August, 2017: Hurricane Harvey Floods in Texas
Media claims they were CO2-Enhanced
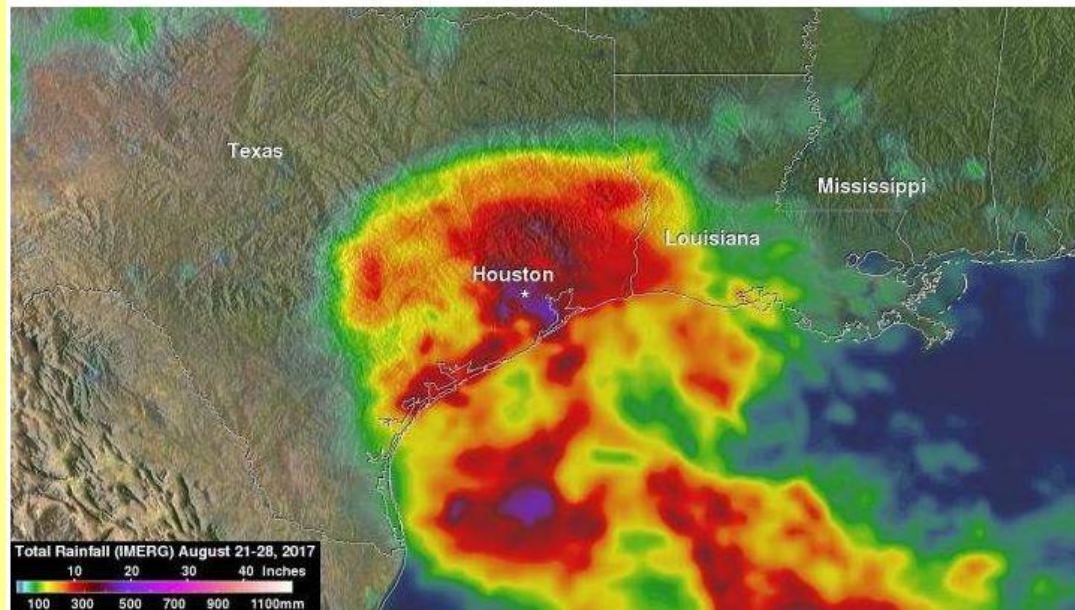

Bob Endlich

bendlich@msn.com

10 Sep 2017

OLLI UTEP Class

Genesis of Hurricane Harvey's Flooding Rains:

1) A strong tropical cyclone, with access to abundant moisture, which evaporated from the Gulf of Mexico,
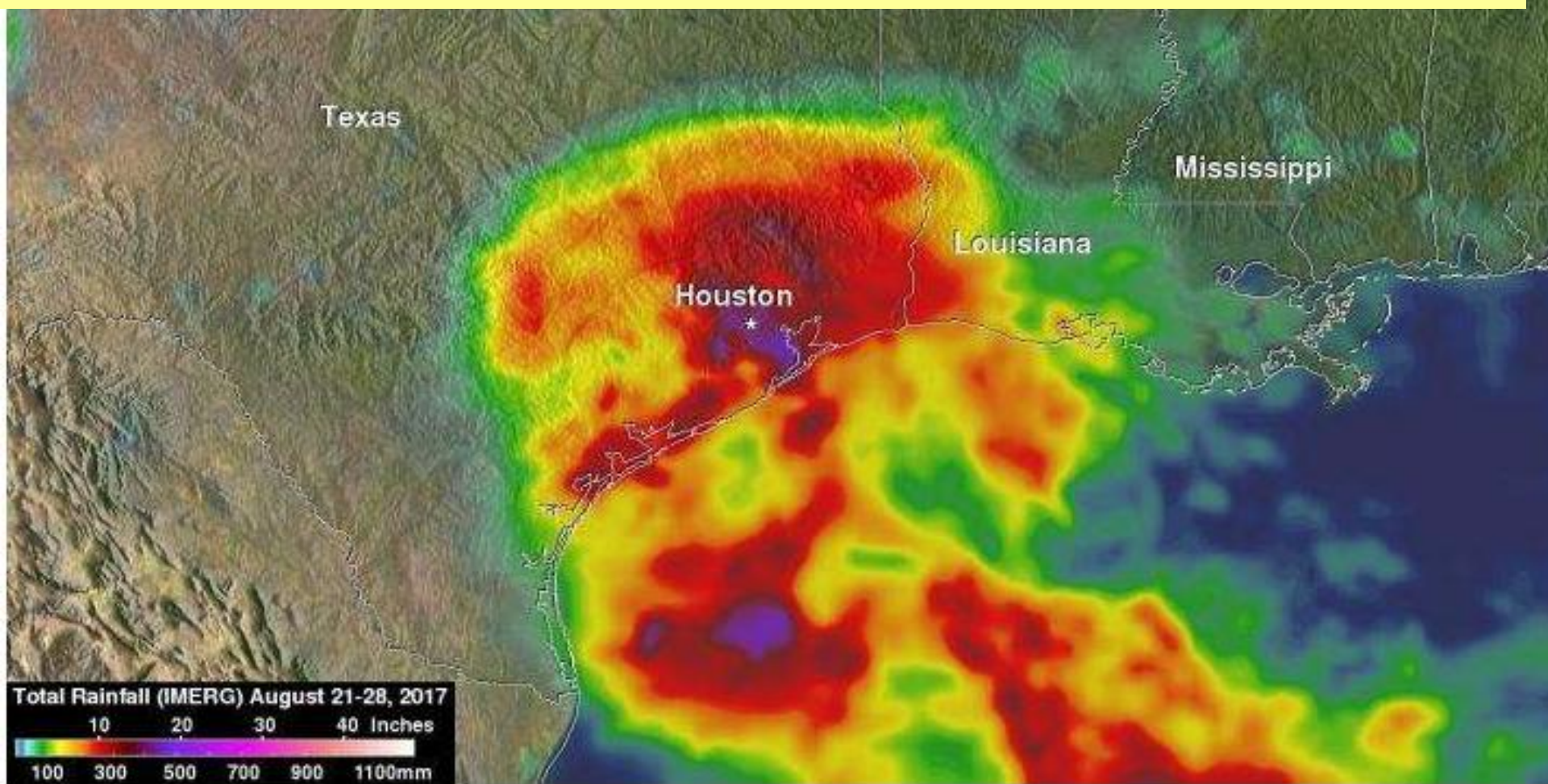
and

2) Little movement by the cyclone after landfall.

Total Rainfall (IMERG) August 21-28, 2017

NASA's IMERG rainfall analysis for Tropical Storm Harvey covers the period from Aug. 21 through Aug. 28, 2017. IMERG shows rainfall totals to 20 inches (purple shading) from the coast near Galveston Bay to in and around the Houston area. At least 10 inches (red shading) are shown to have fallen from western Louisiana all the way to near Corpus Christi on the coast. Credit: NASA/JAXA, Hal Pierce
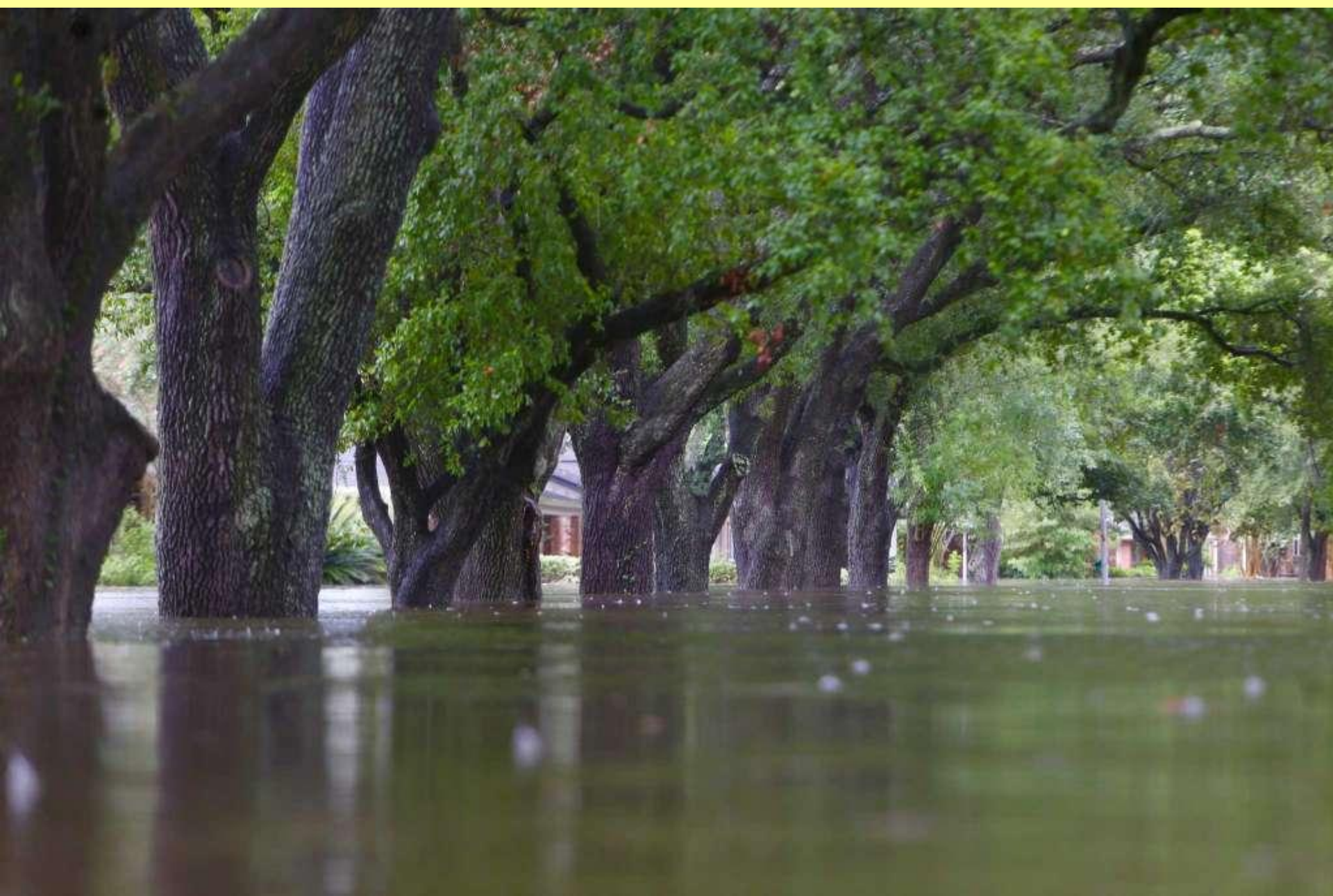
Total Rainfall (IMERG) August 21-28, 2017

NASA's IMERG rainfall analysis for Tropical Storm Harvey covers the period from Aug. 21 through A[...] 2017. IMERG shows rainfall totals to 20 inches (purple shading) from the coast near Galveston Bay t[...] around the Houston area. At least 10 inches (red shading) are shown to have fallen from western Lou[...] the way to near Corpus Christi on the coast. Credit: NASA/JAXA, Hal Pierce

How did it make it worse?
Warmer seas evaporate more quickly.
Warmer air holds more water vapour. So, as temperatures rise around the world, the skies store more moisture and dump it more intensely.

Is this speculation or science?
There is a proven link – known as the Clausius-Clapeyron equation – that shows that for every half a degree celsius in warming, there is about a 3% increase in atmospheric moisture content.

Is tropical storm Harvey linked to climate change?
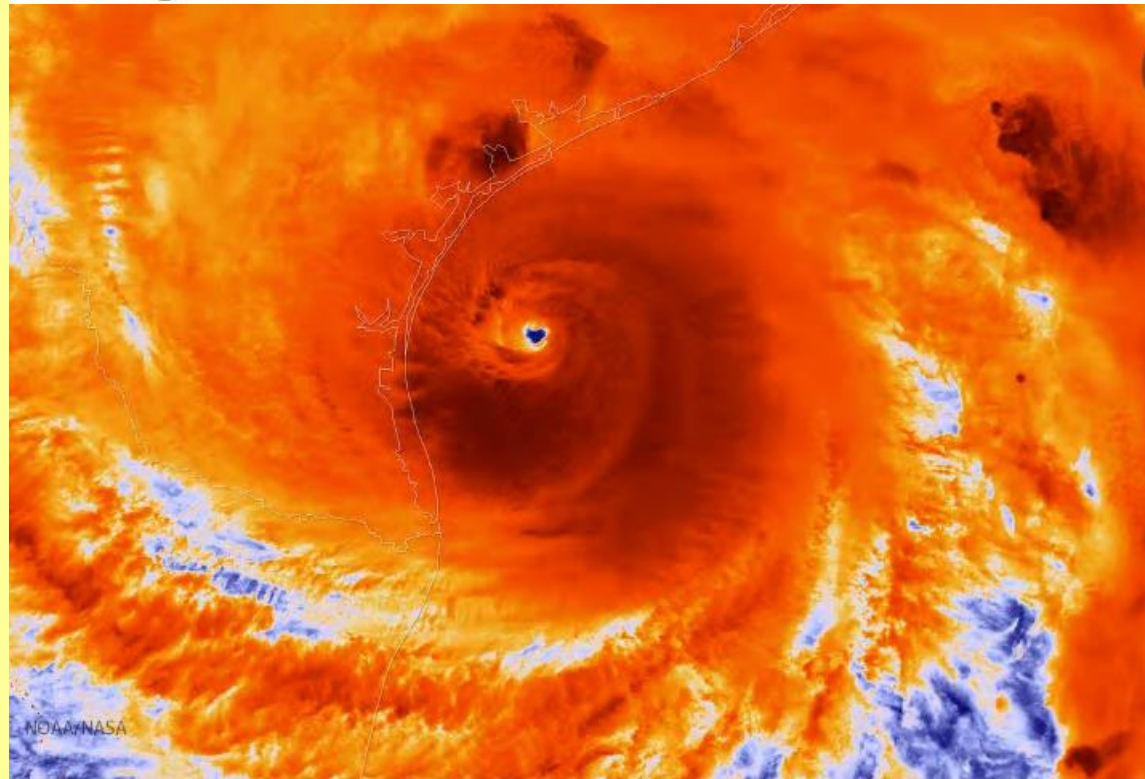
ⓘ Infrared image of Hurricane Harvey just prior to making landfall along the Texas coast, US. Photograph: NOAA

This sounds reasonable…

so, what do the data say?

Texas **Major Hurricane Landfalls** and Western Gulf of Mexico Sea Surface Temperatures

http://drroyspencer.com

X-Axis Time Years   Y-Axis: Gulf of Mexico Sea Surface Temperature SST Anomaly

Texas **Major Hurricane Landfalls** and Western Gulf of Mexico Sea Surface Temperatures

Great Galveston Hurricane of 1900: up to 12,000 died

http://drroyspencer.com

Texas **Major Hurricane Landfalls** and Western Gulf of Mexico Sea Surface Temperatures

1969 Hurricane Camille: Second strongest Hurricane to hit the USA

Texas **Major Hurricane Landfalls** and Western Gulf of Mexico Sea Surface Temperatures

1988 Hurricane Gilbert strongest hurricane to hit Mexico

http://drroyspencer.com

The data show the Guardian's claim that the intensity of the Gulf of Mexico Hurricanes is directly related to Gulf Sea Surface Temperatures is False.

Texas Major Hurricane Landfalls and Western Gulf of Mexico Sea Surface Temperatures

http://drroyspencer.com

Additional thought on the subject:

Sunlight (not, e.g., infrared energy in the CO2 band) Heats Seawater

Alarmists claim increasing <CO2> causes increasing Sea Surface Temperatures.
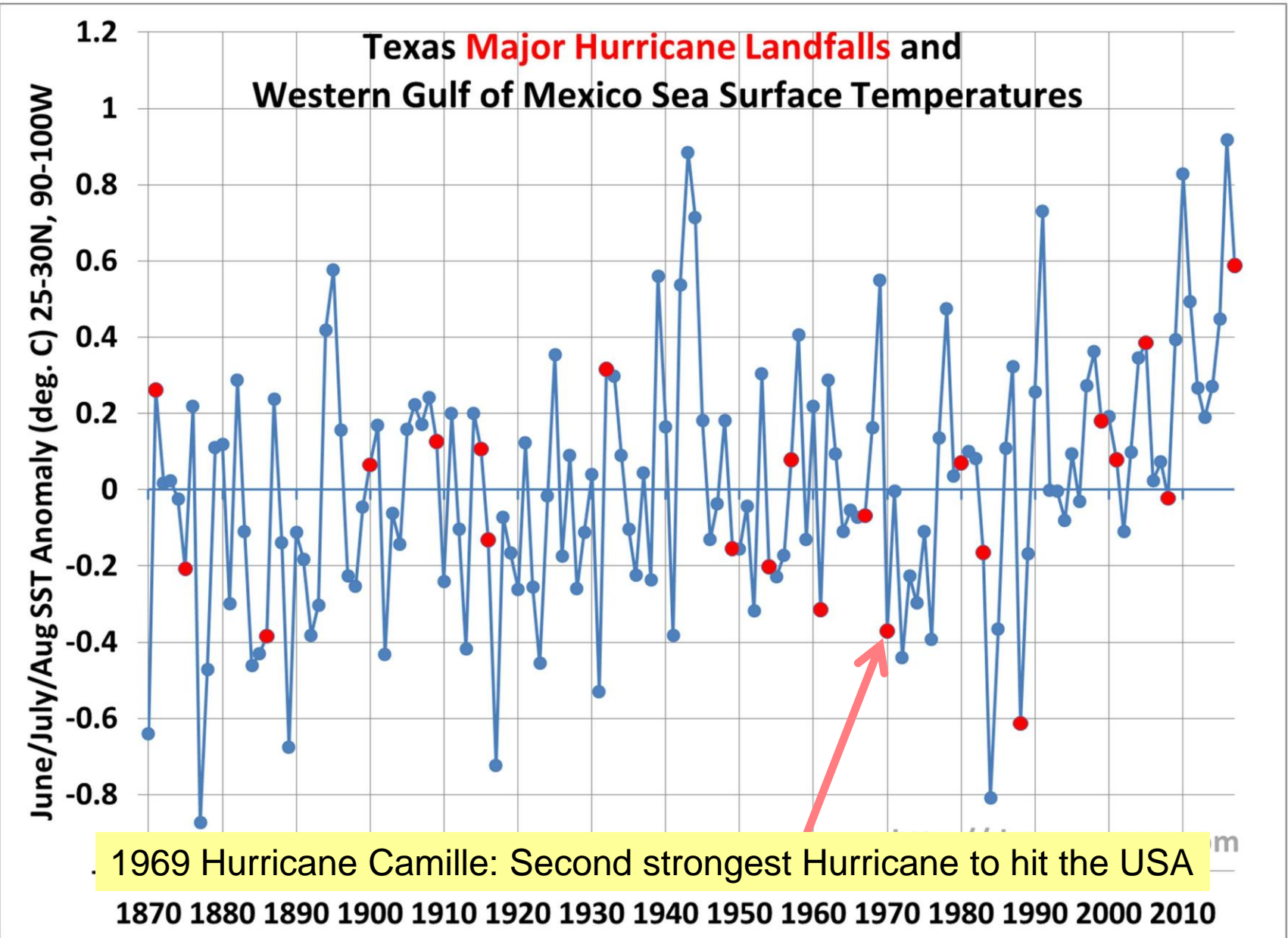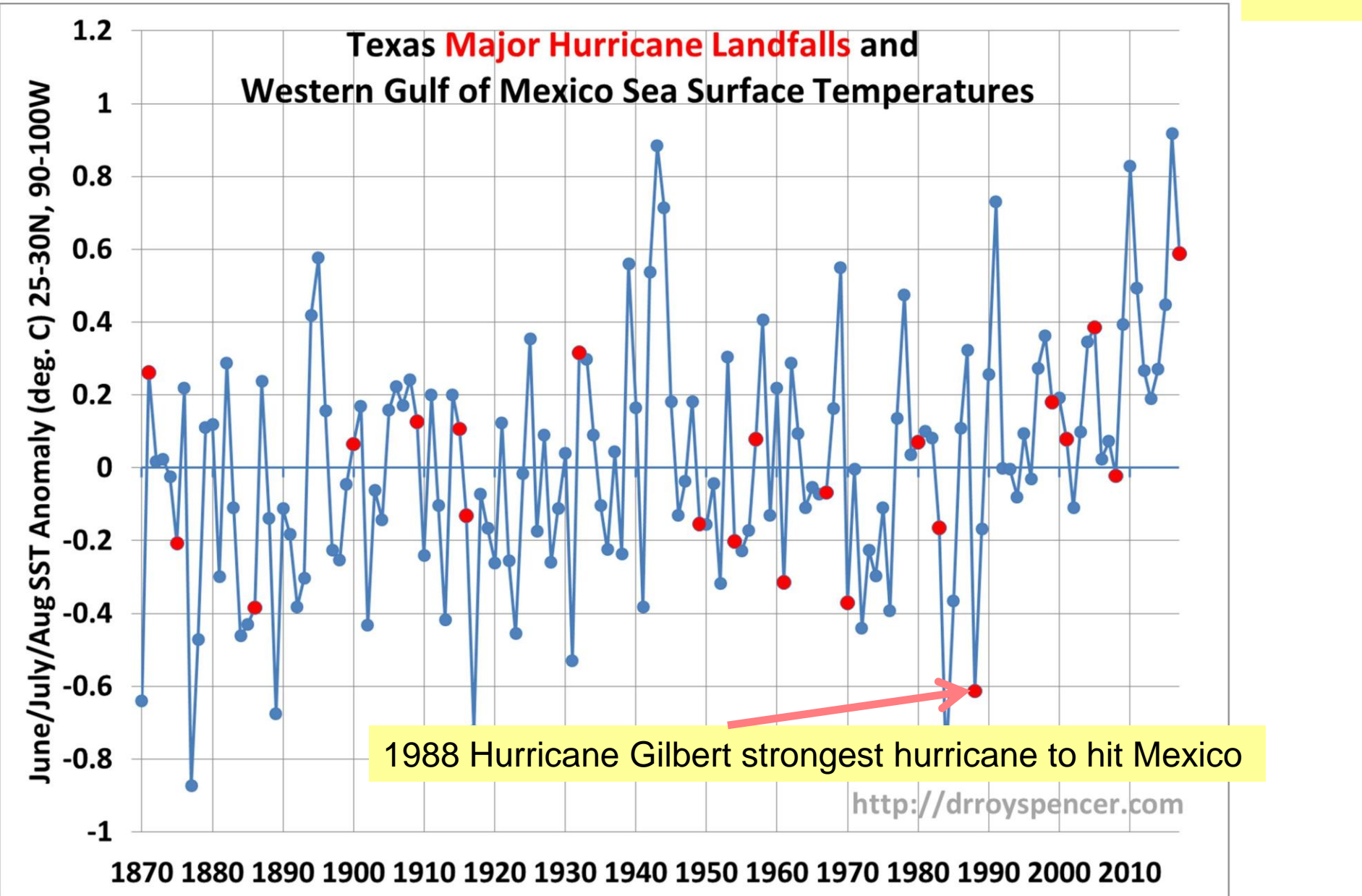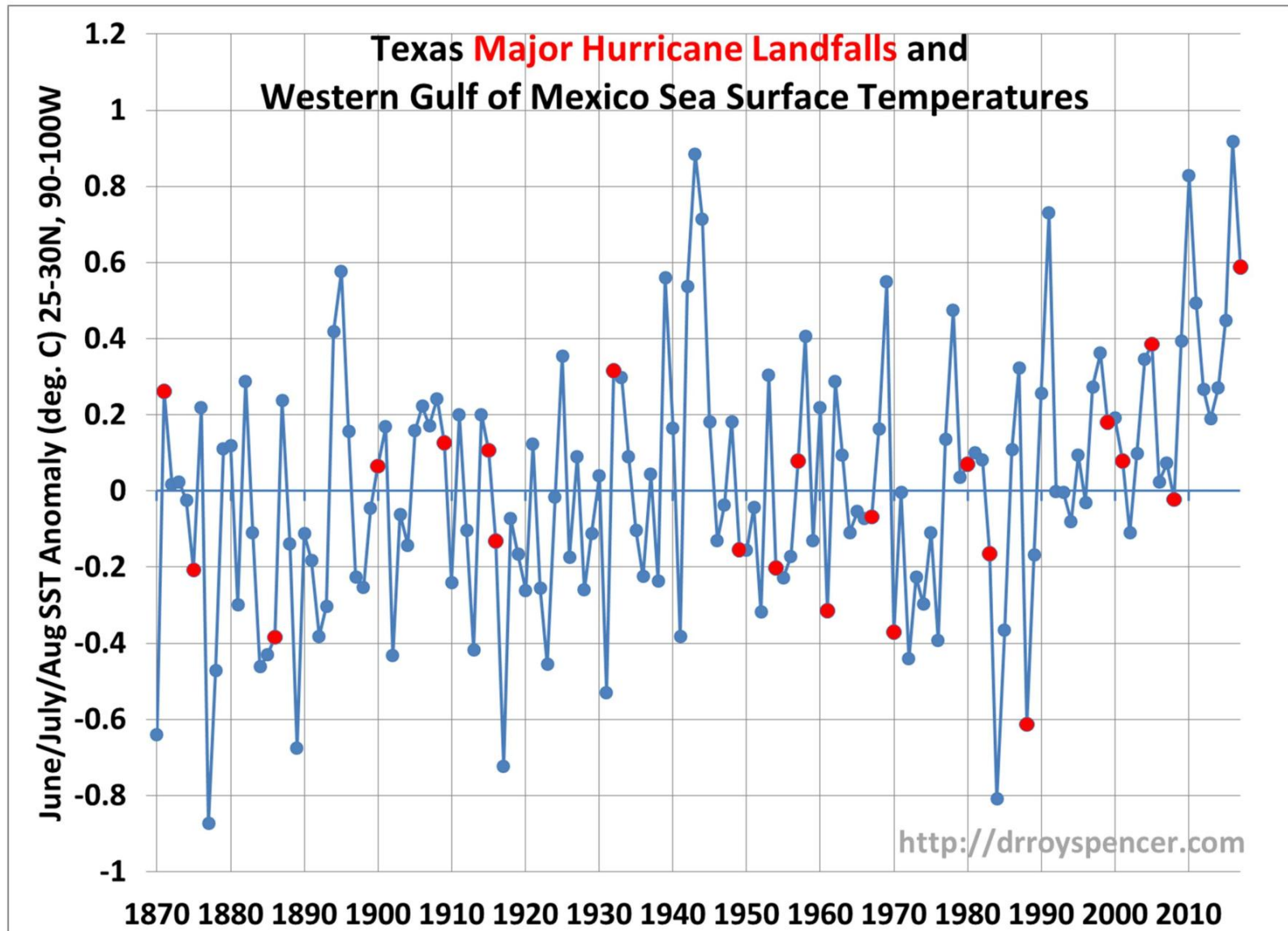
This is incorrect.

It is **only visible sunlight** which **penetrates sea water** (and other water s and heats the sea.

Infrared radiation does not penetrate sea water, or any water.

A simple validation of this is viewing into a pool. Solar radiation penetrates the water and illuminates the bottom of the pool.

A percentage of that light reflects from the bottom and comes back through the water and into the air.

The fact that we see the structures on the sides and bottom of the pool is evidence that sunlight penetrates water…(and heats it.)

Sunlight, not infrared energy heats bodies of water.

When fishing, for instance in the Gulf of Mexico, you see your bait as it sinks into the Gulf.

After a fish is on the line, as you reel in, you can see the fish as it emerges from the depths.

This observation means that sunlight is penetrating the water, heating surface waters, and to several tens of meters, and some sunlight reflects off the fish which you can see as the fish gets closer.

Pictured with a screen capture from a YouTube Video on the following slide:

Let's compare :

 Great Galveston Hurricane of 1900 with 2017's Hurricane Harvey

Both Category 4 Hurricanes that struck Texas' Gulf Coast:

Galveston Hurricane's strength: Estimate Speed 145 MPH

Lowest Surface Pressure: 936 mb   **CO2: 294 PPM**

Storm Surge: 15 Ft: Galveston was only 8 ft MSL   Human Deaths: 8,000-12,000

Often cited as the worst natural disaster to befall the USA
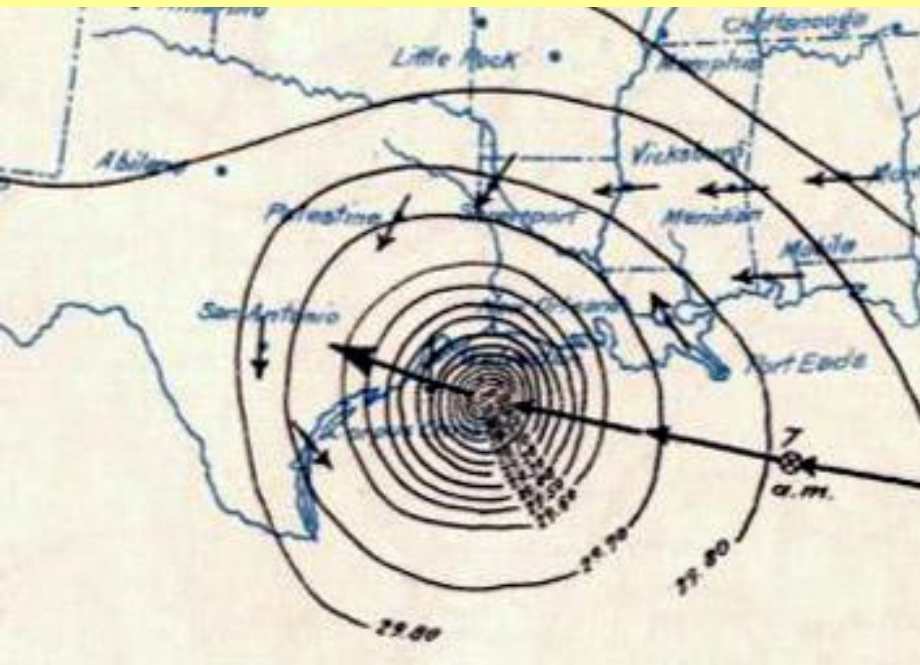
Hurricane Harvey's strength: Measured Speed 132 MPH

Lowest Surface Pressure: 938 mb.   **CO2: 407 PPM**

Human Deaths: 71 as of 10 August t2017

http://www.wpc.ncep.noaa.gov/discussions/nfdscc1.html
Flooding Rains Houston: CEDAR BAYOU AT FM 1942   51.88 inches storm total

HURRICANE HARVEY
TRACKING THE STORM
San Antonio
Schulenburg
Houston
Victoria
Bay City
Port Lavaca
Three Rivers
Rockport
Corpus Christi
NBC NEWS SPECIAL REPORT
HURRICANE HARVEY MAKES LANDFALL AS CAT 4
130 MPH WINDS AND HEAVY RAINS LASH TEXAS COAST

Is tropical storm Harvey linked to climate change?

Are there other links between Harvey and climate change?

Yes, the storm surge was greater because sea levels have risen 20cm as a result of more than 100 years of human-related global warming.

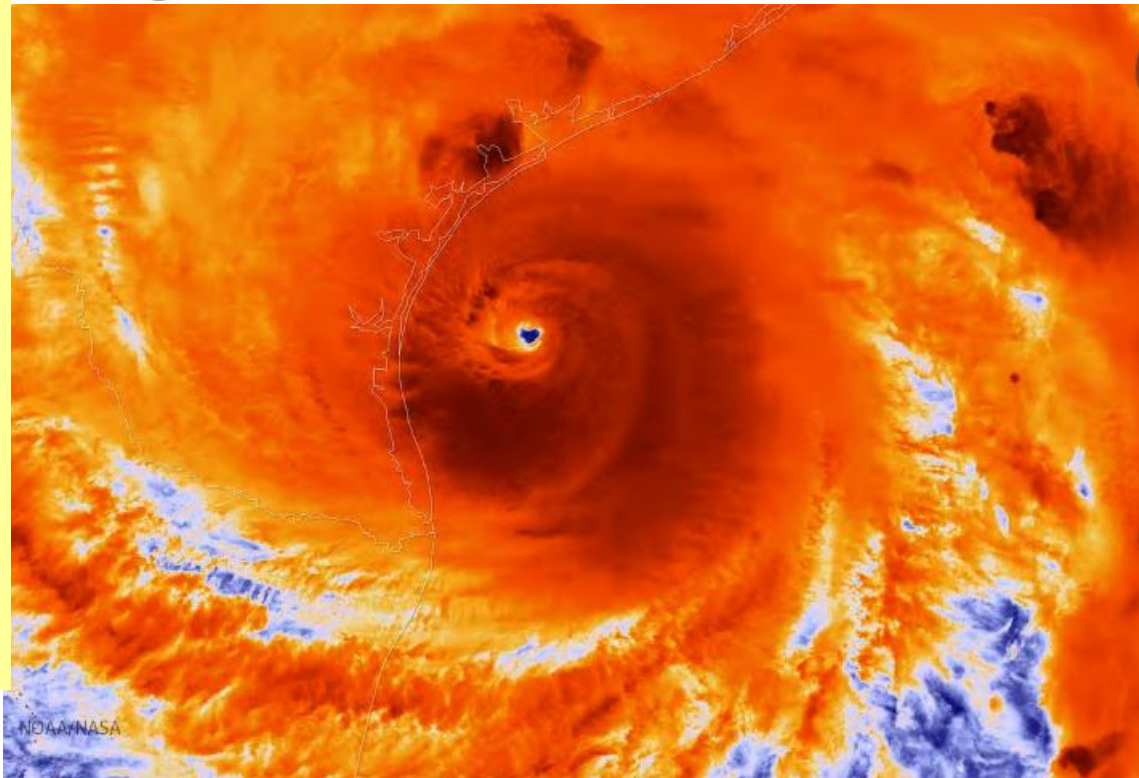This has melted glaciers and thermally expanded the volume of seawater.

ⓘ Infrared image of Hurricane Harvey just prior to making landfall along the Texas coast, US. Photograph: NOAA

"Human-Caused Sea Level Rise Acceleration"

The false notion of human-caused, CO2-fueled sea level rise will be a separate topic on another day.

It is difficult to find a century-long term tide gage near Houston or Galveston, Texas.

The one at Freeport, TX, has a datum shift about 1972

The ones at Eugene Island, Louisiana, and Grand Isle, Louisiana, have been affected by the channelization of the Mississippi River in the 1800s, which cuts off the annual flooding and silting of the Delta.

All major river deltas of the earth are sinking because of compression of the silt of which they are made.

Here is the one from Key West, Florida, which starts in 1913:

8724580 Key West, Florida   2.40 +/- 0.15 mm/yr

X-axis: time, Years.   Y-axis Sea Level Height, Meters

I really like this site, because Dave Burton provides the atmospheric <CO2> in the default plot

http://www.sealevel.info/MSL_graph.php?id=Key+West
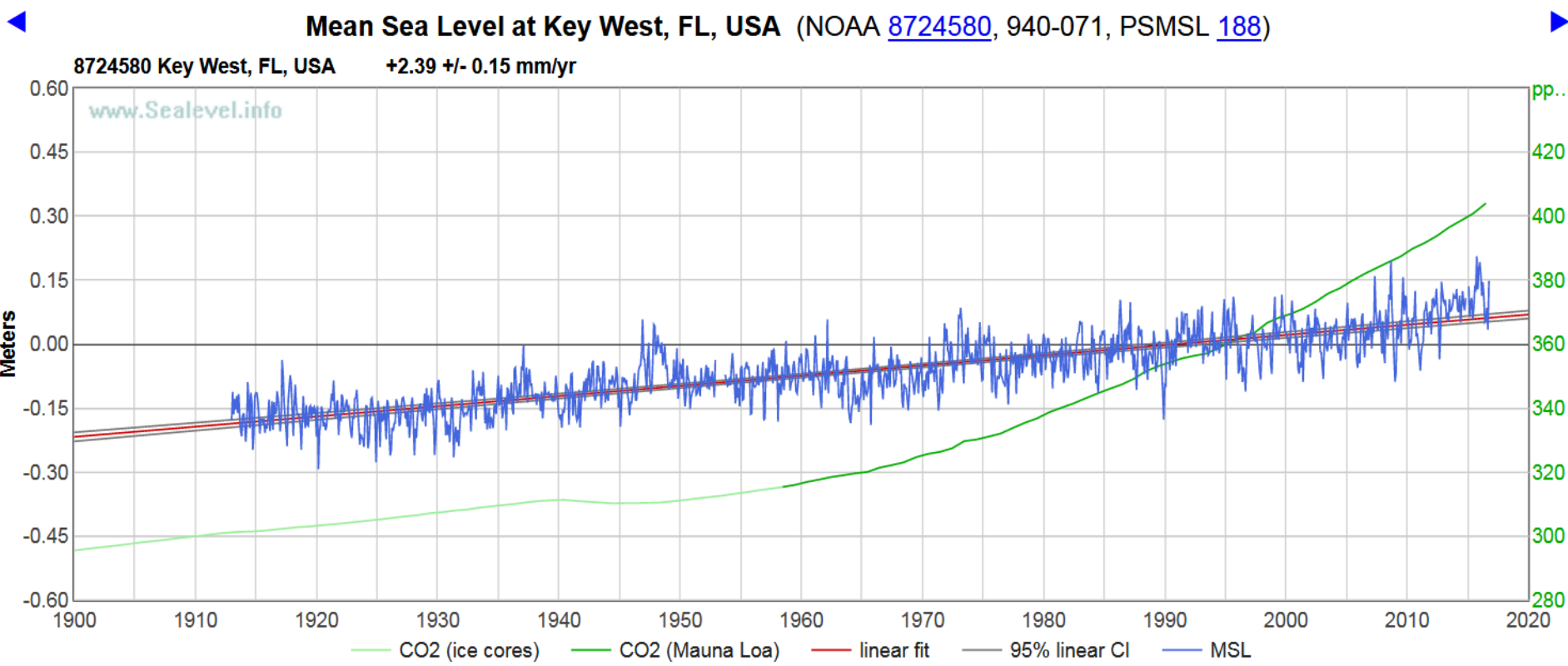
Mean Sea Level at Key West, FL, USA (NOAA 8724580, 940-071, PSMSL 188)

8724580 Key West, FL, USA   +2.39 +/- 0.15 mm/yr

Legend: CO2 (ice cores) — CO2 (Mauna Loa) — linear fit — 95% linear CI — MSL

X-axis: time, Years.   **Y-axis (Left) Sea Level Height, Meters**

Y-Axis (Right) Atmospheric <CO2>

The Battery in Manhattan has one of the longest tide gage stations in the USA; the data begin in May, 1856, five years before the US' Civil War begins.

Mean Sea Level at The Battery, NY, USA (NOAA 8518750, 960-121, PSMSL 12)

8518750 The Battery, NY, USA   +2.84 +/- 0.09 mm/yr

Legend: CO2 (ice cores) — CO2 (Mauna Loa) — linear fit — 95% linear CI — MSL
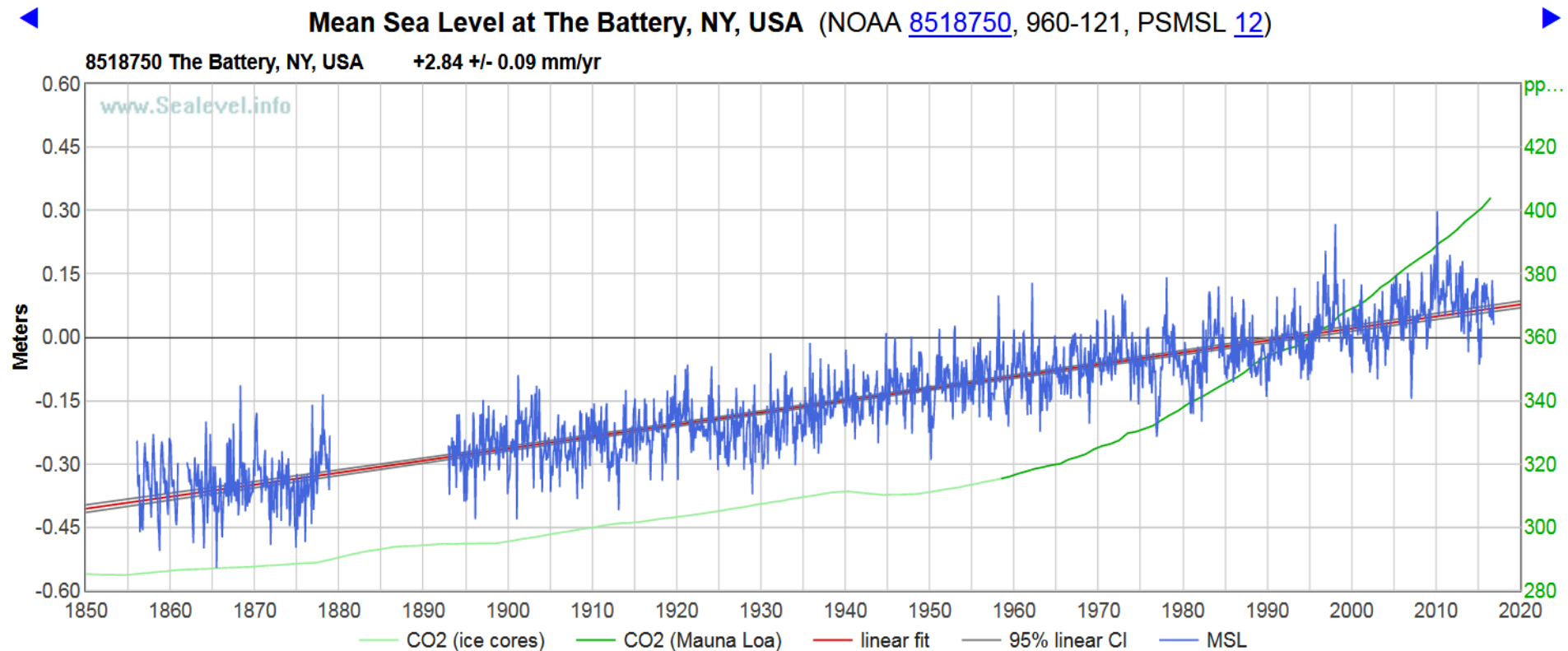
X-axis: time, Years.   **Y-axis (Left) Sea Level Height, Meters**

Y-Axis (Right) Atmospheric <CO2>

The Battery in Manhattan is one of the longest lived tide gage stations in the USA; the data begin in May, 1856, five years before the US' Civil War begins.

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8518750 The Battery, NY, USA   +2.84 +/- 0.09 mm/yr

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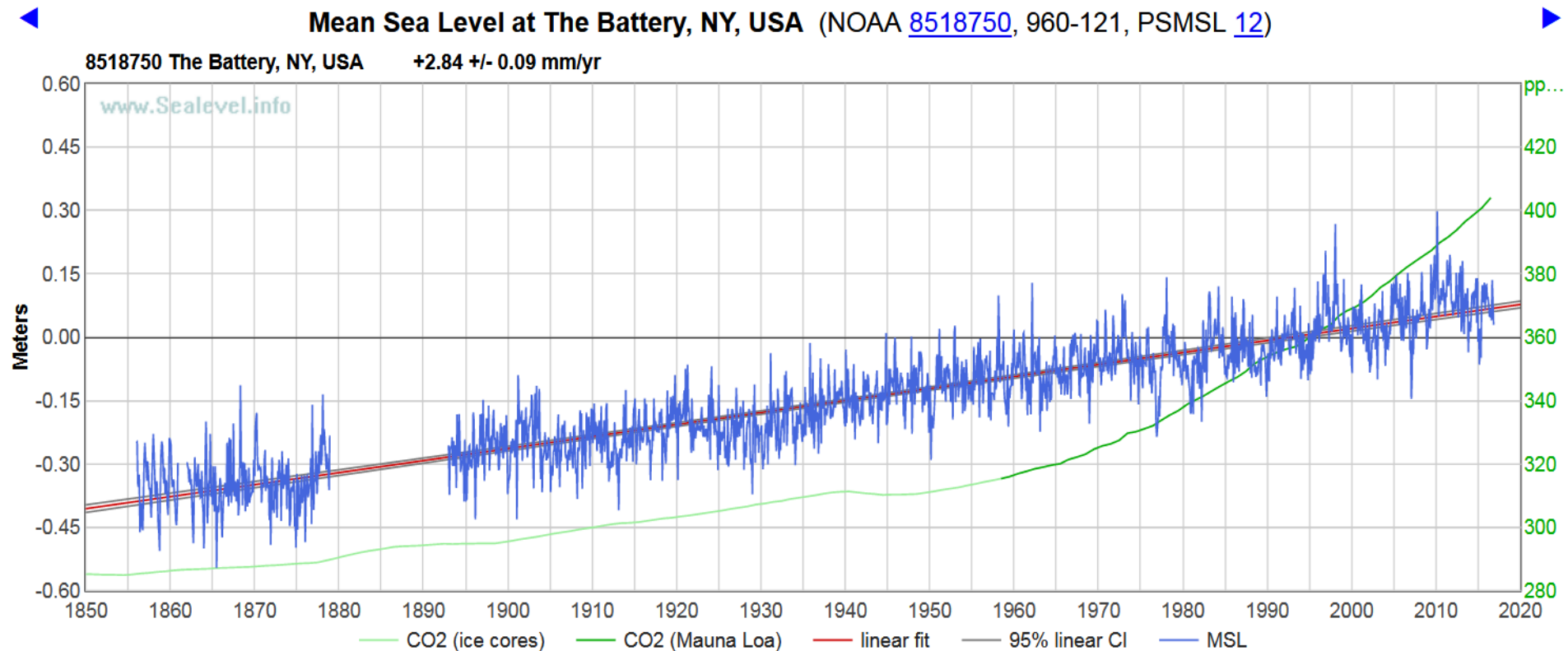
The rate of sea level rise in the over 160 years for which there are data show that the rate is unchanged over this time.

Data show the assertion by the Guardian is incorrect!

Can scientists quantify how responsible humans are for extreme weather like this?

Attribution is a relatively nascent science, but increasingly sophisticated computer models use temperature records, emission figures and recent data to calculate how the rise in greenhouse gases has increased the risk of a hotter world. Last year, researchers with World Weather Attribution and National Oceanic and Atmospheric Administration estimated that man-made emissions nearly doubled the odds of last year's heavy rains in Louisiana….

Is tropical storm Harvey linked to climate change?
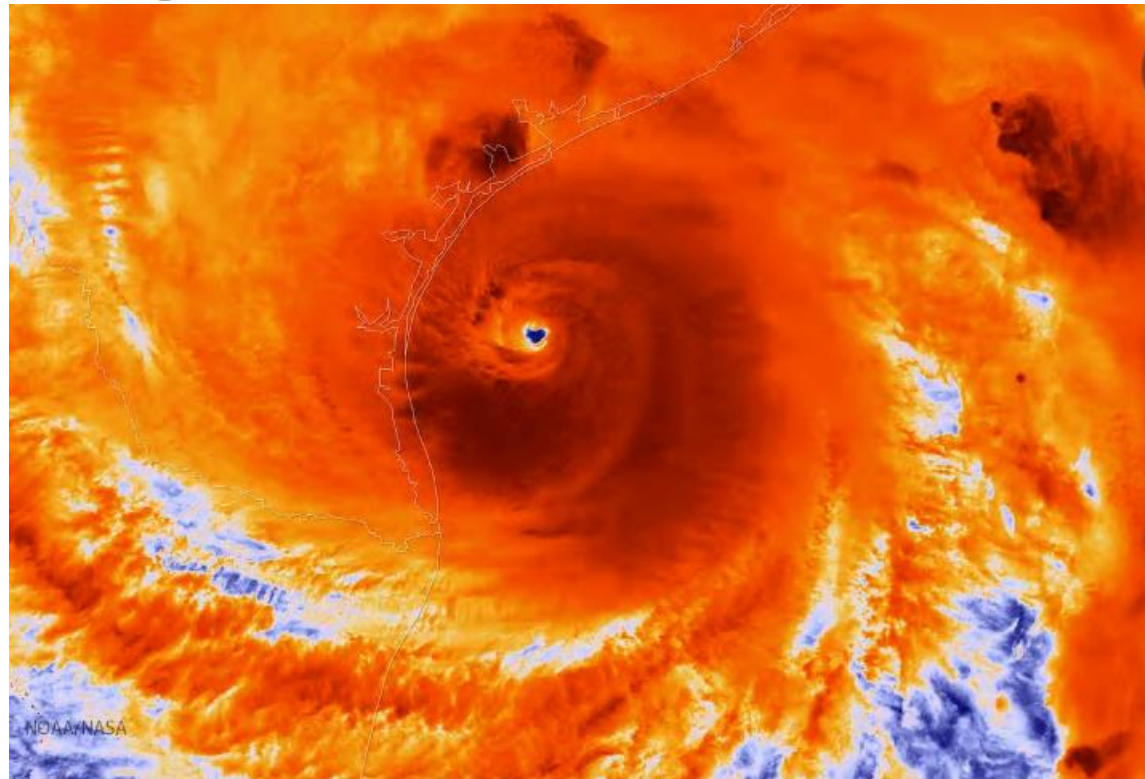
ℹ Infrared image of Hurricane Harvey just prior to making landfall along the Texas coast, US. Photograph: NOAA

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the guardian view / columnists / letters / more

Hurricane Harvey Opinion

It's a fact: climate change made Hurricane Harvey more deadly

Michael E Mann

We can't say that Hurricane Harvey was caused by climate change. But it was certainly worsened by it

What can we say about the role of climate change in the unprecedented disaster that is unfolding in Houston with Hurricane Harvey? There are certain climate change-related factors that we can, with great confidence, say worsened the flooding.

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Hurricane Harvey Opinion

It's a fact: climate change made Hurricane Harvey more deadly

Michael E Mann

"Sea level rise attributable to climate change – some of which is due to coastal subsidence caused by human disturbance such as oil drilling…"

 <Tide gages refute acceleration; subsidence is caused by fresh water pumping>

"… sea surface temperatures in the region have risen …(close to 1F) over the past few decades from roughly.. (87F), which contributed to the very warm sea surface temperatures (or 87-88F). "

<The SST changes have little to do with Western Gulf Hurricane intensities>

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Hurricane Harvey Opinion

It's a fact: climate change made Hurricane Harvey more deadly

Michael E Mann

"Harvey was almost certainly more intense than it would have been in the absence of human-caused warming, which means stronger winds, more wind damage and a larger storm surge."

<The storm damage from Harvey was NOT stronger winds, wind damage, or storm surge.

Damage was due to flooding rains which occurred when Harvey stalled and rain bands dumped rain over the same area for days>

Is tropical storm Harvey linked to climate change?

How did it make it worse?
Warmer seas evaporate more quickly.
Warmer air holds more water vapour. So, as temperatures rise around the world, the skies store more moisture and dump it more intensely.
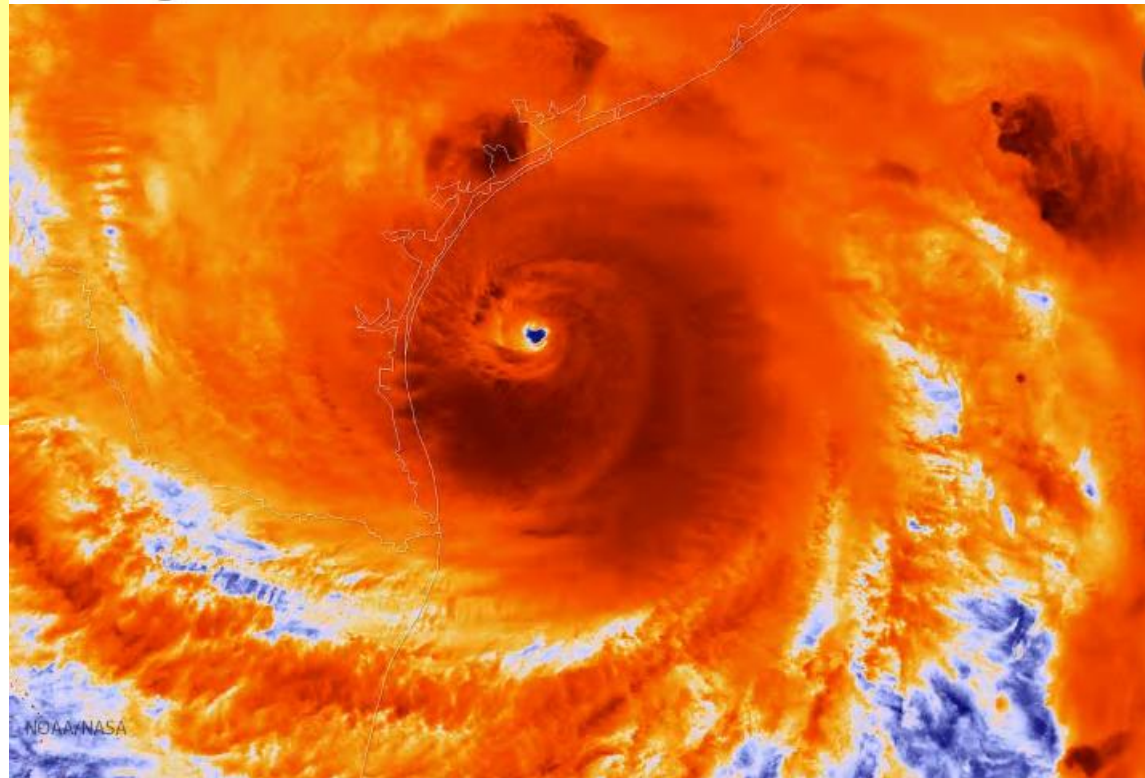
ⓘ Infrared image of Hurricane Harvey just prior to making landfall along the Texa coast, US. Photograph: NOAA

How unusual are the water levels with Hurricane Harvey?

In December of 1935 a massive flood occurred in the downtown area as the water level height measured at Buffalo Bayou in Houston topped out at 54.4 feet.

morial Dr.
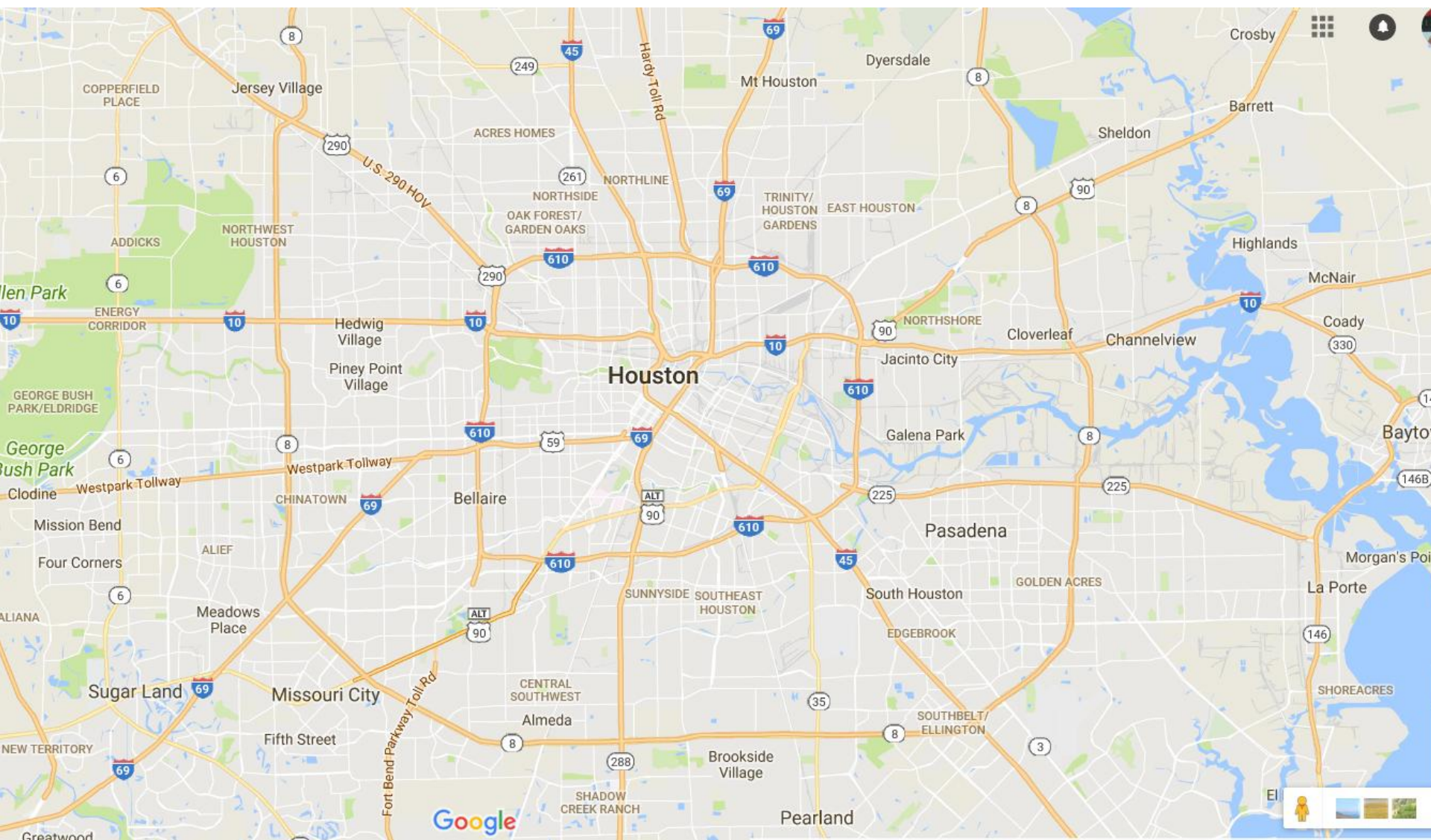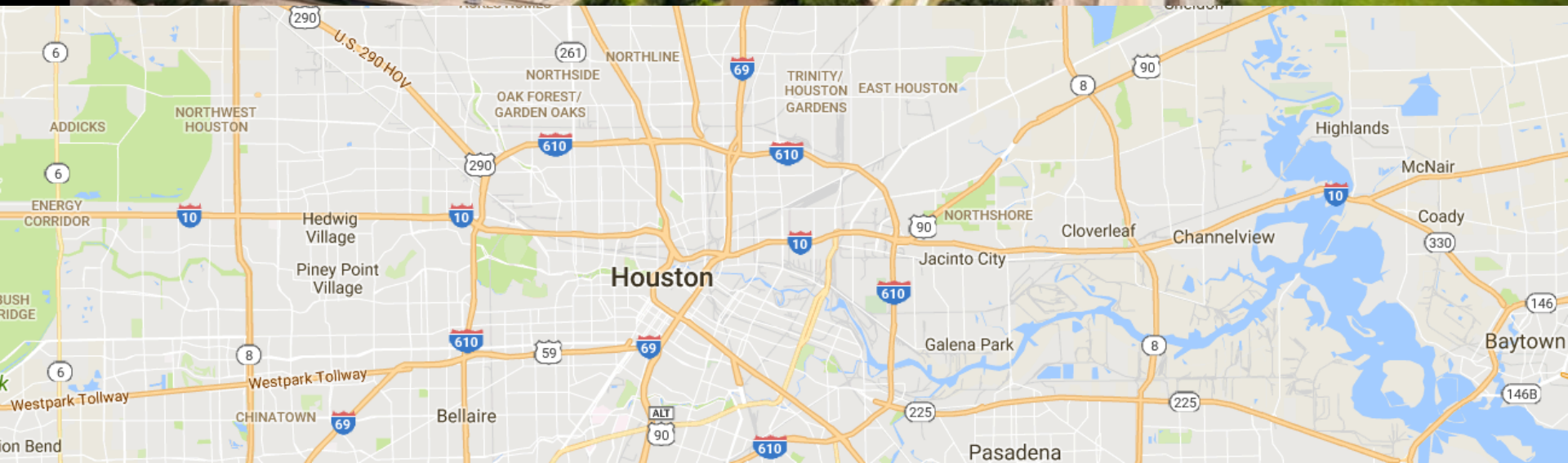
How unusual are the water levels with this storm?
Previous slide showed Buffalo Bayou water height of 54.4 ft, December 1935
Screen capture: Buffalo Bayou, 1 Sep 2017, after Harvey moved away

USGS 08074000 Buffalo Bayou at Houston, TX
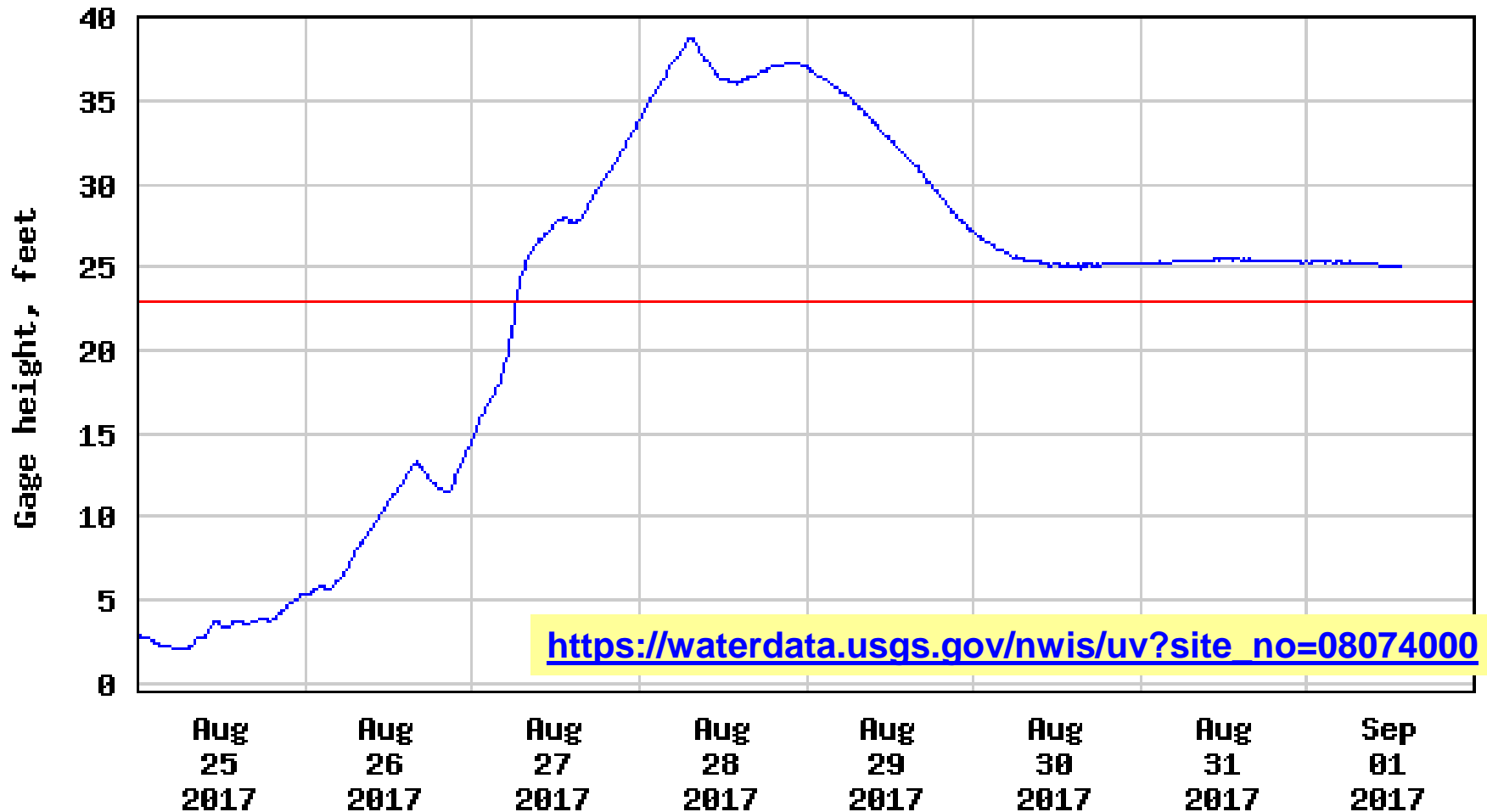
https://waterdata.usgs.gov/nwis/uv?site_no=08074000

---- Provisional Data Subject to Revision ----

— Gage height   — NWS Flood Stage

The Guardian's claim that global warming –enhanced warmer water temperatures result in more intense flooding rains does not bear up to the scrutiny of looking at the data.

The US data and map of record rainfall in the succeeding graphics make this point.
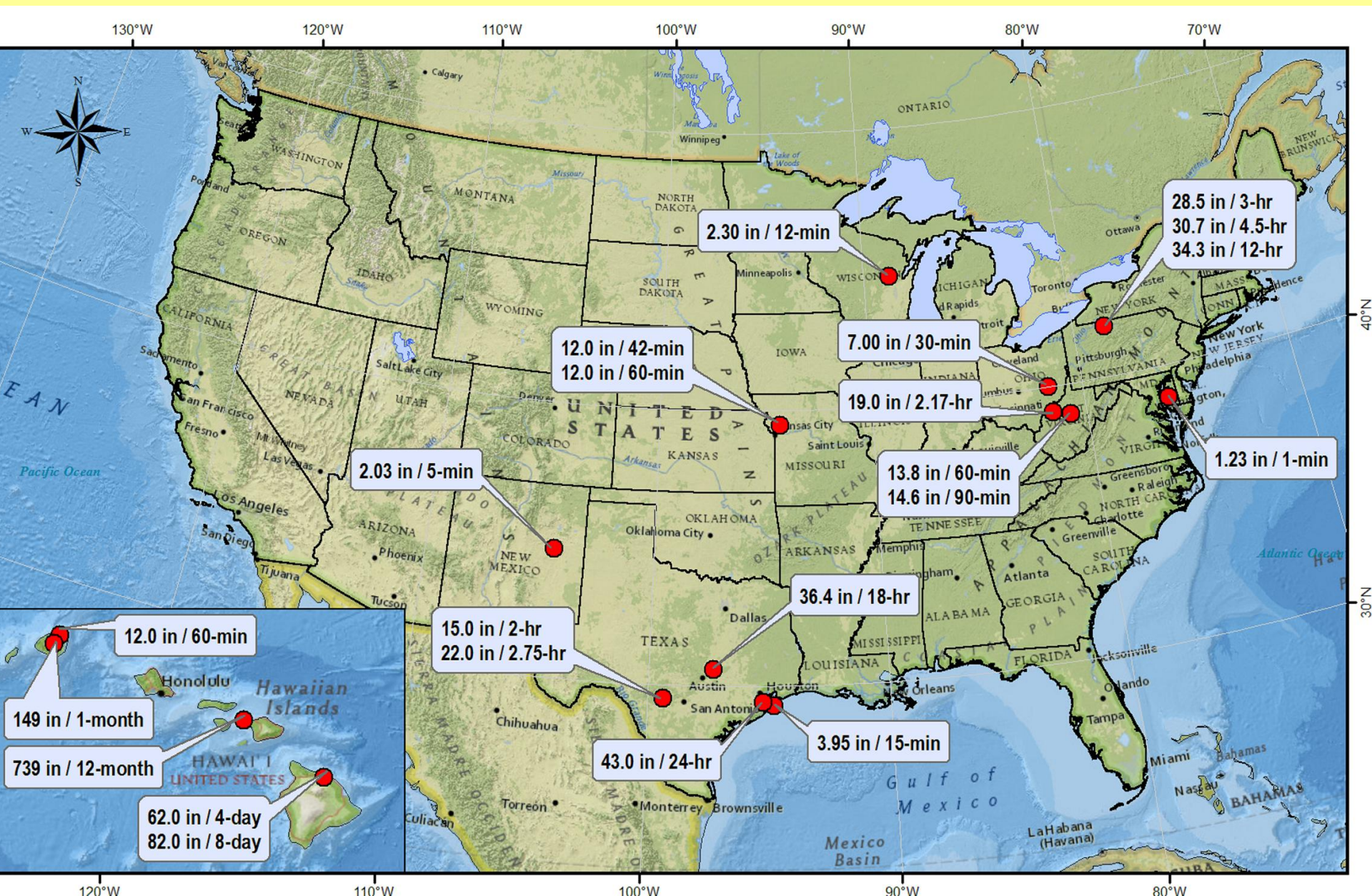
NOAA's National Weather Service

Hydrometeorological Design Studies Center

Organization

Duration	Amount (in)	Amount (mm)	Location	Lat (deg)	Long (deg)	Start date	Ref
1-min	1.23	31.2	Unionville, MD	38.80	-76.13	4 Jul 1956	2,3,4,5
5-min	2.03	52	Alamogordo Creek, NM	34.66	-104.39	5 Jun 1960	4
12-min	2.30	58	Embarrass, WI	44.67	-88.71	28 May 1881	4
15-min	3.95	100	Galveston, TX	29.29	-94.79	4 Jun 1871	4
30-min	7.00	178	Cambridge, OH	40.00	-81.58	16 Jul 1914	4
42-min	12.0	305	Holt, MO	39.45	-94.33	22 Jun 1947	1,4
	13.8*	351*	Burnsville 6 WNW, WV	38.88	-80.77	4 Aug 1943	4
60-min	12.0	305	Holt, MO	39.45	-94.33	22 Jun 1947	2,3,5
	12.0	305	Kilauea Sugar Plantation, Kauai, HI	22.21	-159.41	24 Jan 1956	3,5

It may be possible to create a new category for 3-day rainfall for Hurricane Harvey, 2017.

The map and data show that Texas' coastal plain is the site of many rainfall records,

…and…

claims Harvey is somehow different seem far-fetched.

90-min	14.6*	371*	Burnsville 6 WNW, WV	38.88	-80.77	4 Aug 1943	4
2-hr	15.0	381	Woodward Ranch (D'Hanis), TX	29.49	-99.38	31 May 1935	4
2.17-hr	19.0	483	Rockport, WV	39.07	-81.55	18 Jul 1889	1
2.75-hr	22.0	559	Woodward Ranch (D'Hanis), TX	29.49	-99.38	31 May 1935	1,4
3-hr	28.5	724	Smethport, PA	41.80	-78.45	18 Jul 1942	4
4.5-hr	30.7	780	Smethport, PA	41.80	-78.45	18 Jul 1942	1,4
12-hr	34.3	871	Smethport, PA	41.80	-78.45	17 Jul 1942	4
18-hr	36.4	925	Thrall, TX	30.59	-97.30	9 Sep 1921	4
24-hr	43.0	1092	Alvin, TX	29.42	-95.24	25 Jul 1979	3,4,5
4-day	62.0	1575	Kukaiau, Hamakua, HI	20.02	-155.37	27 Feb 1902	4
8-day	82.0	2083	Kukaiau, Hamakua, HI	20.02	-155.37	28 Feb 1902	4

Dr. Roger Pielke, Jr.,
Professor, Center for Science and
Technology Policy Research,
University of Colorado

Extreme weather expert Dr. Roger Pielke Jr. issued this statement:

"There is no reason to be debating Harvey and climate change in the context of an unfolding
 disaster, other than political opportunism and attention seeking.
 It's not a good look for scientists or journalists who are promoting this issue.
 The IPCC and other assessments are quite clear on this subject and one storm doesn't
 change that.
 A better focus in the short term is on those with expertise in disaster response and
recovery. The politicized debate over climate change can wait."

Presidential Hurricanes

		TOTAL	Per Year
Obama	2009-2016	4	0.5
Hoover	1929-1932	4	1.0
Kennedy	1961-1963	2	1.0
Ford	1974-1976	3	1.0
Carter	1977-1980	5	1.3
Bush	1989-1992	5	1.3
Roosevelt	1901-1908	11	1.4
Nixon	1969-1973	7	1.4
Coolidge	1923-1928	9	1.5
Reagan	1981-1988	12	1.5
Clinton	1993-2000	12	1.5
Harding	1921-1922	2	2.0
Eisenhower	1953-1960	16	2.0
Roosevelt	1933-1944	25	2.1
Truman	1945-1952	17	2.1
Johnson	1964-1968	9	2.3
Bush	2001-2008	18	2.3
Wilson	1914-1920	14	2.3
Taft	1909-1913	13	2.6

Science

△ AAAS

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In Depth   Climate Science
How an ocean climate cycle favored Harvey

Summary   (Paragraphing, Bolding, Underlining Added)

Hurricane Harvey was the first major hurricane to make landfall in the United States since 2005, but in some ways, it was long overdue.

For decades now, tropical storms have been getting a boost from a **powerful but still mysterious long-term cycle in North Atlantic sea surface temperatures**, which appears to be holding steady in its warm, storm-spawning phase.

Science

AAAS

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**In Depth   Climate Science
How an ocean climate cycle favored Harvey**

This cycle, called the **Atlantic Multidecadal Oscillation (AMO),** swings between warm and cool phases every 20 to 60 years, shifting North Atlantic temperatures by a degree or so and setting the backdrop for hurricane season.

Since about 1995, the AMO has been in a warm state, but researchers aren't sure where it's headed next.

The AMO has traditionally been attributed to natural shifts in ocean currents, and some think it's on the cusp of shifting back toward a cool, quiescent phase.

Science

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In Depth   Climate Science
How an ocean climate cycle favored Harvey

But others propose that human activities—a combination of declining air pollution and greenhouse warming—might prolong the current warm period, keeping hurricane activity high.
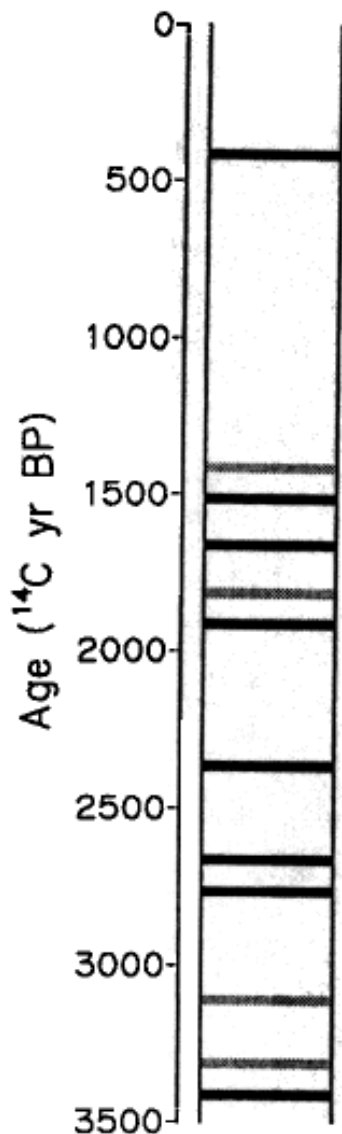
Is this really an unprecedented event?

We'll look at another flood event, Baton Rouge, Louisiana in 2016

Humans have been keeping rainfall records in this area for only 150 years or so...

There are flood records in Louisiana since the French settled Louisiana ~1708, or a little over 300 years.

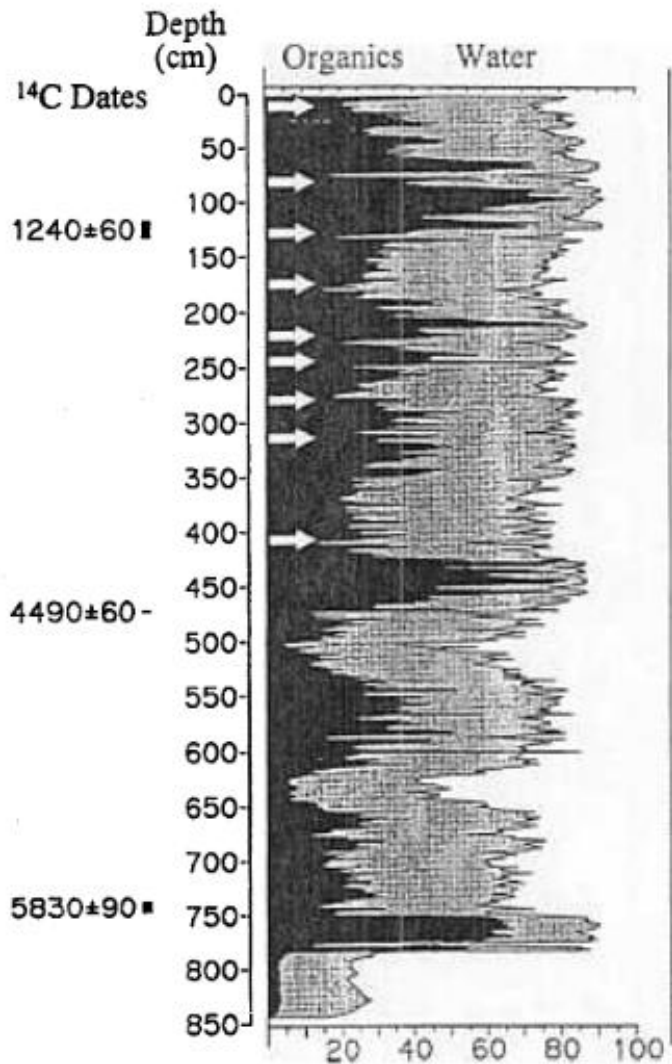What do geological records of longer periods for this region show?

"**Holocene history of Catastrophic Hurricane Landfalls along the Gulf of Mexico Coast Reconstructed from Coastal Lake and Marsh Sediments**"

http://coastandenvironment.lsu.edu/docs/faculty/liu/paleoecology_web/index_files/marsh.pdf

Fig. 5. Abbreviated chronostratigraphic column of Western Lake core I for the past 3500 years showing the radiocarbon-dated ages of the major sand layers (solid lines) and minor sand layers (stippled lines). The vertical axis is time measured in uncalibrated ¹⁴C years before present. At least 12 sand layers occur within the past 3400 years.

Pearl River Marsh

Fig. 6. Loss-on-ignition curves for a core from the Pearl River Marsh, Louisiana, showing the organic matter contents (dark) and water contents (stippled) of the sediments. The occurrence of clastic layers (storm deposits), denoted by arrows, is reflected by an abrupt drop in both water contents and organic matter contents. At least 9 such clastic layers occur within the last 4000 years.

White arrows show storm deposits from flood events for the past few thousand years.

1000 years BP

4500 years BP

Holocene history of Catastrophic Hurricane Landfalls along the Gulf of Mexico Coast Reconstructed from Coastal Lake and Marsh Sediments

http://coastandenvironment.lsu.edu/docs/faculty/liu/paleoecology_web/index_files/marsh.pdf

HOUSTON

H.PAYNE ©17UNIVERSAL comics.com/EMAIL:hpayne@detroitnews.com

U.S. Landfalling Category 4-5 Hurricanes Ranked by Pressure (1851-2017)

Rank	Year	Storm_Name	Wind (Knots)	Pressure (mb)	SS_ Category
1	1935	Labor Day	160	892	5
2	1969	Camille	150	900	5
3	1992	Andrew	145	922	5
4	1886	Indianola	130	925	4
5	1919	Florida Keys	130	927	4
6	1928	Lake Okeechobee	125	929	4
T-7	1926	Great Miami	125	930	4
T-7	1960	Donna	125	930	4
9	1961	Carla	125	931	4
10	1916	1916 Texas Hurricane	115	932	4
11	1989	Hugo	120	934	4
12	1932	Freeport	130	935	4
13	1900	Galveston	120	936	4
T-14	1898	Georgia	115	938	4
T-14	1954	Hazel	115	938	4
T-14	**2017**	**Harvey**	**115**	**938**	**4**
T-17	1915	Galveston	115	940	4
T-17	1948	1948 Florida Hurricane	115	940	4
19	2004	Charley	130	941	4
20	1947	Fort Lauderdale	115	943	4
21	1893	Chenier Caminanda	115	948	4
22	1945	Homestead	115	949	4
23	1959	Gracie	115	951	4
24	1949	1949 Florida Hurricane	115	954	4
25	1950	King	115	955	4

Anyone blaming Harvey on global warming doesn't have a leg to stand on.

...Judith Curry.

https://www.gfdl.noaa.gov/global-warming-and-hurricanes/

It is premature to conclude that human activities–and particularly greenhouse gas emissions that cause global warming

–have already had a detectable impact on Atlantic hurricane or global tropical cyclone activity.

That said, human activities may have already caused changes that are not yet detectable due to the small magnitude of the changes or observational limitations, or are not yet confidently modeled (e.g., aerosol effects on regional climate)…

Current datasets indicate no significant observed trends in global tropical cyclone frequency over the past century …

No robust trends in annual numbers of tropical storms, hurricanes and major hurricanes counts have been identified over the past 100 years in the North Atlantic basin

… In summary, confidence in large scale changes in the intensity of extreme extratropical cyclones since 1900 is low

Continued improvements to the global forecast models (e.g. ECMWF, NOAA GFS/GEFS) and to the mesoscale hurricane models are increasing the accuracy of hurricane forecasts at longer time horizons.

… Apart from longer range considerations of genesis forecasts, the NHC seems focus on the 5 day forecasts from its mesoscale models.

Because they are driven by a single realization of the global forecast model, substantial errors can result if this single realization has large scale dynamics and a track that are in error.

You really need to work with an ensemble of forecasts.