Climate Change & Catastrophic Trends: An Insurance Perspective

Prepared for the CAS Spring 2020 Meeting

Empower Results®

POLLING QUESTION

Do you believe that increasing catastrophe losses are attributable to climate change?

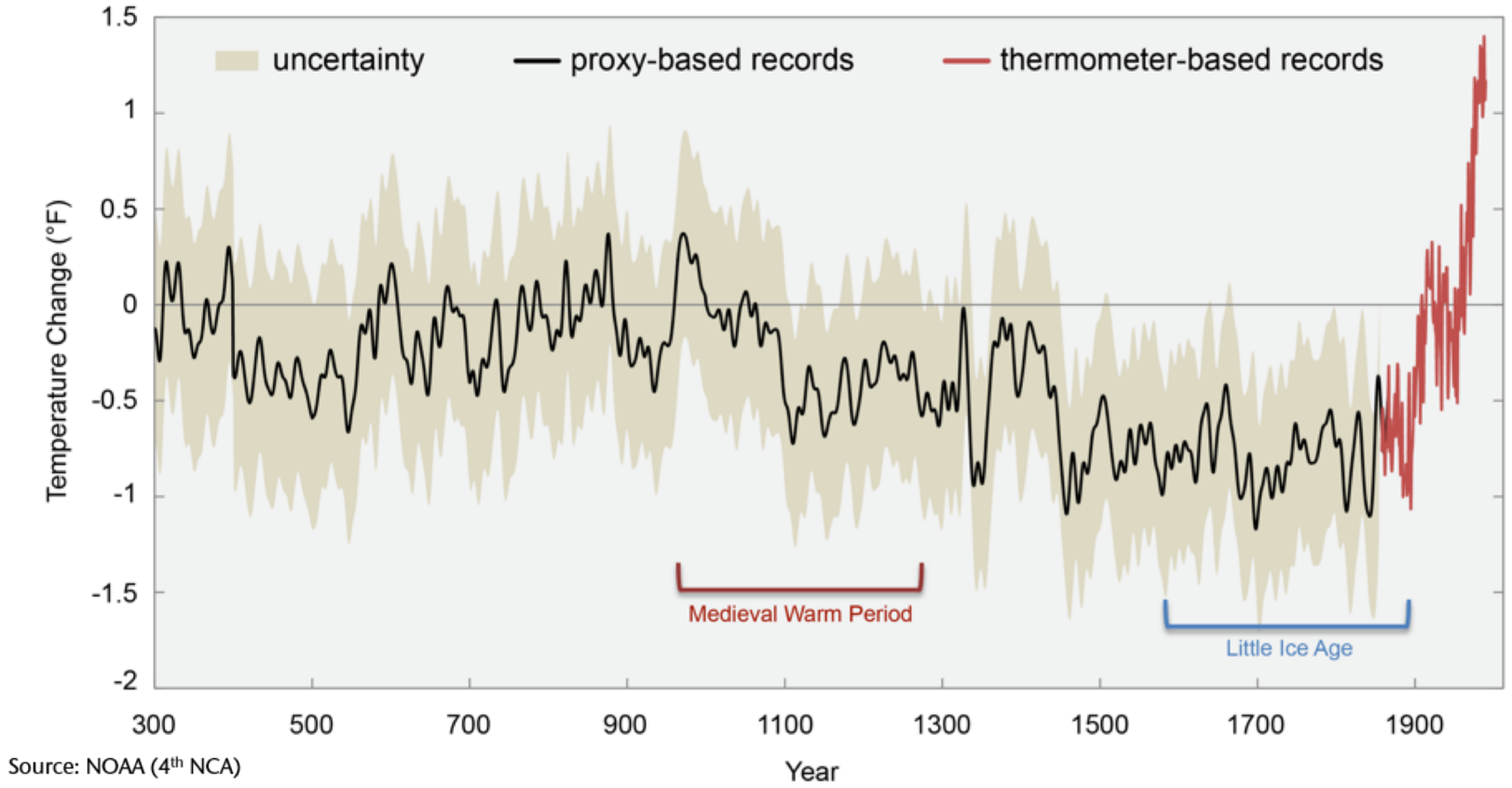
A. Yes, a lot
B. Yes, a little
C. No
D. Unsure


Climate Change: What We Know
AON
Empower Results®

What is Climate Change?

...in the simplest explanation possible...

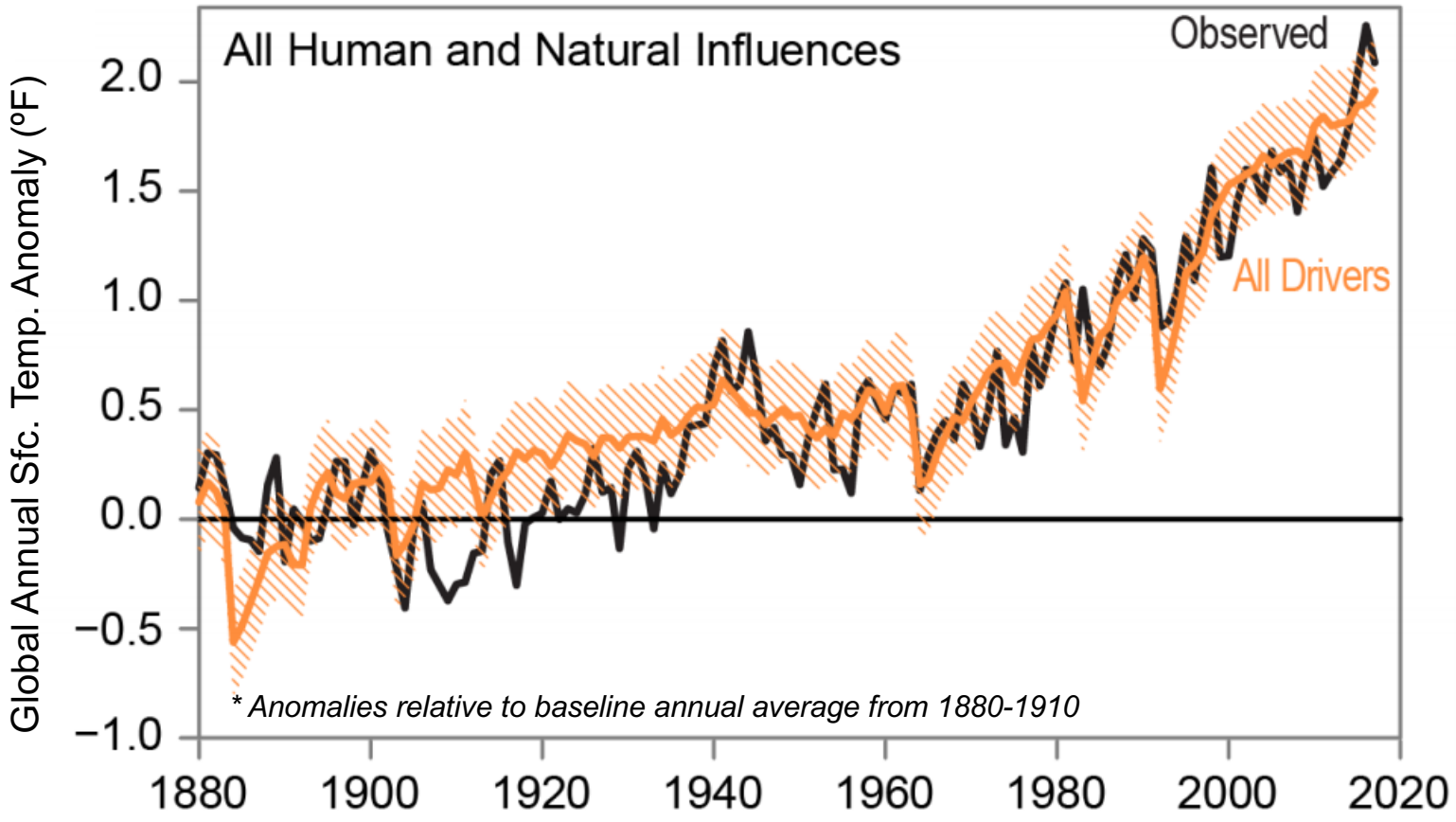
Long-Term Global Temperature Trend



Source: NOAA (4th NCA)

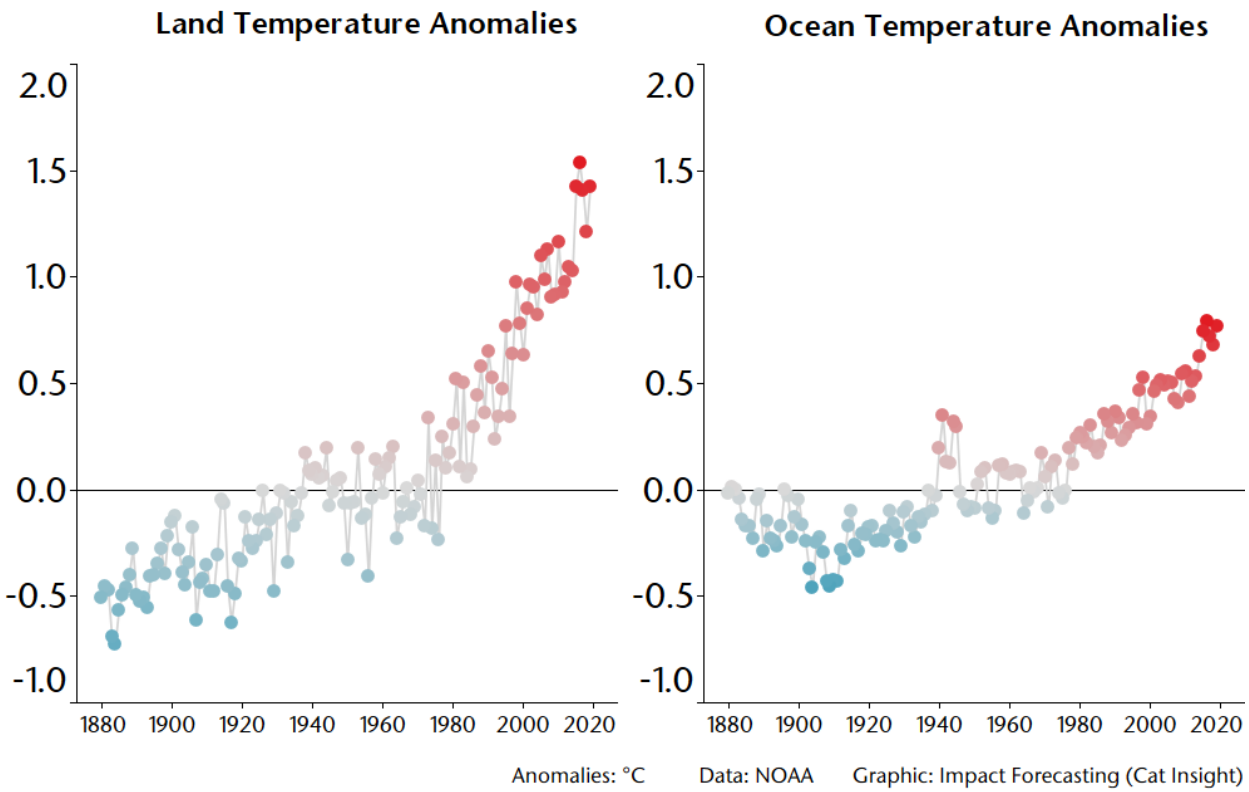
** Anomalies relative to baseline annual average 1901-2000*

What's Driving the Global Temperature Increase?



Source: NOAA (4th NCA)

Global Land & Sea Surface Temperatures are Rising



25% of atmospheric carbon dioxide is absorbed by the ocean…

…But 93% of global warming is stored in the world's oceans

** Anomalies relative to baseline annual average from 1901-2000*

What to expect in an era of climate change?

More Tornadoes
Per Outbreak

More Precipitation
Per Event

Wavier Jet Stream
More Weather Weirdness

More Cold Spells &
Heavy Snow Events

Climate Change Risk

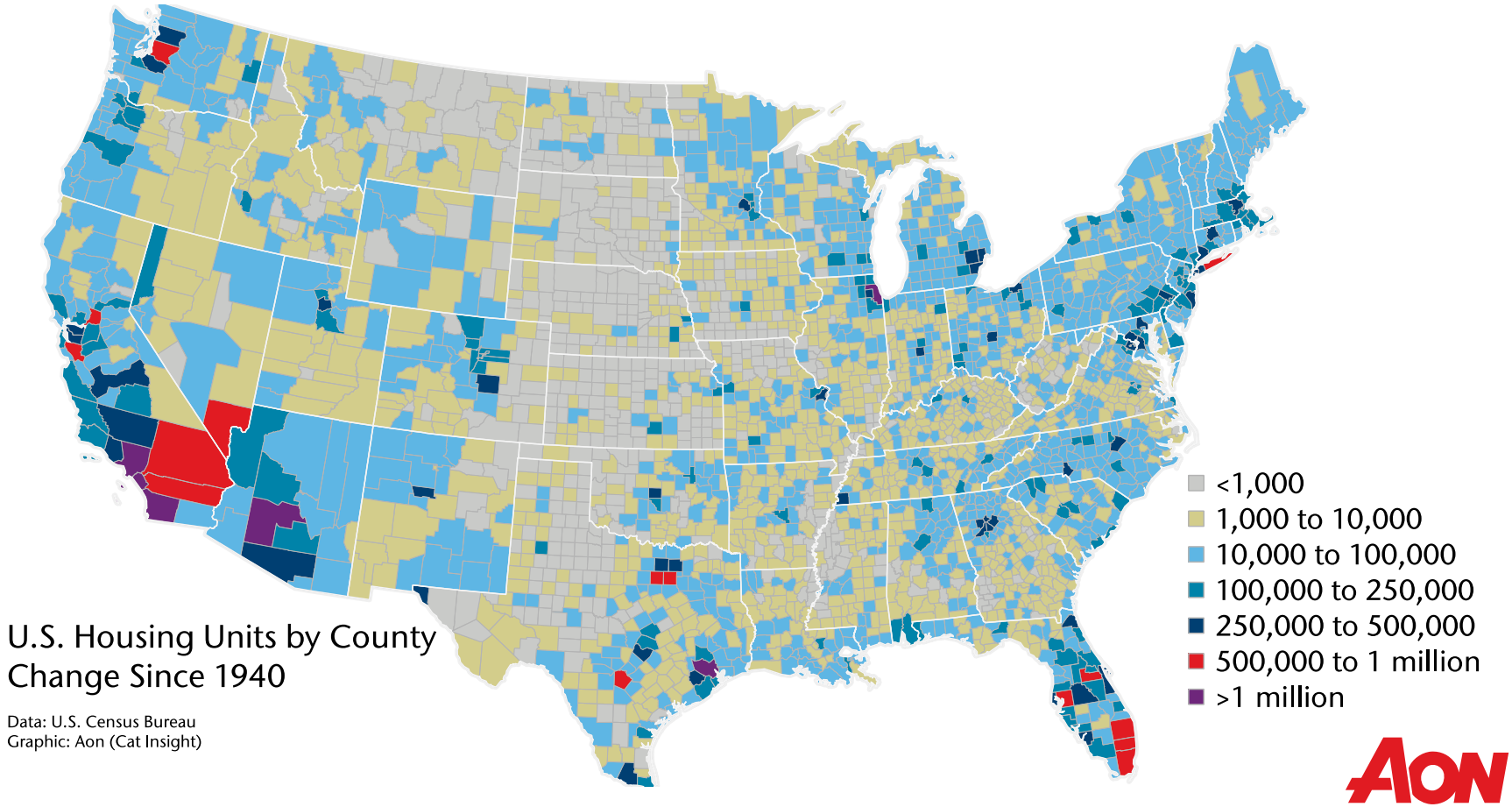
More Intense
Droughts

Increased Frequency of
Rapidly Intensifying Storms

Prolonged
Fire Seasons

Sea Level Rise
More Nuisance Flooding

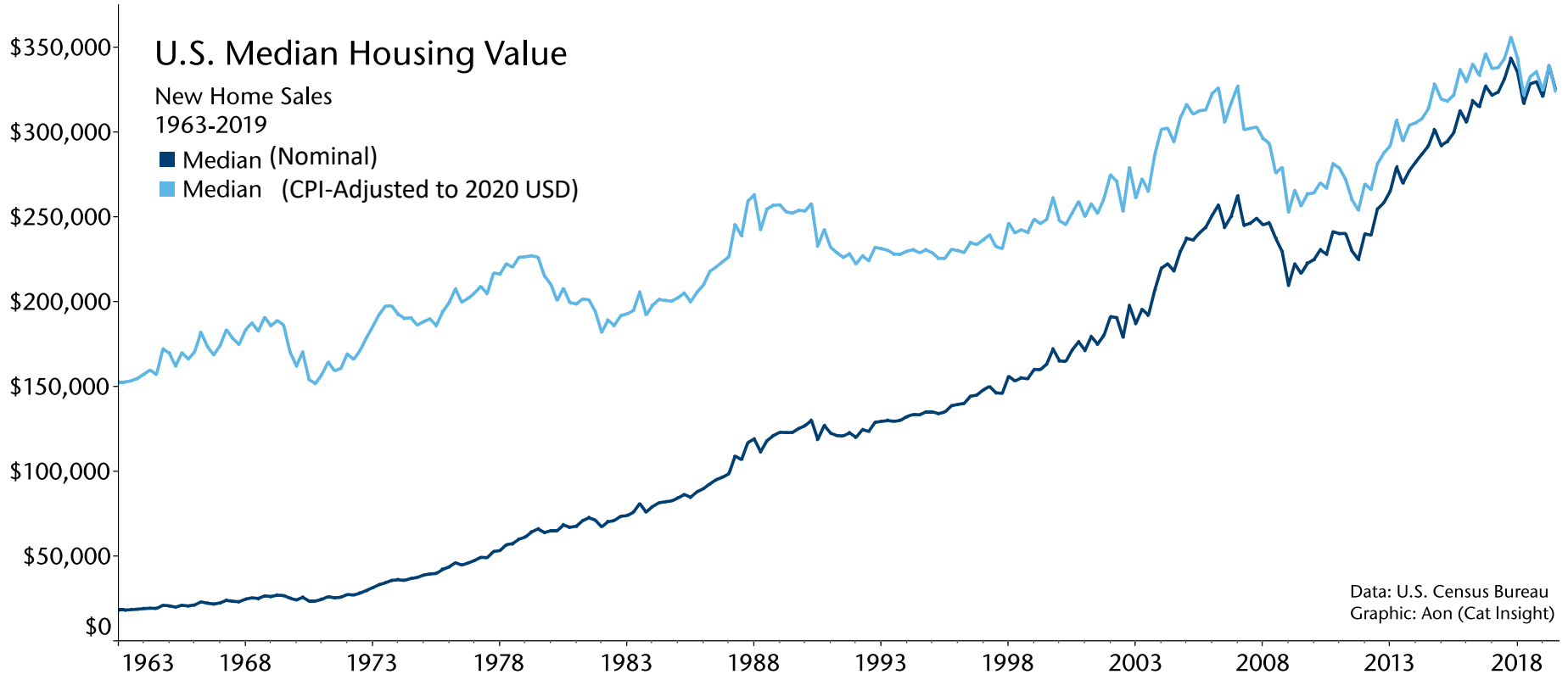
Expanding Population. More Exposure. More Risk...



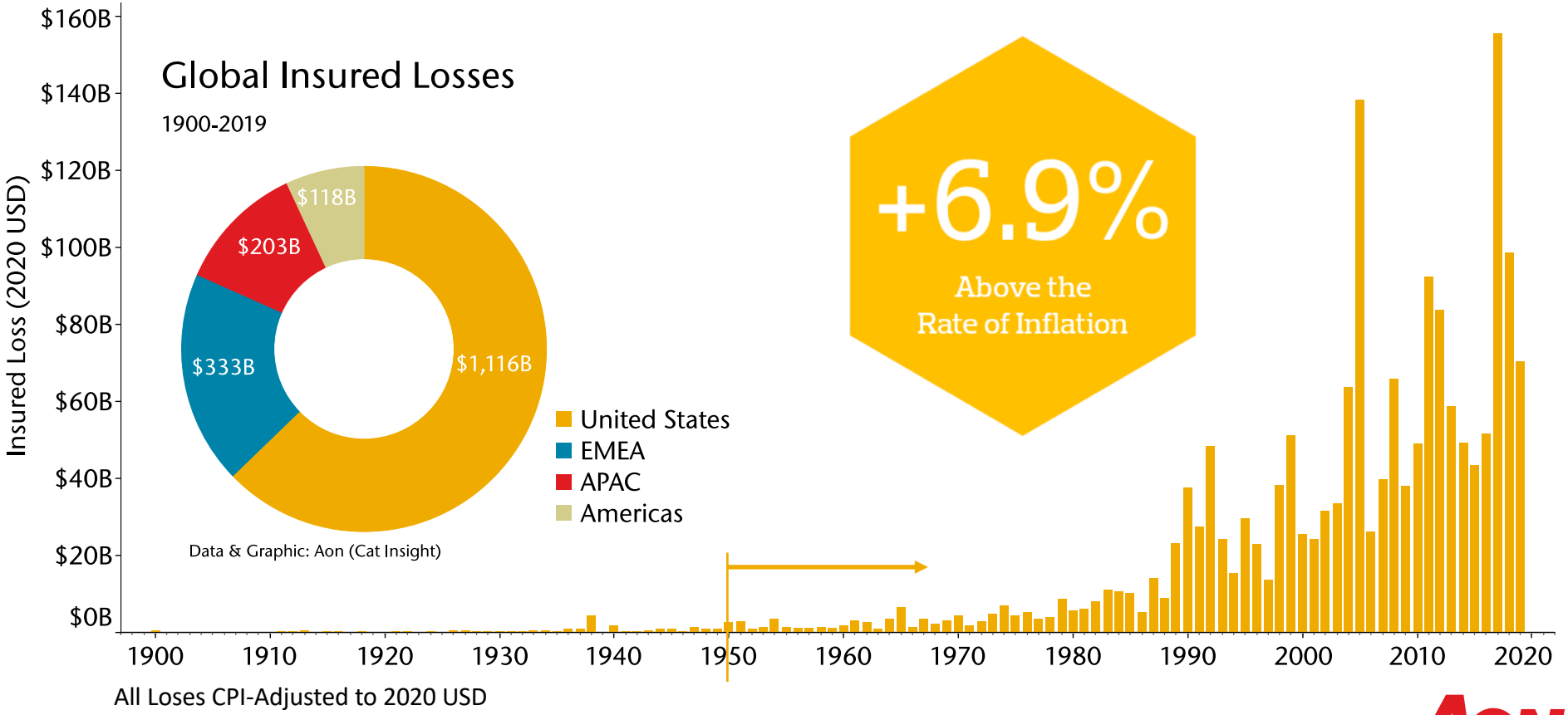
U.S. Housing Units by County
Change Since 1940

Data: U.S. Census Bureau
Graphic: Aon (Cat Insight)

... and Homes are Getting Bigger and More Expensive

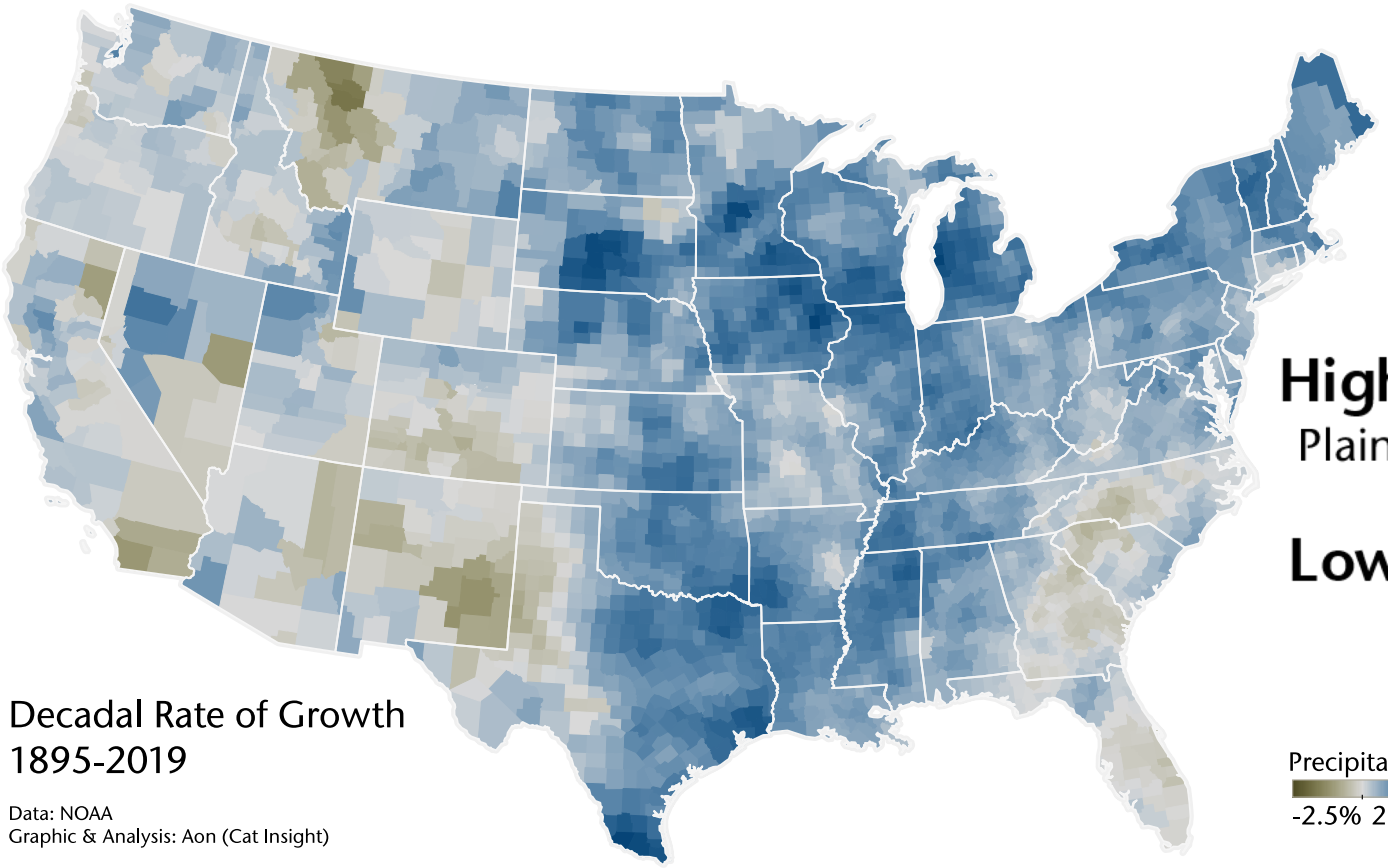


Insured Weather Losses are Increasing




Key Considerations
Driving Weather Loss Trend
AON
Empower Results®

Changing Precipitation Patterns



Decadal Rate of Growth
1895-2019

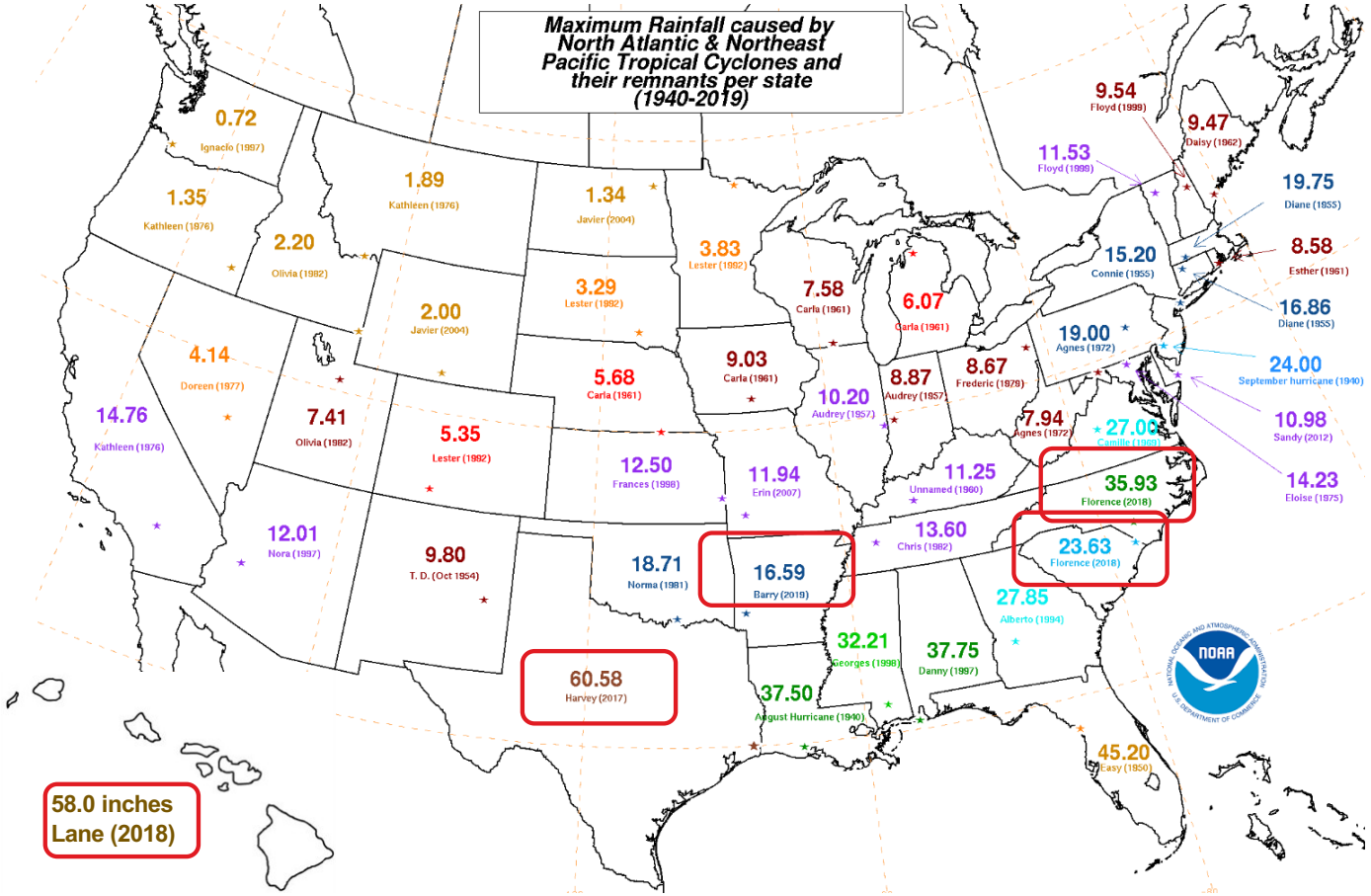
Data: NOAA
Graphic & Analysis: Aon (Cat Insight)

Higher Precipitation
Plains, Midwest, Northeast

Lower Precipitation
West, Southeast

Precipitation
-2.5% 2.5%

Changing Precipitation Patterns: Tropical Cyclone Rainfall

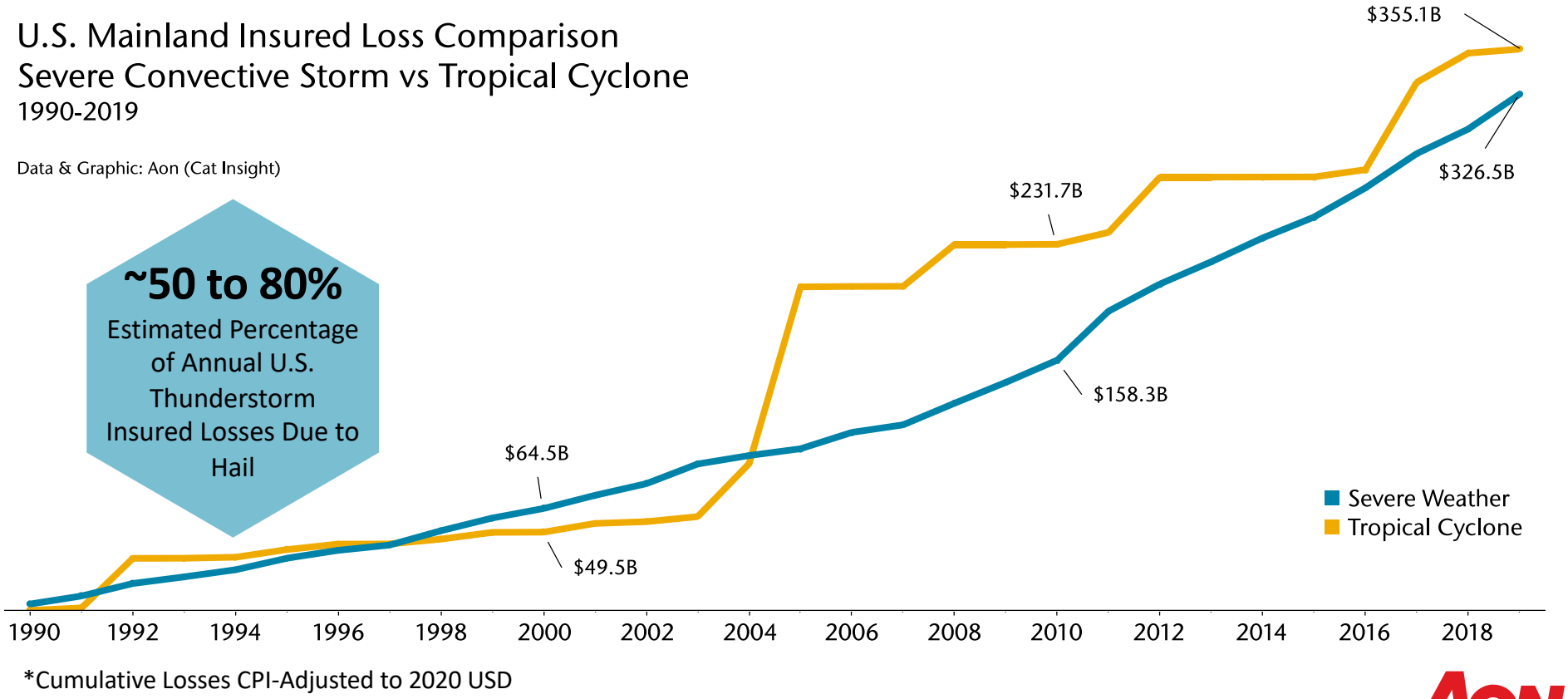


2017-2019
Tropical Cyclone Rainfall Records set in 5 States

60.58 in
Harvey (2017) sets all-time TC rainfall record for the U.S.

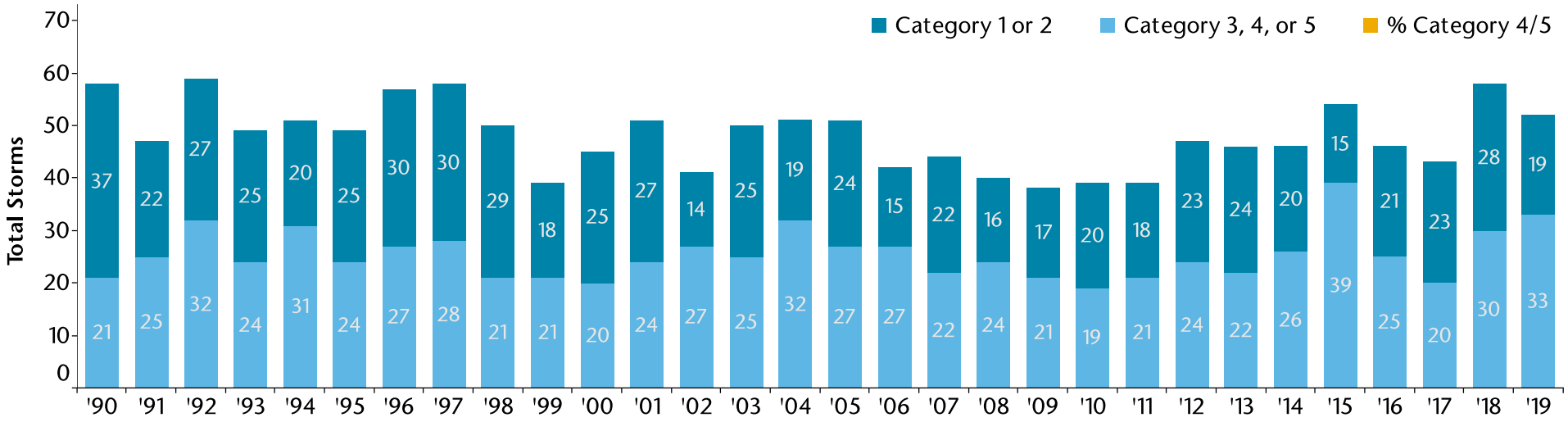
4 of Top 5
Tropical Cyclone Rainfall Records Occurred in Texas

Costlier for Insurers in the U.S. – SCS or Tropical Cyclone?

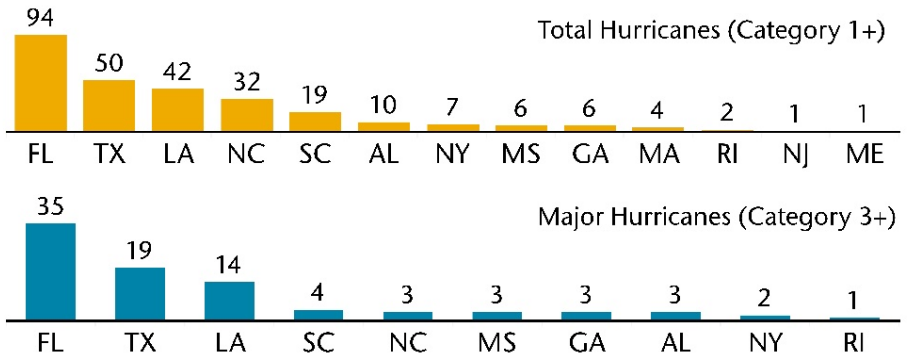


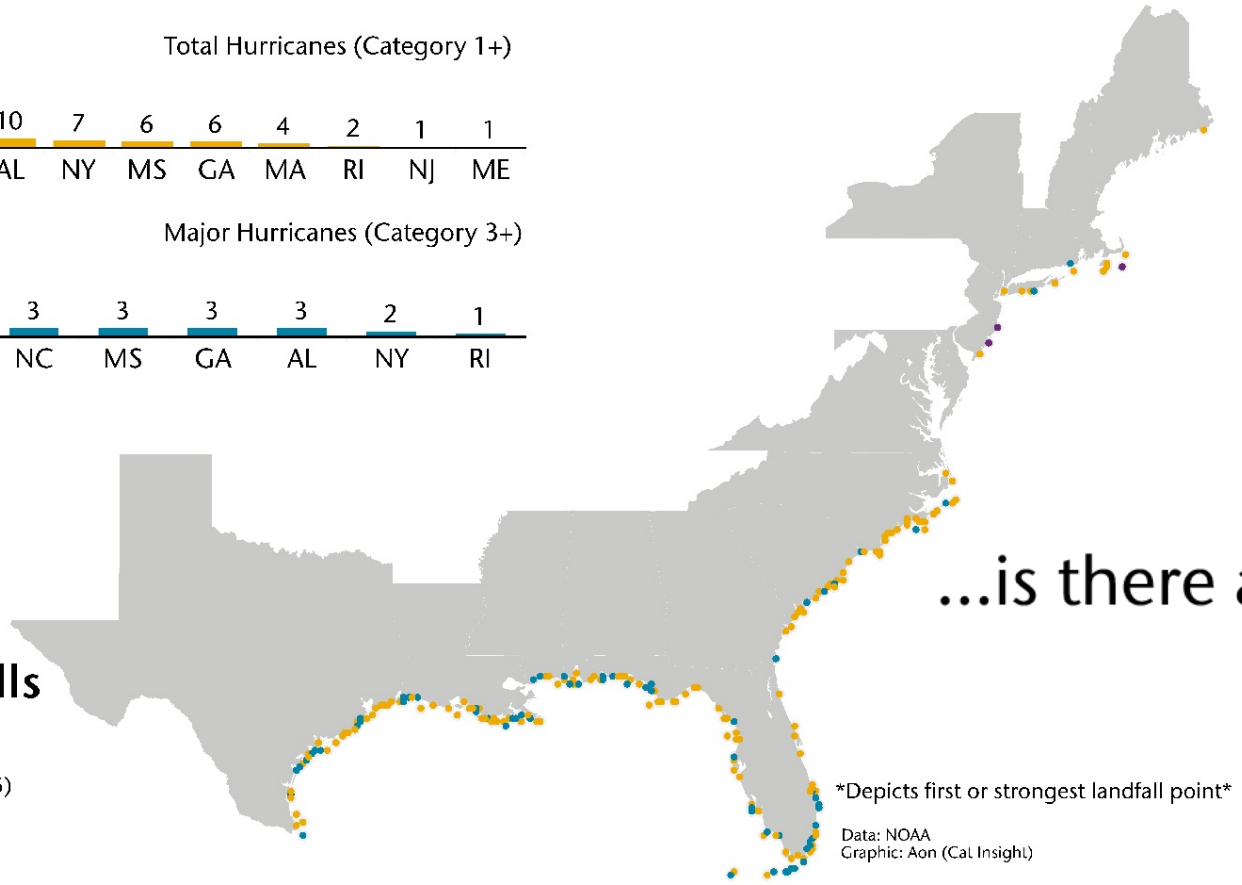
*Cumulative Losses CPI-Adjusted to 2020 USD

Global Tropical Cyclones



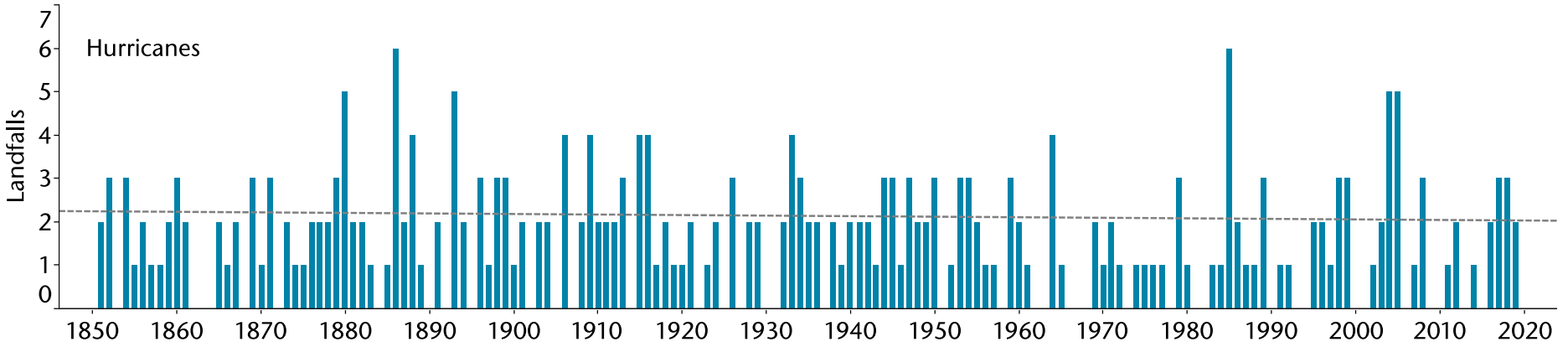
U.S. Mainland Hurricane Landfalls



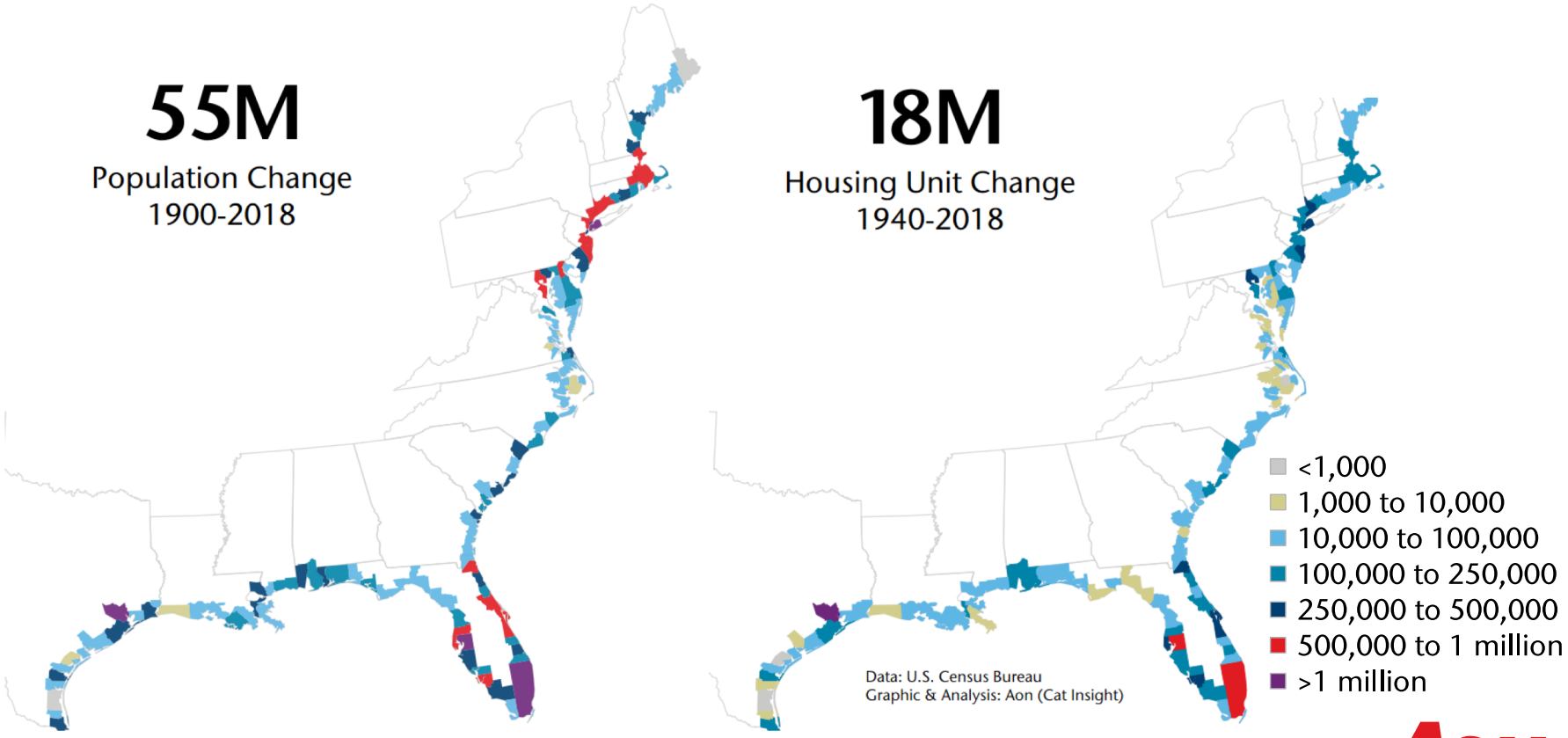


...is there a trend?

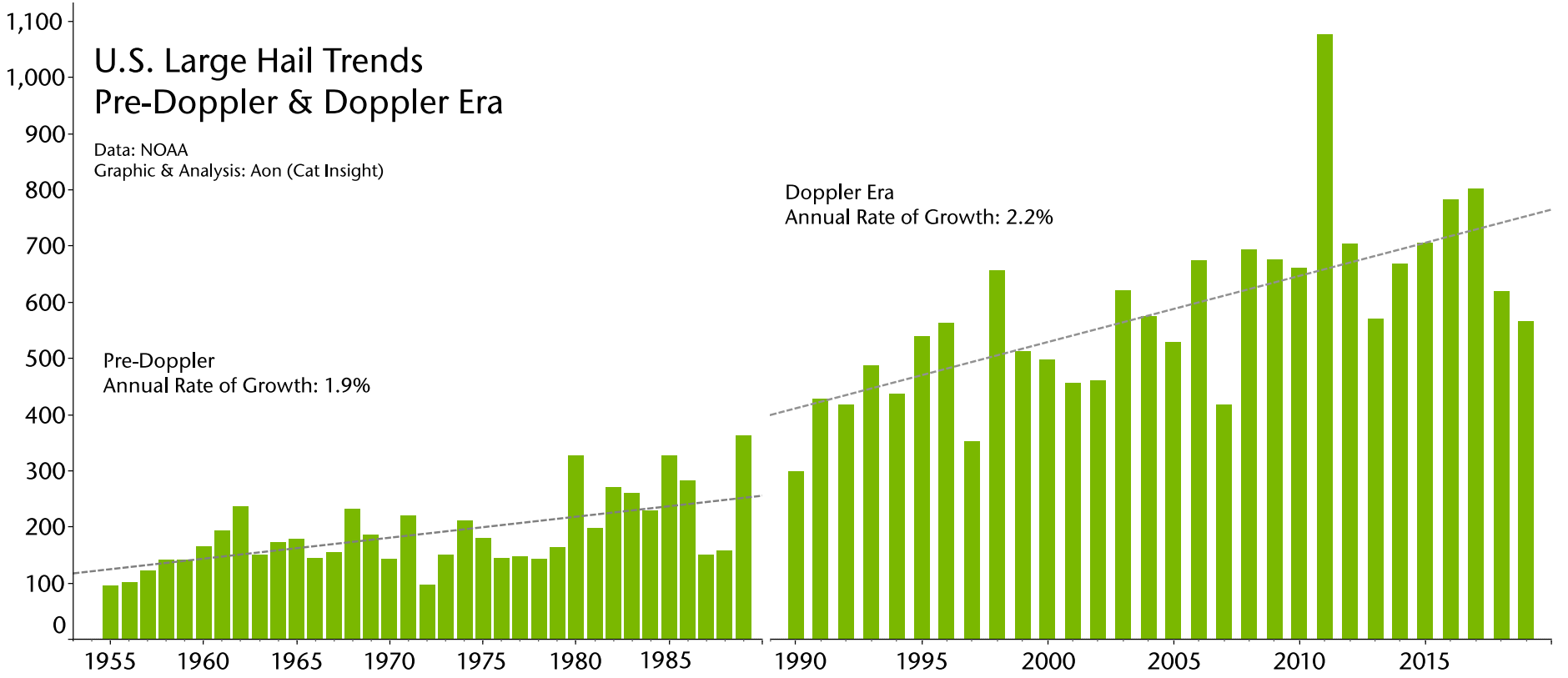
U.S. Mainland Hurricane Landfalls



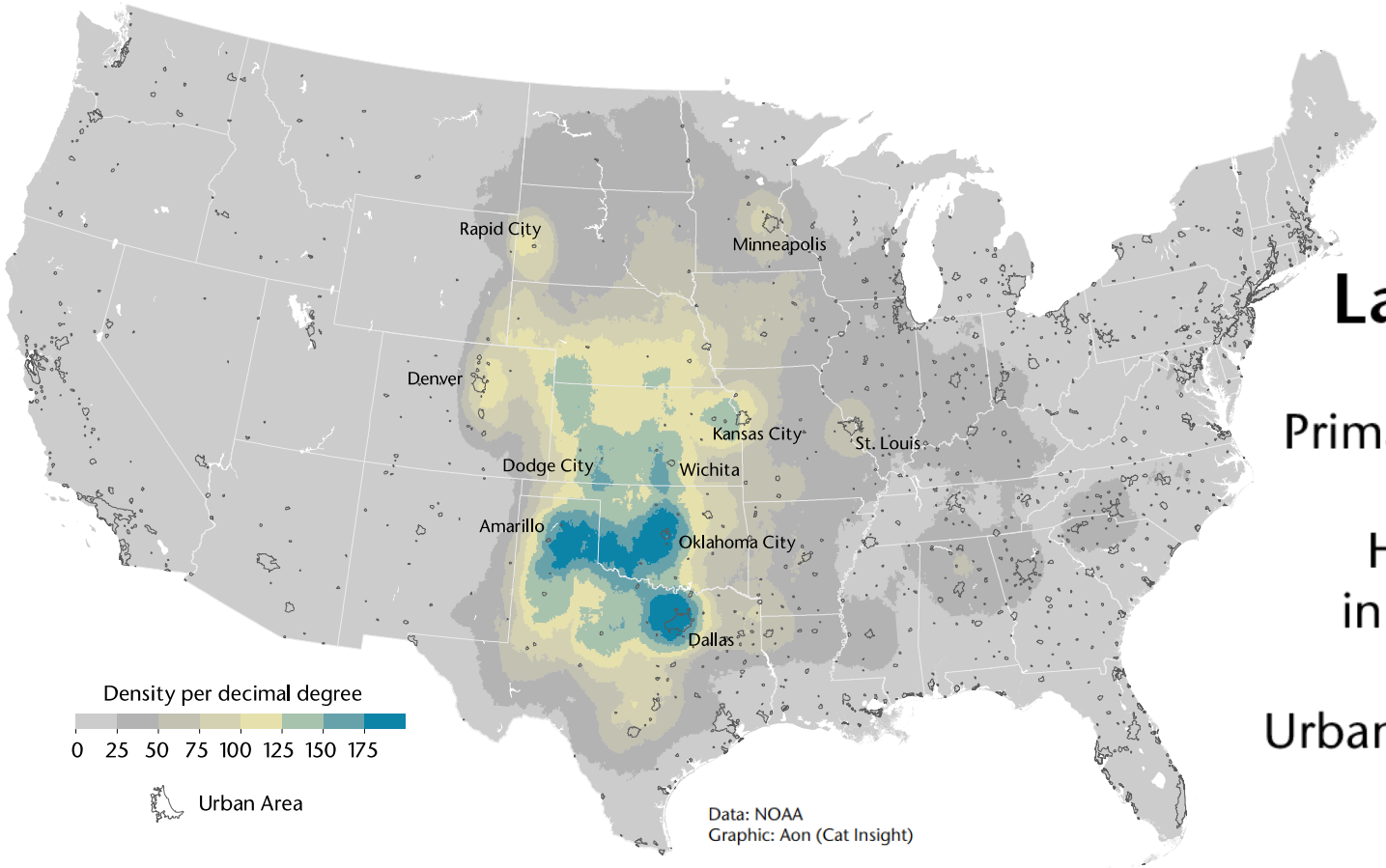
Socioeconomic Factors Increasing Hurricane Risk



U.S. Large Hail (2”+) Trends



Hail: Dominant Driver of Thunderstorm Impacts



Large Hail: 2″+

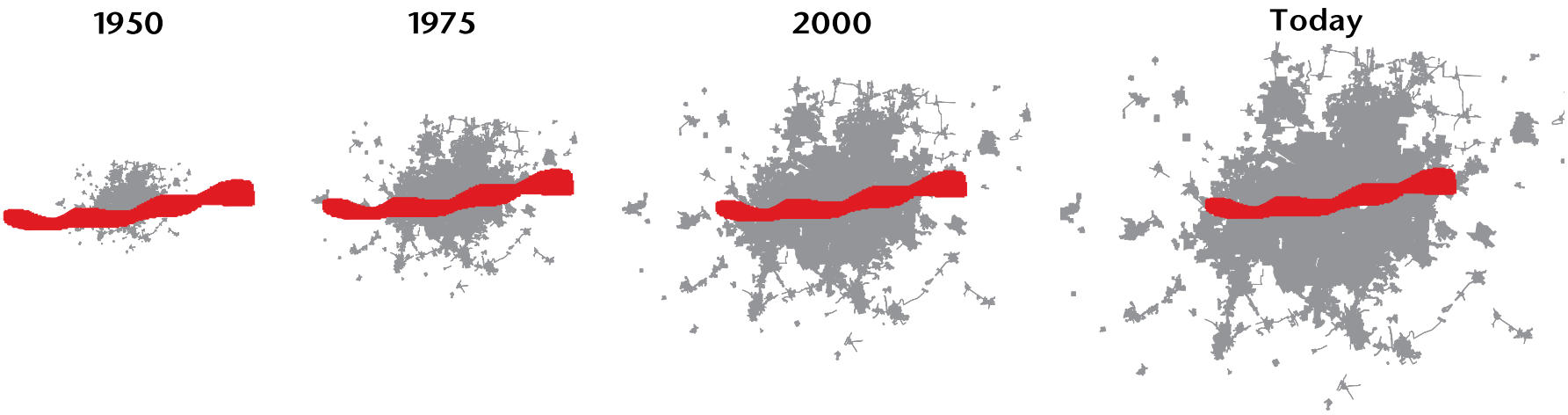
Primary Driver of SCS Loss

Highest Frequency
in Major Metro Areas

Urban Bias in NOAA Dataset

Socioeconomic Impact of Expanding Urban Footprints: Hail

Dallas - Fort Worth, Texas Metroplex

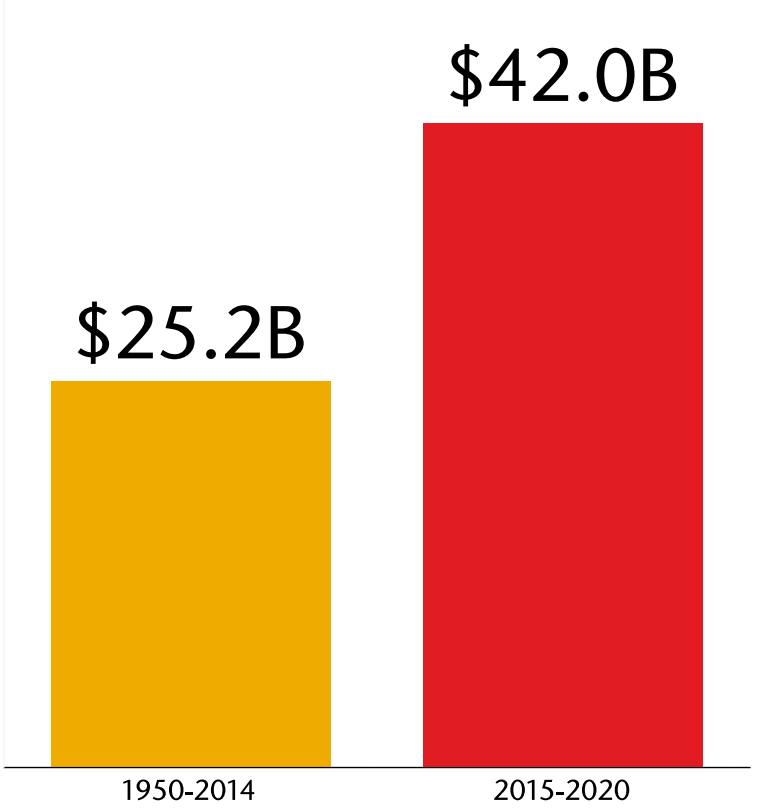


1950	1975	2000	Today
Housing Units: 403K	Housing Units: 1.01M	Housing Units: 2.01M	Housing Units: 2.82M
Pop: 1.25M	Pop: 2.65M	Pop: 5.19M	Pop: 7.47M

*Totals include Collin, Dallas, Denton, Ellis, Hunt, Johnson, Kaufman, Parker, Rockwall, Tarrant, and Wise counties

Based on work by Ashley, et al (2014) Data: U.S. Census Bureau Graphic: Aon (Cat Insight)

Wildfires: A Growing Risk

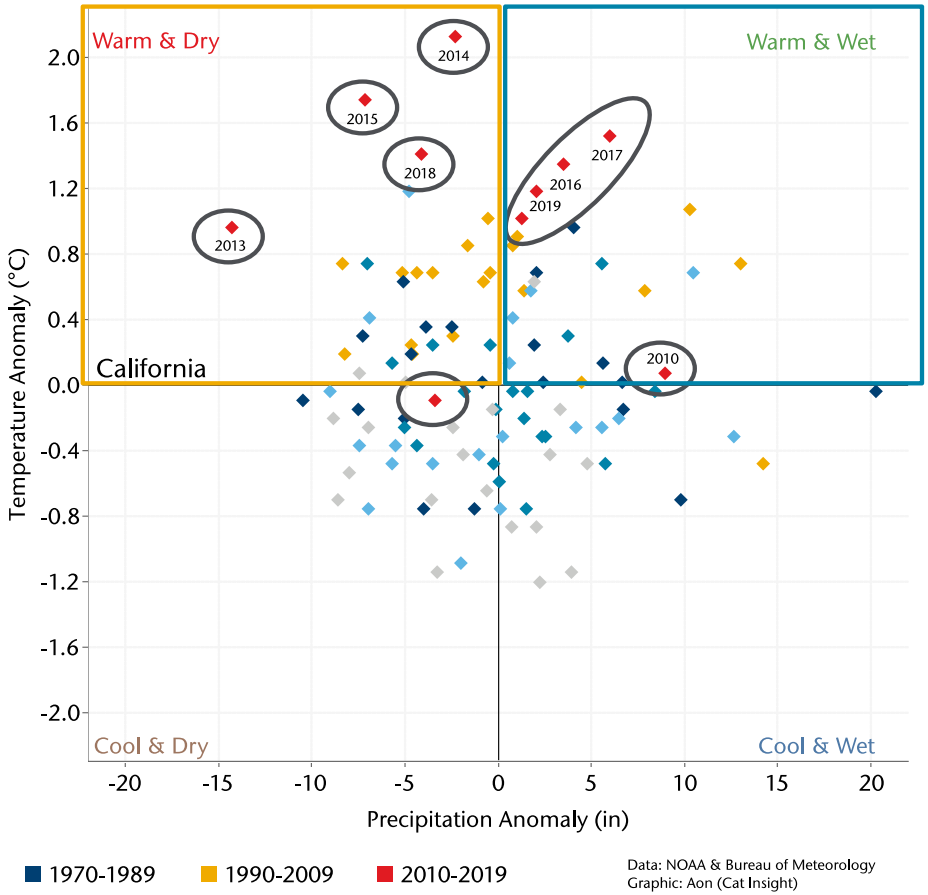


Insured Losses CPI-Adjusted to 2020 USD

9 of 14
Events have Occurred Since 2015

Losses in 2020 USD
Data & Graphic: Aon (Cat Insight)

Extended Fire Seasons



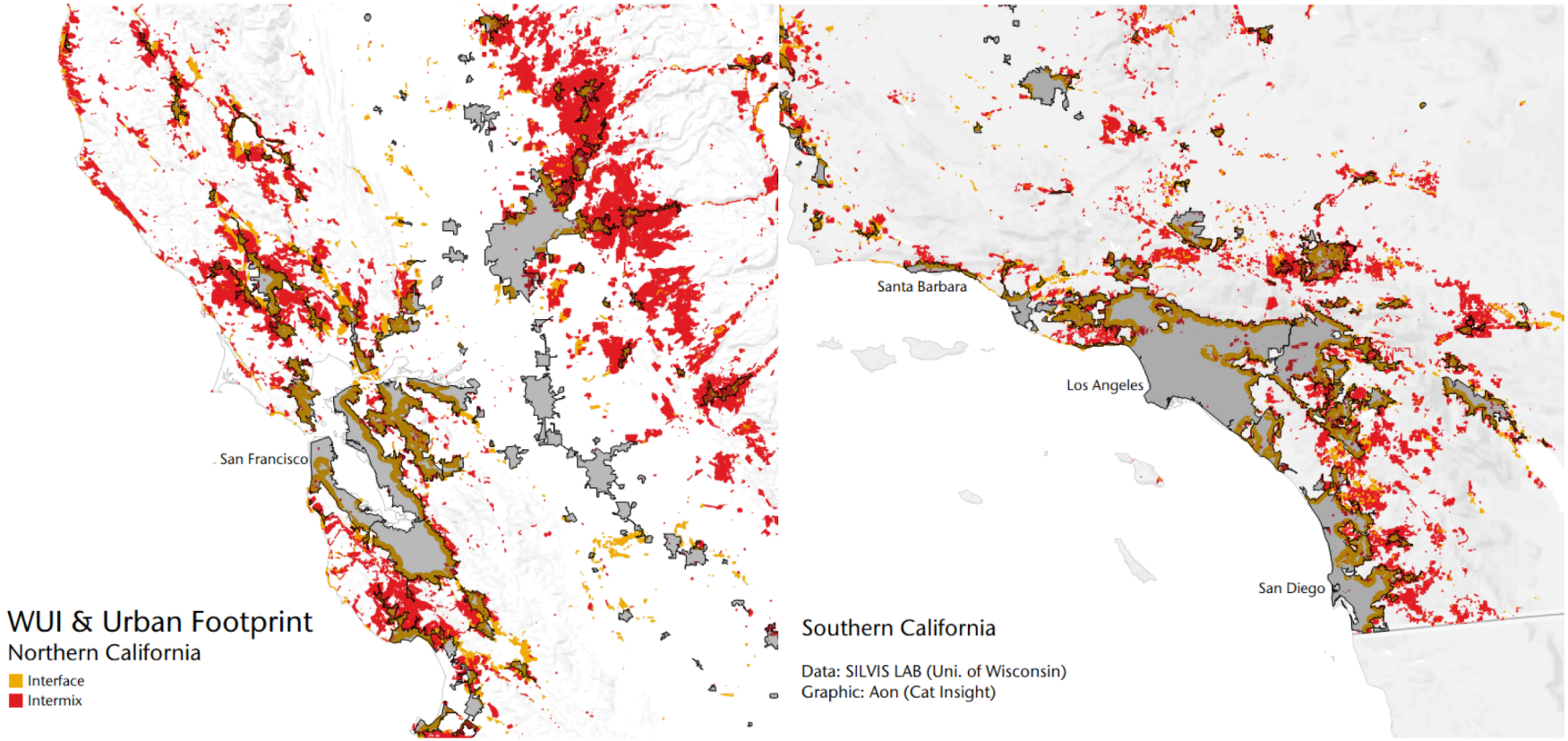
Data: NOAA & Bureau of Meteorology
Graphic: Aon (Cat Insight)

9 of Last 10
Years with
Above Normal
Temperatures

Drier Conditions
Yield Higher
Combustible
Fuel Load

Wetter
Conditions Yield
Pre-Season
Fuel Growth

Socioeconomic Impact of Expanding Urban Footprints: Wildfire



More Risk!

More People & Property in Highly Vulnerable Areas

Combination of More Intense Events & More "Stuff" in Harm's Way? Greater Loss Potential

Socioeconomic Factor are Predominant Driver of Increased Natural Disaster Losses

Insurance is…

… getting better at acknowledging the reality of climate change.

… utilizing new scenario-based tools to analyze the risk, such as catastrophe models and the latest from the growing insurtech industry.

… working to identify and quantify changes to its business framework in order to adequately price for climate change risk.

Contact Information

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4th National Climate Assessment Report (2018)
https://nca2018.globalchange.gov/downloads/NCA4_2018_FullReport.pdf

MAY 12, 2020
CAS SPRING MEETING:
ACI/ACRI UPDATE

Rich Gibson, Senior Casualty Fellow, MAAA, FCAS

ACI/ACRI—Basics

- Climate risk continues to be an important public policy issue
- Actuaries are making an impact

- ACI – Actuaries Climate Index
- ACRI – Actuaries Climate Risk Index

POLLING QUESTION

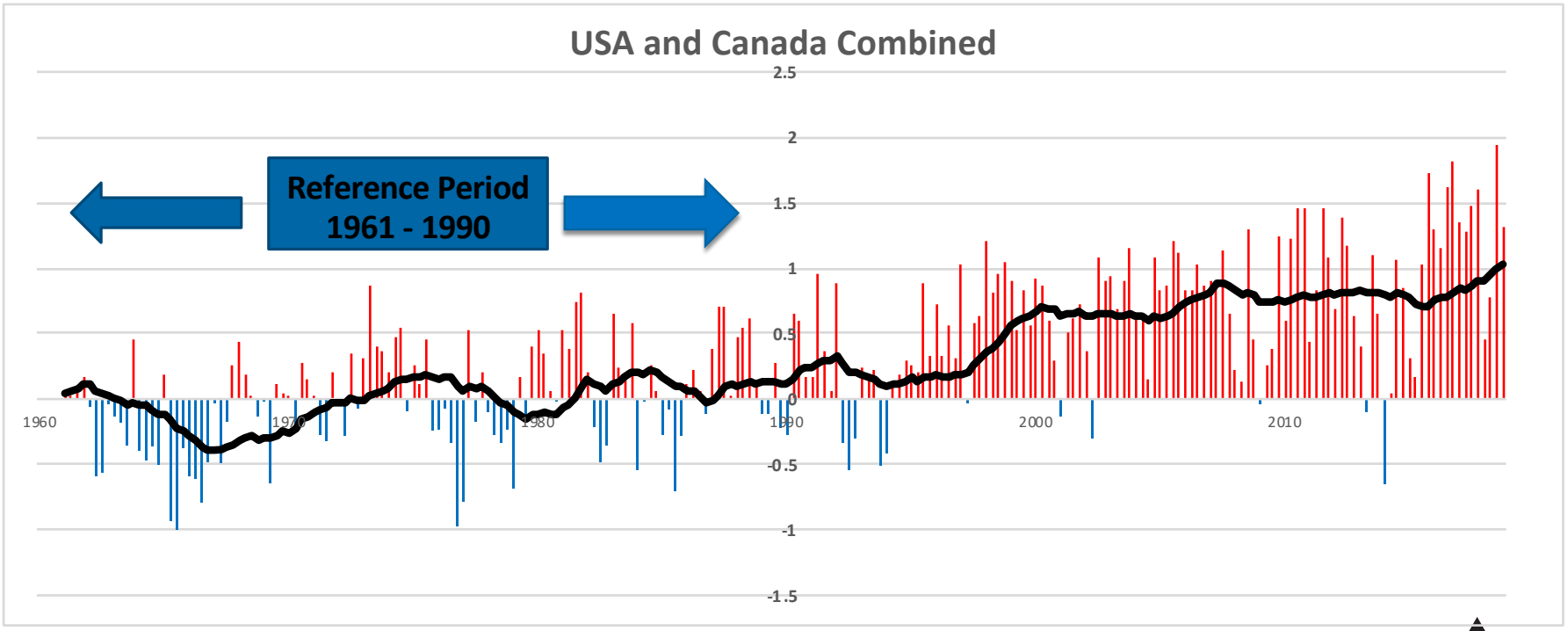
Has your company used the ACI or ACRI in Marketing, Underwriting or Pricing of property insurance products?

A. Marketing / Underwriting
B. Pricing
C. Marketing / Underwriting and Pricing
D. None
E. Unsure

ACI—Background

- An educational tool providing information about weather trends in the United States and Canada, updated quarterly
- Retrospective analysis of data as opposed to a forecast of future trends
- Covers rainfall, temperature, dry spells, wind speed, and sea level
- Breaks U.S. and Canada into 12 regions, and analyzes each region separately
- Spans the period from 1961 to the present, with 1961–90 as a reference period
- Foundation for Actuaries Climate Risk Index

Actuaries Climate Index® (ACI), 1961–2018: reveals increasing frequency of extreme weather



ACI—Components

- Six component:
  - Warm temperature index
  - Cool temperature index
  - Extreme precipitation index
  - Consecutive dry days
  - Extreme wind index
  - Sea level index
- Combined to form the ACI

U.S./Canadian Actuarial Associations Responsible for the Actuaries Climate Index

American Academy of Actuaries
Objective. Independent. Effective.™

Canadian Institute of Actuaries / Institut canadien des actuaires

CAS

Society of Actuaries 1949

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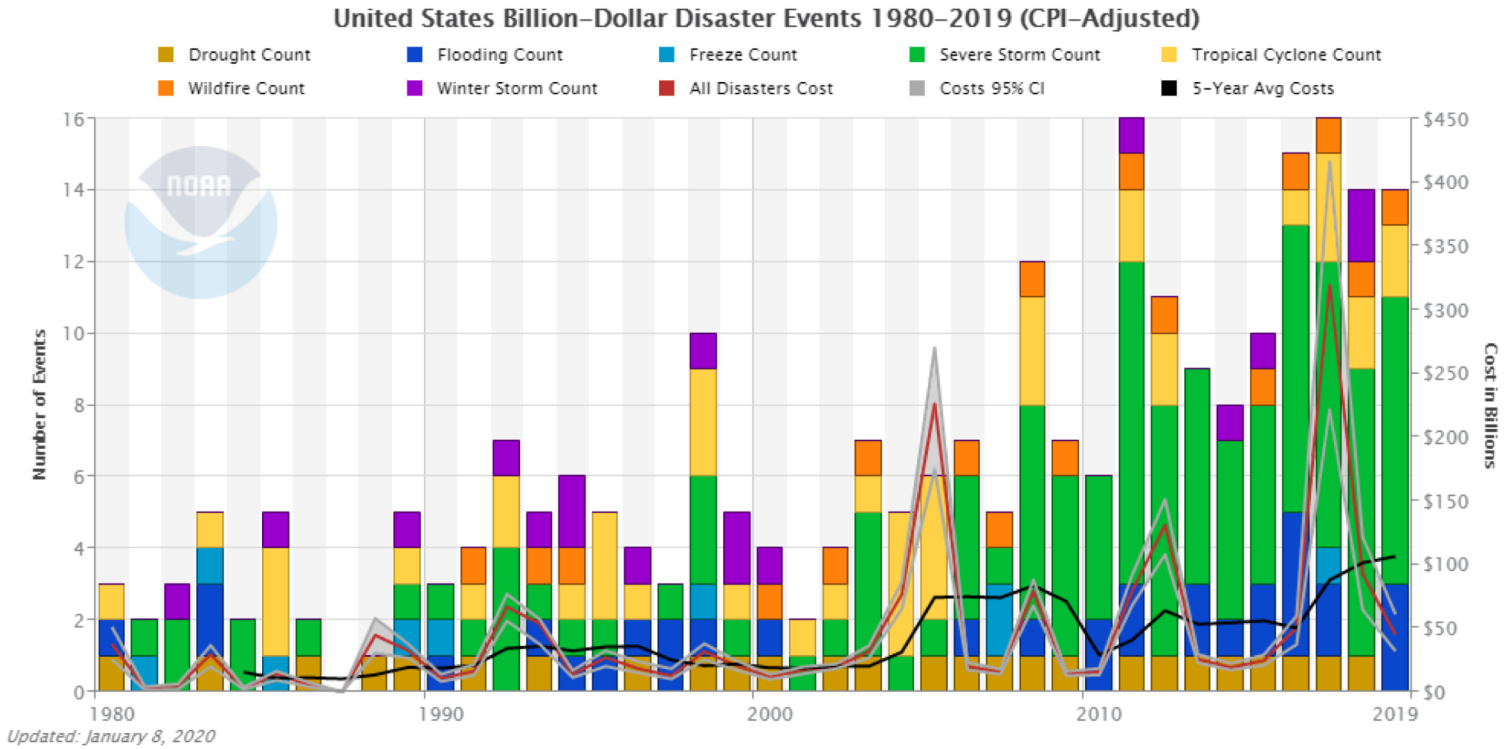
ACI Climate Regions:
Large, Climatologically Heterogeneous

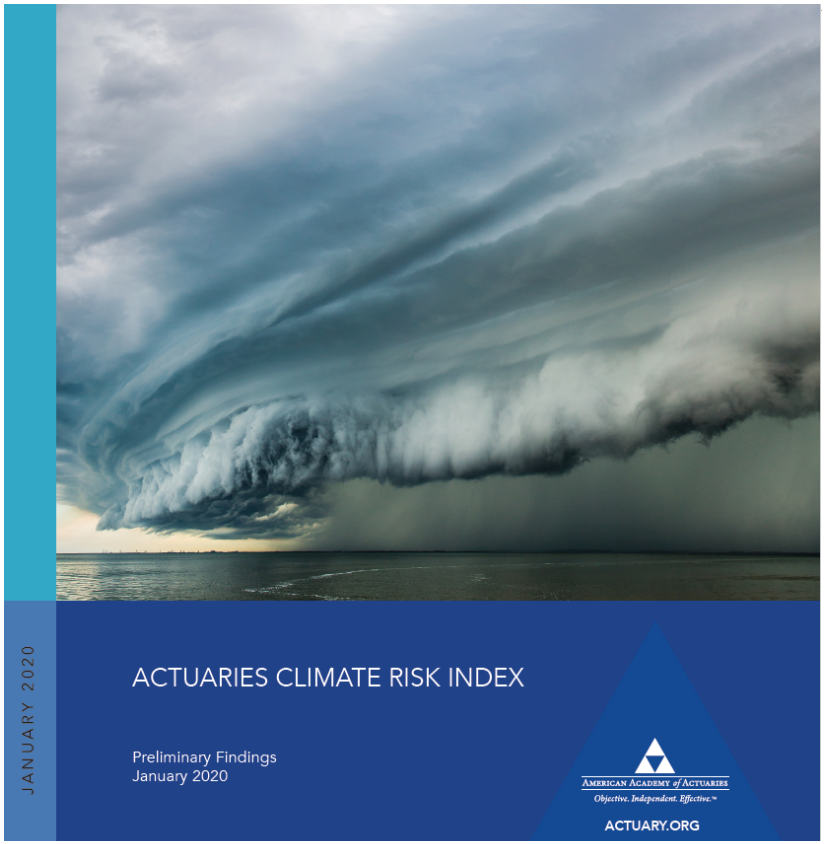
Region Name	Region
Central Arctic	**CAR**
Northeast Atlantic	**NEA**
Northeast Forest	**NEF**
Northern Plains	**NPL**
Northwest Pacific	**NWP**
Alaska	**ALA**
Central East Atlantic	**CEA**
Central West Pacific	**CWP**
Midwest	**MID**
Southeast Atlantic	**SEA**
Southern Plains	**SPL**
Southwest Pacific	**SWP**

Frequency of Billion-Dollar Weather Events in United States Increasing, 1980–2016



Source: https://www.ncdc.noaa.gov/billions/time-series, accessed March 2020

Actuaries Climate Risk Index (ACRI): Preliminary Findings



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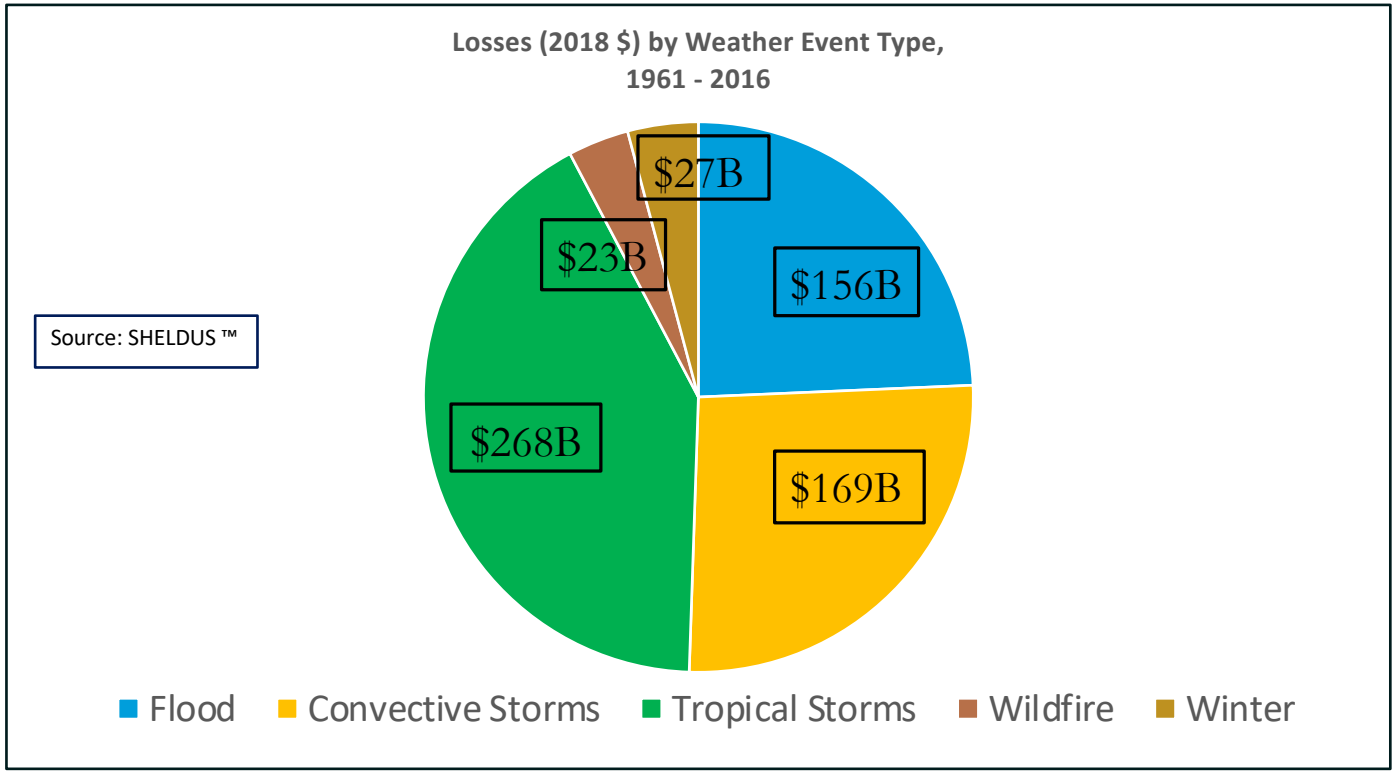
ACRI—Status Update

- ACRI: Preliminary Findings published by American Academy of Actuaries, January 2020
- Estimates relationships between the ACI's weather metrics and weather-related losses; derives ACRI from those estimates
- ACRI 1.0 focuses only on the United States due to data limitations for Canada; uses four of six ACI elements (excludes Drought and Sea Level)

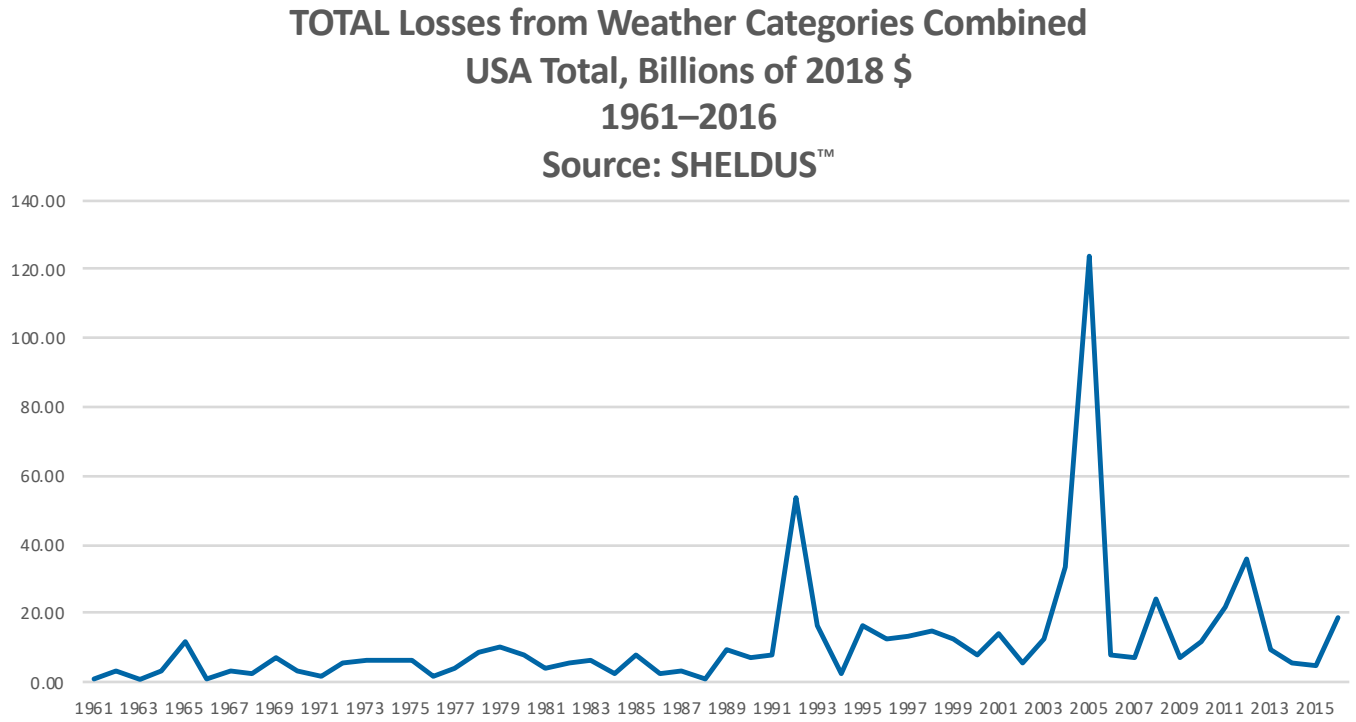
Spatial Hazard Events and Losses Data for the United States (SHELDUS)

- Loss Data from SHELDUS™, Arizona State University
- SHELDUS™ is a county-level hazard data set for the U.S. and covers natural hazards such as thunderstorms, hurricanes, floods, wildfires, and tornados as well as perils such as flash floods, heavy rainfall, etc. The database contains information on the direct losses caused by events (property and crop losses, injuries, and fatalities) from 1960 to present.
- Information primarily derived from National Oceanic and Atmospheric Administration (NOAA) Storm Event Monthly Reports which, since 1996, are included in the NOAA Storm Events database.

Losses by Weather Categories, 1961–2016



Weather-Related Losses Combined, 1961–2016: increasing



Imprecise Models Convey Insight

"Methods used to estimate the potential economic effects of climate change in the United States … and the studies that use them produce imprecise results because of modeling and other limitations but can convey insight into potential climate damages across sectors in the United States."

GAO 17-720, "Climate Change," September 2017

Greatest Contributor to Increased Cost Is Rising Exposure

"Economic costs of extreme weather events have increased over the period 1960–2000. … However, the greatest contributor to increased cost is rising exposure associated with population growth and growing value of assets."

IPCC, 2014: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects.*

ACRI: Conclusion

- While others find likely large losses due to changes in weather by end of 21st century, little loss yet when controlling for changes in exposure. We find small increases in loss likely already occurred, 1991–2016 (~5% of total weather-related losses).
- We also find substantial uncertainty in these estimates.
- Challenges prompting us to version 2.0.

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Climate Change Context & IFoA Practical Guide for GI Practitioners

James Orr

Member of '*GI Practical Guide*' Working Party

POLLING QUESTION

Do you believe that your company has appropriately considered climate change issues for 1) today and 2) in the future?

A. Yes for today, Yes for the future

B. Yes for today, No for the future

C. No for today, Yes for the future

D. No for today, No for the future

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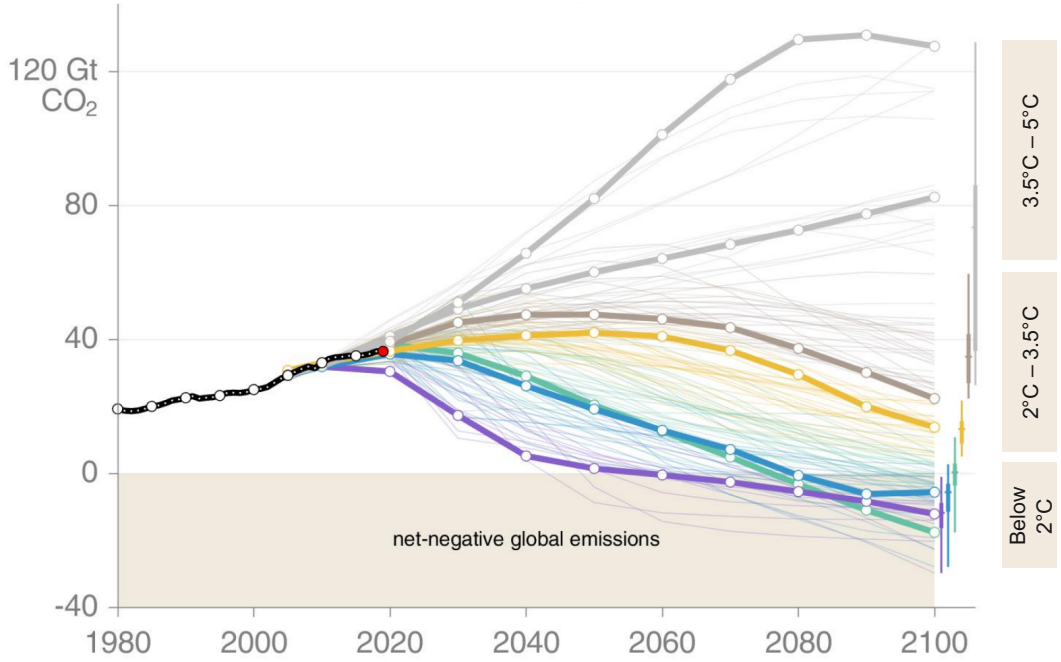
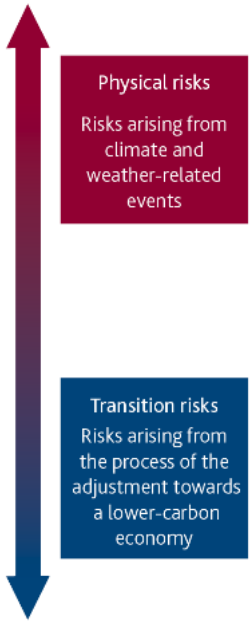
The Financial Risks from Climate Change are different: Far-reaching, foreseeable, for action today





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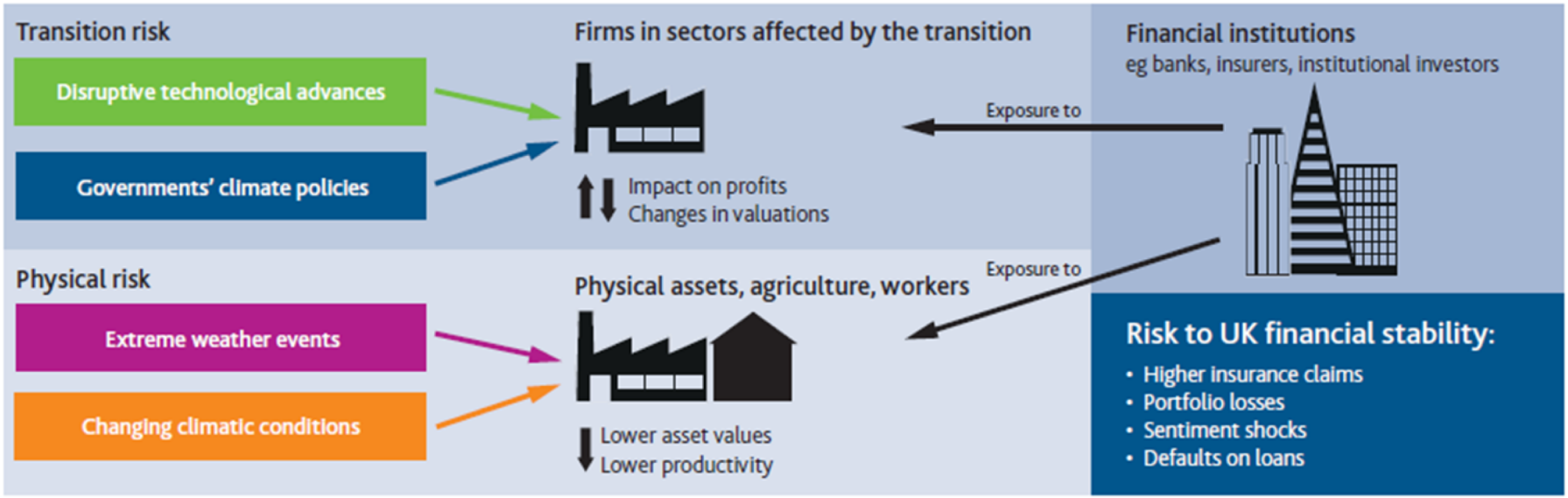
Climate Change brings Financial Risks



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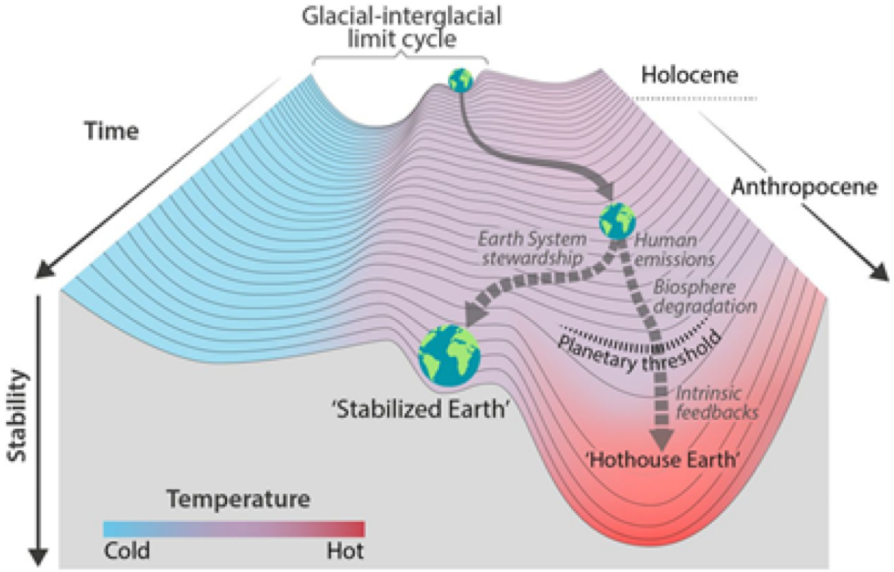
Avoiding a "*Hothouse Earth*"



"Precisely where a potential planetary threshold might be is uncertain. We suggest 2°C because of the risk that a 2°C warming could activate important tipping elements, raising the temperature further to activate other tipping elements in a domino-like cascade that could take the Earth System to even higher temperatures (Tipping Cascades). Such cascades comprise, in essence, the dynamical process that leads to thresholds in complex systems." (Steffen, et al., 2018)

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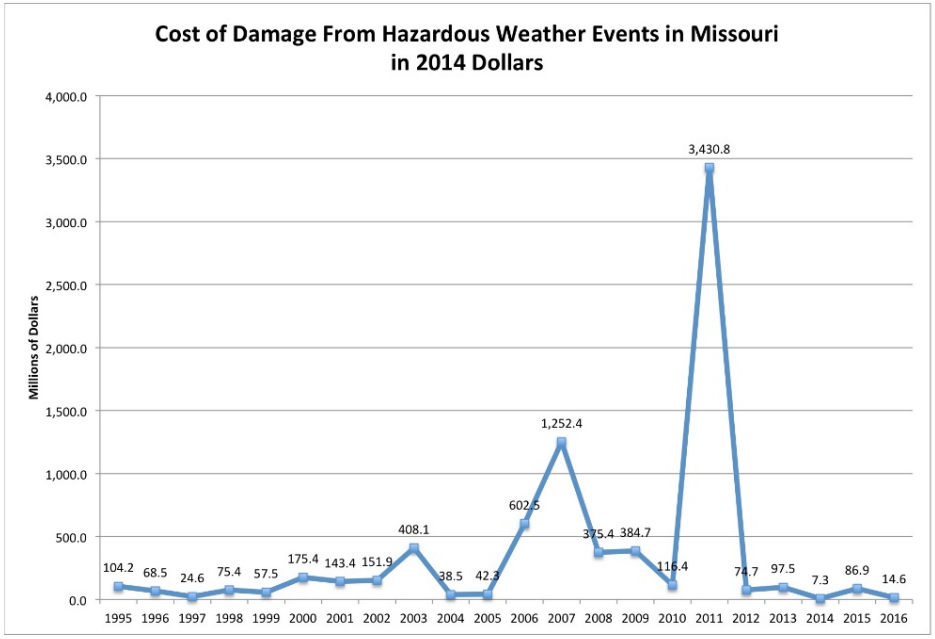
Pricing needs to think beyond the annual renewal…

Experience and exposure rating are both reliant on extrapolating past trends…

> "It may be tempting to assume that slow gradual changes in the climate will be experienced and only small differences in premiums will be needed to reflect these changes. However, acute physical risks include changes in the frequency of large cat events, where trends are difficult to identify."
>
> *Practical Guide to Climate Change for GI Practioners*

Pricing practitioners may need to think about:

- how climate change influences past data,
- the likely impact it has on trends, and
- the outlook for the future



Source: mogreenstats.com

Pricing for catastrophe risk

"Pricing practitioners may use catastrophe models to inform their assumptions about the incidence, expected value and potential variability of losses from catastrophe events. Practitioners may consider the range of climate change risks and the degree to which they are considered within the calibration of those models. Similarly, there may be new risks emerging outside the scope of the catastrophe models being used. For example, climate change may create new wildfire and subsidence risks in areas previously considered low risk, due to changed precipitation patterns including the occurrence of prolonged dry spells."

Practical Guide to Climate Change for GI Practitioners

Image: By Tobin - [1], CC BY-SA 2.0, https://commons.wikimedia.org/w/index.php?curid=

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Reserving for chronic and acute physical risks

What existing chronic (high frequency) or acute (high impact) weather- and climate-related drivers of insurance claims might be affected by climate change? For example:

- will freeze-related claims frequencies on household and motor policies reduce or lie within a wider range?
- will the incidence and extent of flooding or windstorm events increase with changed weather patterns, or will there be an increased tendency for clustering of events?
- are there any leading indicators, based on physical (weather and climate) rather than financial (claims) data, that could provide more insights?
- are these physical effects largely short-term in their impact, and therefore less subject to uncertainty beyond the original period of exposure?
- what changes, in response to climate-change, such as changes in agriculture practices and investment in physical resilience, might impact future claims costs?

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Reserving for liability risks

For professional indemnity and other relevant classes, practitioners may need to consider the nature of the exposure:

- are policies on a claims-made or losses-occurring basis, the latter being more exposed to latent claims?
- are there existing court cases, reflected in the current reserves or that are relevant to the existing reserves, that could indicate likely trends for the future?
- applying the three broad liability headings of "failure to mitigate", "failure to adapt" and "failure to disclose" what claims might arise against these business classes?
- for longer tail classes of business, to what extent might the emergence of climate change impacts, say on investors' propensity to sue under Directors & Officers (D&O) policies or for physical asset owners to sue under Architect & Engineer policies, be spread over time and subject to greater uncertainty?

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Investment

General Insurance actuaries may wish to consider the implications of climate change for investment portfolios.

- **Physical Risks** to investment portfolios could include threats to infrastructure or real estate arising from rising sea levels or extreme weather events.
- **Transition Risks** include the possibility of a fall in the value of the shares or debt securities of carbon-intensive companies due to "stranded assets", or legislation to deal with climate change. As "Environmental, Social and Governance" (ESG) investment strategies become more widespread, investors may disinvest from securities issued by carbon-intensive companies, leading to a fall in their price, even if their assets do not actually become "stranded".

Alongside the "downside" risks, there may also be investment opportunities arising – investment in new technologies such as "green energy", new infrastructure or electric cars.

Risk management and capacity building

"Firms would be expected to identify, measure, monitor, manage, and report on their exposure to these [climate-related] risks. Firms should be able to evidence this in the written risk management policy, management information and board risk reports."

PRA SS3/19, 2019

Where understanding, and awareness is lacking, the Risk Management function may need to consider "capacity building" within the business, e.g. providing:

- training,
- guidance,
- case studies, and
- supporting research,

with the aim of building "carbon literacy" and integrating climate change risks within the firm's systems of governance and control.

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Questions

Comments

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