2008 HURRICANE SEASON FORECASTS AND ACCURACY
with a Close Look at Hurricane Ike and Hurricane Preparedness

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How was this study done?

The National Hurricane Center (NHC) Official Atlantic Hurricane Season is from June 1-November 30. During the 2008 season, 15 classified storms passed through the Atlantic, Caribbean, and Gulf of Mexico sector. Once a storm becomes a classified tropical depression and is assigned a number (its alias before being assigned a name) the NHC issues a forecast discussion for the storm every 6 hours. Postings occur at 3, 9 15, and 21 Coordinated Universal Time (UTC or Z) or, in Eastern Daylight Time (EDT), 11pm day before, 5am, 11am, and 5pm day of respectively. These forecast discussions include a description of the storm's status as well as its current latitude and longitude. Forecasted coordinates for 12, 24, 36, 48, 72, 96, and 120 hours from the discussion time are also included at the bottom of the discussion.

To calculate forecast errors, forecasted latitude and longitude coordinates were collected from the discussions posted on the NHC web site. Coordinates were assembled into an excel spread sheet so that each day during Gustav and Hanna has its actual center at 9Z, as well as the forecasted position from 24, 48, and 72 hours earlier. The same was done for Ike, but instead of comparing coordinates once every 24 hours for three days a comparison was done for each forecast discussion, or 4 times each day. The "Latitude/Longitude Distance Calculator" available on the NHC web site was then used to find the distance in nautical miles (n mi) from the initial position and each forecasted time for each specific forecast discussion for each hurricane. This data was then assembled into the data sheet underneath the coordinates so the distance errors fall under the appropriate dates. This display of data can be seen in the tables below.

Table 1. Hurricane Gustav Coordinates.

GUSTAV 9Z	25-Aug	26-Aug	27-Aug	28-Aug	29-Aug	30-Aug	31-Aug	1-Sep	2-Sep
Initial	16.3N 71.0W	17.2N 71.9W	18.4N 73.3W	18.8N 73.5W	19.1N 75.6W	19.7N 78.5W	20.2N 81.3W	24.2N 85.0W	28.4N 89.6W	31.7N 91.4W
24Hr Forecasted Position		18.4N 73.3W		18.8N 74.3W	19.1N 75.0W	17.8N 76.9W	19.5N 81.0W	20.9N 84.8W	22.5N 88.4W	30.7N 92.9W
48Hr Forecasted Position				20.2N 75.5W	19.4N 76.9W	19.5N 78.9W	19.1N 81.2W	22.0N 84.6W	30.2N 88.1W	30.5N 92.2W
72Hr Forecasted Position					21.3N 77.5W	20.0N 79.3W	21.0N 82.5W	22.0N 85.5W	26.4N 88.1W	29.5N 91.5W
Error in n mi from Initial										
24Hr Forecasted Position			107	48	77	29	40	81	79	98
48Hr Forecasted Position				147	121	99	58	93	131	95
72Hr Forecasted Position					236	133	83	135	142	185

Table 2. Hurricane Hanna Coordinates.

HANNA 9Z	28-Aug	29-Aug	30-Aug	31-Aug	1-Sep	2-Sep	3-Sep	4-Sep
Initial	19.8N 57.9W	21.7N 62.3W	21.9N 66.6W	23.2N 69.0W	23.6N 72.4W	21.3N 72.7W	24.0N 72.8W	
24Hr Forecasted Position		22.0N 60.5W	24.0N 66.0W	23.2N 70.0W	25.7N 71.4W	23.4N 73.5W	22.0N 73.5W	23.2N 74.1W
48Hr Forecasted Position			25.0N 64.5W	26.0N 70.0W	23.5N 72.5W	23.3N 73.1W	24.2N 74.5W	24.1N 75.5W
72Hr Forecasted Position				26.0N 67.0W	26.0N 71.5W	23.5N 74.0W	23.6N 73.9W	26.2N 76.5W
Error in n mi from Initial								
24Hr Forecasted Position			102	127	58	55	133	130	86
48Hr Forecasted Position				211	177	8	122	272	150
72Hr Forecasted Position					200	152	152	225	240

Table 3. Hurricane Ike Coordinates.

IKE	9Z	9Z	9Z	21Z	2-Sep	3Z	21Z	3-Sep	13Z	14-Sep
Initial	18.0N 41.6W	18.6N 43.1W	19.6N 45.0W	19.2N 46.3W	19.9N 47.9W	20.8N 49.6W	20.3N 51.2W	21.5N 52.7W	32.4N 95.3W	34.3N 93.9W	36.N 92.5W
24Hr Forecasted Position	18.0N 41.6W	18.6N 42.8W	19.0N 44.5W	18.5N 43.8W	19.2N 46.7W	19.9N 48.9W	19.0N 50.2W	20.5N 51.5W	31.5N 95.2W	33.2N 96.5W	35.5N 93.9W
48Hr Forecasted Position			19.0N 44.6W	18.5N 45.5W	19.2N 47.7W	19.5N 49.3W	19.9N 50.3W	20.0N 51.3W	31.9N 96.0W	33.2N 95.3W	34.4N 94.7W
72Hr Forecasted Position				19.5N 48.5W	20.0N 49.6W	20.0N 51.3W	20.0N 49.6W	20.5N 50.5W	31.5N 95.5W	32.9N 95.7W	32.5N 96.0W
Error in n mi from Initial											
12Hr Forecasted Position			40	72	58	49	50	33	99	104	
24Hr Forecasted Position			29	62	80	99	74	93	65	96	128
48Hr Forecasted Position				83		91	102	111	69	151	129
72Hr Forecasted Position						43	94	15	55	123	161
									105	213	291

Tables 1 - 3 provided an organized way to plot the actual and forecasted coordinates for each storm onto Atlantic Hurricane Tracking Charts. Plotting the 24, 48, and 72Hr forecasted positions individually against the actual storm path provides a visual way to see that the further out the forecast, the less accurate the forecast. This trend can also be seen in the error portion of the tables above as the n mi distance increased with earlier forecasts.
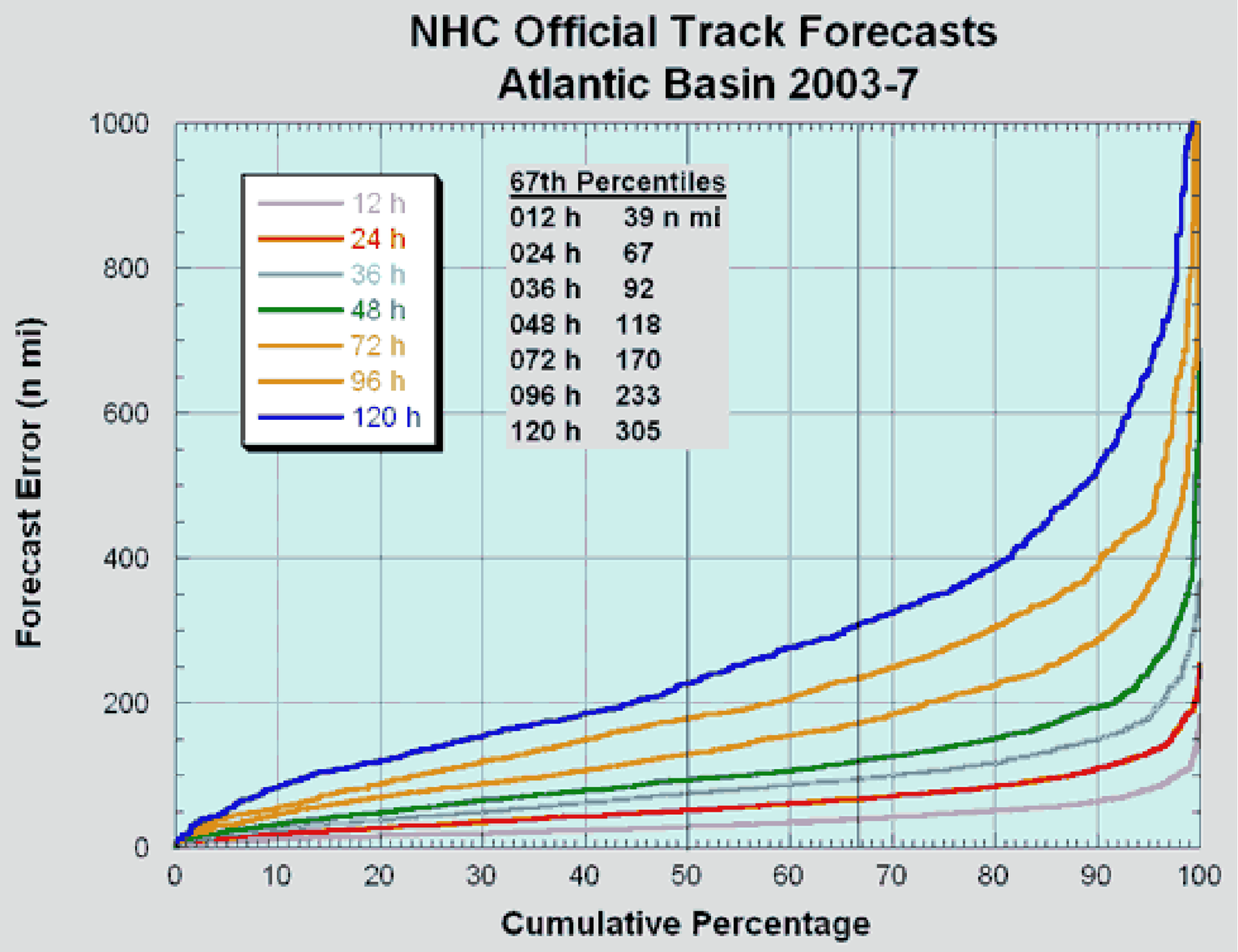
Figure 1 Each storm's actual track is represented by the black line. The 24Hr forecasted positions are plotted in blue, 48Hr in orange, and 72Hr in purple (first, second, and third row respectively).

Gustav   Hanna   Ike
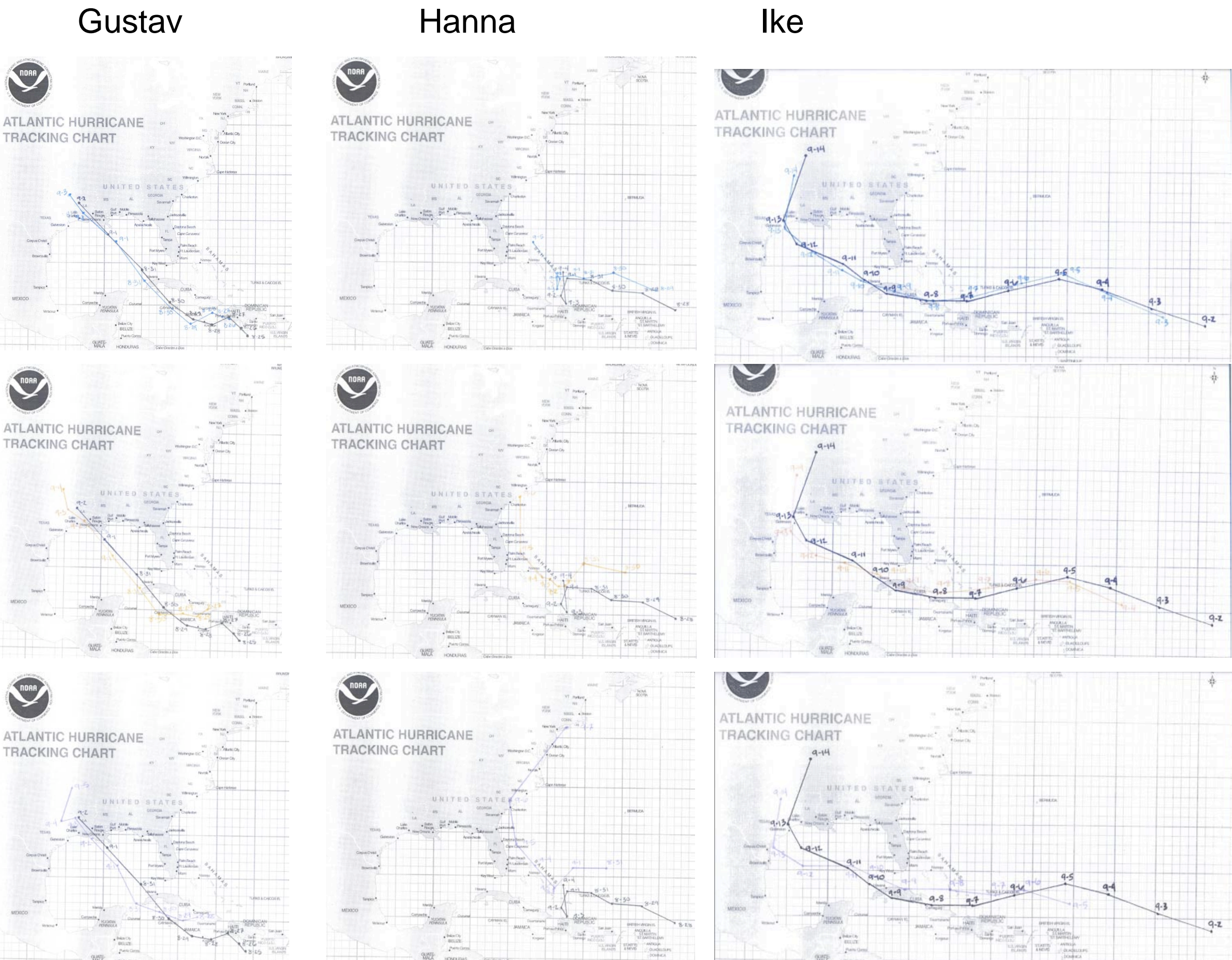
How did the forecasts from the 2008 season compare with those from the previous five years?

After calculating the forecast errors in n mi distance, an analysis was done to compare this year's data with the data from storms during the 5-year period of 2003-2007 using the following chart from the NHC web site.

Figure 2. NHC Official Track Forecasts Atlantic Basin 2003-2007.

NHC Official Track Forecasts Atlantic Basin 2003-7

	67th Percentiles
012 h	39 n mi
024 h	67
036 h	92
048 h	118
072 h	170
096 h	233
120 h	305

Courtesy of NHC web site http://www.nhc.noaa.gov/

This chart displays the percentage of forecasts having an error less than the value along the y-axis. To determine the percent of forecasts having an error less than a certain n mi, follow the desired n mi until you hit the forecast hour of interest and then read down to discover the percentage. By using this method, the following forecast error percentages were found for this 5-year period:

Table 4. Cumulative Percentages of Hurricane Forecast Error for 2003-2007.

	12 Hr	24 Hr	36 Hr	48 Hr	72 Hr
≤100 n mi	98%	87%	70%	56%	36%
≤200 n mi	100%	99%	96%	92%	73%
≤300 n mi	100%	100%	99%	97%	91%

The calculated forecast errors for Hurricanes Gustav, Hanna, and Ike were then analyzed to observe how with each storms' percentages compared with the previous 5-year period for the n mi.

Table 5. Percentages for 2008 Hurricanes Gustav, Hanna, and Ike.

Percentages for Hurricane Gustav

Gustav	24 Hr	48 Hr	72 Hr
≤100 n mi	88%	57%	17%
≤200 n mi	100%	100%	83%
≤300 n mi	100%	100%	100%

*Please note percentages based on data collected once every 24Hrs during this storm for a total of 8 for 24Hr, 7 for 48Hr, and 6 for 72Hr.

Percentages for Hurricane Hanna

Hanna	24 Hr	48 Hr	72 Hr
≤100 n mi	43%	17%	0%
≤200 n mi	100%	67%	60%
≤300 n mi	100%	100%	100%

*Please note percentages based on data collected once every 24Hrs during this storm for a total of 7 for 24Hr, 6 for 48Hr, and 5 for 72Hr.

Percentages for Hurricane Ike

Detailed Ike	12 Hr	24 Hr	36 Hr	48 Hr	72 Hr
≤100 n mi	96%	92%	74%	70%	48%
≤200 n mi	100%	100%	100%	100%	95%
≤300 n mi	100%	100%	100%	100%	100%

*Please note percentages based on data collected 4x every 24Hrs during this storm for a total of 50 for 12Hr, 48 for 24Hr, 46 for 36Hr, 44 for 48Hr, and 40 for 72Hr.

Not surprisingly, the 24Hr forecasted positions were the most accurate and the 72Hr were the least for all three storms. With the exception of Hanna's 48 and 72Hr forecasts, all storms' percentages agree, or nearly agree, with the percentages from the previous five year period. It was therefore concluded that the forecast errors for 2008 were consistent with the cumulative errors from 2003-2007.

12 December 2008

The third most costly storm to hit the United States, Hurricane Ike.

Hurricane Ike resulted in an estimated $27 billion in property damage, making the storm the 3rd most costly Atlantic hurricane for the United States. The storm has been traced to a westerly wave off the west coast of Africa on August 19th 2008. As it passed through the Atlantic Ocean it developed into a tropical depression. It eventually developed into tropical depression Nine and the National Hurricane Center issued forecast advisories from September 1st through the 14th. Ike was most intense just before crossing over Cuba on September 7th, with sustained winds at 135 mph. As it crossed the east side of Cuba the storm weakened and turned towards the south, but quickly changed course to northwest. After it crossed over the west side of Cuba it strengthened over the warm waters of the Gulf of Mexico. Forecasters had a difficult time determining the path Ike would take during its time in the gulf. Below are two selected images from the archived graphic forecast loop from the NHC web site to illustrate the drastic change in direction the hurricane took.

Figure 3. Selected Hurricane Ike Graphic Forecasts.

Courtesy of NHC web site http://www.nhc.noaa.gov/
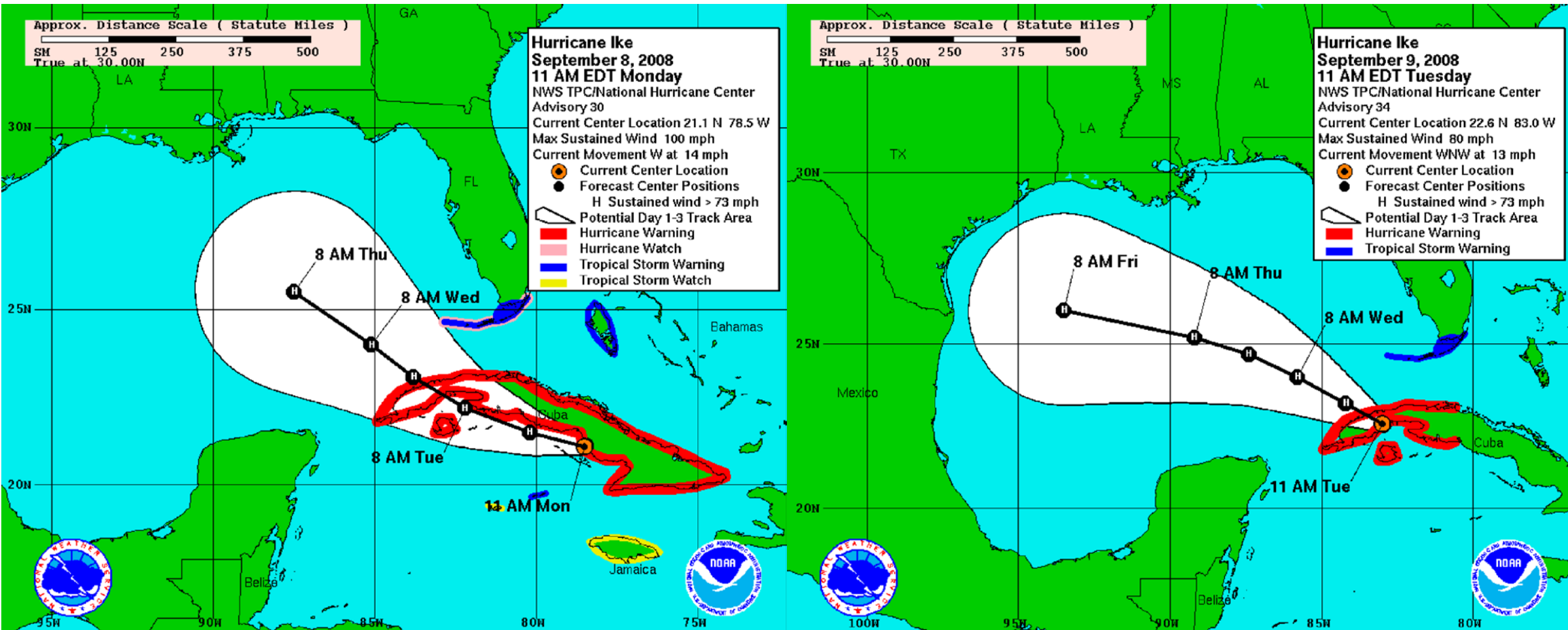
With forecasters' thoroughly thought out storm path potentially changing direction abruptly, it is important to consider when local emergency management should react to approaching storms. Hurricane Ike made landfall over Galveston, TX on September 13th, but the specific warning for Galveston was not far in advanced. **Figure 4** below demonstrates how a forecasted track can change day to day.

Figure 4. Selected Graphic Forecasts for Hurricane Ike. This series demonstrates how forecasted tracks change on a daily basis.

Courtesy of NHC web site http://www.nhc.noaa.gov/
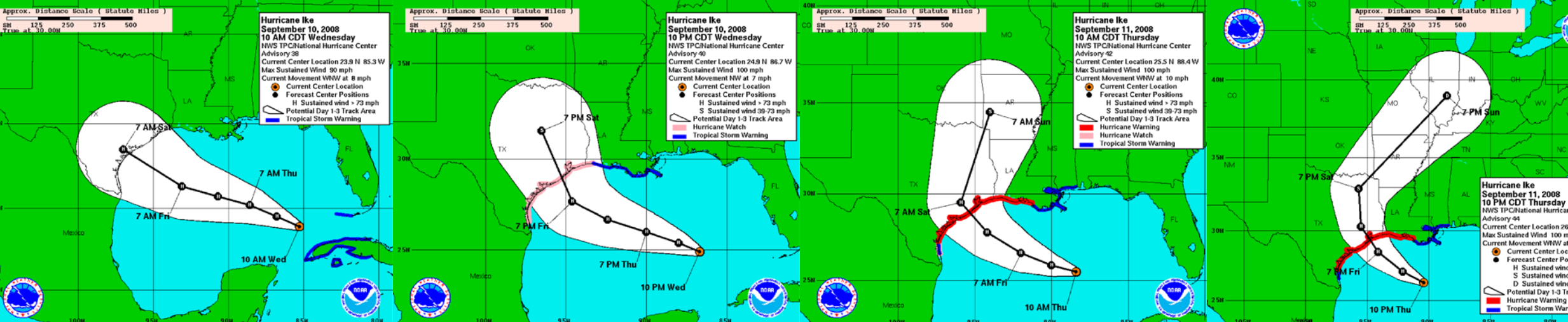
So when should emergency action be taken? Referring back to the percentages from the past 5-years, there is a 56% chance the forecasts put into place 48Hrs, or two days, in advance will have an error less than or equal to 100 n mi. Should odds close to that of flipping a coin be considered in the decision to order a mandatory evacuation? The same table shows that 70% of forecasts 36Hrs in advance will have an error ≤ 100 n mi. This is a much better probability however, one must question, is a day and a half enough time to effectively evacuate 55,000+, the population of Galveston, TX?

Figure 5. Galveston, TX, before and after Hurricane Ike.

Courtesy of United States Geological Survey http://geology.com/usgs/hurricane-ike-pictures.shtml