Claim: Global warming is causing more hurricanes and stronger hurricanes

REBUTTAL

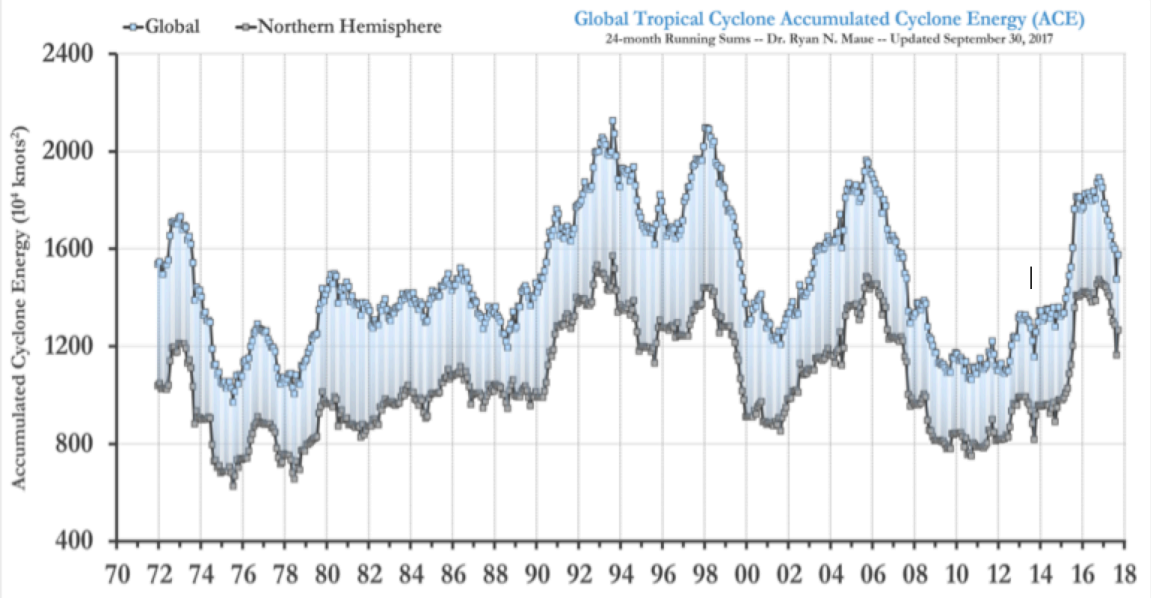
There has been no detectable long-term trend in the number and intensity of hurricane activity globally. The activity does vary year to year and over multidecadal periods as ocean cycles including El Nino/La Nina, multidecadal cycles in the Pacific (PDO) and Atlantic (AMO) favor some basins over others.

The trend in landfalling storms in the United States has been flat to down since the 1850s. Before the active hurricane season in the United States in 2017, there had been a lull of 4324 days (almost 12 years) in major hurricane landfalls, the longest lull since the 1860s.

Harvey was the first hurricane to make landfall in Texas since Ike in 2008 and the first Category 4 hurricane in Texas since Hurricane Carla in 1961. There has been a downtrend in Texas of both hurricanes and major hurricanes. Texas is an area where Gulf Tropical Storms and hurricanes often stall for days, and 6 of the heaviest tropical rainfall events for the U.S. have occurred in Texas. Harvey's rains were comparable to many of these events. Claudette in 1979 had an unofficial rainfall total greater than in Harvey.

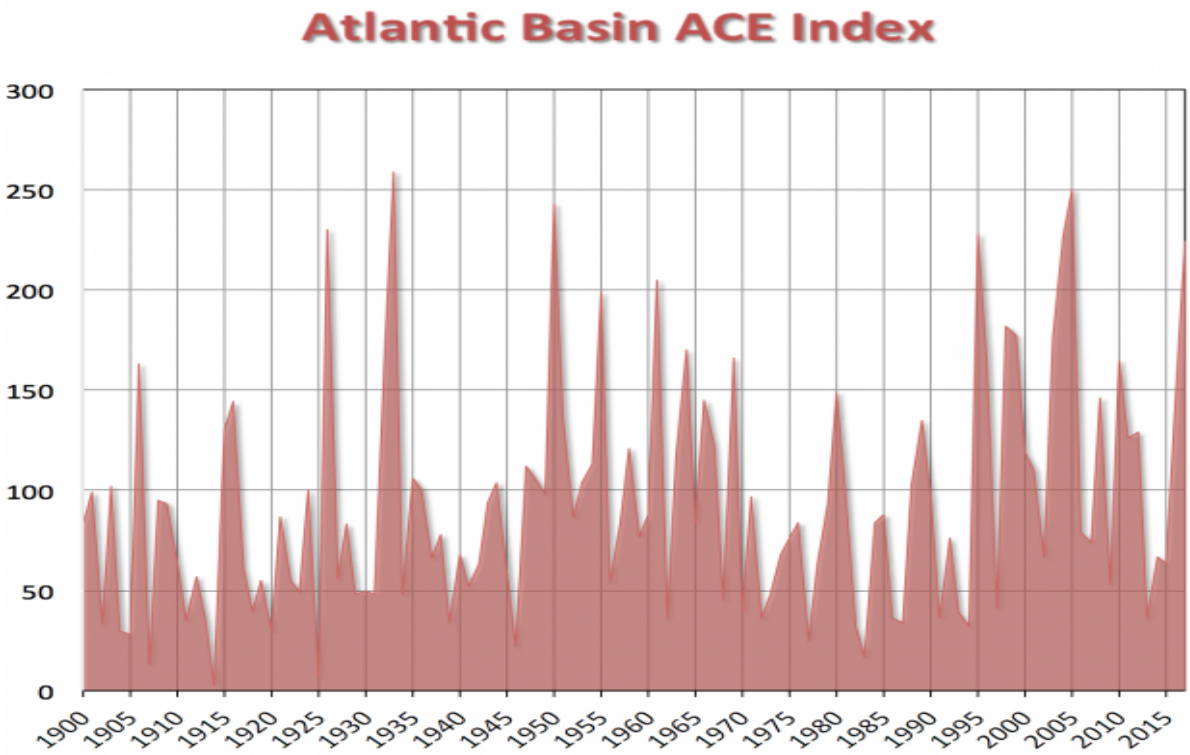
In Florida, where Irma hit as a category 4 on the Keys, it came after a record 4339 days (just short of 12 years) without a landfalling hurricane. The previous record lull was in the 1860s (8 years). There has been no trend in hurricane intensity or landfalling frequency since at least 1900.

The Accumulated Cyclone Energy (ACE) Index takes into account the number, duration and strength of all tropical storms in a season. It shows variability but no trend in the record the last 45 years for the Northern Hemisphere or globe. In pre-satellite eras, many storms were not seen or counted away from land, the islands or shipping lanes. The early seasonal storm counts were not doubt higher, though landfalling storm numbers are likely reliable.



Source: Dr. Ryan Maue with NHC data

The Accumulated Cyclone Energy Index for the Atlantic shows a cyclical behavior with no long-term trend but with spikes in 1893, 1926, 1933, 1950 then again in 1995, 2004 and 2005. 2017 ranks 7th now (UCO Tropical Meteorology Project)



Source: University of Colorado Tropical Meteorology Project Phil Klotzbach

Rank	Season	ACE
1	1933	259
2	2005	250
3	1893	231
4	1926	230
5	1995	228
6	2004	227
7	2017	226
8	1950	211
9	1961	205
10	1998	182
** As of November 28*		

Source: NOAA AOML

The Saffir–Simpson hurricane wind scale (SSHWS), formerly the Saffir–Simpson hurricane scale (SSHS), categorizes Western Hemisphere tropical cyclones by the intensities of their sustained winds. Category 3, 4 and 5 storms are called major hurricanes. Before 2010, both central pressure and wind had been used in categorizing hurricanes.

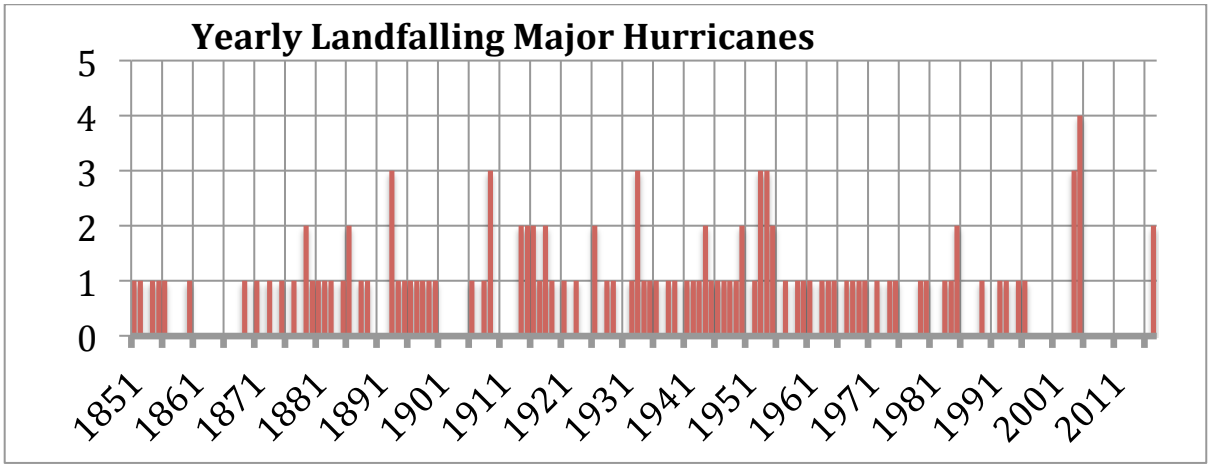
Saffir-Simpson Scale

Category	Wind Speeds
Category 5	More than 157 mph (more than 137 knots)
Category 4	130 to 156 mph (112 to 136 knots)
Category 3	111 to 129 mph (96 to 112 knots)
Category 2	96 to 110 mph (83 to 95 knots)
Category 1	74 to 95 mph (64 to 82 knots)
Tropical Storm	39 to 73 mph (34 to 63 knots)
Tropical Depression	Less than 38 mph (less than 33 knots)

Source: NHC

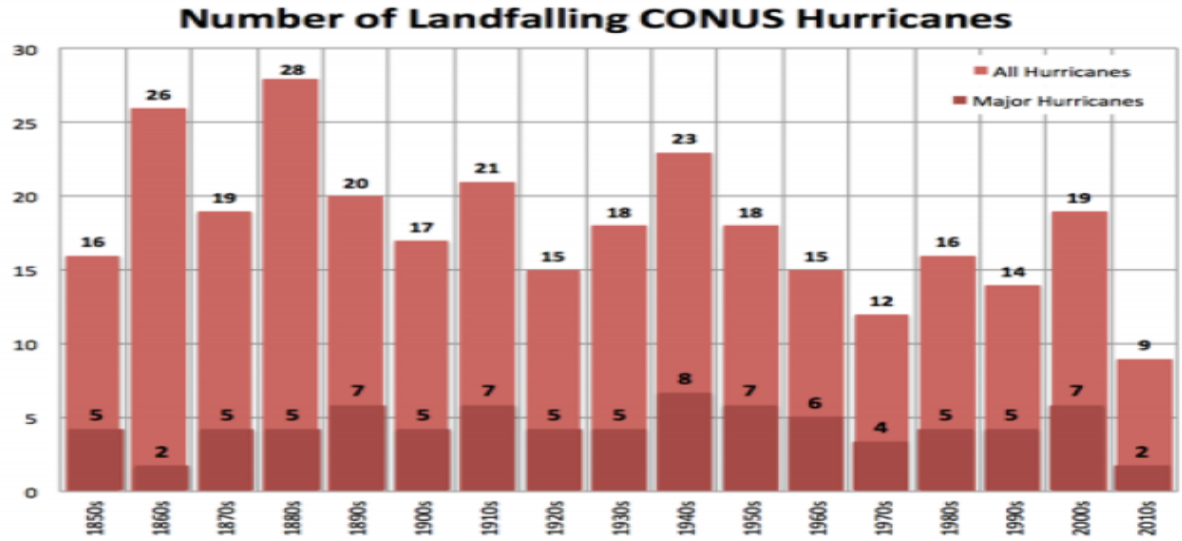
THE ACTIVE 2003 TO 2005 PERIOD THEN A RECORD LULL

Isabel in 2003, Charley, Frances, Ivan and Jeanne in 2004 and Dennis, Katrina, Rita and Wilma in 2005 all made landfall on the mainland. Emily in 2005 was another major hurricane but turned west into Mexico. 2005 holds the record for 5 category 4 or greater and 4 category 5 impact storms. Some speculated this was the new norm for the Atlantic. However, after the active 2005 season and before the landfall of two major storms on the U.S. in 2017, the U.S. had gone 4324 days (just short of 12 years) without a major hurricane landfall, the longest such lull since the 8 years in the 1860s.



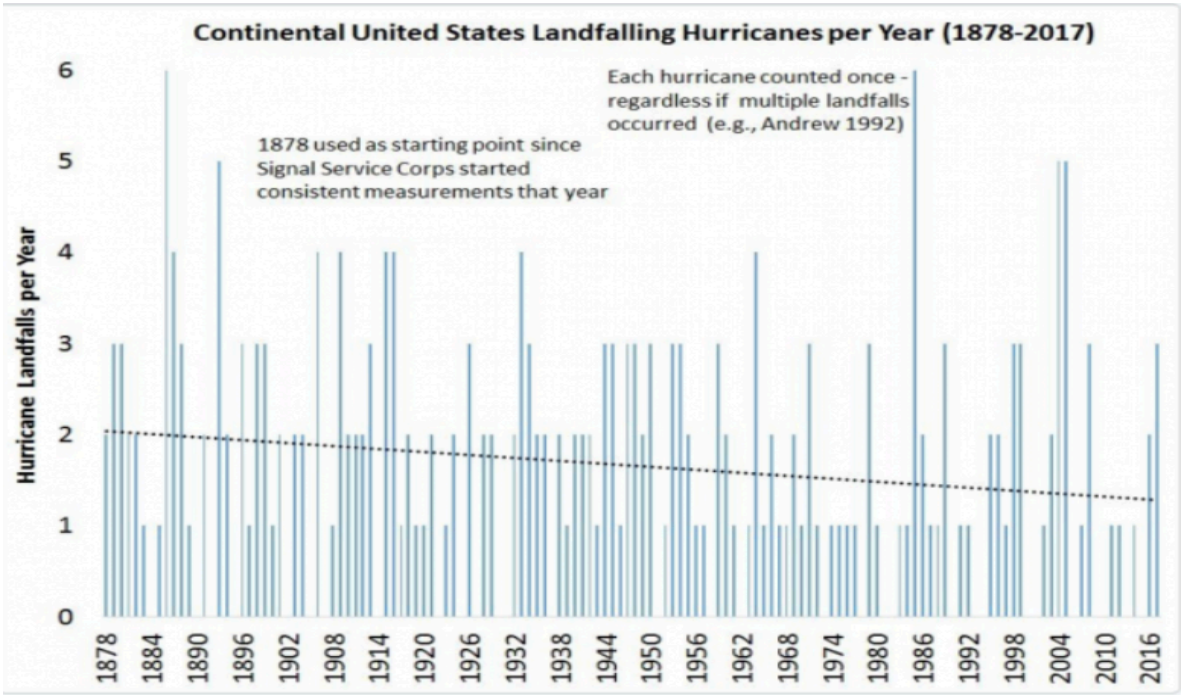
Source: NOAA AOML

In fact, the number of U.S. landfalling hurricanes and major hurricanes have been on the decline since the late 1800s.



Source: NOAA AOML

The downward trend in landfalling hurricane by year since 1878 was documented by Roger Pielke Jr.

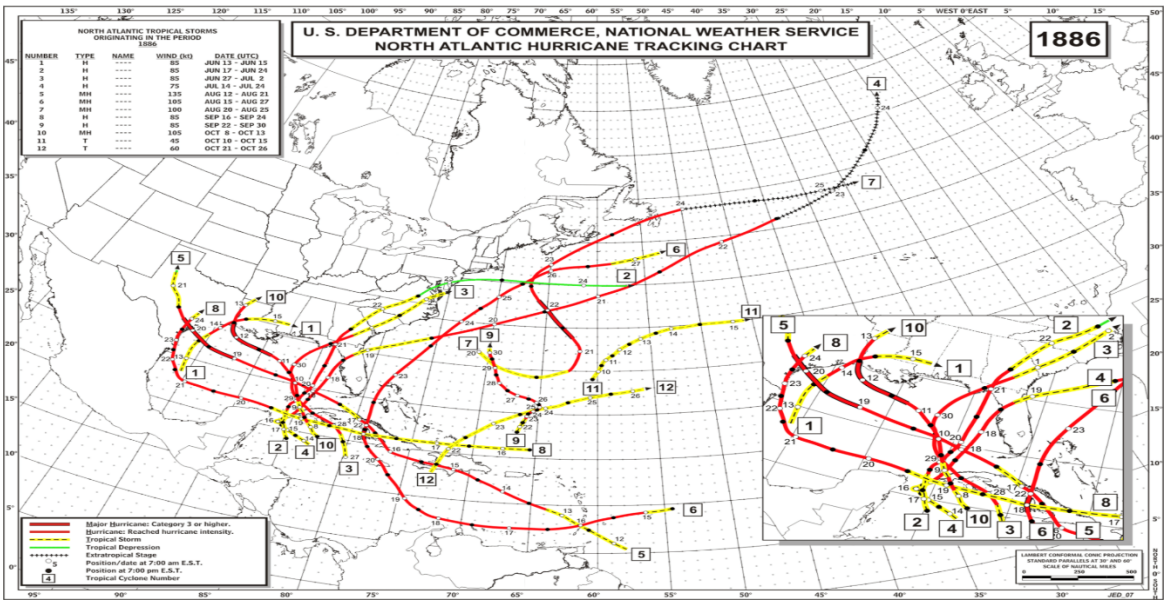


Source: Pielke Jr. from NOAA AOML

Alarmists claim that this level and intensity of hurricane activity is unprecedented. But nothing new has happened in the weather. Great Colonial hurricanes in the northeast with storm surges up to 20 feet occurred in 1635 and 1675. A Katrina like storm made landfall in Louisiana in 1722 with major flooding and damage in Louisiana. The Great Chesapeake storm in 1769 like Isabel in 2003 brought major flooding to North Carolina and Virginia. In the Caribbean, the Great Hurricane of 1780 killed an estimated 27,500 people while ravaging the islands of the eastern Caribbean with winds estimated to top 200 mph. It was one of three hurricanes that year with death tolls greater than 1000.

1893, had at least 10 hurricanes. Of those, 5 became major hurricanes. Two of the hurricanes caused over two thousand (2000) deaths in the United States; at the time, the season was the deadliest in U.S. history.

1886 came close with at least 10 hurricanes, 7 making landfall. **4 of the 1886 hurricanes were major hurricanes.**

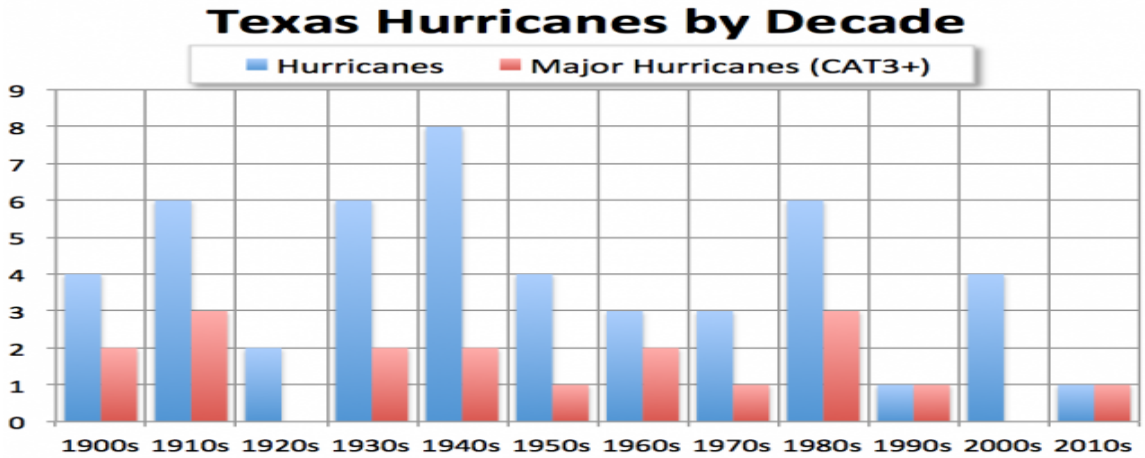


Source: U.S. Department OF Commerce, National Weather Service, North Atlantic Tracking Chart

The Galveston Hurricane in 1900 killed at least 8,000 people with some estimates as high as 12,000, making it the deadliest natural disaster in U.S. history.

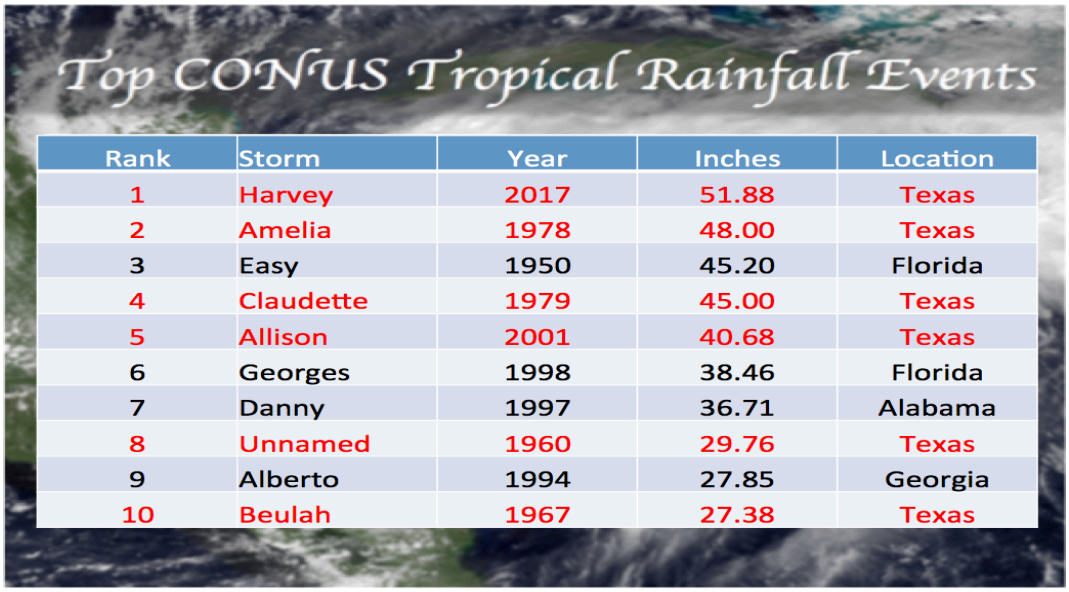
The 2017 Season in Perspective

The 2017 hurricane season got started very early with Arlene in April but the real action held off until the last week of August when Hurricane Harvey flooded Texas and Louisiana. Harvey was the first hurricane to make landfall in Texas since Ike in 2008 and the first Category 4 hurricane in Texas since Hurricane Carla in 1961. Note the downtrend in Texas of both hurricanes and major hurricanes.



Source: NOAA AOML

As for the heaviest rain record, Texas is the location where tropical storms often go to die dumping heavy rains for days. Six of the top ten tropical rain events have occurred in Texas.



Top CONUS Tropical Rainfall Events

Rank	Storm	Year	Inches	Location
1	Harvey	2017	51.88	Texas
2	Amelia	1978	48.00	Texas
3	Easy	1950	45.20	Florida
4	Claudette	1979	45.00	Texas
5	Allison	2001	40.68	Texas
6	Georges	1998	38.46	Florida
7	Danny	1997	36.71	Alabama
8	Unnamed	1960	29.76	Texas
9	Alberto	1994	27.85	Georgia
10	Beulah	1967	27.38	Texas

Source: NOAA

Harvey meandered for several days drawing on a steady influx of Gulf moisture. The Houston area had between 30 and 45 inches generally but one gauge in the 154 rain gauge network in Harris County recorded over 51 inches. Breaking the record of 48 inches in Amelia in 1978.
Cliff Mass of the University of Washington in his blog did a careful analysis of the possible impacts of 'global warming 'on Hurricane Harvey. Based on the data he concluded *"the results are clear: human-induced global warming played an inconsequential role in this disaster….There is no evidence that global warming is influencing Texas coastal precipitation in the long term and little evidence that warmer than normal temperatures had any real impact on the precipitation intensity from this storm…"The bottom line in this analysis is that both observations of the past decades and models looking forward to the future do not suggest that one can explain the heavy rains of Harvey by global warming, and folks that are suggesting it are poorly informing the public and decision makers."*

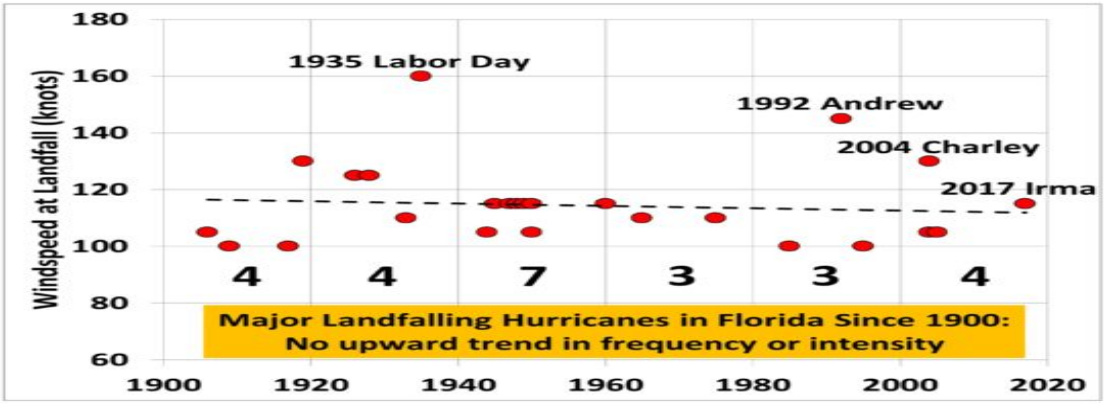
Irma, the 11th strongest Atlantic storm on record (using central pressure) had major impacts on Islands like Barbuda and St. Martin, the Virgin Islands, the Turks and Caicos and southern Bahamas. Then crossing northern Cuba it curled back into Florida.

It was the first landfalling hurricane and major hurricane in Florida since Wilma in 2005. **This also was a record lull – 4439 days**. The previous record lull back to 1851 was 2191 days from 1979 to 1985.

In terms of intensity, Maria had the 9th lowest pressure ever recorded in the Atlantic Basin and Irma was tied for 11th. In 2005, three storms, Katrina, Rita and Wilma had lower pressure than any storm in 2017.

STRONGEST ATLANTIC STORMS		
Storm	Year	Pressure (mb)
Wilma	2005	882
Gilbert	1988	888
Labor Day	1935	892
Rita	2005	895
Allen	1980	899
Camille	1969	900
Katrina	2005	902
Mitch	1998	905
Dean	2007	905
Maria	2017	908
Cuba	1924	910
Ivan	2004	910
Janet	1955	914
Irma	2017	914
Cuba	1932	915
Isabel	2003	915
Opal	1995	916
Hugo	1989	918
Gloria	1985	919
Hattie	1961	920
Floyd	1999	921
Andrew	1992	922
Bahamas	1929	924
David	1979	924
Igor	2010	924

Dr. Roy Spencer showed there was no trend in frequency or intensity in Florida since 1900.

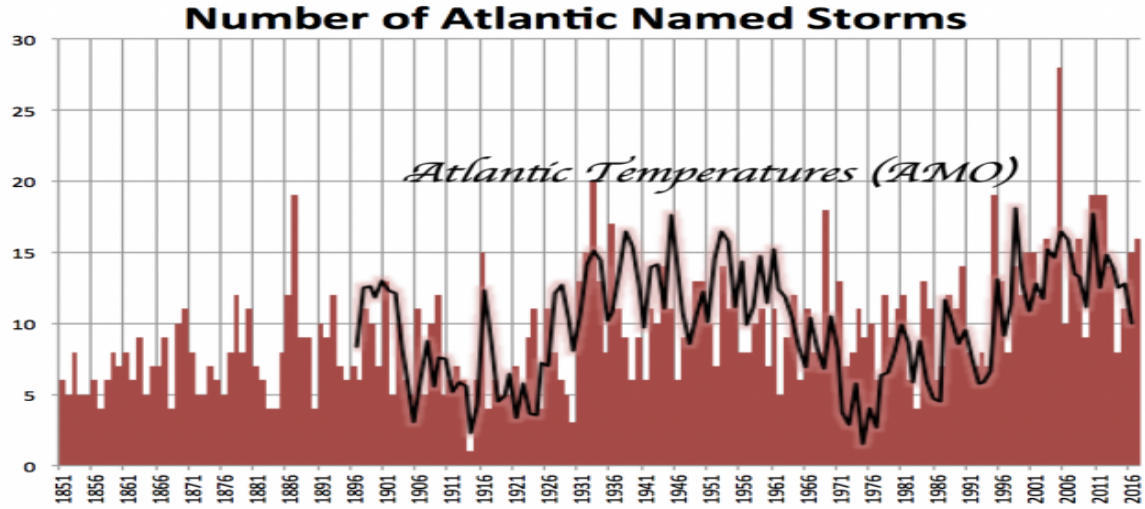


Source: Dr. Roy Spencer

Maria was the third major Hurricane in 2017. It crossed the northern Leeward Islands and plowed through Puerto Rico, doing catastrophic damage to the island, And then Hurricane Nate avoided another 'Katrina moment for New Orleans but produced storm surge damage to southeast Louisiana, Mississippi, Alabama and the Florida Panhandle.

Ocean Temperature And Pressure Patterns

The North Atlantic like the Pacific undergoes multi-decadal changes in ocean temperature and pressure patterns. It has long been known, when the Atlantic is in what its' warm Atlantic Multidecadal Oscillation (AMO) mode, there are more storms. Since 1995, when the current warm Atlantic mode began, we averaged 14.6 named storms per year, more than 5 more than the long-term 1851-2017 average. See the close fit of the AMO and the number of Atlantic Storms and the ACE Index (graph shown earlier).



Source: PSD AMO and ACE from UCO Tropical Meteorology Project

El Nino and La Nina affect Landfall

An important factor that impacts whether hurricanes affect the United States is El Nino and La Nina. When El Ninos develop, more storms develop in the eastern and central Pacific threatening Mexico, Hawaii and sometimes in weakened forms Arizona and California.

These storms enhance high-level winds that cross into the Atlantic. These winds produce shear that disrupts developing storms causing them to weaken or dissipate and/or turn harmlessly north into the North Atlantic. Storms can still develop near the coast where the water is warm like in the Gulf and near the Gulf Stream off the southeast coast.

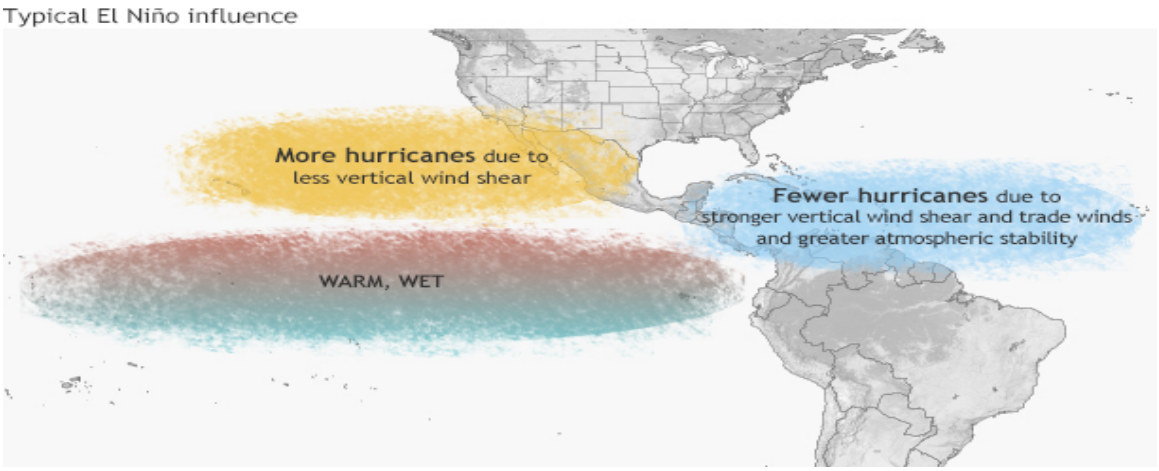


Image courtesy of climate.gov based on originals by Gerry Bell

When La Ninas develop there are usually fewer storms in the eastern Pacific and less shear to disrupt the Atlantic storms.

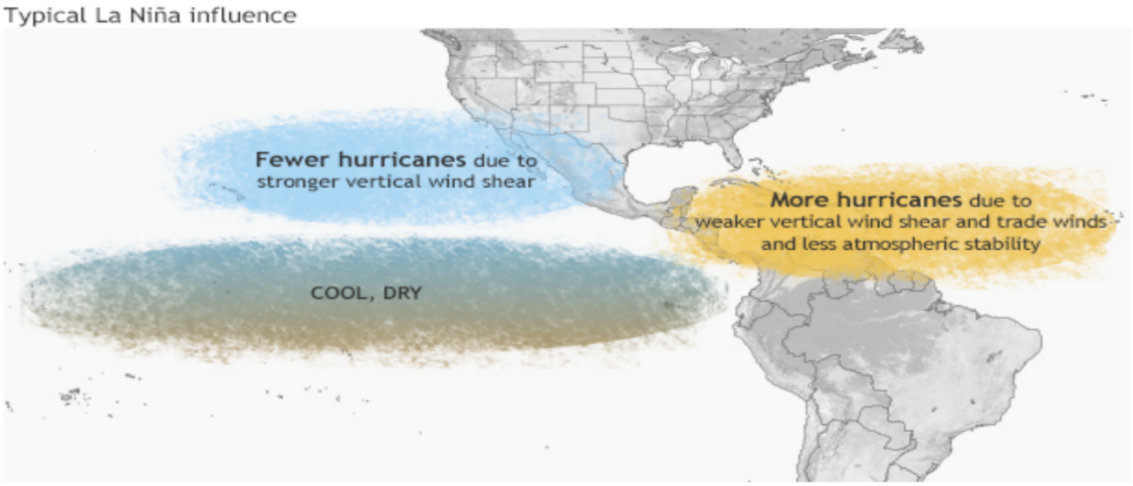
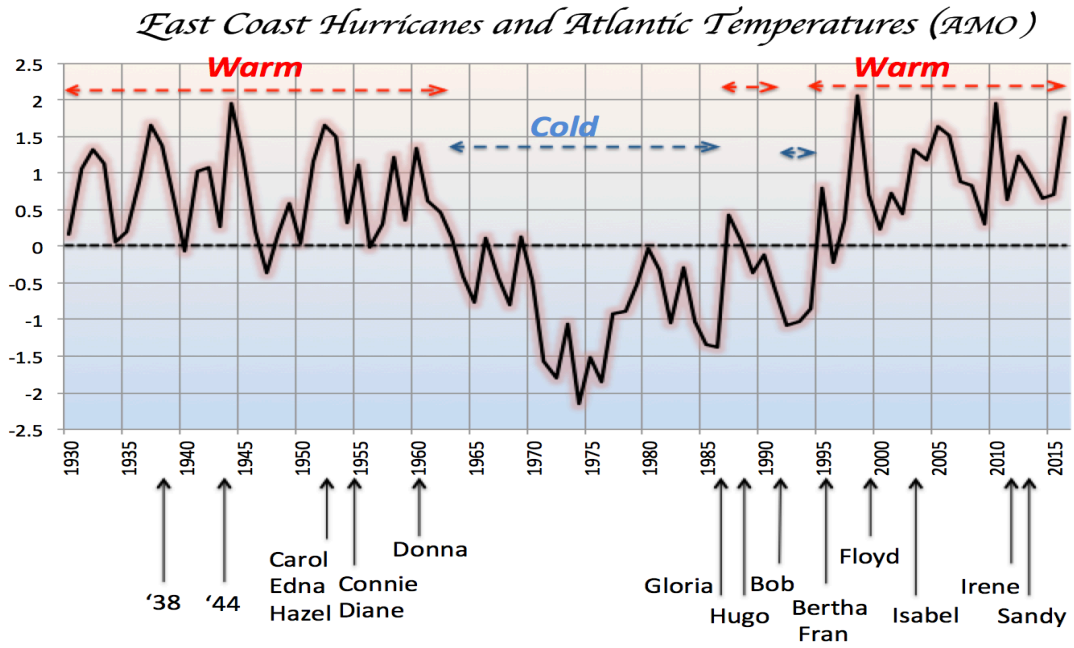


Image courtesy of climate.gov based on originals by Gerry Bell

In warm Atlantic years, that means trouble as the storms can track the entire Basin with more time to turn into major hurricanes. Even the east coast is more vulnerable to a landfalling hurricane when the Atlantic is warm. There were 8 high impact east coast hurricanes from 1938 to 1960 and 9 from 1988 to 2012.

The last important La Nina stretch was in 2010/11 to 2011/12. A major hurricane hit was avoided, though major hurricanes at sea made final landfall in the NYC metro - Irene (as a tropical storm) in 2011 and Sandy in 2012 (as a post tropical cyclone). They caused massive flooding (from rains with Irene in upstate NY and Vermont and from a storm surge with Sandy in New York City and New Jersey).



Source: PSD AMO

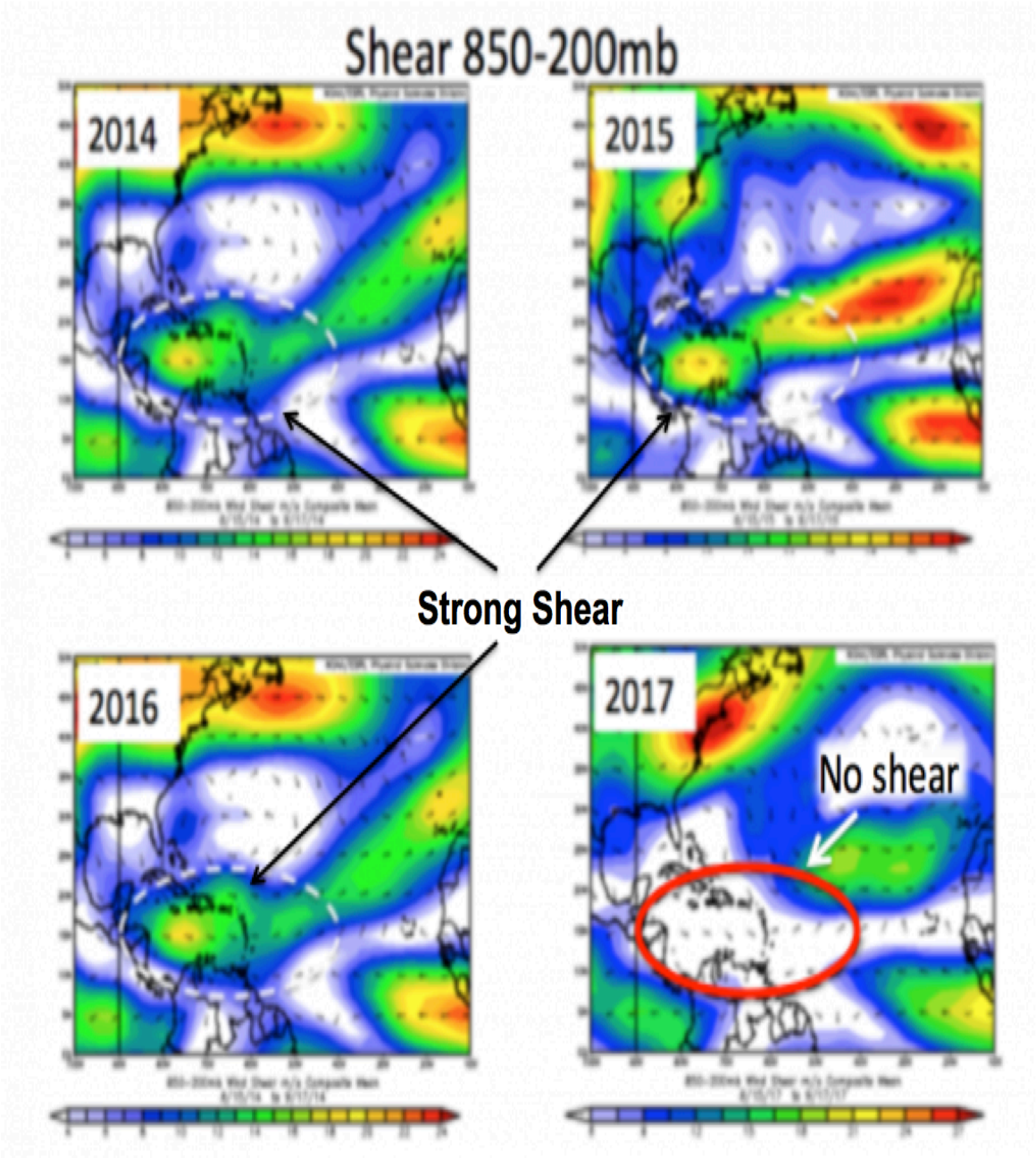
The Atlantic is still in the latest warm period. This year, a spring attempt at an El Nino failed and La Nina -like conditions developed. Had El Nino succeeded, Harvey which developed near the Texas coast may still have happened, and Nate too, which came out of the bath water in the western Caribbean. But maybe Irma and Maria would have been weakened or deflected. However, with La Nina conditions developing, no wind shear and warm Atlantic water, the big storms returned just as happened in 2004 and 2005.

So when a year like 2017 occurs or back-to-back bad years like 2004 and 2005, it is necessary to accept that this is how the weather works. Permadroughts ended with record wet years for Texas and California this decade. The record nearly 12 year major hurricane 'drought' ended with 2017.

Alarmists also claim that the hurricanes in 2017 were particularly massive in size and stayed strong for a very long period fed by CO_2 warming. The strongest tropical system on record, Pacific super typhoon Tip in 1979 still holds the record for size (diameter of 1380 miles), strength (190 mph) and lowest pressure (870mb).

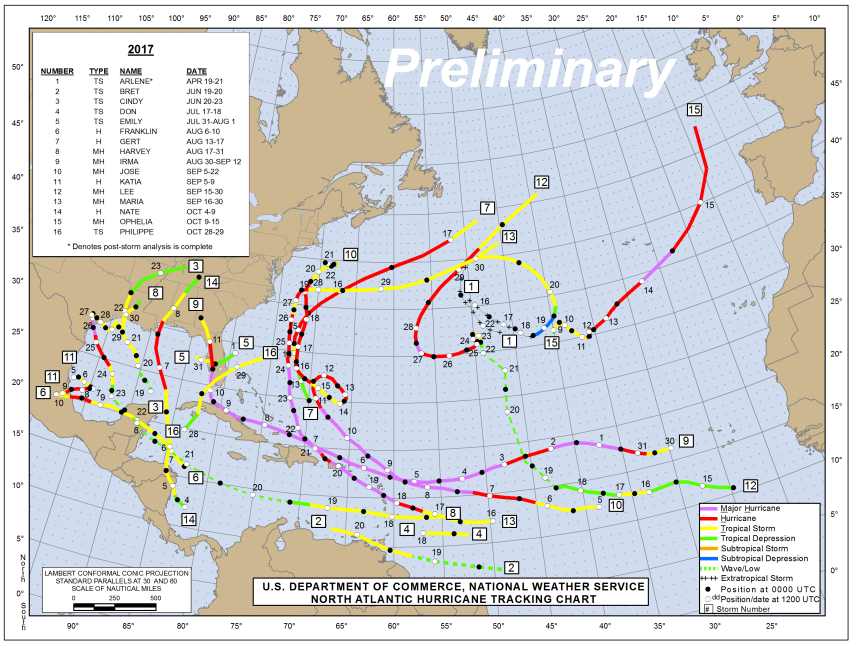
Source: Harris and Khandekar

Compare Tip with Harvey and Irma. These storms maintained their intensity for a long time because in the warm Atlantic mode and with a developing La Nina, atmospheric wind shear, which kept the storms at bay and short lived in recent years, was absent in the key regions.



Source: PSD Reanalysis

The storms also managed to navigate through the islands and avoid the mountainous islands like Hispaniola, which disrupts or even destroys many hurricanes. The purple segments along the tracks show the strongest storms were in this favorable environment. Given these conditions, the behavior of these storms was hardly unusual.



Source: NWS

Authors:

Dr. Neil Frank
PhD, MS degrees in Meteorology Florida State University
BS Chemistry, Southwestern College
Longest Standing Director of the National Hurricane Center (1974–1987)
Chief Meteorologist at KHOU-TV in Houston ,1989 Texas Press Awards for the Best weathercast, 2004 recipient of the Belo William H. Seay Award.
Councilor, American Meteorological Society,

Roy W. Spencer
Ph.D. in meteorology at the University of Wisconsin-Madison
Before becoming a Principal Research Scientist at the University of Alabama in Huntsville in 2001, he was a Senior Scientist for Climate Studies at NASA's Marshall Space Flight Center, where he and Dr. John Christy received NASA's Exceptional Scientific Achievement Medal for their global temperature monitoring work with satellites.
Dr. Spencer's work with NASA continues as the U.S. Science Team leader for the Advanced Microwave Scanning Radiometer flying on NASA's Aqua satellite.
Dr. Spencer's research has been entirely supported by U.S. government agencies: NASA, NOAA, and DOE.

Joseph D'Aleo
BS, MS degrees in Meteorology, University of Wisconsin

ABD Air Resources NYU, honorary PhD Lyndon State College
Professor and Meteorology Department Chair, Lyndon State College
Certified Consultant Meteorologist, Fellow of the AMS, Councilor at the AMS, Chair of the AMS Committee on Weather Analysis and Forecasting
Co- founder and First Director of Meteorology at The Weather Channel
Chief Meteorologist at WSI, Hudson Seven LLC, WeatherBell Analytics LLC, Icecap