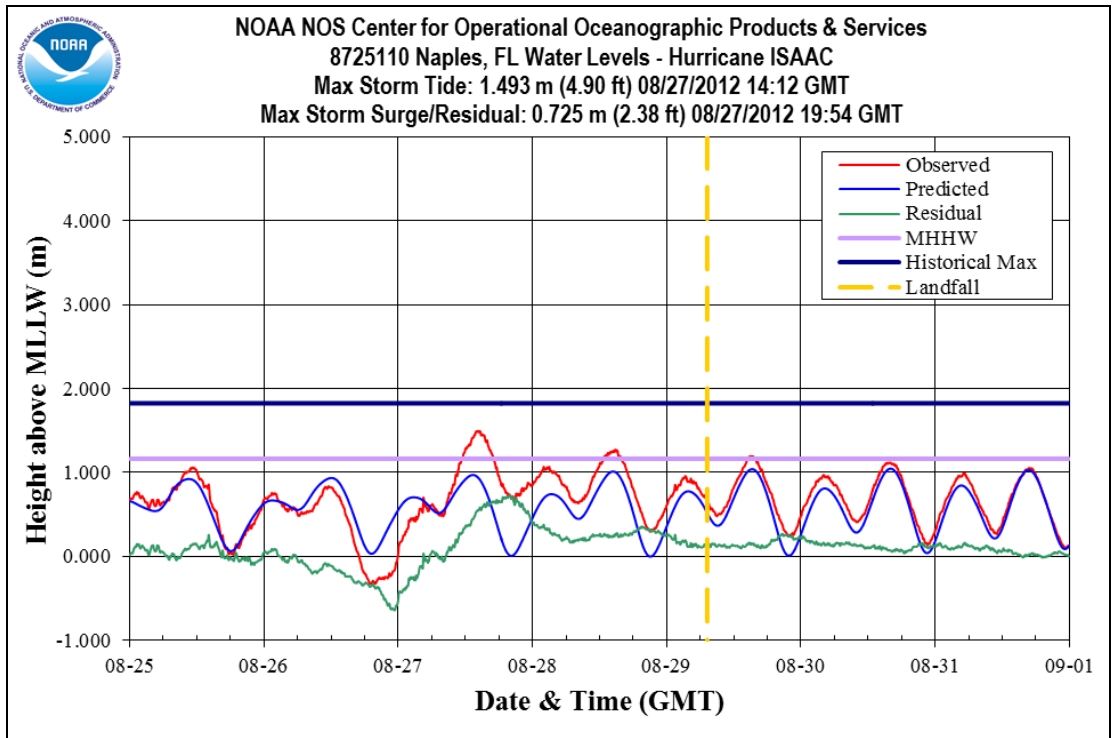


Figure 24: Water levels above Mean Lower Low Water (MLLW) at Naples, FL. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

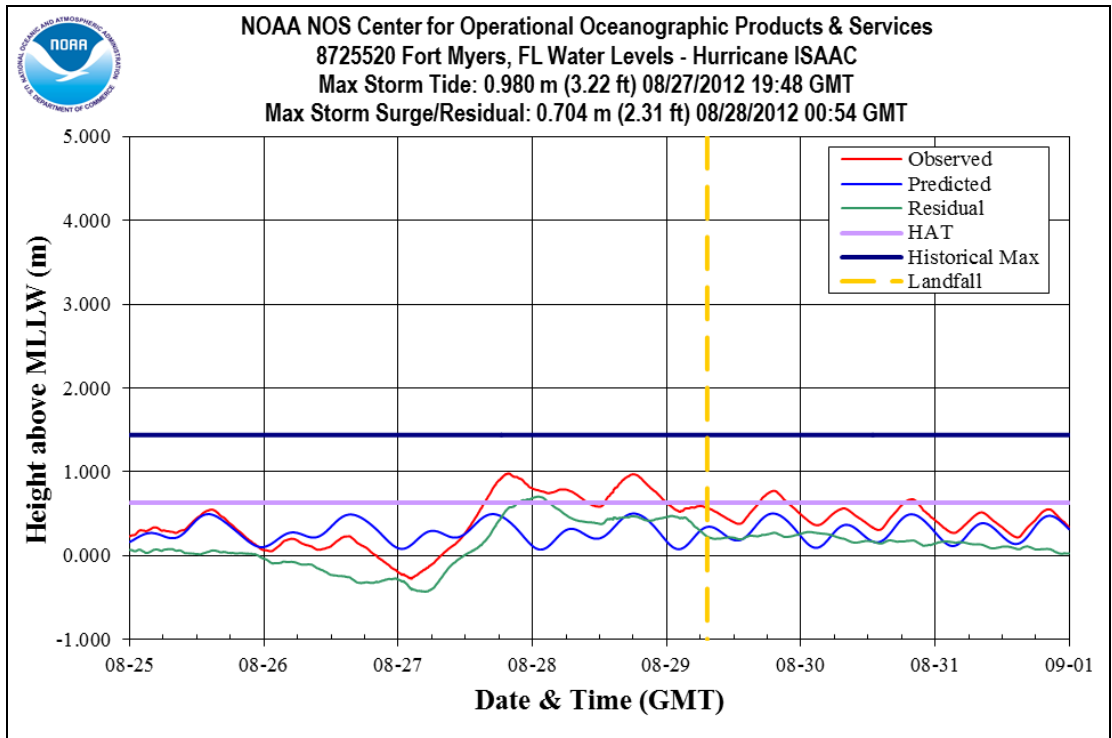


Figure 25: Water levels above Mean Lower Low Water (MLLW) at Fort Myers, FL. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

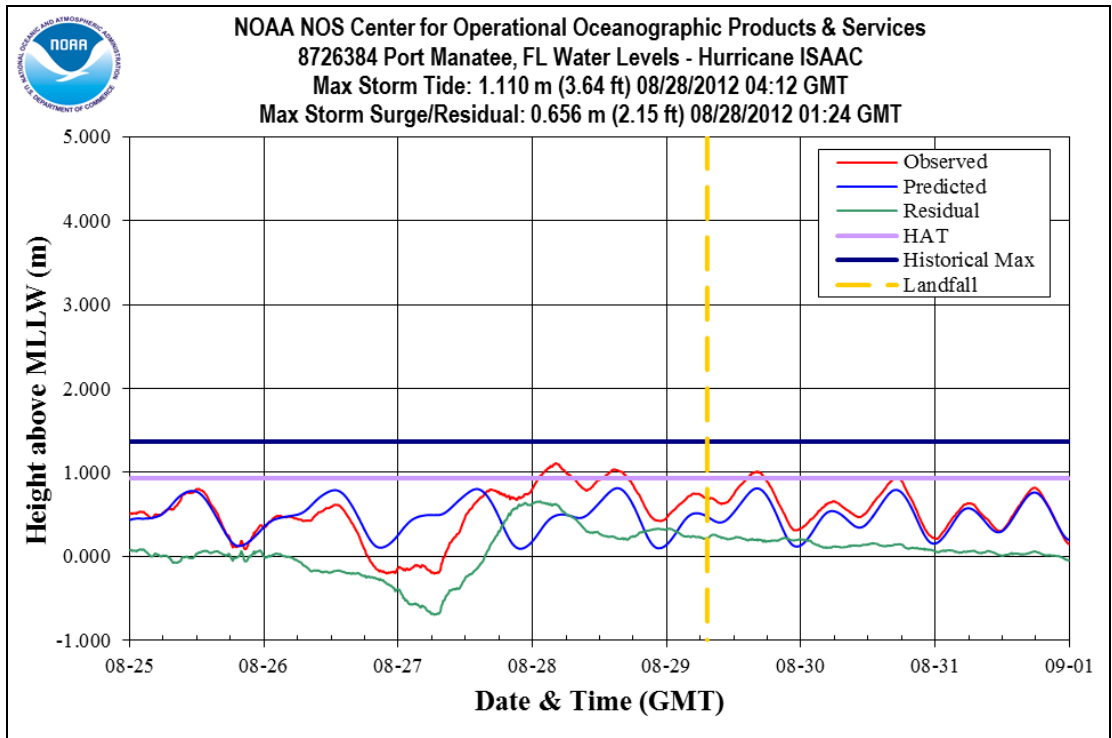


Figure 26: Water levels above Mean Lower Low Water (MLLW) at Port Manatee, FL. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

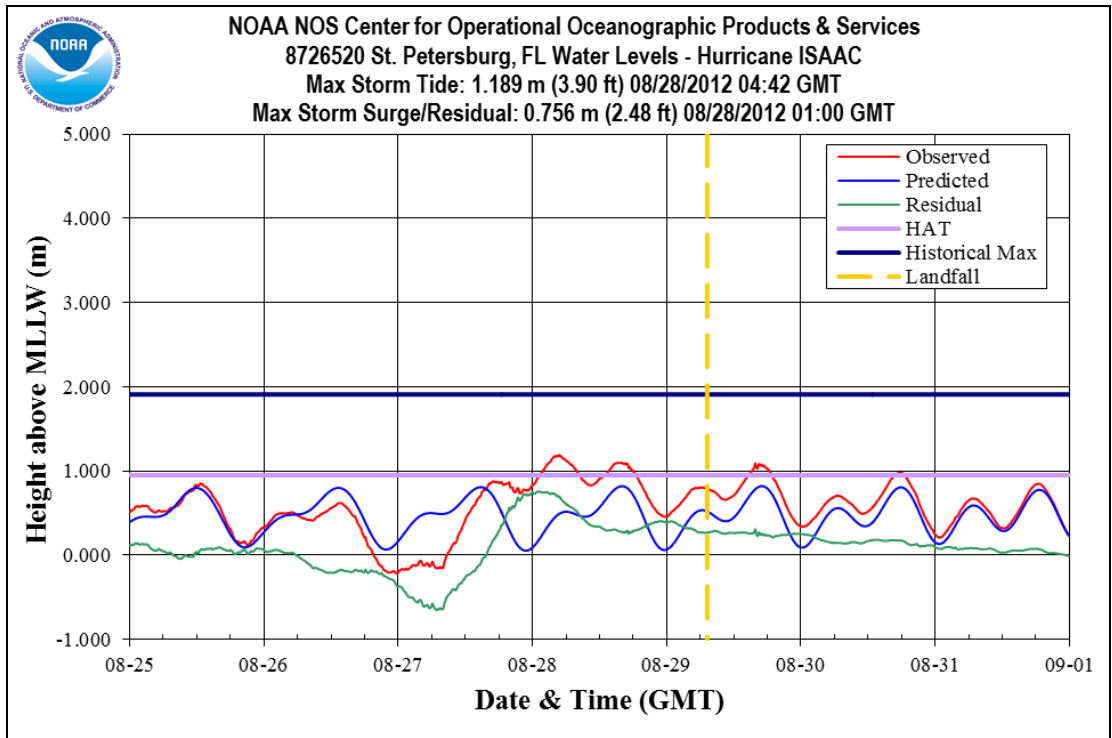


Figure 27: Water levels above Mean Lower Low Water (MLLW) at St. Petersburg, FL. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

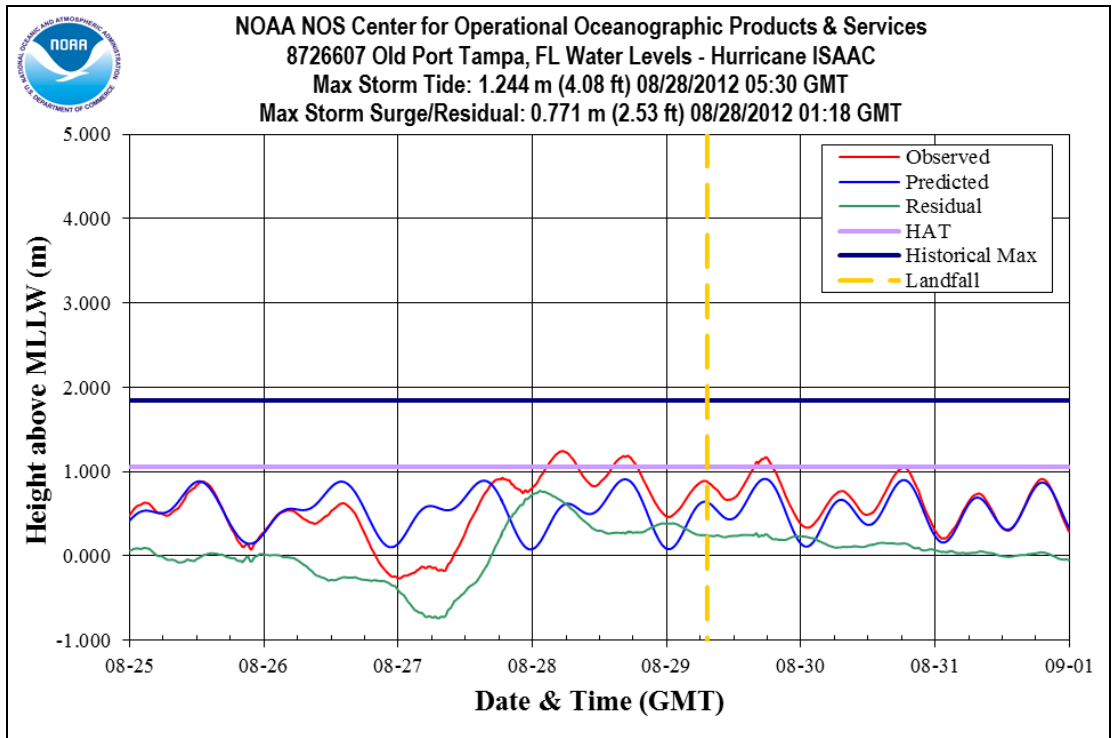


Figure 28: Water levels above Mean Lower Low Water (MLLW) at Old Port Tampa, FL. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

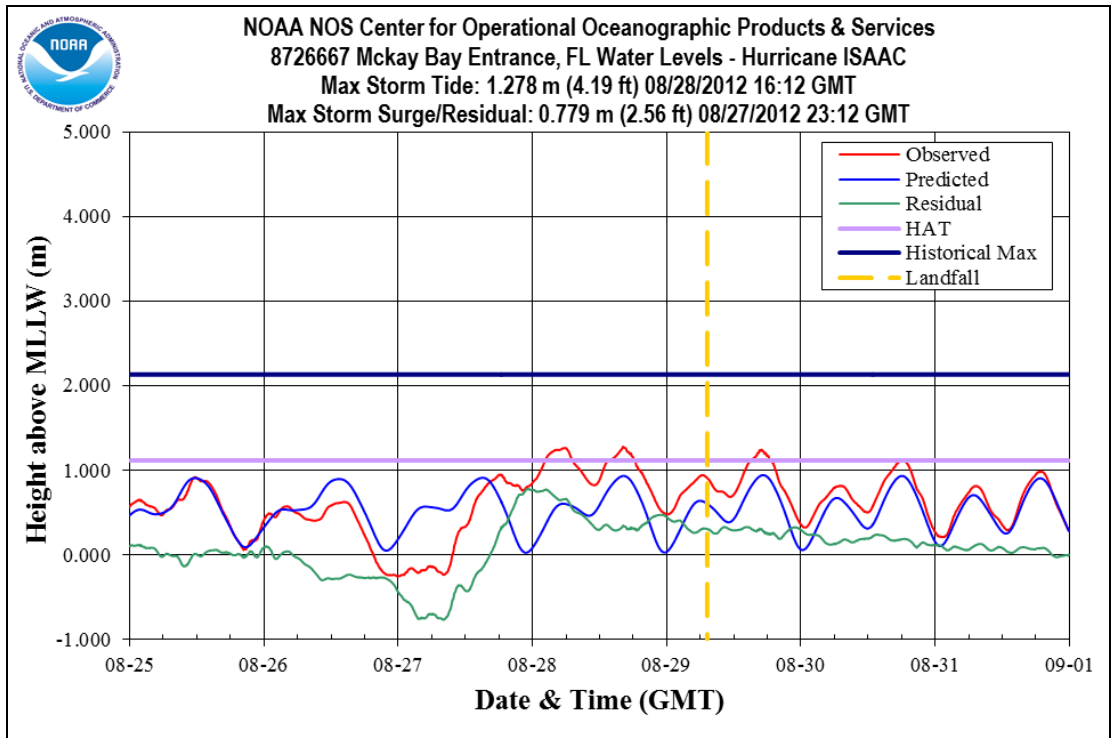


Figure 29: Water levels above Mean Lower Low Water (MLLW) at McKay Bay Entrance, FL. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

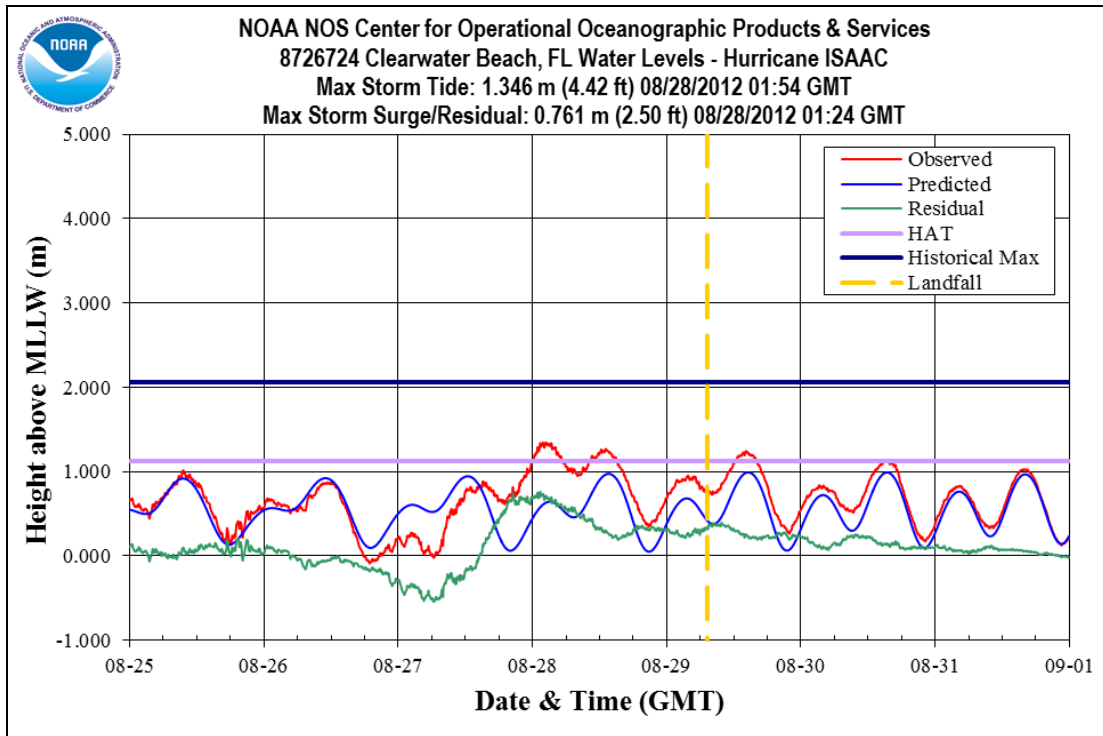


Figure 30: Water levels above Mean Lower Low Water (MLLW) at Clearwater Beach, FL. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

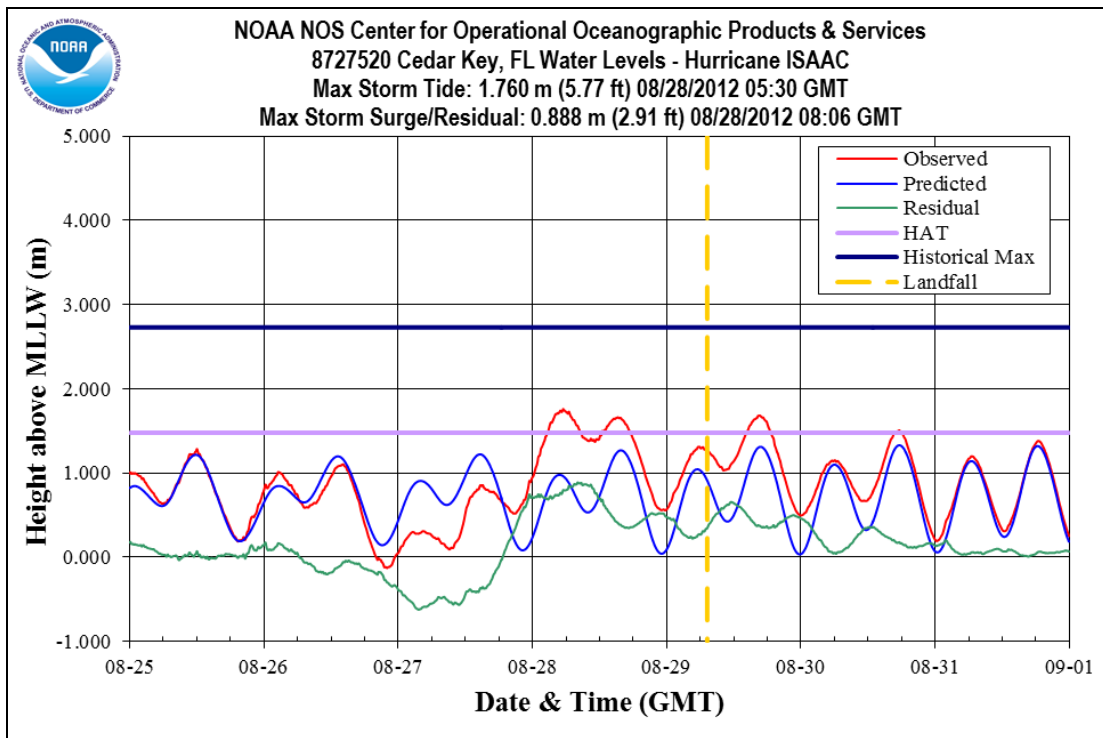


Figure 31: Water levels above Mean Lower Low Water (MLLW) at Cedar Key, FL. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

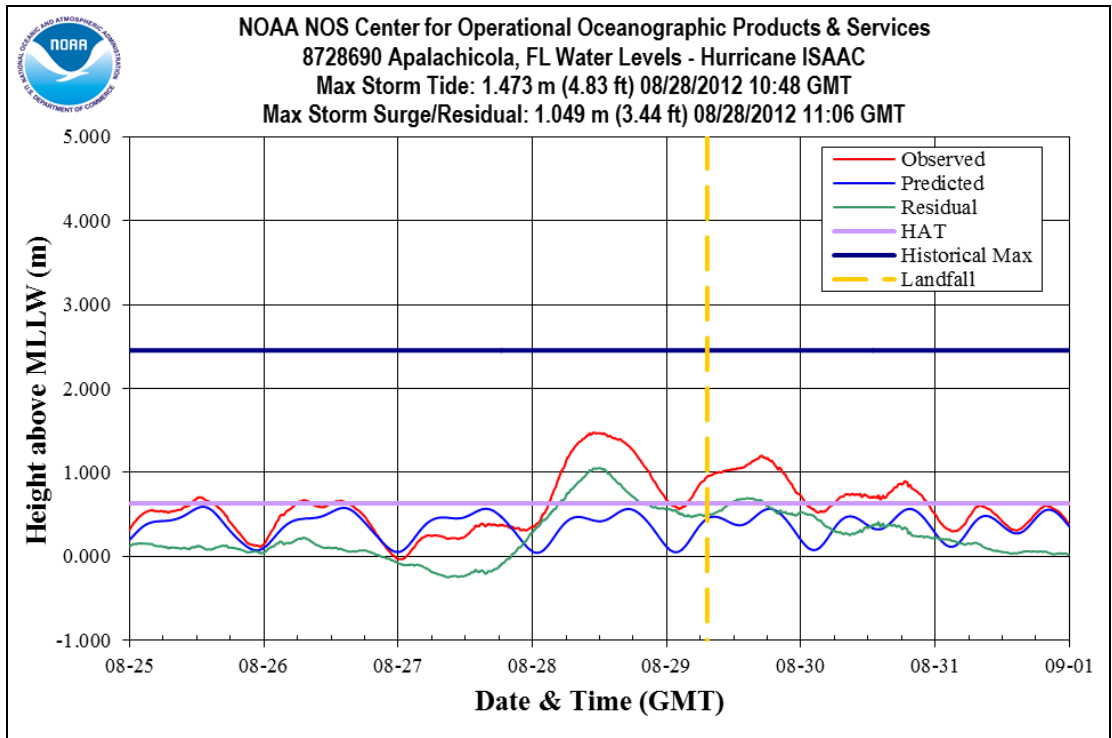


Figure 32: Water levels above Mean Lower Low Water (MLLW) at Apalachicola, FL. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

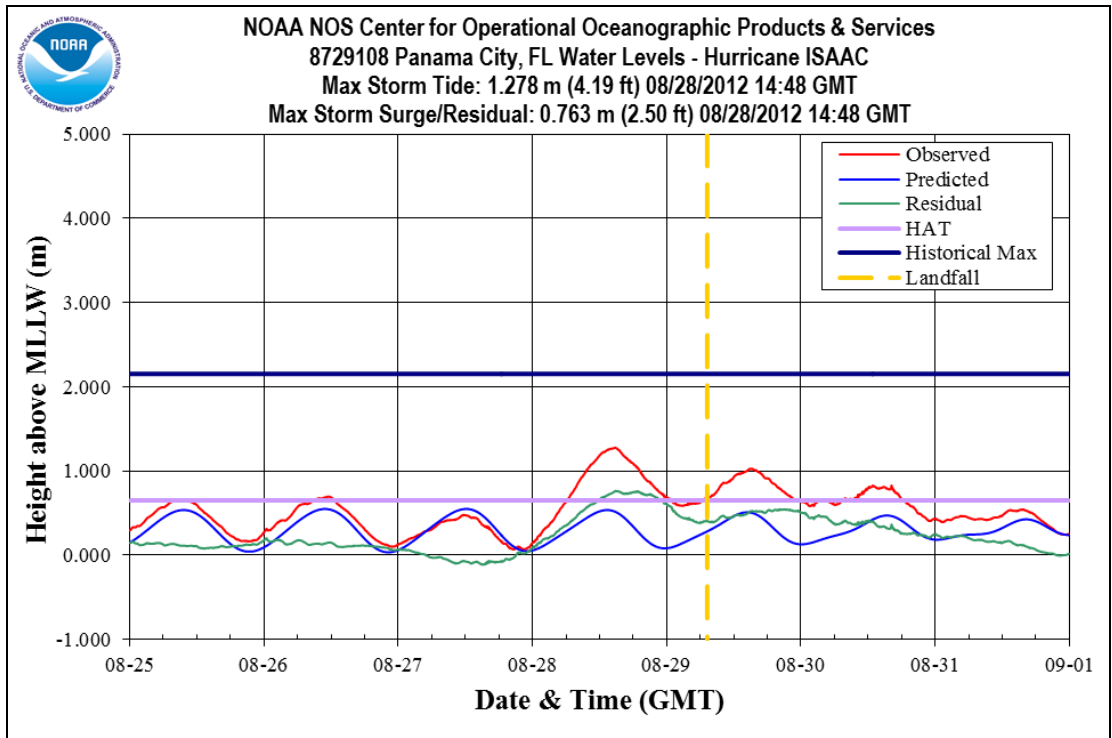


Figure 33: Water levels above Mean Lower Low Water (MLLW) at Panama City, FL. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

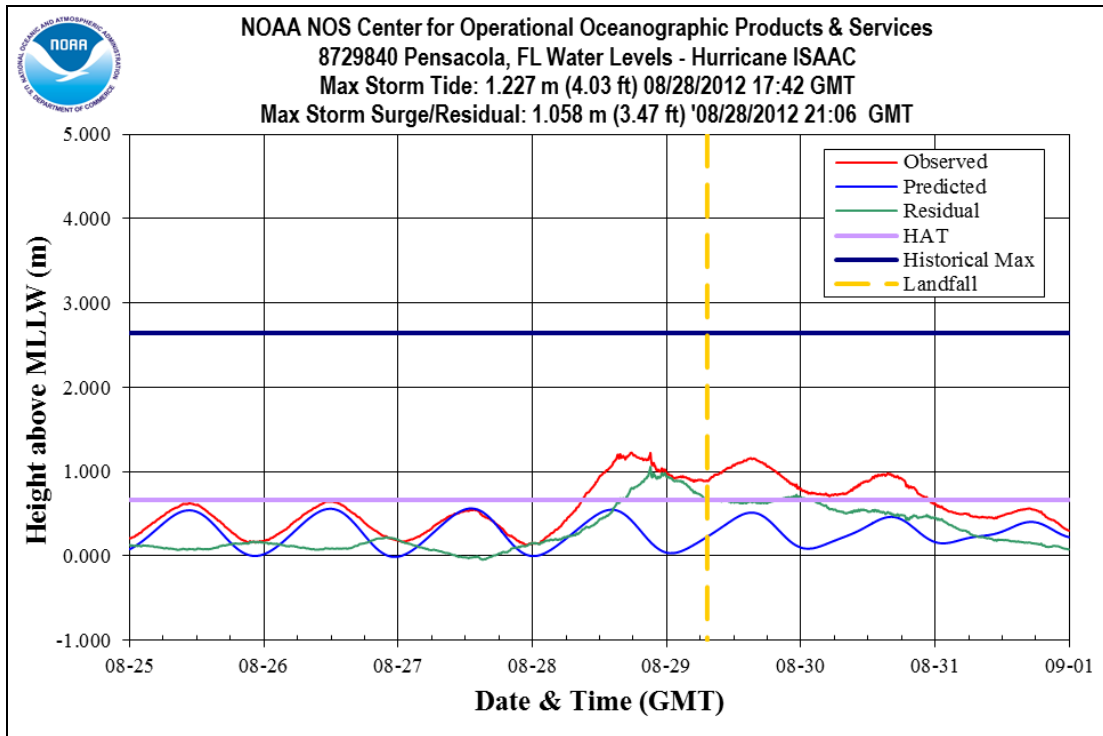


Figure 34: Water levels above Mean Lower Low Water (MLLW) at Pensacola, FL. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

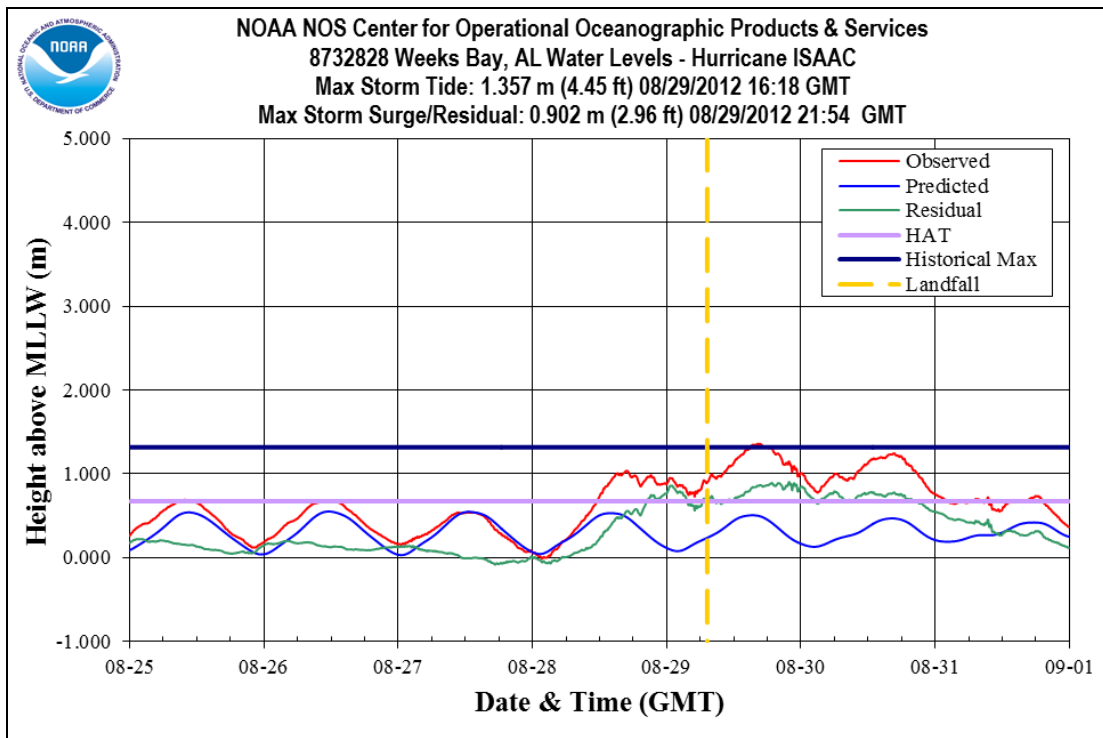


Figure 35: Water levels above Mean Lower Low Water (MLLW) at Weeks Bay, AL. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Maximum recorded water level value exceeded the historical maximum value. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

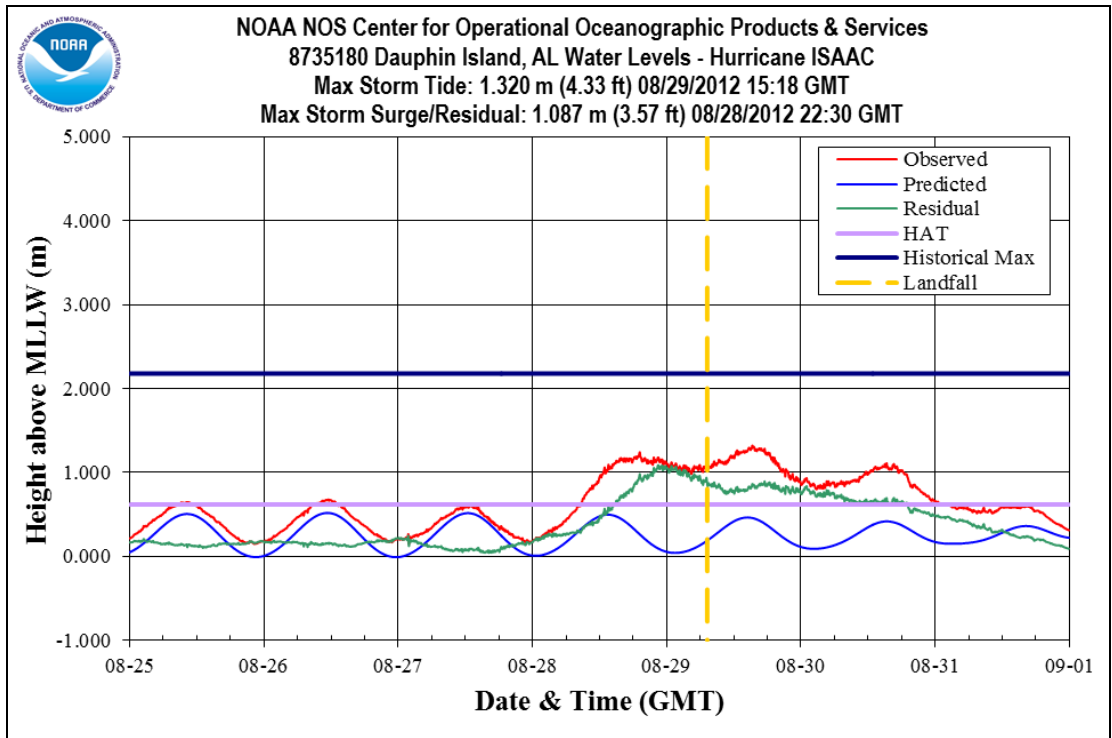


Figure 36: Water levels above Mean Lower Low Water (MLLW) at Dauphin Island, AL. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

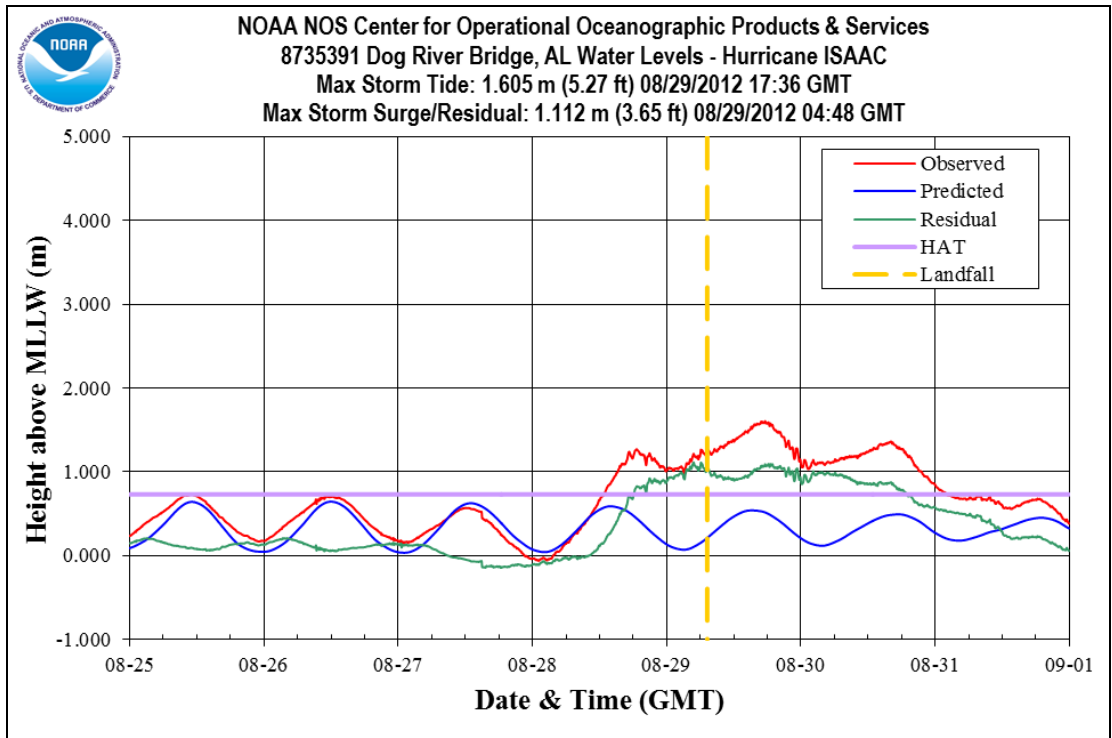


Figure 37: Water levels above Mean Lower Low Water (MLLW) at Dog River Bridge, AL. A line denoting Highest Astronomical Tide (HAT) is displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.



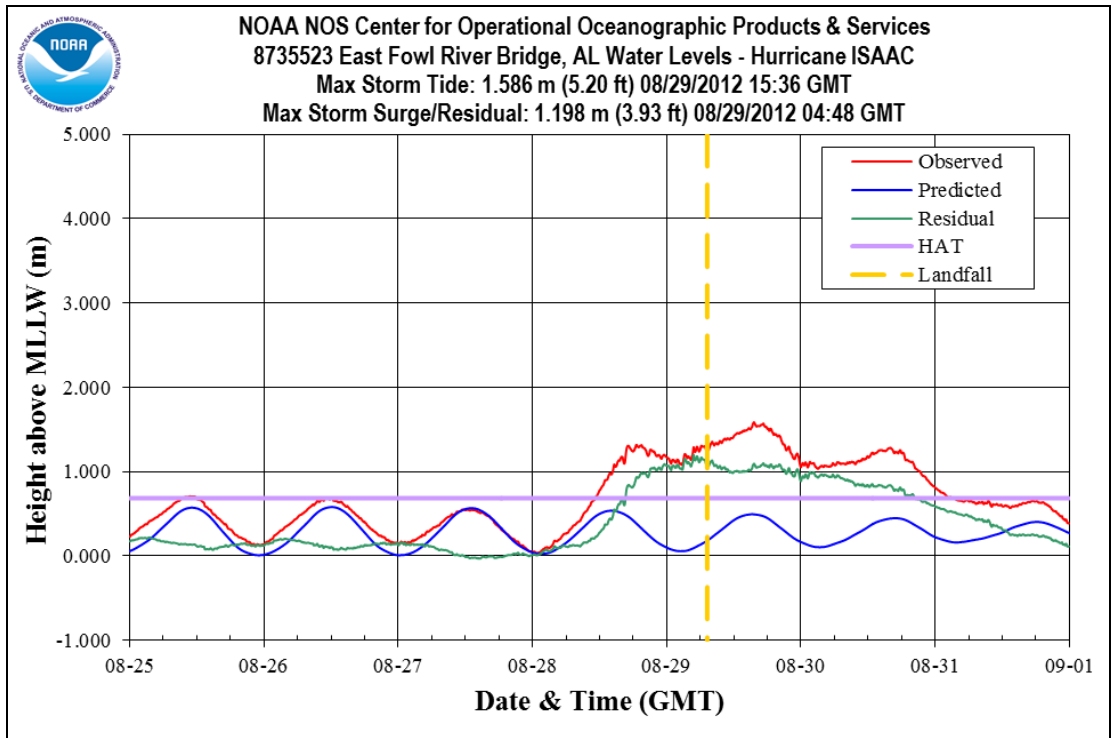


Figure 38: Water levels above Mean Lower Low Water (MLLW) at East Fowl River Bridge, AL. A line denoting Highest Astronomical Tide (HAT) is displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

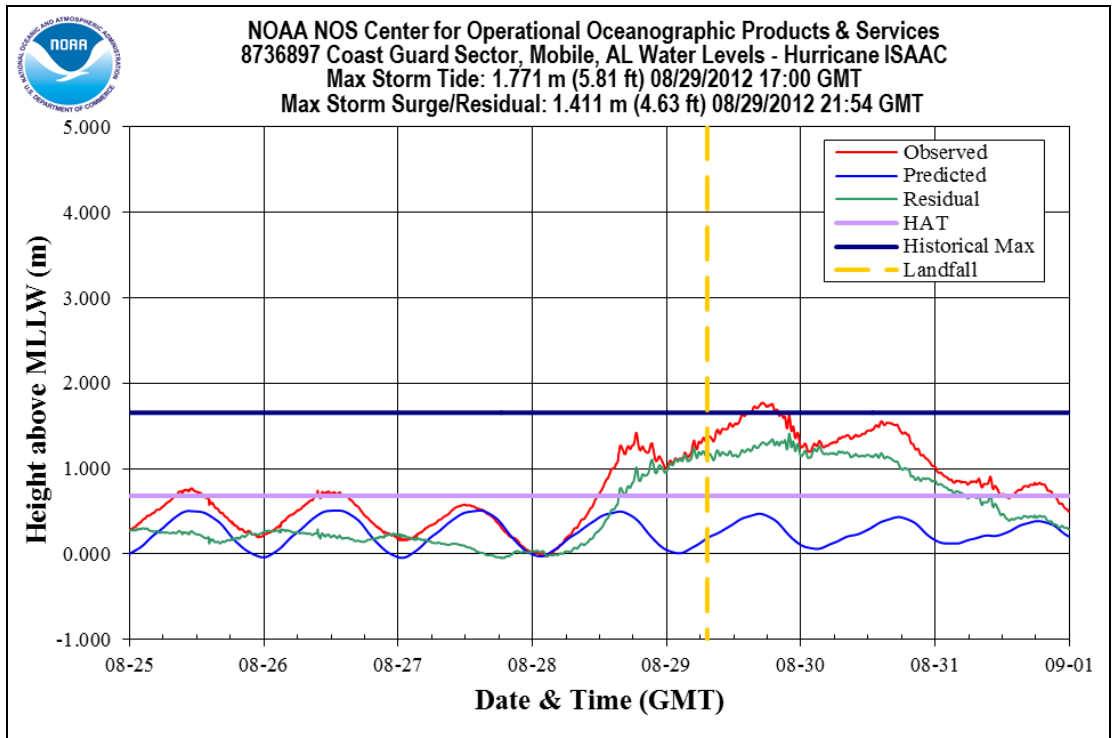


Figure 39: Water levels above Mean Lower Low Water (MLLW) at Coast Guard Sector Mobile, AL. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Maximum recorded water level value exceeded the historical maximum value. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

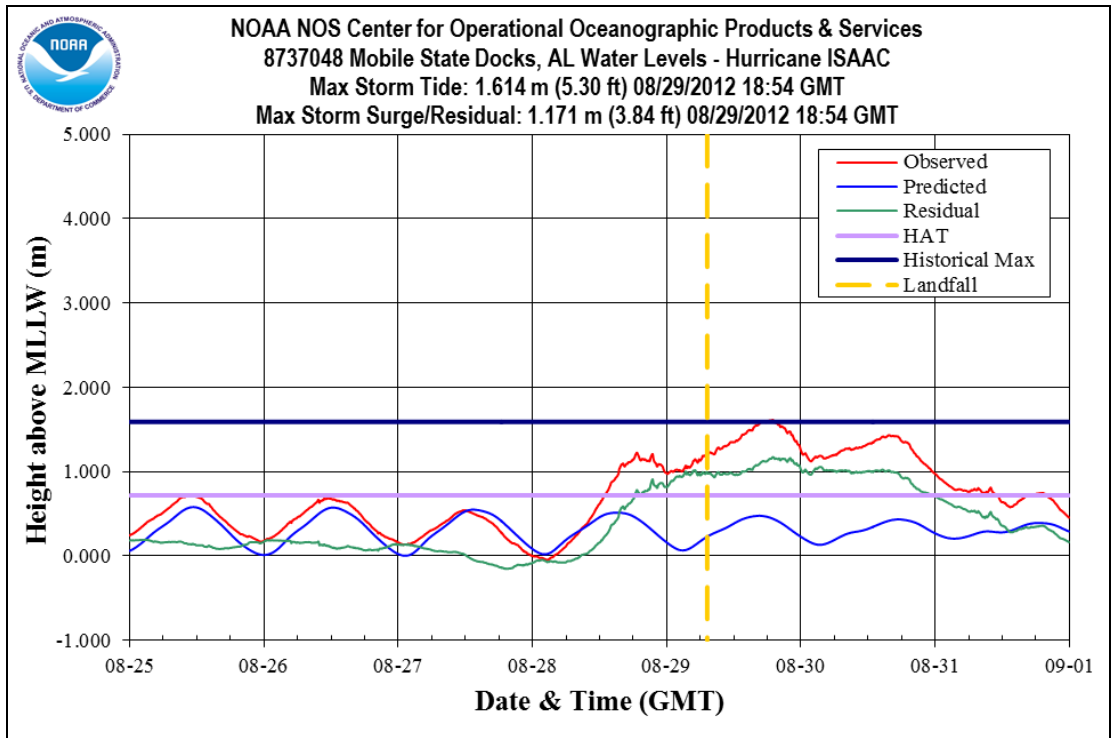


Figure 40: Water levels above Mean Lower Low Water (MLLW) at Mobile State Docks, AL. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Maximum recorded water level value exceeded the historical recorded maximum tide level. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

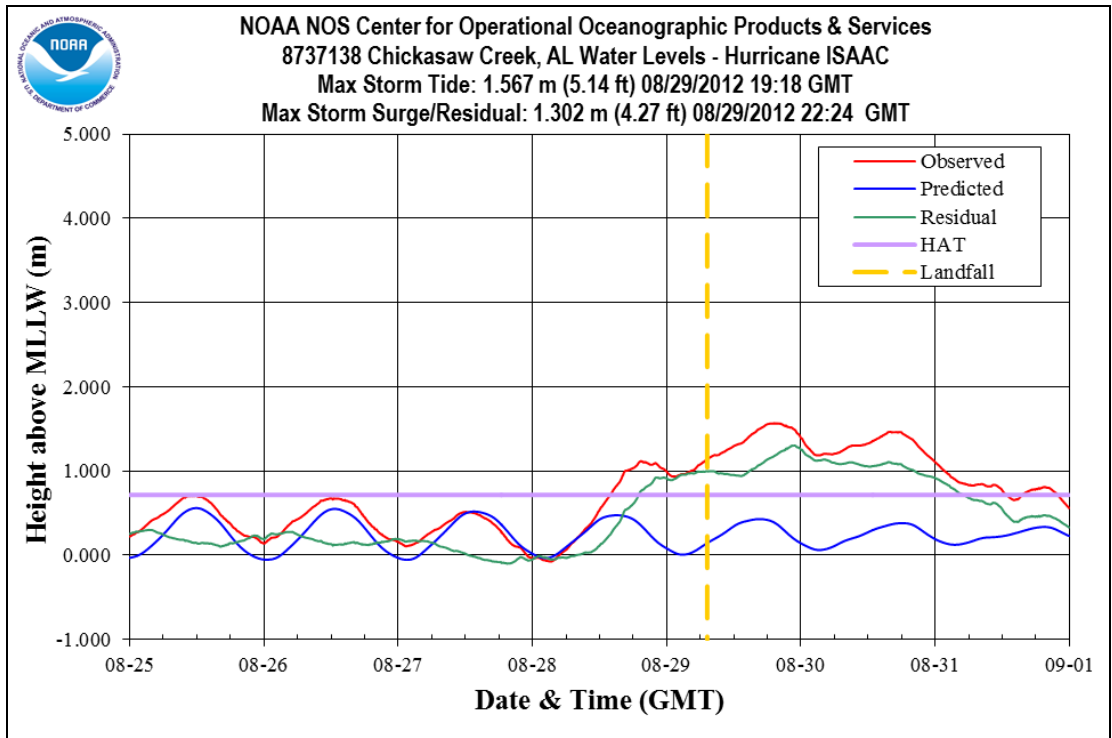


Figure 41: Water levels above Mean Lower Low Water (MLLW) at Chickasaw Creek, AL. A line denoting Highest Astronomical Tide (HAT) is displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

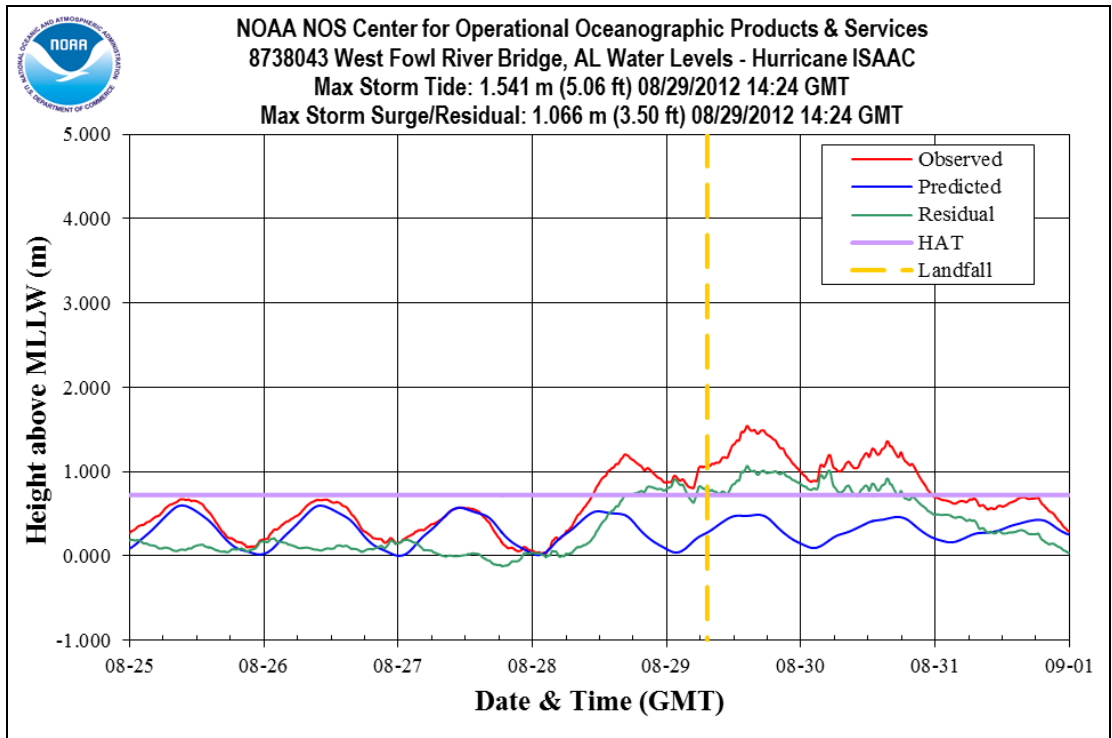


Figure 42: Water levels above Mean Lower Low Water (MLLW) at West Fowl River Bridge, AL. A line denoting Highest Astronomical Tide (HAT) is displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

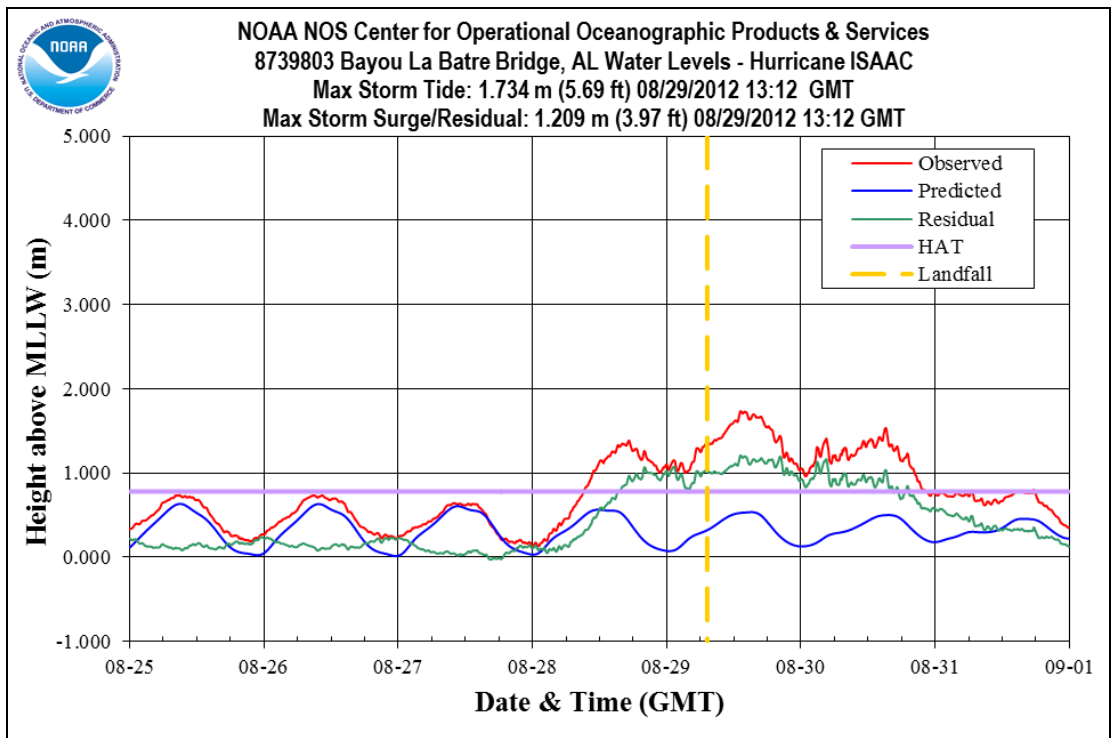


Figure 43: Water levels above Mean Lower Low Water (MLLW) at Bayou La Batre Bridge, AL. A line denoting Highest Astronomical Tide (HAT) is displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

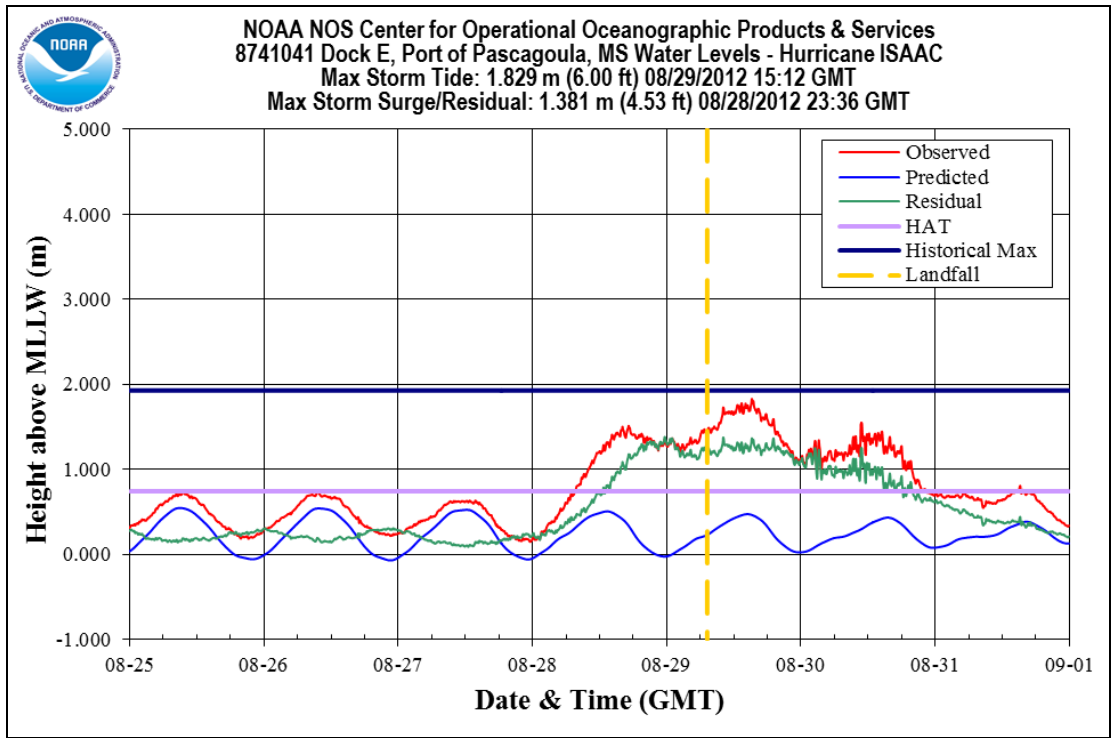


Figure 44: Water levels above Mean Lower Low Water (MLLW) at Dock E, Port of Pascagoula, MS. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

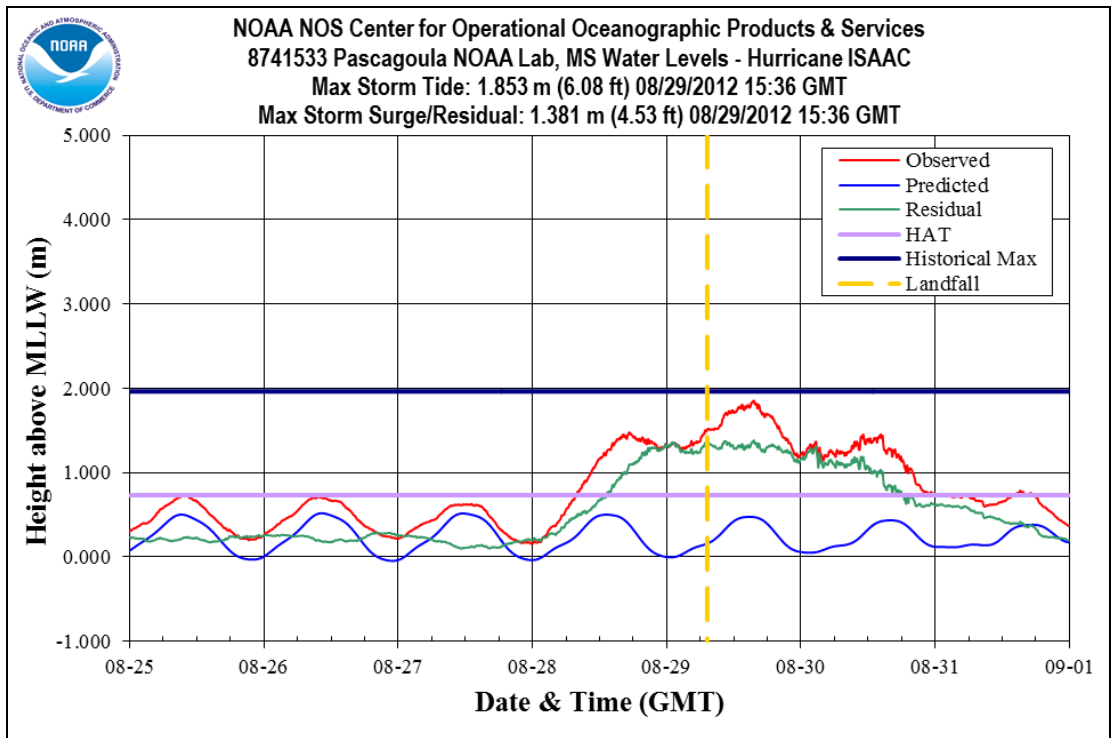


Figure 45: Water levels above Mean Lower Low Water (MLLW) at Pascagoula NOAA Lab, MS. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

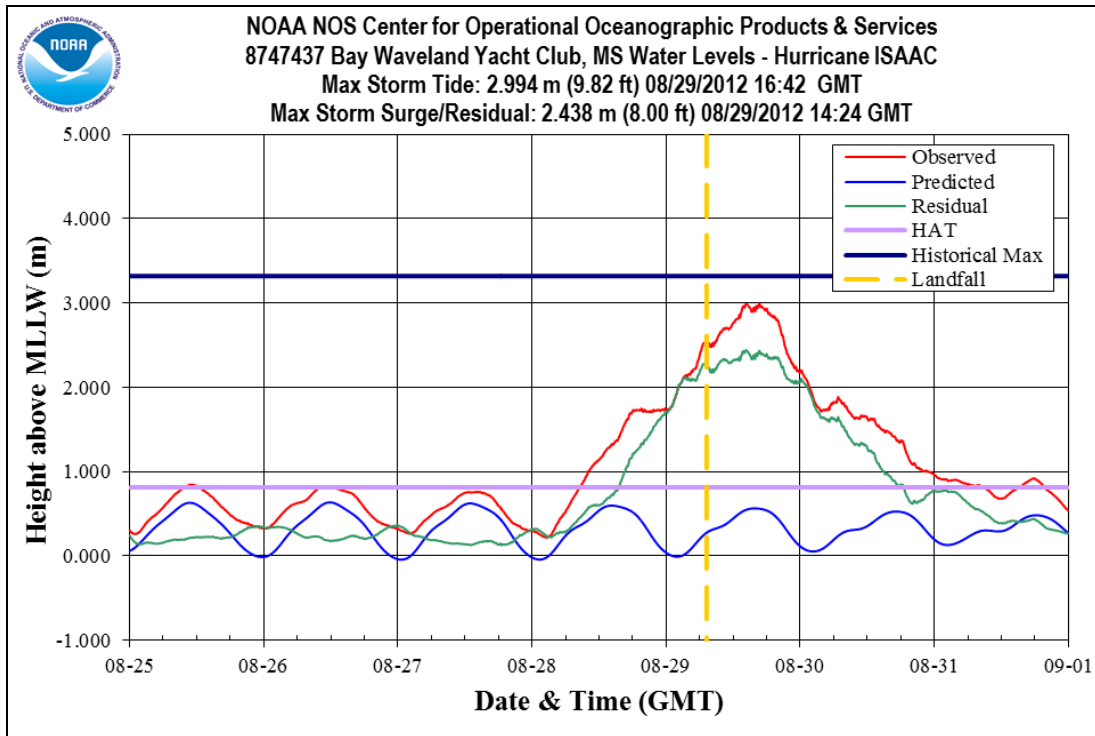


Figure 46: Water levels above Mean Lower Low Water (MLLW) at Bay Waveland Yacht Club, MS. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

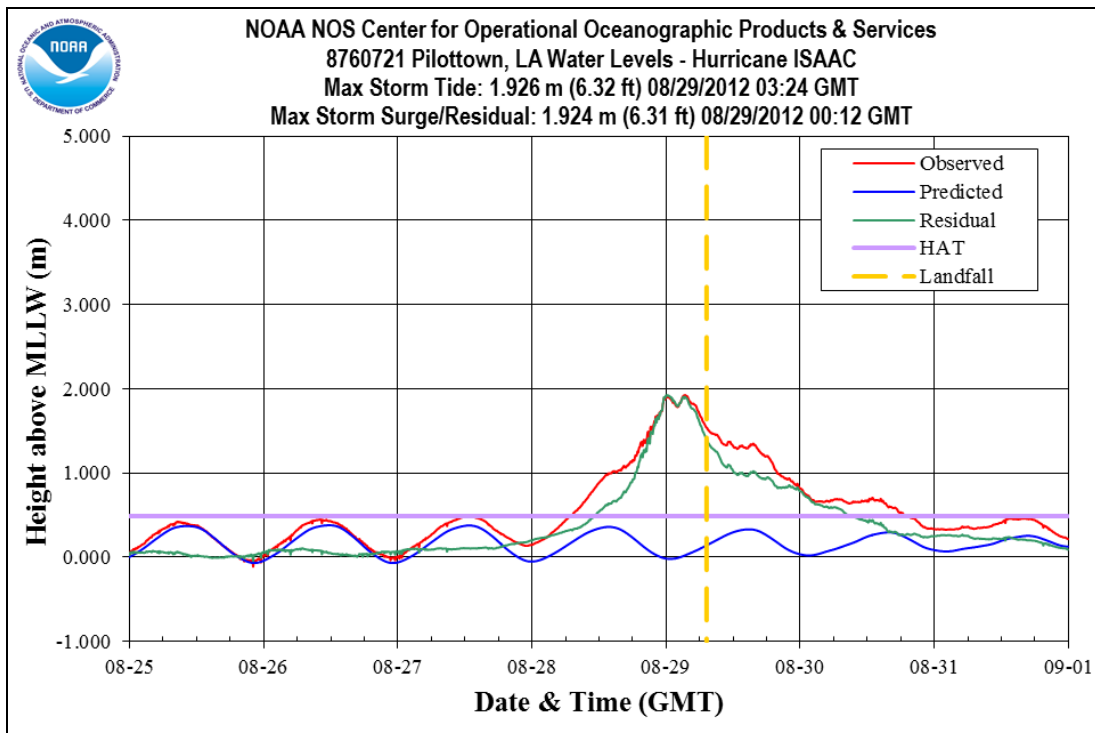


Figure 47: Water levels above Mean Lower Low Water (MLLW) at Pilottown, LA. A line denoting Highest Astronomical Tide (HAT) is displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

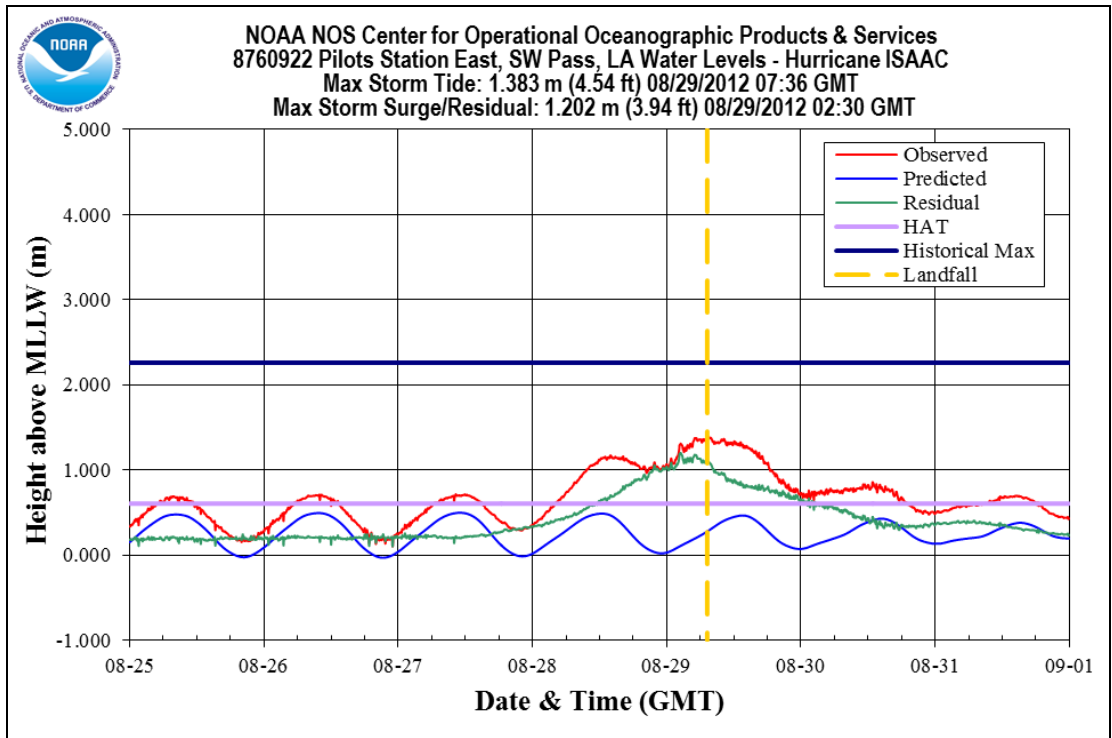


Figure 48: Water levels above Mean Lower Low Water (MLLW) at Pilot Station East, SW Pass, LA. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

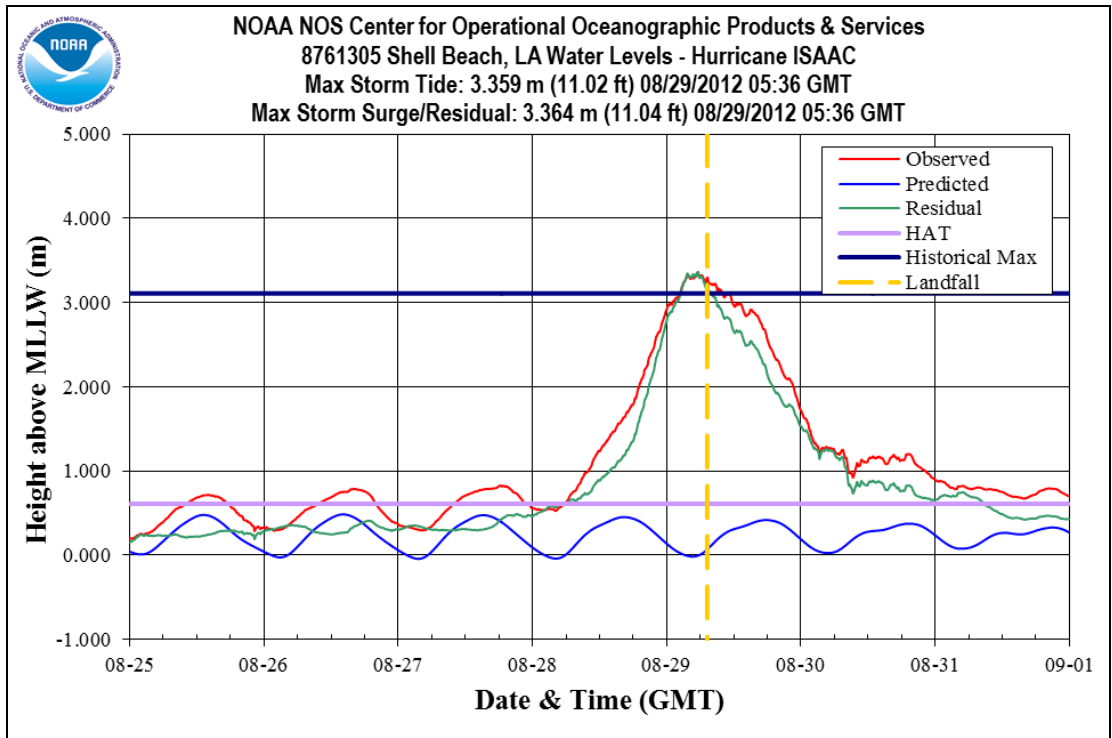


Figure 49: Water levels above Mean Lower Low Water (MLLW) at Shell Beach, LA. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Maximum recorded water level value exceeded the historical maximum value. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

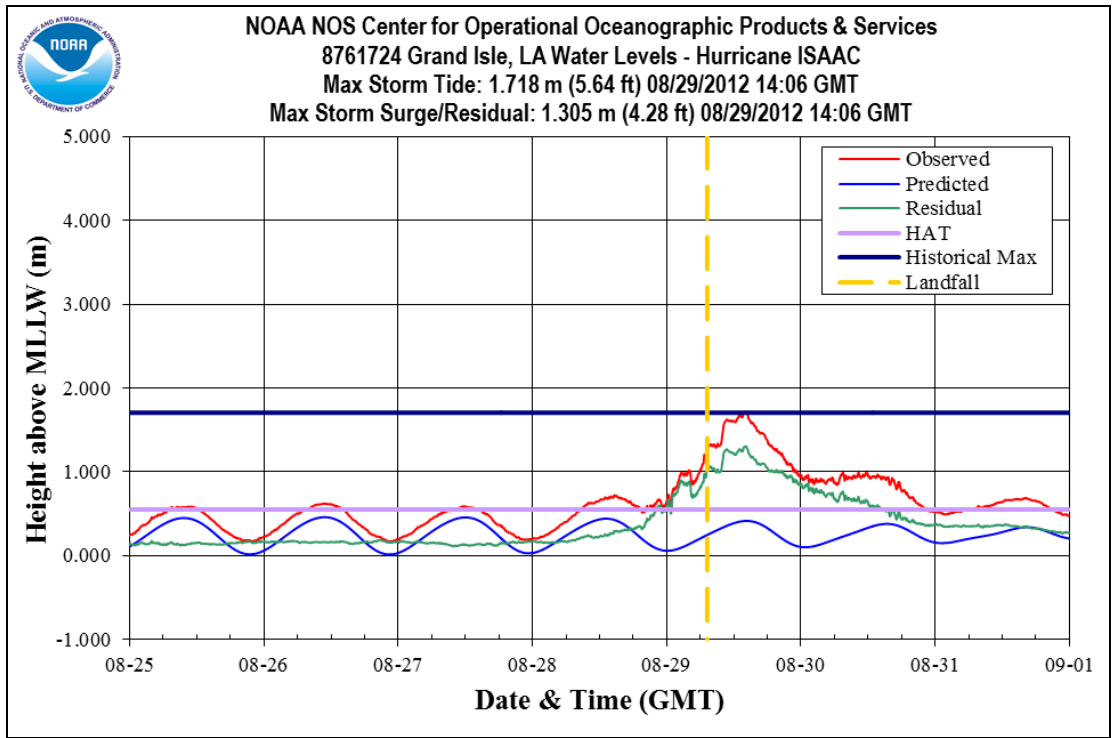


Figure 50: Water levels above Mean Lower Low Water (MLLW) at Grand Isle, LA. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Maximum recorded water level value exceeded the historical maximum value. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

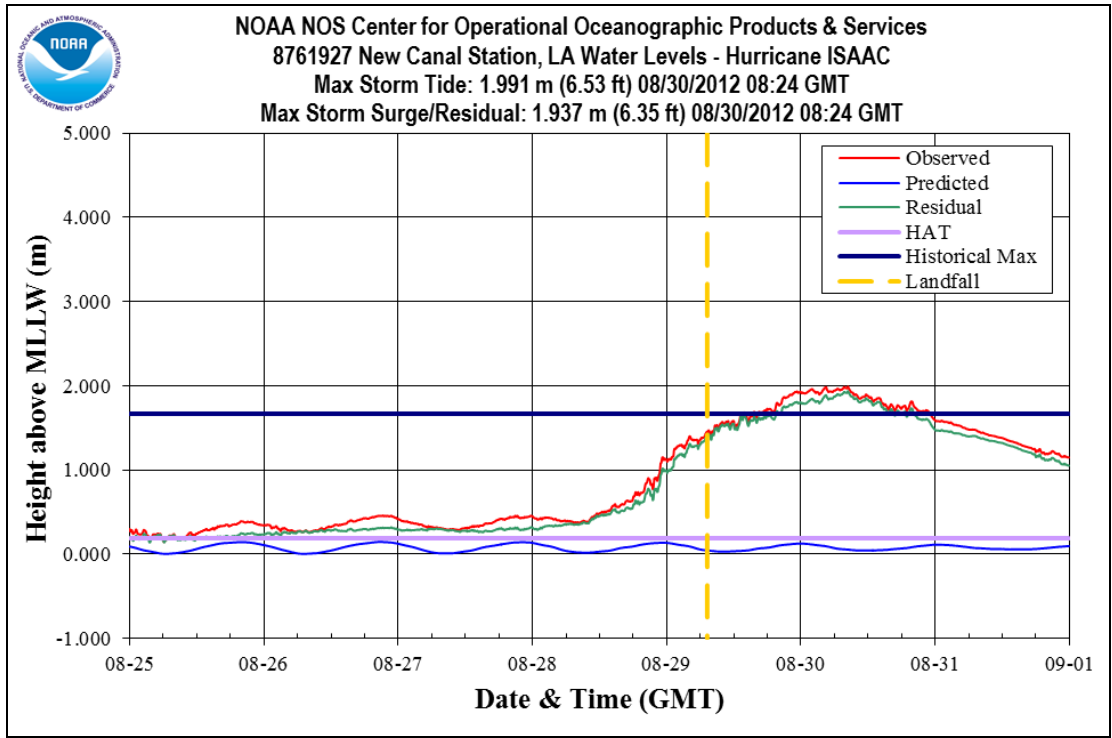


Figure 51: Water levels above Mean Lower Low Water (MLLW) at New Canal Station, LA. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Maximum recorded water level value exceeded the historical maximum value. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

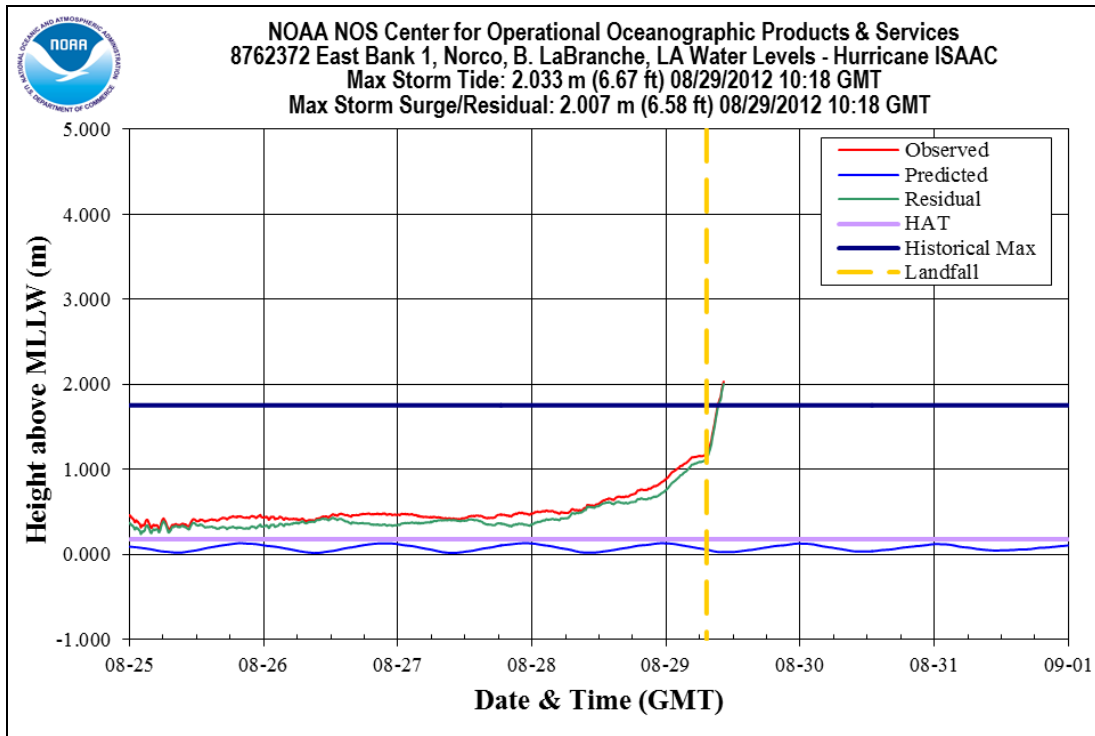


Figure 52: Water levels above Mean Lower Low Water (MLLW) at East Bank 1, Norco, B. LaBranche, LA. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. The sensor reached physical limit on measurements and did not record a maximum value for the storm, however the maximum recorded water level value exceeded the historical maximum value. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

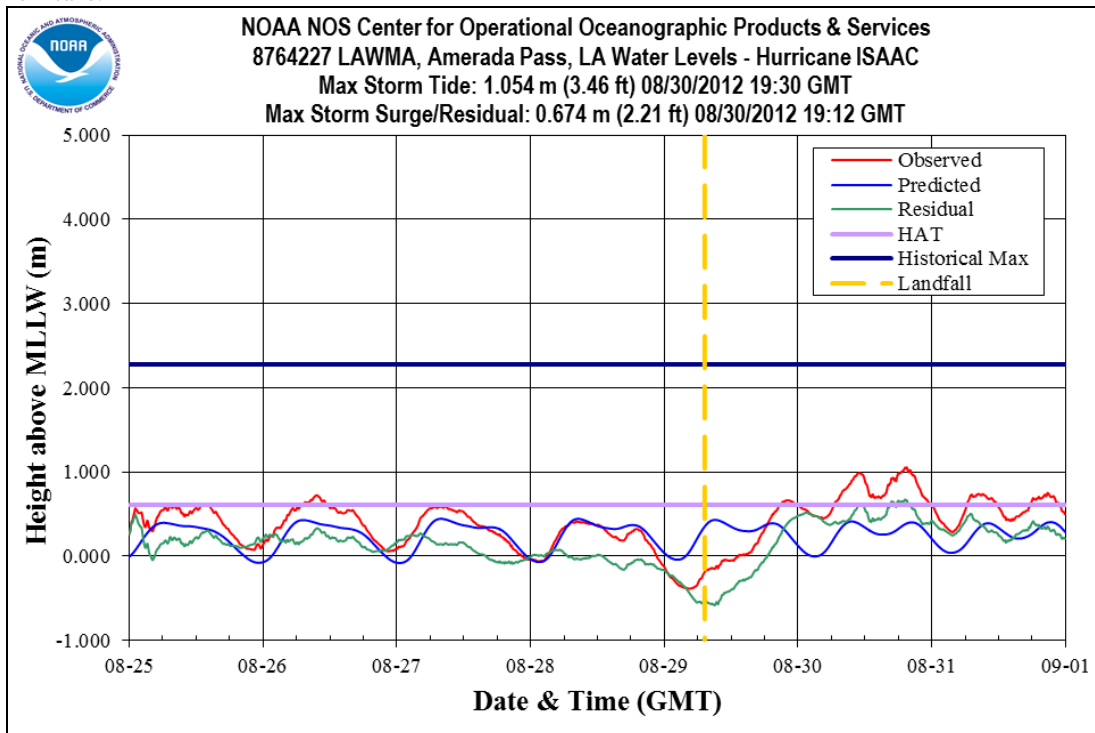


Figure 53: Water levels above Mean Lower Low Water (MLLW) at LAWMA, LA. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.



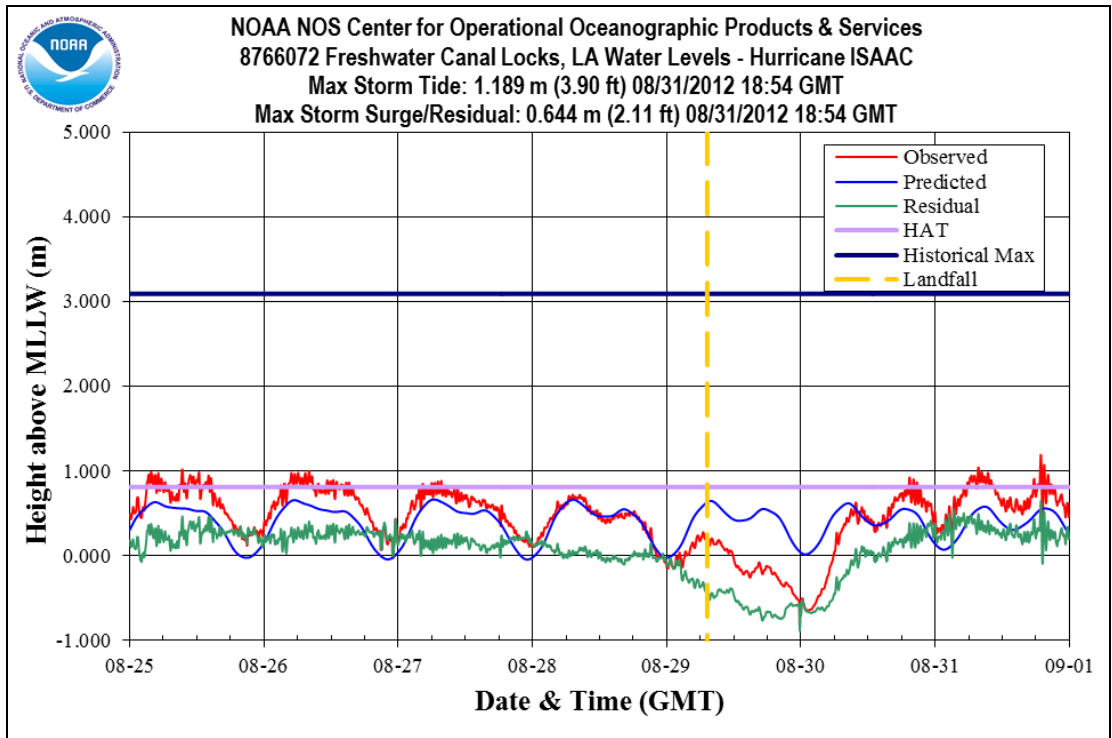


Figure 54: Water levels above Mean Lower Low Water (MLLW) at Freshwater Canal Locks, LA. Lines denoting Highest Astronomical Tide (HAT) and Historical Maximum Water Level are displayed. Isaac made final landfall near Port Fourchon, LA on 08/29/2012 07:15 GMT as a Category 1 hurricane.

## **Appendix 1: References and Contact Information**

NOAA, 2008. Center For Operational Oceanographic Products & Services Specifications and Deliverables for Installation, Operation, and Removal of Water Level Stations, NOAA/NOS, March 2008.

NOAA, 1991. Next Generation Water Level Measurement System (NGWLMS) Site Design, Preparation, and Installation Manual, NOAA/NOS, January 1991.

Center for Operational Oceanographic Products & Services Environmental Measurement Systems , Sensor Specifications and Measurement Algorithm, NOAA/NOS.

For further information or updates on the Storm Technical Reports and Storm QuickLook product, contact:

Storm QuickLook  
Center for Operational Oceanographic Products and Services (CO-OPS)  
1305 East-West Highway  
Silver Spring, MD 20910-3281  
Phone: (301) 713-2877 ext. 211  
Fax: (301) 713-4437  
E-mail: Storm QuickLook ([tide.predictions@noaa.gov](mailto:tide.predictions@noaa.gov))

## Appendix 2: Station Locations

Station Name	Station ID	Latitude N	Longitude W
Barbuda	9761115	17.59069	-61.82056
Christiansted Harbor, St Croix, VI	9751364	17.75000	-64.70500
Lameshur Bay, St. John, VI	9751381	18.31825	-64.72422
Lime Tree Bay, VI	9751401	17.69472	-64.75381
Charlotte Amalie, VI	9751639	18.33583	-64.92000
Culebra, PR	9752235	18.30086	-65.30247
Isabel Segunda, Vieques Island, PR	9752619	18.15253	-65.44381
Esperanza, Vieques Island, PR	9752695	18.09386	-65.47136
Fajardo, PR	9753216	18.33522	-65.63111
Yabucoa Harbor, PR	9754228	18.05508	-65.83300
San Juan, PR	9755371	18.45894	-66.11642
Arecibo, PR	9757809	18.48053	-66.70236
Magueyes Island, PR	9759110	17.97008	-67.04642
Mayaguez, PR	9759394	18.22000	-67.16000
Aguadilla, PR	9759412	18.45664	-67.16458
Mona Island, PR	9759938	18.09000	-67.93833
Lake Worth Pier, FL	8722670	26.61170	-80.03330
Virginia Key, FL	8723214	25.73140	-80.16180
Vaca Key, FL	8723970	24.71170	-81.10500
Key West, FL	8724580	24.55570	-81.80790
Naples, FL	8725110	26.13170	-81.80750
Fort Myers, FL	8725520	26.64770	-81.87120
Port Manatee, FL	8726384	27.63870	-82.56210
St. Petersburg, FL	8726520	27.76060	-82.62690
Old Port Tampa, FL	8726607	27.85778	-82.55269
Mckay Bay Entrance, FL	8726667	27.91333	-82.42500
Clearwater Beach, FL	8726724	27.97830	-82.83170
Cedar Key, FL	8727520	29.13500	-83.03170
Apalachicola, FL	8728690	29.72670	-84.98170
Panama City, FL	8729108	30.15228	-85.66694
Pensacola, FL	8729840	30.40440	-87.21120
Weeks Bay, AL	8732828	30.41670	-87.82500
Dauphin Island, AL	8735180	30.25000	-88.07500
Dog River Bridge, AL	8735391	30.56517	-88.08800
East Fowl River Bridge, AL	8735523	30.44369	-88.11392
Coast Guard Sector Mobile, AL	8736897	30.64830	-88.05830

**Appendix 2: Station Locations (continued)**

<b>Station Name</b>	<b>Station ID</b>	<b>Latitude N</b>	<b>Longitude W</b>
Mobile State Docks, AL	8737048	30.70830	-88.04330
Chickasaw Creek, AL	8737138	30.78189	-88.07361
West Fowl River Bridge, AL	8738043	30.37664	-88.15856
Bayou La Batre Bridge, AL	8739803	30.40567	-88.24769
Dock E, Port of Pascagoula, MS	8741041	30.34770	-88.50540
Pascagoula NOAA Lab, MS	8741533	30.36790	-88.56300
Bay Waveland Yacht Club, MS	8747437	30.32639	-89.32578
Pilottown, LA	8760721	29.17830	-89.25830
Pilots Station East, SW Pass, LA	8760922	28.93220	-89.40750
Shell Beach, LA	8761305	29.86811	-89.67325
Grand Isle, LA	8761724	29.26333	-89.95667
New Canal Station, LA	8761927	30.02717	-90.11342
East Bank 1, Norco, B. LaBranche, LA	8762372	30.05033	-90.36800
LAWMA, Amerada Pass, LA	8764227	29.44958	-91.33811
Freshwater Canal Locks, LA	8766072	29.55500	-92.30500

### Appendix 3: Definitions

Excerpts From: *Tide and Current Glossary*, NOAA National Ocean Service, Silver Spring, MD, 2000 (<http://www.tidesandcurrents.noaa.gov/publications/glossary2.pdf>), *Tidal Datums homepage* ([http://www.tidesandcurrents.noaa.gov/datum\\_options.html](http://www.tidesandcurrents.noaa.gov/datum_options.html)) and the *Storm QuickLook Frequently Asked Questions homepage* ([http://www.tidesandcurrents.noaa.gov/quicklook\\_faqs.shtml](http://www.tidesandcurrents.noaa.gov/quicklook_faqs.shtml))

**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.

**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. 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.

**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.

**Geodetic datum:** The NOAA National Geodetic Survey defines a geodetic datum as: "A set of constants used for calculating the coordinates of points on the Earth." In surveying and geodesy, a datum is a reference point on the earth's surface against which position measurements are made, and an associated model of the shape of the earth for computing positions. Horizontal datums are used for describing a point on the earth's surface, in latitude and longitude. Vertical datums are used to measure elevations or underwater depths.

**Highest Astronomical Tide (HAT):** The elevation of the highest predicted astronomical tide expected to occur at a specific tide station over the National Tidal Datum Epoch.

**Historical Recorded Maximum Tide Level:** The maximum tide elevation measured by a water level station with a continuous time series throughout a high tide cycle. A complete cycle is required to calculate the maximum tide elevation, using a best fit curve of the observations. These historical records may not have included the highest water levels measured at a station during an event if a complete high tide cycle was not measured due to station/sensor damage. See storm tides.

**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.

**Mean Higher High Water (MHHW):** A tidal datum. The average of the higher high water height of each tidal day observed over the 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.

**Mean Sea Level (MSL):** A tidal datum. The arithmetic mean of hourly heights observed over the National Tidal Datum Epoch. Shorter series are specified in the name; e.g. monthly mean sea level and yearly mean sea level.

**National Tidal Datum Epoch:** The specific 19-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 1983 through 2001. It is reviewed annually for possible revision and must be actively considered for revision every 25 years.

**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.

**National Tidal Datum Epoch:** The specific 19-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 NTDE is 1983 through 2001 and is actively considered for revision every 20-25 years. Tidal datums in certain regions with anomalous sea level changes (Alaska, Gulf of Mexico) are calculated on a Modified 5-Year Epoch.

**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.

**Neap tides:** Tides of decreased range occurring semimonthly as the result of the Moon being in quadrature (first or last quarters).

**Non-tidal:** Water levels may be classified as tidal or non-tidal. Water bodies with little or no range in tide and where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm due to masking of the tide by hydrologic, wind, or other effects are non-tidal.

**Range of tide:** The difference in height between consecutive high and low waters. The mean range is the difference in height between mean high water and mean low water. The great diurnal range or diurnal range is the difference in height between mean higher high water and mean lower low water. For other ranges see spring, neap, perigean, apogean, and tropic tides; and tropic ranges.

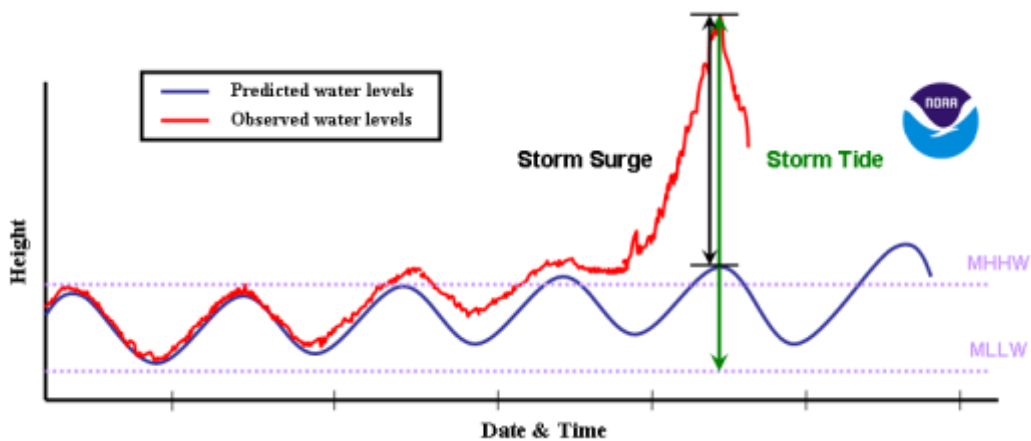
**Tide:** The periodic rise and fall of a body of water resulting from gravitational interactions between Sun, Moon, and Earth. The vertical component of the particulate motion of a tidal wave. Same as astronomic tide.

**Tide (water level) gauge:** An instrument for measuring the rise and fall of the tide (water level). Water levels may be classified as tidal and non-tidal.

**Spring tides:** Tides of increased range occurring semimonthly as the result of the Moon being new or full.

**Storm Surge/Residual:** The onshore rush of sea or lake water caused by the high wind and the low pressure centers associated with a landfalling hurricane or other intense storm. The amplitude of the storm surge at any given location is dependent upon the orientation of the coast line with the storm track, the intensity, size and speed of the storm, and the local bathymetry. In practice, storm surge is usually estimated by subtracting the normal or astronomical tide from the observed storm tide at tide stations. This difference between observed storm tides and astronomical tide can have other components such as regional elevated mean sea levels in the Gulf of Mexico due to the Loop Current, elevated sea levels on the West Coast due to El Niño Southern Oscillation (ENSO), or local elevated sea levels due to river runoff in tidal rivers.

**Storm Tide:** The maximum water level elevation measured by a water level station during storm events. Depending on location, the storm tide is the potential combination of storm surge, local astronomical tide, regional sea level variations and river runoff during storm events. 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 astronomical tide. It is potentially catastrophic, especially on low lying coasts with gently sloping offshore topography.



#### Appendix 4: Saffir-Simpson Hurricane Wind Scale Classification

Category	Wind speed (kt)	Wind speed (mph)	Pressure (mb)
Tropical Depression	20-34	23-38	n/a
Tropical Storm	35-63	39-73	n/a
Category 1	64-82	74-95	> 980
Category 2	83-95	96-110	965-979
Category 3	96-113	111-130	945-964
Category 4	114-135	131-155	920-944
Category 5	> 135	> 155	< 920

National Hurricane Center: The Saffir-Simpson Hurricane Wind Scale is a 1-5 rating based on the hurricane's present intensity (<http://www.nhc.noaa.gov/aboutshs.shtml>). The scale does not address the potential for other hurricane-related impacts, such as storm surge, rainfall-induced floods, and tornadoes. Note that all winds are using 1-minute averaged wind speeds at a 10-meter elevation with an unobstructed exposure.