



PRESENTED BY UNIVERSITY OF HOUSTON

TAMEST NATURAL HAZARDS SUMMIT

*Responding
to and
Mitigating
the Impacts*

PART I: VIRTUAL SUMMIT

10.19.2021

#NATURALHAZARDSSUMMIT

Theme Three:

LONG-TERM OUTLOOK, RISK AND MITIGATION FOR CLIMATE CHANGE

Moderated by:

DANNY REIBLE, PH.D., P.E. (NAE)

Professor of Chemical Engineering, Professor of Civil, Environmental,
and Construction Engineering

Texas Tech University



TAMU NATURAL HAZARDS

Responding to and Mitigating the Impacts

SUMMIT

Presented by:
UNIVERSITY of
HOUSTON



Panel:

Building Resilience to Mitigate Natural Hazards: Science and Policy



LOUISE K.
COMFORT, PH.D.

Professor
University of Pittsburgh



KATHARINE
HAYHOE, PH.D.

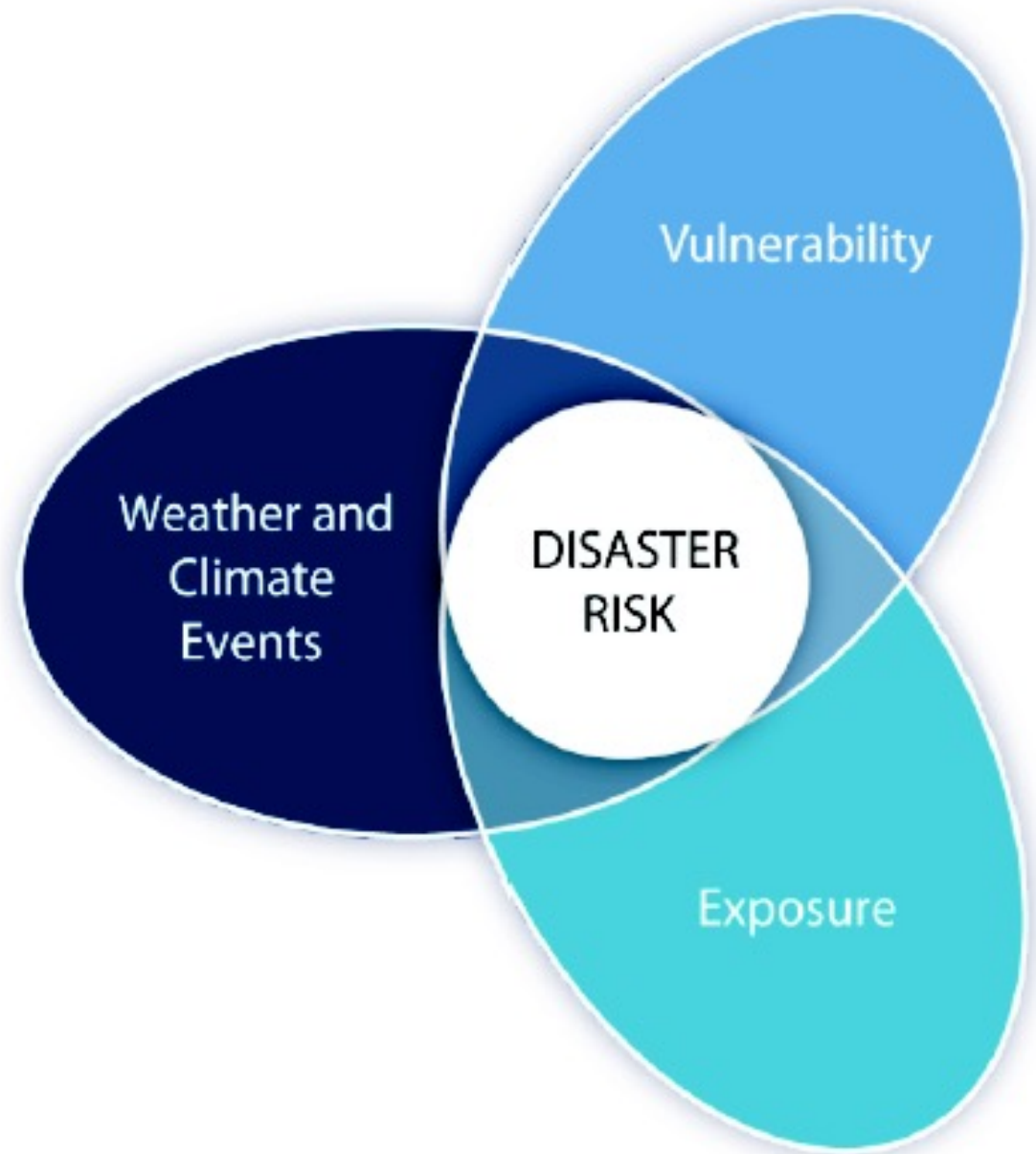
Chief Scientist
The Nature Conservancy



JOHN WILLIAM
NIELSEN-
GAMMON, PH.D.

**Director of the Southern
Regional Climate Center**
Texas A&M University

WHETHER AN
EVENT TURNS
INTO A
DISASTER IS
DETERMINED
BY THREE
FACTORS



AMERICA

New Census Data Show Texas Cities Are Growing Faster Than All Other States

May 24, 2018 · 6:59 PM ET

LOCAL // HOUSTON

Dissecting Houston's massive infrastructure



John D. Harden | Jan. 9, 2017 | Updated: Jan. 12, 2017 5:42 p.m.

EXPOSURE

As the country's fourth largest city and biggest in Texas, it needs a massive, well-functioning infrastructure to support its residential, commercial and industrial growth.



URBANIZATION

Urbanization exacerbates
flood response and total
rainfall

For Hurricane Harvey, it
made its floods 20 times
more likely

Zhang et al. (2018)

Impermeable developed surfaces

2001

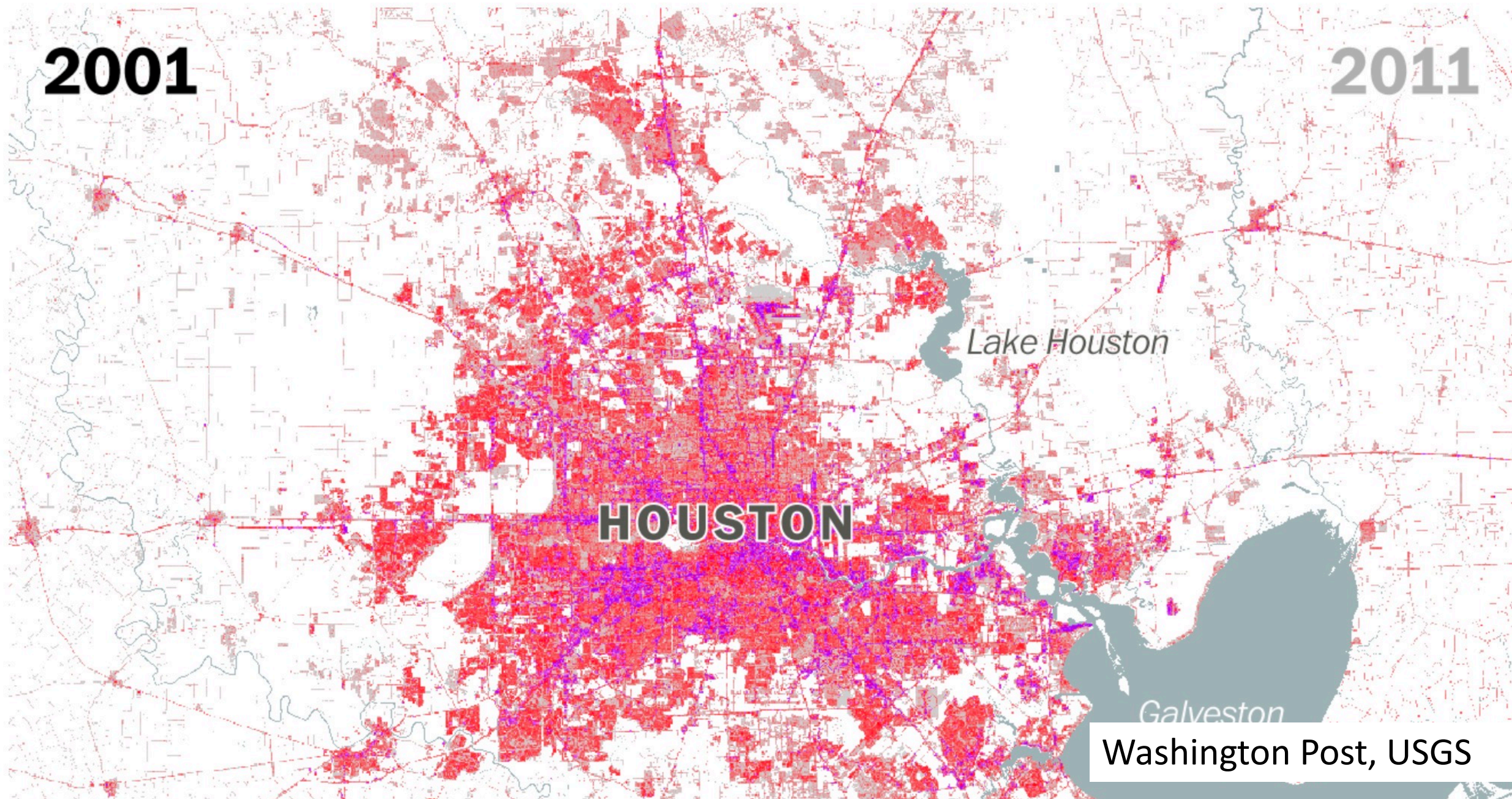
2011

HOUSTON

Lake Houston

Galveston

Washington Post, USGS



Impermeable developed surfaces

2001

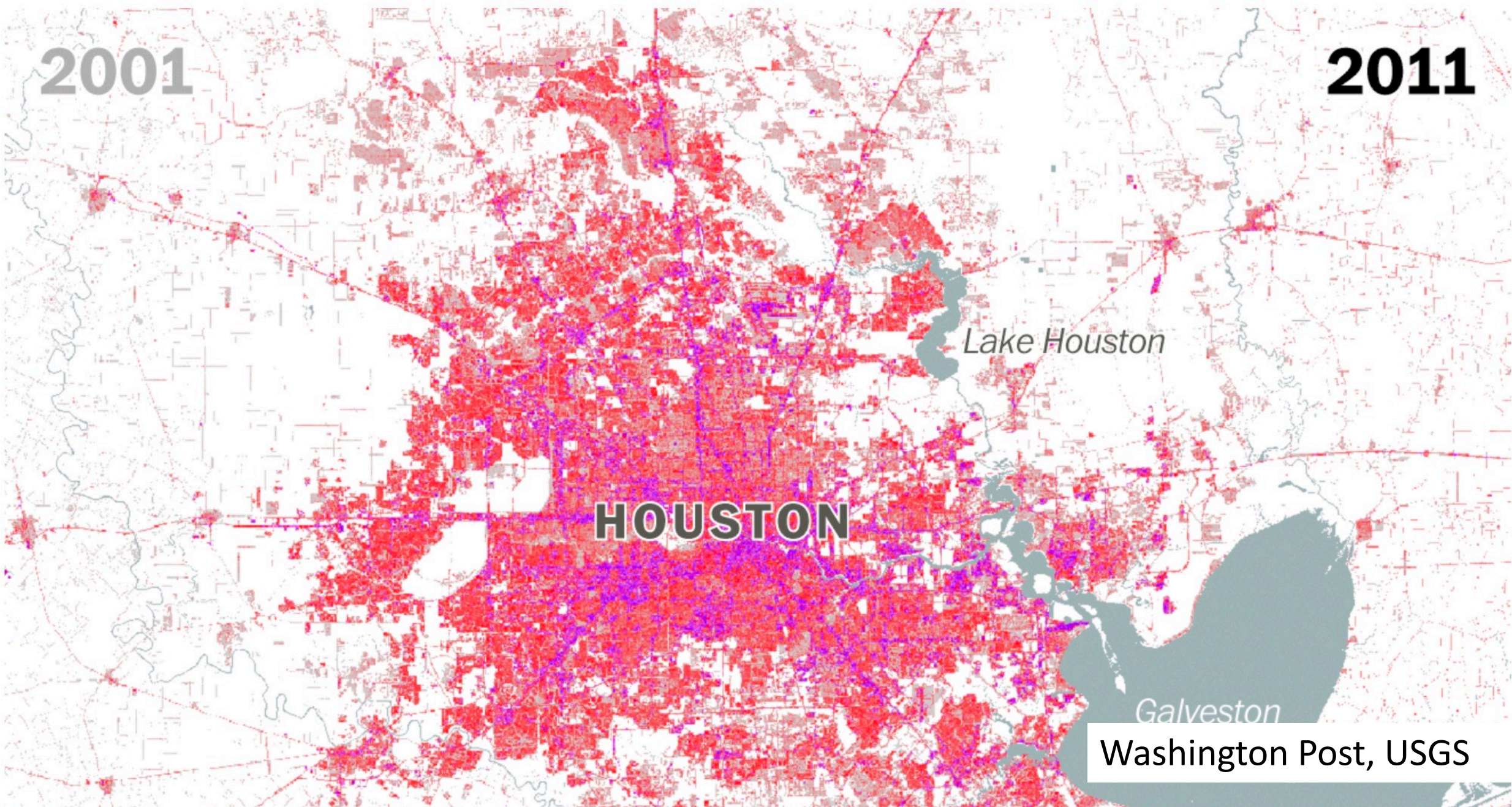
2011

HOUSTON

Lake Houston

Galveston

Washington Post, USGS



MAINTENANCE

America's infrastructure is falling apart – here's a look at how bad things have gotten

Cadie Thompson  

🕒 Feb. 12, 2018, 10:20 AM 🔥 387,564

America's infrastructure is desperately in need of investment, according to the American Society of Civil Engineers'. The ASCE estimates the US needs to spend some \$4.5 trillion by 2025 to fix the country's roads, bridges, dams, and other infrastructure.

A background photograph of a large-scale infrastructure construction project. In the foreground, a massive, dark-colored pipe is being installed in a deep trench. Several workers wearing hard hats and safety vests are visible in the background, standing near yellow caution tape that cordons off the work area. The scene is set outdoors with greenery in the distance.

AVIATION - D
BRIDGES — C+
DAMS — D
DRINKING WATER — D
ENERGY — D
HAZARDOUS WASTE — D+
LEVEES — D
PORTS - C+
RAIL - B
ROADS - D

**FOR THE US AS A WHOLE,
MOST INFRASTRUCTURE
GETS A FAILING GRADE**



African Americans Are Disproportionately Exposed to Extreme Heat

ADRIENNE HOLLIS, SENIOR CLIMATE JUSTICE AND HEALTH SCIENTIST | JULY 22, 2019, 4:52 PM EDT

SOCIAL VULNERABILITIES

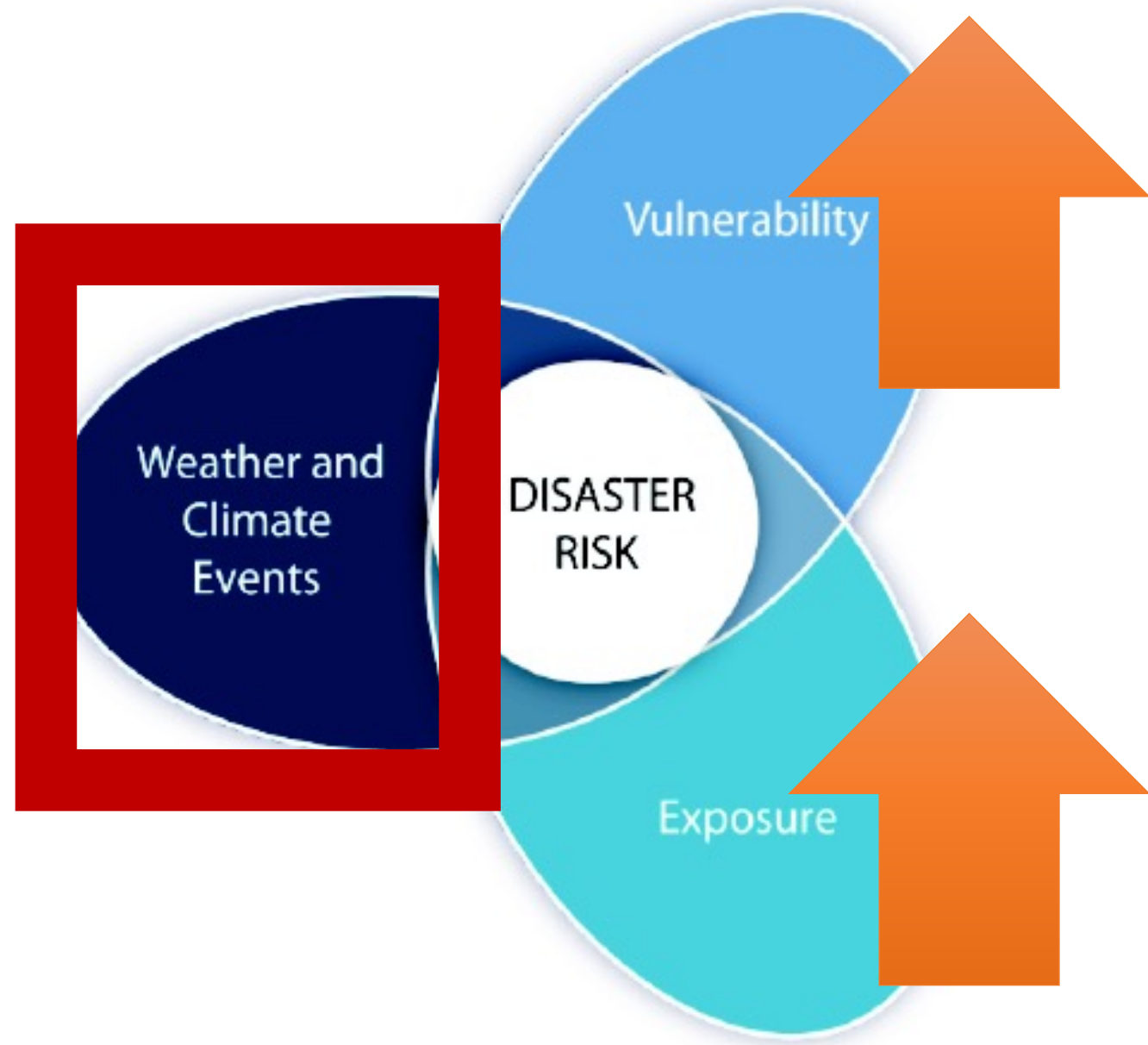
Rising heat could disproportionately harm African-American communities

Extreme heat is growing more common because of global warming.

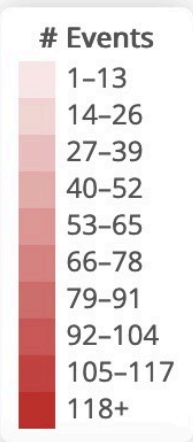
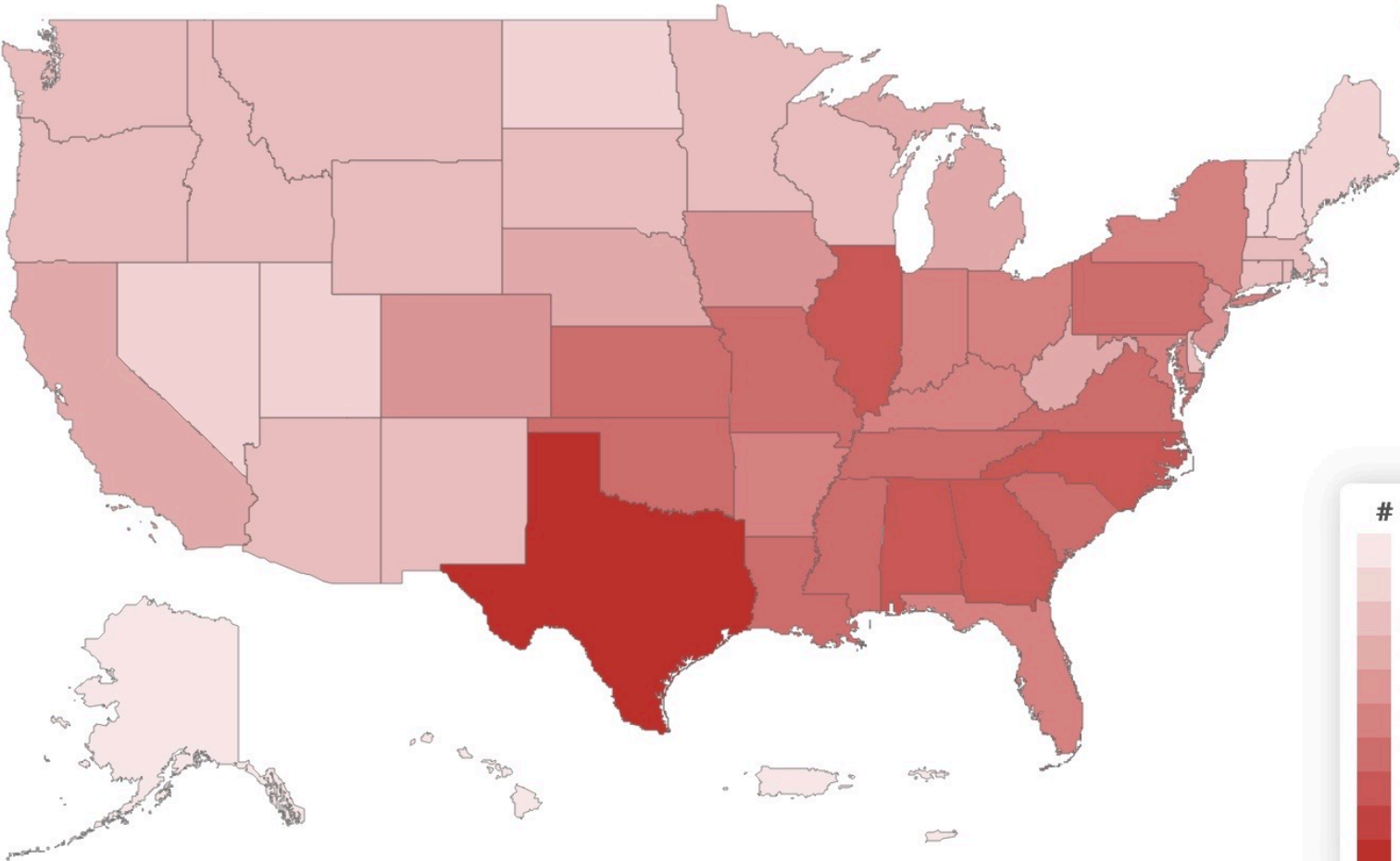
As the climate warms, hot days are getting hotter – often dangerously so. And the risks fall disproportionately on many communities of color.

“When we look at counties that have a high proportion of African Americans in the continental U.S., they tend to be concentrated in the Southeast region – places like Georgia, Alabama, Mississippi,” says Kristina Dahl of the Union of Concerned Scientists. “Those also are some of the hottest places in our country already.”

WHETHER AN
EVENT TURNS
INTO A
DISASTER IS
DETERMINED
BY THREE
FACTORS



1980-2021* Billion-Dollar Weather and Climate Disasters (CPI-Adjusted)



United States

Drought:	29	Flooding:	35	Freeze:	9	Severe Storm:	141
Tropical Cyclone:	56	Wildfire:	19	Winter Storm:	19	All Disasters:	308

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).

*as of October 8, 2021

A photograph showing a severe flood on a multi-lane highway. Numerous cars, including SUVs, sedans, and pickup trucks, are partially submerged in murky brown water. A white sedan is seen driving through the water in the middle of the frame. The highway is flanked by green trees and a city skyline is visible in the background under an overcast sky. An orange rectangular graphic element is located in the top left corner of the image.

We get floods



...and hurricanes



water shortages



record- breaking fires





Rain and flood



THESE ASSUMPTIONS DETERMINE...



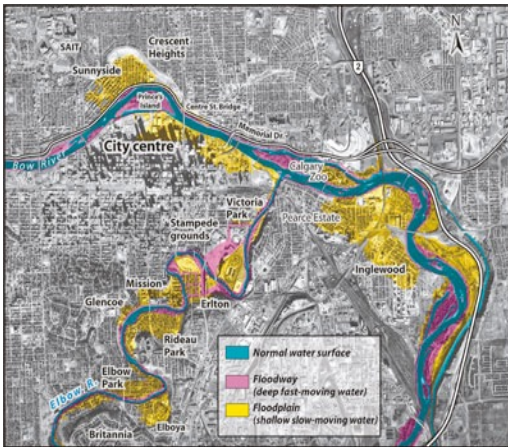
RESIDENTIAL + COMMERCIAL
BUILDING CODES



WHAT TYPES OF CROPS WE
GROW, AND WHERE



THE ENERGY DEMAND WE
PLAN FOR




FLOOD ZONES



INVESTMENT IN SNOW
REMOVAL CAPACITY--OR NOT



WATER PLANNING
AND MUCH MORE ...



PLANNING FOR THE
FUTURE BASED ON THE
PAST IS LIKE DRIVING
DOWN A ROAD,
LOOKING IN THE REAR-
VIEW MIRROR.



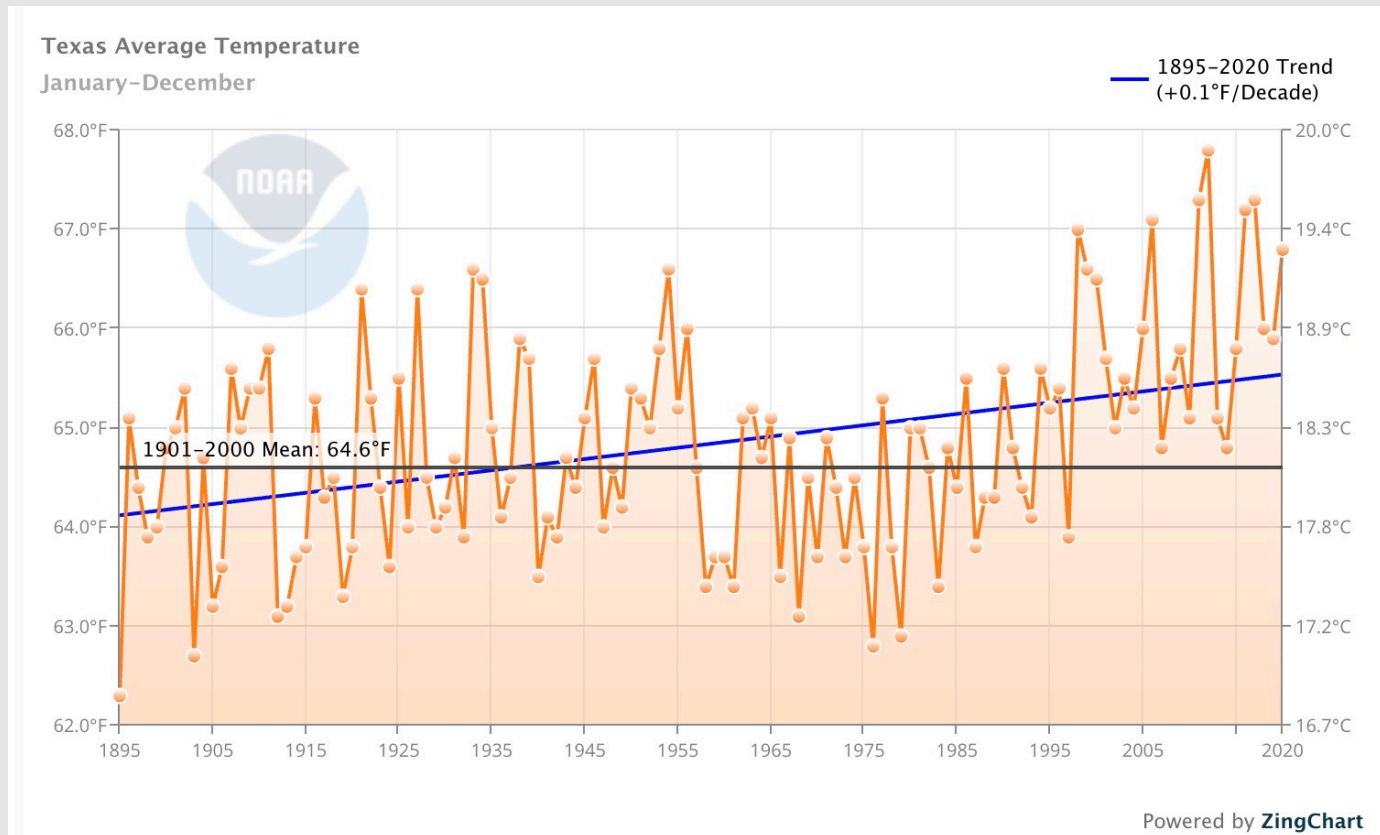


IT WORKS ...
WHEN
CLIMATE IS
RELATIVELY
STABLE



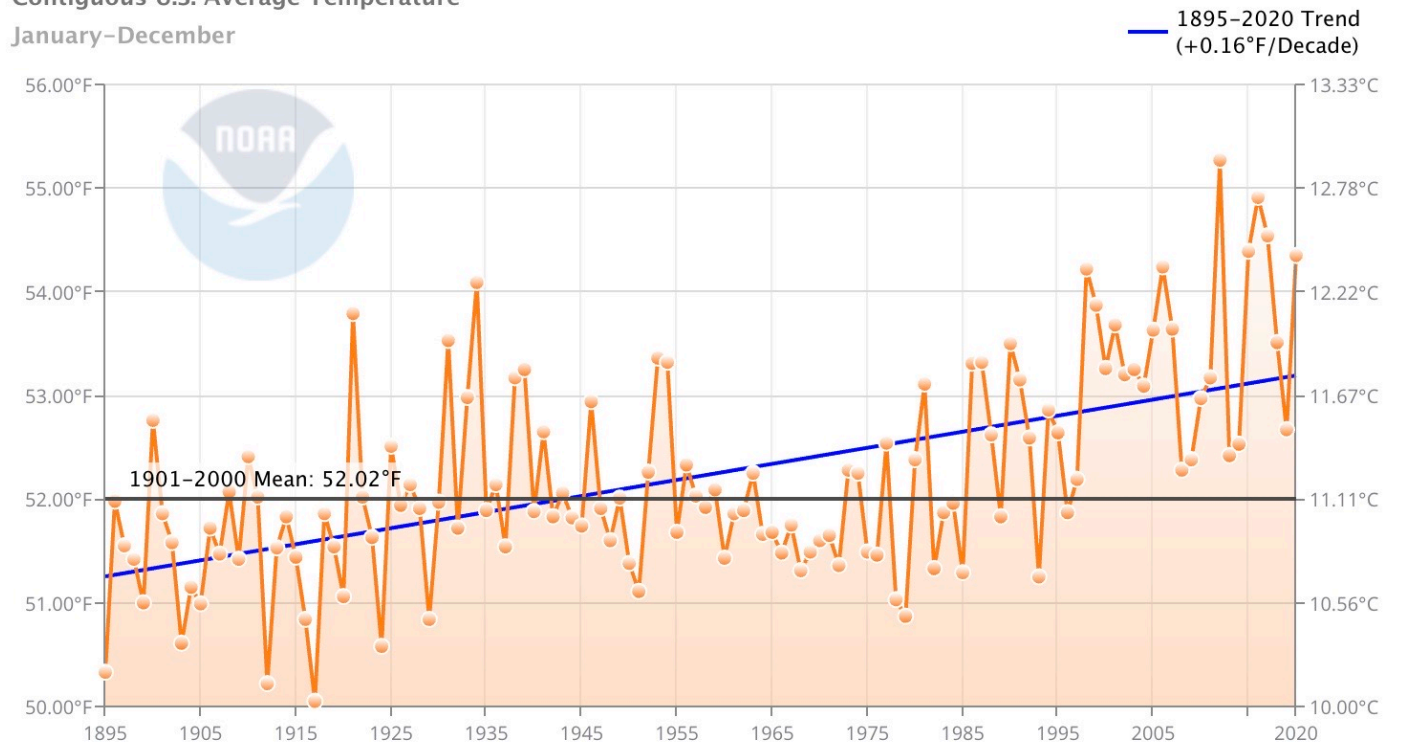
WHAT'S HAPPENING IN TEXAS?

- Every season has been warming since the 1950s
- Winter is warming fastest

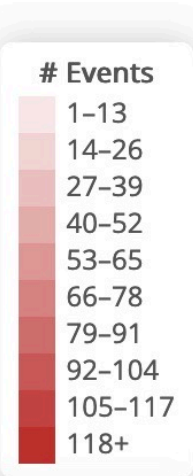
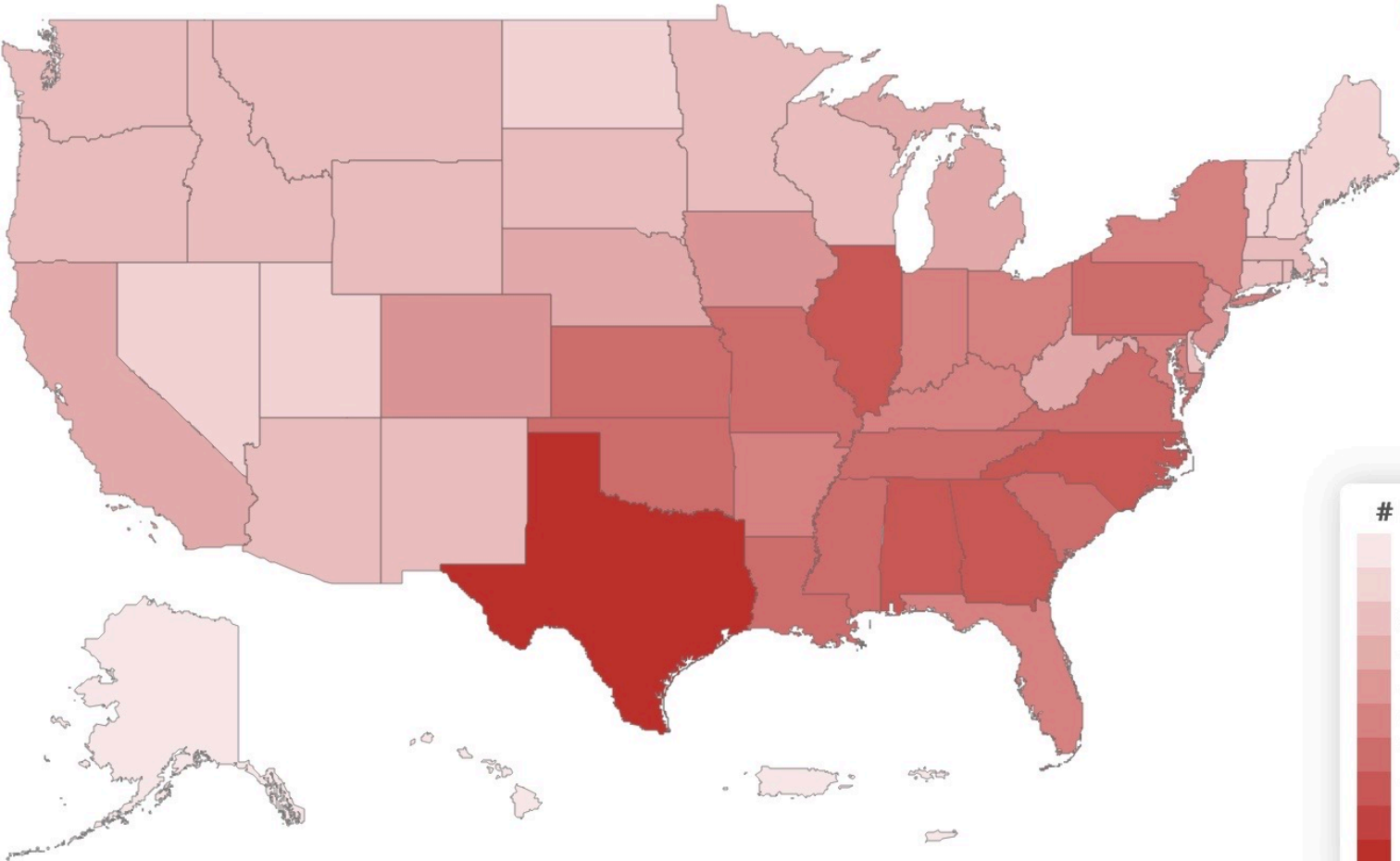


What's
happening in
the U.S.?

Contiguous U.S. Average Temperature
January–December



1980-2021* Billion-Dollar Weather and Climate Disasters (CPI-Adjusted)



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*as of October 8, 2021

SIX



SIX

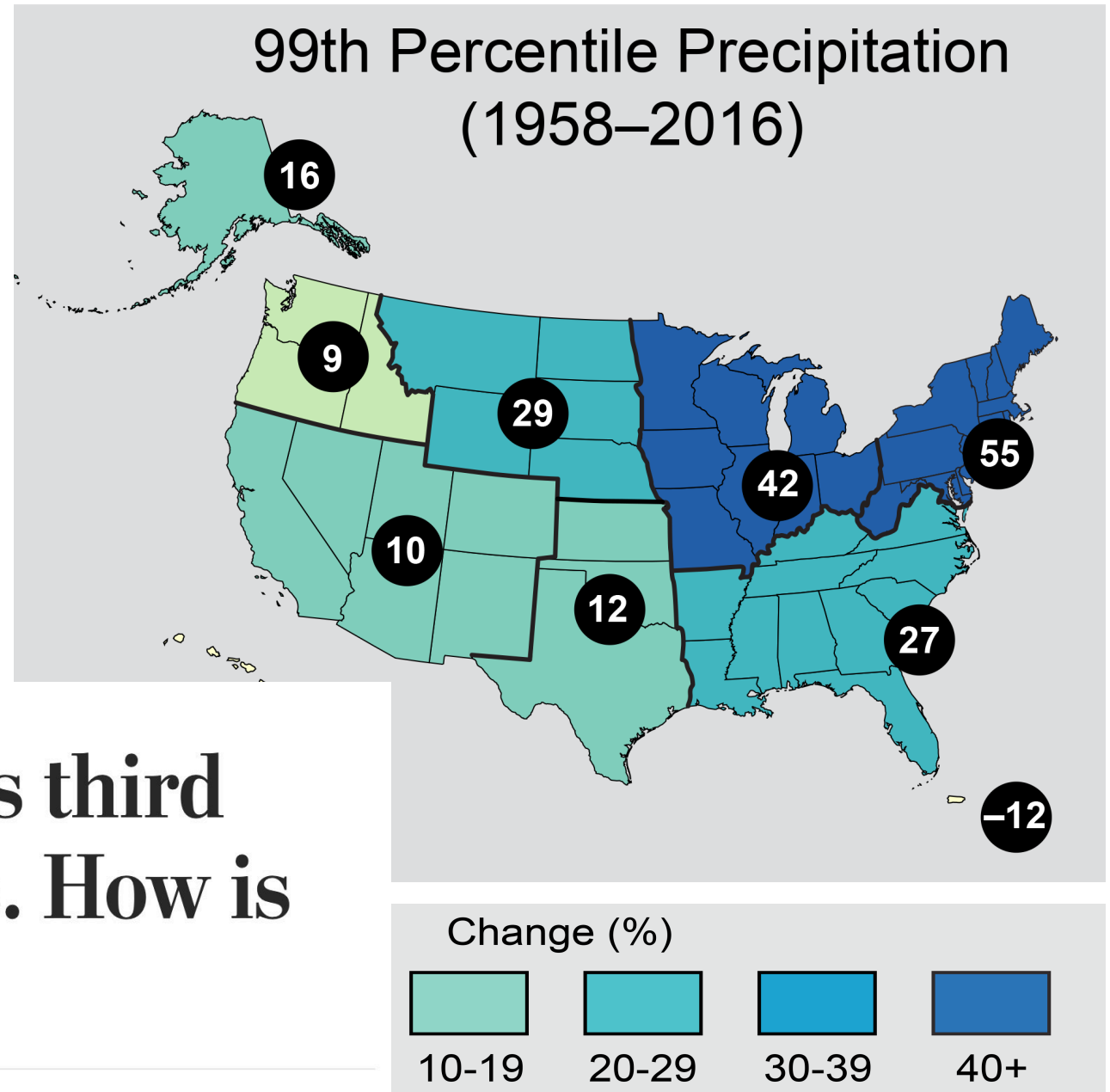


SEVEN

Heavy rainfall is becoming more frequent, as warmer air holds more water vapor

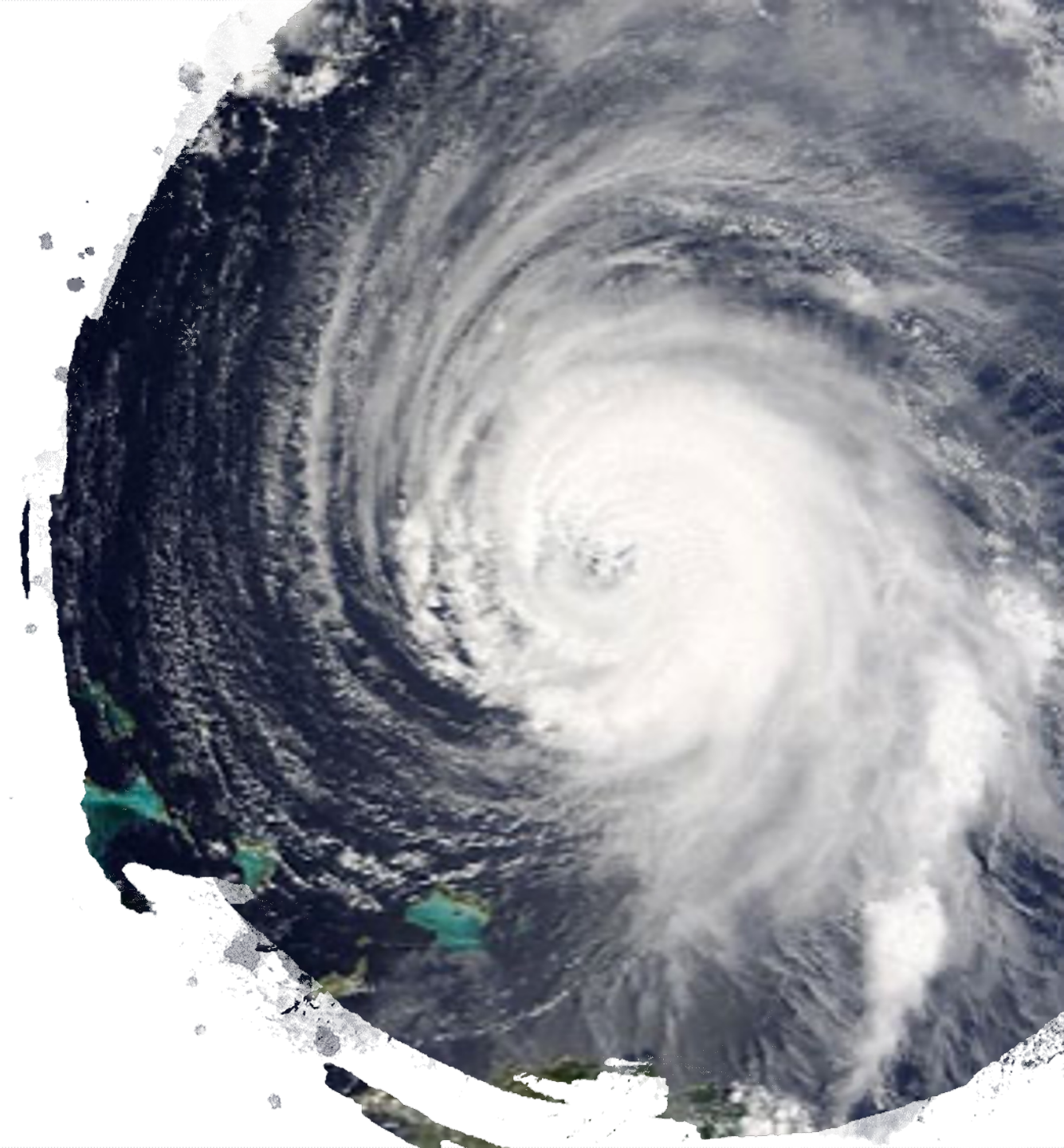
Economic Policy • Analysis

Houston is experiencing its third ‘500-year’ flood in 3 years. How is that possible?



Not just normal storms,
but hurricanes too

1. More rain
2. Intensifying faster
3. Stronger
4. Slower



WHAT DOES THE SCIENCE SAY ABOUT HARVEY?

- More intense precipitation (15%, van Oldenborgh et al. 2017)
- More precipitation overall (38%, Risser and Wehner, 2017)
- Sustained and intensified by high ocean heat (Trenberth et al. 2018)
- Significantly greater economic damages (75%, Frame et al. 2020)

Climate change made North American heatwave 150 times more likely



ENVIRONMENT 7 July 2021

By [Adam Vaughan](#)

Europe has had five 500-year summers in 15 years. And now this

A continent without air conditioning struggles with 100-degree days in June—and wonders how it will cope with the hotter years ahead.

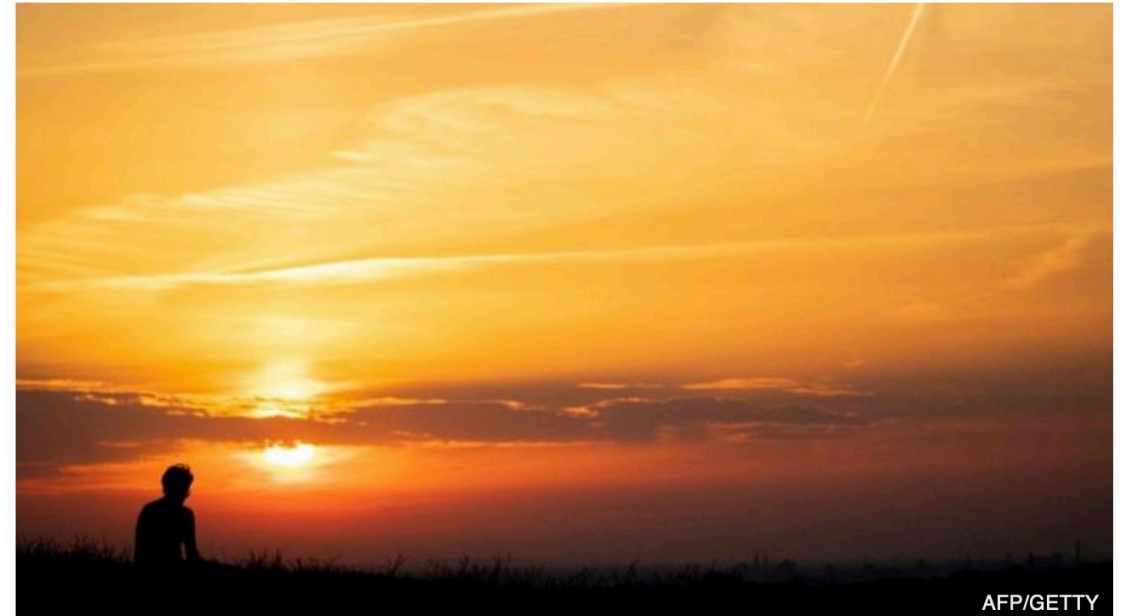
Hundreds of temperature records broken over summer

By Nassos Stylianou and Clara Guibourg
Data journalists

🕒 9 October 2019 | 🇬🇧

[f](#) [💬](#) [🐦](#) [✉](#) [Share](#)

UK heatwaves



Almost 400 all-time high temperatures were set in the northern hemisphere over the summer, according to an analysis of temperature records.

LIVING



Study: Warmer Arctic led to killer cold in Texas, much of US

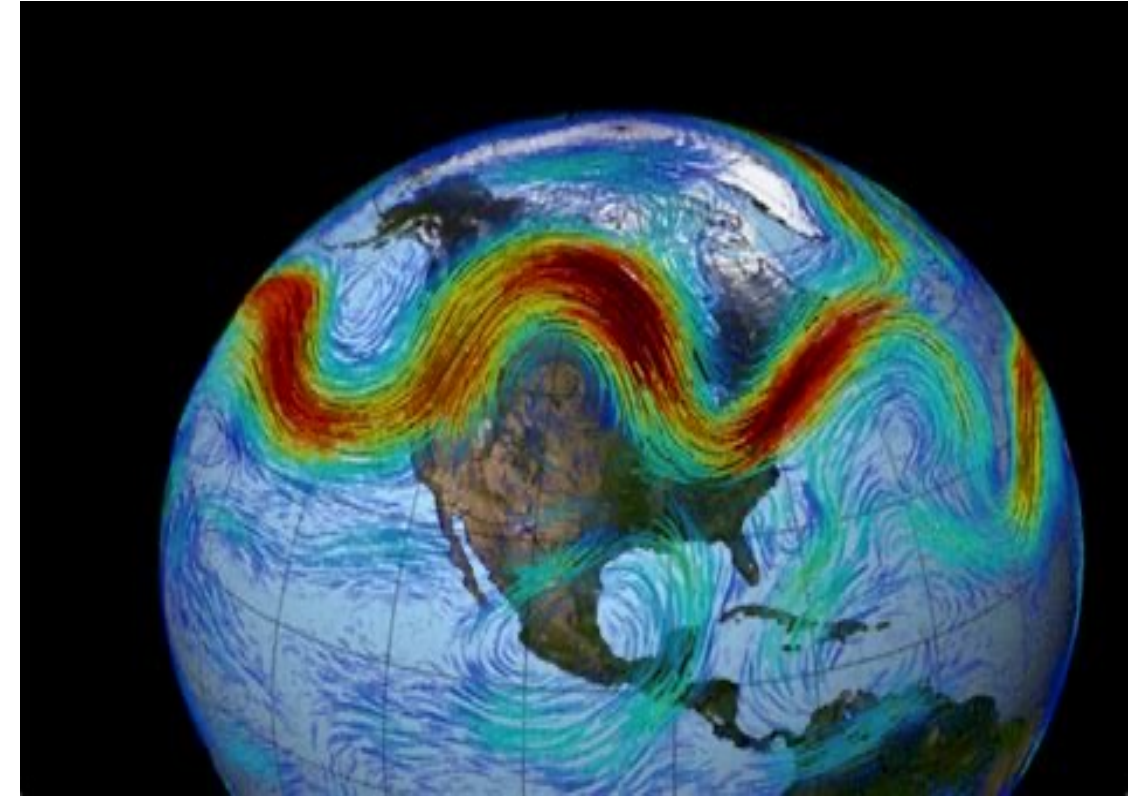
By Associated Press

September 3, 2021 | 2:47pm | Updated



In this Monday, Feb. 15, 2021 file photo, Traffic is sparse on the snow-covered Interstate 45 near The Woodlands Parkway following an overnight snowfall in The Woodlands, Texas, as temperatures plunged into the teens with light snow and freezing rain.

Brett Coomer/Houston Chronicle via AP



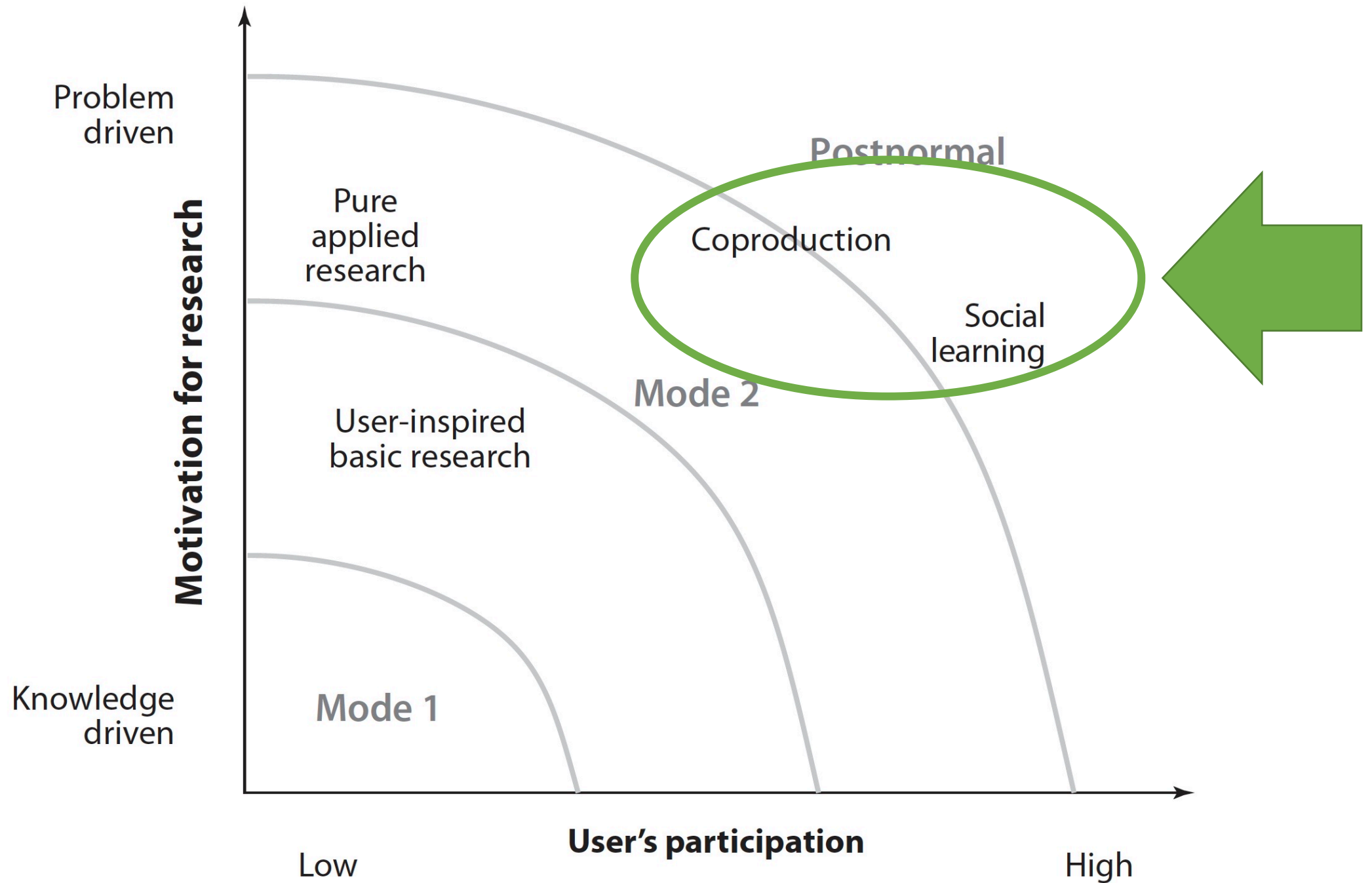
As the Arctic warms 2x faster than the rest of the world, it makes the jet stream wavier.

The question is not, “did climate change *cause* this event?”

The question is, “did climate change make it *worse*?”

YES

How can we
reduce the risk of
DISASTER?



STEP ONE: What concerns do we already have?



COASTAL INFRASTRUCTURE AT RISK
OF FLOODING DURING HURRICANES
AND STORM SURGE



INLAND INFRASTRUCTURE AT RISK OF
FLOODING DURING EXTREME
RAINFALL EVENTS

STEP ONE: What concerns do we already have?



SOCIAL JUSTICE AND
ECONOMIC INEQUALITY



AGING INFRASTRUCTURE AND
COSTLY REPAIRS

STEP ONE: What concerns do we already have?



AIR QUALITY
AND HEALTH IMPACTS



ECOSYSTEM CONSERVATION,
SUCH AS FRESHWATER
INFLOWS TO GALVESTON BAY

STEP TWO: How do these connect to climate?



HEAVY RAINFALL
EVENTS

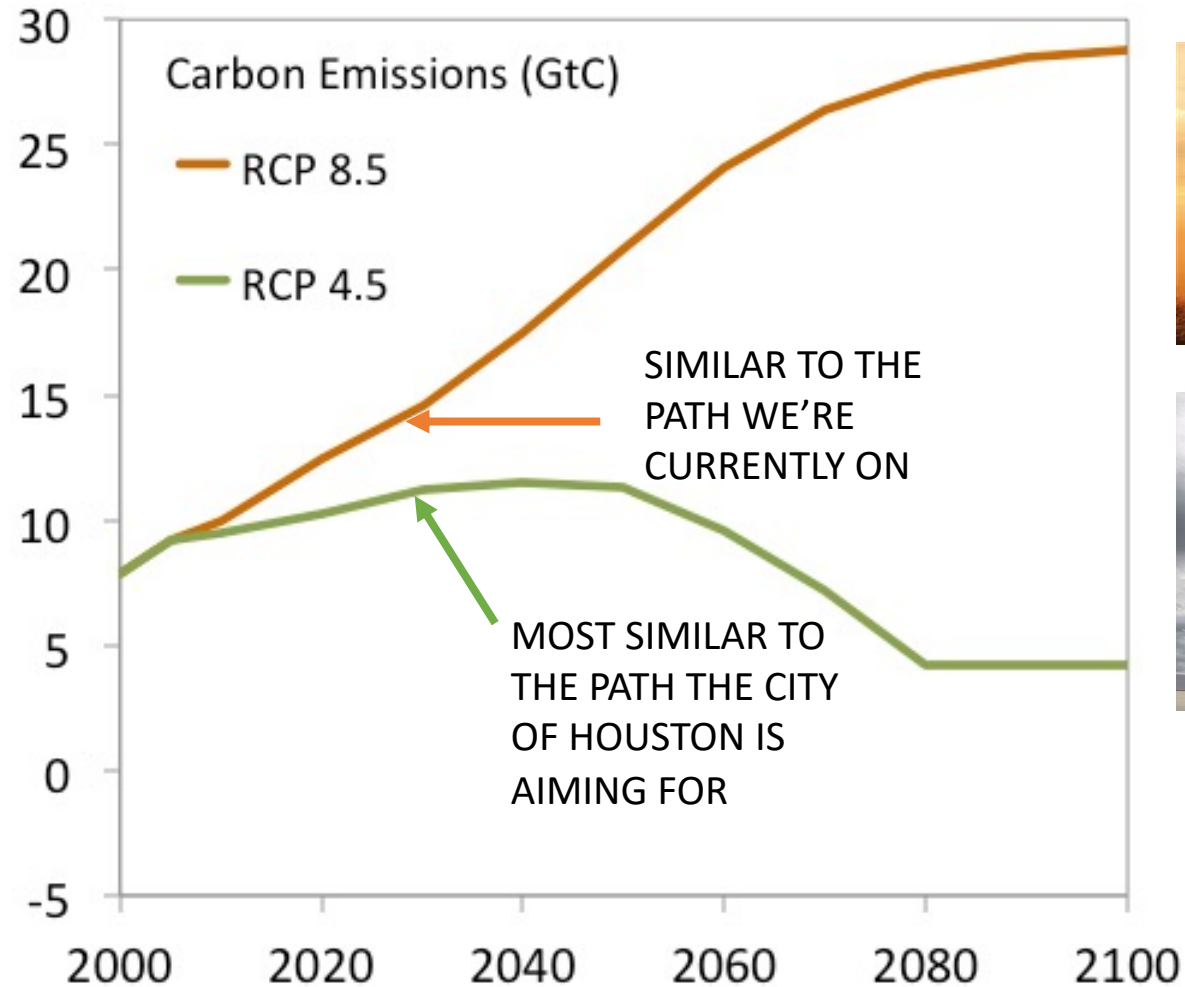


DROUGHT

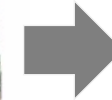
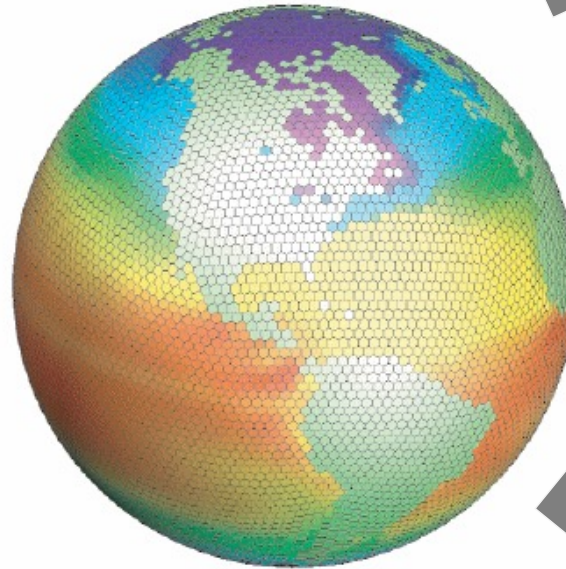


HEATWAVES

THEN WE ADD IN FUTURE CHANGES – THAT DEPEND ON OUR CHOICES



WE TRANSLATE GLOBAL MODEL PROJECTIONS INTO LOCAL-SCALE INFORMATION



TO SEE WHAT THIS MEANS FOR TEMPERATURE

Every season is getting warmer

Summer is getting longer

We are seeing more hot days and warm nights

The hottest days are getting hotter and heatwaves are getting longer

CLIMATE CHANGE NOV 28



Climate change to bring North Texas longer droughts, heavy rains, 120-degree temps within 25 years



Anna Kuchment, Science writer  

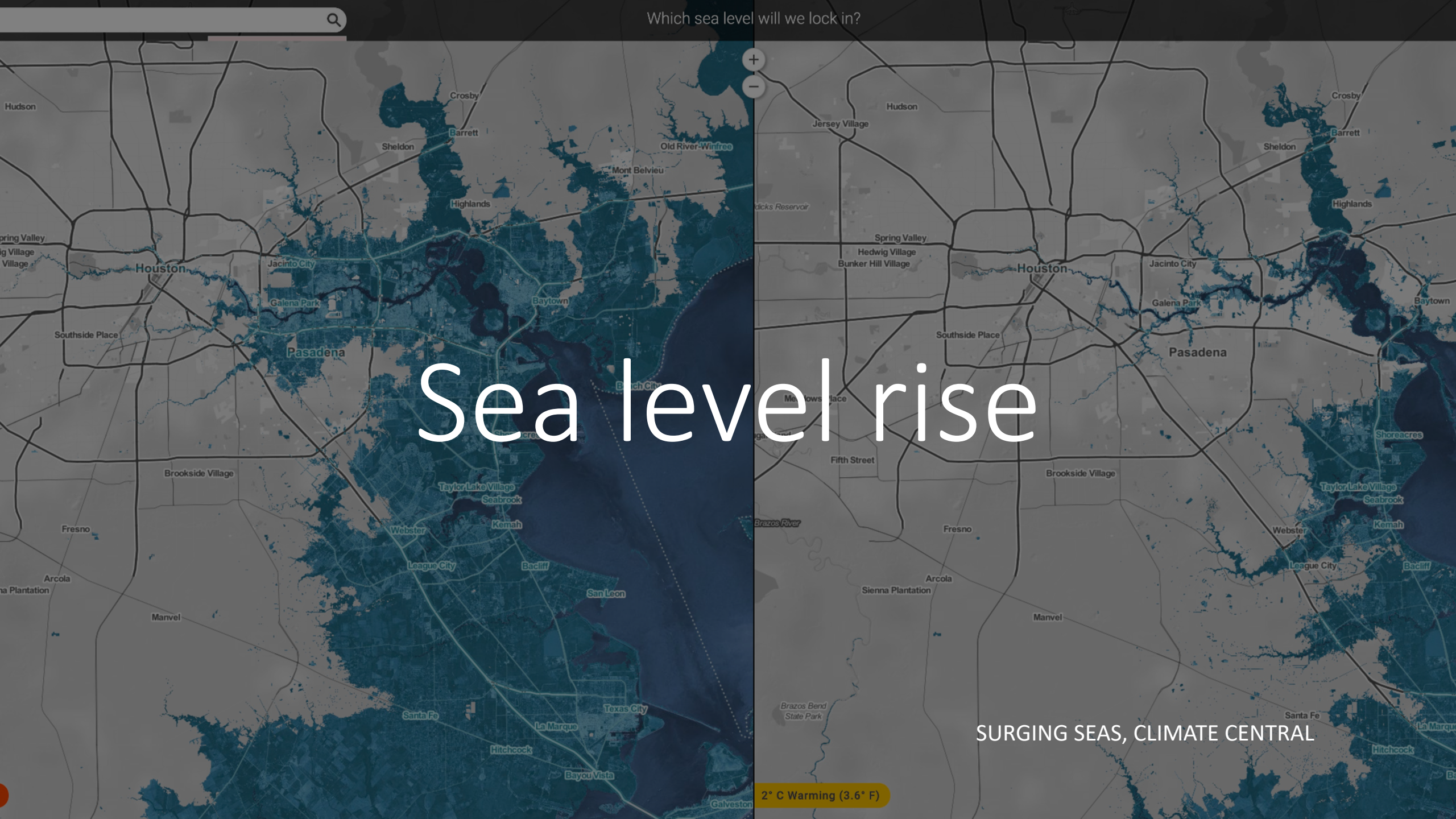
SCIENCE AND TECHNOLOGY

Climate Change Will Be Very Bad For Dallas County

A new study looks at the economic effects of climate change at a county-by-county level, demonstrating that global warming is a local issue.

BY ALEX MACON | PUBLISHED IN FRONTBURNER | JULY 20, 2017 | 12:46 PM

...Precipitation



Which sea level will we lock in?

Sea level rise

SURGING SEAS, CLIMATE CENTRAL

2° C Warming (3.6° F)

NEWS

Sea Level Rise Is Costing Texas Homeowners Millions In Property Values, Study Finds

Most of the impact is on the Houston-Galveston region.

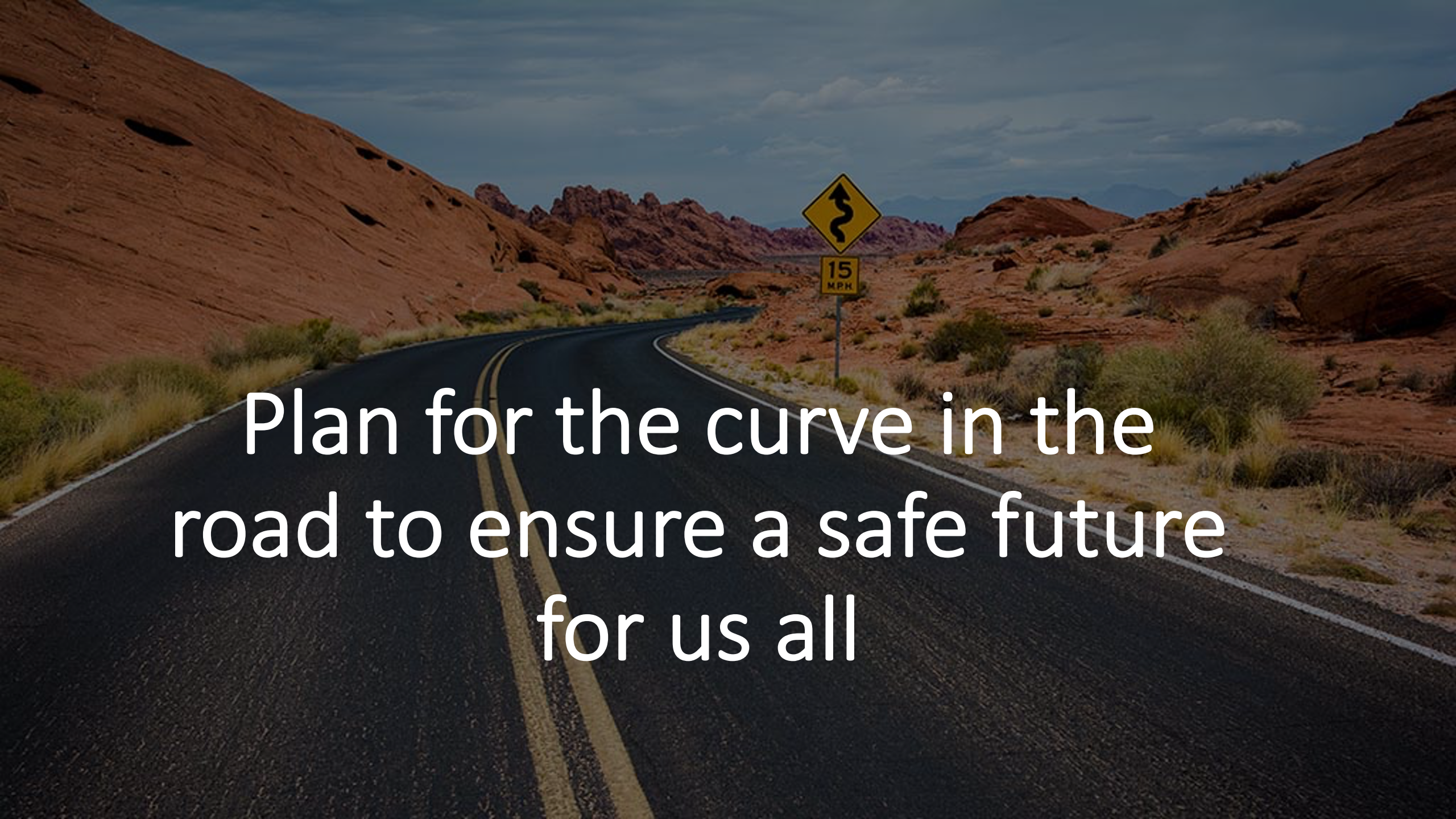
FLORIAN MARTIN | APRIL 23, 2019, 5:08 PM (LAST UPDATED: APRIL 24, 2019, 10:47 AM)

From 2005 to 2017, homes along the Texas Gulf Coast lost more than \$76 million in potential value due to tidal flooding, according to a [study by First Street Foundation](#).

Nearly half of that loss in property value – \$35 million – was from homes in five communities in the Greater Houston and Galveston area: Galveston, Jamaica Beach, Bolivar Peninsula and Nassau Bay.

We don't need to move
climate change *up* anyone's list

Whatever we care about is already being
affected today. Resilient planning requires
incorporating climate changes tomorrow.

A photograph of a two-lane asphalt road winding through a desert landscape. The road has a double yellow line in the center and a white line on the right. To the right of the road, there is a yellow diamond-shaped warning sign with a black squiggle indicating a curve, and a rectangular speed limit sign below it that reads "15 MPH". The surrounding terrain is arid with red rock formations and sparse green shrubs under a cloudy sky.

Plan for the curve in the
road to ensure a safe future
for us all