

# **Texas Hurricane History**

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# Preface

Every year, about one hundred tropical disturbances roam the open Atlantic Ocean, Caribbean Sea, and Gulf of Mexico. About fifteen of these become tropical depressions, areas of low pressure with closed wind patterns. Of the fifteen, ten become tropical storms, and six become hurricanes. Every five years, one of the hurricanes will become reach category five status, normally in the western Atlantic or western Caribbean. About every fifty years, one of these extremely intense hurricanes will strike the United States, with disastrous consequences.

Texas has seen its share of hurricane activity over the many years it has been inhabited. Nearly five hundred years ago, unlucky Spanish explorers learned firsthand what storms along the coast of the Lone Star State were capable of. Despite these setbacks, Spaniards set down roots across Mexico and Texas and started colonies. Galleons filled with gold and other treasures sank to the bottom of the Gulf, off such locations as Padre and Galveston Islands. Over time, French settlers began colonies in eastern sections of the state. Finally, Americans came into play.

Over the long coast of Texas, many settlements were founded over the centuries. Some disappeared almost as soon as they began due to the viciousness of these “equinoctial” storms. As they moved inland, flooding rains invaded interior sections of the state, causing massive floods in east Texas and the Balcones Escarpment.

In olden times, hurricanes were named after religious holidays or places they struck. Galveston and Indianola have major hurricanes which bear their names. All names found in this document were found during research; none were ascribed by the author. From 1950 onward, naming has been the duty of those who forecast hurricanes in Washington, D.C., before it became the role of the National Hurricane Center, in West Miami, in 1958.

This document attempts to put into one source all of the damaging storms that have ever been known to impact the Lone Star State. It is highly likely that some storms were missed; these will be added in later editions. Disputes between different sources on the same storm, from 1837 onward, were usually settled by newspapers at the time. The information with the most sources normally won out.

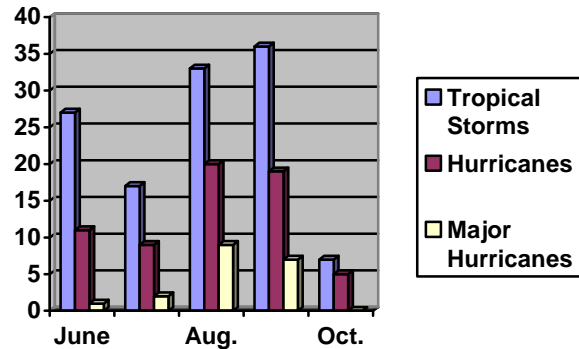
This chronology is important for those who inhabit Texas, or are interested in the state’s history. More hurricanes will strike Texas over the coming years. Learning what happened in past storms can help to prepare you for the future. If the past is ignored, mistakes made in previous storms are likely to occur again.

# Climatology of Texas Tropical Cyclones

Since we cannot prevent hurricanes, the next best thing is to know what they can do and be prepared. Those that do not study history are doomed to repeat it, which can be deadly during hurricane season.

**Frequency.** The frequency of hurricanes in along any fifty mile segment of the Texas coast is one about every six years. Annual probabilities of a strike along a fifty mile segment range from 31% at Sabine Pass to 41% around Matagorda Bay. The annual average occurrence of a tropical storm or hurricane per year is 0.8, or 3 per every 4 years. Since 1829, the longest hurricane-free period for Texas was nearly 10 years: between October 1989 and August 1999. In contrast, one or more hurricanes affected the coast each year from 1885 to 1888. In 1886, four hurricanes struck the Texas coast with the first and last both hitting Sabine Pass.

Since the sixteenth century, hurricanes and tropical storms have struck Texas in the time frame between June 2<sup>nd</sup> and November 5<sup>th</sup>. The following is a monthly chart of tropical cyclones that have affected the Texas coast since 1850. This list does not include storms cross Mexico from the East Pacific Ocean, like Lidia in 1991, because Pacific storms were rarely documented before 1966. August is the most likely time that a hurricane or major hurricane will strike the Lone Star State.



The relative lack of storms prior to 1829 is mainly due to sparse population across the study area and few surviving records. Many ships that may have encountered hurricanes took their storm encounters with them to the bottom of the Gulf of Mexico. The following chart lists storm strikes from 1851 decade by decade. It shows that the busiest decade for Texas landfalling tropical cyclones was the 1940's. The 1880's and 2000's are the next most active decades for Texas.

### Tropical Cyclone Strikes By The Decade

Decade	Hurricanes	Tropical Storms	Total
1850's	3	1	4
1860's	4	1	5
1870's	2	4	6
1880's	8	3	11
1890's	3	3	6
1900's	4	2	6
1910's	7	1	8
1920's	2	3	5
1930's	5	4	9
1940's	8	6	14
1950's	2	5	7
1960's	3	3	6
1970's	2	7	9
1980's	5	4	9
1990's	1	4	5
2000's	5	5	10
Total	64	56	120
Annual average	0.4	0.4	0.8

**Rainfall.** By far, the most serious threat from a tropical cyclone to Texas residents is flooding. And the worst thing about it is that the weaker the system is, the more efficient it is at producing heavy rains and catastrophic flooding. Claudette (1979), Allison (both 2001 and 1989), and Charley (1998) stand out as recent examples of this fact. Amelia (1978) showed that a system can meander around the state for over a week, creating a headache for residents anywhere between the High Plains and Coastal Plain. This proves the point that any system, no matter what strength, can create major problems for Texas.

Tropical cyclones tend to exhibit different rainfall patterns, depending on the synoptic situation in which they are embedded, and the orography of the affected region. In other words, any pre-existing boundaries such as warm fronts/cold fronts and elevated terrain focus higher rainfall amounts. Outside of these effects, the maximum amount of rain can be expected to the right of the track of the storm. If the system is a hurricane, the maximum will be near the coast, with lesser amounts inland. Tropical storms usually have a double maximum in storm total rainfall; one will be near the coast, the other some distance inland (Schoner). Weak tropical cyclones have produced some of the worst flooding in Texas history.

In Schoner's paper on Texas tropical storm rainfall patterns, he notes a couple interesting exceptions for cyclones entering the coastline near and south of Matagorda Bay. The two

hurricanes in his 35-storm sample which struck Matagorda Bay had rainfall maxima just to the left of the track. At a first glance, it is unclear why this would happen. However, in a work by Gilbert and LaSeur prepared in 1956, an explanation becomes apparent. While studying rainfall patterns associated with Hurricane Florence of 1953, they noted a rainfall minimum east of the center reminiscent of a dry slot around a mature nontropical low.

In Texas, this situation would occur when a storm approaches the Lower coast. West winds through a deep layer of the troposphere wrap dry air around the south side of a modest to large-sized cyclone initially. This dry air comes from parcels which have descended adiabatically from the much higher terrain of northeast Mexico. As dry air wraps around the east side of the center, residual moisture tends to pool on the north and west sides, leading to this uncharacteristic maximum just to the left of the track.

There are other impacts on the storm's structure due to this dry air intrusion. Major hurricanes such as Allen (1980) and Carla (1961) have weakened due to the decrease in latent heat produced by less condensation as dry air wraps around the center, effectively shutting down the heat engine of the tropical cyclone. Gilbert likely did not reintensify to its former category 5 status, partially due to dry air intrusion (it also upwelled the Gulf waters, cutting off its own fuel source). Another important effect of dry air intrusion is a higher incidence of severe weather, such as microbursts, tornadoes, and hail. Celia's microburst led to 170+ mph winds on the west side of the storm. Beulah's 115 tornadoes may well have been due to dry air encircling the cyclone.

**Benefits of tropical cyclones.** Of the 122 storms chronicled in this survey, 11 are credited with alleviating drought conditions across the Lone Star State. Without tropical storms and hurricanes moving into Texas, summer rainfall would be about 10% lower than what currently falls across eastern Texas. This could be disastrous for cotton, corn, and rice grown statewide, as they are highly dependent on this added rainfall contribution.

**Movement of tropical storms through Texas.** Two main tracks exist for tropical cyclones moving through the state. Most enter from the southeast, and curve north and northeast through eastern and central portions of Texas. Storms that strike the lower coastline tend to stay on a more westward track, such as Corpus Christi's 1919 hurricane, Celia (1970), Allen (1980), Charley (1998), Bret (1999), and Dolly (2008). This is due to a combination of the circulation around the perennial Mexican Plateau low/trough, which dominates the low level winds in south Texas through ten months of the year, including the hurricane season, and the subtropical ridge which normally becomes established across the Southern Plains during the summer months. The thermal low in Mexico is present due to air at the same altitude surrounding the Mexican plateau being cooler, similar to the way (but much smaller in scale) that the low that develops over the Himalayas of Southeast Asia, which creates the epic monsoons over that portion of the world.

Early and late in the season, mainly June and October, storms can enter from the south or southwest, then move north and northeast across the state. Northerly and northeasterly tracks are due to cold frontal intrusions from the north that cause steering winds to become southerly across

much of the state during those months. This explains why tropical cyclones from the eastern Pacific wield influence across the Lone Star State, even if their low level circulations have been destroyed by the Sierra Madre Occidental, the mountain range that crosses Mexico from southeast to northwest. It also explains why there are very few October landfalls from Gulf cyclones as very little of the upper Texas coastline lies north or northeast of the Gulf of Mexico.

**Long term trends/hurricane cycles.** Studies were made back in the 1950's by Dr. W. Armstrong Price on hurricane incidence along the Texas coast and the sunspot cycle. Regardless of whether this pattern exists because of sunspots or some other interannual climate cycle, using data back to 1829 there are periods in the hurricane climatology that have greater activity than others. These periods were defined as being "hurricane-rich" or "hurricane-poor". Hurricane-rich periods last, on average, 11 years with an average of 8 landfalls in their midst. Hurricane-poor periods last, on average, 14 years and only 2 landfalls usually occur.

We are currently in a hurricane-rich period which began in 2003. This is expected to last until around 2014, plus or minus a few years. Texas will be extremely prone to hurricane landfalls during the time frame. Whether or not we should expect as few as two or as many as 8 storms in the next decade, all it takes is one to make life miserable for residents along the coast.

**Main sources of information for the history.** The list of hurricanes compiled on the following pages was extracted from various sources. Data since 1851 was referenced against records maintained by the National Hurricane Center in Sweetwater, Florida. Coordination with Chris Landsea of the National Hurricane Center has been ongoing since the late 1990's, as the hurricane database it undergoing a necessary revision as many old hurricane records have been unearthed during the past couple decades. Some of the information in this work has been of value during the hurricane reanalysis, and vice versa. Most data prior to 1851 came from Ivan Ray Tannehill's classic book Hurricanes, David Ludlum's compendium on hurricane history Early American Hurricanes (1492-1870), local newspapers, publications of the United States Geological Survey (USGS), and the Army Corp of Engineers. The Western Region Technical Memorandum by Smith (1986) provided information on many of the east Pacific tropical cyclone impacts on western Texas.

# Texas Hurricanes - 1527 through 2009

Date	Name	Landfall	Wind	Category	Dead	Min Cent Pres
1527, 11/?	-	Matagorda Bay	-	-	200	-
1553, -	-	Lower TX Coast	-	-	1,700	-
1554, 4/?	-	Brownsville	-	-	50-100	-
1766, 9/04	-	Galveston	-	-	-	-
1791, -	-	Lower TX Coast	-	-	-	-
1818, 9/12	-	Galveston	-	-	<1,000	-
1829, 9/10	-	Brownsville	-	-	-	-
1830, 6/?	-	S of Brownsville	-	-	-	-
1831, 8/18	-	Brownsville	-	-	-	-
1834, 9/?	-	South Texas	-	-	-	-
1835, 8/18	Antigua Hurricane	Brownsville	-	-	-	-
1835, 9/18	-	Corpus Christi	-	-	14	-
1837, 10/5	Racer's Storm	Brownsville	-	-	105	-
1838, -	-	Lower TX coast	-	-	-	-
1839, 11/5	-	Galveston	-	-	-	-
1840, -	-	Brownsville	-	-	-	-
1842, 9/11 or 18	-	Galveston	-	-	-	-
1842, 10/5	-	Galveston	-	-	-	-
1844, 8/06	-	Brownsville	-	-	70	-
1848, 10/17	-	Lower TX Coast	-	-	-	-
1851, 6/25	Number 1	Matagorda	90	1	-	-
1854, 9/19	Number 4	Matagorda	105	2	20	-
1857, 9/30	Number 4	Port Isabel	105	2	-	-
1865, 9/13	Number 4	Cameron, LA	105	2	25	-
1866, 7/15	Number 1	Port O'Connor	105	2	-	-
1867, 10/3	Number 7	Entire Coast	105	2	-	-
1869, 8/16	Number 2	Indianola	105	2	-	-
1871, 10/2	Number 7	Galveston	80	1	3+	-
1875, 9/16	Number 3	Indianola	115	3	270	-
1877, 9/16	Number 2	Entire Coast	80	1	-	-
1879, 8/23	Number 3	High Island	105	2	-	964
1880, 8/12	Number 2	Brownsville	150	4	5	931
1881, 8/13	Number 3	Corpus Christi	90	1	-	-
1886, 6/13	Number 1	Cameron	100	2	-	-
1886, 8/20	Number 5	Indianola	155	4	20	925
1886, 9/22	Number 6	S of Brownsville	100	2	-	-
1886, 10/12	Number 10	Beaumont	120	3	150	-
1887, 9/21	Number 9	Brownsville	100	2	-	980



Date	Name	Landfall	Winds	Category	Dead	Min Cent Pres
1888, 6/16	Number 1	Matagorda	80	1	-	-
1891, 7/05	Number 1	Matagorda	100	2	-	-
1895, 8/29	Number 2	Brownsville	110	2	-	-
1897, 9/12	Number 2	Beaumont	85	1	13	-
1900, 9/08	Galveston Hurricane	Galveston	145	4	8,000	936
1902, 6/26	Number 2	Port Lavaca	80	1	0	-
1909, 7/21	Number 4	Velasco	115	3	41	959
1909, 8/27	Number 6	Brownsville	120	3	-	-
1910, 9/14	Number 3	Baffin Bay	110	2	0	965
1912, 10/16	Number 6	Corpus Christi	100	2	0	-
1913, 6/27	Number 1	Corpus Christi	75	1	0	-
1915, 8/17	Number 2	Galveston	135	4	275	940
1916, 8/18	Number 6	Corpus Christi	135	4	20	932
1919, 9/14	Number 2	Corpus Christi	143	4	284	931
1921, 6/22	Number 1	Matagorda	95	1	0	980
1929, 6/28	Number 1	Matagorda	85	1	0	982
1932, 8/13	Number 2	Freeport	140	4	40	941
1933, 8/05	Number 5	Brownsville	100	2	-	975
1933, 9/04	Number 11	Brownsville	125	3	40	949
1934, 7/25	Number 3	Rockport	100	2	19	975
1936, 6/27	Number 3	Port O'Connor	80	1	-	987
1938, 8/15	Number 2	East of Sabine Pass	75	1	-	-
1940, 8/07	Number 2	East of Sabine Pass	100	2	-	972
1941, 9/23	Number 2	Texas City	120	3	4	958
1942, 8/21	Number 1	Galveston Is.	80	1	-	992
1942, 8/30	Number 3	Matagorda	115	3	8	950
1943, 7/27	Number 1	Galveston	100	2	19	969
1945, 8/26	Number 6	Matagorda	110	2	3	967
1947, 8/24	Number 3	Galveston	80	1	1	992
1949, 10/3	Number 10	Freeport	110	2	2	972
1954, 6/26	Alice	S of Brownsville	80	1	17	-
1955, 9/05	Gladys	S of Brownsville	85	1	-	-
1957, 6/27	Audrey	Sabine Pass	145	4	9	945
1959, 7/25	Debra	Galveston	85	1	0	984
1961, 9/11	Carla	Port Lavaca	145	4	46	931
1963, 9/17	Cindy	High Island	75	1	3	997
1967, 9/20	Beulah	Brownsville	135	3	15	931
1970, 8/03	Celia	Corpus Christi	125	3	11	945
1971, 9/10	Fern	Matagorda	90	1	2	978
1971, 9/16	Edith	East of Sabine Pass	100	2	0	977
1980, 8/09	Allen	Port Mansfield	115	3	7	945

Date	Name	Landfall	Winds	Category	Dead	Min Cent Pres
1983, 8/18	Alicia	Galveston	115	3	13	963
1986, 6/26	Bonnie	Beaumont	85	1	4	982
1988, 9/17	Gilbert	S of Brownsville	135	4	-	950
1989, 8/01	Chantal	High Island	80	1	2	984
1989, 10/16	Jerry	Galveston Island	85	1	3	983
1999, 08/22	Bret	Padre Island	115	3	4	951
2003, 07/15	Claudette	Port O'Connor	85	1	1	982
2005, 09/24	Rita	Sabine Pass	100	2	59	945
2007, 09/13	Humberto	High Island	90	1	1	985
2008, 09/13	Ike	Galveston Island	110	2	84	951

# Tropical Cyclone Records in Texas

## Pressure

Pressure	Date	Location	Number	Dates
27.83"	8/13/1932	East Columbia	8000	9/7-9/1900
27.89"	8/03/1970	Ingleside	1700	4/1554
28.00"	8/18/1916	Kingsville	<1000	9/12/1818
28.02"	9/05/1933	Brownsville	284	9/14/1919
28.07"	9/20/1967	Brownsville	275	8/17/1915
28.07"	9/13/2008	Port Bolivar	270	9/16/1875
28.10"	8/30/1942	Seadrift	200	11/1557
28.14"	8/17/1915	Velasco	150	10/12/1886
28.44"	9/08/1900	Galveston	105	10/3-6/1860
28.50"	9/14/1910	South Padre Island	70	8/6/1844

## Deaths

## Highest Winds

Winds	Date	Location
180 mph	8/03/1970	Aransas Pass
175 mph	9/11/1961	Port Lavaca
161 mph	8/03/1970	Corpus Christi
150 mph	8/17/1875	Indianola
138 mph	8/10/1980	Port Mansfield
136 mph	9/20/1967	Port of Brownsville
135 mph	10/3-4/1949	5 W of Freeport
135 mph	8/26/1945	Collegeport
132 mph	7/27/1942	Houston
125 mph	9/4-5/1933	Brownsville
125 mph	9/7-8/1900	Galveston

## Heaviest Rains

Amount	Date	Location
46.00"	8/1-4/1978	Bluff
45.00"	7/24-27/1979	Alvin
40.68"	6/5-11/2001	Moore Detent. Pond
40.00"	9/7-11/1921	Thrall
36.99"	6/5-11/2001	Port of Houston
36.40"	9/9/1921	Williamson Cnty
35.67"	6/5-11/2001	Green's Bayou
32.00"	8/1-4/1978	Albany
30.00"	6/27-30/1899	Hearne
29.76"	6/23-26/1960	Port Lavaca

## Hurricanes of the Sixteenth Century

**November 1527:** There is record of a storm sinking the poorly-anchored boat of Panfilade Narvaez off Galveston Island. Up to 200 lives were taken in this storm. This is the first record known of storms along the Texas coastline and also one of the most unusual...it struck during the month of November; only one hurricane has ever struck during November (1839).

**April 1554:** Fifteen of the twenty ships of the New Spain Flota, with around 300 passengers en route from Vera Cruz to Havana, and loaded with silver and gold along the Lower Texas coast, were demolished during a springtime gale. Three of the heaviest vessels sunk immediately. The other 17 were either scattered across the Gulf of Mexico, grounded, or had capsized just off Padre Island near Devil's Elbow...three of which were the *San Estevan*, *Santa Maria de Yciar*, and *Espiritu Santo Andres*. Only 300 of the 2000 aboard ship made it to shore alive. But to the misfortune of the Spaniards, they had horrible relations with the local tribe of Native Americans, known as the Karankawa. As they struggled to go south into Mexico, they had to fight them off along the way. Only two of the original 2000 ever lived to tell the tale of their misfortune. Their story prompted salvage vessels to visit the site on July 22<sup>nd</sup> (Chipman).



**Early November 1590:** A hurricane was encountered in the Gulf of Mexico. Over 1000 lives were lost on ships at sea.

**September 12<sup>th</sup>, 1600:** A hurricane offshore New Spain (Mexico) took 60 lives at sea.

## Hurricanes of the Seventeenth Century

**August 30<sup>th</sup>, 1615:** The ship *San Miguel* sunk in a storm off the coast of Mexico. No belongings aboard nor passengers were able to be saved.

**October 21<sup>st</sup>, 1631:** A hurricane took over 300 lives at sea while moving through the Gulf of Mexico.

## Hurricanes of the Eighteenth Century

**September 4<sup>th</sup>, 1766:** This hurricane hit modern-day Galveston. A mission, named San Augustine de Ahumado was located in what is nowadays known as Chambers County. This mission was destroyed and subsequently abandoned. A seven foot storm surge put the area under water. A richly-laden treasure fleet of 5 galleons en route from Vera Cruz to Havana was driven ashore and had to wait many weeks for assistance to come. *La Caraqueña* wrecked on Galveston Island while *El Nuevo de Constante* sank along the western Louisiana coast. Fortunately, much of the treasure and people aboard were saved.

**1791:** A hurricane struck the Lower Coast. Padre Island and mainland to the west was put under water. A head of 50,000 cattle belonging to a Spanish cattle baron were drowned (Ellis).

## Hurricanes of the Early Nineteenth Century

**September 12-14<sup>th</sup>, 1818:** Among the earliest accounts of a direct hurricane strike on the Texas coast was this storm which formed near the Cayman Islands, then moved west into the Bay of Campeche and moved northwest to hit Galvez's town (Galveston). It was described as a storm of extraordinary violence. Settlers on the island saw the signs of an approaching storm, but did not think anything of it since they had been through similar situations before. They anchored their boats and went to sleep like it was any other night.

They were awakened by the fierce winds, thunder, and waves crashing against their homes. The entire island was overwhelmed by the storm surge, which flooded the French colony of Champ d'Asile by four feet. By morning, the city had become a "picture of chaos". As water began to invade the hospital, people moved the sick to Maison Rouge (Red House), the residence of the pirate/privateer Jean LaFitte (Gaillardet).

All but six buildings were reported destroyed on the Island. The pirate Jean LaFitte was occupying Champ d'Asile at the time and played an intriguing role during the storm, as both a Spanish spy and a hero. The Spaniards had paid him to keep an eye on this French town, located in the heart of Spanish territory. His house was used for the sick during the storm, which earned praise from the community. However, he too suffered losses as most of the ships in his fleet were destroyed; four in all. Wreckage from some of these ships was dug up by a dredge boat building portion of the Texas City jetty fifty years later (Block).

War ships from Vera Cruz who encountered this storm were put out of commission for months. Ships and boats in harbor dragged their anchors and were carried out to sea. Two of the

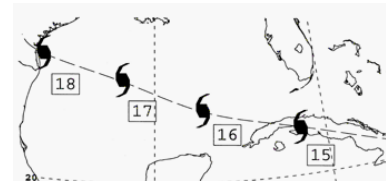
boats were later found in “six leagues inland”. Altogether, fourteen ships were claimed by the hurricane. After the storm, those who had survived fled to New Orleans, bringing an end to the short history of Champ d’Asile (Gallardet). Estimates of the lives lost during the cyclone approach 1000 (Cartwright).

**September 10<sup>th</sup>, 1829:** A hurricane struck Mouth of Rio Grande. It inundated the Lower coast. Corpus Christi reported high water. It flooded the Rio Grande as it moved northwest, washing away the Socorro Mission, originally built south of El Paso in 1691. The building, made of adobe brick, “melted and sank into the ground” (Ellis). Port Isabel and Brazos Santiago were destroyed.

**August 18<sup>th</sup>, 1831:** A hurricane made landfall near Mouth of Rio Grande. Settlements at the Mouth of the Rio Grande fell victim.

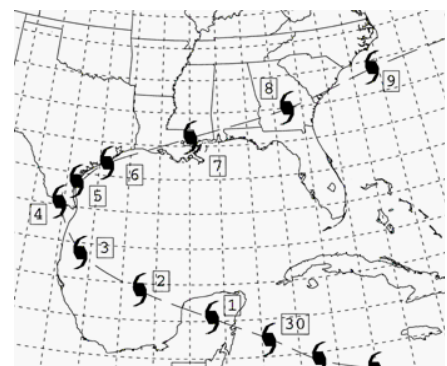
**September 1834:** A hurricane struck South Texas. Establishments at the Mouth of the Rio Grande suffered severely.

**August 18<sup>th</sup>, 1835 (Antigua-Texas Hurricane):** This storm passed directly over the island of Antigua on the 12<sup>th</sup>. It then raked the Greater Antilles; passed over Puerto Rico, Hispaniola, and Cuba before it emerged back into water in the Florida Straits. The hurricane hit near Corpus Christi on the 18<sup>th</sup>. In its 28 hour duration, many houses were blown down at Matamoros. The storm surge engulfed Padre Island and lowlands along the river.



The hamlet of Villa Hermosa de Santa Anna disappeared during the tempest. Every vessel in the nearby harbor of Brazos Santiago was either driven out to sea or beached high and dry. One ship was carried out to sea; when the crew realized the gales and tides were moving them further and further from land, they jumped into the angry Gulf waters. Galveston Island saw flooding as well. The schooner *Bravo* capsized while in Matagorda Bay. The hurricane continued westward, moving into the mountains of Northern Mexico. At least 14 perished in the storm.

**October 2-6<sup>th</sup>, 1837 (Racer’s Storm):** The first recorded storm to rake the entire Texas coast was Racer’s Storm, named for a British sloop of war which encountered the system in the extreme northwestern Caribbean on September 28<sup>th</sup>. It is remembered as one of the most destructive storms of the nineteenth century due to its extreme duration and 2000 mile path of destruction.



The hurricane made landfall briefly south of Brownsville near Matamoros, lashing the coast for three days as the storm slowed to a near halt from the 2<sup>nd</sup> through the 4<sup>th</sup> of October. All vessels in Brazos Santiago fell victim to the storm. Paralleling the coast northeast, the storm took another ship victim offshore Matagorda Bay. Settlements along the bay all suffered heavy losses. All vessels at Velasco were driven ashore. Velasco and Brazos river shipping suffered immensely.

The storm at Galveston lasted from the 3<sup>rd</sup> through the 5<sup>th</sup>. A storm surge six to seven feet higher than the spring tide inundated the coast. The scene on the Island was one of utter desolation. The new Tremont hotel was blown over. Nearly all the homes on the island were blown down; all provisions were lost. Two churches also met their fate. Water levels at Houston rose four feet. The whole character of the harbor entrance shifted during the hurricane.

Ships were shoved as far as three miles inland. A three-masted bark was driven high aground across the Golden Triangle, being left seven miles from the beach. For decades, residents of Sabine Pass scavenged the wreck for firewood and timbers to use in house and boat construction (Block). Two Texas Naval schooners were dashed to pieces on Galveston Island. The storm passed offshore of Sabine Pass on the 6<sup>th</sup>, then into Louisiana. At least two people perished with Texas' borders.

**1838:** A hurricane made landfall along lower Texas coast and caused high tides. Settlements at the Mouth of the Rio Grande again suffered at the hands of a tropical cyclone.

**November 5<sup>th</sup>, 1839:** A hurricane struck Galveston unusually late in the year.

**1840:** A hurricane destroyed villages at Mouth of Rio Grande. Flooding was also noted.

**September 17-18<sup>th</sup>, 1842:** A strong tropical storm hit Galveston. The city was on the west side, as waters invaded from the bay to their north. About four feet of water covered the island, destroying smaller buildings and houses. Forty cattle were crushed under a house that was leveled during the storm. Damage totaled \$10,000.

**October 5<sup>th</sup>, 1842:** A storm brushed by Galveston, flooding the town. Losses were limited to a few houses and the new Trinity Episcopal church. The main thoroughfares were inundated by the storm surge (Block). The schooner *Dream* foundered between Galveston and New Orleans. All aboard the ill-fated vessel were rescued (Ellis).

**The village of Brazos Santiago** had been established by the Mexican government as a customs point for many years prior. An army garrison had been established there after Texas gained independence. The village site was just a few feet above sea level on Brazos Island and was extremely vulnerable to coastal flooding.

**August 6<sup>th</sup>, 1844:** This hurricane produced the first records of large loss of life along the lower Texas coast on the 6th. Residents on Padre Island fled to Matamoros for shelter. The 1844 storm completely destroyed the settlement of Brazos Santiago with a loss of 70 lives after the waters eroded a pass clear through the old settlement. The only survivor was reported to be the captain of the pilot boat who remained offshore. In Corpus Christi, high winds and tides capsized a pirate raft, loaded with their treasures. The Mexican Customs Office was moved to the mainland due to this storm.

**October 17<sup>th</sup>, 1848:** A hurricane struck the Lower Coast. Brazos Santiago Island was under two feet of water. Several vessels were lost near Point Isabel. Tides were reported as high at Corpus Christi (Ellis). This storm relieved “spotty drought conditions” along the Middle Texas coast (Malsch).

**September 13-14<sup>th</sup>, 1849:** A tremendous gale swept the coast near the Mouth of the Rio Grande. East wind filled the lagoon west of Point Isabel before a “severe” north wind set in on the 13<sup>th</sup>, driving waters over Brazos Island, covering the low portions by four feet. People fled to sand dunes to escape the rising tide. The “late gale” at Corpus Christi blew down the Oil Factory that was recent built. The storm helped to cause a 5-6 foot rise on the Brazos river during the succeeding two weeks. The cyclone put a dent in the drought conditions north of Navisoto, where cattle abandoned the prairie searching for new sources of water. The steamer Yacht encountered a “heavy gale” on the Gulf of Mexico. She was detained so long at sea that fuel ran out, and wood was dismantled from the vessel to help fuel the passage to Southwest Pass, Louisiana.

**June 27<sup>th</sup>, 1850:** A “severe squall” came across Matagorda Bay at Indianola, causing damage. The force of the gale tore the *Palmetto* from her anchored position, and drove her aground. The lighter *Jerry Smith* suffered extensive damage to its upper works (Malsch).

## Hurricanes of the Late Nineteenth Century

**June 25-26<sup>th</sup>, 1851:** A short yet severe storm passed over Matagorda Bay and was described as the most disastrous experienced up until that time. Salt water contaminated the water supply at Saluria, on Matagorda Island. Widespread wind damage was reported at Goliad, Saluria, Port Lavaca, and Port Cavallo. Its reach extended as far westward as Refugio. Every wharf at Port Lavaca was destroyed by the wind. The brunt of the cyclone struck Indianola at 2 PM, increasing throughout the night. The Government Wharf was battered by the waves. Buildings suffered damage on the bay, but the storm surge did not cover the nearby spit, creating a false sense of security. Corn was laid flat by the wind. The highest rainfall report noted was three inches at



Corpus Christi.

The schooner *William and Mary* was cast onto the beach, left “high and dry” (Malsch). The *William Penn* was torn from her mooring, and sank in five feet of water. The sloop *Commercial* was dashed to pieces. In the Gulf, the steamship *Maria Birt* was lost, but all aboard survived. Victoria citizens were “greatly annoyed” that all the mail for Victoria, San Antonio, and West Texas was swept into Matagorda Bay. Rail was used for mail service from then onward.

**June 24-27<sup>th</sup>, 1854:** This minor hurricane brought winds near tropical storm-force as far north as Galveston between the 24<sup>th</sup> and 27<sup>th</sup>. Brazos Santiago experienced the full force of the storm. Winds blew “a perfect hurricane” out of the south-southeast on the backside of this system. Many buildings in the settlement were unroofed and moved around. A cistern at the Quartermaster’s Department was destroyed. The storm surge washed away bath houses at Lavaca. The Aransas bar was deepened and widened by the storm. A total of 6.63” of rainfall was recorded at Fort Ringgold, and their pressure fell to 29.40”.

**September 17-19<sup>th</sup>, 1854:** A hurricane hit Matagorda/Galveston. The main impact of the storm was around Matagorda and Lavaca Bays. Every vessel and wharf on Matagorda Bay was destroyed. Wharves at Old Town also met an untimely fate. The storm surge went through with such force that the channel was straightened and deepened by two feet. The town of Matagorda was leveled. Many buildings fell victim, including the Methodist and Episcopal churches. The storm led to a yellow fever outbreak, which would spread from Indianola to other surrounding communities over the next several weeks. Saluria suffered \$20,000 in damage.

Merchants on the Strand and Market Streets in Galveston suffered much water damage from the eight foot storm surge. The lower floors of Galveston business houses were overwhelmed by the rising tide. The storm came at the worst possible time, as the city was enduring a deadly yellow fever outbreak (Block). Brazoria also encountered strong winds from the storm. Crops of sugar cane and cotton were ruined. Many small vessels perished. The steamer *Kate Ward* and her crew were a total loss. The little steamer *Nick Hill* went down off Dollar Point in Galveston Bay.

The storm then moved northwest over Columbus, and in its dissipating stage became a widespread rainstorm over the western and central Gulf Coast causing 5.55” of rain in Baton Rouge between the 17<sup>th</sup> and the 21<sup>st</sup> with rain falling as far east as Pensacola. Four lives were lost in Matagorda...while many more were claimed by yellow fever.

**September 30<sup>th</sup>, 1857:** This storm hit Port Isabel. It swept away several hundred homes and damaged the towns of Brazos Santiago, Clarksville, and Bagdad, all near the Mouth of the Rio Grande.

**September 28-October 1<sup>st</sup>, 1863:** A tropical storm moved just offshore southeast Texas on the 28<sup>th</sup> and 29<sup>th</sup> into Louisiana. Pressures fell to 29.49” as it bypassed Houston, Texas. Its worst

impact along the Texas coast from Galveston eastward. Winds were high at Velasco as the storm passed by. Washington endured heavy rains (Mock, personal communication). Limbs were removed from trees by the wind at Sabine Pass. The Yankee schooner *Manhasset* was captured by the Confederates at Sabine Pass as it was driven ashore by the cyclone.

**September 13<sup>th</sup>, 1865:** A hurricane hit southwestern Louisiana. Orange saw the greatest damage. Four out of 200 homes were left standing. Twenty five people were killed by falling debris and flying timbers. At Bagdad, near the Mouth of the Rio Grande, backwater flooding and swells from the storm inundated the town. Nineteen of 20 ships capsized in the Sabine River. Texas' largest inland steamboat, the 220-foot *Florilda*, capsized in the Sabine river. The only boat to survive was a survivor of the African slave trade, the ancient schooner *Waterwitch* (Block).

The schooner *Lone Star* was wrecked near Redfish Bar on Galveston Bay, in nine feet of water. By the time the steamer *Nashua* was sent in search of survivors, the *Lone Star* had gone to pieces. Survivors were scattered widely across the area. One of the sloops in search of the *Lone Star* and her former crew almost foundered itself in the high winds. All cargo of the *Lone Star* was lost.

**July 15<sup>th</sup>, 1866:** A strong tropical storm struck Port O'Connor. It was considered severe, but no lives or buildings were lost. Affects were noted at Galveston and Port Isabel.

**During the Civil War**, most of the Confederacy's cotton was shipped out of South Texas and Mexico. Two communities two miles inland of the mouth of the Rio Grande boomed because of this commerce, particularly the town of Bagdad on the Mexican side of the river, which grew to a population of several thousand. Clarksville, on the U.S. side, was much smaller. Bagdad had a reputation for lusty living and was compared to New Orleans in its style.

**October 2-3<sup>rd</sup>, 1867:** A hurricane moved northeast, offshore the Texas coast. This storm struck the mouth of the Rio Grande with great fury and devastated both cities. Brazos Santiago was again devastated, with most of the buildings leveled. Clarksville was soon abandoned, and a later storm in 1874 finished off Bagdad. A few glass and metal relics buried in the sand are all that remain of both towns. The population at their peaks totaled over 20,000. Brownsville, Port Isabel, and Matamoros were severely crippled. The military railroad ceased to exist. Four steamboats were sunk.

Galveston was inundated by the storm surge on the 3<sup>rd</sup>, measured as one foot higher than the 1854 storm. Chaos reigned in the city, as it was engulfed in a yellow fever epidemic that decimated 11% of the population that year. The invading Gulf swept away bodies of the plague victims. Hundred perished. The brick Washington Hotel, the new Old Fellow's Lodge, hundreds of homes, and the rail bridge to the mainland were destroyed (Block). All wharves were "nearly

demolished”. A Trinity river steamboat and a dozen large schooners anchored at the bay were wrecked, foundered, or were swept ashore by the rising tide. At the time, it was considered the most severe and disastrous storm in the city’s history. Mud slides buried Matamoros.

This storm followed a path similar to the Racer’s Storm, and produced great damage along the entire coast. It is regarded as the first “million dollar” hurricane in Texas, most inflicted upon Galveston. In an editorial after the storm in the Ranchero, a newspaper that evolved into the present day Brownsville Herald, the editor asked the question, “What would happen if a similar storm struck Galveston directly as it had the lower coast?”

**August 16<sup>th</sup>, 1869:** A “short but severe” hurricane struck the lower Texas coast, doing the most damage at Refugio and Indianola. Several houses were blown off their foundations in Rockport, St. Mary’s, and Saluria. “Tornadic winds” demolished the Episcopal church of Ascension in Indianola. Several buildings were unroofed. All orange and apple orchards in Sabine Pass were destroyed in the storm. No oranges, plums, peaches, or figs bore fruit that year due to the cyclone. Limited damage was seen at Rockport and Corpus Christi.

Along the Indianola waterfront, boats were beached and capsized, while wharves and warehouses were battered by wave action. The storm surge invaded Indianola, leaving water in the streets that was one foot deep. After the storm, Indianola congratulated itself about “the obvious security of our little city” (Malsch). Only six more years would pass before this claim became unjustified.

**June 2-5<sup>th</sup>, 1871:** A tropical storm made landfall along the Texas coast. Lowest pressure at Galveston was 29.51", where 15.57" of rain fell during the storm...four inches fell in only 15 minutes. The 8.55" that fell on the 4<sup>th</sup> established a daily rainfall record. Port Aransas recorded an “extraordinary high tide” and a fresh gale. Minor wind damage was experienced at Indianola, where Gulf waters flooded lower portions of town.

The *Virginia Dare* grounded on the outer sandbar off the beach of Galveston. Its crew was rescued. The steamship *Alabama* was thrown ashore, her cargo of cattle swam ashore. A party of four men drowned while attempting to pass through the breakers. Several small beach houses at Galveston were washed away. At Houston, several houses were blown down and trees were uprooted.

**June 9<sup>th</sup>, 1871:** A second tropical storm within one week moved through East Texas. A large Trinity cotton steamer *Mollie Hambleton* sank, a total wreck at Williams Wharf. Several sailing ships were also lost (Block). In Galveston, it wrecked many ships and leveled the St. Patrick church. Several houses were destroyed and the east end of the Island went underwater. Minor coastal flooding was seen at Indianola. Winds blew off the roof of the Catholic church in Refugio, killing one person.

**September 30-October 3<sup>rd</sup>, 1871:** The third tropical cyclone to affect Texas in 1871 moved

just offshore the length of the coast. On Mustang Island, it was the strongest gale in 16 years. On the 30<sup>th</sup>, strong east winds at Indianola increased tides “at an alarming rate”...lower portions of town quickly flooded. As winds increased, most of Indianola flooded. Damage was widespread near Powder Horn Bayou. Waters receded on the 2<sup>nd</sup>, as northerly winds swept flood waters back into the Gulf of Mexico. Tides at Indianola were the highest since 1844. A weather observation site was established at the city soon afterward by the U.S. Signal Service, in May 1872.

Torrential rains wreaked havoc at Lavaca. High tides flooded warehouses under the bluff. The jail at Lavaca was washed away. The 4.90” of rain which fell on the 2<sup>nd</sup> established a rainfall record for the date for Galveston. Serious damage was done to the railroad property near Chocolate Bayou. Water became knee deep on the Strand in Galveston. Many people perished, including at least three from Galveston.

The steamer *Beardstown* was blown onto the wreck of the *Mollie Hambleton* and received significant damage. The steamer C. K. Hall went down off Cedar Point. All hands were lost except for one Swedish sailor (Guthrie). The steamer *Matthews* sunk during the storm. A ship named the *S.S. Hall* sank during the storm; all hands were lost. Many people perished, at least three in Galveston. The steamer *Twelfth Era*, initially anchored off the point of Pelican Island, was totally wrecked. A 25-ton schooner washed upon the railroad tracks near Galveston. The schooner *Sarah Cole* was also blown ashore.

**July 2-4<sup>th</sup>, 1874:** A tropical storm made landfall near Indianola. Damage was noted as far away as Corpus Christi, where damage to the waterfront and extensive erosion were seen.

**September 4-6<sup>th</sup>, 1874:** A tropical cyclone originating in the Bay of Campeche made landfall just south of the Rio Grande. It was the worst storm at Corpus Christi since the city was named Kinney’s Rancho. A gale accompanied by rain increased in intensity towards the evening of the 4<sup>th</sup>. Bathhouses and wharves were beaten by the waves back into lumber. Waves “mountainous high” rolled onshore. Heavy winds and rains continued until 3 PM on the 5<sup>th</sup>, when the eye passed overhead.

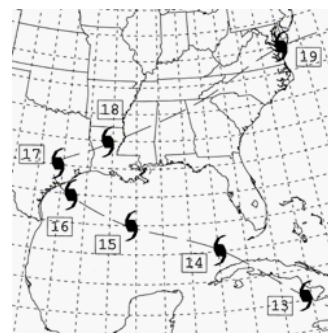
Soon after, winds became southerly and were at their worst. Schooners were shoved inland, ramming houses and trees on their way. Water Street was no longer in existence. Half the chickens in the city met an untimely fate (Ellis). A booming salt trade on Padre Island ended when the salt lakes on the island were destroyed (St. John). The Brazos Santiago lighthouse, already rotting, was completely wrecked, and the light keeper’s wife lost her life in the storm (Cipra).

**Velasco**, one of the oldest towns in Texas, was located at the Mouth of the Brazos River. Soon after its founding in 1821, population swelled. By the time of the Texas Revolution in 1835, over 25,000 people resided in the town. It briefly became capital of the Republic of Texas in 1836.

# First Indianola Hurricane - September 1875

**September 14-17<sup>th</sup>, 1875:** The first indication of a new storm in the Atlantic came from a ship southwest of the Cape Verde Islands on the 1<sup>st</sup>. Near 12N 27W, the *Tautallon Castle* encountered a “heavy gale accompanied by all the peculiarities of a hurricane” (Malsch). A vessel in the Atlantic on the 5<sup>th</sup> also encountered the hurricane, noting a “terrific sea” and a pressure of 29 inches. Other ships encountered the cyclone around the same time, but did not live to tell their tale.

It moved west into the Caribbean and grazed the coast of Haiti. On the 12<sup>th</sup>, the isle of Nauassa, off Haiti’s Cape Carcasse, reported seas breaking over cliffs between 45 and 75 feet above sea level, large trees uprooted, and many buildings destroyed. It then passed over Cuba on its way to the Gulf of Mexico. As it passed south of the Florida Keys, many vessels were driven ashore, including the steamer *City of Waco* (Dunn 1964). By the 14<sup>th</sup>, the Chief Signal Officer in Washington, D.C. believed the hurricane would go to Mobile, and warnings were issued for the Alabama coast.



At the same time, a shield of cirrostratus clouds led to the appearance of a solar halo along the Texas coast. Around Matagorda Bay, winds gusted to 40 mph that day, backing to a more northerly direction that night. Waters on the bay began to rise on the 15<sup>th</sup>, as squall moved inland. By the morning of the 16<sup>th</sup>, increasing tides had broken the high tide mark set in 1871.

The cyclone made landfall at San Jose Island, before crossing Copana Bay and moving inland. Sand dunes were leveled on Matagorda Island. Several chickens, roosting in trees during the storm, perished on Mustang Island. Old Velasco was leveled in the storm. It wasn’t until 1888 when it was rebuilt four miles upstream of its previous location on the east bank of the Brazos river. The East and West Shoal lighthouses, at Pass Cavallo, were swept out to sea, along with their four light keepers. At Upper Saluria, 90% of the residents drowned.

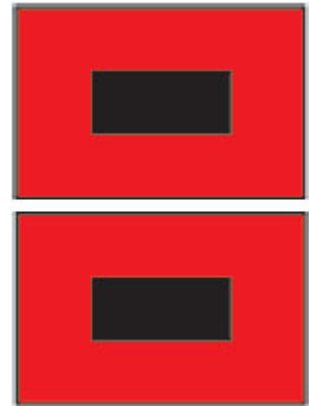
Indianola was adversely affected by the tempest. By noon on the 16<sup>th</sup>, wharves were being carried away by the invading storm surge. By 6 PM, the Signal Office collapsed. The eye passed overhead Indianola just after midnight on the 17<sup>th</sup>. Tides reached fifteen feet above the normal high tide. Three-fourths of the town was swept away...270 lives were lost. The highest wind measured was 88 mph, before the anemometer blew away. Later gusts were estimated between 145 and 150 mph. Winds were estimated to be sustained near 100 mph at the storm’s peak. Winds slowly abated during the evening of the 17<sup>th</sup>. Twelve new bayous were carved out by the storm, as the waters receded quickly back into the Gulf. Boats were carried 9 miles inland. Looters caught pillaging the dead were killed, 15 in all. After the storm, Indianolans considered a move further inland; however, political ambitions interfered, and the matter was

forgotten about.

In Galveston, northeast winds began on the night of the 14<sup>th</sup>. The wind was “higher and harder” than in 1867. Winds reached gale force by 11 AM on the 15<sup>th</sup>. Buildings began to be crushed by the increasing tides at 2 AM on the 16<sup>th</sup>. By the 17<sup>th</sup>, the tide had risen to 6.48 ft above mean low water...tides up to ten feet were seen around Galveston Island. Winds were highest from the northwest, 60 mph, after the storm passed by...estimates of 110 mph were made by several on the scene. The pressure fell to 29.05". The 6.48" deluge of rainfall set a record for the date. Two channels were cut across the east end of the Island, with one prolonging the Bolivar Channel. Several houses were swept away from the east end of the Island. The Santa Fe railroad bridge was obliterated. The *Beardstown*, while in Galveston Bay, was blown into the mud flats and eventually sank (Guthrie).

At Harrisburg and Houston there was a “terrific gale”. The water was driven up from the bay higher than known before. Several buildings were destroyed in Wallisville, with moderate damage experienced in Beaumont and Liberty. In Austin county, the storm raged for 48 hours. Cotton plants were stripped and trees fell in great numbers. The railroad from Port Isabel to Brownsville was put out of commission.

The steamship *Australian*, loading with cotton, went ashore near St. Bernard. The bark *Edward McDowell* went aground in eight feet of water. Boats were pushed five miles inland. Out in the Gulf of Mexico, the steamer *Paisana*, its hull loaded with \$200,000 in canvas bags, was lost of its way from Brazos Santiago to Galveston. After this hurricane, on October 1<sup>st</sup>, cautionary signals for hurricanes consisting of a red flag ten by eight feet, inset with a black rectangle, went into use (image of pattern to the right). At night, these flags were to be illuminated so those on land and at sea knew when to expect the next storm.



**September 15-17<sup>th</sup>, 1877:** This hurricane affected the entire Texas coast. In Galveston, winds were noted out of the east on the night of the 15<sup>th</sup>. By the 17<sup>th</sup>, tides increased to 5.2 feet above mean low water. Winds increased to 60 mph at that time. Heavy rains fell as well, with 4.64" on the 17<sup>th</sup> establishing a new daily record for Galveston. High tides were the main impact of this storm. Matagorda Bay saw light winds and squally weather. A fresh gale at Mustang Island destroyed their wharf.

**August 22-23<sup>rd</sup>, 1879:** The Golden Triangle of southeast Texas coast hit by a hurricane. At Orange, winds rapidly increased until 7 PM, when the eye passed overhead. Winds then shifted to the south. All sawmills in the region were damaged. Railroad cars were blown off their tracks. Trees were uprooted as well. The steamboat *Flora* sank, with other steamers reported as seriously damaged. Mustang Island reported high winds and tides during the storm.

The steamboat *Flora* sank at Orange, with other steamers reported as seriously damaged. The old cotton boat *Era No. 8* lost its stacks and pilot house. The steamer *Pelican State*, at the Neches river channel clearance, was driven “irretrievably” a quarter-mile into the marsh. The old cotton boat *Laura* lost its stacks, pilot house, and sustained hull and deck damage (Block).

**August 12<sup>th</sup>, 1880:** On the 3<sup>rd</sup>, a tempest loomed east of the Lesser Antilles, moving on a westerly course. It moved through the northern Caribbean to strike near Cancun and the northeast Yucatan peninsula on the 9<sup>th</sup>. After moving west northwest through the Gulf, the hurricane made landfall just south of the Rio Grande on the 12<sup>th</sup>, moving northwest to dissipate in Central Texas on the 14<sup>th</sup>.

Matamoros was left in shambles. Corpus Christi saw “a furious gale” and the pressure fell to 29.52". Structures on Padre Island were leveled. A number of “fine pigs” were lost during the storm. An eight foot storm surge flooded the area under the bluff. At Brownsville, it was one of the worst hurricanes in their history. It took 45 minutes for the eye to pass overhead. The city reported 7.82" on that day...which set a 24 hour rainfall record for the month of August. At least five people died.

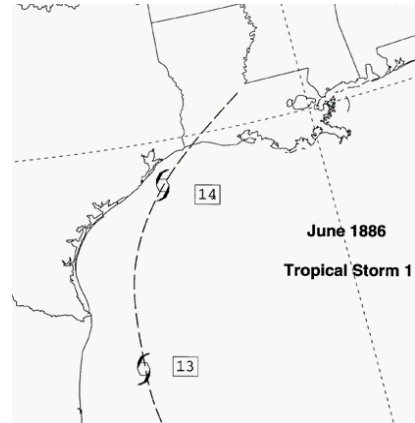
**October 12<sup>th</sup>, 1880:** A storm passed over Cuba from the 3<sup>rd</sup> through the 9<sup>th</sup>, moving west into the Gulf of Mexico. It struck Brownsville on the 12<sup>th</sup>. The city was nearly destroyed and many lives were lost. Telegraph wires were down from Indianola southward.

**August 12-14<sup>th</sup>, 1881:** A storm in the central Gulf of Mexico moved west northwest into Corpus Christi. At Murdock’s Landing, signals were blown down and a flat boat was lost. High tides and squalls were seen at Indianola.

**September 14<sup>th</sup>, 1882:** A strong tropical storm hit the Mouth of the Sabine River. A “terrific wind and rain storm” caused damage to homes in Sabine Pass. The Lake Charles Echo reported it as a “hurricane” that destroyed a house and injured its occupant. Streets in town were covered by 3 feet of water. Fences were blown over a mile from their previous location.

**September 18-20<sup>th</sup>, 1885:** This hurricane hit Brownsville before recurving northeast into Louisiana and moving through the southeastern United States. Indianola saw winds of 48 mph. By 9 AM on the 19<sup>th</sup>, Indianola was inundated. In Galveston, storm warnings were hoisted but the flag was blown away. The city saw more than six inches of rain, along with coastal flooding. High seas caused the coal barge *Orient* to drift free of its tugboat and wedge into the Gulf bottom. Four on the barge died.

**June 14<sup>th</sup>, 1886:** Two tropical cyclones made landfall that season near the Sabine River. The first, a strong tropical storm, caused inundation to extend several miles inland, worst at 10 AM. Galveston had barely recovered from a fire seven months before. It was considered their worst storm since 1875. Winds began briskly out of the northeast early that Monday morning, shifting to the south at speeds greater than 50 mph. The pressure fell to 29.43". Galveston Island was submerged. Damage was scattered in nature. Cottages were swept away, railroad tracks were undermined, and a large number of sloops and yachts fell victim. The tug *Idler* was wrecked during the storm.



Winds were considered worse at Sabine Pass. Telegraph poles were thrown several hundred yards. Seven feet of water overwhelmed the town. Five to six miles of railroad track was washed away. All the wharves disappeared. Several buildings were leveled. One man helped others escape the area, despite water up to his neck. One life was lost, a ferry man, during the storm.

## **Last Indianola Hurricane - The Loss of One of Texas' Major Ports**

The city of Indianola was founded on the west shore of Matagorda Bay in 1844. Immigrants from Germany, Switzerland, and France led to its establishment. After going through several rough years as an immigrant camp, homes were built. The city's burgeoning trade with the West led to the town's prosperity...even though the hurricane of 1875 dampened some of those hopes. The summer of 1886 was a hot and dry one, with below normal rainfall for 14 months. When cloudiness rolled in on the 18<sup>th</sup>, people were eager for rain. However, a strong east wind set in, causing blowing sand and dust to envelop the region.

**August 18-20<sup>th</sup>, 1886:** Indianola suffered its fatal calamity from a hurricane, only 11 years after the last major storm swept through the area. Winds increased throughout the night of the 19<sup>th</sup>. Matagorda Bay began to invade the city by daylight on the 20<sup>th</sup>. The wind increased to 72 mph before the Signal Office building collapsed; the observer was killed by a falling timber during his attempt at escape. A lamp in the office burned down the building, along with more than a block of neighboring buildings on both sides of the street, despite the heavy rain. Although the storm was of shorter duration than the one in 1875, winds were considered higher. A storm surge of 15 feet inundated the region, covering the base of the Matagorda Island lighthouse with four feet of water. A large schooner was carried five miles inland (Malsch).

The town was a "universal wreck;" not a house that was left standing was safe to dwell in. Buildings that survived the 1875 storm were destroyed. Houses, carriages, personal property, and



dead animals were strewn along the coastal plain. About two and a half miles of railroad track was washed away, not to be rebuilt. The village of Quintana, formerly the sister city of Velasco and also located at the mouth of the Brazos River, was almost entirely swept away. Despite Texas legend and according to the Houston Post, Indianola was not totally abandoned after this storm, as the next storm in this history shows. However, most people in town permanently left for the greener pastures of Victoria and San Antonio.

In Galveston, winds were “furiously from the southeast” at 10 AM on the 19<sup>th</sup>, causing area sand to reduce visibility to near zero (Houston Post). Winds increased until 5 PM, and remained high until noon on the 20<sup>th</sup>, peaking at 50 mph at 10 AM. Houses careened in the storm surge after midnight. Wires and trees were downed, bridges were submerged, and communication was cut off. In Houston, winds increased to gale force at 9:30 AM on the 19<sup>th</sup>. The height of the bayou rose 5-6 feet during the storm.

In Victoria, the worst of the storm occurred at 5 AM on the 20<sup>th</sup>. An eastbound train was blown over. Two churches were damaged beyond repair; six were heavily damaged. Very few buildings escaped the hurricane unharmed. At Rockport, 6 or 7 houses were leveled along with Temperance Hall and Fulton’s cistern factory. Many homes in Beeville were damaged. A couple trying to cross the swollen stream near Floresville were swept downstream, and one of the pair perished. Cuero reported a considerable loss. Several houses were destroyed at Edna. Corpus Christi saw winds of 75 mph out of the northwest, drying up the bay for two hours, leaving boats “high and dry”.

It was considered the worst storm ever in much of interior Southern Texas. Goliad had numerous homes unroofed. La Grange had considerable damage to fruit and cotton. Weimar saw two churches leveled and great destruction to corn and cotton. Throughout Bexar county, cotton was in ruin; its Methodist church was also destroyed. In south-central Texas, damage was considerable. The storm continued northwest and caused a gale to blow at 10 AM on the 20<sup>th</sup>...with the center of the system over San Antonio at 2:40 PM. Winds increased to near 80 mph and the lowest pressure observed was 29.03." Damage at San Antonio alone totaled \$2.5 million. At New Braunfels, the International freight depot was destroyed.

One of the most positive aspects of the tempest was the rain it brought. A serious drought had developed across the region. In Galveston, water was being sold for 10¢ a bucket, twice the going rate for beer. It was so bad at Corpus Christi that residents had to give water to the poor, lest they die of dehydration. The drought was considered broken at Stephenville. Heavy rains led to flooding of streams in central Texas.

A number of ships met their fate off Galveston. A large schooner went on a rampage and broke through the Santa Fe bridge, pushing the train into the angry seas. The schooner *Livonia* capsized just off the sand bar in 6 fathoms of water. The *J.W. Perry* foundered fifteen miles offshore. Around 30 people died and total damages were estimated near \$3 million.

Preceding this disaster, Indianola had been Texas' leading port of call. Due to the major destruction to the infrastructure, Galveston reaped the benefits, thereby becoming Indianola's successor. The winds of change would blow again around the turn of the century.

**September 22-24<sup>th</sup>, 1886:** The battered Texas coast was struck again, this time at Brownsville. This was a fairly large sized storm, accompanied by a significant amount of rain as nearly 26 inches (25.98") fell at Brownsville. The 11.91" that fell on the 22<sup>nd</sup> set a 24 hour rainfall record for the month of September. Very heavy rain fell west of Victoria. The 2.66" of rain which fell at Galveston on the 24<sup>th</sup> was enough to establish a daily rainfall record.

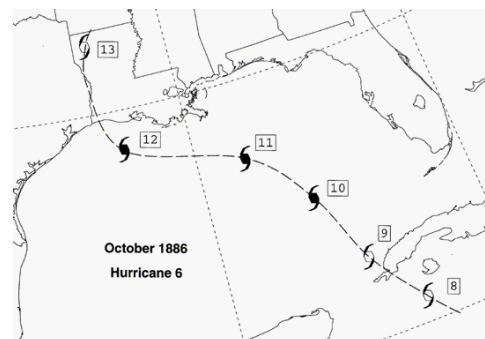
Indianola was again in peril. Before winds increased fully, reaching 60 mph by 6 PM, waters flooded the area from Matagorda Bay for the second time in five weeks, waist deep by noon. Almost all persons from there evacuated, many in boats, except for one family. Due to the mass exodus from the area, the post office at Indianola was closed in October 1887, officially signaling the end of the town.

The cast-iron Matagorda lighthouse was battered by the powerful storm. The tower shook so hard that part of the lens was smashed onto the floor of the lantern. Everything in its vicinity, outside of the lighthouse and the keeper's quarters, was swept away by the storm surge (Roberts). Victoria also saw gale force winds that evening. The railroad track between Edna and Wharton was underwater for a twenty-mile length, due to excessive rains. After the hurricanes of 1886, the region around Matagorda Bay sank into an economic depression that would last more than fifty years (Malsch).

Near Abbott, a tornado touched down three miles west of town. People watched in awe as the twister unroofed a barn and plowed harmlessly through a corn field before lifting back into the clouds. Its width was only a couple hundred yards. In Galveston, winds increased out of the east to 25 mph at 7 PM. The railroad track was buried in sand. Only slight damage occurred.

**October 12-13<sup>th</sup>, 1886:** This second hurricane to affect the Upper Texas coast proved much more devastating. At Galveston, winds reached 50 mph, causing the Gulf to invade the island. Little, if any, damage was seen there. At Orange, trees were downed and the Catholic Church was leveled.

Sabine Pass, at the time a small city of several hundred, was "virtually swept out of existence." The full fury of the storm raged during the afternoon of the 12<sup>th</sup>. The winds began out of the east and became southerly with time. By 5 PM, winds reached 100 mph. All rail and wire communication from Beaumont was severed for 48 hours, limiting the truth of the devastation to be known in real-time. Waves 20 feet high rolled in from the Gulf. Nearly every house in the area was removed from its foundation, including a hotel with 15-20



people inside, which was washed out to sea.

Ten to eleven miles of railroad track was damaged. Furniture was strewn along the coast. One hundred two people perished in that city alone. Thousands of dead cattle, hogs, horses, and fowl laid everywhere after the storm. A huge schooner loaded with 300 tons of Mexican mahogany was deposited five miles inland of the beach. The schooner *Henrietta* went ashore and was considered a total loss. The schooner *Silas* was shoved across the railroad track, out onto the prairie.

Johnson's Bayou and Sabine Pass were overwashed by the storm surge of up to seven feet, which extended 20 miles inland. A woman crossed Sabine Lake on a feather mattress during and after the storm. She was without food for 40 hours before making her final landfall. Due to the totality of the destruction seen across southwest Louisiana from this hurricane, Beaumont and Orange engaged in their largest relief effort up to that time, raising \$50,000 for 1200 survivors of the storm.

**September 21<sup>st</sup>, 1887:** This cyclone eyed the battered Middle Coast before turning west. Brownsville saw its second hurricane in as many years. Winds were observed out of the north as high as 78 mph. The pressure fell to 28.93" and stayed below 29 inches for several hours. Subsequent flooding from the 36 hours of rain invaded low areas, damaging crops. Fourteen sailors were lost at sea.

In Galveston, three days of wind were seen as fringe effects from the storm; as high as 36 mph between 8 and 9 PM at the observation site and 50 mph along the immediate coast. Water only invaded low areas on the island. Corpus Christi fared well, only experiencing a northeast gale, but no damage.

**June 16-17<sup>th</sup>, 1888:** The upper Texas coast was struck by this hurricane. Corpus Christi saw their pressure fall to 28.72" and three inches of rain. At Galveston, 6.40" of rain fell on the 17<sup>th</sup>, setting a daily rainfall record.

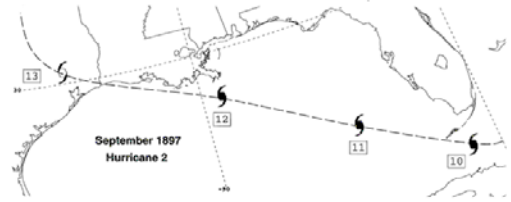
**July 5<sup>th</sup>, 1888:** A second hurricane hits Galveston, making eight tropical cyclone landfalls in three seasons for the battered Texas coast. Corpus Christi saw two inches of rain from the system.

**July 5<sup>th</sup>, 1891:** A hurricane formed in Bay of Campeche on the 3<sup>rd</sup> and made landfall near Sabine Pass on the 5<sup>th</sup>. It affected the entire coast; part of Galveston was inundated.

**August 29<sup>th</sup>, 1895:** This hurricane moved through Caribbean and Gulf of Mexico before making landfall 80 miles south of Rio Grande on the 29<sup>th</sup>. The town of Abasola in Mexico was totally washed away. The nearby town of Rodriguez no longer had a house standing. Corpus Christi saw 75 mph winds; trees and houses were blown away. Rockport experienced a severe gale for 36 hours, building high tides not seen since 1883. Velasco had winds of 40-50 mph,

heavy rain, and a 3-4 foot storm surge. The tide was high enough at Galveston to flood several blocks of the city.

**September 12-13<sup>th</sup>, 1897:** A minimal hurricane moved into extreme southeast Texas from Louisiana. The pressure at Galveston fell to 29.58". At New Sabine Pass, water was six feet deep; only 2 buildings were left intact. Sabine Pass had 3 ½ feet of water in its streets. Port Arthur was nearly wiped out. Winds began blowing a gale there at 10 AM. By 2 PM, Sabine Lake had become a "seething, rolling body of water" (Houston Post). By 6 PM, winds reached hurricane force. The air was filled with flying boards and timber. Conditions improved after 9 PM. Hardly a building escaped unharmed. The newly completed pier was washed away, as well as miles of railroad track in Jefferson County.



In Winnie, every house in town saw damage. Every rice farm in Taylor's Bayou was leveled. Winnie reported a \$12,000 loss to its rice crop. The storm raged until midnight in these locations. Burnet set a 24 hour rainfall record for September when 3.17" of rain fell. In Beaumont, winds were high between 6 and 11 PM. The Baptist Church in Beaumont was demolished. Two dozen buildings, including the large new Kansas City Southern railroad depot were totally destroyed.

Telegraph and telephone lines were downed. It was considered the worst storm at Orange since 1875. Roofs were blown off, trees uprooted, and windows were smashed. Homes in Liberty County suffered as well. Cotton was in jeopardy across much of eastern Texas. In Galveston, sections of roof were peeled off Olympia.; its third floor caving in. Smaller ships in the Bay perished in the high seas. The steamer *Umbreland* was delayed getting into port at Corpus Christi due to high seas.

A frightening Union Pacific train ride occurred during the storm between Beaumont and Devers, heading westward towards Houston. Its headlight was torn away, the smoker's roof was sheared away by the wind, and the ladies coach was twisted. The train only ended up being an hour and 20 minutes late. The bark *Ceries* and the tug boats *Fannie*, *Florence*, *Guillotte*, and *John P. Smith* met their fate. Looters invaded the area, but quickly left when threatened with hanging. Sea gulls were blown inland as far as Bryan. Six died at Port Arthur, three offshore, four in Sabine Pass, and sixteen others perishing at Beaumont; damage totaled \$150,000.

**June 27-30<sup>th</sup>, 1899:** A tropical storm moved off the Gulf of Mexico on the 27<sup>th</sup>. Torrential rains fell over the Brazos River basin from Granbury and Waco south to the coast. Between ten and twenty inches fell between Temple and Palestine. At Hearne, in Robertson county, the rain gage overflowed at 24"; the observer estimated

Twenty-four hour rainfall records set for June during this storm

Brenham	29 <sup>th</sup>	8.76"
Hewitt	29 <sup>th</sup>	8.10"
Danevang	28 <sup>th</sup>	8.00"
Temple	27 <sup>th</sup>	6.65"
Panter	28 <sup>th</sup>	3.75"
Lampasas	28 <sup>th</sup>	3.45"

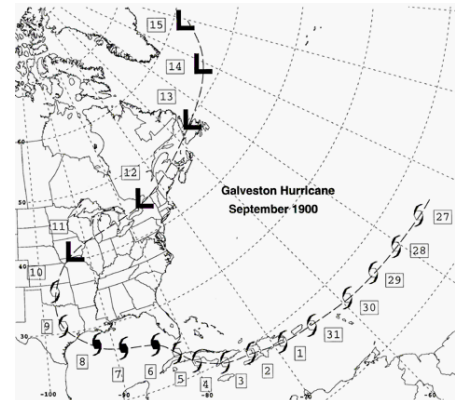
that over 30" fell. The flood on the Brazos was the worst since 1852. At Waco, it compared to the Flood of 1885. Farm equipment and tenant houses were washed away. The town of Quintana, at the mouth of the Brazos river, was nearly swept out to sea (Guthrie). Ten million dollars in damage occurred. Twenty-four people perished in Robertson county alone.

## The Great Galveston Hurricane -

### The Last and Worst Hurricane of the Nineteenth Century

The question from the Racer's Storm was tragically prophetic as the Great Galveston Hurricane showed on **September 7<sup>th</sup>, 1900**. It towers alone as the worst natural disaster in the United States in terms of lives lost; the most frequently used estimate of the death toll is 8,000. The potential of this disaster had been shown in the destructions of Santiago in 1844, Clarksville/Baghdad in 1867, and Indianola in 1875 and 1886. At the time, the population of Galveston was near 30,000. Most of its structures were of wood frame, built just above ground level and supported by pilings.

A new innovation helped relay details about what the storm did in the Caribbean Islands; it was known as the wireless telegraph. Word had been received of a hurricane which had struck Trinidad and destroyed almost all the structures on that island. Word of the storm's passing over Cuba and moving northwest into the Gulf in the direction of Texas had been relayed to the local weather office in Galveston Island. Sailors began to arrive in the port telling of nasty weather offshore.



On the 6<sup>th</sup>, a hurricane watch was posted along the

Gulf Coast, westward to New Orleans. Winds began to increase as high, fish-scale shaped clouds (altocumulus) began to move inland. By the next day, the hurricane watch was extended west to include Texas. Driving rain began at 4 AM. Large waves began to pound the shores of Galveston Island. The pressure began to fall rapidly at the Weather Bureau station. This caused them to hoist a Hurricane Flag - their version of a hurricane warning. This action caused about 20,000 people to evacuate, a move that saved many lives.

Yet a number of people ignored the warning. Gentry from Houston rode out to the island via train to witness the huge waves first hand. Through the morning of the 8<sup>th</sup>, greater and greater numbers of people crowded the beaches. Isaac Cline of the Weather Bureau could not believe what was happening. He took matters into his own hands and rode with his brother down the beach in a horse-drawn buggy, warning people to go back to the mainland - in effect, making him a modern day Paul Revere. Unfortunately, few listened. The weather, however, changed their

minds as a wooden pagoda along the beach and its associated boardwalk became mere driftwood before the crowd's eyes. Then they began to disperse. For many, it turned out to be far too late. A steamer broke free of its moorings and went on a rampage, destroying all three bridges to the mainland.

Winds of 100 mph blew away the anemometer at the Weather Bureau. The pressure fell to 28.44". Winds gusting over 125 mph sent raging waters covering Galveston Island by 15 feet just before midnight, with additional waves much higher on top of the storm surge. As flood waters rose, people fled towards the center of the island, which had slightly higher ground. This turned out to be fruitless, as it merely delayed the inevitable. The force of the wind sent boards, chairs, and tree limbs sailing through the air. Pebbles and shards of glass became deadly missiles. When the water began rising, Harry Claiborne, keeper of the Bolivar Point Lighthouse, fled to the safety of his workplace. People soon after began pounding on the door, begging entry into the sanctuary of the lighthouse. The tower was soon crammed with 124 people, many of which were from a train stranded in the rising waters. After a while, the big door to the lighthouse was hidden under four feet of water. The lighthouse survived the storm (Roberts).

Wooden buildings floated off their pilings and smashed into one another. As houses disintegrated, unfortunate occupants were thrust into the water to drown. In all, more than 2600 houses were demolished. The picture to the right shows the devastation which occurred to Galveston, provided by



the Galveston County Daily News. Twelve square blocks, 3/4 of the city, were completely wiped out. All bridges across the bay were destroyed, along with 15 miles of railroad track. All communications with the mainland were lost. Vast quantities of rain fell, with Galveston (10") and Brazoria (10") setting 24 hour rainfall records for September.

The British Freighter *Kendall Castle* was moored offshore. Several ships were driven against it. But it was when the Norwegian freighter *Guller* nudged against the *Castle* that it was sent on a "wild ride" over the Halfmoon Shoal lighthouse, pounding it into the sand, on its way to Texas City (Cipra). Very little damage was seen at Sabine Pass, which shows how small the core of this storm was in areal extent.

However, fewer than 2000 of those remaining on the island survived. The weather office chief survived, but his wife drowned. Bolivar Point Lighthouse became the center of relief activities after the storm. The lighthouse over the ensuing days let people in the area know that at least one thing still worked on the island, as it helped storm-battered ships return to shore. Martial law was declared. Looters were shot on the spot.

The old first capitol building of the Republic of Texas at West Columbia was destroyed. Mustang Island also saw many bodies littering the beach. Alvin saw 8.05" of rain fall on the 9<sup>th</sup>, setting a 24 hour rainfall record for September. Quintana was partially abandoned, after being

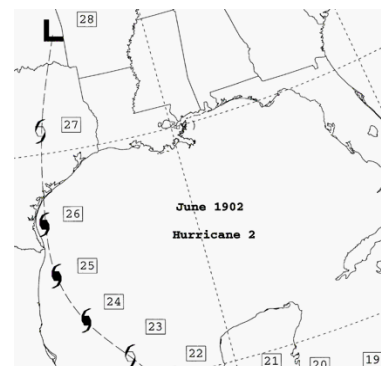
seriously harmed by both the 1899 Flood and this hurricane. Corpus Christi had a stiff northeast breeze, but exceptional fishing. In Flour Bluff Harbor, millions of red, trout, and mullet infested the waters, in their avoidance of the hurricane. Local residents feasted on the tarpon and helped out Galveston with over \$1000 for food and clothing. The storm accelerated after moving inland, racing north to the Great Lakes while still packing 70 mph winds. The low then moved across Canada, the North Atlantic, and Northern Europe before finally dying in Siberia. Thirty million dollars in damage occurred.

A massive public works project was then undertaken to raise the Galveston's elevation and build a three mile long, 17 foot high, concrete seawall. This has, to date, prevented a tragedy of such proportions from occurring in Galveston. The city never quite regained its importance as a port, due to the construction of the Houston ship channel, similar to the fate of Indianola fourteen years before. As population swells along the coast, construction expanded into areas not protected by the seawall. Those that have not learned from history are doomed to repeat it.

## Hurricanes of the Early Twentieth Century

**June 26-July 1<sup>st</sup>, 1902:** A tropical storm was noticed off the northern coast of Nicaragua on the 18<sup>th</sup>. It moved west-northwest into the southern Gulf of Mexico, before turning northwest on the 22<sup>nd</sup>. The storm became a hurricane about 100 miles off the coast of Tampico on the 24<sup>th</sup>, then took on a more northerly track, grazing the length of Padre Island before it struck Port Lavaca. Texas had gone six weeks without rainfall, and area crops were beginning to fail. For the corn crop, it was too late. Withered stalks were easily blown down by the wind. Cotton and rice, in general, were helped out greatly by the storm, to the tune of several million dollars.

On the night of the 26<sup>th</sup>, a high southeast wind was seen at Galveston, with gusts up to 65 mph at 3 AM on the 27<sup>th</sup>. A freight train was blown down from the track between 8 and 9 PM at East Bernard, as a tornado touched down in Wharton County. This twister moved northeast to sweep through Krasna, near Wallis, killing five. A severe sand storm blasted Franklin, in Robertson County. At El Campo, fruit was whipped off trees. Windmills and chimneys were the main casualties in Edna. Louise and Ganado saw outhouses and barns leveled. Bathing piers were demolished in La Porte. Morgan's Point was three feet under water. Corpus Christi saw 36 mph winds, on the weaker west side of the system.



Heavy rains were common with this large cyclone. At Galveston, 5.54" of rain fell on the 27<sup>th</sup>, setting a daily rainfall record. Greater than six inches of rain, accompanied by gale force winds,

hit La Porte. Over 100 tons of hay was ruined west of town. Alvin saw 50 mph winds and 8.04" of rain on the 26<sup>th</sup> alone. Rock Island reported more than six inches. Wharton set a 24 hour rainfall record for June on the 27<sup>th</sup>, when 6.20" of rain fell. In Houston, trees were uprooted and outhouses destroyed by the gale. Electric wires were downed. Navasota also had a stiff gale. Lavaca County had trees uprooted and damage to its sorghum crop.

Inland sections of east Texas endured flash flooding. Nacogdoches saw 14.22" of rain in a 24 hour period on the 28<sup>th</sup>, setting a 24 hour rainfall record for June. This swelled Lanana and Bonita Creeks. All bridges were swept away and communication was cut off to the outside world. The south side of town was underwater. In Greg and Harrison counties, heavy rains washed out the Texas and Pacific railroads. Flooding occurred across the upper Sabine basin as well. The area between Lanana and Lufkin was described as a "perfect sea".

This storm continued north and wreaked havoc across the central United States as a non-tropical low on the 28<sup>th</sup> and 29<sup>th</sup>. Heavy rain fell across Missouri. Tornadoes were seen in Indiana. A four-day long rain event soaked Nebraska and kept their temperatures in the 50's. And a unique event happened in Denver - the storm in the Plains set up a cold and moist easterly wind which caused a rare late June snowstorm; eight inches fell in all.

**July 21-22<sup>nd</sup>, 1909:** A storm was noted entering the eastern Caribbean on the 13<sup>th</sup>. It moved towards the west-northwest, passing over the Isle of Pines on the night of the 17<sup>th</sup>. The steamship *El Siglo* struggled for twelve hours on the 19<sup>th</sup> against the estimated 90 mph winds near 26.1N 87.3W in the southeastern Gulf of Mexico. The westerly storm motion continued, and on the 21<sup>st</sup> it made landfall near Velasco. Only eight buildings remained standing after the storm's passage. The calm of the eye passed over the city for 45 minutes.



Winds gusted to 68 mph at Galveston at 10 AM. The strongest winds were noted at Port Arthur, East Bernard, and Nottawa between 3 and 4 PM. Richmond gusted to 60 mph during the storm that afternoon. Austin and Eagle Pass saw windy weather around midnight, with the latter having gusts to 80 mph and trees defoliated. A severe gale raged at Cameron, Texas overnight as well. El Campo also had high winds.

At numerous sites across southeast and central Texas, trees were uprooted; corn, rice, sugar cane, and cotton crops were crippled; and numerous lines were downed. Fruit was lost at Eagle. At Bay City, the pressure fell to 29.00" at 2:30 PM. The pressure bottomed out at 29.56" in Galveston towards noon. The cities of Quintana, Columbus, and Columbia were totaled; all houses experienced severe damage.

Twenty-four hour rainfall records set for July during this hurricane		
Boerne	22 <sup>nd</sup>	6.50"
Fredericksburg	21 <sup>st</sup>	6.15"
Columbia	21 <sup>st</sup>	5.00"

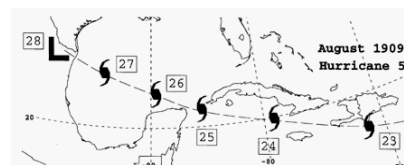


Trains were blown off tracks on top of the Galveston Jetty and Rosenberg. A caboose was thrown thirty feet from the tracks at Brazoria. Considerable damage was experienced at train stations between Houston and Corpus Christi. The train depots at Allenhurst and Brazoria were leveled by the wind. Homes and businesses met their fate at Nottawa, East Bernard, Eagle Pass, Angleton, Blessing, Palacios, and Wallis. Houses were unroofed at Austin, where it was the worst storm in memory, and at Richmond, where it was the worst since 1900. Barns were disposed of easily by the wind in Richmond and Alvin. Windmills were destroyed at Alvin, smoke stacks fell at Richmond, and rice mills were downed at Eagle Pass.

This system was also an efficient rain maker. Five inches fell at Lockhart, four inches of beneficial rain was measured at Nacogdoches, while Eagle and Austin had three inches. Heavy rain was also seen at Brazoria, Allenhurst, and Crosby (where it was needed the most).

The storm surge was as high as twenty feet at Velasco, ten feet at Galveston (where five of the fatalities occurred; none were behind the seawall), and 6.5 feet at Sabine Pass. Tides were above normal at Orange as well. Oil derricks at Sour Lake were blown down. Lower portions of Port Arthur and much of Sabine Pass and Virginia Point were underwater, but not to a “dangerous depth”. Eighty percent of cattle on the west end of Galveston Island were drowned. Numerous bathhouses and piers were in ruin in Galveston, La Porte, and Jennings Island. The derrick barge *Miller*, among other craft, were driven aground at West Bay near Galveston. The *Miriam* was sunk by a submerged log near Galveston. The schooner *Ed Gibbs* was dashed to pieces at La Porte. Property damage was estimated at 2 million dollars and 41 lives were lost.

**August 27<sup>th</sup>, 1909:** On the 21<sup>st</sup>, a storm was seen east of the Virgin Islands. It tracked westward just south of the Greater Antilles. Many houses were wrecked at Mole St. Nicholas, Haiti by the high easterly gales. Havana had northeast winds of 60 mph on the 24<sup>th</sup>. As the storm passed through the Yucatan Channel, the captain of the ship *S.S. Cartago* sent a wireless



message to New Orleans, giving an account of the estimated 100 mph winds he had sailed through. This was the first wireless message to be sent out in real-time from a ship at sea during a tropical cyclone. On the 26<sup>th</sup>, a vessel 100 miles southeast of Galveston reported stiff northeast winds and heavy seas. Tides rose to three feet at Galveston, as winds blew from the east northeast at 24 mph. The tug Higgins saw 45-50 mph winds and seas were “mountain high.”

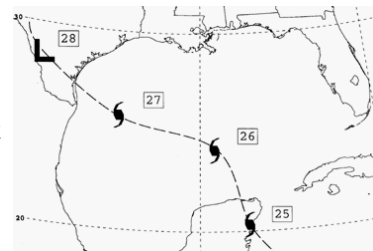
As the system approached the Mexican coast, gales and tremendous seas were experienced along the lower Texas coast; some sites experiencing their highest tides in many years. At 3:30 PM, a tornado struck one mile northwest of Beeville. A large barn and an outhouse were reduced to shreds of lumber. It traveled 250 yards, and was 100 yards wide. At Corpus Christi, winds gusted to 66 mph. At Tarpon Beach, every building except the lighthouse and quarantine station were destroyed by the storm surge. A lifesaving crew from Brazos Santiago rescued all persons on Tarpon Beach, when it was being inundated by the rising Gulf. Wreckage washed ashore at Point Island, three miles away. Point Isabel was underwater as winds blew at a rate of 50 mph.

Portions of Mustang and St. Joseph islands went underwater and several houses fell victim to the wind and waves. It rained heavily in La Parra....5.85" on the 27<sup>th</sup> set a 24 hour rainfall record for the month of August. Torrential rains were also seen at Brownsville.

About 1500 people perished in Mexico as a result of floods along the Santa Catarina river caused by 22 inches of rain over a 96 hour period. The resultant flooding made for a national disaster in the northeastern section of that country. The Santa Catarina went way out of its banks, washing people and homes away. Adobe homes melted into mud, trapping their unfortunate occupants inside. The old San Francisco church, built in 1572, perished during the storm. Matamoros saw winds howl to 90 mph. There were no reports of deaths in Texas with this cyclone.

**September 14<sup>th</sup>, 1910:** A hurricane struck the lower Texas coast. Padre Island was totally submerged during landfall. Southern sections of the Island saw the pressure fall to 28.50" and 120 mph winds. In Marlin, high winds, heavy rain, and hail damaged windows and leveled small frame buildings. Winds of 60 mph at Corpus Christi blew down several homes, and the city received 4.96" of rain. Twenty-four hour rainfall records were established for the month of September at Brighton (6.83"), La Parra (7.75"), and Sarita (7.75"). Heavy rains in the Rio Grande valley swelled the Rio Grande and San Juan rivers until they overflowed Camargo, where the river rose 17 feet.

**October 16-17<sup>th</sup>, 1912:** Winds of 55 mph howled through Brownsville as a hurricane made landfall in the sparsely settled area between there and Corpus Christi. Heavy rain also accompanied the storm. Twenty-four hour rainfall records were broken for October at Brownsville (6.34") and Raymondville (4.90") on the 16<sup>th</sup> while Marble Falls experienced a 4.60" deluge on the 17<sup>th</sup>. The steamship *Nicaragua* was wrecked 80 miles down Padre Island. Two of the ships boilers can still be seen today.



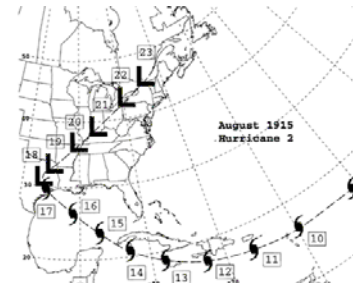
**June 27-July 2<sup>nd</sup>, 1913:** Greenville saw a flash flood associated with a hurricane which originally made landfall near Corpus Christi on June 27<sup>th</sup>. Montell, in Uvalde County, received 20.6" of rain in only 19 hours. The flood peaked at 4 PM, reaching as high as three to four feet inside area homes. The storm surge reached 12.7 feet at Galveston. Over \$1 million in damages occurred.

Twenty-four hour rainfall records set for June and July during this storm		
Montell	28 <sup>th</sup>	20.60"
Uvalde	28 <sup>th</sup>	8.50"
Crosbyton	30 <sup>th</sup>	5.78"
Lamesa	29 <sup>th</sup>	5.72"
Greenville	3 <sup>rd</sup>	5.70"
Tahoke	30 <sup>th</sup>	5.12"
Post	29 <sup>th</sup>	3.90"

**August 16-19<sup>th</sup>, 1915:** A monstrous hurricane formed near the Cape Verde Islands on the 4<sup>th</sup> and moved just south of the greater Antilles, to reach the Texas coast near Galveston on the 16<sup>th</sup>. It was a storm of great diameter. In Galveston, many people, with memories of the 1900 hurricane still fresh in their minds, fled for the hills. It was said to be as strong of

a storm and lasted for twice as long. Winds reached 120 mph out of the east at 3 AM on the 17<sup>th</sup>...the pressure fell to 28.66". Storm surges of 12 feet overwashed the island, inundating the business district to a depth of five or six feet. Many houses were demolished and all beach front bathhouses were washed away.

At Port Arthur, windy conditions set in on the morning of the 16<sup>th</sup>. Both the wind and rain increased rapidly during the afternoon. At 9:30 PM, area power was out and people were seeking higher ground. At 2:30 AM, Sabine Lake invaded the city as winds increased to an estimated 90 mph. All first floor structures were flooded by noon on the 17<sup>th</sup>. Proctor Street was deluged with eight to ten feet of water. All but one oil derrick in the Sour Lake Field collapsed. The winds abated after 5 AM. Sabine Pass saw an eleven foot tide. A 50,000 barrel oil tank was shoved inland to Nederland (Block). Total rain was 7.69". Six died at Sabine Pass and three died at Beaumont. This storm led to a locally-sponsored seawall, which was constructed during the 1930's to prevent such another such loss from a tropical cyclone's storm surge.



The Bolivar Point lighthouse, near Galveston, became a refuge for sixty people during the hurricane. The oil supply for the light was carried away by the storm surge. This caused a two day outage of the light during the critical period following the storm (Roberts). A four-masted schooner named *Crockett* was blown over the seawall while dragging her anchors. The cistern of the Redfish Bar light was torn away. The superstructure of the Galveston Jetty light was damaged. Within days, the city began to recover. A storm surge of 15.3 feet above mean low gulf was noted at Virginia Point; its hotel was claimed by the high Gulf waters. The Trinity Shoals buoy, weighing 15 tons including the chain, was dragged ten miles west of its prior location.

Velasco had the pressure fall to 28.14". Houston reported winds of 62 mph. As the storm slowly moved northeast, it regained strength across Missouri, becoming nontropical. High winds and heavy rains spread into the Ohio Valley thereafter. Despite ample warnings from the Weather Bureau 24 hours in advance, 275 people died in the storm (only twelve died in Galveston, with no one behind the seawall taken victim). Damage was estimated as high as fifty million dollars.

**The Coastal Bend** had felt protected from the worst hurricanes in its early history. Corpus Christi, with its high bluff and the protective barrier island, felt particularly secure. Quickly forgetting the Hurricane of 1874, local newspapers in 1886 referred to Corpus Christi as “the only really safe place on the Texas coast.” An article in 1909 continued to sing praises as “the oldest inhabitants cannot recall a storm of sufficient severity to alarm even a timid woman” and “nine-tenths of the area of Corpus Christi is on a bluff 30 feet high, probably the safest point in saltwater America,” or so they thought.

Beaumont	16 <sup>th</sup>	7.02"
Hillsboro	18 <sup>th</sup>	7.00"
Waxahachie	18 <sup>th</sup>	6.95"
Anderson	17 <sup>th</sup>	6.68"
Rockland	17 <sup>th</sup>	6.40"
Mexia	18 <sup>th</sup>	6.12"
Corsicana	18 <sup>th</sup>	5.95"
Crockett	17 <sup>th</sup>	5.48"
Lufkin	17 <sup>th</sup>	5.30"
Palestine	17 <sup>th</sup>	5.16"
Grapevine Dam	17 <sup>th</sup>	5.06"
Greenville	18 <sup>th</sup>	5.00"
Trap	17 <sup>th</sup>	4.55"
Crossing	18 <sup>th</sup>	4.15"
5 NE Naples	18 <sup>th</sup>	4.00"
Riverside	17 <sup>th</sup>	4.00"
Paris	18 <sup>th</sup>	3.85"
Salado	17 <sup>th</sup>	2.65"

**August 18-20<sup>th</sup>, 1916:** On the 12th, a storm formed east of the Windward Islands and sped through the Caribbean and the Gulf with an unusually rapid motion. During the morning of the 18<sup>th</sup>, the Corpus Christi office warned it would strike between there and Brownsville. An evacuation was ordered by the mayor. Ironically, many visitors to the area were trying to evade Galveston, due to the hurricane the year before. Refugees fled to sturdy buildings away from the waterfront. It reached the coast near



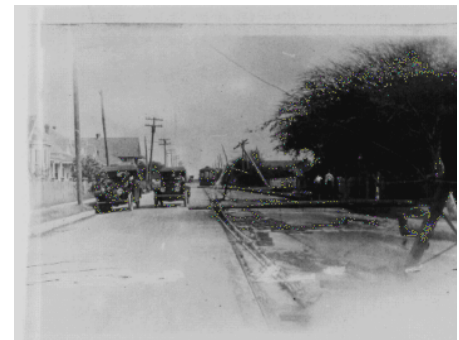
Corpus Christi. The winds were very destructive but the storm moved too rapidly to form an excessive surge.

Winds increased to 22 mph at 7 AM the 18<sup>th</sup>. Rain began by 7:45. Winds became squally around 9:30. Winds gusted to 70 mph by 1:53 PM and debris was flying. The wind instruments there were destroyed at 6:30. Maximum sustained winds were estimated to 90 mph between 7 and 9 PM; the highest gust estimated was 100 mph. Gusty winds continued until noon the next day. The pressure bottomed out at 29.07". Below is an image of the some of the damage produced at Corpus Christi from this storm, used with the permission of Mike Coyne, formerly of the Corpus Christi forecast office.

At Kingsville, the pressure fell to 28.00" at 8:15 PM on the 18<sup>th</sup>. As the center moved over Del Rio, pressures there fell to 28.69" at 7:30 am the 19<sup>th</sup>. Damage was strewn across a wide area. In the interior of Texas, crops were badly damaged by winds and heavy rain. Rainfall records set during this storm are listed on the left. Windmills and barns were blown down. Six lives were lost in the Rio Grande valley as hurricane-force winds blew through the region.

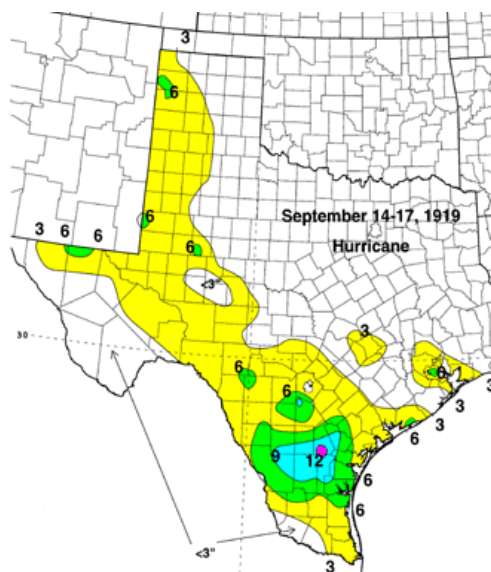
Harlingen	18 <sup>th</sup>	5.97"
Cotulla	18 <sup>th</sup>	5.50"
Encinal	18 <sup>th</sup>	5.50"
Brownfield	20 <sup>th</sup>	4.56"
Big Wells	18 <sup>th</sup>	3.75"
La Pryor	17 <sup>th</sup>	3.50"
Montell	18 <sup>th</sup>	3.45"
Rockport	18 <sup>th</sup>	3.00"

The storm surge demolished many boats and every pier in the Bay. Most of the damage was below the bluff with downed power lines everywhere. At the Aransas Pass lighthouse, the keeper's dwelling and all outbuildings fell victim. Six lives were lost by the foundering of the steamer *Pilot Bay* off Port Aransas. In all, twenty people died and damages were near \$1.8 million. The Corpus Christi Caller Times newspaper ran the headline "CORPUS CHRISTI DEFIES TROPICAL HURRICANE". This would prove to be short lived.



# Corpus Christi's Devastating Hurricane - 1919

**September 14-16<sup>th</sup>, 1919:** A severe hurricane formed just east of the Virgin Islands on the 1<sup>st</sup> of September. It gained much of its strength between Santo Domingo and the Central Bahamas, one of the favored areas for major hurricane development (track to right). The pressure at Key West fell to 28.81" as the storm passed by on the 9-10<sup>th</sup> ; gales were experienced for 26 ½ hours due to the storm's slow movement. The Sand Key Weather Bureau station was abandoned at 1 PM on the 9<sup>th</sup>. The anemometer was blown away as winds passed 84 mph and the pressure fell to 28.35" at midnight.



As it moved over the Dry Tortugas on the 10<sup>th</sup>, the pressure had dived to 27.51"...a nearby ship reported a pressure of 27.36". Ten vessels were lost in the Florida Straits, among them included a ship with 488 people on board. Gales began along the entire Gulf coast, yet the Weather Bureau had difficulty keeping track of it due to very few ship reports. Storm warnings were hoisted on the 11<sup>th</sup> for Texas. People from Galveston took no chances and prepared for the impending cyclone. Fish invaded the Corpus Christi Bay in great numbers that day. On the 12<sup>th</sup>, a ship about 300 miles south of New Orleans reported a pressure of 27.50"...and Galveston already had a storm surge of 8.8 feet!

Rumors had spread that the hurricane made landfall in Louisiana and Mississippi and the storm warnings were dropped. Even as the Bay became frothy early on the 14<sup>th</sup>, the Weather Bureau advised it would be smaller than the 1916 hurricane, and winds would only be 40 mph. Soon after, hurricane flags were put back up. Padre and Brazos Islands were quickly submerged. West winds of 40 to 50 mph swept the Lower Rio Grande valley, damaging a few buildings. Brownsville reported 4.75" of rain during the storm; see chart on the right for rainfall records set during this hurricane. Later that day, the storm moved inland 25 miles south of Corpus Christi while the storm continued its slow forward trek, putting

Twenty-four hour rainfall records set for September in 1919 storm

George West	15 <sup>th</sup>	12.00"
Alice	15 <sup>th</sup>	10.50"
Rossville	15 <sup>th</sup>	9.09"
Ricardo	14 <sup>th</sup>	8.85"
Encinal	15 <sup>th</sup>	8.25"
Beeville	15 <sup>th</sup>	8.20"
Runge	14 <sup>th</sup>	6.08"
Piersall	14 <sup>th</sup>	6.56"
Big Wells	14 <sup>th</sup>	6.25"
Montell	15 <sup>th</sup>	6.20"
Houston	14 <sup>th</sup>	6.15"
Matagorda	14 <sup>th</sup>	6.02"
Uvalde	15 <sup>th</sup>	5.70"
Midland	16 <sup>th</sup>	3.01"
Dalhart	16 <sup>th</sup>	3.00"
Romero	15 <sup>th</sup>	3.00"
Lamesa	15 <sup>th</sup>	2.90"
Smithville	15 <sup>th</sup>	2.79"
Plainview	16 <sup>th</sup>	2.76"
Fort Davis	15 <sup>th</sup>	2.44"

the city in the dreaded right-front quadrant of the system, where the highest winds and storm surges normally occur. Corpus Christi's number was finally up. Winds of 110 mph and a pressure of 28.65" were experienced. Storm surge there was sixteen feet.

Timbers from the docks at Port Aransas became battering rams, destroying buildings on their way inland. Residents on North Beach took an 18 hour trip across Nueces Bay, but it was no pleasure cruise. People clung to whatever they could find to survive the trip amongst ten foot waves. Fifteen hundred cattle were driven off Padre Island into the Laguna Madre. After the storm, the beaches were littered with debris and bodies, which were quickly buried in a mass grave near White Point. A ten foot storm surge along the Matagorda peninsula inundated the area, causing damage to agriculture.

The S.A.U.& G. railroad west of Odem was washed out. Summer houses in Victoria were leveled and the cotton crop was destroyed. An eight foot storm surge overwashed Sabine Pass. At Port Aransas, the steamship Media was lifted onto the docks. As the storm passed inland, San Antonio saw the pressure fall to 29.48" and winds southeast of 34 mph. Over 310 lives were lost. Heavy rains were experienced across much of Texas (see map above (after Ward & Grice)). Damage estimates were at \$20 million. During the storm's life, Miami, Burrwood in Louisiana, and Galveston all reported winds at least as high as 60 mph, indicating this storm's large size. This storm led to a breakwater off Corpus Christi in 1925, and ultimately to their seawall by 1940.

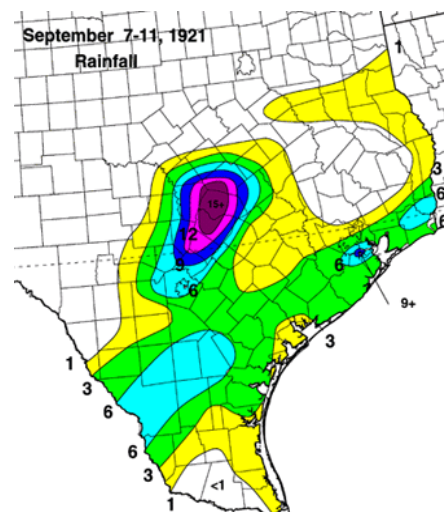
**June 21-23<sup>rd</sup>, 1921:** A tropical storm was born in the western Caribbean on June 14<sup>th</sup>. The storm entered the Gulf by the 19<sup>th</sup> and moved slowly north-northwest. On the night of the 21<sup>st</sup>/22<sup>nd</sup>, winds rose to 68 mph at Corpus Christi as the system moved by to the east. The center passed directly over Palacios, Wharton, and Wallis. At Houston, the pressure fell to 29.37". Winds reached 60 mph at Galveston and Houston. Heavy rains fell across southeast Texas; to the right is a list of rainfall records set in the cyclone. A government survey barge carrying 18,000 barrels of oil sank at Port Aransas. A tide of 7.1 feet invaded Pass Cavallo.

Twenty-four hour rainfall records for June set in June 1921 storm		
Matagorda	22 <sup>nd</sup>	10.10"
3 SW Edna	22 <sup>nd</sup>	10.00"
Austwell	22 <sup>nd</sup>	8.74"
Columbus	23 <sup>rd</sup>	7.71"
Sealy	22 <sup>nd</sup>	6.44"
Rosenburg	22 <sup>nd</sup>	5.41"
Hempsted	23 <sup>rd</sup>	5.26"
Navasota	23 <sup>rd</sup>	5.13"
Pierce	21 <sup>st</sup>	4.75"

## San Antonio's Great Flood - 1921

**September 7-11<sup>th</sup>, 1921:** Later that year, a tropical storm rapidly spun up in the Bay of Campeche. It progressed northwest into Mexico and crossed the Rio Grande. After passing

inland into Texas on the 8<sup>th</sup>, it could barely be identified as a cyclone, except for its associated deluge that drifted northward through Texas. At Taylor, 23.11" of rain fell in 24 hours. A new 18 hour rainfall record for the United States was set in Williamson County when 36.40" fell. Thrall reported nearly 40 inches of rain in total, 38.2" in a 24 hour period. The map to the right shows the rainfall accumulations throughout southern and central Texas related to this cyclone (after Tannehill).



Torrential rains accompanying the decaying system caused one of the most destructive floods in San Antonio’s history. The waters rose so rapidly (a flash flood) that automobiles were deserted and the occupants sought safety in high buildings. Nearly seven feet of water stood in the large hotels, theaters, and stores. In San Antonio alone, 51 lives were lost in the flooding and damage was estimated at \$5 million. The largest floods occurred on the Little and San Gabriel Rivers north of Austin and south of Temple. Along the Little River, at least 159 drowned. Total damages were estimated near \$19 million. In all, 215 died due to the flood in the five county area around San Antonio.

**June 15-16<sup>th</sup>, 1922:** The first tropical storm of the season formed in the western Caribbean on the 11<sup>th</sup>. It moved northwest across the Yucatan Peninsula on the 13<sup>th</sup> and made final landfall 100 miles south of Brownsville late on the 15<sup>th</sup>. As the system moved northwest parallel to the Rio Grande, unprecedented flooding occurred in northern Mexico and southern Texas. The floods were the highest on record.

**September 6-7<sup>th</sup>, 1925:** A hurricane formed in the Bay of Campeche and moved northwest into Mexico before crossing the Rio Grande with reduced winds. Winds gusted to 42 m.p.h. at Corpus Christi. Torrential rain was seen statewide. Grass on Padre Island was denuded by the storm surge.

**June 28<sup>th</sup>, 1929:** A very compact, but minimal, hurricane made landfall at Port O’Connor at about 4:30 PM on the 28<sup>th</sup>. Port Lavaca experienced 90 mph winds howl through town. The area of destruction was only 20 miles wide, and the lowest pressure reported was 29.12". Damage totaled \$675,000 and three were killed.

**August 13-14<sup>th</sup>, 1932:** A disturbed area of weather was noted near Belize and Honduras on the 10<sup>th</sup>. The system moved northwestward across the Gulf before intensifying rapidly about a day prior to landfall. A ship 200 miles southeast of Galveston radioed in a pressure of 28.88" on the morning of the 13<sup>th</sup>. The

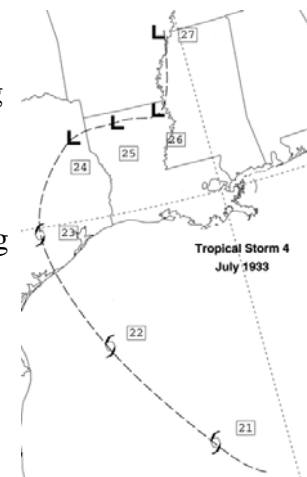
Twenty-four hour rainfall records for August set during 1932 hurricane		
4 NE Angleton	13 <sup>th</sup>	9.93"
Flatonia	14 <sup>th</sup>	6.73"
Matagorda	14 <sup>th</sup>	6.04"
Alvin	14 <sup>th</sup>	6.00"



center passed slightly east of Freeport and directly over East Columbia where winds were estimated at 100 mph with a lowest pressure of 27.83". In Galveston, telephone and electrical service were out for several days. Heavy rains fell near the coast; see the table above for records set during this hurricane. The storm was also very compact. Eight hundred birds in Wharton perished in the heavy rain. As the system moved northward into Oklahoma, twelve inches of rain fell. Forty died in Brazoria County and total damage was near 7 ½ million dollars.

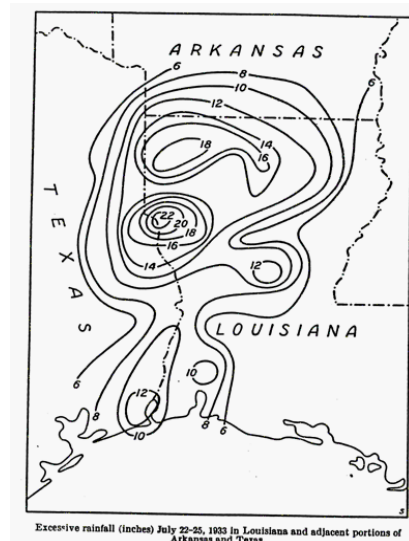
**1933:** The year when the Atlantic Basin woke up. After 1929 and 1930, which had 5 storms combined, subsequent hurricane seasons began picking up the statistical slack. This culminated in the 1933 season, where 21 storms formed. Only 1995 and 1969 come close to this amount of activity during a single season. Also noteworthy, seven of the systems made landfall between Corpus Christi and Tampico.

**July 6<sup>th</sup>, 1933:** The path to the first hurricane of the season was unique. The storm formed at very low latitudes in the Atlantic (8.8 degrees latitude) late during the month of June, moved south of Trinidad, scraped the South American coast westward to Venezuela, before moving north across western Cuba, surviving a Caribbean Sea passage during a period normally quite hostile towards development. It then turned west, and southwest through the Gulf of Mexico, making landfall between Brownsville and Tampico in a sparsely settled region of the coast, causing considerable property damage. Brazos Island and Port Isabel were flooded. A five foot storm surge put Port Aransas partially underwater.



**July 22-26<sup>th</sup>, 1933:** Originating in the Caribbean Sea, this cyclone (the fourth of the season) crossed the Yucatan peninsula and began to recurve northward through the western Gulf of Mexico. This tropical storm moved up the Texas coast for several days and brought heavy rains and flooding to extreme eastern Texas (see rainfall map to the right). At 6 AM on the 22<sup>nd</sup>, the pressure at Freeport reached a minimum of 29.63".

As the system approached Tyler on the 23<sup>rd</sup>, it transcribed a small loop as it linked up with a cold front to its north. A high pressure to the north of the front blocked its movement. It resumed its northward trek on the 26<sup>th</sup>. An area of over 25,000 square miles saw rainfall amounts of 12.5". Twenty inches of rain were seen in a small area of east Texas and western Louisiana. The track of the storm is to the left.



Shelby and Panola counties experienced a ten inch deluge that blocked highways for over twelve hours. The Santa Fe railroad was washed out between Carthage and Longview. It was

considered the heaviest downpour in the area in seventeen years. Portions of a bridge at Henderson were swept away by flood waters. Corn, cotton, and watermelon crops were in ruin. Damage in Shelby and Panola counties totaled \$1.5 million.

**August 4-5<sup>th</sup>, 1933:** The fifth storm of the season formed in **Late July** near the Lesser Antilles, moving west-northwest across Southern Florida, then westward across the Gulf, striking just south of Brownsville on the 4<sup>th</sup>. Winds there reached 72 mph, and its associated rainfall caused considerable damage from Brownsville to Monterey. Water overspread Padre Island. Damage totaled \$1.75 million.

**September 4-5<sup>th</sup>, 1933:** The eleventh storm of the season was stronger and struck the furthest north. It passed over Turks Island in the Bahamas with a pressure of 27.47" on August 30<sup>th</sup>. Havana saw winds reaching 94 mph on late afternoon of the 1<sup>st</sup>. The next day, in the east-central Gulf, a ship reported a pressure of 27.99". Warnings were then issued for Texas. During the night of the 4<sup>th</sup>, it moved inland just north of Brownsville.

Twenty-four hour rainfall records for September set in 1933 storm

7 S Mercedes	5 <sup>th</sup>	15.00"
San Benito	5 <sup>th</sup>	12.67"
Raymondville	5 <sup>th</sup>	6.61"
Hidalgo	5 <sup>th</sup>	4.00"

The pressure fell to 28.02" at 1 AM on the 5<sup>th</sup> with winds estimated at 80 mph in the city; gusts were seen to 125 mph. The storm lasted 38 hours in the Valley. Thirteen inches of rain fell across the area. As waves collapsed the twenty cottages at Redfish Landing, four boys jumped into an ice box, which then floated two miles across the King Ranch (West). Many buildings were destroyed at Harlingen and San Benito. The Lower Rio Grande valley saw 90% of its citrus crop wiped out.

A 13 foot storm surge was noted near Brownsville; high tides occurred along the entire coast. Strong gales were seen from 11 AM on the 4<sup>th</sup> to 11 am on the 5<sup>th</sup> at Corpus Christi. Winds gusted to 57 mph at 2 AM. Many places on North Beach were washed away. The Pleasure Pier was virtually destroyed. To the left is a picture of flooding done from the storm surge, used courtesy of Mike Coyne, formerly of the Corpus Christi forecast office. Many homes at Rockport and Port Aransas were swept away. The Don Patricio causeway from Flour Bluff to Padre Island was destroyed. On South Padre Island, the Sportsman's hotel (known as the casino) was severely damaged during this storm, with the worst destruction on the top floor. All dunes



in South Padre Island were flattened. Over 40 cuts were made through the Island, which was then abandoned until after World War II. Distant Galveston measured tides 4.5' above normal. Several boats sank near Corpus Christi. There were forty people killed and \$12 million of damage to property.

**July 24-26<sup>th</sup>, 1934:** The third storm of the season formed off the North Carolina coast on the

21<sup>st</sup>. It then moved south and southwest across Florida into the eastern Gulf...a move only one other cyclone on record has ever matched. It then developed rapidly south of Louisiana on the 24<sup>th</sup> and struck just north of Corpus Christi (Rockport) on the 25<sup>th</sup> as a minimal hurricane. Winds at Corpus Christi gusted to 56 mph as the pressure fell to 29.12". Rockport saw a pressure of 28.79". Twenty-four hour rainfall records were set for July at Falfurrias (4.52" on the 26<sup>th</sup>) and Fowlerton (4.75" on the 24<sup>th</sup>) St. Joseph's Island had a 10.2 foot storm surge. Damage estimates were near \$4.5 million, mostly to crops. Nineteen died in Texas due to the storm.

**August 24-26<sup>th</sup>, 1934:** Another most unusual storm formed in the Eastern Gulf. It moved west-northwest, grazed the coast near Freeport on the 27<sup>th</sup>, before moving due south, then west into Mexico south of Tampico. It was a minimal hurricane at its most intense. Heavy rains and high tides were the main impact. A new 24 hour rainfall records was set for the month of August at Garden City (6.25" on the 24<sup>th</sup>).

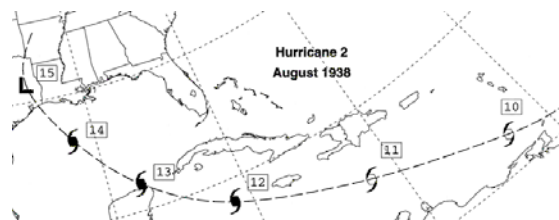
**June 27<sup>th</sup>, 1936:** During the night of the 26<sup>th</sup>, a hurricane formed in the western Gulf. It struck Port Aransas shortly before noon on the 27<sup>th</sup>. It came virtually without warning. After a clear night, a few clouds moved into Corpus Christi at 12:40 AM. The clouds covered the sky and thickened by 1:30, and rain began by 3. Squalls buffeted the area until 7, when it subsided, due to the eye passing overhead. Winds increased again after 8:11. Gusts to 55 mph occurred at Corpus Christi. The Coast Guard Cutter *Woodbury* measured a pressure of 29.23".

Twenty-four hour rainfall records set for July in 1936

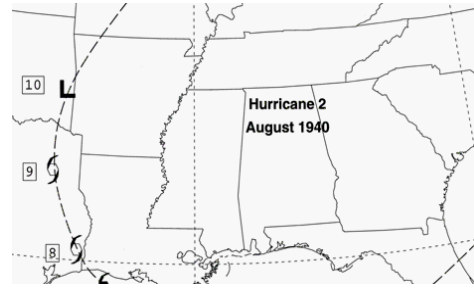
Eagle Pass	29 <sup>th</sup>	15.60"
Seguin	30 <sup>th</sup>	8.07"
Langtry	29 <sup>th</sup>	7.00"
Boerne	30 <sup>th</sup>	6.07"
2 N Rio Medina	29 <sup>th</sup>	5.00"
Blanco	30 <sup>th</sup>	4.87"
Carrizo Springs	28 <sup>th</sup>	4.40"

At Ingleside, winds gusted to 90 mph from the southwest. Cooling towers were destroyed at the Humble Oil Refinery. Crops were severely damaged west northwest from there to Gregory and Sinton with corn practically destroyed and cotton damaged. Camp lodges were leveled at Aransas Pass and Port Aransas when winds of 80 mph blew through. Houses were badly damaged at Rockport. Heavy rains fell across south Texas; records set during the cyclone shown above and to the right. Damage amounted to \$550 thousand. Fortunately, no loss of life was seen with the storm.

**August 15-16<sup>th</sup>, 1938:** A category two hurricane made landfall near Cameron, LA on the 15<sup>th</sup> (track to the right). A high tide was seen along the Upper Coast. Vernon saw 2.24" of rain on the 16<sup>th</sup>.



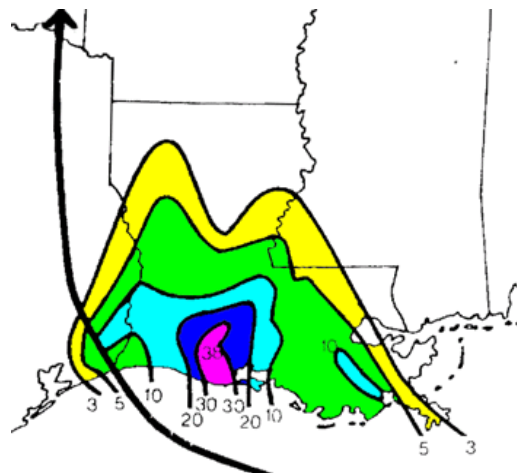
**August 7-8<sup>th</sup>, 1940:** This was the other storm to form off the Carolinas and affect Texas. It formed on the 1<sup>st</sup> and moved across the Florida peninsula on the 2<sup>nd</sup>. It hit near Cameron, Louisiana on the 7<sup>th</sup>. Maximum sustained winds reached 82 mph...gusts to 91 mph blew from the northeast...the pressure fell to 28.87"...and 5.87" of rain were measured at Port Arthur. Their anemometer was torn away by the winds, and repaired during the tempest.



Twenty-four hour rainfall records set for August in 1940 hurricane		
Kirbyville	8 <sup>th</sup>	6.99"
Bon Weir	8 <sup>th</sup>	5.95"
Weirgate	7 <sup>th</sup>	5.56"
Follett	8 <sup>th</sup>	4.32"
Balmorea	6 <sup>th</sup>	3.17"
Mount Locke	12 <sup>th</sup>	2.30"

Pressures fell to 28.74" at Sabine Pass. Houses were unroofed, trees uprooted, and billboards were sent "whirling through the air". Four wooden oil derricks were blown down in the Ged Oil Field. Over ten inches of rain fell in the Beaumont area while triple that amount fell across Acadiana in Louisiana, making it that state's wettest hurricane on record. Damage estimates were near \$1.75 million in Texas. One person perished.

**September 23<sup>rd</sup>, 1941:** A storm formed over the central Gulf on the 17<sup>th</sup>. It made a counter-clockwise loop, moved west, then northward to near Matagorda on the 23<sup>rd</sup>. On the 22<sup>nd</sup>, a ship near 27.1N 93.7W recorded a force 12 northeast wind, and a pressure of 29.11". Winds were estimated near 100 mph at several locations along the coast. A ship at Texas City reported a pressure of 28.66" and winds of 83 mph. The pressure fell to 29.05" at Matagorda, 29.19" at Port O'Connor, and 29.31" at Freeport. Port Arthur saw winds of 73 mph, 6.68" of rain, and tides of 5.4'. Freeport had a tide of 9.9 feet while very high tides were experienced from Matagorda to Galveston. Galveston measured a seven foot tide. The rice crop was ruined.



Wind damage occurred at Houston as the system turned northeast and winds gusted to 77 mph. The approach of this storm was so heralded that 25,000 people evacuated, leaving the smaller towns practically deserted. Small buildings were leveled, and most forms of communication were lost. Heavy rains fell in Texas (see table to the upper left). Thirty-five percent of the cotton crop was lost. Coastal flooding was seen from Corpus Christi northward to the Louisiana shore. Seabrook was inundated by five feet of water. Only four lives were lost to this hurricane, mainly due to the evacuation of 25,000 from the threatened area. Over \$7 million in damage was incurred.

**August 21<sup>st</sup>, 1942:** Due to World War II and this storm's small size, reports of this hurricane were not received until it struck the Bolivar peninsula. It was thought to only be of tropical storm intensity. Port Arthur reported 72 mph winds from the southeast and a pressure of 29.35" and 5.33" of rain. Tides up to seven feet above mean low water were seen at High Island. Damage was confined to piers and small craft in the area. Damage totaled \$790,000, mostly to the rice crop. No person was injured during this storm.

**August 29-30<sup>th</sup>, 1942:** A severe hurricane crossed Matagorda Bay and was quite expansive in area; hurricane force winds were covering a 150 mile wide diameter across the center. About 50,000 people evacuated from the Galveston area alone as the storm approached, most likely due to the hurricane that struck only eight days beforehand. The Halfmoon Reef lighthouse, in the middle of the bay, was knocked off its pilings during the storm (Roberts). There was a partial calm at Seadrift at 2 AM on the 30<sup>th</sup>, when the pressure fell to 28.10" and winds were as high as 115 mph. Corpus Christi experienced gusts to 72 mph. Storm force winds were felt as far inland as San Antonio, where considerable property damage occurred.

Matagorda saw a 14.7 foot tide put the town under about six feet of salt water. Freeport had an 11.8' storm surge invade from the Gulf. Two 1933 channels around Corpus Christi Pass were reopened by the storm. Two old cottages on North beach met their fate. Rainfall was not excessive with the system, due to its rapid movement. Rainfall was greater on the left side of the track; 9.25 inches fell 25 miles left of the point of landfall. Eight died; damage estimates were near \$26.5 million, over half of which was due to failed crops.

Twenty-four hour rainfall records set during September 1941 storm

Conroe	24 <sup>th</sup>	6.88"
Orange Dupont	24 <sup>th</sup>	6.60"
Shepherd	23 <sup>rd</sup>	6.34"
Goose Creek	24 <sup>th</sup>	5.80"
Livingston	24 <sup>th</sup>	5.50"
Houston-Satsuma	23 <sup>rd</sup>	5.12"
Sugarland	24 <sup>th</sup>	5.00"
Edom	24 <sup>th</sup>	4.92"
Liberty	24 <sup>th</sup>	4.40"
Lufkin	24 <sup>th</sup>	4.35"
Moscow	24 <sup>th</sup>	4.05"
Kirbyville	24 <sup>th</sup>	3.91"
Riverside	24 <sup>th</sup>	3.76"
Hyatt	24 <sup>th</sup>	3.59"
Huntsville	24 <sup>th</sup>	3.40"
Nouvelle	24 <sup>th</sup>	3.40"
Dialville	24 <sup>th</sup>	3.25"
Navasota	24 <sup>th</sup>	3.03"
Gary	25 <sup>th</sup>	2.55"

**July 27<sup>th</sup>, 1943:** War censorship came into question during this hurricane. This storm was detected just off the Mississippi Delta on the 25<sup>th</sup> of July. It formed into a hurricane rapidly and moved inland in Chambers County. Its eye was 13 miles in diameter as it passed inland, yet the storm itself was not much more than 70 miles in diameter. It was considered the worst storm in the region since 1915, and at La Porte, worse than the Galveston Hurricane of 1900. The brunt of the storm passed over the Houston Metropolitan Area between noon and 4 PM (population was 600,000 at the time).



Gusts above 100 mph occurred in the Galveston- Houston area. Two utility towers over the Houston Ship Channel were blown down (these were rated to withstand winds of 120 mph). Four cooling towers at the Humble Oil and Refining Co. (now Exxon) were demolished as they reported gusts to 132 mph. The anemometer at the Metropolitan airport had a gust to 132 mph as well. Oil derricks across Chambers and Jefferson County met their fate during the hurricane (Fincher, et al.). The pictures above and to the right were provided with the permission of Lew Fincher.

Heavy rainfall fell across southeast Texas. La Porte received over 17 inches of rain while 19.48 inches fell at Port Arthur on the 27<sup>th</sup> and 28<sup>th</sup>...with 17.76" occurring within 24 hours, rainfall records that remain standing today. Winds gusted to 65 mph at Port Arthur. Ellington Field saw the pressure fall to 28.78", where five planes were destroyed. A number of brick business buildings and churches collapsed on Galveston Island. Winds caused a great deal of the damage, which totaled \$17 million (U.S. Army Corp of Engineers).



Water and High Winds Damage Galveston Texas, July 27, 1943

Due to the northerly winds across Galveston Bay, tides were extremely low. On Galveston Island, a storm surge of six feet was measured. The U.S. Army Corp of Engineer's hopper dredge, *Galveston*, broke up on the north jetty, causing 11 of the casualties. The tug *Titan* foundered between Corpus Christi and Port Neches; three lives were lost. Nineteen lives were taken by the storm in all. This was the first storm where aircraft reconnaissance was utilized.

**August 26-28<sup>th</sup>, 1945:** An intense hurricane struck Matagorda and then took 48 hours to move up the coast to Bay City. It was the worst storm along the Lower Texas coast since September

1933. Thousands evacuated in advance of the hurricane. Two-thirds of the coast experienced hurricane force winds. Winds in excess of 100 mph howled in locations between Point Aransas and Port O'Connor. The highest gust noted was 135 mph at Collegeport. Winds gusted to 70 mph at Corpus Christi at 7:40 PM on the 26<sup>th</sup>. Port Isabel gusted to 76 mph. The pressure at Palacios fell to 28.57". Tides as high as fifteen feet inundated Port Lavaca. The coastline retreated as much as 50 feet due to the storm.

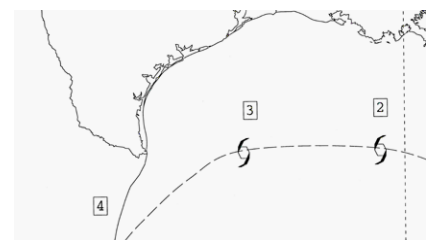
Rainfall amounts of thirty inches were common along the coast. A tornado eight miles north-northeast of Houston led to a fatality. Extensive damage was seen in the following counties: Nueces, San Patricio, Aransas, Calhoun, Matagorda, and Wharton. Severe crop and livestock losses were suffered along nearly all the Middle and Upper Texas coast. Three were killed in all; damage estimates were near \$20.1 million.

**August 24<sup>th</sup>, 1947:** Galveston was struck by a minimal hurricane. Their pressure fell to 29.30" and winds gusted to 72 mph at 4:45 PM. Wind-driven rain caused damage to the interior of homes as windows were blown out. Roofs experienced damage as well. Sabine Pass had a 3.6 foot tide. One person died and damage totaled \$2 million.

**October 3-4<sup>th</sup>, 1949:** This system formed in the eastern Pacific Ocean before crossing into the Gulf west of Vera Cruz...only three other storms are known to make such a crossing from the east Pacific to the Gulf of Mexico. Freeport was struck by the strong hurricane. Winds were estimated at 135 mph five miles west of Freeport. The pressure fell to 28.88". Harrisburg's tide rose to 11.4 feet above mean sea level. Moderate erosion damaged streets in Galveston and destroyed a wooden fishing pier. The South Jetty lighthouse was slightly damaged. Only two people died and \$6.7 million in damage occurred, mostly due to crop failure.

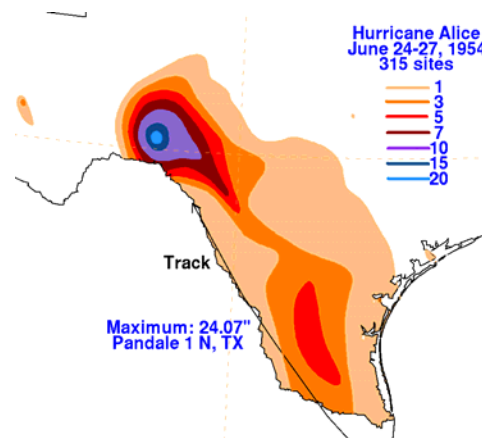
**The naming of tropical storms:** The Pacific Fleet began unofficially naming tropical cyclones during World War II as a method of discerning one storm from another. It unofficially continued in the Weather Bureau thereafter until 1950. In 1950, the U.S. Military started to use a phonetic alphabet to name storms in the Atlantic Ocean. The public finally became aware of the naming of storms in 1954, when women's names were used for storms worldwide. This was mainly due to a change in the military's phonetic code! Men's names were included by 1979.

**October 4<sup>th</sup>, 1950 (How):** Hurricane How hit the coast of Mexico 150 miles south of Brownsville (track to the right). Damage was reported as far north as Port Aransas. Corpus Christi had gusts to 39 mph and tides rose to four feet on Padre Island. Gusts to 60 mph howled at Brownsville. Sections of highway on North Padre Island at Gulf Park washed out.

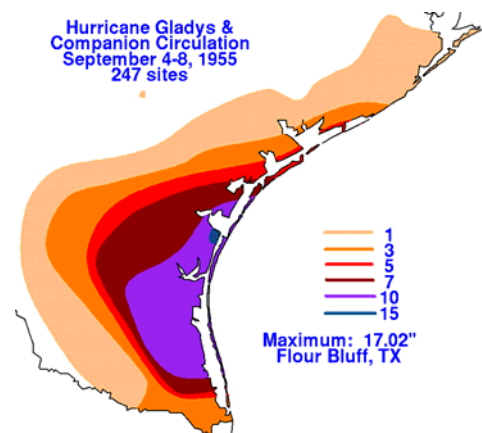


## Hurricanes of the Late Twentieth Century

**June 25-27<sup>th</sup>, 1954 (Alice):** The first storm with a woman's name in the Atlantic Basin, Alice developed rapidly south of Brownsville. It made landfall about 24 hours after formation. Most residents did not know about it until it struck their area. Heavy rains near Langtry resulted in 24.07" of rain at Pandale. Rains of 12-21" over a short period of time plagued Comstock, Sonora, and Sheffield. This caused the greatest rise on the Rio Grande since 1865. The river rose 30-60 feet at Eagle Pass and Laredo. An 86 foot high wall of water rushed down the Pecos River washed out a bridge normally 50 feet above it. The International Bridge at Laredo was also washed out. A bulk of the death and destruction occurred in Mexico. Five shrimp boats were beached. Seventeen casualties in Texas were the result of Alice.



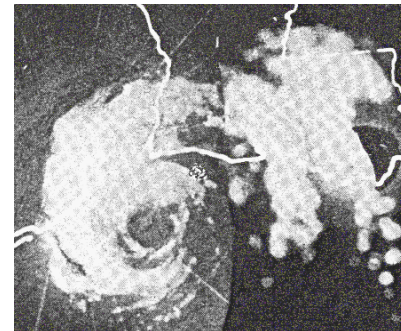
**September 5-7<sup>th</sup>, 1955 (Gladys):** Gladys struck 140 miles south of Brownsville as a category one hurricane. The rainfall total at Flour Bluff was 17.02". Corpus Christi Naval Air Station received 12.23" of rain in only 24 hours. Corpus Christi saw 7.64" of rain in 24 hours (a new daily rainfall record). Tides rose 4.5 feet. A circulation center, most likely a mesoscale low pressure system, formed offshore on the 7<sup>th</sup> and rotated around Gladys into the coast near Baffin Bay. Locals named it "Glasscock", after the oil platform that recorded 83 mph winds located 15 miles east of Port Aransas. The Weather Bureau conceded that this secondary circulation may have been an independent tropical storm (Dunn).



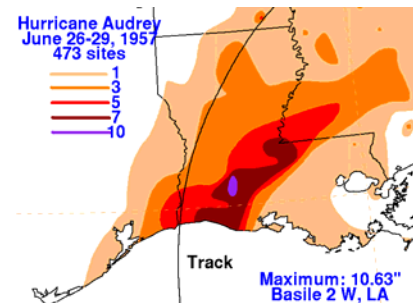
Winds of 60 mph were seen in Flour Bluff. Most of the damage from this small scale system was confined to the coast (Ellis). Overall, damage totaled \$400,000. Due to the limited warnings given to the lower Texas coast over the previous couple years, tropical weather outlooks began to be issued by Hurricane Warning Offices, so that there would be "no surprise" in the future.



**June 27<sup>th</sup>, 1957 (Audrey):** Audrey, the hurricane that southwest Louisiana will never forget, and the most intense hurricane that has ever formed in the Gulf of Mexico during the month of June, also made an impact in southeast Texas on June 27<sup>th</sup> (track on the right). At Port Arthur, winds gusted to 85 mph and the pressure dropped to 28.52" at 9:23 AM. Rainfall from Jefferson County Airport reached 7.35", setting a daily rainfall record that still exists today. On the upper left is a rarely seen radar composite of the hurricane from Houston, Shreveport, and New Orleans radars, courtesy of the Air Force.

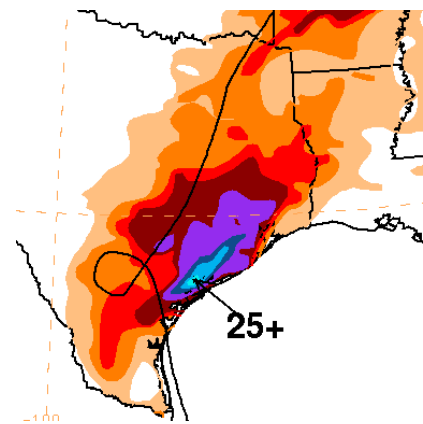


Moderate damage was reported around Port Arthur to power lines and phone lines. Trees were uprooted during the storm and Highway 87 was damaged. Storm surges of six feet or more extended from Galveston eastward into Louisiana. Corpus Christi even experienced tides of 3-4 feet above normal. Mustang Island Park Road washed out between Corpus Christi Pass and Packery Channel. A 400-foot tanker, a tug, and a few barges washed aground near Corpus Christi (Menard). Nine people died in Texas, 7 of which resulted from the sinking of the fishing boat *Koturah* off of Galveston (Morgan). Damage was only estimated at \$8 million, compared to what the storm wrought to the east. Audrey proved to be a storm unparalleled in the history of southwest Louisiana.



**July 24<sup>th</sup>, 1959 (Debra):** Hurricane Debra struck the region between Freeport and Galveston. The Coast Guard cutter *Cahoone* measured a pressure of 29.07" late in the day. Winds gusted to 105 mph near Freeport. Hurricane force winds extended 100 miles inland. Morgan Point reported the highest tide, 7.9 feet above mean sea level. Orange was saturated with 14.42" of rain. A daily rainfall record was set in Beaumont, 3.62". Total damages from Debra were estimated near \$6.7 million.

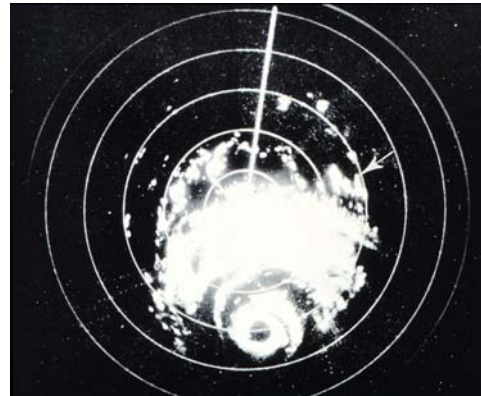
**June 23-26<sup>th</sup>, 1960 (Unnamed):** A tropical storm made landfall on Padre Island with wind gusts to 60 mph reported at Rockport. Alice measured the lowest pressure on land (1002.4 hPa). Tides at Corpus Christi increased to 3.5 feet. Three fishing piers were wrecked on Copano Bay. One shrimp boat beached, while another sank...taking the lives of three of its crew.



Rain on the Middle Coast caused extensive flooding. Corpus Christi set a rainfall record for the 23<sup>rd</sup> (2.87") while Victoria set rainfall records for the 24<sup>th</sup> and 25<sup>th</sup> (2.15" and 2.17"). Over three days, Port Lavaca recorded 29.76" of rain.

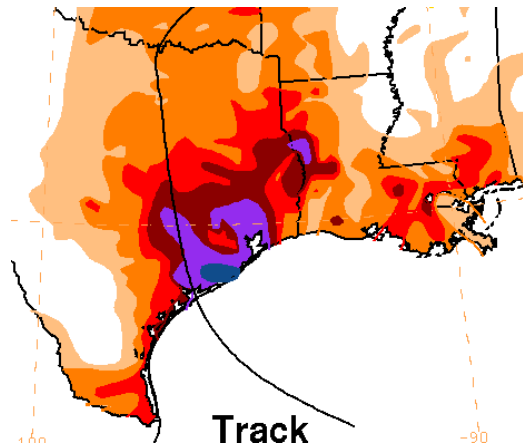
Serious local flooding from the torrential rains hit a five county area extending from Aransas Pass to Freeport. Flood damage exceeded \$3.5 million. Deaths resulting from the flooding totaled 12 in Texas and 3 in Arkansas (Ellis). Fifteen perished in all from this unnamed storm in Texas.

**September 11-13<sup>th</sup>, 1961 (Carla):** No history of Texas hurricanes would be complete without a thorough mention of Carla, which made landfall near Port Lavaca. Carla was among the largest hurricanes of historical record. It stalled offshore, making a fairly large loop off Pass Cavallo, before finally striking the coast. The storm produced many tornadoes, gusts estimated to 175 mph, torrential rains, and a 22 foot storm surge at Port O'Connor. Hurricane force gusts were seen along nearly the entire coast of Texas. Winds gusted to 86 mph at Corpus Christi.



Her path of devastation inland extended from Victoria to Dallas. The death toll was limited to 34, which was attributed in part to what was the largest peace time evacuation of an area in history, up until that time. A quarter million people fled the Middle and Upper Texas coasts to move inland to safety. Evacuation was slow however; it took four hours to get from Port Arthur to Beaumont on U.S. 69.

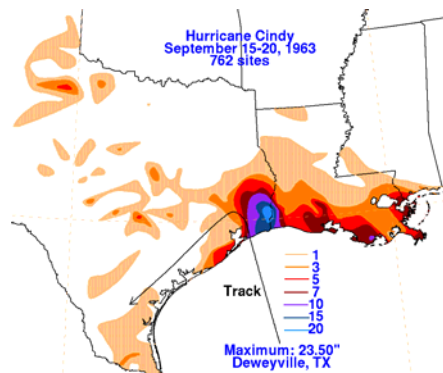
Twenty-six tornadoes were spawned, one of which tore apart 120 buildings and killed six in Galveston. Structures outside the seawall were severely damaged by the storm surge. The Ursuline Convent, which was the oldest educational institution in Galveston, was destroyed by Carla (Guthrie). Texas City saw 90% of its homes flooded. Surfside, near Freeport, saw extensive damage. The trail of destruction extended down the coast to Port Isabel, where 4-5 foot storm surges were seen. Port O'Connor was 75% wiped out. The Matagorda Island Air Force Base was almost erased from existence. Damage to the air force base was \$18 million.



In Jefferson County, 180 miles from the landfalling storm, \$17.5 million in damage occurred, with \$14 million of it water damage. Highway 87 was totally destroyed between Sabine Pass and High Island, but later rebuilt. Three to four feet of water flooded Port Arthur. The only injuries reported there were due to snake bites. Rain totaled 19 inches at Votan. The 5.15" of rain that

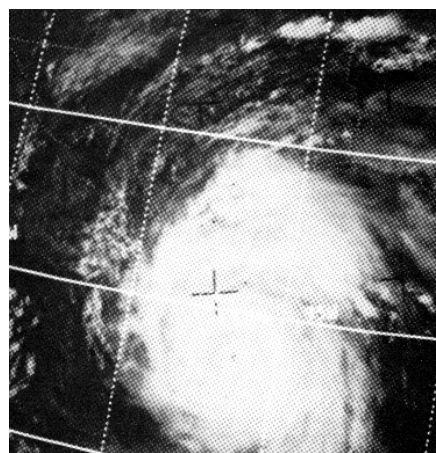
fell in Victoria set a rainfall record for the 11<sup>th</sup>. A vast amount of coastline was inundated, which totaled 1.7 million acres. Carla's area of destruction extended well to the east into Louisiana. Total damages were estimated at \$408 million for Texas.

**September 16-20<sup>th</sup>, 1963 (Cindy):** Hurricane Cindy formed over the northwest Gulf on the 16<sup>th</sup> along a trough of low pressure. It intensified rapidly, becoming a hurricane by mid-afternoon. It crossed the coast near High Island on the 17<sup>th</sup>. Winds were estimated at 75 mph at Sabine Pass. Lowest pressure observed was 29.45" at High Island. Only slight tidal effects were noted.



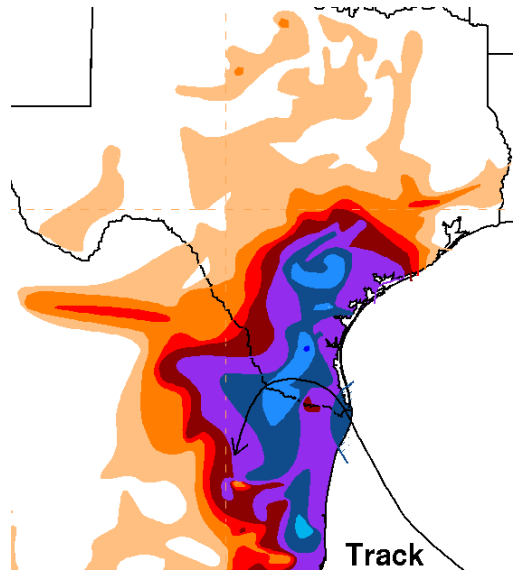
A severe drought had plagued Texas and Louisiana since 1962. Torrential rains ensued after landfall as the center drifted slowly westward, causing flooding of area rivers and streams. The drought was over. Deweyville reported 23.50" of rain while Orange reported 20.80". Rainfall at Jefferson County Airport totaled 14.53" on the 17-18<sup>th</sup>, setting rainfall records for those dates. Port Acres flooded, killing two 18 month old twin sisters on the 22<sup>nd</sup>. One man drowned when he was evacuating an oil rig south of Cameron. A 4.6 ft. storm surge was measured at the Galveston Ship Channel. Damage was estimated at \$12.5 million.

**September 20-22<sup>nd</sup>, 1967 (Beulah):** Hurricane Beulah was the third largest hurricane on record, after Carla in 1961 (see above for more on Carla) and the Great New England Hurricane of 1938. The storm slowly traversed the Caribbean Sea from the 8<sup>th</sup> through mid month (track to the right). It struck the coast near Brownsville at 8 AM on the 20<sup>th</sup>, and then curved left with its track paralleling the coast to the southwest thereafter. To the right is a satellite picture of Beulah lurking just off the Lower Texas coast, courtesy of the National Climatic Data Center.



The lowest pressure recorded on land was 28.07". Winds gusted to 136 mph on the *S. S. Shirley Lykes*, located in the Port of Brownsville. Hurricane-force winds extended up along the coast to Corpus Christi, which received gusts to 86 mph at 8:35 PM on the 20<sup>th</sup>. Winds gusted to 110 mph at their local U.S. Army Corp of Engineers office. The storm surge reached 20 feet along lower sections of Padre Island. Thirty one cuts were made completely through the Island. At Port Isabel, only the new bank and the lighthouse escaped any damage. Citrus fruit and tree damage totaled \$15 million in the Rio Grande Valley due to the winds.

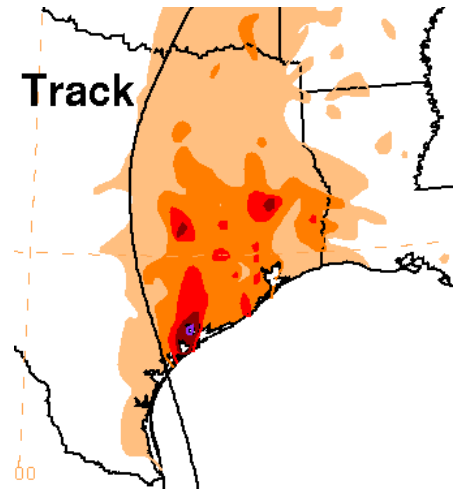
San Antonio saw horrible flooding with Beulah. A few locations saw over 30" of rain with the storm. At Pettus, in Bee County, rainfall reached 27.38". At Falfurrias, in Brooks County, more than 25 inches of rain fell; more than falls during a normal year. The San Antonio River went 18.4 feet above flood stage at Goliad, the Lavaca River near Edna crested 5.2 feet above flood stage. The Navidad River at Ganado crested 10.9 feet above flood stage. The area south and east of a Laredo, San Antonio, Matagorda arc was isolated over a week due to the massive flood; 1.4 million acres were submerged. Daily rainfall records were set at Laredo (3.61" on the 22<sup>nd</sup>), Victoria (6.63" on the 20<sup>th</sup> and 5.27" on the 21<sup>st</sup>), and at Corpus Christi (3.48" on the 20<sup>th</sup> and 6.38" on the 21<sup>st</sup>). Only 0.04" of rain fell at Nederland. Record streamflow in Late September flooded the Rio Grande downstream from Falcon Dam near Roma. Most of it was due to the heavy rains which fell in Mexico the week before.



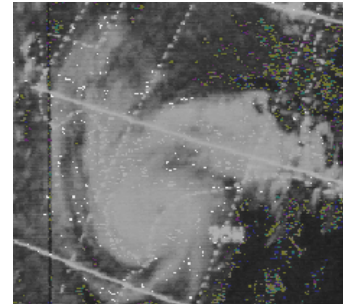
An amazing 115 tornadoes were spawned by the system, the most ever known to be generated by a tropical system (7 times the previous record set by Isbell in 1964). Most of the tornadoes were confined to the entire coast of Texas. One killer tornado touched down in Palacios on the morning of the 10<sup>th</sup>, killing 4 people and injuring 6 more. A tornado near Louise in Wharton County caused one death. Twenty nine counties were declared major disaster areas by then President Lyndon Baines Johnson. Forty-four people died in Texas during Beulah; 5 by tornado, 39 by flood. One hundred ten boats were also victim to the storm. Damages were estimated at \$160 million.

**June 22-26<sup>th</sup>, 1968 (Candy):** Formed by a cutoff low over Texas, this tropical cyclone developed only seventy miles east-southeast of Brownsville. When reconnaissance aircraft reached the system on the 23<sup>rd</sup>, winds had already achieved tropical storm force. The system accelerated west of due north at 20 mph, moving inland near Port Aransas late that day. Palacios experienced the highest storm surge, measured at 4.5 feet.

The lowest pressure reported on land was 997 hPa at Port Aransas. Winds at Austnell peaked at 71 mph. Heavy rains fell just east of the center. Point Comfort measured nearly eleven inches (10.98") of rain from Candy. Significant flood damage was confined to the east and west forks of the San Jacinto River, in Harris and Montgomery counties. Daily rainfall records were set at Laredo (1.57" on the 22<sup>nd</sup>) and Victoria (3.10" on the 23<sup>rd</sup>). Nineteen tornadoes were spawned across Arkansas, Louisiana, Missouri, Ohio, and Texas. Of the five tornadoes in the Lone Star State, none produced appreciable damage. The cost of Candy was \$1 million to property and \$2 million to crops in East Texas.



**August 3<sup>rd</sup>, 1970 (Celia):** Hurricane Celia hit Corpus Christi on the 3<sup>rd</sup>. The system developed as a tropical depression in the northwest Caribbean on July 30<sup>th</sup> and moved on a west-northwest heading. Celia became a hurricane on the 1<sup>st</sup>, when centered about midway between Tampa, Florida and Merida, Mexico. Evacuations of the upper Texas coast began at 11 AM on the 2<sup>nd</sup> and hurricane warnings were extended southward to Corpus Christi at 5 AM on the 3<sup>rd</sup>.



Celia made landfall between Corpus Christi and Port Aransas by 3 PM and moved across Mathis, Fowlerton, Cotulla, Eagle Pass, and Del Rio as a small but powerful hurricane. Gusts of 150 mph blew down the anemometer at Aransas Pass; gusts an hour later were estimated near 180 mph. Corpus Christi reported sustained winds of 125 mph with gusts to 161 mph occurring at 5:38 PM on the 3<sup>rd</sup>. To the right is an image of the damage wrought by the storm in Corpus Christi, provided by Mike Coyne, formerly of the Corpus Christi forecast office.

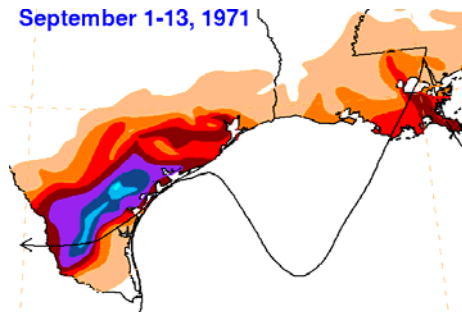


Damage reached \$1 million in Del Rio as winds gusted to 89 mph. Robstown measured 7.24" of rain, while Aransas Pass reported 6.5" of rain and Corpus Christi saw 6.38" (a new daily rainfall record for the 3<sup>rd</sup>). At least nine tornadoes were spawned by the hurricane (Novlan & Gray 1974). The remains of Celia drifted into southern New Mexico by the 5<sup>th</sup>.

A storm surge of 9.2 feet was seen at Port Aransas Beach. An oil derrick designed to withstand 175 mph winds was blown away at Robstown. Lowest station pressure recorded on

land was 27.89" at 4:45 PM in Ingleside. Damages totaled \$500 million, mostly due to high winds...similar to what happened in Houston from their "surprise hurricane" in 1943. This is quite unusual considering most damage is usually caused by the storm surge.

**September 9-13<sup>th</sup>, 1971 (Fern):** Hurricanes Fern and Edith, in that order, affected the coast from September 7<sup>th</sup> through the 16<sup>th</sup>. Fern slowly paralleled the Texas coast while a hurricane and made landfall as a tropical storm on the 11<sup>th</sup>. Up to 26 inches of rain inundated areas near Beeville, with large amounts of rain falling primarily along the Coastal Bend, causing the worst flooding since Beulah. Amounts in excess of fifteen inches deluged

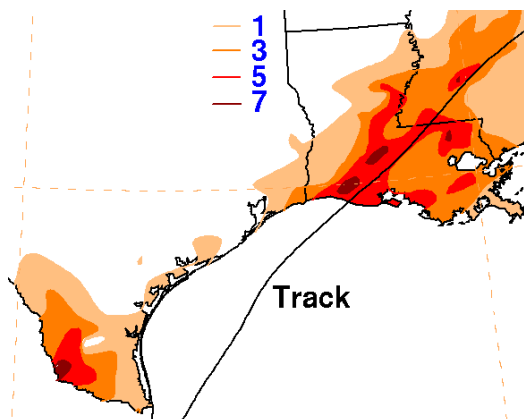


Bee, Refugio, and San Patricio counties. Daily rainfall records were set at Corpus Christi (3.74" on the 10<sup>th</sup>), Victoria (4.33" on the 10<sup>th</sup>), and Laredo (1.53" on the 10<sup>th</sup> and 6.48" on the 12<sup>th</sup>).

Major flooding occurred along portions of the Frio, Lavaca, Navidad, San Antonio, Guadalupe, Mission, and Aransas Rivers. Waters went crashing over the Wesley Seale Dam at Lake Corpus Christi, causing major flooding. A levee broke at Robstown, flooding 40 blocks of the southwest side of town. Railroad tracks were washed out between Falfurrias and Alice due to the flooding rains.

Wind gusts over 100 mph blew away the anemometer at Port O'Connor at 10 AM on the 10<sup>th</sup>. Gusts above 60 mph were seen from Galveston down to coast to Corpus Christi. The lowest pressure noted on land was 28.92" at Ingleside at 10:45 PM on the 10<sup>th</sup>. Five tornadoes were generated by Fern. The highest storm surge noted was six feet at Freeport. Four Cuban fishing boats were driven ashore on Mustang Island and were held for days while the Cuban government went through the process of paying the bill for repair. Damages totaled \$30 million, \$5 million of which occurred at Sinton alone. Two people died during the storm.

**September 14-17<sup>th</sup>, 1971 (Edith):** Edith made landfall as a category two hurricane in Louisiana on the 16<sup>th</sup>. A six foot storm surge overran Highway 87 between Sabine Pass and High Island. Galveston saw the highest wind gust - 53 mph. Port Arthur gusted to 47 mph. Moderate to heavy rains across Texas were restricted to Deep South Texas and the Upper Texas coast as a bulk of the precipitation fell near and east of Edith's track. The highest rainfall report from Texas was 8.66" at Falcon Dam.



A hailstorm early on the 16<sup>th</sup> across southern Swisher and northern Hale counties, attributable to the fringe effects of Edith, covered the ground two to three inches in depth and incurred \$7.4

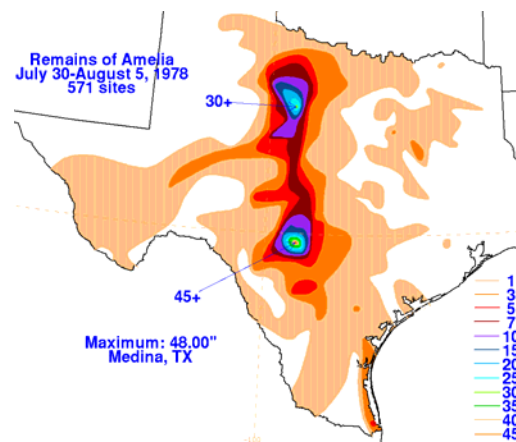
million in damage to crops. Late on the 16<sup>th</sup>, the worst hailstorm in the history of Lynn county dropped stones 3" in diameter which caused \$5 million in damage to their cotton and sorghum crops. Power lines and trees being downed, and slight property damage occurred elsewhere (\$180,000). All survived Edith.

**July 30-August 5<sup>th</sup>, 1978 (Amelia):** Tropical storm Amelia developed suddenly fifty miles off the Lower Texas coast near Brownsville...quite similar to Alice in 1954. On the next page is the exceedingly short track of this cyclone. Winds increased by mid-afternoon on the 30<sup>th</sup>. During the evening, blinding sand blew across South Padre Island, keeping all who hadn't evacuated indoors.

Even though it was a mere tropical storm, six vessels sank. The shrimper *Margaret Webster* broke up near the jetties of Lower Padre Island. A wave lifted the shrimper *Miss Lorie Ann* 30 to 40 feet into the air, tore the cabin off the ship, and dropped her hull down near the coast of Padre Island. Those inside were rescued from their predicament the next day by a Port Isabel fisherman, who busted the hull open with a sledge hammer (St. John).

Corpus Christi set a new daily rainfall record on the 31<sup>st</sup> when 3.77" of rain fell during the storm's landfall into the Lone Star State. The tropical cyclone revived west of San Antonio as it moved into the High Plains. The interaction between the remains of Amelia and a tropical disturbance which moved across Mexico from the Pacific Ocean led to a rejuvenation of thunderstorm activity across the Hill Country and Big Country between the 1<sup>st</sup> and the 4<sup>th</sup>.

Torrents of rain fell along the Balcones Escarpment. Drifting north across the Edwards Plateau, copious rains fell again near the city of Abilene. At the headwaters of the Medina River, near the town of Bluff, 46" of rain fell from the 1<sup>st</sup> through the 4<sup>th</sup>. Albany saw 32" of rain deluge the town. An area of 20" of rain caused local rivers and streams to flash flood. By the 2<sup>nd</sup>, 26 people had died during the ensuing flood along the Guadalupe, Medina, and Sabinal Rivers. Before the low finally died in North Central Texas on the 5<sup>th</sup>, five inches of rain relieved areas south of the Red River, a region that had endured a drought up until that time.

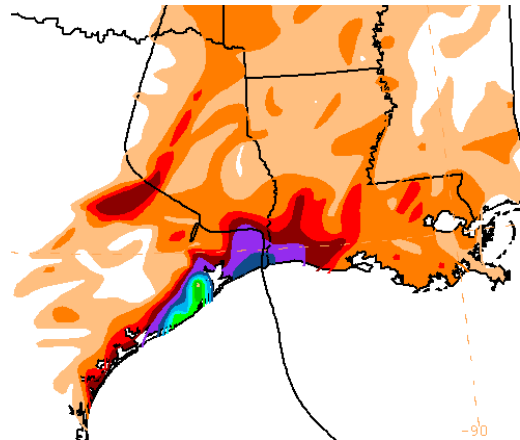


Seventeen counties saw severe and widespread damage, eight of which were declared flood-disaster areas. In the three counties of Bandera, Kerr, and Medina, \$50 million in water damage had been incurred. In all, losses totaled \$110 million. Thirty-three people perished in the great flood.

**July 24-30<sup>th</sup>, 1979 (Claudette):** The tropical storm named Claudette proved that Amelia was no fluke; slow-moving tropical storms can cause catastrophic damage. This “weak” tropical storm

made landfall near Galveston and made a loop just after landfall, essentially stalling over southeast Texas for two days (25<sup>th</sup> and 26<sup>th</sup>). At Nederland, between Port Arthur and Beaumont, the pressure bottomed out at 29.46" and winds gusted to 60 mph. Chocolate Bayou had tides as high as five feet.

A deluge of rain ensued, causing amounts greater than ten inches within 40 miles of the coast from Matagorda Bay to Sabine Pass (storm total rainfall in the graphic above). Totals reached 45 inches at Alvin (their 42 inches in a 24 hour period set a new national rainfall record). This excessive rain caused widespread and unprecedented flooding across the area; most streams didn't return to their banks until the 30<sup>th</sup>. Fifteen thousand homes and hundreds of businesses were flooded out. The rice crop was beaten into the soil by the heavy rainfall. President Jimmy Carter declared six counties in southeast Texas major disaster areas.



In Austin, two inches of rain in less than an hour's time around 7 AM on the 27<sup>th</sup> caused flash flooding. Daily rainfall records were set at Corpus Christi (1.59" on the 29<sup>th</sup>), Victoria (2.35" on the 26<sup>th</sup>), and Laredo (0.44" on the 26<sup>th</sup>). A hail storm, accompanied by high winds, occurred at 1:45 PM on the 27<sup>th</sup> in Val Verde county between Loma Alta and Bakers Crossing. Claudette produced \$750 million in damages, putting it on the National Hurricane Center's list of history's most damaging tropical cyclones in the United States. One person drowned at a flooded underpass in the Golden Triangle.

**August 9-12<sup>th</sup>, 1980 (Allen):** Allen formed 1100 miles east of Barbados on the 1<sup>st</sup>. It moved westward through the Atlantic and became a hurricane on the 3<sup>rd</sup>, when about 120 miles east of Barbados (track above). The storm became the strongest hurricane ever in the Caribbean on the 7<sup>th</sup>, with winds of 185 mph and higher gusts, and a pressure of 899 Mb (26.55"). To the right is a picture hurricane hunters took while inside the eye of Allen, provided by the University of Washington.

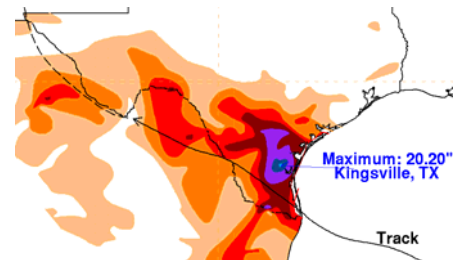




Allen began to weaken as it entered the Gulf of Mexico on the 8<sup>th</sup> as it moved west-northwest. Dry air began to intrude into the system which caused weakening. As it slowed to a crawl off of Brownsville, dry air continued to invade the system, causing more weakening. Allen made landfall as a category 3 hurricane near Corpus Christi on the 10<sup>th</sup>. To the right is an image of taken during Allen on the 11<sup>th</sup> near Kingsville, used with the permission of Jim Leonard.



Daily rainfall records were set for Corpus Christi on the 9<sup>th</sup> and 10<sup>th</sup> (6.34" and 6.93" respectively), which led to a new rainfall record for the month of August (14.39"). Daily rainfall records were also set at Victoria (2.51" on the 10<sup>th</sup>) and Laredo (3.92" on the 10<sup>th</sup>).

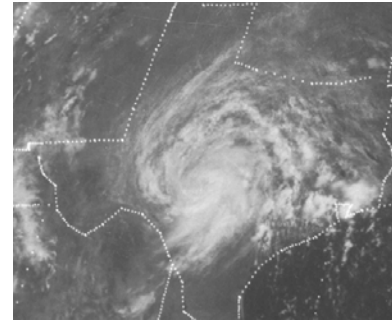


The highest wind gust reported was from Port Mansfield, 138 mph. Storm surges reached 12 feet at Port Mansfield. Five foot surges were reported up to Galveston Island. The pressure at Brownsville fell to 28.62". Buildings had up to four feet of standing water inside them. Winds gusted to 92 mph at Corpus Christi. Padre Island was cut through in 68 places. Dunes previously on the island were leveled. Most buildings on South Padre were destroyed except the Champion Club, its oldest building (dating from 1899). Purdy's Pier was destroyed.

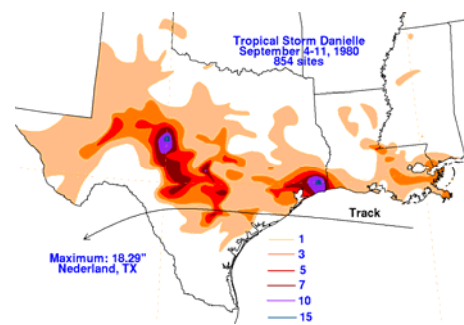
Tornadoes damaged 25 homes in Penita and injured 3 in San Antonio; 34 tornadoes were known to have touched down across south Texas. About 300,000 people evacuated. To the left is a satellite picture of Allen, while centered well inland, at noon on the 11<sup>th</sup>, provided courtesy of NESDIS. Seven died in Texas and 17 in Louisiana; most in Louisiana died as a helicopter evacuating them from an offshore platform crashed. Damages totaled \$1 billion...\$40 million on South Padre Island and Port Isabel. Rains from Allen relieved a serious drought in southern Texas.



**September 5-10<sup>th</sup>, 1980 (Danielle):** Areas of southeast, central, and west Texas remained in drought when Allen moved by to the south. This situation would be remedied by the rain-laden Tropical Storm Danielle. A tropical depression formed 70 miles south of the Mouth of the Mississippi river on the 4<sup>th</sup>. As it moved west, offshore of Sabine Pass, the system became a tropical storm. The storm made landfall near Galveston and moved slowly west and northwest across Texas. Its circulation weakened rapidly by the 7<sup>th</sup>, as the system passed Del Rio.



Due to the excessive rainfall in Jefferson county (over 17 inches at Nederland, Groves, and Port Arthur), over 1000 structures flooded. In Bandera county, a bridge on Highway 16 washed out. Three thousand goats drowned in Mason County. Several days of heavy rain led to patchy flash flooding in southern Concho and southwestern McCulloch counties where up to eight inches of rain fell.



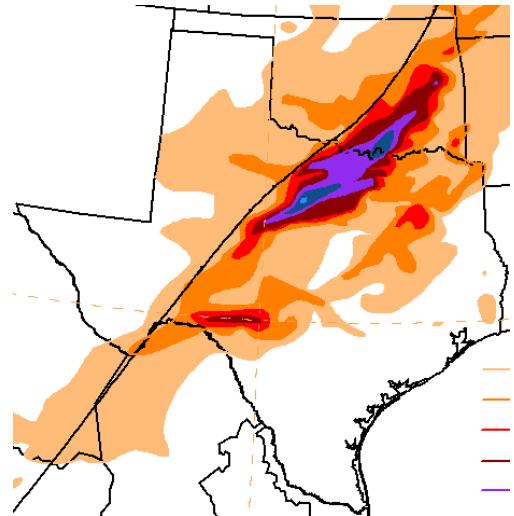
Mountain Creek crested at fifteen feet, causing considerable damage at the city golf course. The rain extended northwest into Tom Green county where six to eight inches of rain flooded seventy five roads, including another segment of U.S. 87. Over nine inches inundated Mitchell county, causing flooding of area creeks. Flooding was seen across southeast, central, and west Texas. In southeast Texas, the recently-damaged Highway 87 yet again went underwater as Danielle approached on the 5<sup>th</sup>. Tides increased to 3.5 feet.

Ten inches of rain in Nolan county forced 300 to evacuate Roscoe. Portions of I-20 were closed. Flooding spread into Midland then north into Crane, Howard, Glasscock, and Martin counties. Midland/Odessa experienced further flooding on the 10<sup>th</sup> when additional rains fell. Around 25 inches of rain fell ten miles northwest of Junction, almost twice as much as falls in an average year. Bear Creek carried away part of I-10 in the flash flood. This rain led to the second highest crest ever reported along the Llano river, leading to severe flooding. Five tornadoes touched town in southeast Texas from the 5<sup>th</sup> through the 8<sup>th</sup>. Several houses were set ablaze by lightning strikes. Total damages were \$20-30 million. Two people died; one drove into a flooded underpass and the other due to a heart attack.

**It came from the Pacific Ocean.** Before 1966, tropical storm activity in the eastern Pacific was fairly undocumented. This was due to the fact that most tropical systems formed south of Mexico and moved west and northwest, harmlessly out to sea, away from normal shipping lanes. With the advent of continuous satellite surveillance, the true magnitude of the activity in areas southwest of Mexico became known; double the value previously thought to be true. About once a year, one of these storms will recurve northeast into Mexico as a significant tropical cyclone.

Sometimes their remnants will adversely affect the Lone Star state.

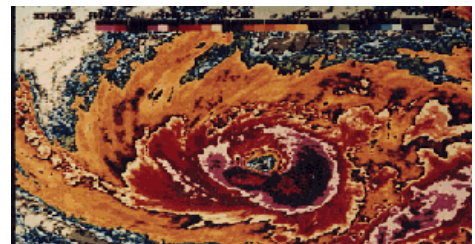
**October 12-13<sup>th</sup>, 1981 (Norma):** The eastern Pacific hurricane known as Norma hit Mexico south of Mazatlan late on the 11<sup>th</sup> and accelerated northeast. It crossed the Rio Grande north of Del Rio into the United States 24 hours later. Three days of rain added up to 25 inches at Gainesville, Breckenridge, and Bridgeport. The remainder of central Texas saw five to ten inches of rain. Laredo set a daily rainfall record for the 13<sup>th</sup> (0.27"). Tarrant County sustained more than \$50 million in damage to property. Stephens County saw the skies open up when more than 21 inches of water fell in less than a day's time; \$20 million in flood damage was seen there. Lake Bridgeport's reservoir went from 30 feet below normal up to their normal level within a few days.



Grayson county suffered a 100-year flood with this storm on the 12<sup>th</sup> and was then visited by a more epic flood on the 16<sup>th</sup>. Elm Creek in Gainesville flooded the city zoo, drowning many animals. Its elephant, Gerry, was swept away by the nearby creek and lodged into a tree. The only reason it survived was that it held its trunk above water level for more than a dozen hours as waters receded around him.

**Late September 1982 (Paul):** An east Pacific tropical storm made landfall southeast of Los Mochis on September 26<sup>th</sup>. Historic flood crests on the Rio Grande were the result of its eastern movement into southwest Texas. Five to fifteen inches of rain soaked the Trans Pecos region from the Guadalupe to the Davis Mountains during the entire last week of September. Equally heavy rains fell in Northern Mexico as well. Around Presidio, 25' river stages were experienced three times, flooding 70,000 acres. The railroad bridge connecting the United States and Mexico was wiped out. The Rio Grande swelled to two miles across at Candelaria, which suffered five days of road washouts.

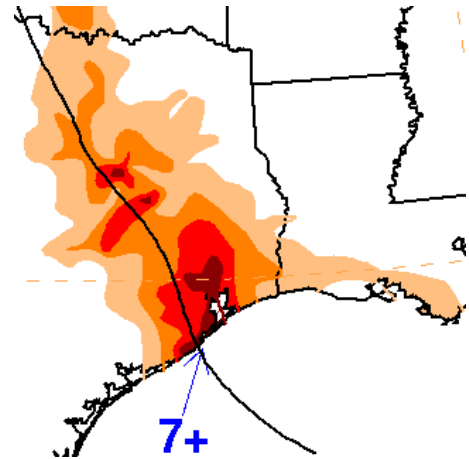
**August 17-18<sup>th</sup>, 1983 (Alicia):** A weak frontal trough drifted in the northern Gulf of Mexico on the night of the 14<sup>th</sup>. A huge area of thunderstorms developed off the coasts of Mississippi, Alabama, and northwest Florida. A large cluster of thunderstorms, known as a Mesoscale Convective Complex (MCC), was seen 150 miles south of the Louisiana coast during the morning and early afternoon of the 14<sup>th</sup>. It drifted west-southwest and by the afternoon of the 14<sup>th</sup>, thunderstorms developed over an apparent surface circulation. A weak low was analyzed in that area. The system became Alicia, a



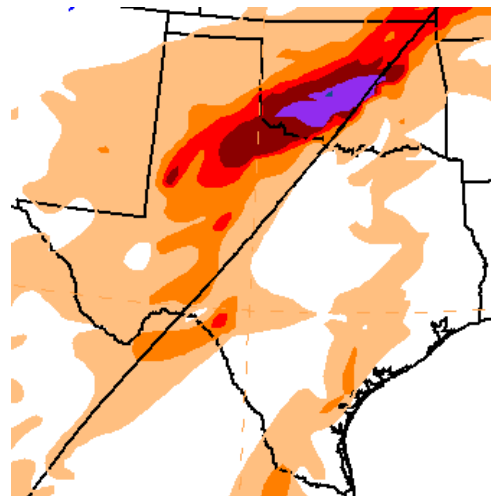
tropical storm, by the afternoon of the 15<sup>th</sup> and a hurricane by the afternoon of the 16<sup>th</sup>.

Hurricane Alicia struck the coast at around 2 AM on the 17<sup>th</sup> in southwestern Galveston Island after moving painfully slow in the Gulf. The pressure fell to 28.55" at the Alvin weather office. In Houston, glass from skyscrapers filled the streets below. It weakened into a tropical depression as it passed east of College Station. Storm surges were 12.1 feet at Morgan Point, along Galveston Bay.

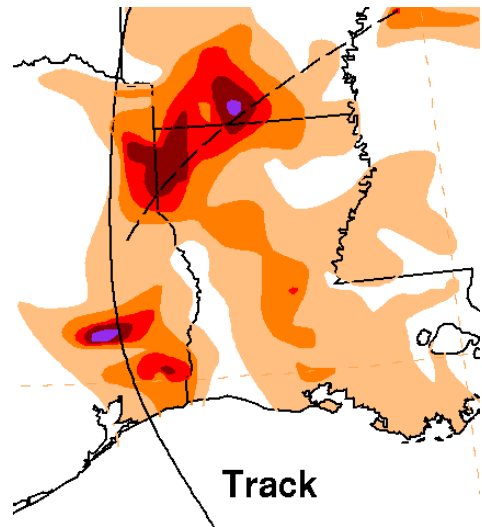
As Alicia moved northward through Oklahoma, it relieved drought conditions across the Plains. The highest rainfall total noted was 10.75 inches at Greens Bayou, while 9.70 inches fell at Deweyville. Highest winds measured were 102 mph gusts at Galveston. Twenty-three tornadoes were spawned by the cyclone in southeast Texas and twenty-one people perished. A major crude oil spill occurred around Texas City. About 60 gallons of water had to be removed from the National Weather Service Office in Alvin. An ocean going tug capsized 50 miles south of Sabine Pass. Fifty to 200 feet of the Galveston Island coast eroded away. Damages totaled over \$3 billion.



**October 17-21<sup>st</sup>, 1983 (Tico):** The Pacific hurricane known as Tico moved slowly northeast ahead of a closed mid-level low in the southwestern United States. As it moved along an old frontal boundary, heavy rains fell in a swath from the Texas Panhandle northeastward across central Oklahoma and central Missouri. Over 11 inches fell to the west of Wichita Falls (see rainfall figure to the left from Storm Data). Daily rainfall records were set on the 21<sup>st</sup> at Corpus Christi (2.47") and Victoria (1.73"). A damaging F2 tornado struck Elgin, OK. One life was claimed and total damage exceeded \$93 million (Byrd & McCaul).

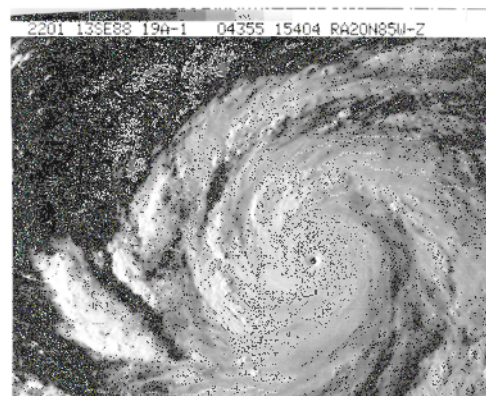


**June 26<sup>th</sup>, 1986 (Bonnie):** Bonnie made landfall along the upper coast as a minor hurricane. Jefferson County Airport gusted to 75 mph while Sabine Pass reported gusts to 97 mph at the coast guard station near Sea Rim State Park. Debris littered the streets of Port Arthur and Beaumont. High winds ripped roofs off numerous homes and businesses. Tractor-trailer rigs were flipped over. Highway 87 was closed due to fallen power poles early on the 26<sup>th</sup>. Several aircraft were damaged at area airports. Winds in Sam Rayburn reservoir caused \$1 million in damage to boats and marinas. Heavy rains fell between Beaumont and Lake Livingston. As much as 13 inches deluged Ace, in Southern Polk county.

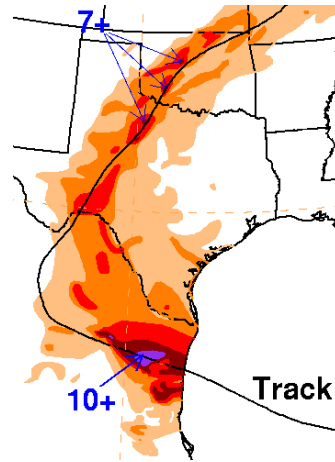


In San Jacinto County, flooding of Big Creek closed U.S. 59 for several hours. The 7 ½ inches of rain at Bridge City led to local flooding as well. Several tornadoes touched down, causing minor damage. Four perished due to Bonnie.

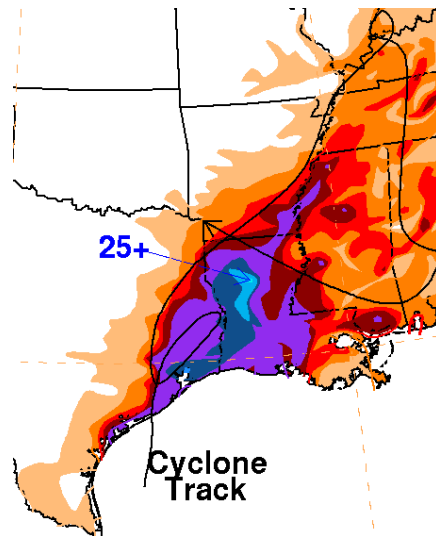
**September 16-17<sup>th</sup>, 1988 (Gilbert):** The hurricane with the second lowest pressure ever recorded within the Western Hemisphere, Hurricane Gilbert tore across Jamaica with winds of 115 mph, before striking Cancun, Mexico as a strong category five with sustained winds estimated at 185 mph. To the right is an image of this hurricane on the 13<sup>th</sup>, provided by the National Climatic Data Center. As it moved into the Gulf of Mexico, its intensity never rose back above category three intensity. It is believed that significant dry air intrusion and cooler sea surface temperatures prevented Gilbert from restrengthening futher. Gilbert struck the coast of Mexico on the 17<sup>th</sup>, before accelerating north and east into the Central Plains.



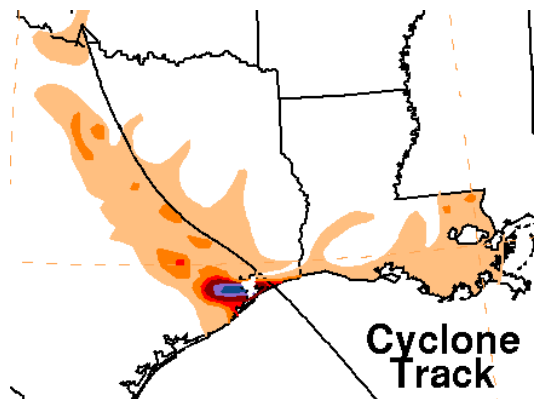
Even though Gilbert struck well south of the border, gusty winds and 29 tornadoes were seen with the system in Texas. The thirteen tornadoes that touched down in the San Antonio area caused \$35 million of the damage. Gusts to 83 mph were measured near Brownsville. Although the heaviest rainfall from Gilbert fell south of the border in northeast Mexico, heavy rains fell along the Rio Grande valley past Del Rio, then across the Trans Pecos and Big Country regions of the state. Laredo set a daily rainfall record for the 16<sup>th</sup> (1.85"). South Padre Island was flooded by its storm surge. Three perished in San Antonio from tornadoes. Damages totaled \$50 million.



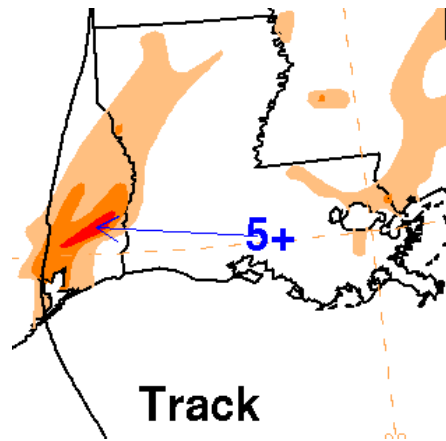
**June 26-28<sup>th</sup>, 1989 (Allison):** Allison formed from the remains of Pacific hurricane Cosme, which made landfall near Acapulco and accelerated northeast into the western Gulf. A new surface circulation formed in the western Gulf of Mexico and moved north-northeast, strengthening into a tropical depression and then a tropical storm offshore the Texas coastline. Winds gusted to 56 mph at Galveston on the 26<sup>th</sup> as Allison made landfall. One tornado touched down on the Bolivar peninsula and did minor damage (Lichter). Over 30 inches of rain led to severe flooding in extreme Southeast Texas...only ten years after the extreme flooding from Claudette. Eleven died during the storm. Damage from Allison totaled \$500 million, putting it on the list of the United States' most damaging storms.



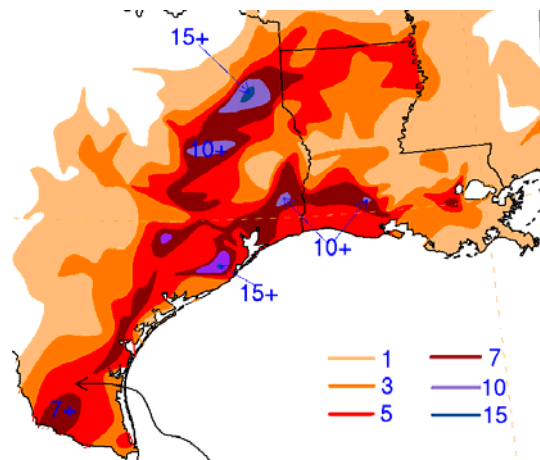
**August 1<sup>st</sup>, 1989 (Chantal):** This system formed as a tropical depression on July 30<sup>th</sup> in the Gulf of Mexico, moving north-northwestward. The system strengthened into a tropical storm on the 31<sup>st</sup> and a hurricane on August 1<sup>st</sup>, before striking High Island as a minor hurricane. Its strongest winds were within its western semicircle. Rainfall amounts were most extreme around Houston, with a peak of 20 inches falling at Friendswood. Beach erosion occurred at High Island. Two tornadoes touched down, with one reported at Crystal Beach. Damages totaled \$100 million. Thirteen people perished.



**October 15-16<sup>th</sup>, 1989 (Jerry):** This hurricane crossed the east end of Galveston Island and became the latest landfalling hurricane in recent Texas memory. Winds of 75 mph gusting to 100 mph were measured at Scholes Field on Galveston Island. Tides were as high as eight feet near the entrance of the Houston Ship Channel (Lichter). Six tornadoes were spawned by Jerry. When it hit during an astronomical high tide, Highway 87 was destroyed for the final time between Sabine Pass and High Island, never again to be rebuilt. Damages totaled \$70 million. Three people passed away due to Jerry.



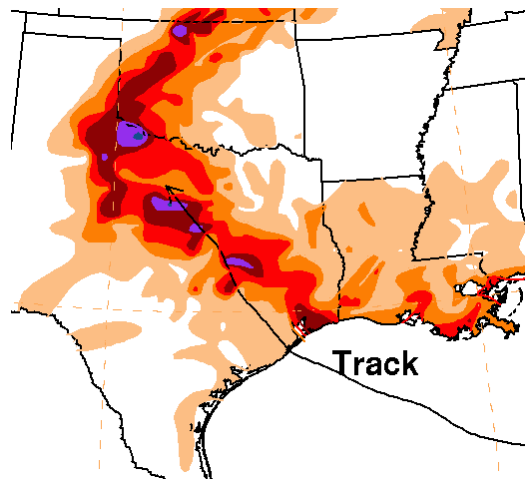
**June 18-23<sup>rd</sup>, 1993 (Arlene):** A mid to upper level low formed over the Bay of Campeche on the 16<sup>th</sup> as a tropical wave approached from the east. Convection in the western Caribbean associated with the tropical wave, active since the 9<sup>th</sup>, expanded west-northwest. Late on the 16<sup>th</sup>, a low pressure area formed over the Yucatan peninsula. By the night of the 17<sup>th</sup>, convective organization increased in the southern Gulf of Mexico, and the low became a tropical depression. It moved northwest between the upper low, now to its southwest, and a warm core high to the northeast. . By the 18<sup>th</sup>, southwest flow from both the upper low to the southwest and the outflow from Tropical Storm Beatriz in the eastern Pacific kept the cyclone weak.



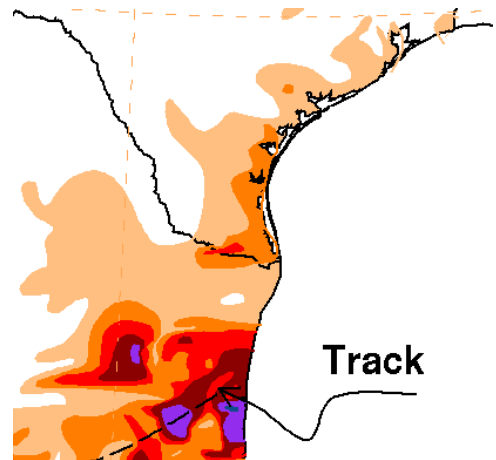
On the 19<sup>th</sup>, a convective band tried to wrap around the north and east side of the center. On the northwest edge of the band, a new circulation formed which quickly became the dominant center, and it was strong enough to be upgraded to a tropical storm. It continued its slow march to the west-northwest, making landfall across Padre Island about 40 miles south of Corpus Christi early on the morning of the 20<sup>th</sup>. The weakening cyclone moved slowly over the lower Rio Grande Valley of Deep South Texas and northeast Mexico.

**July 30-August 7<sup>th</sup>, 1995 (Dean):** On the 27<sup>th</sup>, a weak surface low developed in the eastern Gulf of Mexico. It moved west-northwest, slowly getting better organized. While situated sixty miles offshore the Texas coast, reconnaissance aircraft and Doppler radar data indicated that the fourth tropical depression of the season had intensified into a tropical storm, then named Dean. The cyclone crossed the coast near Freeport. At Scholes Field, in Galveston, winds gusted to 51 mph. Two tornadoes touched down around the time of landfall, near High Island and to the southeast of Anahuac.

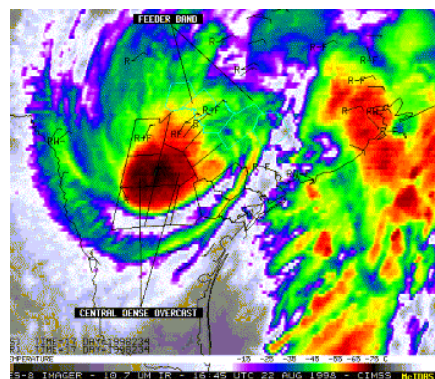
Heavy rains fell across Chambers and southern Liberty counties...with Monroe City in Chambers county reporting 16.78" of rain. As the low moved inland, it interacted with the dryline and terrain across central Texas to induce flooding from the 1<sup>st</sup> through the 3<sup>rd</sup>. Abeline saw its roads go underwater quickly, and for days. Catclaw and Cedar Creeks went into flood, putting a duplex and mobile home park underwater. One child drowned near the Foard/Wibargar county line, as it was swept away by the flood waters. Laredo set a daily rainfall record for August 1<sup>st</sup> (1.21"). Damage totaled under \$1 million.



**August 9-12<sup>th</sup>, 1995 (Gabrielle):** A tropical depression formed just off the Mexican coast. Normally, a system such as this would move right on inland. However, there was a tropical storm developing just offshore the west coast of Mexico in the Pacific Ocean. This caused winds aloft to fade, and the system became stationary, intensifying fairly rapidly to tropical storm status. Just before moving inland, an eyelike feature formed with the 70 mph tropical storm. The effects across Texas were minimal. Four to six inches of rain helped relieve significant drought conditions across deep south Texas. Laredo set a daily rainfall record for the 12<sup>th</sup> (0.36"). Some damage occurred to unharvested cotton.



**August 22-25<sup>th</sup>, 1998 (Charley):** A large cluster of thunderstorms, also known as an MCC (mesoscale convective complex) formed just offshore the southeast Texas and southwest Louisiana coastline on the 15<sup>th</sup>. The system drifted southeast into the central Gulf of Mexico by the 19<sup>th</sup>, with thunderstorms redeveloping each day. On the 20<sup>th</sup>, an upper level low moved westward to the west of this disturbance, producing a less hostile upper level environment. By the 21<sup>st</sup>, advisories were initiated by the National Hurricane Center on Tropical Depression #3.



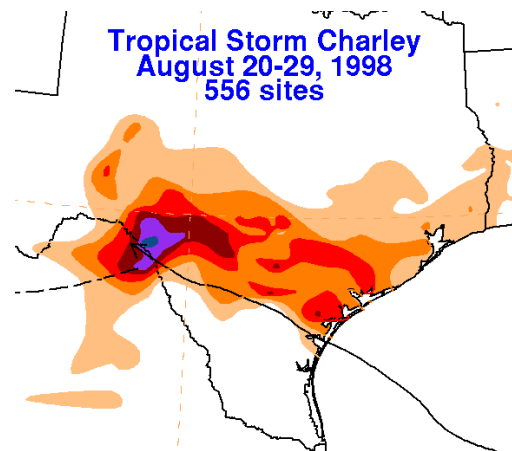
This system became a tropical storm, named Charley, soon after as it moved northwest back towards Texas. The upper low that initiated rapid development also moved the storm more to the



north than originally thought. Also, all the deep convection remained on the north side of the circulation center, preventing Charley from becoming a hurricane. It made landfall just after midnight on the 22<sup>nd</sup>, in the vicinity of Rockport, with sustained winds of 60 mph.

The gulf invaded North Padre Island, where seawater reached the dunes. Immediate shoreline roads were closed. Gusts to tropical storm force were felt across southwest Louisiana and the northern 2/3 of the Texas coast. The Port O'Connor Coast Guard reported gusts to 63 mph while the Colorado River Locks in Matagorda county measured gusts to 69 mph. The pressure fell to 29.55" at Rockport at 5:59 AM on the 22<sup>nd</sup>.

As the storm moved inland and weakened, heavy rains fell across southern Texas, ending an extreme drought (storm total rainfall to the right). An observer at the Mouth of the San Bernard river in Brazoria county reported nine inches of rain. Three miles southwest of Refugio, 7.3" fell. Amounts up to 11 inches were seen that night over southeast Bee and southwest Refugio counties, leading to significant flash flooding. Highway 77 near Woodsboro was closed for 36 hours due to one and a half feet of water on the roadway. Homes in the Madison Oaks subdivision of Woodsboro were flooded. The town of Three Rivers saw water flood cars in the area. Victoria set a daily rainfall record for the 22<sup>nd</sup> (2.49").



On the night of the 23<sup>rd</sup>/24<sup>th</sup>, the dying tropical depression caused another round of heavy rainfall, this time near Del Rio. A total of 11.83" of rain fell at Del Rio on the 24<sup>th</sup>, simultaneously breaking the all-time daily and August monthly rainfall records. That August also became the wettest month ever at Del Rio when over 18 inches fell in all. On the right is an image of the flooding associated with Charley in Del Rio, Texas on the 25<sup>th</sup>, taken by the Texas Department of Public Safety. To the upper right is a picture of the flooding at Laughlin Air Force Base, courtesy of the Air Force.



Two-thirds of the city of Del Rio went underwater. Four people were reported drowned in the flood waters in Real county. Twelve lives were lost in Texas and three perished in Mexico due to the floods. Many livestock were lost near Quemado in Maverick county. The Rio Grande rose to near the base of the International Bridge in Laredo and over the bridge at Eagle Pass.

Early on the 25<sup>th</sup>, another round of rain fell from the skies in extreme northeast Mexico and west Texas, with more than six inches of rain falling in Crockett county, which led to a continuation of the epic flood in Del Rio. At least \$5 million in damages was caused by this tropical storm.

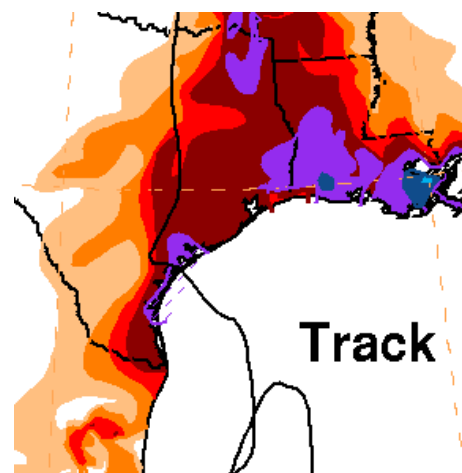
**September 10-14<sup>th</sup>, 1998 (Frances):** On the 7<sup>th</sup>, an area of disturbed weather formed in the Central Gulf of Mexico. It was complex with a broad area of low pressure, induced by a nearby upper level low to the west of the surface circulation. Strong east winds had barely relaxed after Charley, which had just made landfall in Texas, before redeveloping along the Texas shore. Air Force aircraft flew into the system on the 8<sup>th</sup>, and a tropical depression was found 220 miles southeast of Corpus Christi. It moved very little over the next 24 hours, slowly strengthening into a tropical storm by the 9<sup>th</sup>.

Strong winds along the Louisiana and Texas coasts increased, resulting in a large area of coastal flooding. Sabine Pass was cut off to travel by land on the 10<sup>th</sup> and remained so for the next week, until Hermine passed by to the east. Indianola and Alamo Beach were flooded and isolated from the mainland. To the right is an image of damage caused by Frances on West Galveston Island, courtesy of the Texas Bureau of Land Management.



Frances began to move north on the 10<sup>th</sup>, and the drought-ending rains began across east Texas and Louisiana. A large area of tropical storm force winds buffeted the coasts of Louisiana and Texas, worsening the coastal flooding and leading to backwater flooding of area rivers, as water was no longer able to drain into the Gulf of Mexico due to the high tides. Meacom's pier was nearly destroyed. San Luis pier was damaged. Bob Hall pier was undermined by erosion. Tides ran as high as eight feet at the Matagorda Locks and 5.4 feet at Cameron and Sabine Pass. Offshore oil platforms saw howling winds reaching as high as 90 mph in gusts.

The system strengthened and moved north as feeder bands moved inland. The deluge caused a large area of ten inches or more of rain across south Louisiana and east Texas. The highest rainfall total in Texas was 17 inches at the Matagorda Colorado Locks; to the right is a map of the storm total rainfall across the western Gulf coast from Frances, with dark blue indicating areas with over 15 inches of rain. The pressure induced by the rain in New Orleans caused manholes to be blown skyward. Sections of I-10 in New Orleans and Houston and U.S. 59 west of Beeville were underwater during the 11<sup>th</sup>. Roads and bridges were submerged near Corpus Christi. Numerous towns evacuated from the flash flooding.



The center made landfall at midnight on the night of the 10<sup>th</sup> near Matagorda and became stationary again on the 11<sup>th</sup>, prolonging the wind and rain. Winds gusted as high as 66 mph at Sea Rim State Park in Jefferson county and 54 mph at Galveston. The lowest pressures reported were 29.33" at Rockport and 29.38" at Palacios. Three tornadoes touched down in Texas; at Caney Creek, La Porte, and Palm Beach (on the west end of Galveston Island). During the 12<sup>th</sup>, the system resumed a northerly course through east Texas before accelerating into Iowa by the 14<sup>th</sup>. Rains of five inches or more soaked Louisiana, Mississippi, Oklahoma, Arkansas, and Missouri.

The coastal flooding and beach erosion southward to Sargeant were the worst seen since Carla in 1961. River flooding was significant across east Texas and Louisiana. A major disaster declaration was issued for Brazoria, Galveston, and Harris counties. Over \$10 million in damage was experienced across southwest Louisiana and extreme southeast Texas.

**August 21-23<sup>rd</sup>, 1999 (Bret):** On the 16<sup>th</sup>, an area of disturbed weather developed off the coast of Nicaragua. The area moved northwest, becoming a broad low pressure system over the Yucatan peninsula of Mexico on the 16<sup>th</sup> and 17<sup>th</sup>. It formed into a tropical depression within the Bay of Campeche the morning of the 18<sup>th</sup>. By noon, ship reports indicated it formed into a tropical storm. Bret remained nearly stationary through the 20<sup>th</sup>, as upper level winds from an upper level low passing to the north countered the easterly winds at the surface.

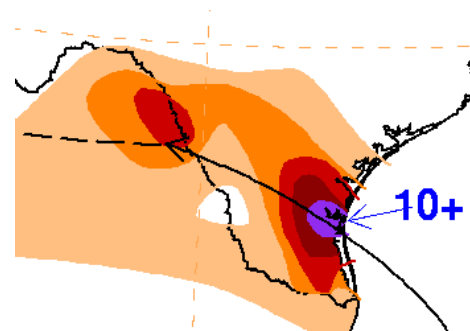


As the upper low moved to the west, winds aloft became favorable for development and the system rapidly became a hurricane, moving northward. This motion continued until the night of the 21<sup>st</sup>, when the upper low moved further to the west and southwest, steering Bret on a more westward track. Peaking in intensity as a category four hurricane as it made its turn toward Texas, the storm began encountering much cooler sea surface temperatures near the coast. Weakening quickly, Bret made landfall in sparsely-populated Kenedy county around 7 PM CDT on the 22<sup>nd</sup>. The system became a tropical storm on the morning of the 23<sup>rd</sup> and a tropical depression that evening as it crossed the Rio Grande near Laredo, into Mexico. Highest sustained winds reached 73 mph from the northwest before power failure at Rincon Del San Jose. Falfurrias measured gusts to 98 mph at 11:30 pm CDT on the 22<sup>nd</sup> before power failure. Gale-force winds extended from Corpus Christi to Brownsville. The lowest pressure was measured at Falfurrias....28.84".

Six tornadoes were reported from the coast inland to Burnet county. An F0 tornado tore across Weslaco during the early afternoon of the 23<sup>rd</sup>. Mobile homes and a laundry mat experienced damage, while a 300-foot tall radio tower blew down. Three dozen homes were destroyed in Nueces county. To the right is a picture of a downed Citgo gas station canopy, taken by George Gongora of the Corpus Christi Caller-Times. Insured losses totaled near \$60 million.



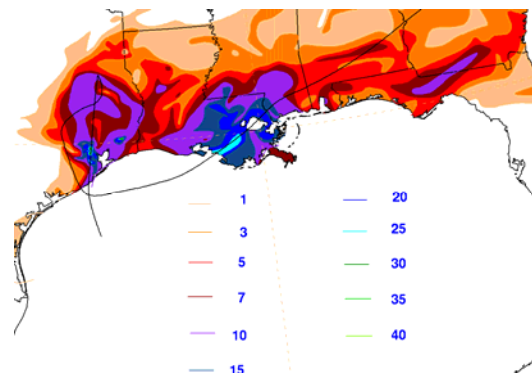
Doppler radar estimated rainfall amounts approaching 40 inches in northeast Kenedy county...the highest recorded total came from Sarita, which experienced a 13.18" downpour. Rainfall from the storm helped out area crops and rose levels in area reservoirs that were very low after periodic droughts from 1995 to 1998. Extensive flooding occurred in Brooks and Kenedy counties. Los Olmas creek crested at 10 feet in Falfurrias, requiring evacuations. The Rio Grande rose to its banks in Laredo, but stopped short of flooding.



Storm surges only reached 1.3 feet at Port Isabel. Even at Port Mansfield, bay levels only rose to 1.1 feet above mean sea level. Twelve cuts were made in Padre Island as the storm surge receded (three were major). Four died in Laredo when a tractor-trailer jack knifed during the storm, crushing a pickup truck.

## Hurricanes of the Early Twenty-First Century

**June 4-11<sup>th</sup>, 2001 (Allison):** A tropical wave moved off the west coast of Africa on May 21st. Tracking westward, the wave moved through the tropical Atlantic and Caribbean Sea reaching the eastern Pacific Ocean on June 1st. A low level circulation formed on the 3<sup>rd</sup> south of Vera Cruz, and this low moved north into southeast Mexico steered by deep southerly flow. The low moved into the Bay of Campeche on the 4<sup>th</sup> as an area of thunderstorms, guided north-northwest through the western Gulf of Mexico.



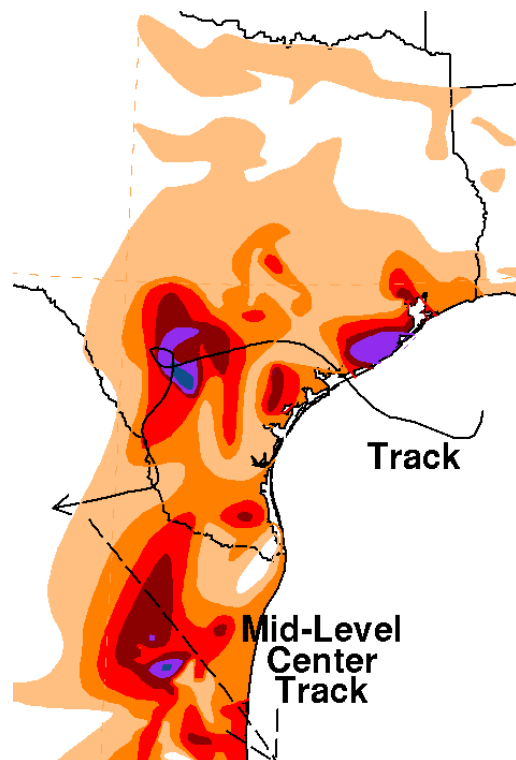
The low became increasingly organized, and became a tropical storm about 80 miles south of Galveston Texas. Steered by the subtropical ridge off the southeast, Allison moved north into Texas that evening, eventually tracking as far inland as Lufkin by the morning of the 7th. After already dropping ten or more inches of rain across portions of Texas and Louisiana, the cyclone began to move southward as a ridge over New Mexico strengthened just as the high off the southeast flattened and moved southeast.



This set the stage for massive flooding in southeast Texas on the 7th and 8th. The highest totals noted were 40.68 inches at Moore Road Detention Pond in Jefferson

county, with 36.99 inches at the Port of Houston Texas, and 29.86 inches at Thibodaux Louisiana. Portions of Houston, Beaumont, Thibodaux, Lafayette, New Orleans, and Baton Rouge saw severe flooding from this excessive rainfall. Rains would continue into the 11th, as Allison moved back off the Texas coast, paralleling the coast of Louisiana before making a second landfall in the Teche region of the Bayou State. Damage to Texas totaled \$5 billion and 22 people perished within the state borders from this tropical storm.

**September 4-14<sup>th</sup>, 2002 (Fay):** Tropical Storm Fay developed from an area of disturbed weather that included a broad, non-tropical low pressure system over the northwestern Gulf of Mexico. During the first few days of September, a broad mid- to upper-level trough moved southward from the United States and became stationary across the northern Gulf of Mexico. Thunderstorms developed along a surface low pressure trough that hugged the northern Gulf of Mexico coastal areas. Gradually, the trough and a series of weak low pressure systems drifted southward over the very warm waters of the Gulf. A low in the northwestern Gulf of Mexico became the dominant circulation and developed persistent deep convection near the low-level center by the 4th. On the 5th, an Air Force Reserve Reconnaissance aircraft investigated the system when it was centered about 85 miles southeast of Galveston, Texas and found that a tropical depression had formed by noon.

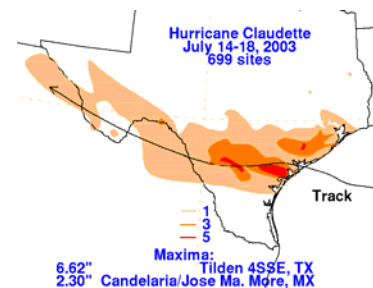


The depression moved steadily south-southwestward and strengthened fairly quickly, becoming Tropical Storm Fay on the evening of the 5<sup>th</sup> about 110 miles southeast of Galveston. Fay moved south-southwestward for 12 hours before turning toward the west where it reached its peak intensity of 60 mph on the morning of the 6<sup>th</sup>. Shortly thereafter, Fay turned and moved erratically west-northwestward and maintained intensity until landfall occurred early on the morning of the 7<sup>th</sup> on the southern Matagorda Peninsula near Port O'Connor, Texas. As it made landfall, the broad circulation reformed in a convective complex farther north, northwest of Palacios. Fay then made a sharp turn toward the west and accelerated. With more of the circulation being over land, the faster forward speed hastened the weakening process and by the night of the 7<sup>th</sup>, Fay had degenerated into a remnant low pressure system about 30 miles southwest of Hondo, Texas. The remnant low meandered across southern Texas and northeastern Mexico for another three days producing near 20 inches of rainfall before finally dissipating about 65 miles northwest of Monterrey, Mexico. Its residual thunderstorm activity drifted through northeast Mexico, back into the Western Gulf of Mexico before dissipating.

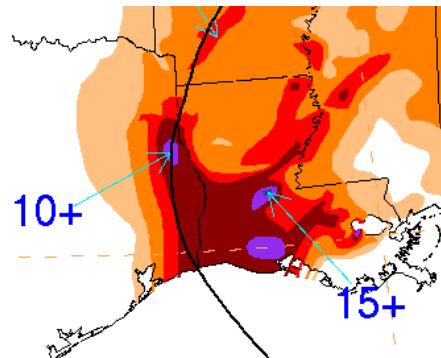
**July 14-17<sup>th</sup>, 2003 (Claudette):** Hurricane Claudette developed from a tropical wave over the central Caribbean Sea on July 8<sup>th</sup>. The tropical wave that Claudette developed from produced gusty winds and locally heavy rains over St. Lucia, where minor damage was reported. The storm moved westward until the 10<sup>th</sup> before moving northwest across the northwestern Caribbean Sea, bringing the center across the northeast Yucatan peninsula on the 11<sup>th</sup>. Claudette became a hurricane briefly on the 10<sup>th</sup>.



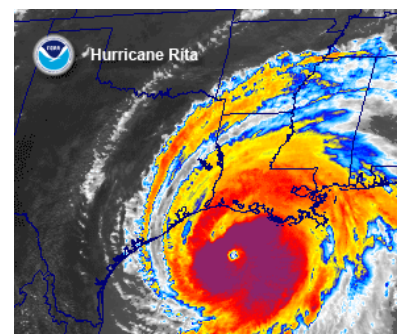
Its motion became erratic across the central Gulf of Mexico on the 13<sup>th</sup> before it turned north-northwest on the 14<sup>th</sup> due to southwesterly upper level winds. A building warm core ridge to its northwest forced a more westerly motion on the 15<sup>th</sup> as it regained hurricane strength. This motion brought the center to Port O'Connor, Texas on the 15<sup>th</sup> as a strong category one hurricane. The cyclone tracked quickly across southern Texas into northeast Mexico before moving across the southern Big Bend of Texas while dissipating on the 17<sup>th</sup>. One death was associated with Claudette in Texas. Damages totaled \$180 million.



**September 22-26<sup>th</sup>, 2005 (Rita):** Rita was an intense, destructive, and deadly hurricane that significantly impacted the Florida Keys and devastated extreme southeast Texas and southwest Louisiana. It formed off an old frontal zone, and developed into a tropical depression on the 17<sup>th</sup> just east of the Turks and Caicos Islands and moved westward, becoming a tropical storm on the afternoon on the 18<sup>th</sup> and a hurricane on the 20<sup>th</sup> as it moved through the Florida Straits. As it emerged into the Gulf of Mexico, Rita began to rapidly intensify.

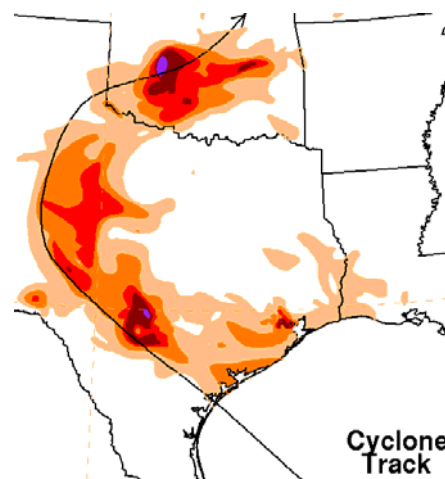


Maximum sustained winds increased to 175 mph on the 22<sup>nd</sup> while moving through the central Gulf of Mexico, and its pressure fell to 897 hPa, the third lowest on record for the Atlantic Basin and the lowest reported from the open waters of the Gulf of Mexico. Easterly gales into Lake Pontchartrain led to renewed flooding in the ninth ward of New Orleans soon after Katrina's flooding had receded. A significant shearline aloft lured Rita more northwesterly, and the tropical cyclone weakened as it moved away from



the warm waters of the loop current. Landfall occurred at 230 am CDT between Sabine Pass and Johnsons Bayou, LA while a category 3 hurricane. Rita slowly weakened as it accelerated inland, and maintained at least tropical storm strength when it crossed back into northwest Louisiana. The cyclone moved northeast and merged with a frontal wave on the 26<sup>th</sup>. A total of four direct and 55 indirect fatalities were associated with Rita in Texas. Damages totaled \$10 billion.

**August 14-22<sup>nd</sup>, 2007 (Erin):** A broad low pressure area formed near the Yucatan channel. The system organized as it moved through the central and western Gulf of Mexico, becoming a tropical depression and then tropical storm as it headed towards southern Texas. The system moved inland and weakened to a tropical depression. As is typical for a non-sheared tropical cyclone, thunderstorms developed near the center each night. Early on the morning of the 19<sup>th</sup>, a shortwave moved by to its north which significantly enhanced divergence over the tropical depression and led to significant strengthening. Beginning at 1 am CDT, maximum sustained winds reached tropical storm force, peaking at 50 mph between 2 and 3 am with gusts near 80 mph as the system briefly formed an eye feature. The central pressure of the depression dipped from 1007 hpa to



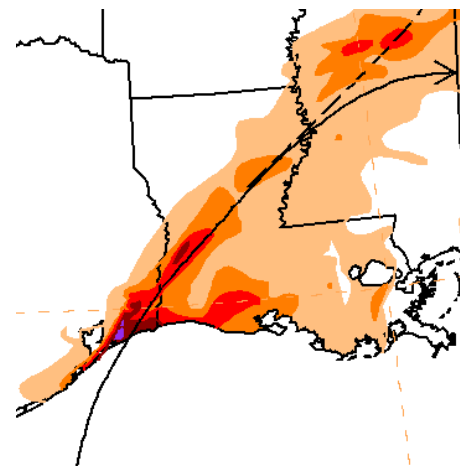
at least 1000 hpa per observations from the Oklahoma mesonet.

After sunrise, the shortwave that led to the deepening moved by to the east and began to shear the cyclone from the northwest. The system weakened back into a tropical depression by noon and its low level circulation was gone by 4 pm CDT. Its remnant mid level circulation led to one last burst of very heavy rainfall over Missouri. Thereafter, the shortwave accelerated eastward and its associated rainfall dropped off significantly. Flooding in Houston led to 400 homes and 40 businesses becoming submerged. Nine died due to Erin in Texas. Damages were minimal from this storm.

**September 11-15<sup>th</sup>, 2007 (Humberto):** A broad low pressure area formed along a surface trough in the western Gulf of Mexico. An area of thunderstorms formed on the northern end of the trough, which forced the development of a new, well-defined low pressure area. The system organized into a tropical depression on the morning of the 12<sup>th</sup>. Rapid development ensued, and within 18 hours of becoming a tropical depression Humberto became a tropical storm and then a hurricane as it headed north-northeast into the Golden Triangle of Southeast Texas during the early morning hours of the 13<sup>th</sup>, becoming the most rapidly developing tropical cyclone known to develop close to land in the Atlantic basin.



Weakening slowly after landfall, Humberto regained tropical storm and then tropical depression status as it moved through Louisiana into Mississippi. Its surface circulation was left behind across Louisiana as west-southwest vertical wind shear carried its mid-level center northeastward. According to surface analyses and satellite imagery, as Humberto's remnant mid-level circulation continued progressing northeast, it spawned a new low pressure area in Georgia which forced the original circulation southeast towards northern Florida before dissipation. As the mid-level center continued progressing, a third cyclone in southeast Virginia developed and moved northeast into the western Atlantic, absorbing the second low. Within Texas, one person died and damage totaled \$50 million.

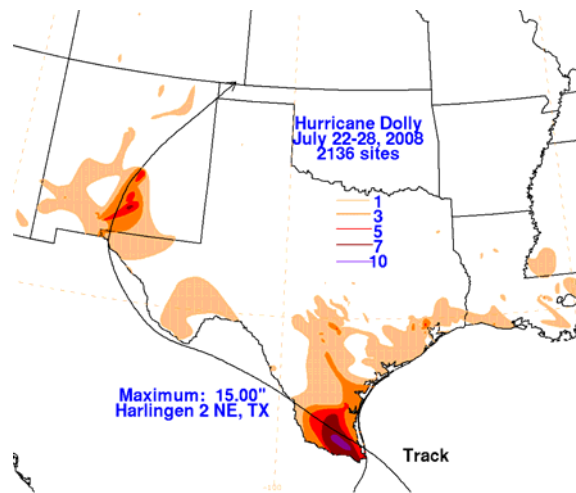




**July 22-28<sup>th</sup>, 2008 (Dolly):** A tropical wave moved offshore the coast of Africa on July 11<sup>th</sup>. The wave moved westward, generating a surface low midway between Africa and the Lesser Antilles on the 13<sup>th</sup>. The low moved westward, crossing the Windward Islands on the 17<sup>th</sup>. While the system had tropical storm force winds, it had no well-defined center until reaching the western Caribbean on the 20<sup>th</sup>, when it was declared a tropical storm. The system became ill-defined while moving around the periphery of the Yucatan peninsula, reorganizing in the southern Gulf of Mexico on the 21<sup>st</sup>.



Moving west-northwest, Dolly strengthened into a category 2 hurricane before moving inland into Texas southeast of Port Mansfield. Weakening while moving inland, Dolly became a tropical depression on the 25<sup>th</sup> and moved into northern Mexico. Identifiable on surface analyses for another few days, Dolly led to a burst of heavy rainfall across southern New Mexico on the 26<sup>th</sup> and 27<sup>th</sup>. By the morning of the 28<sup>th</sup>, its surface circulation had dissipated, with its mid-level center becoming stretched out before merging with an upper level low that night. Damages caused by Dolly in southern Texas totaled \$1.05 billion.

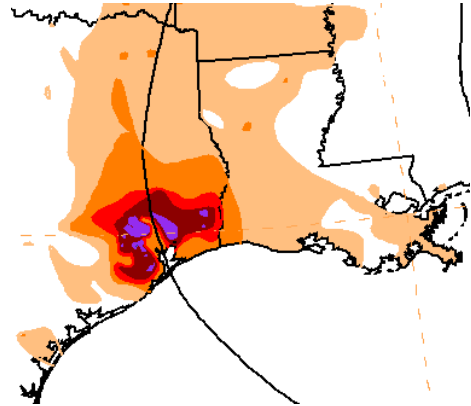


**September 12-15<sup>th</sup>, 2008 (Ike):** A tropical wave left the coast of Africa on August 28<sup>th</sup>. The system slowly organized, becoming a tropical depression, then a tropical storm by September 1<sup>st</sup>. The cyclone moved westward for much of its lifetime as the subtropical ridge extended westward to its north. By the 3<sup>rd</sup>, Ike had become a major hurricane as it rapidly intensified underneath an upper level high. Ike wavered between category 2 and 4 strength as the effect of northerly vertical wind shear and eyewall replacement cycles caused fluctuations in strength. On the 7<sup>th</sup>, Ike moved through the southeast Bahamas into eastern Cuba. Briefly emerging into the northwest Caribbean, Ike remained a hurricane through its next landfall across western Cuba on the 9<sup>th</sup>. Land interaction with western Cuba appears to have made Ike a larger cyclone, and after emerging into the Gulf of Mexico, its central pressure fell significantly on the 10<sup>th</sup> as it moved over the warm waters of the Loop Current. The large system strengthened back



into a category 2 hurricane, which moved west-northwest through the Gulf of Mexico around the periphery of the subtropical ridge.

On the 12<sup>th</sup>, Ike became slightly more compact as it moved into a confluent zone between the subtropical ridge to its east-northeast and upper level troughing across the Plains. This allowed maximum sustained winds to increase despite a relatively constant central pressure. Ike developed a banding-type eye, and moved into Galveston, Texas, and weakened as it moved into through eastern Texas and Arkansas. The system became an extratropical cyclone as it approached the Mid-Mississippi Valley, and rapidly accelerated northeast through southeast Canada on the 14<sup>th</sup> and 15<sup>th</sup>.



A large storm surge accompanied Ike, particularly along the western Louisiana and upper Texas coastlines. The worse damage was seen in Galveston and Chambers counties. The communities of Crystal Beach, Gilchrist, and High Island experienced near total destruction of property. The storm knocked out power to 2.6 million people across Texas and Louisiana. There were 20 direct and 64 indirect deaths associated with Ike. Damages totaled \$19.3 billion.

## Acknowledgments

During the initial three year journey in preparing this Texas Hurricane History in the late 1990's, many people helped along the way. The base framework for the document is the eight page work titled "Hurricane History Along the Texas Coast", produced in 1994 at the San Antonio National Weather Service office via the work of Larry Eblen, their Warning Coordination Meteorologist (WCM). Roger Erickson, WCM at Lake Charles, helped in locating some of the material locally for this work while I was stationed at the Lake Charles, Louisiana forecast office. A great deal of support was given by management on this endeavor: the list includes Ellie Pittman (former Data Acquisition Program Manager (DAPM) at Lake Charles), Steve Rinard (former Meteorologist in Charge at Lake Charles), and Rick Gravitt (current DAPM at Lake Charles).

A significant amount of research was acquired from other sources. All tracks from 1886 onward were provided in the database done by Neumann, et al, and maintained by the National Hurricane Center in West Miami, and generated using nMAP software at the Hydrometeorological Prediction Center in Camp Springs, MD. Documents and pictures relating to the Coastal Bend were obtained with the help of Mike Coyne, Brian Lamarre, and Chris Jacobson (now at Oxnard, CA), from the National Weather Service Office in Corpus Christi. Tawnya Parke of the Corpus Christi office provided daily rainfall records from the Corpus Christi county warning area. The rainfall graphics used in this document were constructed by the author

while developing a tropical cyclone rainfall database between 1999 and 2010, using data supplied by the National Climatic Data Center in Asheville, North Carolina for the United States, and the Servicio Nacional del Agua, the parent agency of Mexico's national weather service for Mexico.

Joshua Lichter and Bill Read of the Houston/Galveston office were of invaluable assistance when coordinating data relating to their county warning area, and verifying records during the late 1990's. The main portion of the history of the July 1943 hurricane, along with two pictures, came from a paper by Bill Read, of the National Weather Service in Houston/Galveston, and Lew Fincher. Jim Leonard, a noted hurricane chaser, provided pictures of Allen. Most of the satellite imagery used was provided by the National Climatic Data Center in Asheville, North Carolina. Many visits to McNeese State University in Lake Charles, LA and Louisiana State University in Baton Rouge provided a volume of newspaper articles, along with unique pieces from their respective archives.

Work was coordinated with offices around the coast from New Orleans to Brownsville, and from abroad such as Miami and Washington D.C.. The list of people involved includes John Guiney at the National Hurricane Center (formerly at the Slidell office); Josh Lichter and Bill Read formerly of the Houston/Galveston office; Mike Coyne, Chris Jacobson, Tawnya Parke, Brian Lamarre, and John Cole (former WCM) formerly of the Corpus Christi forecast office; Larry Eblen at the Austin/San Antonio office; and Henry Diaz at the Climate Diagnostics Center in Boulder, Colorado. Posthumously, David Ludlum, Ivan Ray Tannehill, Gordon Dunn, Jose Fernandez-Partagas, and David Cipra are to be honored; without them much of the information on storms before 1871 could have been lost to history.

## Bibliography

Addison, E.L.: "The Galveston Calamity" Meridional 15 September 1900: Abbeville, 2.

Associated Press: "Mexican Coast Caught This One" Daily American 28 August 1900: Lake Charles, 5.

\_\_\_\_\_. "Damage on Tarpon Beach" Houston Post 28 August 1909: 1.

\_\_\_\_\_. "Damage in Jamaica" Houston Post 16 August 1916: 4.

\_\_\_\_\_. "Railroads Were Badly Damaged by Friday's Storm" Houston Post 20 August 1916: 1.

\_\_\_\_\_. "Storm Passed Up Rio Grande Valley Into North Mexico" Houston Post 20 August 1916: 1.

\_\_\_\_\_. "Heavy Rain in El Paso" Houston Post 21 August 1916: 2.

\_\_\_\_\_. "Heavy Rains in Wake of Storm" Lake Charles American Press 15 September 1919, 1.

\_\_\_\_\_. "Water at 2d Floor Corpus Christi Sts. In Business Section - City Under Martial Law" Lake Charles American Press 15 September 1919, 1.

\_\_\_\_\_. "Wreckage Swept 20 Miles Inland" Lake Charles American Press 16 September 1919, 1.

- \_\_\_\_\_. "Tide Drops Steadily at Cameron" Lake Charles American Press 7 August 1940: 1.
- \_\_\_\_\_. "Storm Blows Itself Out, Texans Hurt" Lake Charles American Press 8 August 1940: 1.
- \_\_\_\_\_. "Hurricane Whips Inland Towards Matagorda Area" Lake Charles American Press 24 September 1941: 1.
- \_\_\_\_\_. "Hurricane Slashes Houston in Sudden Sweep Inland" Lake Charles American Press 24 September 1941: 1.
- \_\_\_\_\_. "Galveston Water Supply Hit" Lake Charles American Press 28 July 1943: 1.
- \_\_\_\_\_. "Texas Coastal Area Checks on Hurricane Loss" Lake Charles American Press 29 July 1943: 1.
- \_\_\_\_\_. "Storm Razes All But 4 of 150 Houses" Lake Charles American Press 29 July 1943: 12.

Bailey, W.B.: "The Storm at Orange, Texas" Lafayette Advertiser 30 August 1879: 2.

Barnes, Jay. Florida's Hurricane History. University of North Carolina Press: Chapel Hill, 1998.

Beatty, Guy, William E. Krebs: "Million Dollar Storm in Texas" Daily American Press 3 July 1913: Lake Charles, 1.

\_\_\_\_\_. "Storm Predicted to Go Inland Between Galveston, Corpus Christi Today" Daily American Press 22 July 1933: Lake Charles, 1.

\_\_\_\_\_. "Flood Hits East Texas" Daily American Press 24 July 1933: Lake Charles, 1.

Block, W. T. "Texas Hurricanes of the 19<sup>th</sup> Century: Killer Storms Devastated Coastline" Beaumont Enterprise 19 February 1978, 3.

Bomar, George W. Texas Weather. University of Texas Press: Austin, 1983.

Bovitz, Christopher. Significant Floods in the WGRFC Area. River Forecast Center: Fort Worth, 1998.

Byrd, Gregory P., Eugene W. McCaul, Jr. Analysis of Heavy Rainfall and Severe Weather Associated With the Remnants of Hurricane Tico. University of Oklahoma: Norman, 1984.

Caracana, F., J.M. Fritsch. NOAA Technical Memorandum ERL OWRM-12: Focusing Mechanisms in the Texas Flash Floods of 1978. Office of Weather Research and Modification: Boulder, 1981.

Carr, John T. Hurricanes Affecting the Texas Gulf Coast. Texas Water Development Board, Report 49, 1967.

Cartwright, Gary. Galveston: A History of the Island. Atheneum: New York, 1991.

Cate, Michael. Port Arthur Centennial History: 1898-1998. Looking Glass Media: Port Arthur, 1997.

- Chipman, Donald E. Spanish Texas: 1519-1821. University of Austin Press: Austin, 1992.
- Cipra, David L.: Lighthouses, Lightships, and the Gulf of Mexico. Cypress Communications: Alexandria, 1997.
- Cline, Isaac Monroe. Storms, Floods, and Sunshine. Pelican Publishing Company: Gretna, 2000.
- Curley, Stephen: "A Furious Form of Wind: Hurricanes and Their Impact on Two Texas Coastal Cities" Living on the Edge: Collected Essays on Coastal Texas. Texas A&M University: Galveston, 1989: Section 3, 12 pp.
- Dunn, Gordon E., Banner I. Miller: Atlantic Hurricanes. Louisiana State University Press: Baton Rouge, 1964. Revised edition.
- \_\_\_\_\_, Walter R. Davis, Paul L. Moore. "Hurricanes of 1955" Monthly Weather Review December 1955: Rockville, 315-326.
- \_\_\_\_\_. And Staff: "The Hurricane Season of 1959" Monthly Weather Review December 1959: Rockville, 441-450.
- \_\_\_\_\_. "The Hurricane Season of 1960" Monthly Weather Review March 1961: Rockville, 99-108.
- \_\_\_\_\_. And Staff: "The Hurricane Season of 1961" Monthly Weather Review March 1962: Rockville, 107-119.
- Ellis, Michael J. 1984 Hurricane Almanac. Disaster Resources: Corpus Christi, 1984, 21-46.
- Fernandez-Partagas, J., Henry Diaz, 1996: A Historically Significant Revision of Atlantic Tropical Cyclone Frequency 1851 to 1890, Climate Diagnostics Center, ERL/NOAA, 62 pp.
- Fincher, Lew, Bill Read: The 1943 "Surprise" Hurricane. World Wide Web, 1997, 9 pp.
- Gaillardet, Frederic. Sketches of Early Texas and Louisiana. University of Texas Press: Austin, 1966. Translated by James L. Shepherd, III.
- Gilbert, Sterling C., N. E. LaSeur. "A Study of the Rainfall Patterns and Some Related Features In a Dissipating Hurricane" Journal of Meteorology February 1957: "City of Publishing", 18-27.
- Guthrie, Keith. Texas Forgotten Ports Vol. II. Eakin Press: Austin, 1993.
- Harris, Gerrard: "Storm Reports Getting Worse" Daily American 14 September 1897: Lake Charles, 1.

\_\_\_\_\_: "Echoes of the Sabine Storm" Daily American 15 September 1897: Lake Charles, 1.  
\_\_\_\_\_: "Saw the Storm" American 15 September 1897: Lake Charles, 2.

Hebert, Paul J. Monthly Weather Review. July 1980: 110, 979.

Henry, Alfred J.: "Section III - Forecasts: Forecasts and Warnings for August, 1916" Monthly Weather Review September 1916: 46, 461-462.

Henry, Walter K., Dennis M. Driscoll, J. Patrick McCormack, 1975: Hurricanes on the Texas Coast, College of Geosciences, Texas A&M University, TAMU-SG-75-504, 48 pp.

Holbrook, AM: "Wreck of the Lone Star" The Picayune 19 September 1865: New Orleans, 2.  
\_\_\_\_\_: "The Storm at Galveston" The Picayune 9 June 1871: New Orleans, 1.  
\_\_\_\_\_: "After the Storm" The Picayune 10 June 1871: New Orleans, 4.  
\_\_\_\_\_: "The Great Storm" The Picayune 7 October 1871: New Orleans, 1.  
\_\_\_\_\_: "Terrific Storm in Texas" The Picayune 7 October 1871: New Orleans, 8.  
\_\_\_\_\_: "Latest Telegraph" The Picayune 17 September 1875: New Orleans, 1.  
\_\_\_\_\_: "Latest Telegraph" The Picayune 20 September 1875: New Orleans, 1.

Hutchins, Stilson. "The Texas Storm" Washington Post 24 August 1886: 1.

J.W. Bryan & Co.: "The Storm" Lake Charles Echo 19 June 1886: 2.  
\_\_\_\_\_: "The Storm" Lake Charles Echo 16 October 1886: 2.  
\_\_\_\_\_: "The Storm" Lake Charles Echo 23 October 1886: 2.  
\_\_\_\_\_: "Storm Notes" Lake Charles Echo 23 October 1886: 3.  
\_\_\_\_\_: Lake Charles Echo 30 October 1886: 3.  
\_\_\_\_\_: "Incidents of the Late Storm" Lake Charles Echo 6 November 1886: 1.

Johnston, R.M.: "Wreck and Ruin" Houston Post 21 August 1886: 1.  
\_\_\_\_\_: "The Damage In Town" Houston Post 21 August 1886: 4.  
\_\_\_\_\_: "The Great Storm" Houston Post 22 August 1886: 1.  
\_\_\_\_\_: "Further Casualties" Houston Post 24 August 1886: 1.  
\_\_\_\_\_: "Gloomy Galveston" Houston Post 24 August 1886: 5.  
\_\_\_\_\_: "The Equinox" Houston Post 24 September 1886: 5.  
\_\_\_\_\_: "Texas In Type" Houston Post 25 September 1886: 5.  
\_\_\_\_\_: "Texas By Wire" Houston Post 21 September 1887: 4.  
\_\_\_\_\_: "Storm on the Coast" Houston Post 14 September 1897: 1-2.  
\_\_\_\_\_: "Storms of the Past" Houston Post 14 September 1897: 2.  
\_\_\_\_\_: "On the Sabine Lake" Houston Post 15 September 1897: 2.  
\_\_\_\_\_: "It Has Rained In Texas" Houston Post 28 June 1902: 1.  
\_\_\_\_\_: "Rain Reports" Houston Post 28 June 1902: 2.  
\_\_\_\_\_: "The Wreck of the S.P." Houston Post 28 June 1902: 7.  
\_\_\_\_\_: "Rain Reports" Houston Post 29 June 1902: 5.

- \_\_\_\_\_: "Tornado Did Damage" Houston Post 29 June 1902: 5.
- \_\_\_\_\_: "Disastrous Storm Raged" Houston Post 30 June 1902: 2.
- \_\_\_\_\_: "Flood in East Texas" Houston Post 30 June 1902: 2.
- \_\_\_\_\_: "Hurricane Raged in the Gulf but Sea Wall Saved Galveston" Houston Post 22 July 1909: 1,4.
- \_\_\_\_\_: "Trains Late" Houston Post 22 July 1909: 8.
- \_\_\_\_\_: "Excitement in Houston" Houston Post 22 July 1909: 9.
- \_\_\_\_\_: "Losses Are Heavy Over Wide Territory" Houston Post 23 July 1909: 1.
- \_\_\_\_\_: "Damage is Heavy" Houston Post 23 July 1909: 2.
- \_\_\_\_\_: "Stores Demolished" Houston Post 23 July 1909: 4.
- \_\_\_\_\_: "Storm at Austin" Houston Post 23 July 1909: 5.
- \_\_\_\_\_: "At Galveston" Houston Post 25 July 1909: 4.
- \_\_\_\_\_: "Quintana Devastated" Houston Post 25 July 1909: 7.
- \_\_\_\_\_: "Heavy Rain in Nacogdoches" Houston Post 25 July 1909: 7.
- \_\_\_\_\_: "Report Made" Houston Post 26 July 1909: 9.
- \_\_\_\_\_: "Storms on Land" Houston Post 28 August 1909: 1.
- \_\_\_\_\_: "Hundreds Dead in Floods in Mexico" Houston Post 29 August 1909: 1.
- \_\_\_\_\_: "Beeville Cyclone" Houston Post 29 August 1909: 8.
- \_\_\_\_\_: "Storm Moving Off" Houston Post 27 August 1909: 1-2.
- \_\_\_\_\_: "Two Islands Inundated" Houston Post 28 August 1909: 1-2.
- \_\_\_\_\_: "No Loss of Life" Houston Post 29 August 1909: 6.
- \_\_\_\_\_: "Beeville Cyclone" Houston Post 29 August 1909: 8.
- \_\_\_\_\_: "Damage By Gale" Houston Post 16 September 1910: 3.
- \_\_\_\_\_: "Hail Did Damage" Houston Post 16 September 1910: 3.
- \_\_\_\_\_: "Rio Grande Overflowing" Houston Post 17 September 1910: 1.
- \_\_\_\_\_: "Coast Residents Near Victoria Moving Out" Houston Post 17 August 1915: 4.
- \_\_\_\_\_: "Galveston Still Cut Off From World Texas City Death Loss is 18 Lives" Houston Post 18 August 1915: 1.
- \_\_\_\_\_: "Climbed Staff on Weather Building While Storm Raged" Houston Post 18 August 1915: 7.
- \_\_\_\_\_: "Bayous in the Vicinity of Houston Out of Their Banks" Houston Post 18 August 1915: 10.
- \_\_\_\_\_: "Hurricane Struck Lower Coast" Houston Post 19 August 1916: 1-2.
- \_\_\_\_\_: "Damage at Berdair" Houston Post 20 August 1916: 1.
- \_\_\_\_\_: "No Loss of Life Reported at Texas Coast Points" Houston Post 20 August 1916: 2.
- \_\_\_\_\_: "Marooned Passengers From Storm-Swept Section Arrive" Houston Post 20 August 1916: 3.
- \_\_\_\_\_: "45-Foot Whale Found" Houston Post 21 August 1916: 2.
- \_\_\_\_\_: "Beaumont Traffic Halted by Storm" Houston Post 21 August 1916: 2.
- \_\_\_\_\_: "Nine Lives Were Lost When the Pilot Boy Was Wrecked" Houston Post 22 August 1916: 2.

Lichter, Joshua. Upper Texas Coast Tropical Cyclones. World Wide Web:

[www.srh.noaa.gov/hgx/hurricanes.hurr\\_clim.htm](http://www.srh.noaa.gov/hgx/hurricanes.hurr_clim.htm)

Ludlum, David M.: Early American Hurricanes (1492-1870). Lancaster Press: Lancaster, 1963.

Lumsden, F.A., G.W. Kendall: "Late From Texas" The Picayune 24 October 1837: New Orleans, 2.

Malsch, Brownson. Indianola: The Mother of Western Texas. State House Press: Austin, 1988.

Marx, Robert F. Shipwrecks in the Americas. Dover Publications: New York, 1987.

McCormick, John: "The Storm at Galveston" Lake Charles Commercial 19 June 1886: 2.

\_\_\_\_\_: Lake Charles Commercial 19 June 1886: 2.

\_\_\_\_\_: "The Hurricane. Sabine Pass Washed Away." Lake Charles Commercial 16 October 1886: 2.

Menard, Donald. Hurricanes of the Past: The Untold Story of Hurricane Audrey. Gulf South Printing & Specialties, Inc.: Rayne, 1997.

Morgan, James P., Lewis G. Nichols, Martin Wright: Morphological Effects of Hurricane Audrey on the Louisiana Coast. LSU: Baton Rouge, 1958.

National Climatic Data Center: September 1967 Storm Data. ESSA: Asheville, 1967.

\_\_\_\_\_: September 1971 Storm Data. NESDIS: Asheville, 1971.

\_\_\_\_\_: August 1979 Storm Data. NESDIS: Asheville, 1979.

\_\_\_\_\_: September 1980 Storm Data. NESDIS: Asheville, 1980.

\_\_\_\_\_: December 1980 Storm Data. NESDIS: Asheville, 1981.

\_\_\_\_\_: November 1983 Storm Data. NESDIS: Asheville, 1984.

\_\_\_\_\_: June 1986 Storm Data. NESDIS: Asheville, 1986.

\_\_\_\_\_: July 1995 Storm Data. NESDIS: Asheville, 1996.

\_\_\_\_\_: August 1995 Storm Data. NESDIS: Asheville, 1996.

Neumann, C.J., B.R. Jarvinen, A.C. Pike, 1987: Tropical Cyclones of the North Atlantic Ocean 1871-1986 (plus inserts to 1998), National Climatic Data Center, Historical Climatological Series 6-2, 186 pp.

Novlan, David J., William M. Gray, 1974. Hurricane-Spawmed Tornadoes. Monthly Weather Review, 104: 477.

NWSO Beaumont, U.S. Army Corp of Engineers. Weather Data for the Four Worst Tropical Disturbances in Port Arthur & Vicinity Since 1900. Unpublished, Port Arthur Public Library, 1 pp.



NWSO Corpus Christi. Condensed Summary of Tropical Storm June 27<sup>th</sup>, 1936. Unpublished, 1936, 2 pp.

\_\_\_\_\_. Notes on Storm at Corpus Christi. Unpublished, 1933, 3 pp.

NWSO Lake Charles. Port Arthur, Texas Climate Summaries 1953-1990 & Newspaper Articles. Unpublished, 1994.

NWSO Slidell, 1983: Hurricane Alicia Post Storm Report, Weather Service Hurricane Warning Office, 12 pp.

NWSO Slidell, 1980: Hurricane Allen Post Storm Report, Weather Service Hurricane Warning Office, 11 pp.

Price, W. Armstrong: Hurricanes Affecting the Texas Coast from Galveston to Rio Grande. Department of the Army: Corpus Christi, 1956.

\_\_\_\_\_. Texas Coast Hurricane Study - Laguna Madre Study Segment. Department of the Army: Galveston, 1977.

\_\_\_\_\_. Texas Coast Hurricane Study - Matagorda Bay Study Segment. Department of the Army: Galveston, 1977.

Rappaport, Edward N., Jose Fernandez-Partagas, 1995. The Deadliest Atlantic Tropical Cyclones, 1492-1994, NOAA Technical Memorandum NWS NHC-47, 42 pp.

Roberts, Bruce, Ray Jones. "Lights of Hurricane Alley" Southern Lighthouses: Chesapeake Bay To the Gulf of Mexico. Globe Pequot Press: Old Saybrook, 1995: 83-108.

Roth, David M. Tropical Storm Arlene – June 18-23, 1993. World Wide Web: <http://www.hpc.ncep.noaa.gov/tropical/rain/arlene1993.html> Hydrometeorological Prediction Center: Camp Springs, 2006.

\_\_\_\_\_. Tropical Storm Allison – June 4-18, 2001. World Wide Web: <http://www.hpc.ncep.noaa.gov/tropical/rain/allison2001.html> Hydrometeorological Prediction Center: Camp Springs, 2006.

\_\_\_\_\_. Hurricane Claudette - July 14-17, 2003. World Wide Web: <http://www.hpc.ncep.noaa.gov/tropical/rain/claurette2003.html> Hydrometeorological Prediction Center: Camp Springs, 2006.

\_\_\_\_\_. Hurricane Rita - September 17-26, 2005. World Wide Web: <http://www.hpc.ncep.noaa.gov/tropical/rain/rita2005.html> Hydrometeorological Prediction Center: Camp Springs, 2006.

\_\_\_\_\_. Tropical Storm Erin - August 14-22, 2007. World Wide Web: <http://www.hpc.ncep.noaa.gov/tropical/rain/humberto2007.html> Hydrometeorological Prediction Center: Camp Springs, 2007.

\_\_\_\_\_. Hurricane Humberto - September 11-15, 2007. World Wide Web: <http://www.hpc.ncep.noaa.gov/tropical/rain/humberto2007.html> Hydrometeorological

- Prediction Center: Camp Springs, 2007.
- \_\_\_\_\_. Hurricane Dolly – July 22-28, 2008. World Wide Web:  
<http://www.hpc.ncep.noaa.gov/tropical/rain/dolly2008.html> Hydrometeorological  
 Prediction Center: Camp Springs, 2008.
- \_\_\_\_\_. Hurricane Ike - September 8-15, 2008. World Wide Web:  
<http://www.hpc.ncep.noaa.gov/tropical/rain/ike2008.html> Hydrometeorological  
 Prediction Center: Camp Springs, 2008.
- St. John, Bob. South Padre: The Island and Its People. Taylor Publishing Company: Dallas,  
 1991.
- Schoner, R.W. Frequency and Distribution of Areal Rainfall Averages Associated With Tropical  
 Storms Entering the Texas Coast. Hydrologic Services Division: Washington, 1956.
- Simpson, R.H., Joseph Pelissier: "Atlantic Hurricane Season of 1970" Monthly Weather Review  
 April 1971: Rockville, 269-277.
- \_\_\_\_\_, John R. Hope: "Atlantic Hurricane Season of 1971" Monthly Weather Review April  
 1972: Rockville, 256-267.
- Smith, Walter. NOAA Technical Memorandum NWS WR-197: The Effects of Eastern North  
 Pacific Tropical Cyclones on the Southwestern United States. National Weather Service:  
 Salt Lake City, 1986.
- Stans, Maurice H., Robert M. White, George P. Cressman, 1970: Hurricane Celia July 30-  
 August 5, 1970 Preliminary Report, Environmental Science Services Administration,  
 U.S. Department of Commerce, 37 pp.
- Sugg, Arnold L., Joseph M. Pelissier: "The Hurricane Season of 1967" Monthly Weather Review  
 April 1968: Rockville, 242-250.
- Sumner, H.C.: "North Atlantic Hurricanes and Tropical Disturbances of 1947" Monthly Weather  
 Review December 1947: Rockville, 251-256.
- \_\_\_\_\_: "North Atlantic Hurricanes and Tropical Disturbances of 1945" Monthly Weather Review  
 January 1946: Rockville, 1-6.
- \_\_\_\_\_: "North Atlantic Hurricanes and Tropical Disturbances of 1943" Monthly Weather Review  
 November 1943: Rockville, 179-183.
- \_\_\_\_\_: "North Atlantic Hurricanes and Tropical Disturbances of 1942" Monthly Weather Review  
 April 1943: Rockville, 49-52.
- \_\_\_\_\_: "North Atlantic Tropical Disturbances of 1941" Monthly Weather Review December  
 1941: Rockville, 363.
- \_\_\_\_\_: "Tropical Disturbances of September 1941" Monthly Weather Review September 1941:  
 Rockville, 264-266.

Tannehill, Ivan Ray. Hurricanes. Princeton University Press: Princeton, 1956.

Taylor, J.G., P.A. Calabrese, 1962: Hurricane "Carla" Preliminary Storm Tide Report for the Texas-Louisiana Coast. U.S. Army Corp of Engineers, 9 pp.

United Press International. "Hurricane Strikes Texas Coast" Lake Charles American Press 25 August 1947: 1.

\_\_\_\_\_. "Rains Aid Rice But Hurt Texas Cotton Crop" Lake Charles American Press 26 August 1947: 1.

\_\_\_\_\_. "Heavy Rainstorm Hits Dallas" Lake Charles American Press 27 August 1947: 1.

U.S. Army Corp of Engineers. History of Hurricane Occurrences Along Coastal Louisiana. Department of the Army: New Orleans, 1985.

\_\_\_\_\_: Tropical Storm Claudette. Department of the Army: Galveston, 1980.

U.S. Department of Commerce. Weather Bureau Technical Paper No. 2: Maximum Recorded Point Rainfall. Weather Bureau Analysis Center: Washington, D.C., 1947.

Ward, Jimmy, Gary Grice. A Guide to Precipitation Forecasting in South Texas. National Weather Service Forecast Office: San Antonio, 1983.

West Jr., Thomas. History of Port Mansfield. World Wide Web: <http://mccharen.com/portmansfield/history/history1.htm>. Valley Web Site Design, 1997.

Zoch, Richmond T.: "North Atlantic Hurricanes and Tropical Disturbances of 1949" Monthly Weather Review December 1949: Rockville, 339-342.

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