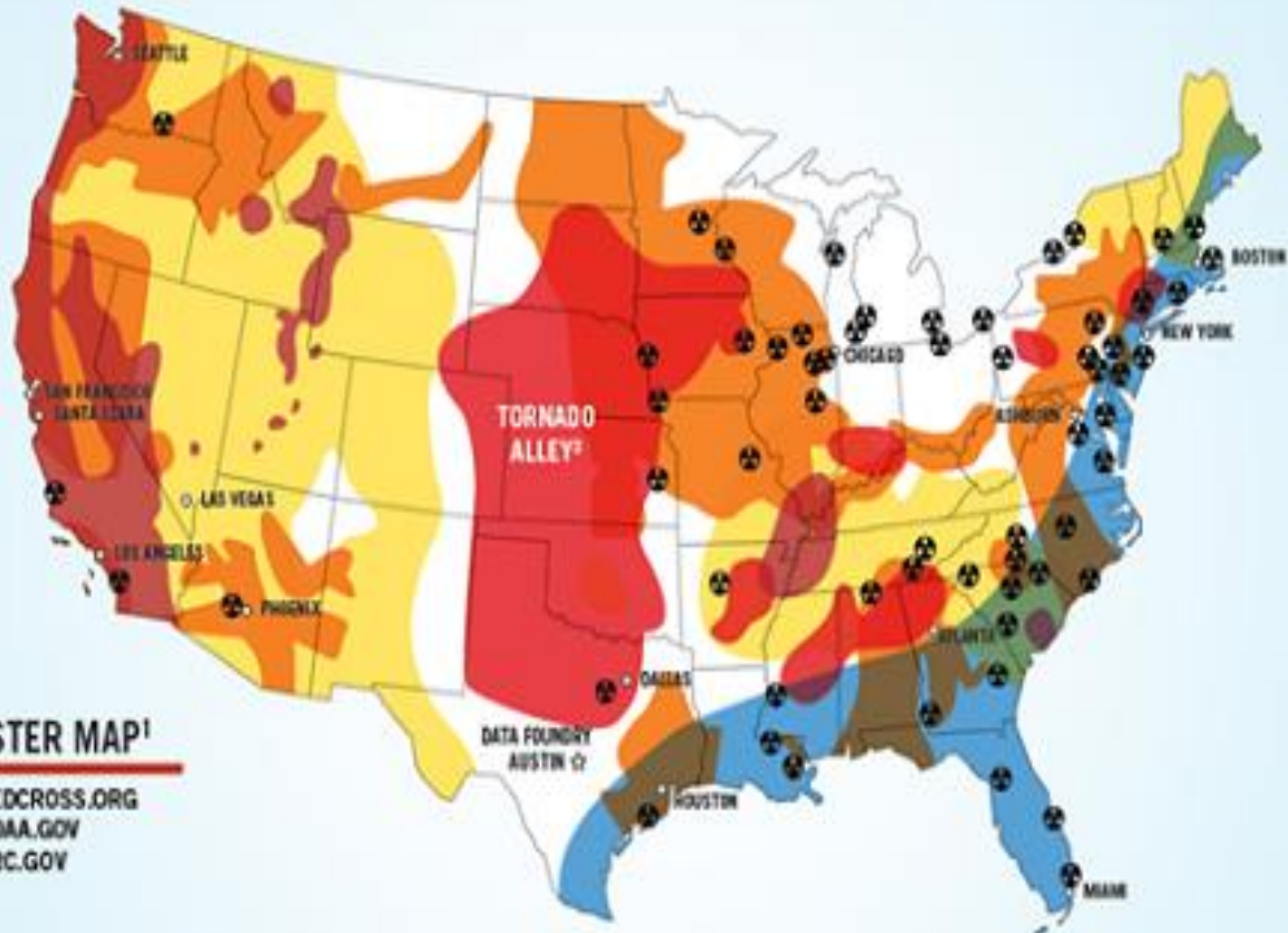




CRISES MANAGEMENT CHALLENGES FOR NORTH AMERICAN UTILITIES

John Sullivan, P.E.
Boston Water and Sewer Commission
November 4, 2017

Natural Disaster Risks



US DISASTER MAP¹

¹SOURCE: REDCROSS.ORG

²SOURCE: NOAA.GOV

³SOURCE: NRC.GOV

DATA FOUNDRY
AUSTIN TX

EARTHQUAKES (MODERATE RISK)

EARTHQUAKES (HIGH RISK)

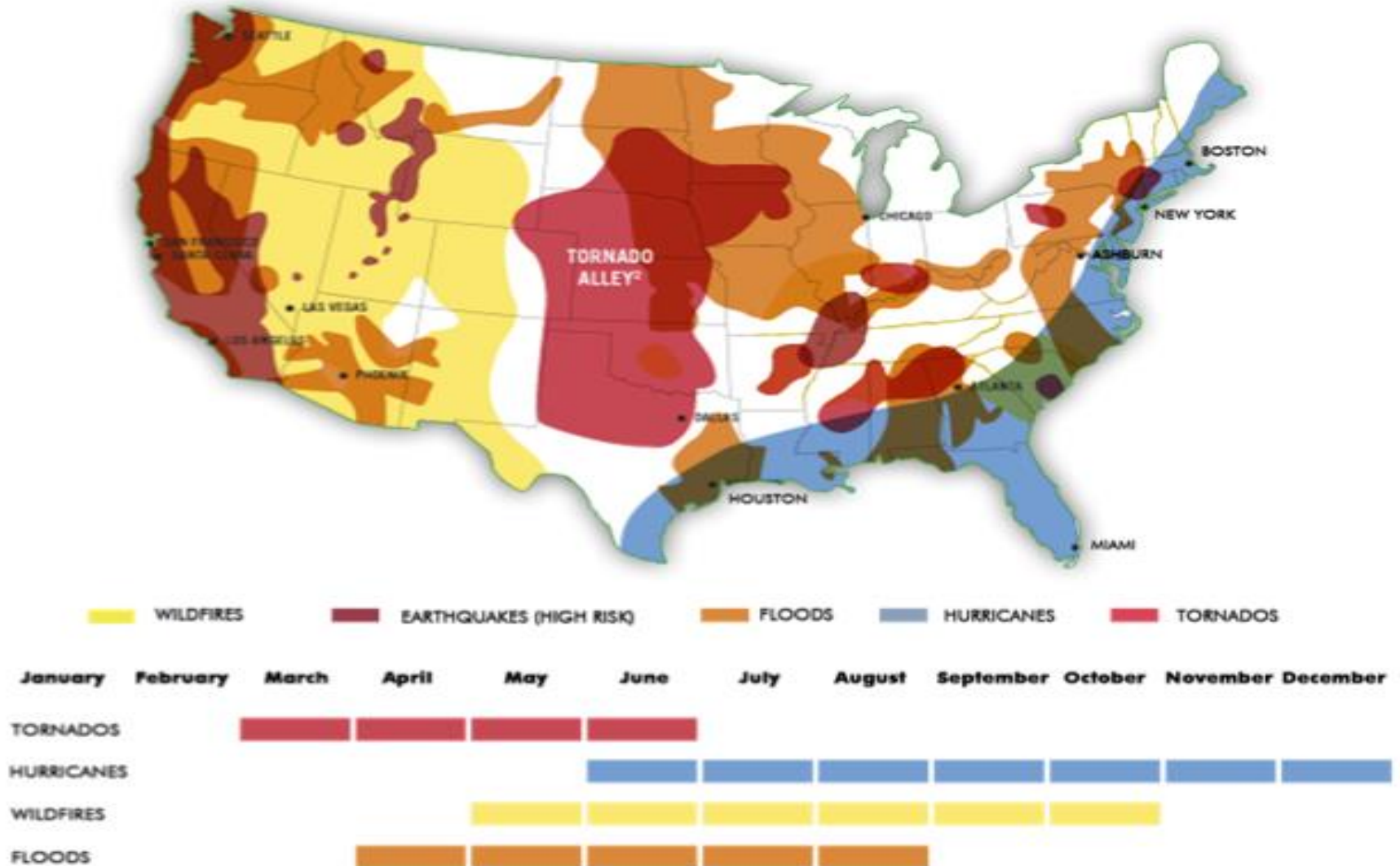
FLOODS

HURRICANES

TORNADOES

NUCLEAR FACILITIES³

Natural Disaster Risks




U.S. Climate Trends

Major U.S. Climate Trends




U.S. Selected Significant Climate Anomalies and Events


April 2016




AK had its warmest Apr on record. Anchorage, Barrow, and Nome were record warm. The year-to-date AK temperature was 11.4°F above average and 2.8°F above the previous record.




ID, OR, and WA had their 2nd warmest Apr contributing to early mountain snow melt and spring runoff.




Snow storms walloped the Central Rockies in Apr boosting end of season snowpack totals.




In early Apr, locations across the Northeast observed record low monthly temperatures, damaging fruit crops.




Northern CA saw some drought improvement in Apr, but drought persisted for about 90% of the state.




On Apr 26-27, severe weather hit the Plains and Ohio Valley with over 50 tornadoes reported and over 500 strong wind and large hail reports.



Drought conditions expanded in the Southeast and Mid-Atlantic, but improved in the Great Plains. The contiguous U.S. drought footprint shrank to 14.6%.



Much of HI was drier than average in Apr. Drought conditions expanded to over 60% of the state.



On Apr 18th, 9.92 inches of rain fell in Houston, the 2nd highest one-day total for the city. Houston had a record wet Apr with 14.39 inches of rain.

The average U.S temperature during April was 53.2°F, 2.2°F above average. The April U.S. precipitation total was 2.95 inches, 0.43 inch above average.

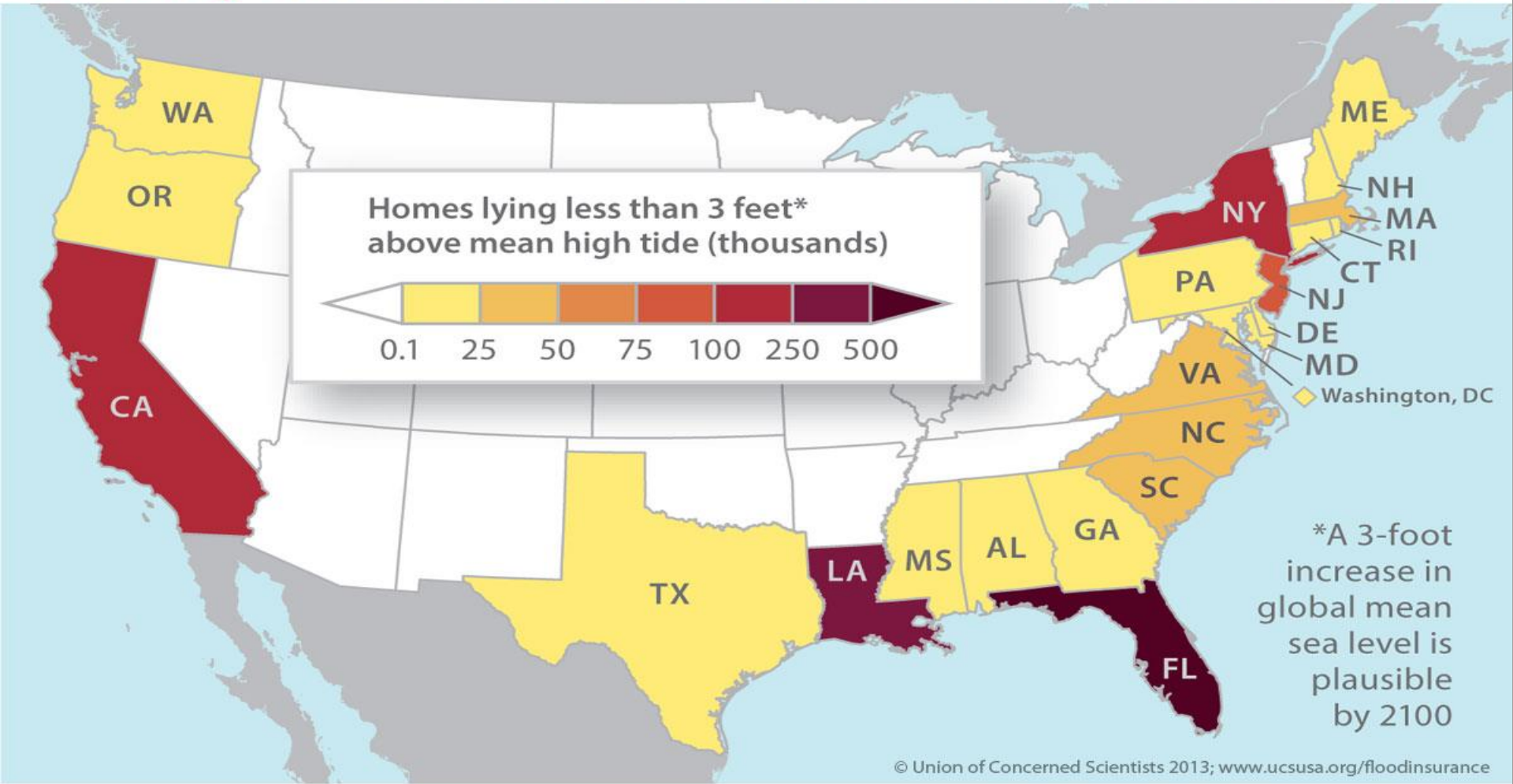
Increased Flooding



Average number of flood days per year:



Growing Risks to Homes from Sea Level Rise and Storms



In recent years, properties in low-lying coastal states have experienced increasing damage from storms and severe flooding. Almost three million people—and their homes—reside within three feet of mean sea level. With rising seas projected to exceed the three-foot mark within this century, a great many homes are clearly at risk.

Map based on data from Strauss et al. 2012.

California Wildfires 2017

≡ 2017 Statewide Fire Map 🔍 ⋮

51,836,809 views

SHARE

✓ Active Fires 2017



Wildomar Fire



Wildomar Fire Perimeter



Tehama Fire



Buffalo Fire

... 10 more

✓ October 2017



Sulphur Fire (Mendocino-Lake Complex)



Sulphur Fire Perimeter

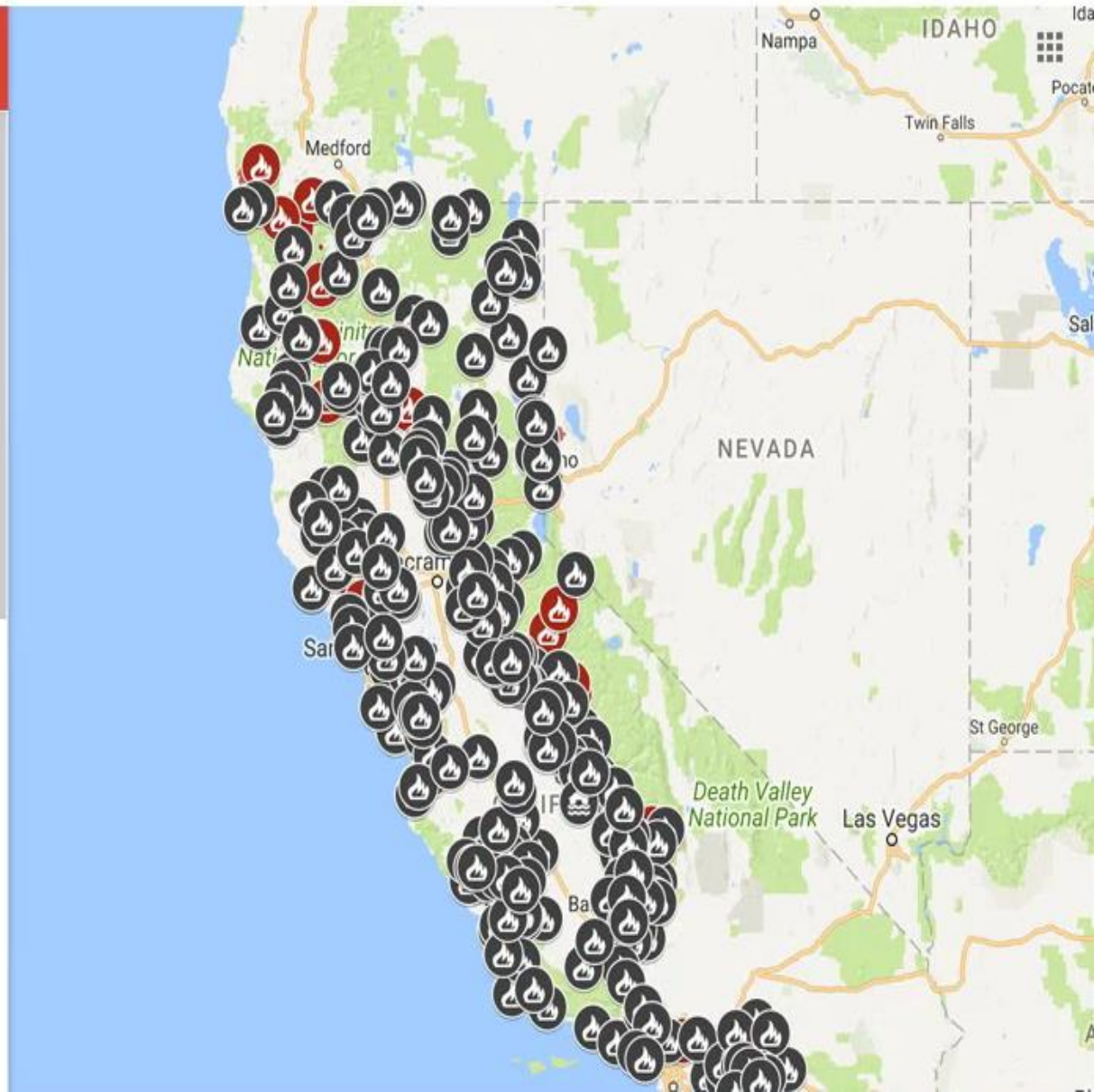


Atlas Fire (Southern LNU Complex)



Atlas Fire Perimeter

... 113 more





42 Dead, 8,400 Structures Burned, More Than \$1 Billion in Damage: the Devastating Toll of California's Wildfires

It was one of the worst natural disasters in the state's history.





Local Landmarks reduced to rubble







Hilton



Expensive Property Destroyed



Before



After





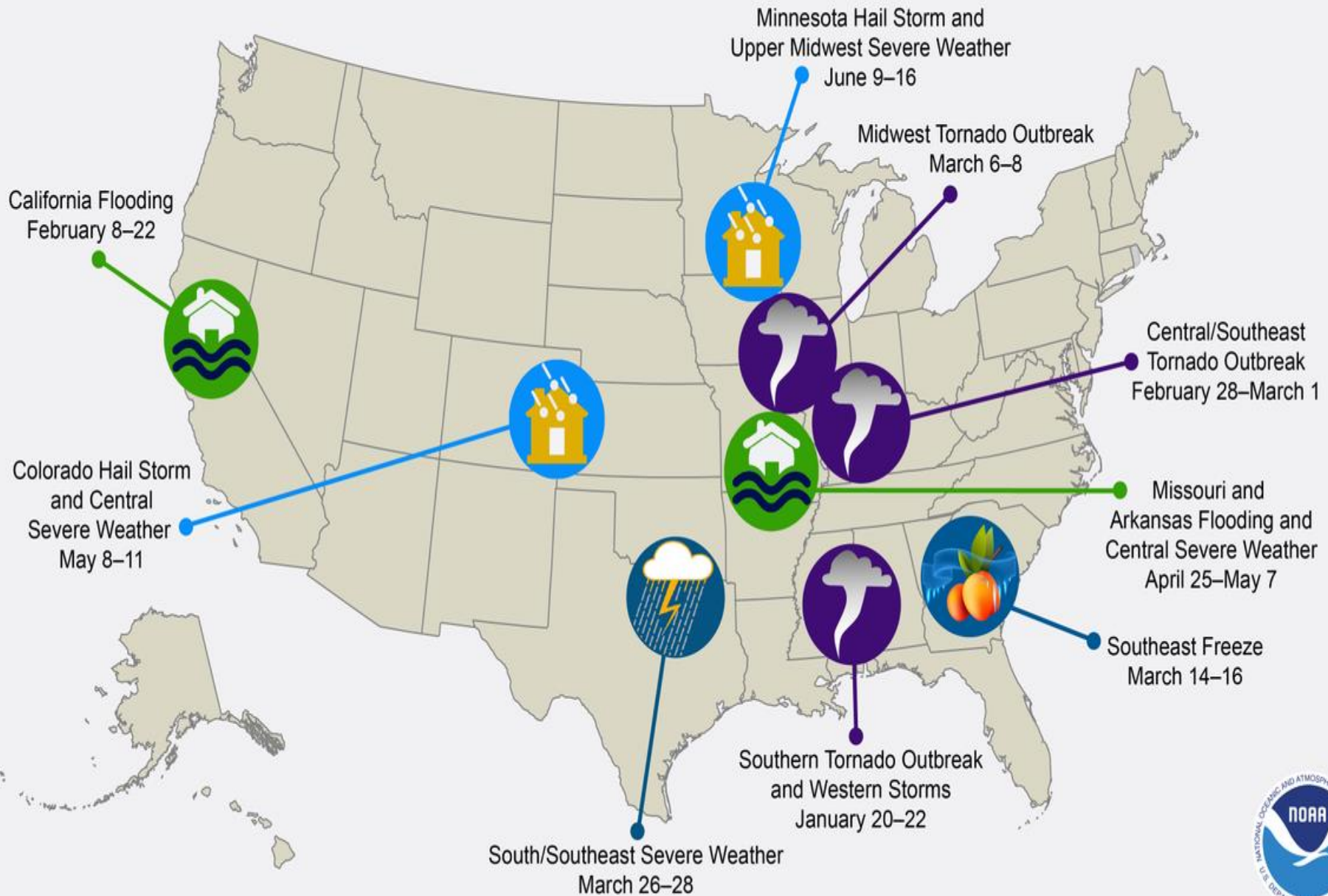
**Nearly 2 million acres of land are burning across the US
in one of the worst fire seasons we've ever seen**

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



This map shows the approximate location for the 15 billion-dollar weather and climate disasters that impacted the U.S. in 2016.

U.S. 2017 Billion-Dollar Weather and Climate Disasters



This map denotes the approximate location for each of the 9 billion-dollar weather and climate disasters that have impacted the United States January through June of 2017, a near record pace.

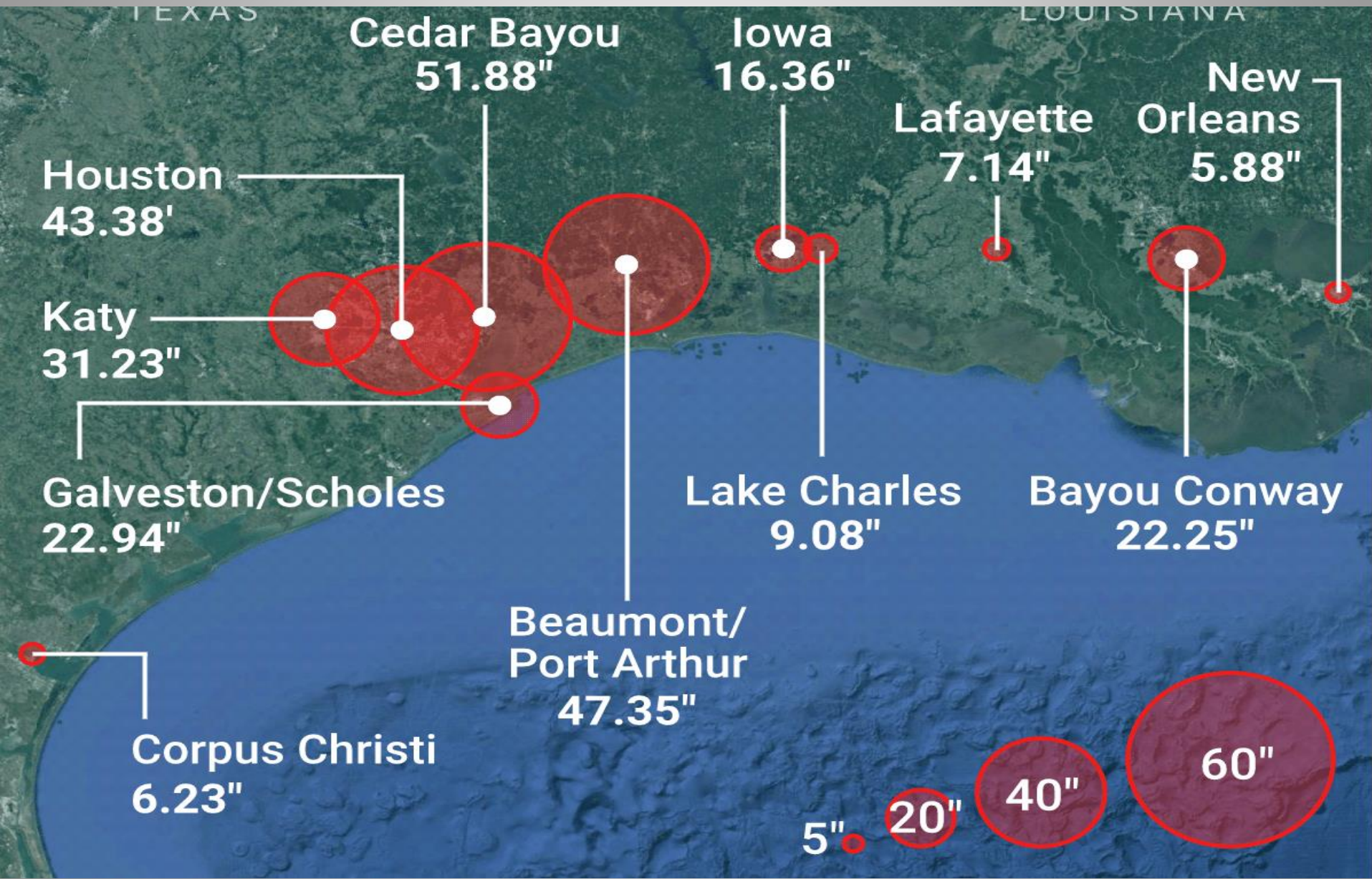
2017 HURRICANE SEASON TRACKS

AS OF SEPT. 30

T.D. T.S. HURRICANE MAJOR



Houston Gets Hammered





Hurricane Harvey



450,000

*Estimated number of victims
who will ask FEMA for
disaster assistance*



30,000

*Estimated number
of people who will
need temporary shelter*



215,000

*Students out of school
after Houston, the 7th largest
school district in the US,
canceled classes*



14,000

*Number of National Guard
members activated to help*



27 trillion

*Gallons of rain Harvey dumped
on Texas (and Louisiana) in 6 days*



51

*Inches of rain — a record
from a tropical cyclone
in the continental US*



75 billion

*Amount, in dollars,
of estimated losses from Harvey*



72,000

*Number of people rescued
(as of Friday)*



56,000

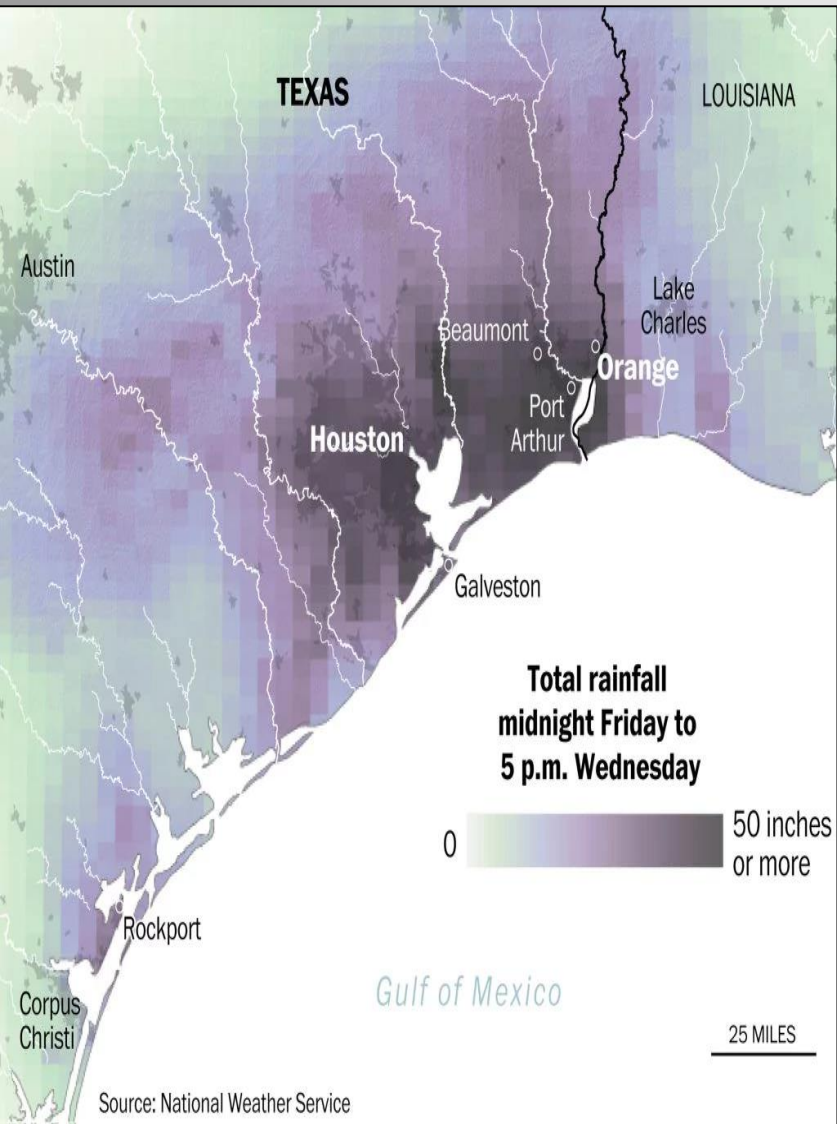
*Number of calls to
Houston 911 in the first 15 hours.
(Average for a typical
day is 8,000)*



33

*Number of Texas counties under
federal disaster declaration*

Harvey = 0.1% or 1,000yr



Beaumont Police

about a month ago



These are pictures of our main intake water pump station. 70% of the City of Beaumont's water comes from this facility on the Neches River. As soon as water recedes we will assess and begin making necessary repairs.









Perpetual rest?





IRMA HITS FLORIDA

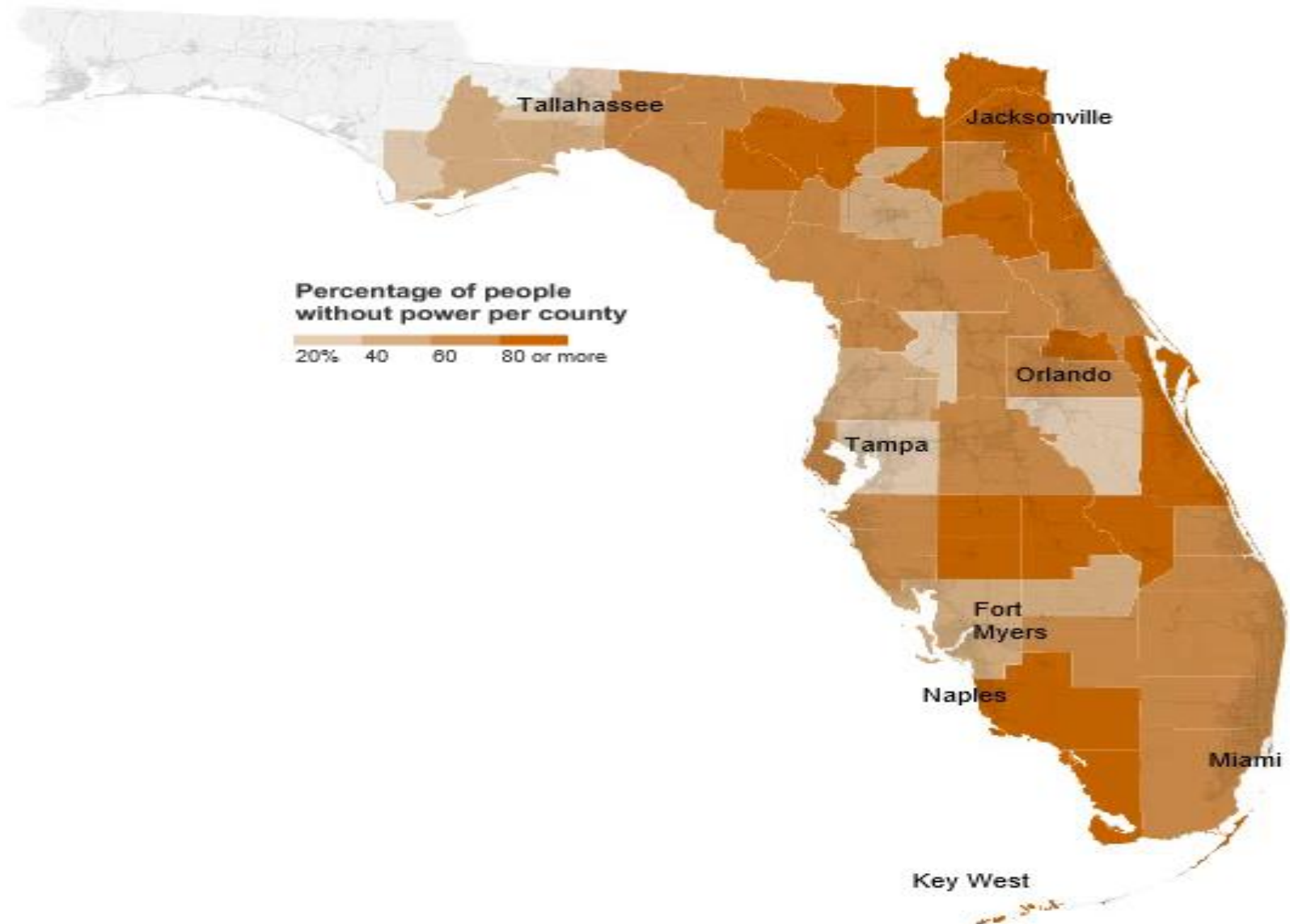


It's hard to figure out where you are going to start over": ...



Much of Florida Lost Power

Six million customers in Florida, or about two-thirds of the state, had power outages as of 9 a.m. on Monday.



Cleanup is extensive



AVOIDING MOLD



Trash



UPDATE

HURRICANE MARIA

FEMA RESPONSE IN PUERTO RICO

PUERTO RICO

The amount of debris could fill
YANKEE STADIUM

7x's



31

PLANES

89

HELICOPTERS

29

CUTTERS

4 NAVAL
VESSELS



MORE THAN

700 AIRDROPS



Longest sustained
air drop mission

10+

MILLION LITERS OF
BOTTLED WATER

3.6

MILLION GALLONS
OF WATER

4th largest

CARGO PLANE
IN THE WORLD



used to transport critical generators.

DELIVERED PER DAY



742
THOUSAND

LITERS OF WATER



600
THOUSAND

MEALS PROVIDED

42,000

TARPS DISTRIBUTED

439

NUMBER OF BLUE ROOFS



134

GENERATORS
INSTALLED



(HARVEY,
IRMA
COMBINED
INSTALLATIONS)

MORE THAN

16,500

FEDERAL CIVILIAN PERSONNEL
& MILITARY SERVICE MEMBERS



POSTAL SERVICE



AIRPORTS OPEN



SEAPORTS OPEN
(OR OPEN WITH
RESTRICTIONS)



6100

PATIENTS SEEN
AT HOSPITALS



61%

TELECOMMUNICATIONS
RESTORED



65%+

RUNNING WATER (PRASA)



3.6 MILLION

GALLONS/DIESEL

128,997

GALLONS GASOLINE



LARGEST USACE

TEMP POWER MISSION IN
HISTORY

ONE OF THE LARGEST

FEDERAL MEDICAL RESPONSE MISSIONS
IN THE U.S.



97,500 lbs
PET FOOD



1 Baby

BORN USNS COMFORT

MEDICAL CARE

100

PATIENTS CARED FOR USNS COMFORT



MORE THAN

74

VOLUNTEER ORGANIZATIONS



Washed-out bridge in Puerto Rico (FEMA): <https://www.fema.gov/media-library/assets/images/148276>





- A **Water and Wastewater Agency Response Network (WARN)** is a **network** of "utilities helping utilities" within a state to respond to and recover from emergencies by sharing **resources** with one another



WARN in Action

CalWARN

Northridge Earthquake, 1994
El Nino Storms, 1998
Sonora Fires, 2001
Southern California Fires, 2007
Baja Earthquake, 2010
Napa Earthquake, 2014
Wildfires, 2015, 2017

FlaWARN

Hurricanes Katrina, Wilma & Rita, 2005
Tornadoes, 2007
Hurricane Irma, 2017

TxWARN

Hurricane Humberto, 2007
Hurricane Dolly and Ike, 2008
Drought, 2012
Hurricane Harvey, 2017

NYWARN, NJWARN, PAWARN, MAWARN

Superstorm Sandy, 2012

NCWaterWARN, PAWARN

Hurricane Irene, 2011

SCWARN

Hurricane Joaquin Flooding, 2015

GAWARN

Hurricane Irma, 2017

CoWARN

Salmonella outbreak, 2008
Flooding, 2013

TNWARN, INWARN, KYWARN

Ice Storm, February 2009

IAWARN, MNWARN

Flooding, 2010, 2011, 2014

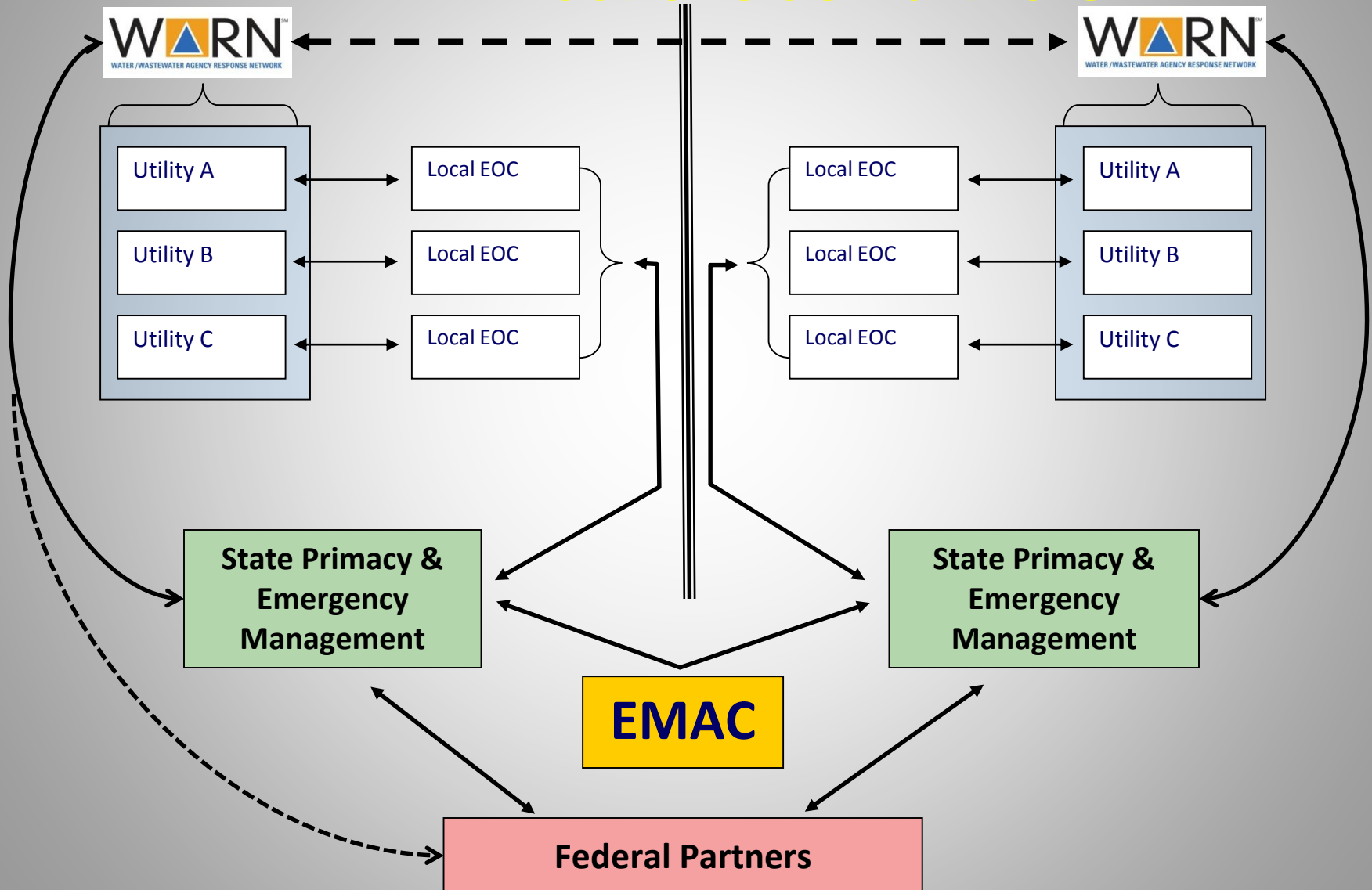
SDWARN

Missouri River Flood, 2011
City of Bison Water Outage, 2012

IDWARN

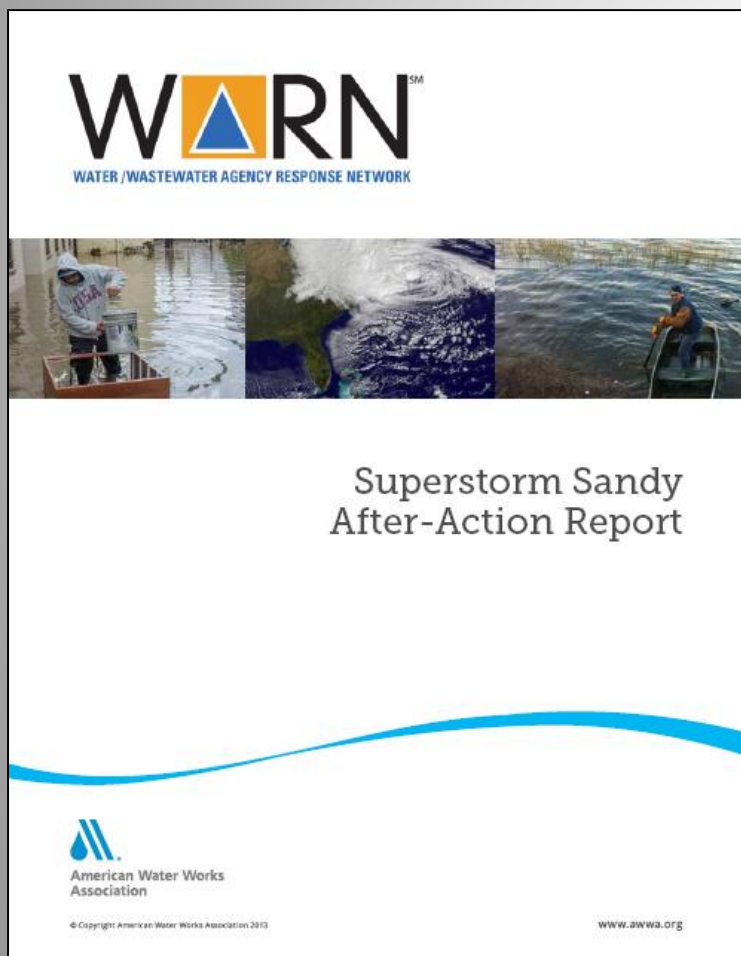
Power Outage, 2015

Coordination & Communications... in ALL Directions as Partners



Conclusions

Key Findings

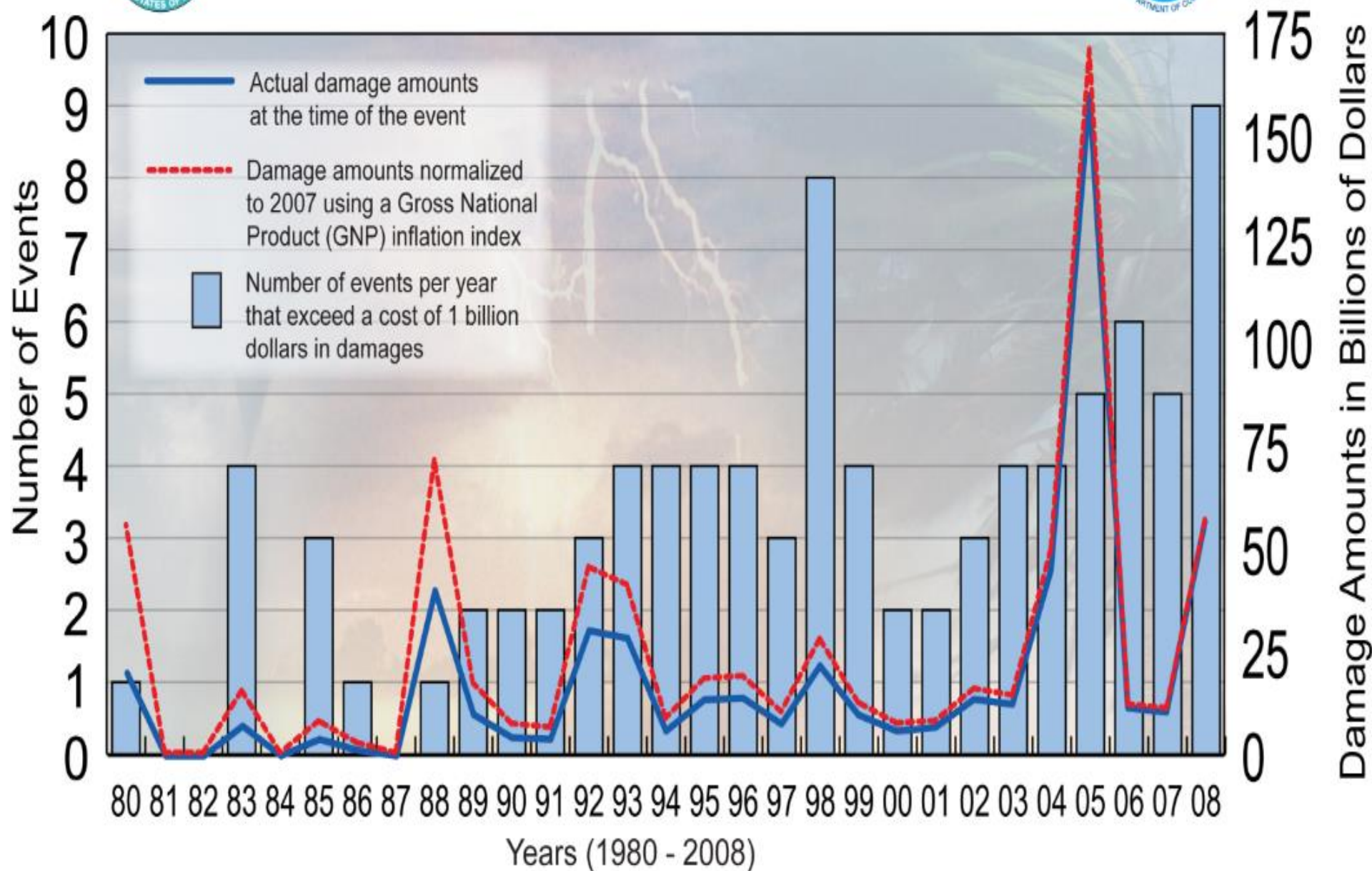


- **Mutual Aid**
- **Priority Status**
- **Power/Fuel**
- **Site Access**
- **Coordination**
- **Situational Awareness**
- **Communications**

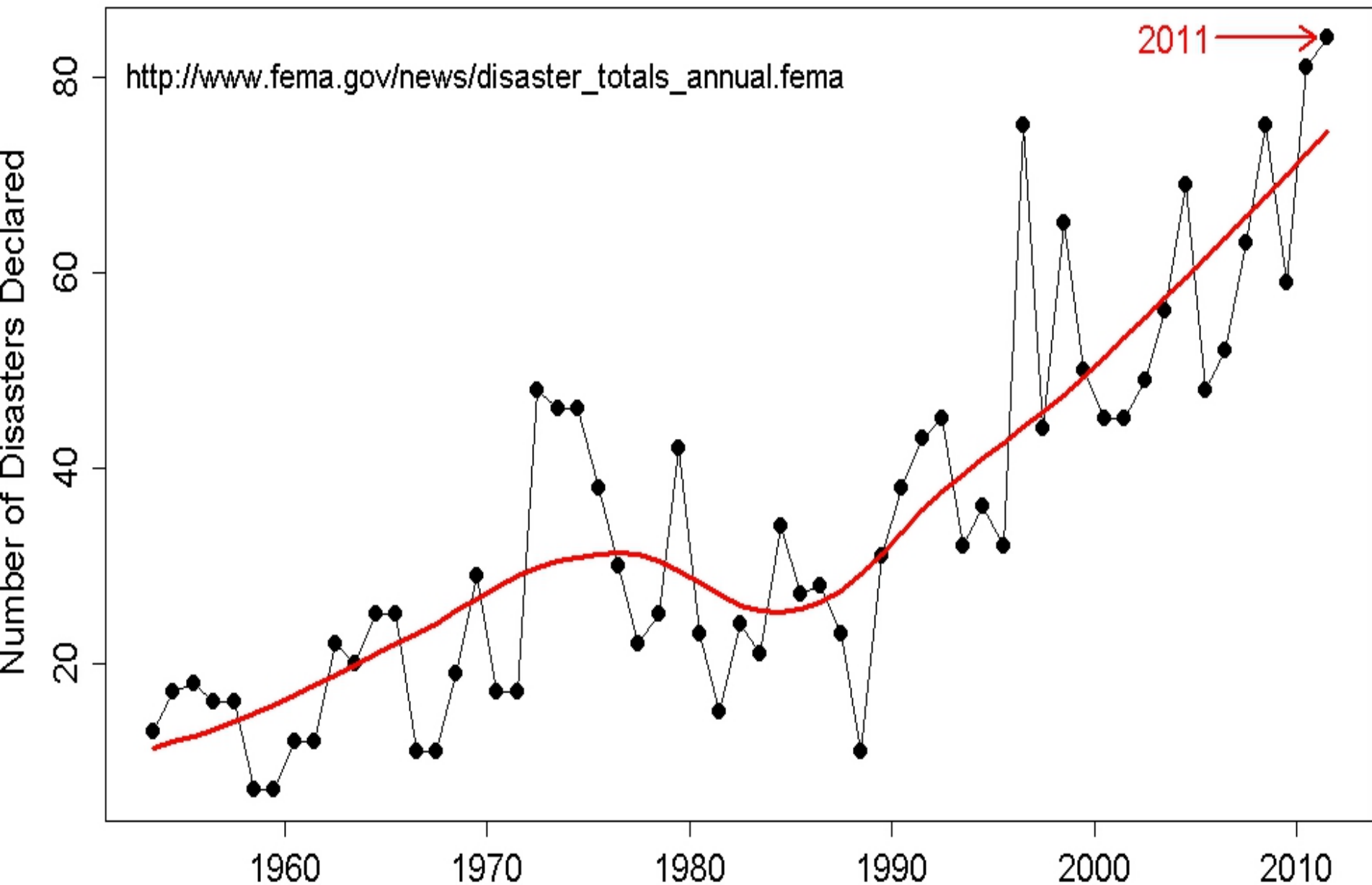


Billion Dollar U.S. Weather Disasters 1980 - 2008

NOAA/NESDIS/NCDC



FEMA Declared Disasters

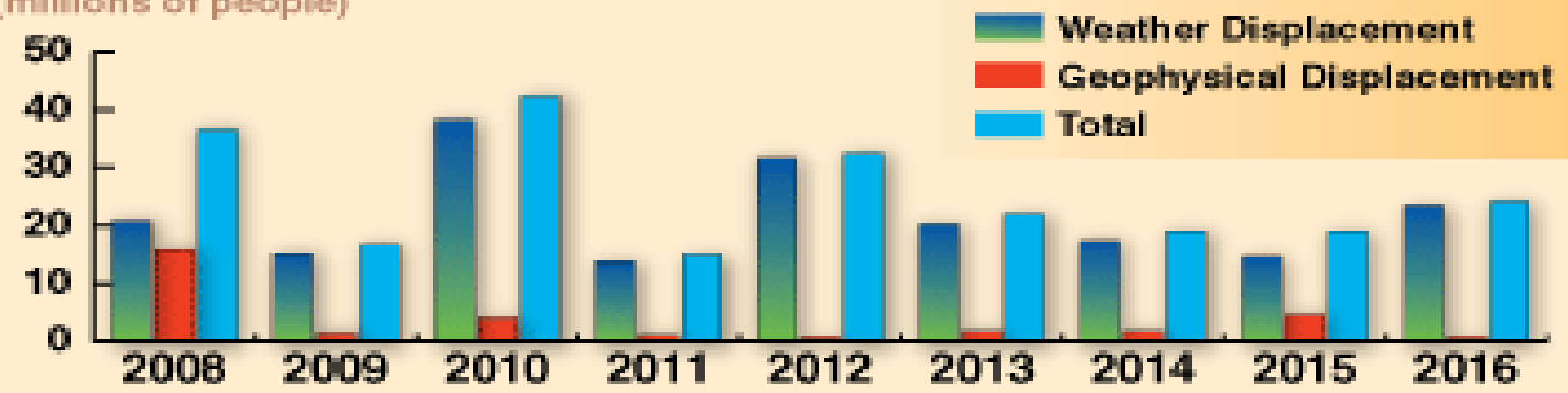


Natural Disasters Force Millions from Homes

From 2008 to 2016, 227.6 million people were displaced worldwide, most of them within their own country's borders, by weather-related or geophysical disasters, such as earthquakes. Weather-related disasters were responsible for 86 percent of the displacements. In the first half of 2017, disasters in 76 countries and territories uprooted another 4.5 million people.

Displacements by Weather or Geophysical Disasters, 2008-16

(millions of people)



Sources: "Global Report on Internal Displacement," May 22, 2017, <https://tinyurl.com/y8dvj789>; "Provisional Mid-year Figures, Internal Displacement in 2017," Aug. 16, 2017, <https://tinyurl.com/ybhc676k>, Norwegian Refugee Council and Internal Displacement Monitoring Centre



**ARE
YOU
READY ?**

“THERE’S NO HARM IN
HOPING FOR THE BEST
AS LONG AS
YOU’RE PREPARED
FOR THE WORST.”

—STEPHEN KING



CHALLENGES

I EXPECTED TIMES LIKE THIS- BUT NEVER
THOUGHT THEY'D BE SO BAD, SO LONG, AND SO FREQUENT.