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Climate Change Risk & Insurance

Casualty Actuarial Society:
Casualty Loss Reserve Seminar
Chicago, September 2016

Cynthia McHale, Insurance Program Director, Ceres

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Agenda

1. Climate Change and Extreme Weather
2. Climate Change and US Insurance Regulation
3. Relevance to P&C Products and Underwriting
4. Pricing the Risk of Climate Change
5. Concluding Remarks and Questions

Hartford Courant

July Was Hottest Month On Record

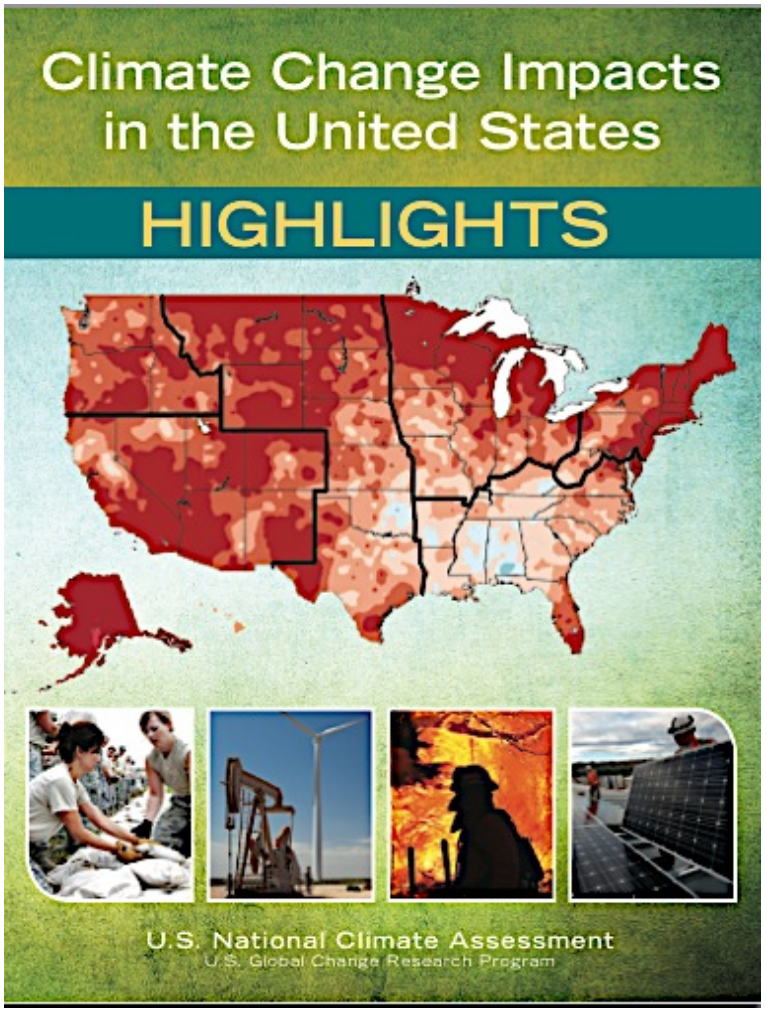
The Hartford Courant

Source: Gregory Hladky, Hartford Courant, August 22, 2016, retrieved online at http://www.courant.com/news/connecticut/hc-the-hottest-july-ever-was-in-2016-20160819-premiumvideo.html

Advancing Our Understanding of the Science of Climate Change

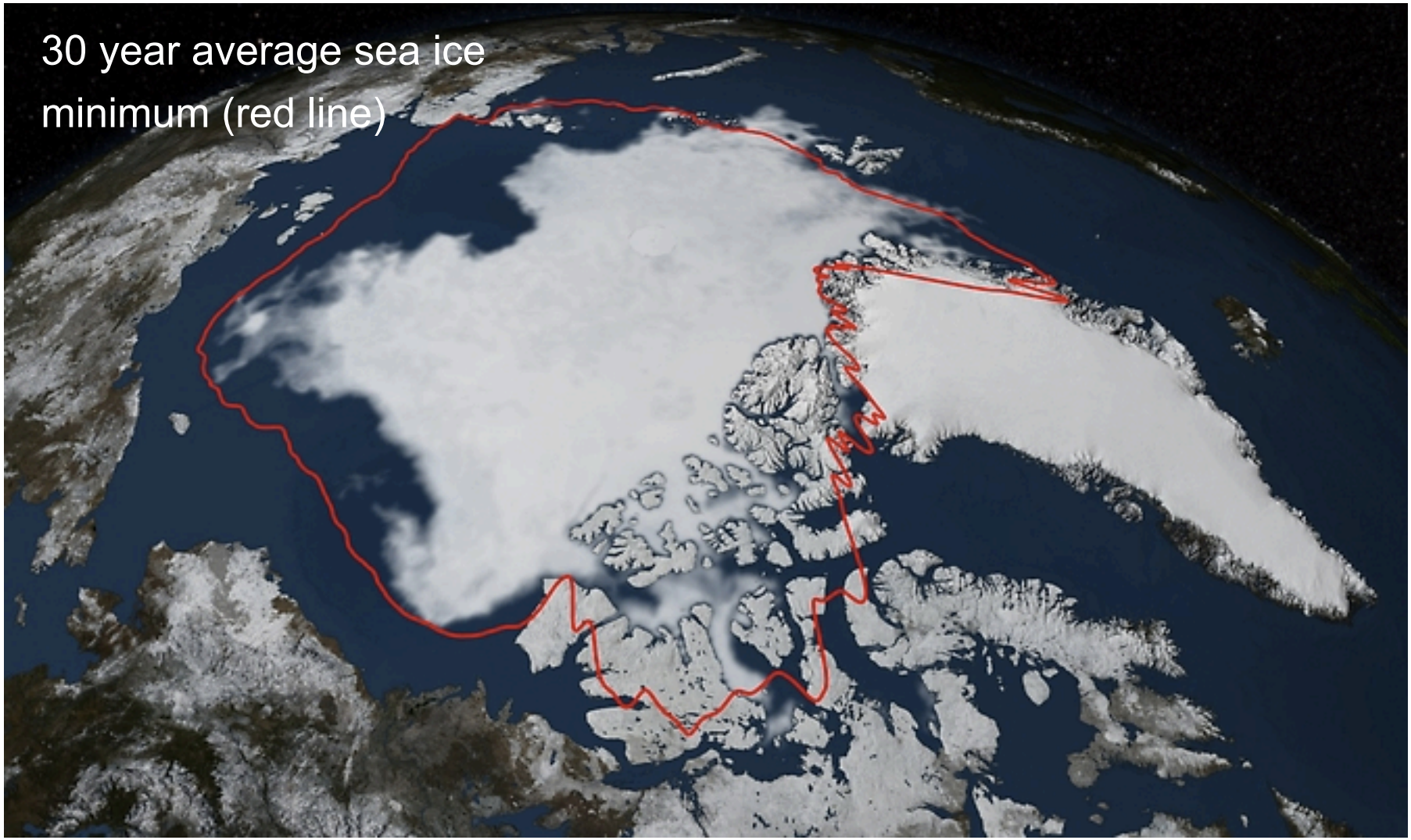
Intergovernmental Panel on Climate Change

US National Climate Assessment



Minimum Arctic Sea Ice Extent

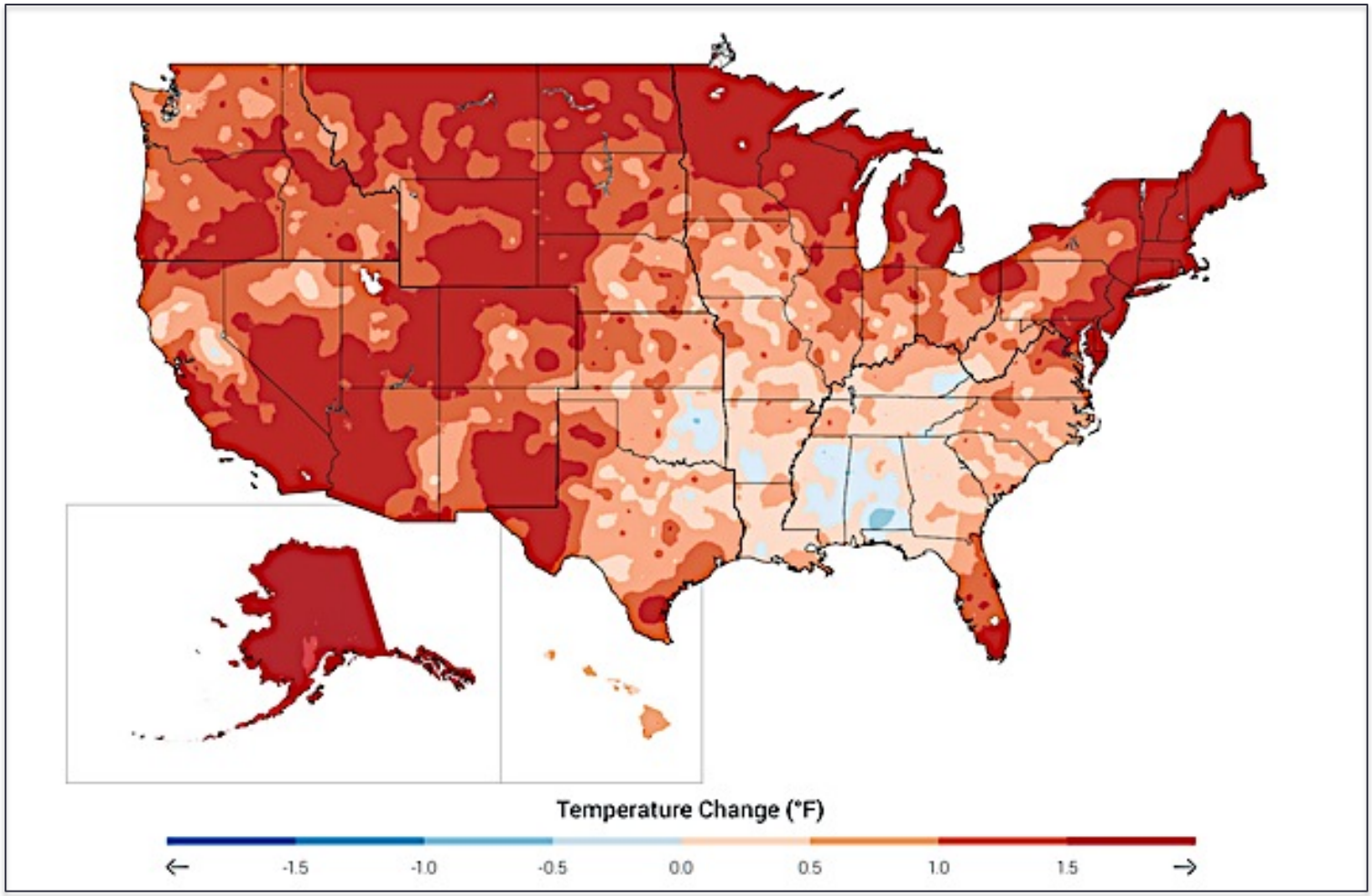
September 17, 2014



Source: NASA/Goddard Scientific Visualization Studio

Observed U.S. Temperature Change

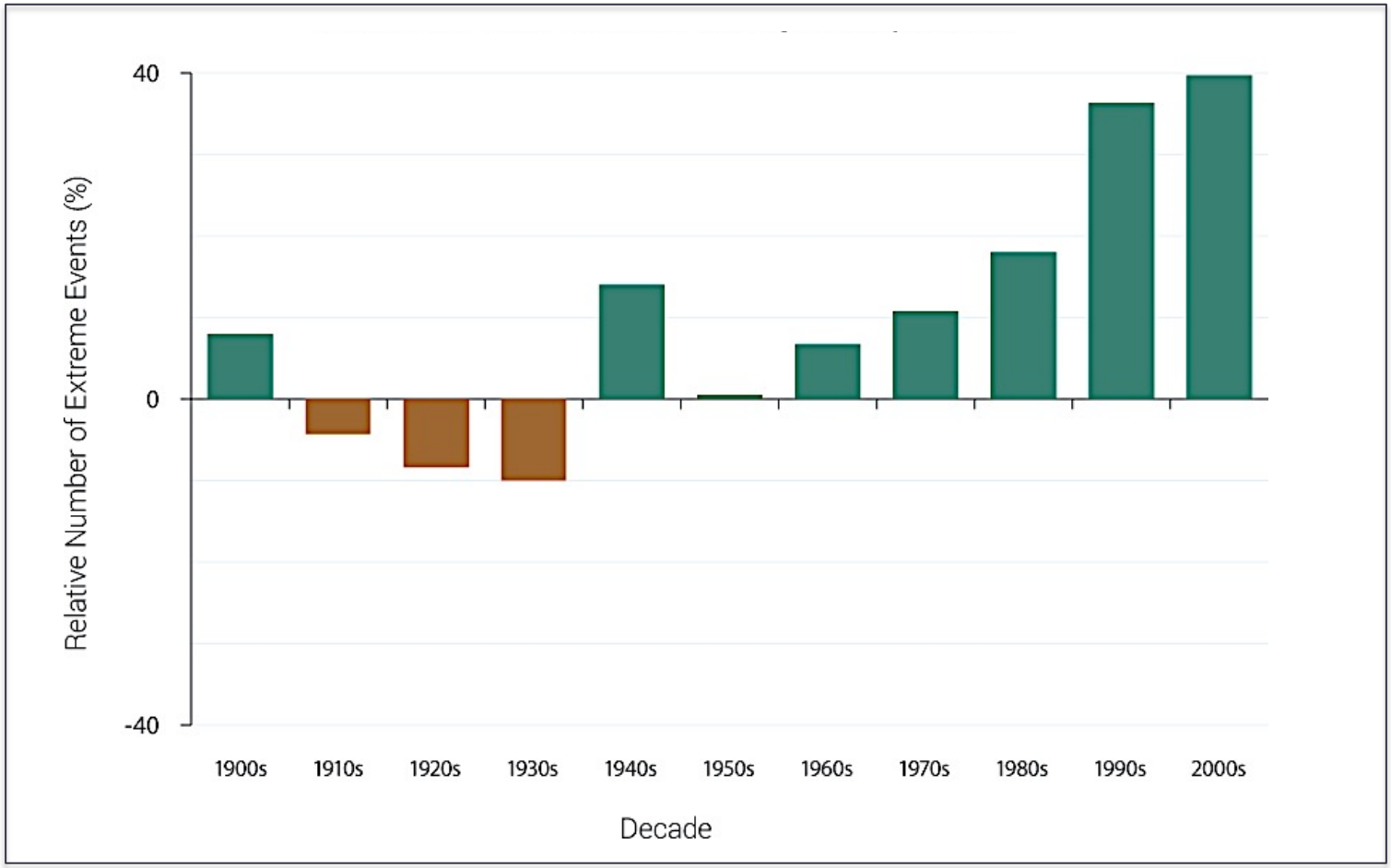
Temperature changes in the past 22 years
(1991–2012 versus 1901–1960 average)



Source: Climate Change Impacts in the United States: The Third National Climate Assessment

Observed U.S. Trend in Heavy Precipitation

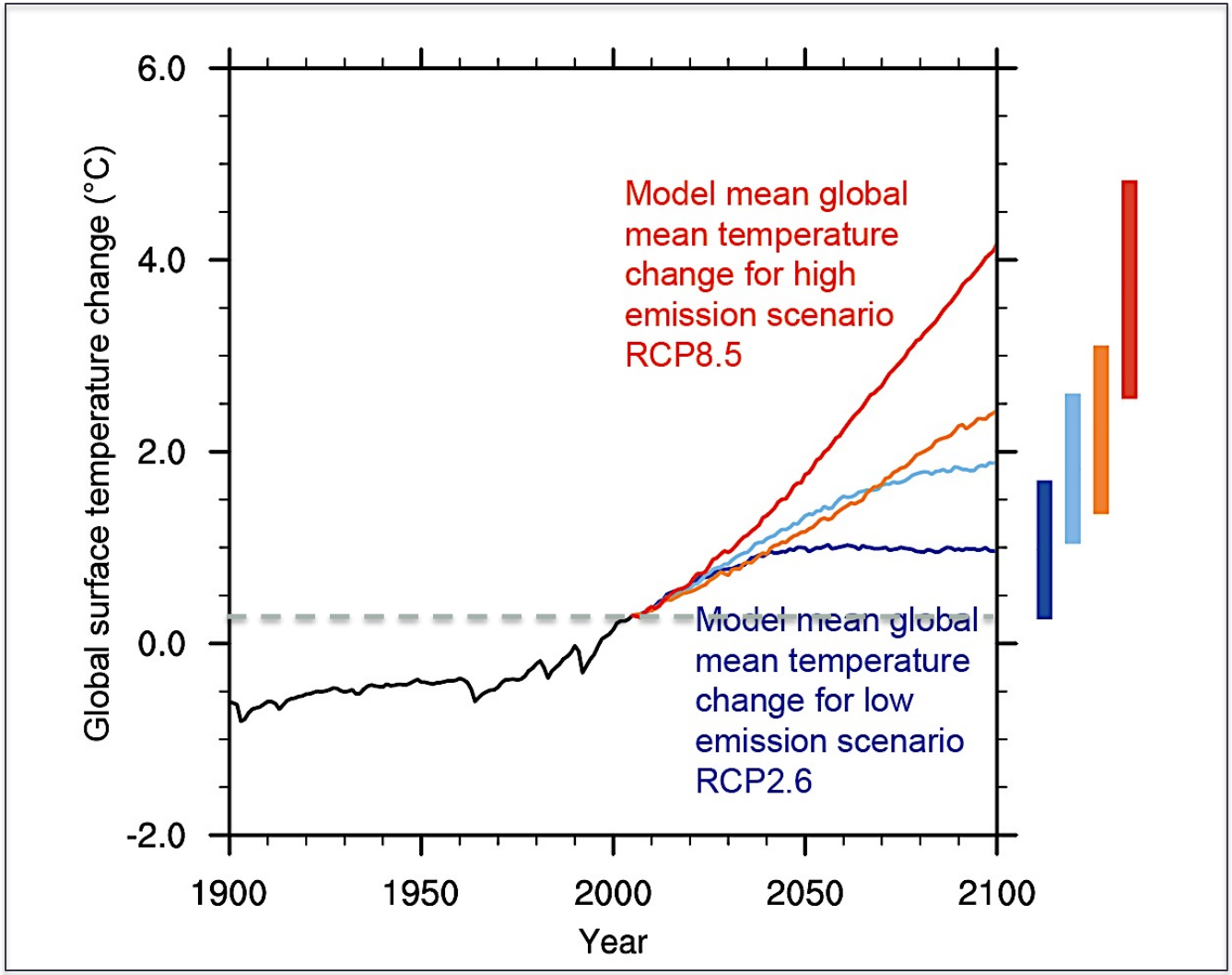
Number of heavy precipitation events by decade
versus the 1901-1960 average



Source: Climate Change Impacts in the United States: The Third National Climate Assessment

Past and Projected Global Average Surface Temperature Change, ° Celsius

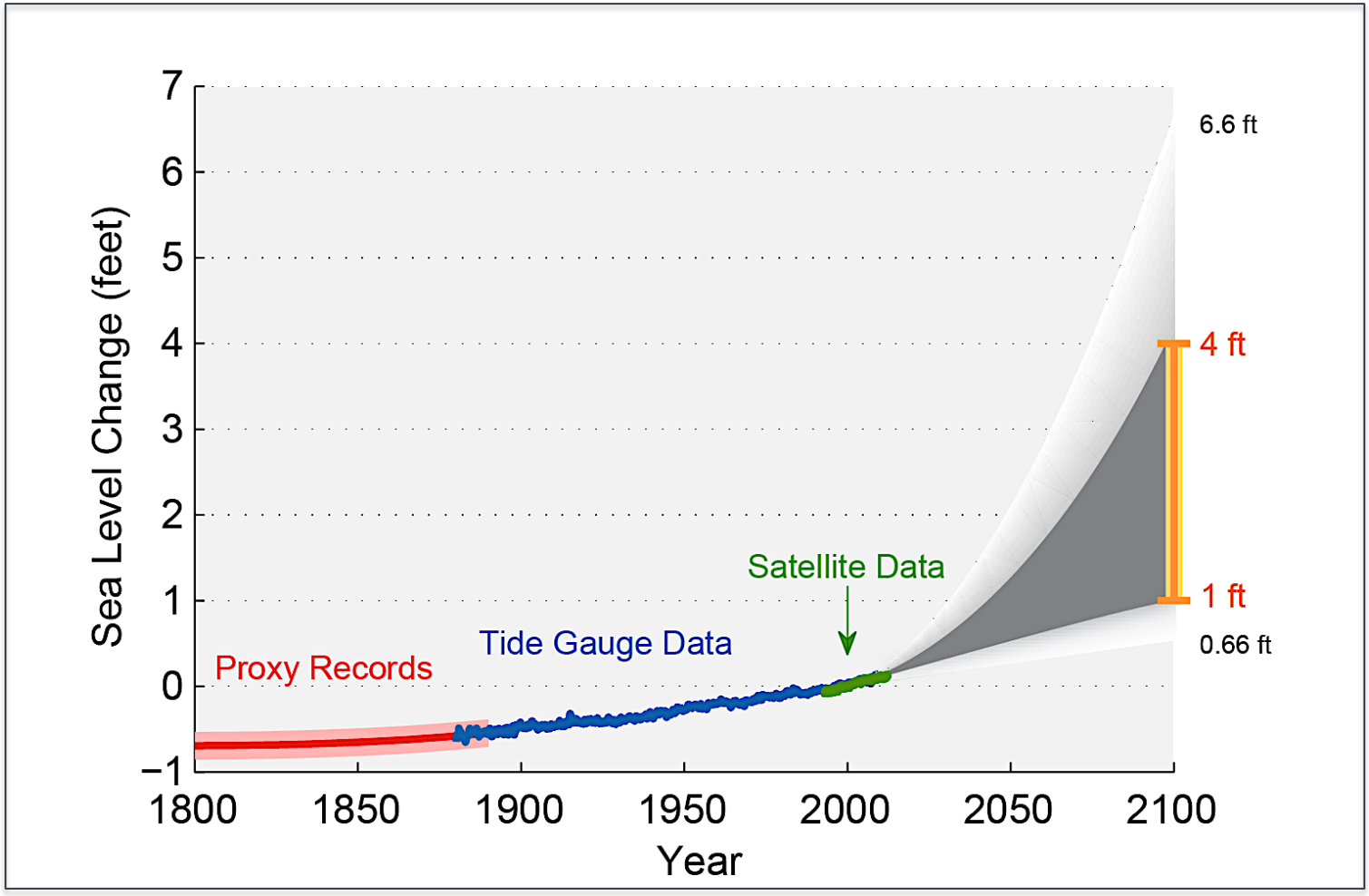
(Relative to 1986 – 2005 average)



Source: IPCC Climate Change 2014 Synthesis Report

Past and Projected Global Sea Level Change

(1800 - 2100)



Source: Climate Change Impacts in the United States: The Third National Climate Assessment

Anticipated Future Climate Extremes and Disaster Impacts

- Heat waves, average temperatures
- Heavy precipitation and flash floods
- Surface water runoff, landslides
- Droughts and water shortages
- Sea level rise, chronic inundation
- More intense hurricane events

Source: IPCC Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation, 2012

Recent extreme weather disasters in the U.S. and Canada, 2016

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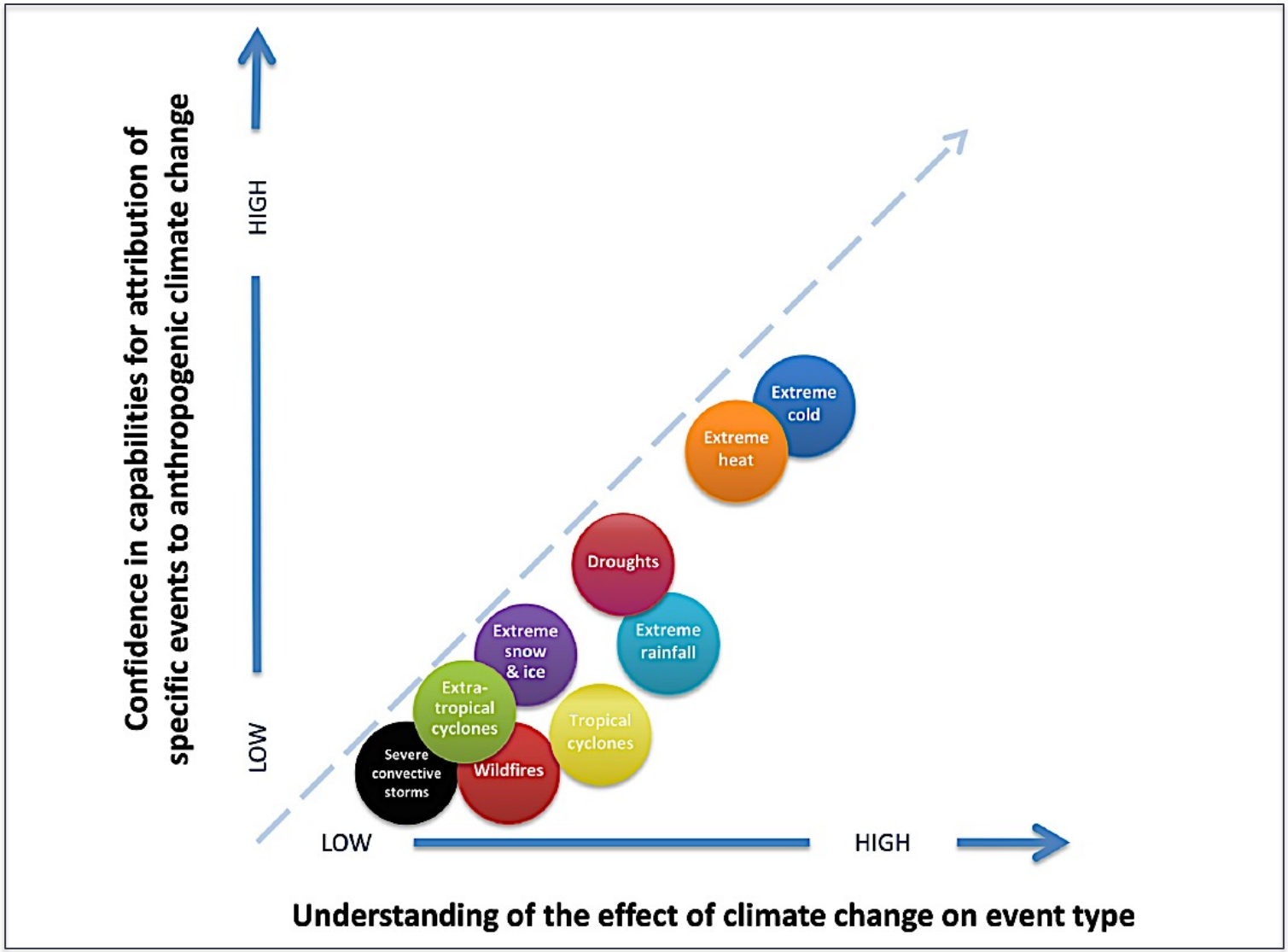
Science of Attributing a Specific Extreme Weather Event to Climate Change



Source: National Academies of Sciences, Engineering, and Medicine. 2016. *Attribution of Extreme Weather Events in the Context of Climate Change*. Washington, DC: The National Academies Press. doi: 10.17226/21852.

Climate Change & Extreme Weather Event Quiz

Question #1: The August 2016 Louisiana floods were devastating and historic. Were the rainfall totals in the Baton Rouge area:

- 1 in 50 year event?
- 1 in 100 year event?
- 1 in 1,000 year event?

Question #2: Did climate change 'cause' the Louisiana floods?

- Yes
- No
- Maybe

Question #3: In the U.S., the first 6 months of 2016 have been:

- The hottest on record?
- The third hottest on record?
- Not in the top 10 hottest on record?

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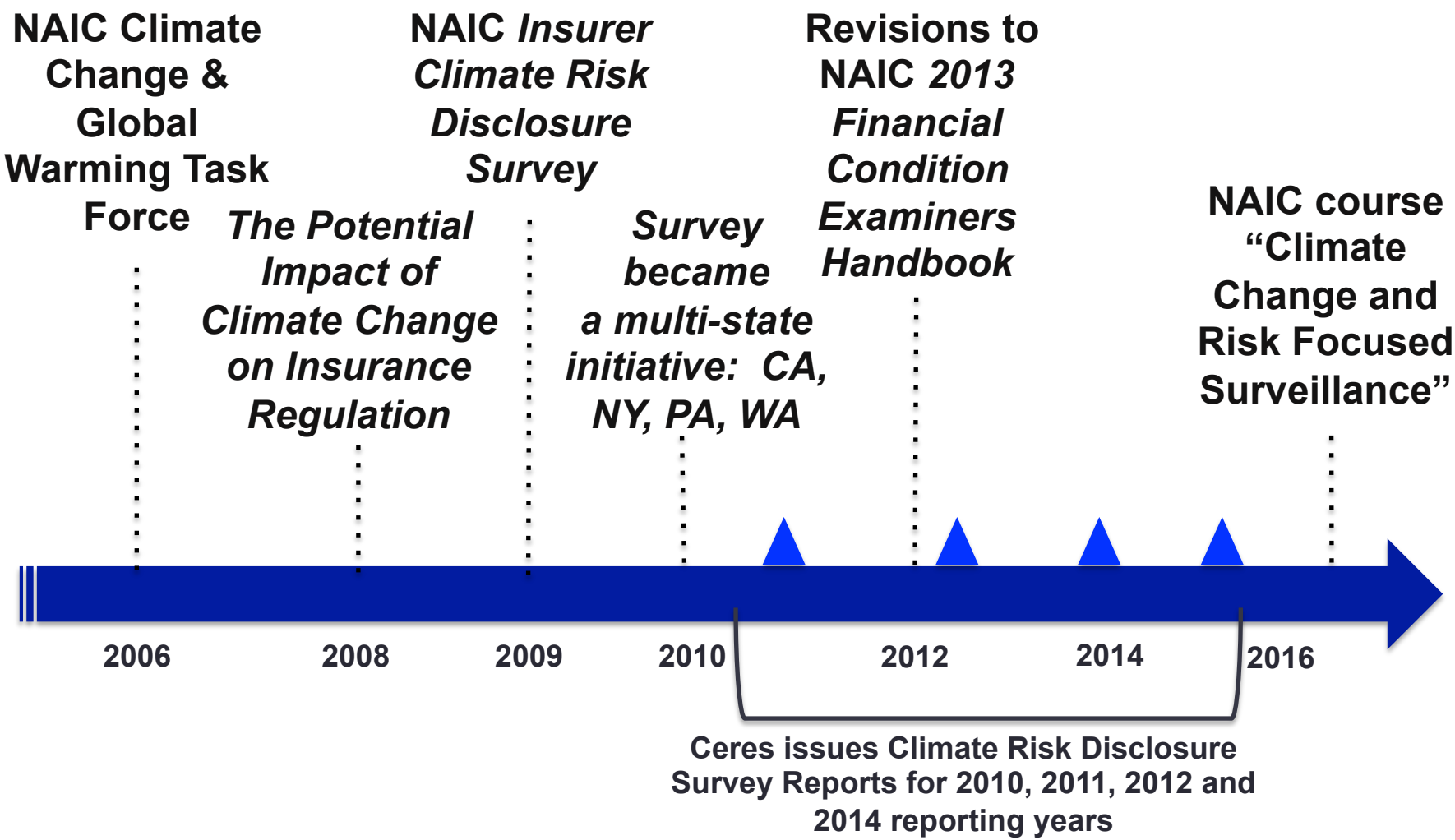
NAIC Climate Change & Risk Disclosure

Major Milestones



Source: NAIC, The Center for Insurance Policy & Research, November 24, 2014.

NAIC Climate Change & Global Warming Task Force, 2006

"Global warming and the resultant climate change will have impacts across multiple lines of insurance. Whether it is property and casualty, health, or life insurance—the impacts will be felt across many sectors of the economy that depend on insurance to provide financial security.

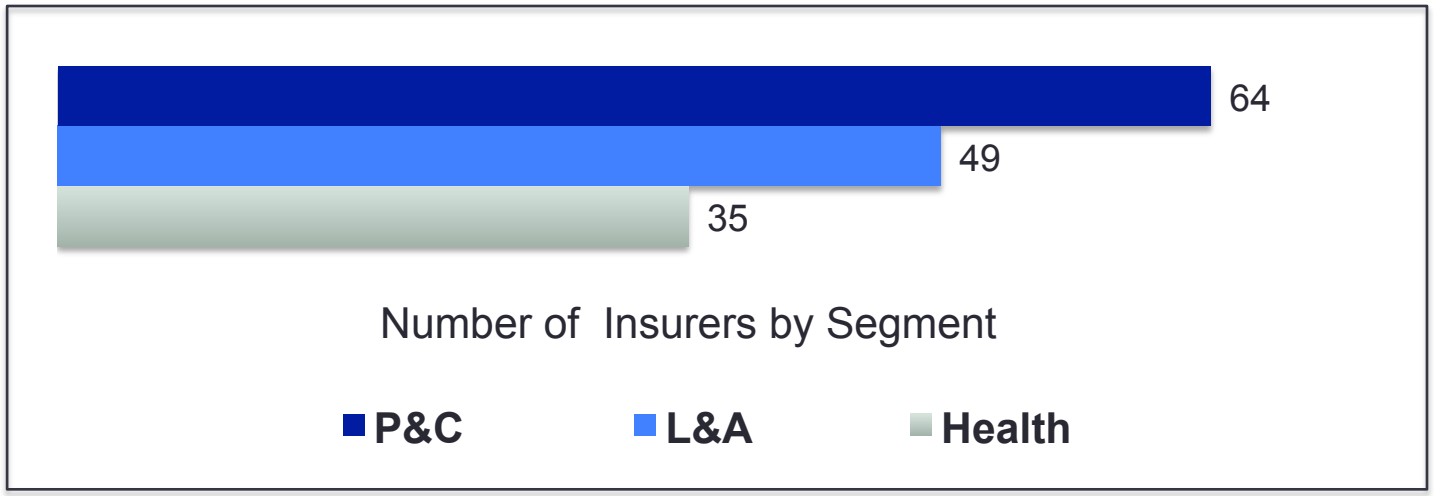
We believe the time has come for regulators to work with the insurance industry to thoroughly examine the impact of climate change issues on the insurance industry and make necessary regulatory changes and raise important issues in order to protect consumers and ensure a vibrant insurance market as we move into the future."

Source: NAIC, The Potential Impact of Climate Change on Insurance Regulation, 2008

NAIC Climate Risk Disclosure Survey

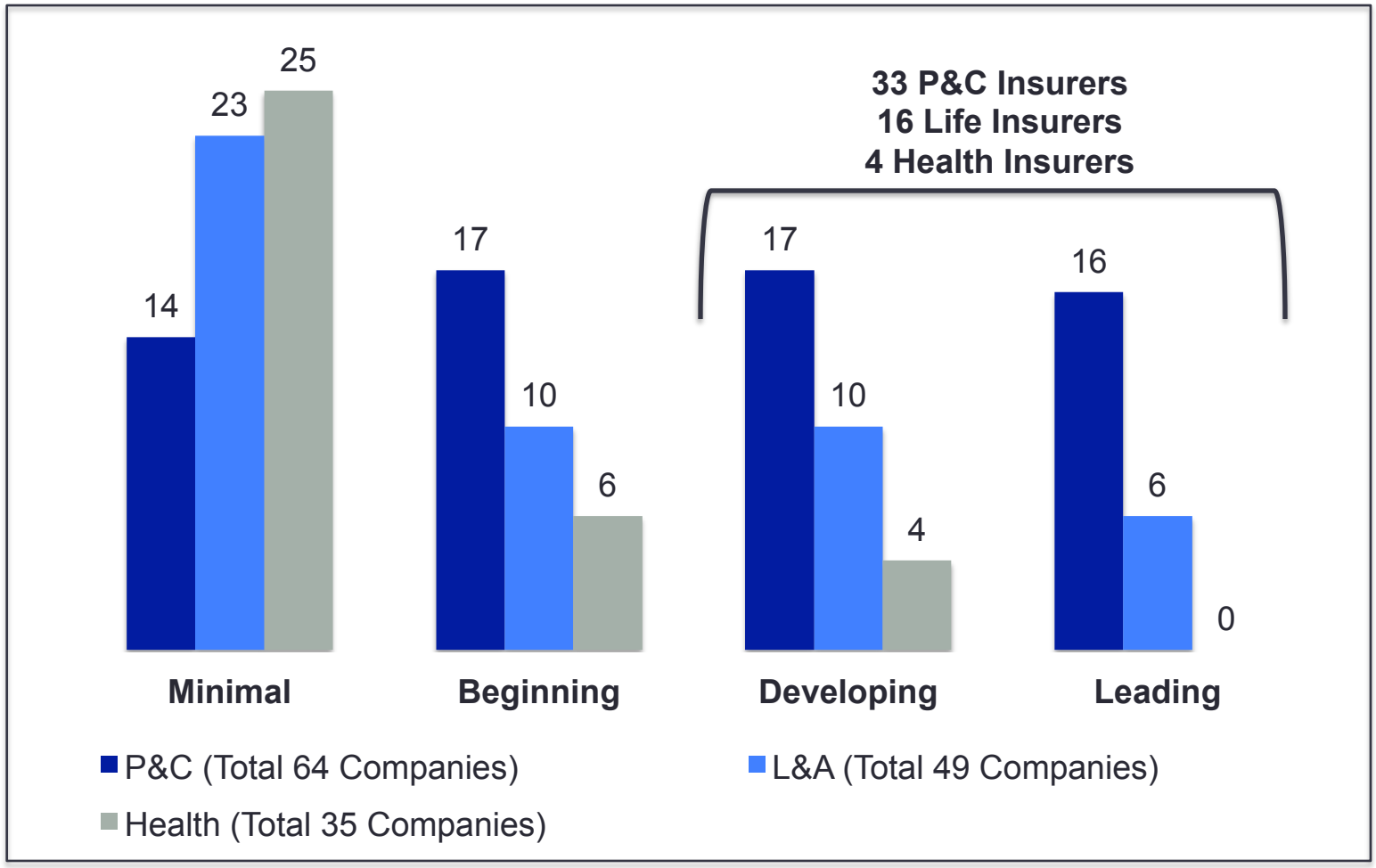
- The **eight-question Survey**, first adopted by the NAIC in 2010, has since been implemented by a coalition of state regulators.
- Insurers doing business in **California, Connecticut, Minnesota, New Mexico, New York and Washington** with $100M+ in direct premiums written required to respond.
- Ceres' latest analysis and report is based on the Surveys submitted by insurers in **September 2015.**

Type of Insurer Responding to the 2014 NAIC Climate Risk Disclosure Survey, Total = 148



Ceres' 2016 Climate Risk Disclosure Survey Report

Number of Insurers by Performance Band
Total = 148 Insurers



Revisions to the NAIC Financial Condition Examiners Handbook (FCEH)

- In 2013, the NAIC revised the FCEH by adding three risk mitigation/control strategies directly **tied to climate change**.
- The first two considerations of climate change risks were included within **underwriting**:
  - Development of risk exposures
  - Adequate pricing
- The third was consideration of climate change risk in the development of a diversified **investment portfolio**.
- They provide examiners with guidance on questions to ask regarding the **potential impact of climate change on solvency.**
- These additions are now included in the final, approved repositories of the 2015 Examiners Handbook—cementing their importance to a **"Risk Focused Examination**" (RFE) approach.

Source: NAIC, The Center for Insurance Policy & Research, November 24, 2014.

NAIC *2013 Financial Condition Examiners Handbook*

Impact of Climate Change Risk:

The impact of climate change risk may be identified as any significant change in the measures of climate over an extended period of time that includes major changes in relative temperatures, precipitation, or wind patterns that occur over several decades or longer.

It may include the effects from the increase in severity and occurrence of climate change-related weather events (some may include but are not limited to: thunderstorms — including severe hail and strong winds; tornadoes; hurricanes; windstorms; the aftermath of floods; heat waves; droughts; rise in sea-level; forest fires; grass fires and the resultant subsequent debilitating effects created by these events).

Source: *2013 Financial Condition Examiners Handbook*, Exhibit B – Glossary

FCEH Key Functional Areas Most Impacted by Climate Change Risks

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"***The insurer has not established and maintained appropriate risk exposure limits***."
(Critical Risk Category – Underwriting and Pricing Adequacy/Quality)

"***The insurer has not established sufficient pricing practices, resulting in inadequate or excessive premium rates in relation to its assumed risks and expense structure***."
(Critical Risk Category - Underwriting and Pricing Adequacy/Quality)

"***The insurer's investment portfolio and strategy are not appropriately structured to support its on-going business plan.***"
(Critical Risk Categories – Appropriateness of Investment Portfolio and Strategy and Liquidity Concerns)

Climate Change Risk Assessment and Financial Examinations

Critical Risk Category – Underwriting & Pricing Adequacy, example of high **inherent climate risk**: An insurer with a large and/or undiversified book of coastal property risks with exposure to sea-level rise.

Critical Risk Category – Investment Portfolio, example of high **inherent climate risk**: An insurer with a large and/or undiversified book of coastal property investments with exposure to sea-level rise.

Climate Change Risk Assessment and Financial Examinations

Critical Risk Category – Underwriting & Pricing Adequacy, example of high **inherent climate risk**: Comprehensive general insurance for coal, oil and gas energy operations with exposure to climate litigation.

Critical Risk Category – Investment Portfolio, example of high **inherent climate risk**: Investments in coal, oil and gas energy operations with exposure to carbon asset risk and/or reputational risk.

Climate Change Risk Assessment and Financial Examinations

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Critical Risk Category – Underwriting & Pricing Adequacy, example of high **inherent climate risk**: Agricultural insurance with exposure to drought, variations in weather patterns and other climate change impacts.

Critical Risk Category – Investment Portfolio, example of high **inherent climate risk**: Agricultural investments with exposure to drought, variations in weather patterns and other climate change impacts.

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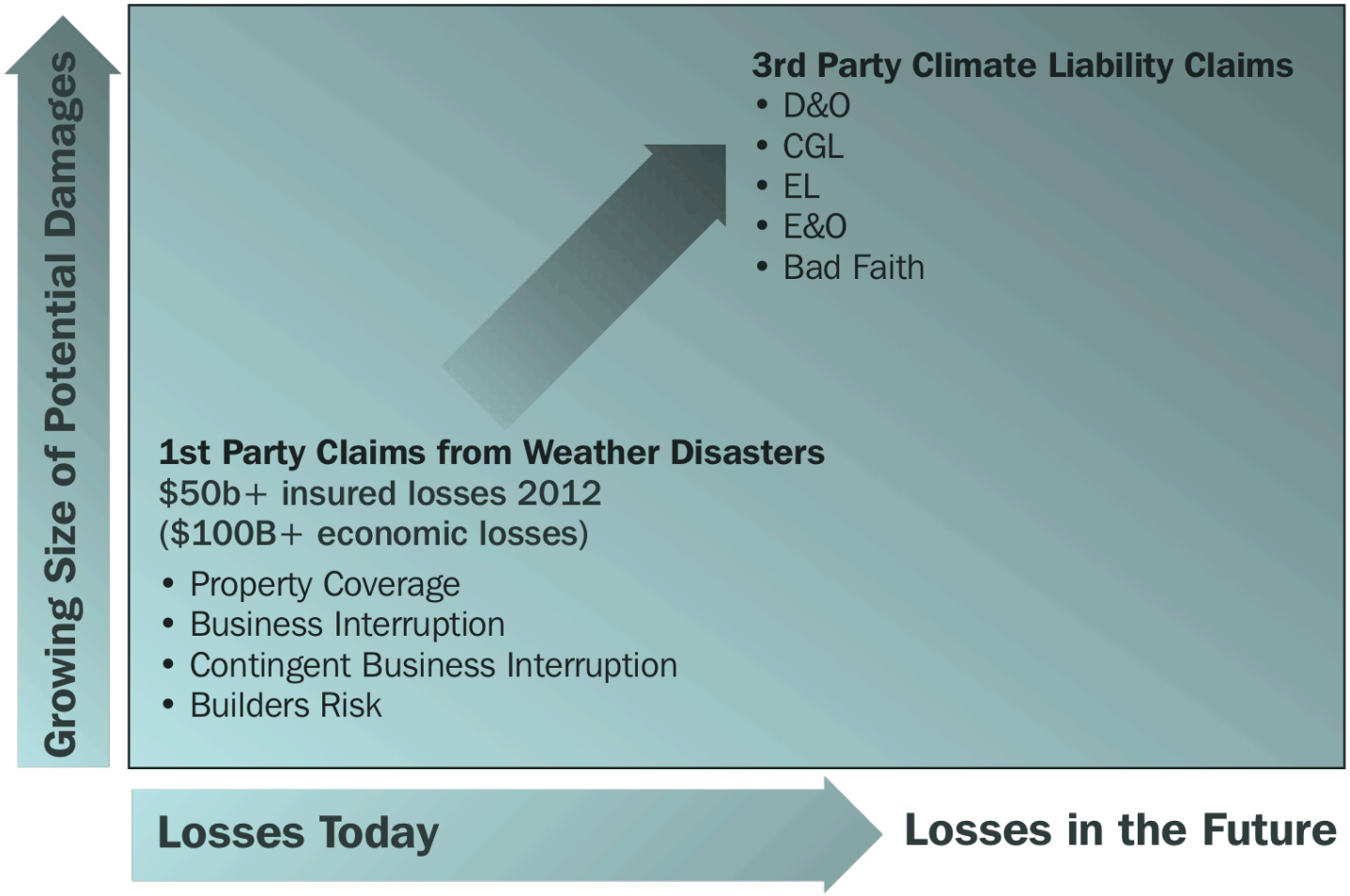
Climate Change and Property/Casualty Insurance Products



Source: Climate Change and Insurance, Carroll, Evans, Patton and Zimolzak, November 2012

Summary of Climate Change Risks for Insurers:
Property and Business Interruption Risks

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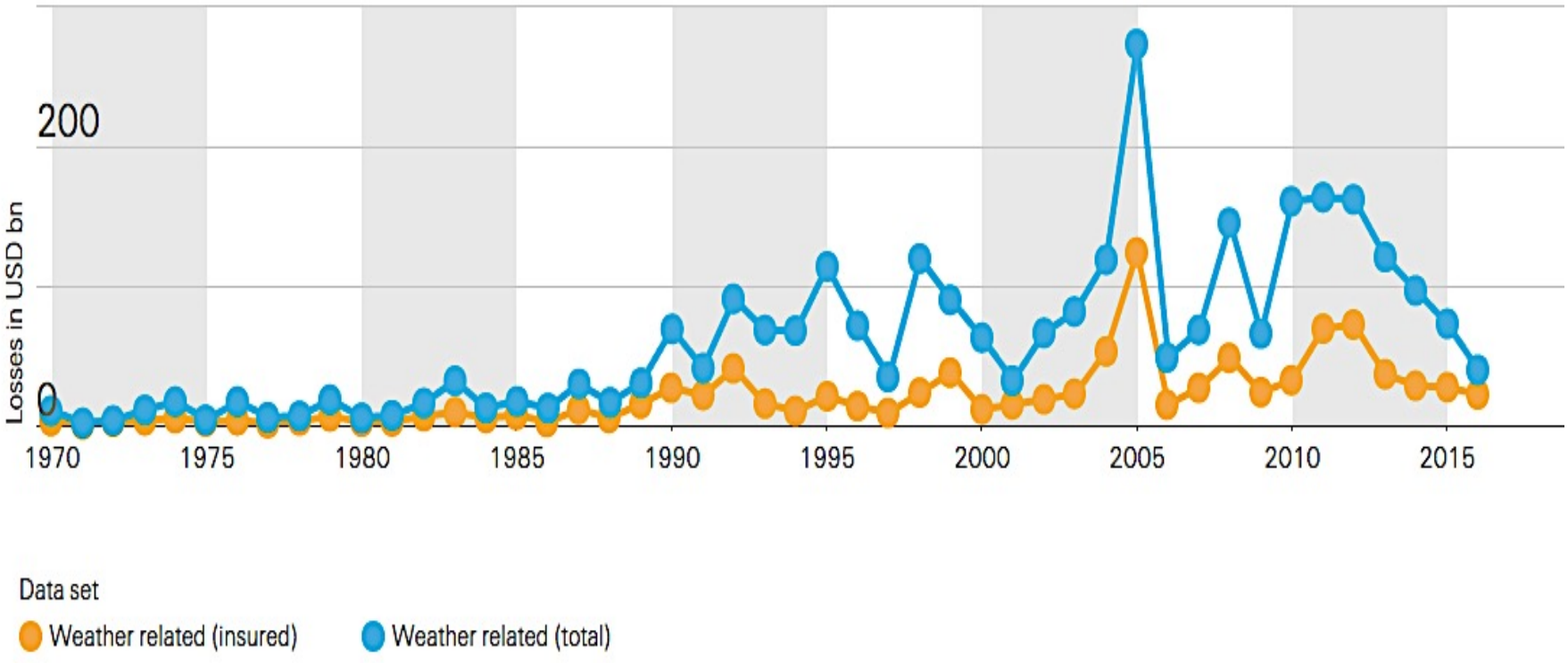
High Impact Issues	Medium Impact Issues	Other Issues
• Accumulation of extreme events threatens liquidity and/or solvency	• Increased losses from business interruption, e.g. failure of public utilities	• New energy technologies present underwriting challenges and opportunities
• Some major markets become uninsurable	• Lack of adequate capital/ reinsurance	
• Inaccurate/ uncertain risk assessment	• Higher losses in certain sectors, e.g. agribusiness	

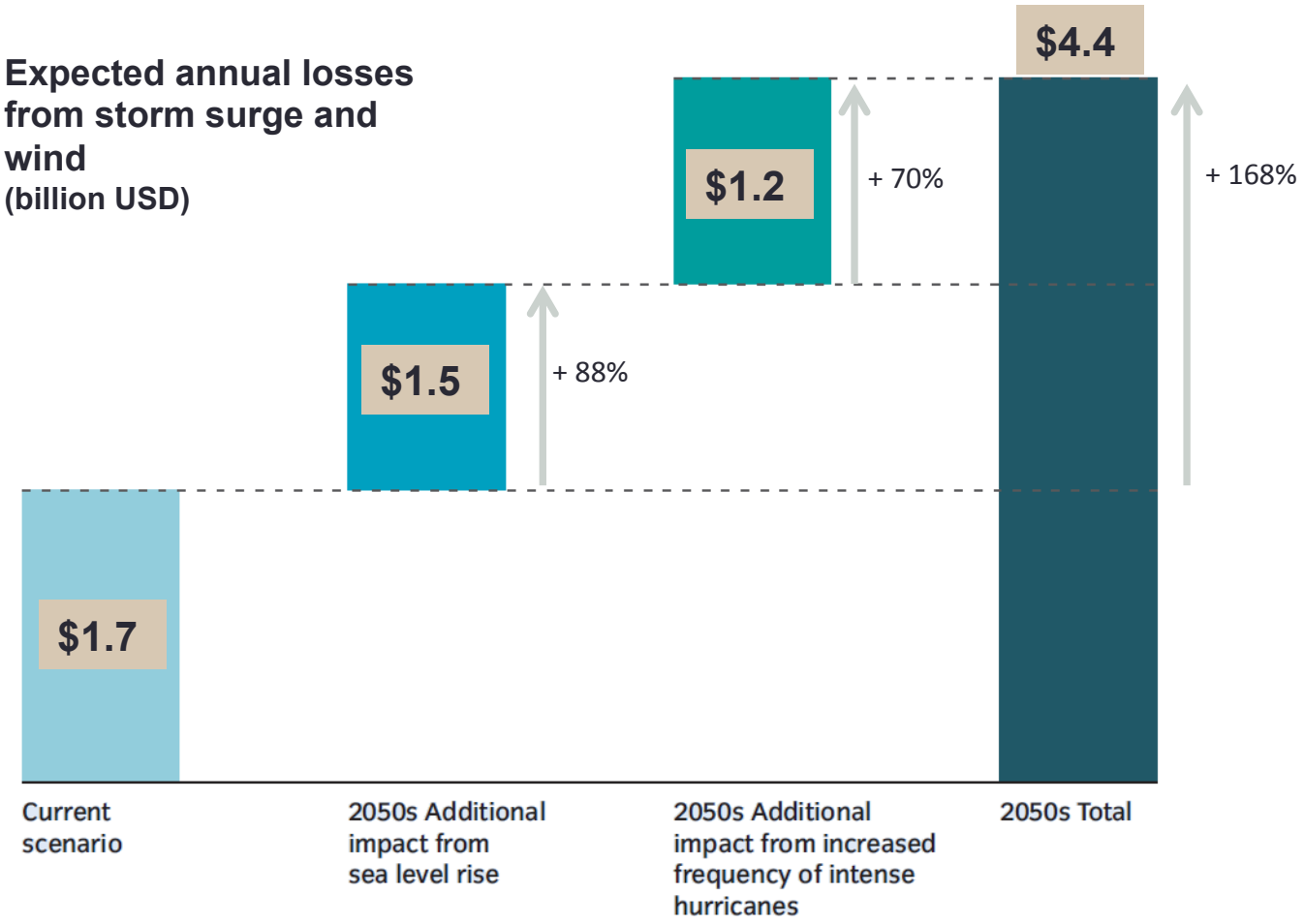
Source: UNEP Finance Initiative 2014 online course, Climate Change: Risks and Opportunities for the Finance Sector.

Global Weather Losses, Insured vs. Uninsured
1970 - 2015



Source: Sigma World Insurance Database, 2015 Swiss Re Economic Research & Consulting.

Example: Higher Future Losses in NYC
Current Scenario vs. 2050's



Source: www.nyc.gov: A Stronger More Resilient New York

Summary of Climate Change Risks for Insurers:
Casualty Risks

High Impact Issues	Medium Impact Issues	Other Issues
• Unexpected claims to D&O, E&O, Bad Faith policies • Manufactured product failures in new conditions • Liability for climate change damages	• Disruption to transport and energy, including electricity due to weather extreme events	• Other unforeseen climate liability related costs (both defense costs and potential damage awards)

Source: UNEP Finance Initiative 2014 online course, Climate Change: Risks and Opportunities for the Finance Sector.

Summary of Climate Change Risks for Insurers:
Casualty Risks

"The PRA views legal liability risks from climate change as an area that may evolve adversely; firms are encouraged to consider all aspects of this risk and be forward-looking in their approach."

- The field of climate change litigation is broad and evolving.
- Businesses are challenging climate change regulations, i.e., taking governments to court to challenge climate regulations.
- Climate litigation goes across borders, i.e., lawsuits from climate-vulnerable nations and communities against large GHG emitters.
- Climate change litigation includes both mitigation and adaptation aspects as well.

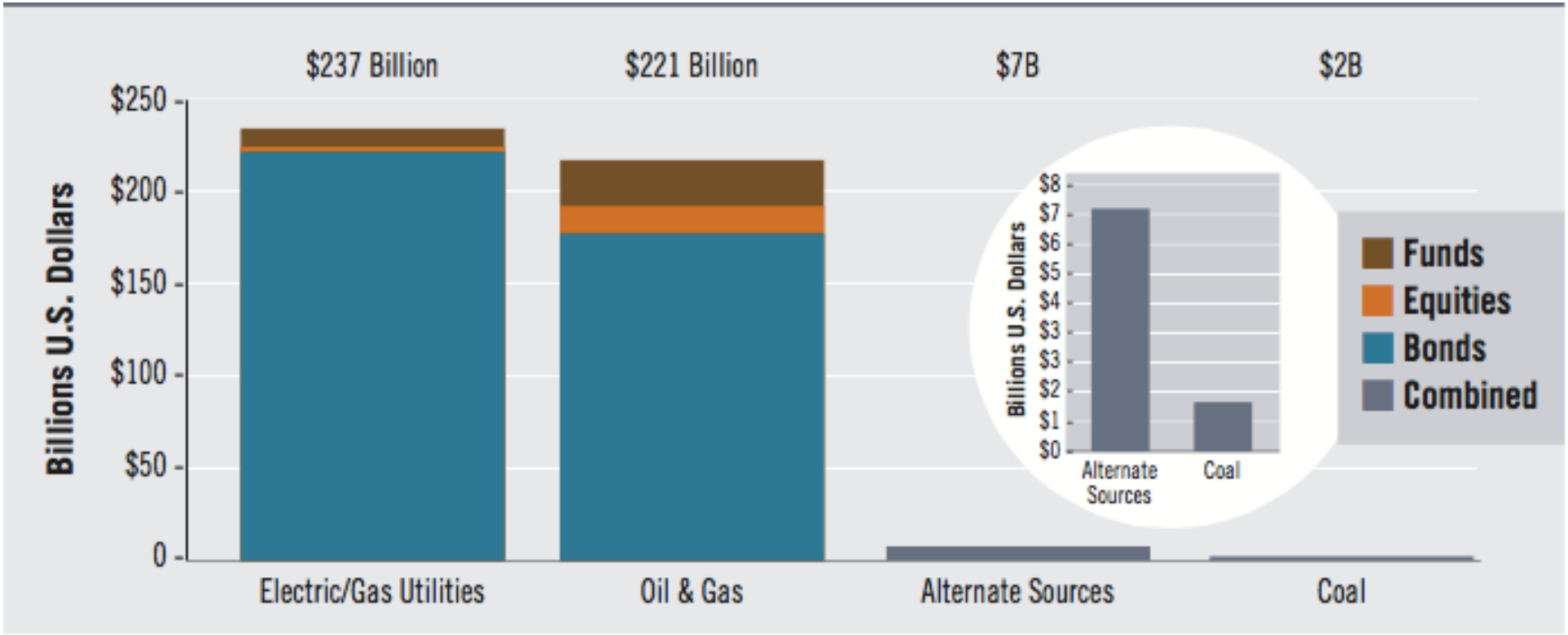
Source: Bank of England, Prudential Regulation Authority, 'The Impact of Climate Change on the UK Insurance Sector', September 2015.

Summary of Climate Change Risks for Insurers:
General Economic and Investment Risks

High Impact Issues	Medium Impact Issues	Other Issues
• Macroeconomic downturn hurts growth	• Social disruptions after disasters	• Reductions in insurance premiums from carbon-intensive energy sectors
• Impact of weather on insurers' operations	• Unpredictable impacts on global financial/ other markets	• Changing internal energy costs and investments in clean energy alternatives
• Re-pricing of carbon intensive assets (e.g. oil, gas, coal)	• Reputational risks for some insurers	

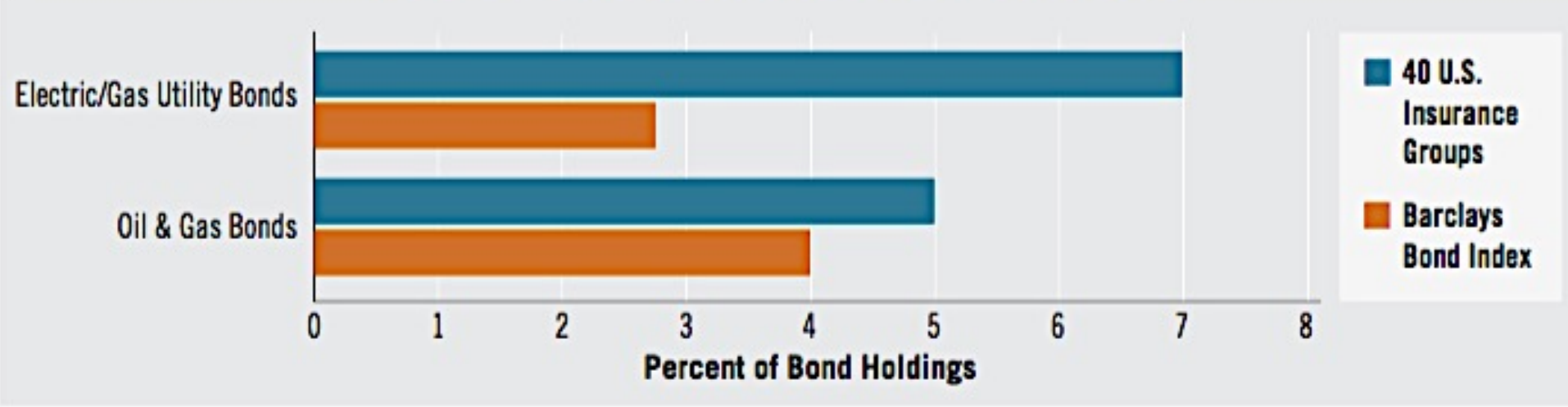
Source: UNEP Finance Initiative 2014 online course, Climate Change: Risks and Opportunities for the Finance Sector.

Top 40 U.S. Insurance Groups
Schedule 'D' Energy & Power Investments
(as of 12/31/14)



Source: Ceres' Assets or Liabilities' report, June 2016

40 Insurer Groups vs. Barclays Bond Index
Average Sector Percent of Total Bond Holdings
(as of 12/31/14)



Source: Ceres' Assets or Liabilities' report, June 2016

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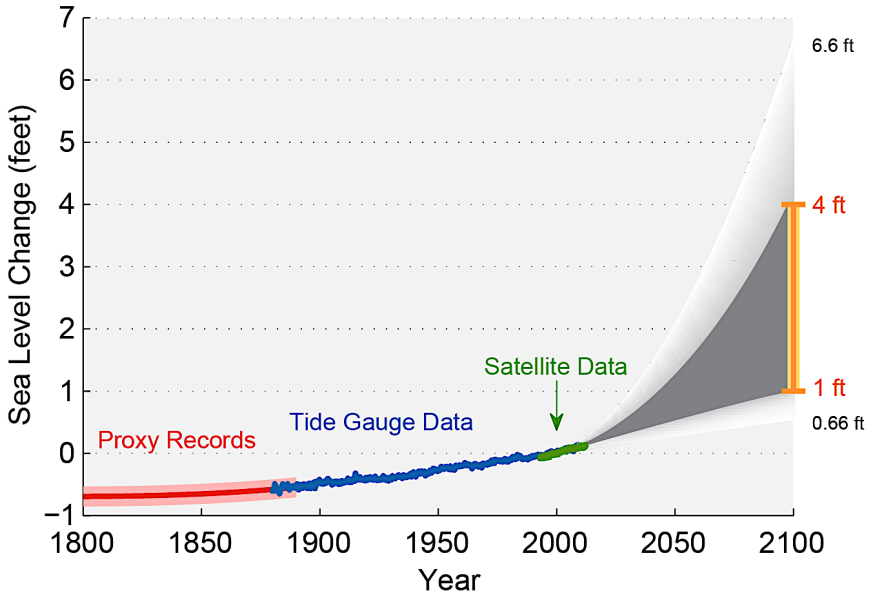
The actuarial profession is working to quantify climate change risk to human health and property.

- **Actuaries Climate Index** (ACI) – an objective index that measures changes in climate over recent decades (the Climate Index Working Group includes CAS, AAA, SOA, CIA).
- Initial focus on the US and Canada, encompassing six variables— **temperatures (high and low separately), precipitation, drought, wind, and sea-level**.
- Focus on measuring **frequency** and **intensity** of extremes rather than averages.
- Measure **correlation of economic loss by peril** to the components of the ACI to produce an index especially useful to the insurance industry.

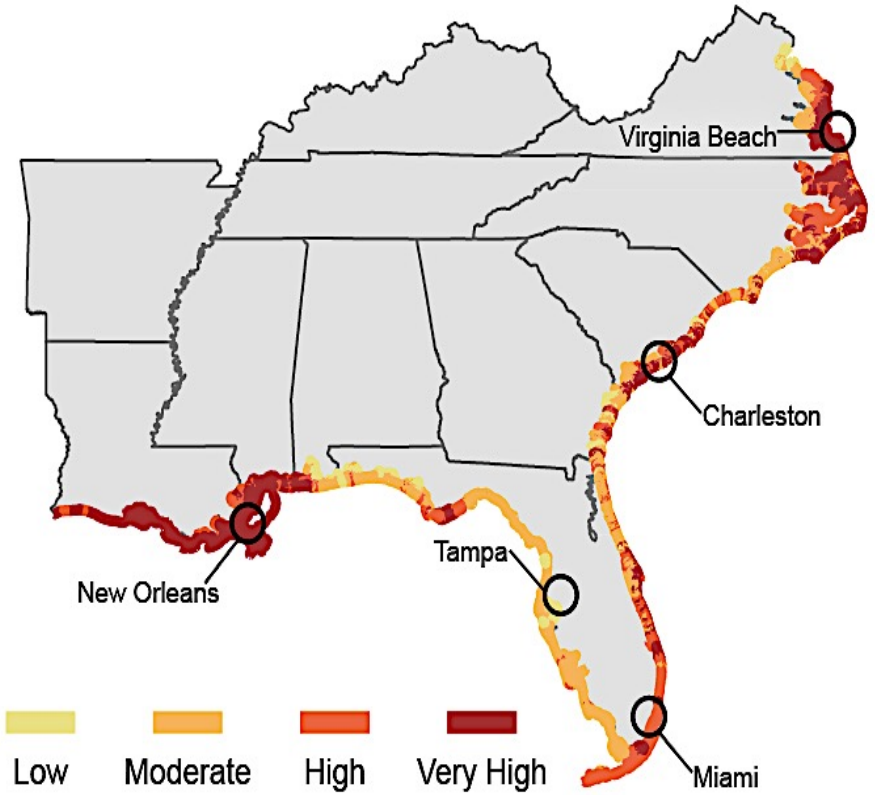
Source: IAA Council Meeting, October 2015

Yet we are just beginning to see the impacts of climate change, and many future variables remain uncertain.

Projected Sea Level Change



Vulnerability to Sea Level Rise



Sources: The Third National Climate Assessments, U.S Environmental Protection Agency

The concentration of future GHG emissions may be the biggest wild card in the climate system.

- How fast will human population grow and how much energy will we choose to use?
- Will our primary sources of energy continue to be fossil fuels (such as coal, oil, and natural gas)?
- To what extent will we continue to slash and burn forested regions, and how fast will we reforest cleared areas?
- These will determine our greenhouse gas emissions and ultimately drive the amount of warming Earth experiences.

The net impacts of these human actions and choices on future greenhouse gas concentrations are fed into models as different "scenarios." Because temperature projections depend on the choices people make in the future, climate scientists can't say which one of the scenarios is more likely to come to pass by the end of the century.

NOAA, Climate Change: Global Temperature Projections

There is a growing body of publically available data generated by climate models that is relevant to understanding potential future impacts.

A. Climate Model Projections

- Data has been produced using the leading climate research models, whose outputs have informed important scientific assessments of climate change and its impacts.
  - Most recent **IPCC assessment reports**
  - The **U.S. National Climate Assessment**

- They have been collected into several archives and portals for increased ease of access to outputs from multiple models and types of simulations. (https://www.data.gov/climate/portals/)

B. Scenarios

- In addition, scenarios.globalchange.gov provides scenarios: quantitative and narrative descriptions of plausible future conditions that provide assumptions for analyses of potential impacts and responses to climate change.

In the current transient environment, the use of stationary approaches to quantify extreme event probabilities and financial risk will increasingly fail.

- Forward-looking approaches have the potential to overcome the data issues in the estimation of current likelihoods of extreme events.
- In the case of warming oceans, multi-year forecast products based on global general circulation models (GCMs) can help to build the basis of the medium-term outlook.
- However, these models come with significant uncertainty, reflecting the limits of the scientific understanding and the ability to predict extreme events in a chaotic system.

Since 2006, RMS has acknowledged it is no longer safe to assume that the activity of any catastrophe peril is best defined as the average of the past fifty or hundred years of history. What then becomes the basis for determining activities and severities?

Robert Muir Wood, Chief Research Officer, RMS

Products/Underwriting/Pricing and Climate Change Quiz

Question #1: What types of losses may increase related to climate change?

- 1st party property/BI claims?
- 3rd party climate liability claims?
- Both of the above?

Question #2: Could climate change (and related factors) drive higher losses on both sides of an insurer's balance sheet?

- Yes
- No
- Maybe

Question #3: What are some of the major factors driving future uncertainty in pricing specific perils, e.g. flooding?

- Future greenhouse gas emissions?
- Rate of global warming?
- Limits of our scientific understanding?
- All the above

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Questions & Discussion

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