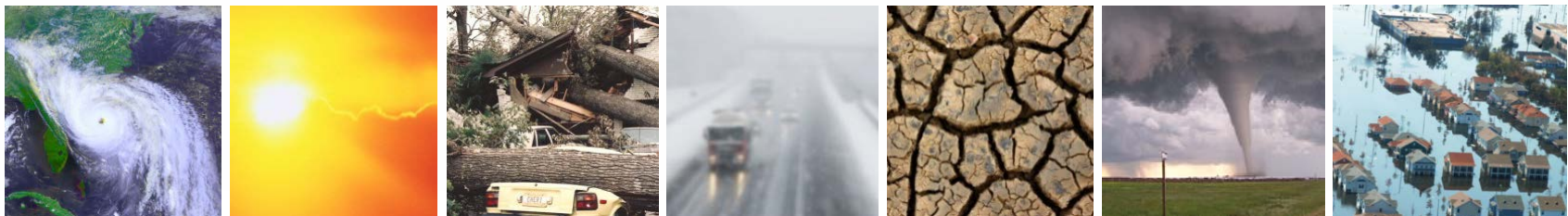




U.S. Billion-dollar Weather and Climate Disasters in 2016

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Center for Weather and Climate



February 2017

Subcommittee on Disaster Reduction (SDR)

U.S. Billion-dollar Weather and Climate Disasters

Outline:

- **Context for Measuring Disaster Impact**
- U.S. Data Sources / What we are Measuring
- 2016 Disasters in Review...
- Disaster Cost Comparison and Mapping



NOAA's National Centers for Environmental Information (NCEI) – Center for Weather and Climate

- Statutory mission to describe the climate of the United States and act as the **"Nation's Scorekeeper"** regarding the trends and anomalies of weather and climate.



- As part of this responsibility we also analyze extreme weather and climate events in the U.S. that have **great economic and societal impacts** known as **“U.S. Billion-dollar Weather & Climate Disasters”**
- **Such extreme events contribute the majority (~75%) of the damage from all recorded U.S. weather and climate events** (NCEI; Munich Re).

Different Ways to Measure Disaster Impact

Disasters



Tornadoes



Wildfires



Floods



Droughts



Heat waves



Snowstorms/
Blizzards



Geophysical



Hurricanes &
Tropical Storms

Impacts

Human Health
and Wellbeing

Business

Public
Infrastructure

Private Property

Environmental Capital
(incl. ecosystem services)

Measures

Loss of
Life

Mental
Health

Physical
Health

Quality of
Life

GDP

Net
Economic

Market

Non-
market

What's the right
- Time scale?
- Space scale?
- Size scale?

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To capture losses requires a broad array of **public** and **private** data

Disaster Types		Hurricanes/ Tropical Storms	Severe Local Storms	Winter Storms	Crop Freeze	Wildfire	Drought / Heat Wave	Inland / Riverine Flooding
Primary data used in assessments	ISO/Property Claim Service	X	X	X		X		
	FEMA (PDD)	X	X	X	X	X		X
	FEMA (NFIP)	X						X
	USDA/RMA	X	X	X	X	X	X	X
Supplemental data used in assessments	NIFC					X		
	EIA	X	X	X		X	X	
	USACE							X
	State Agencies	X	X	X	X	X	X	X

We seek to account for total, direct losses (i.e., **insured** and **uninsured**) for assets including:

- **physical damage** to **residential, commercial** and **government buildings**,
- **material assets** (content) within a building,
- **time element losses** (i.e., time-cost for businesses; hotel-costs for loss of living quarters)
- **vehicles, boats, offshore energy platforms**,
- **public infrastructure** (i.e., roads, bridges, buildings) and
- **agricultural assets** (i.e., crops, livestock, timber).
- Does not take into account: natural capital losses; healthcare-related costs; value (\$) associated with loss of life

<u>Note: not all data sources listed here</u>	ISO/PCS	FEMA (state/local disaster assistance)	FEMA (NFIP)	USDA	USACE	NIFC	State Agencies
Data	<u>Provided:</u> Residential, - Commercial property - Business interruption, - Vehicles (insured w/ comprehensive cover) -Boats, Inland marine -Demand surge <u>Not provided:</u> Agriculture, Flooding, Aviation, Ocean Marine, Loss above limits	<u>Provided:</u> Government disaster assistance, debris removal, financial aid Public Assistance, Housing Assistance, Individual Assistance, Small Business loan Assistance	<u>Provided:</u> Insured flood loss for residential and commercial properties	<u>Provided:</u> Insured multi-peril crop/livestock insurance payouts, crop progress and quality reports market value of crop production	<u>Provided:</u> Annual flood event summaries and major flood event reports that detail levee damage, other damages	<u>Provided:</u> Wildfire losses to structures; commercial timber; wildfire suppression costs, deaths; acreage burned	<u>Provided:</u> Total estimated crop losses Surveyed % of properties with multi-peril and flood insurance
Temporal Period	1949- present	1964-present (state) 1989-present (county)	1968-present	1948-present (state) 1989-present (county)	1983-present	1960-present	By specific disaster
Spatial Resolution	State-level	State-level County-level	State-level	State-level County-level	River-basin, State-level	Region, State, county	State-level
Update Lag Time	Weeks to months	Weeks to months	Several months	Weekly, monthly, Annual (depending on data product)	Annual report	Days to weeks	Several months
Data Sources	Surveys of insurers, market share analysis, air/ground damage surveys, interviews, etc.	State and local disaster needs / grants	Flood insurance payouts	Farmer and field surveys; data from partner insurance companies	Floodplain, household and business surveys	Fields reporting, state and local fire authorities	Local and State farm reporting to USDA; city / state damage assessment
Changes in Recording Threshold	\$1 M (1949-1981) \$5 M (Jan. 1982-1997) \$20 M (Jan. 1997-present)	County/per capita indicators adjusted each fiscal year to reflect changes in CPI. Assists in FEMA's evaluation of disaster impact at county-scale (e.g., \$2.83, \$2.94)	Single-family dwelling limits: 1977-1994 Structure\$150k Content:\$50k 1994-2009 Structure\$250k Content:\$100k	Many programs (e.g., SURE, NAP,LIP) offer assistance from 50% -85% Major crop insurance policy revision in 1994		Stats after 1983 were compiled by states and agencies. Stats before 1983 undergoing reanalysis	

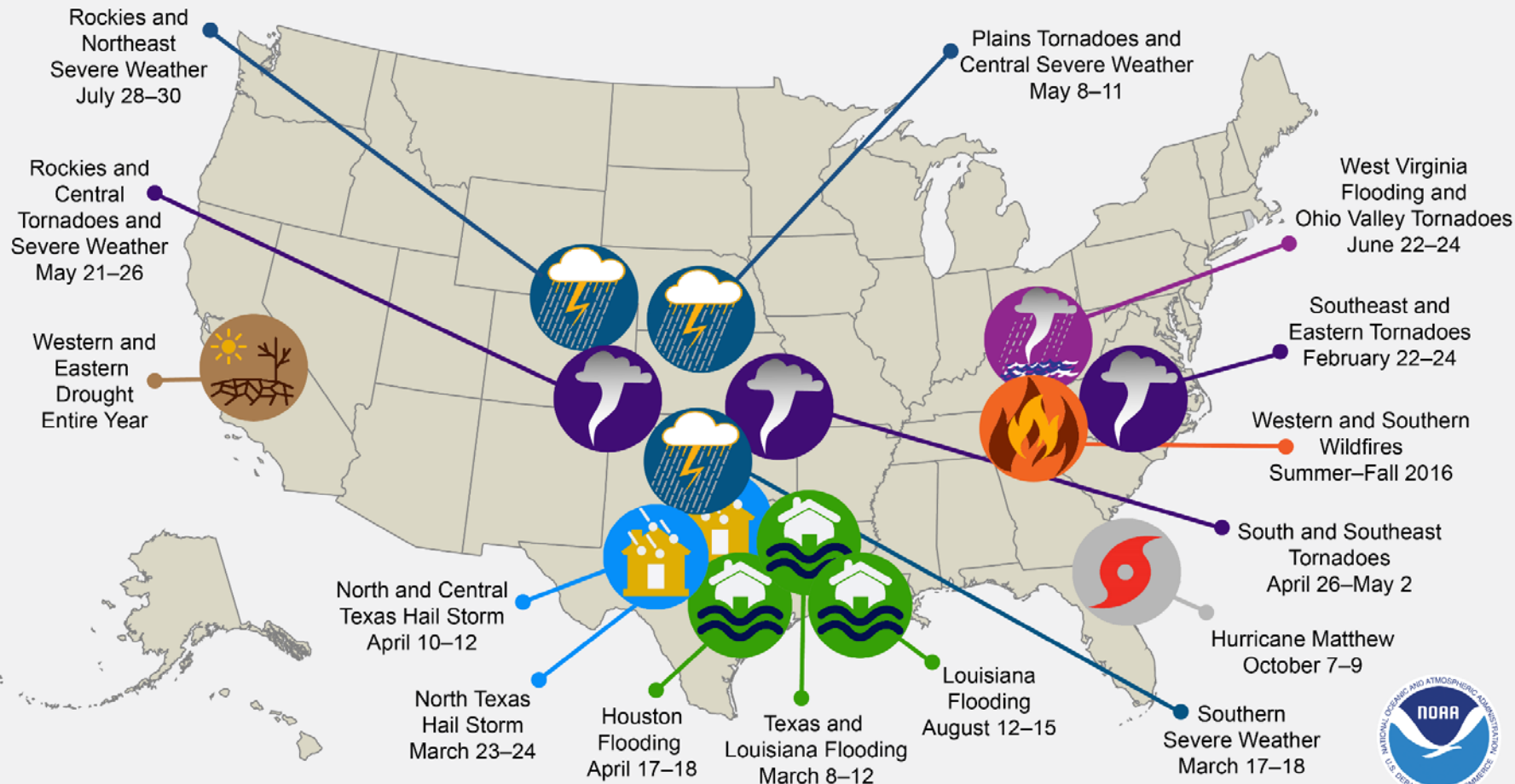
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U.S. 2016 Billion-Dollar Weather and Climate Disasters



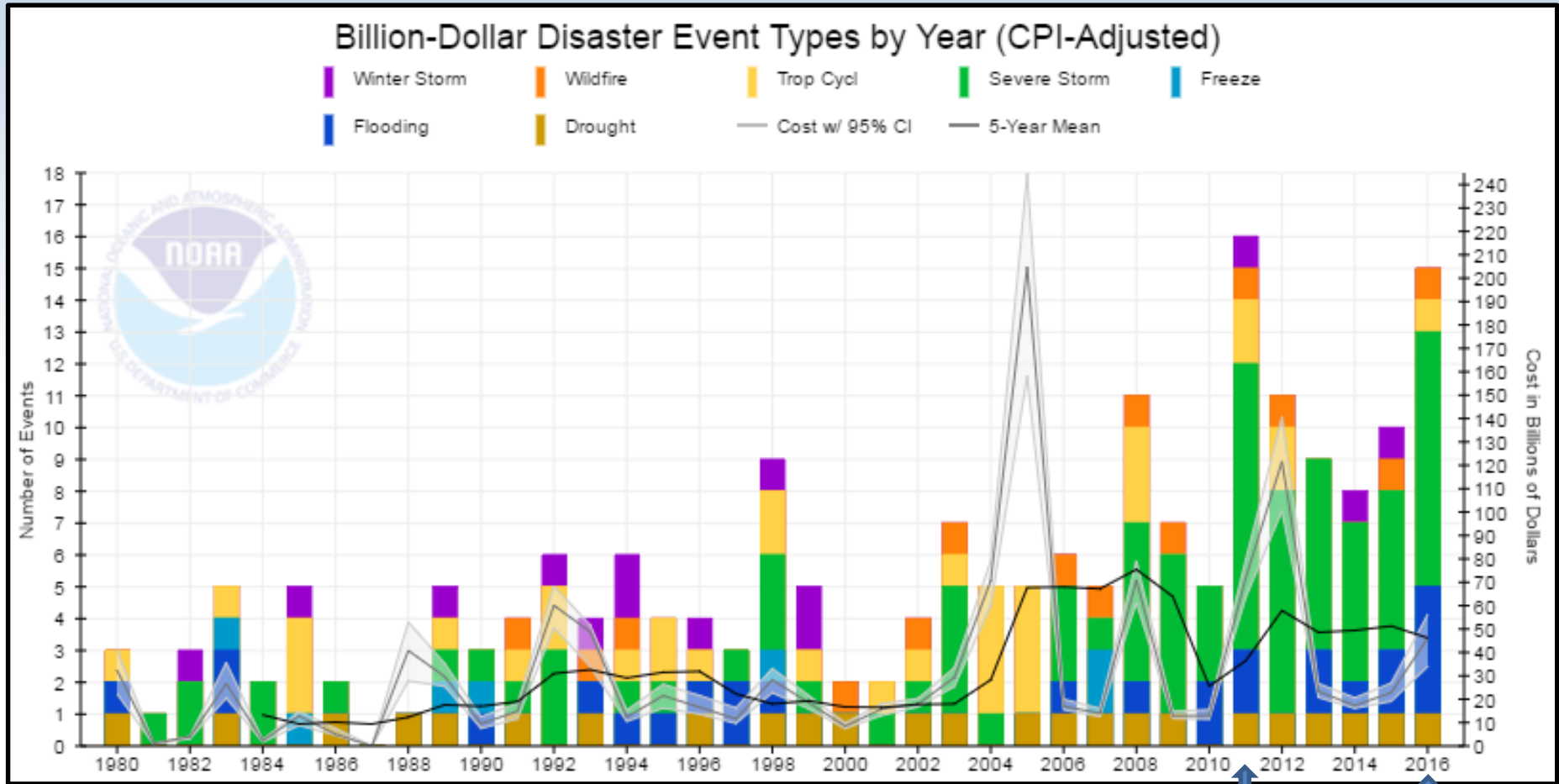
This map denotes the approximate location for each of the 15 billion-dollar weather and climate disasters that have impacted the United States during 2016.



- In **2016**, U.S. experienced **15 disaster events causing \$46.0 billion in damages; 138 fatalities.**
- **Louisiana & Texas** experienced **3 flood events** between March and August; **~\$15.0 billion in losses**

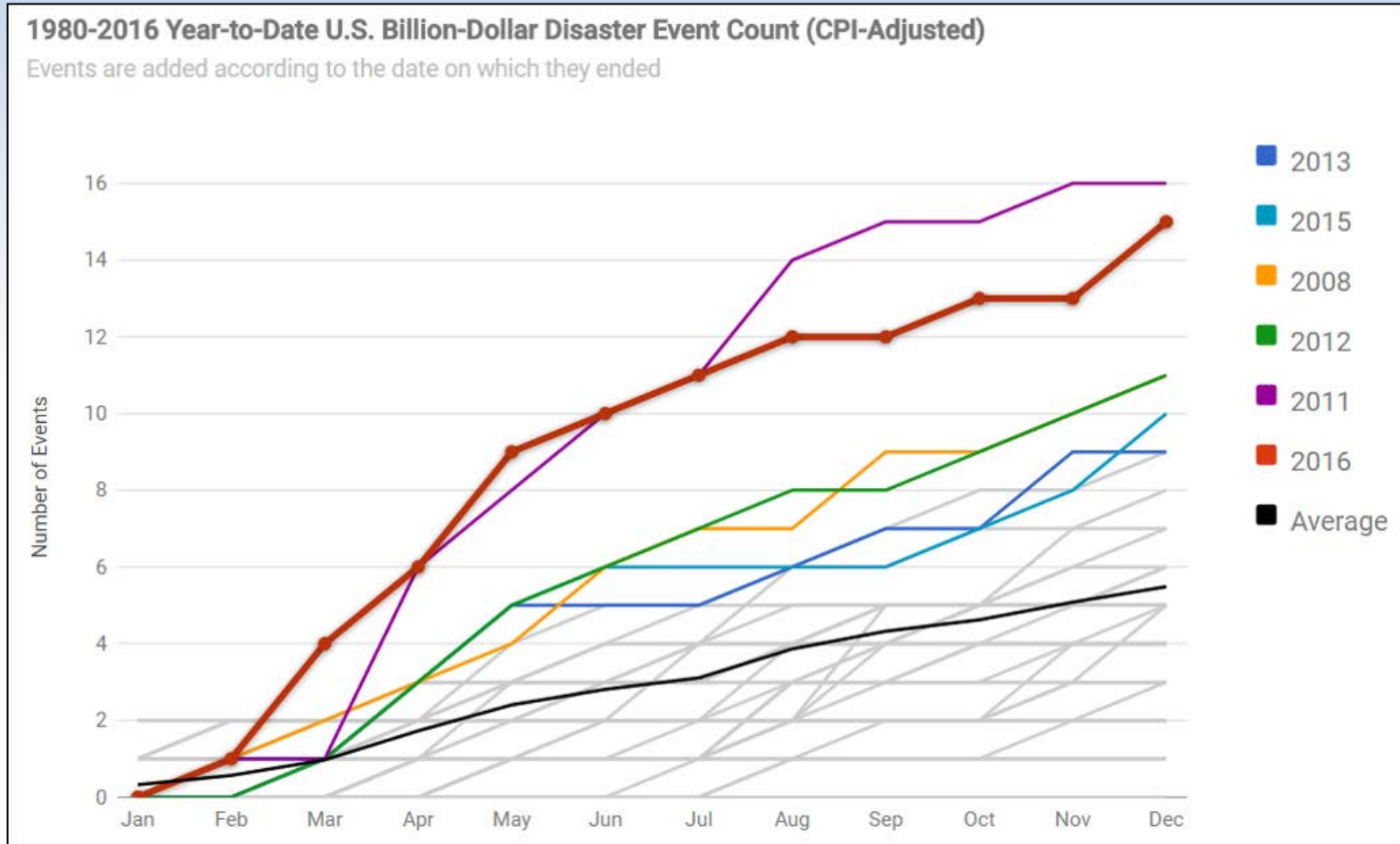


U.S. Billion-dollar event frequency, annual cost, 5-year cost average (1980–2016)



- 2016 had 2nd highest number of billion-dollar disasters on record, behind 16 events in 2011
- 2016 **doubled** the previous annual record for billion-dollar inland (i.e., non-tropical) flood events

Haywood Plot: Cumulative billion-dollar disaster frequency (year-to-date) for all years 1980-2016



- The most active years include **2011** (16 events - many tornado outbreaks), **2016** (15 events - numerous record-breaking inland floods), and **2012** (11 events - historic U.S. drought & Superstorm Sandy)
- 1980–2016 annual average is 5.5 events (CPI-adjusted). Annual average for (2012–2016) is **10.6 events** (CPI-adjusted)



U.S. Billion-dollar Weather and Climate Disasters









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What we find: From 1980-2016, the U.S. has experienced **203** distinct billion-dollar weather & climate events - each causing at least \$1 billion in direct losses

- Total, direct losses from these 203 events exceeds **\$1.1 trillion** (CPI-adjusted, as of Jan., 2017)

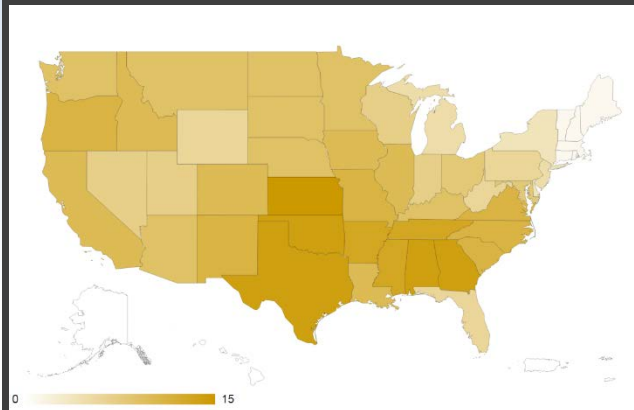
DISASTER TYPE	NUMBER OF EVENTS	PERCENT FREQUENCY	CPI-ADJUSTED LOSSES (BILLIONS OF DOLLARS)	PERCENT OF TOTAL LOSSES	AVERAGE EVENT COST (BILLIONS OF DOLLARS)
 Drought	24	11.8%	\$223.8 <small>CI</small>	19.1%	\$9.3
 Flooding	26	12.8%	\$110.7 <small>CI</small>	9.4%	\$4.3
 Freeze	7	3.4%	\$25.3 <small>CI</small>	2.2%	\$3.6
 Severe Storm	83	40.9%	\$180.1 <small>CI</small>	15.3%	\$2.2
 Tropical Cyclone	35	17.2%	\$560.1 <small>CI</small>	47.7%	\$16.0
 Wildfire	14	6.9%	\$33.0 <small>CI</small>	2.8%	\$2.4
 Winter Storm	14	6.9%	\$41.3 <small>CI</small>	3.5%	\$3.0
 All Disasters	203	100.0%	\$1,174.3 <small>CI</small>	100.0%	\$5.8



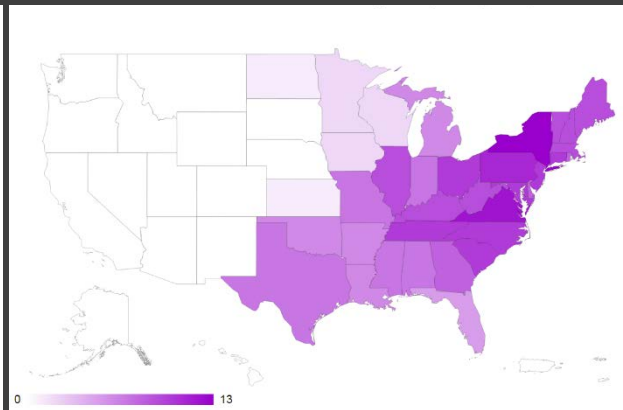
The Nation is weather and climate conscious...for good reason, as each geographic region faces unique hazards

Billion-dollar weather and climate disasters frequency mapping: 1980-2016*

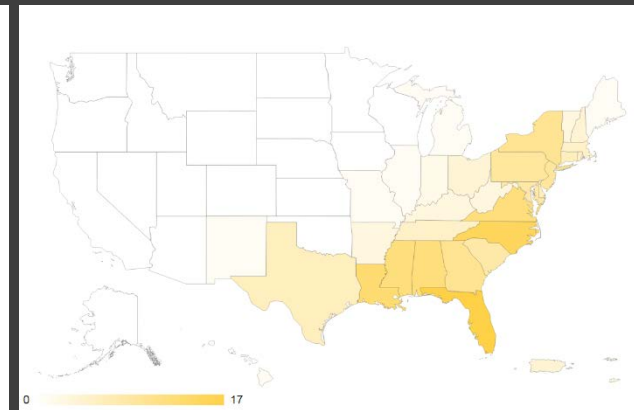
Droughts and Heat Waves



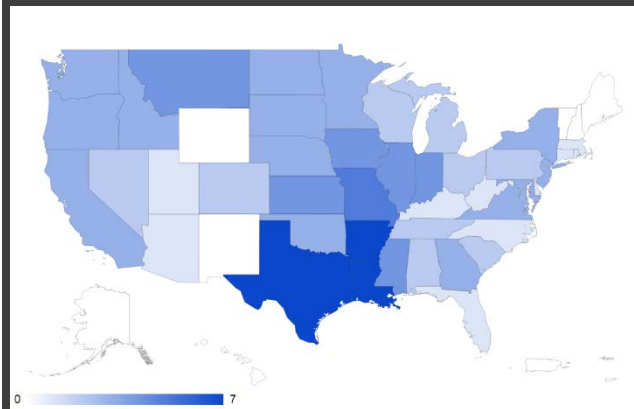
Winter Storms



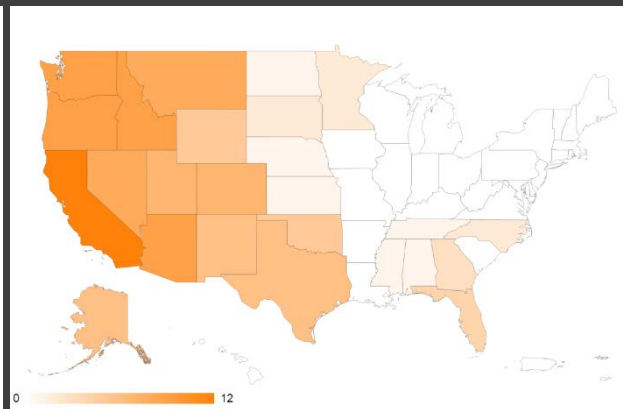
Tropical Cyclones



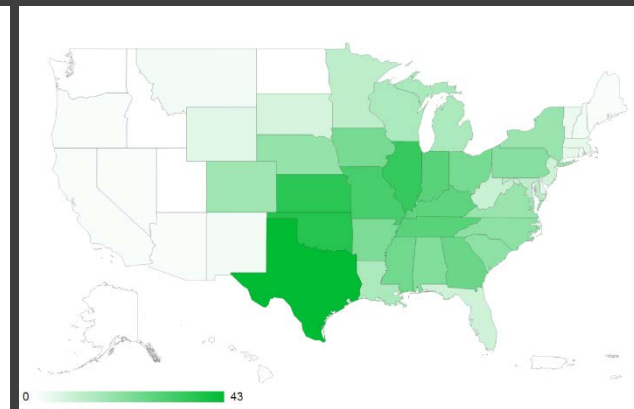
Flooding



Wildfires



Severe Local Storms



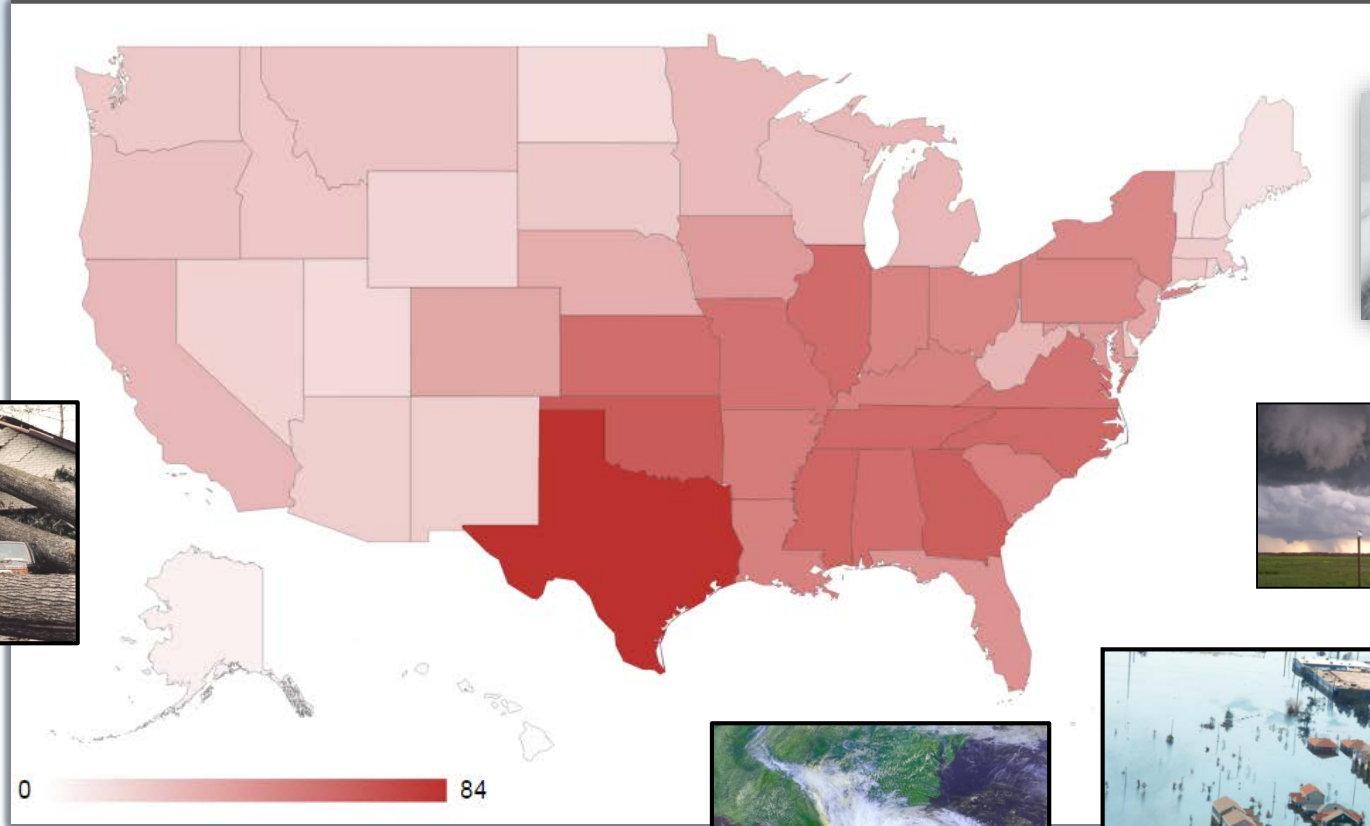
*203 weather and climate disasters reached or exceeded \$1 billion during this period (CPI-adjusted)

Please note that the map reflects a summation of billion-dollar events for each state affected (i.e., it does not mean that each state shown suffered at least \$1 billion in losses for each event).



From 1980–2016, the U.S. **South/Central** and **Southeast** regions experienced a higher frequency of billion-dollar disaster events than any other region

Cumulative Frequency for all U.S. Billion-dollar Disasters



→ Reflects the **diversity, frequency, & severity** of weather & climate events impacting this region

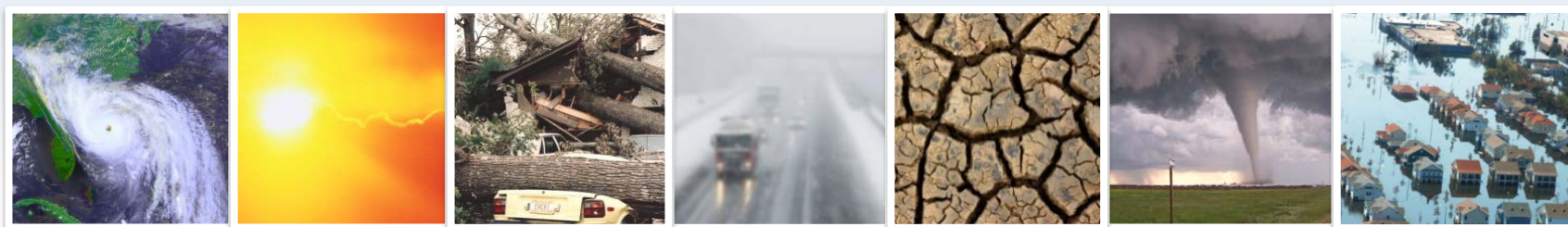


For interactive graphics, summaries and data access, see:

www.ncdc.noaa.gov/billions

“2016: A historic year for billion-dollar weather and climate disasters in U.S.”

<https://www.climate.gov/news-features/blogs/beyond-data/2016-historic-year-billion-dollar-weather-and-climate-disasters-us>



For more detail on data, methodology and uncertainty, see:

- Smith A.B. and J.M. Matthews, 2015: Quantifying Uncertainty and Variable Sensitivity within the U.S. Billion-dollar Weather and Climate Disaster Cost Estimates. *Natural Hazards*, 77, 1829-1851 (<https://www.ncdc.noaa.gov/billions/docs/smith-and-matthews-2015.pdf>)

- Smith, A.B. and R.W. Katz, 2013: U.S. Billion-dollar weather and climate disasters: Data sources, trends, accuracy and biases. *Natural Hazards*, 67, 387–410 (<https://www.ncdc.noaa.gov/billions/docs/smith-and-katz-2013.pdf>)

Backup slides



NCEI products span from local to global, and weekly to decadal scales



2016: U.S. Billion-Dollar Weather and Climate Disaster summaries...

2016

■ **Western/Southeast Wildfires - Summer-Fall 2016:** Western and Southern states experienced an active wildfire season with over 5.0 million acres burned nationally. Most notable was the firestorm that impacted Gatlinburg, Tennessee with hurricane-force wind gusts in extremely dry conditions creating volatile wildfire behavior. These wildfires destroyed nearly 2,500 structures and caused 14 fatalities. The drought conditions in many areas of the Southeast and California worsened the wildfire potential. *Total Estimated Costs: \$2.0 Billion; 21 Deaths*

■ **West/Northeast/Southeast Drought - 2016:** California's 5-year drought persisted during 2016 while new areas of extreme drought developed in states across the Northeast and Southeast. The long-term impacts of the drought in California have damaged forests where 100+ million trees have perished and are a public safety hazard. The agricultural impacts were reduced in California as water prices and crop following declined. However, agricultural impacts developed in Northeast and Southeast due to stressed water supplies. *Total Estimated Costs: \$3.5 Billion; 0 Deaths*

■ **Hurricane Matthew - October 2016:** Hurricane Matthew paralleled the Southeast coast from Florida to North Carolina causing widespread damage from wind, storm surge and inland flooding. The most costly impacts were due to historic levels of river flooding in eastern North Carolina where 100,000 homes, businesses and other structures were damaged. This inland flooding was comparable to Hurricane Floyd (1999) that also impacted eastern North Carolina. Matthew narrowly missed landfall on Florida's east coast as a powerful category 4 storm. *Total Estimated Costs: \$10.0 Billion; 49 Deaths*

■ **Louisiana Flooding - August 2016:** A historic flood devastated a large area of southern Louisiana resulting from 20 to 30 inches of rainfall over several days. Watson, Louisiana received an astounding 31.39 inches of rain from the storm. Two-day rainfall totals in the hardest hit areas have a 0.2% chance of occurring in any given year: a 1 in 500 year event. More than 30,000 people were rescued from the floodwaters that damaged or destroyed over 50,000 homes, 100,000 vehicles and 20,000 businesses. This is the most damaging U.S. flood event since Superstorm Sandy impacted the Northeast in 2012. *Total Estimated Costs: \$10.0 Billion; 13 Deaths*

■ **Rockies and Northeast Severe Weather - July 2016:** Severe storms across the Rockies and Northeastern states (CO, WY, VA, MD, PA, NJ, NY) caused large hail and high wind damage. Storm damage in Colorado was the most costly due to hail. *Total Estimated Costs: \$1.5 Billion; 0 Deaths*

■ **West Virginia Flooding and Ohio Valley Tornadoes - June 2016:** Torrential rainfall caused destructive flooding through many West Virginia towns, damaging thousands of homes and businesses and causing considerable loss of life. Over 1,500 roads and bridges were damaged or destroyed making the impact on infrastructure comparable to the historic 2013 Colorado flood. The storm system also produced numerous tornadoes causing damage across several Ohio Valley states. *Total Estimated Costs: \$1.0 Billion; 23 Deaths*

■ **Rockies/Central Tornadoes and Severe Weather - May 2016:** Sustained period of severe thunderstorms and tornadoes affecting several states including Montana, Colorado, Kansas, Missouri and Texas. The most concentrated days for tornado development were on May 22 and 24. Additional damage was created by straight-line high wind and hail damage. *Total Estimated Costs: \$1.1 Billion; 0 Deaths*

2016: U.S. Billion-Dollar Weather and Climate Disaster summaries...

- **Plains Tornadoes and Central Severe Weather - May 2016:** Tornadoes and severe storms cause widespread damage across the Plains and Central states (NE, MO, TX, OK, KS, CO, IL, KY, TN) over a multi-day period. The damage from tornadoes and high wind was most costly in Nebraska and Missouri. *Total Estimated Costs: \$1.7 Billion; 2 Deaths*
- **South/Southeast Tornadoes - April 2016:** Large outbreak of tornadoes affects numerous states across the South and Southeast. Additional damage also from large hail and straight-line wind during the multi-day thunderstorm event. *Total Estimated Costs: \$2.4 Billion; 6 Deaths*
- **Houston Flooding - April 2016:** A period of extreme rainfall up to 17 inches created widespread urban flooding in Houston and surrounding suburbs. Thousands of homes and businesses were damaged and more than 1,800 high water rescues were conducted. This represents the most widespread flooding event to affect Houston since Tropical Storm Allison in 2001. *Total Estimated Costs: \$2.7 Billion; 8 Deaths*
- **North/Central Texas Hail Storm - April 2016:** Widespread severe hail damage across north and central Texas including the cities of Plano, Wylie, Frisco, Allen and San Antonio. The damage in San Antonio was particularly severe as the National Weather Service verified reports of hail size reaching 4.5 inches in diameter. This ranks as one of the most costly hail events to affect the United States. *Total Estimated Costs: \$3.5 Billion; 0 Deaths*
- **North Texas Hail Storm - March 2016:** Large hail and strong winds caused considerable damage in heavily populated areas of north Texas. This damage was most notable in the cities of Dallas, Fort Worth and Plano. *Total Estimated Costs: \$2.1 Billion; 0 Deaths*
- **Southern Severe Weather - March 2016:** Severe hail impacts the Fort Worth and Arlington metro region in Texas. Additional large hail and high wind damage occurred in other locations of Texas, Louisiana and Mississippi. *Total Estimated Costs: \$1.2 Billion; 1 Death*
- **Texas and Louisiana Flooding - March 2016:** Multiple days of heavy rainfall averaging 15 to 20 inches led to widespread flooding along the Sabine River basin on the Texas and Louisiana border. This prompted numerous evacuations, high-water rescues and destruction, as more than 1,000 homes and businesses were damaged or destroyed. *Total Estimated Costs: \$2.3 Billion; 5 Deaths*
- **Southeast and Eastern Tornadoes - February 2016:** Early outbreak of tornadoes and severe weather across many southern and eastern states including (AL, CT, FL, GA, LA, MA, MD, MS, NC, NJ, NY, PA, SC, TX, VA). There were at least 50 confirmed tornadoes causing widespread damage. *Total Estimated Costs: \$1.0 Billion; 10 Deaths*

