

## Overview of Actuaries Climate Index Research Project

### Actuaries Climate Index Committee

#### CIPR Symposium:

#### Implications for Increasing Catastrophe Volatility on Insurers and Consumers



October



## Agenda

- ✦ **Introduction**
  - ✦ Michael E. Angelina, MAAA, ACAS, CERA
  
- ✦ **About the Actuaries Climate Index (ACI)**
  - ✦ R. Dale Hall, FSA, MAAA, CERA, CFA
  
- ✦ **Possible Future Uses**
  - ✦ Stephen L. Kolk, ACAS

## Actuaries Climate Index Committee Structure

- ✦ CAS Climate Change Committee
  - ✦ Climate Index Working Group
    - ✦ Caterina Lindman, Chair
    - ✦ Members include actuaries from the CIA, CAS, SOA, and the American Academy of Actuaries
- ✦ Climate scientists from Solterra Solutions have been collaborating with the Committee to develop the ACI

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## Actuaries Climate Risk Index Project Overview

- ✦ ACI
  - ✦ An Internet-based index to support scientific consensus on climate risk: frequency/intensity of extreme climate events has increased notably in recent decades
  - ✦ ACI will function as a useful monitoring tool for actuaries, policy makers, the public, and other interested parties
  - ✦ Website will host a variety of graphics depicting changes in ACI, its components, and regional distribution of changes
  - ✦ Quarterly updates with information provided in English and French

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## Actuaries Climate Risk Index Project Overview

- ✦ ACRI
  - ✦ Assessing risk due to changing ACI requires information on the human and built environment: *What/who is currently in harm's way?*
  - ✦ Goal is to provide an index that is especially useful to the insurance industry
  - ✦ Quantifying risk in the form of an ACRI requires establishment of relationships between climatic and socioeconomic factors
  - ✦ Investigation of these relationships in the North American context is underway

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## Background – Climate Change

- ✦ Since 2005, severe weather and climatological events accounted for 85 to 90 percent of natural hazards resulting in claims or property damage or personal injury, according to global totals (Munich Re 2012)
- ✦ A significant increase in the frequency of heavy precipitation events has been observed in the majority of locations where data are available
  - ✦ Particularly in the eastern half of North America and Northern Europe, where there is a long record of observations
- ✦ As expected, regionally, changes can be significantly higher or lower than the global average. For example:
  - ✦ In the SW Pacific Ocean, the rate of sea-level rise is 4x the global mean.
  - ✦ At 66 percent of measurement stations along the continental shores of the U.S., sea-level rising has led to a doubling in the annual risk of what were considered “once in a century” or worse floods

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## Background – Climate Change

- ✦ The main changes that have occurred are:
  - ✦ Global mean surface temperatures have risen by three-quarters of a degree Celsius over the last 100 years
    - ✦ The rate of warming over the last 50 years is almost double the rate over the last 100 years
  - ✦ The 16 warmest years on record occurred in the 17-year period from 1995-2011
  - ✦ Land regions have warmed at a faster rate than the oceans, which is consistent with the known slower rate of heat absorption by seawater
  - ✦ Over the past five decades, the frequency of abnormally warm nights has increased, and that of cold nights has decreased, at most locations on land
    - ✦ Fraction of global land area experiencing extremely hot summertime temperatures has increased approximately ten-fold over the same period

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## The Actuaries Climate Index

- ✦ Measures change in frequency of extreme events and/or magnitude of recent change relative to natural climate variability
- ✦ Focuses on measuring frequency and intensity of extremes in key climate indicators based on quality-controlled observational data
  - ✦ Temperature
  - ✦ Precipitation
  - ✦ Drought
  - ✦ Wind
  - ✦ Sea level
  - ✦ Soil moisture (means)
- ✦ Data observations via a 2.5° by 2.5° grid (275km x 275km at equator)
- ✦ Updatable on a frequent (seasonal) basis from publicly available data sources

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## The Actuaries Climate Index

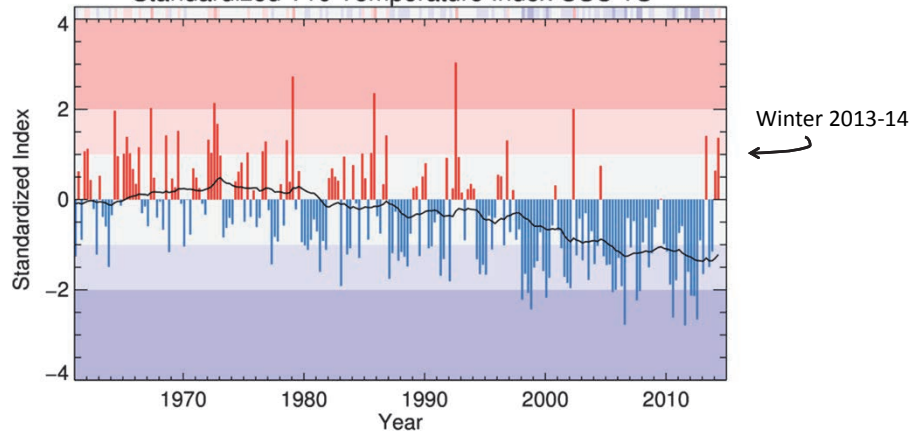
- ✦ Covers U.S. and Canada
- ✦ Also calculated for 12 North American sub-regions
- ✦ Hope to gradually add other parts of world where good data is available
- ✦ Publish Index and related information on website
  
- ✦ Could be readily extended to a more comprehensive Index containing socioeconomic information, serving the needs of actuaries, stakeholders, & the public more directly

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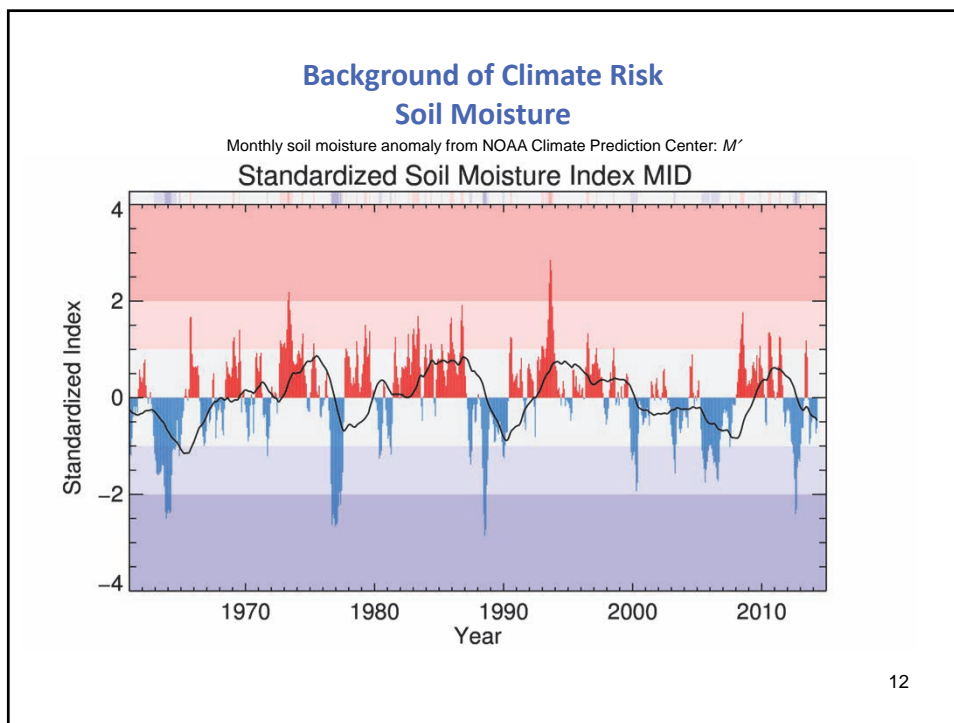
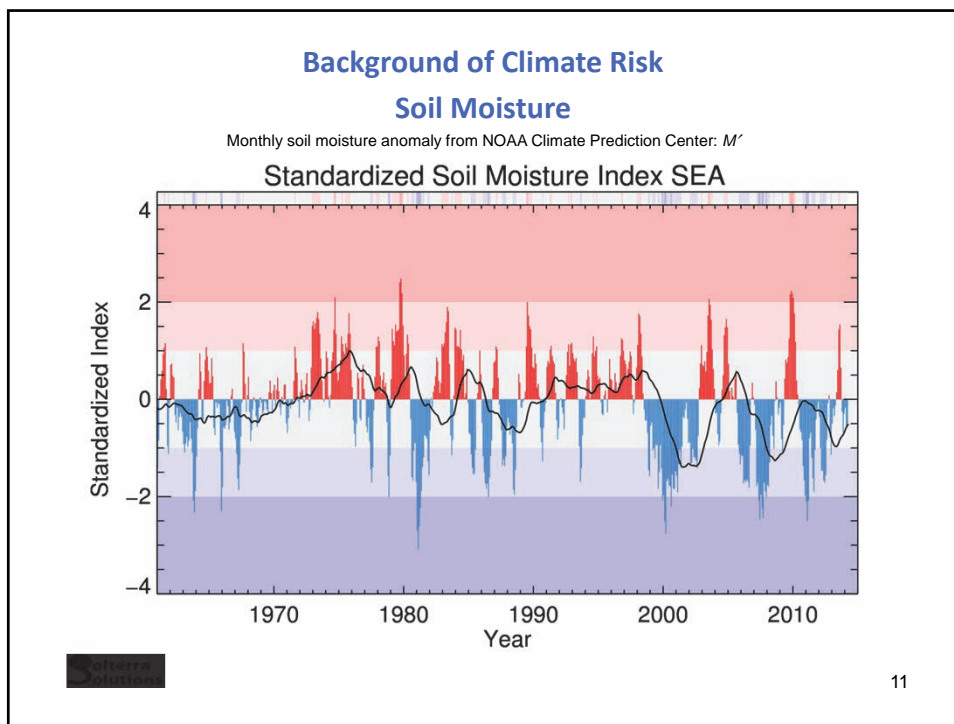
### Background of Climate Risk Index T10: Excess frequency of cool days and nights

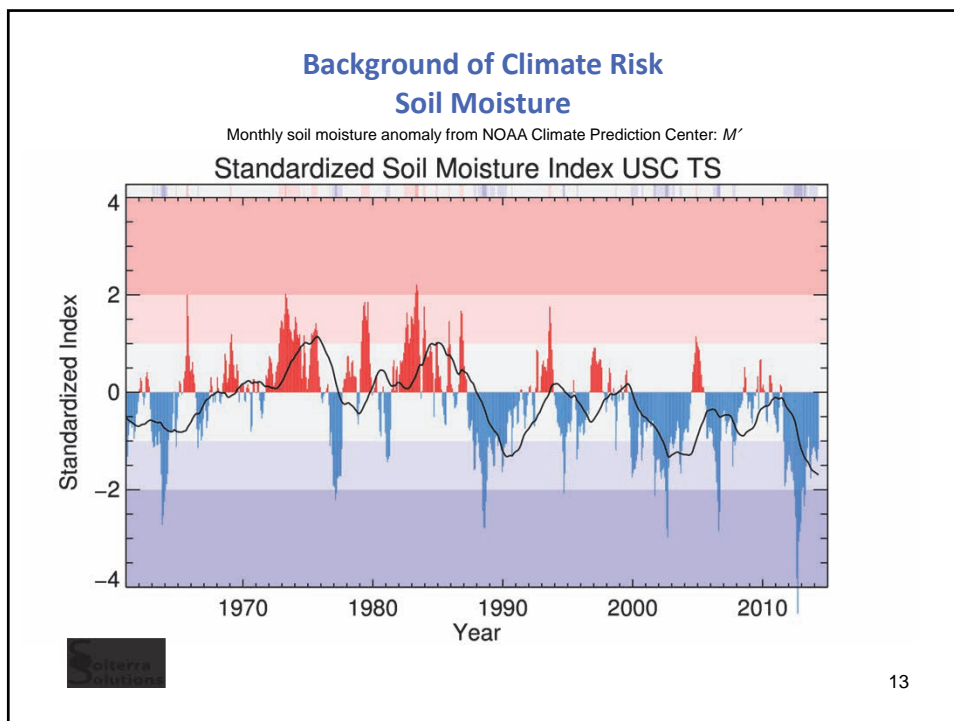
$$T10' = \frac{\Delta TX10}{2 \times \sigma_{ref}(TX10)} + \frac{\Delta TN10}{2 \times \sigma_{ref}(TN10)}$$

Standardized T10 Temperature Index USC TS



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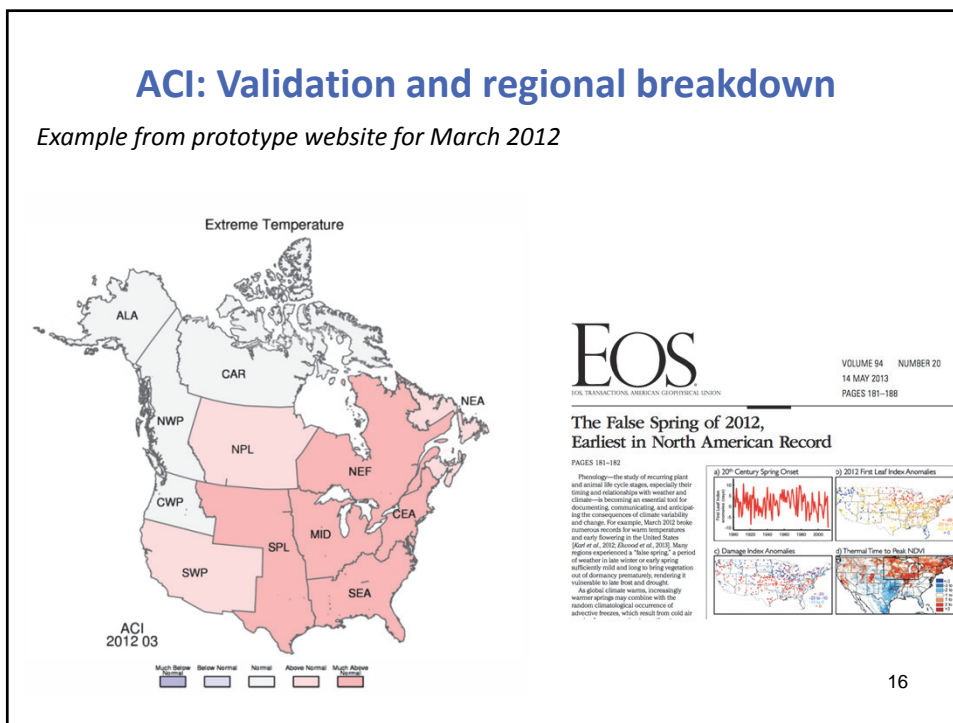
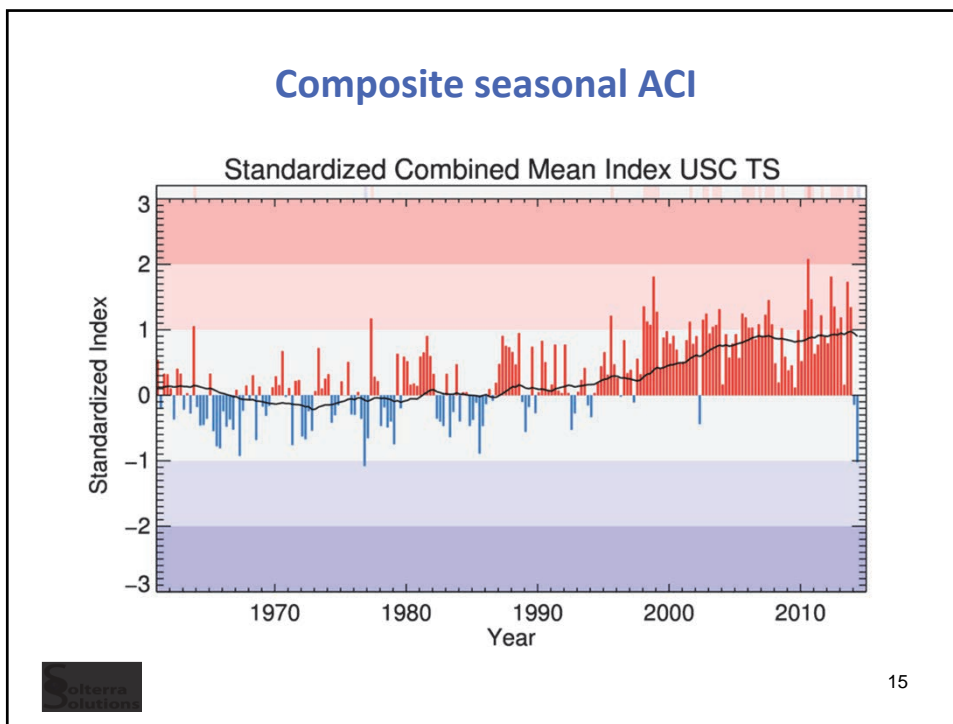


### Composite ACI: Putting it all together

- ✦ Many ways to combine components (e.g., temperature, soil moisture, drought) into a composite ACI, and a couple of options will be available via final website
- ✦ Default form is a simple mean of components:

(soil moisture omitted in this form due to its indirect connection to flooding; but available as an option)

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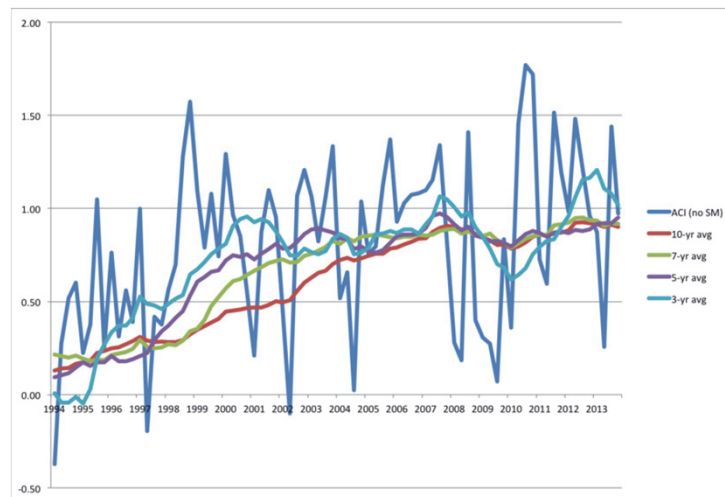




What might actuaries and others do with the ACI (and the Actuaries Climate Risk Index)?

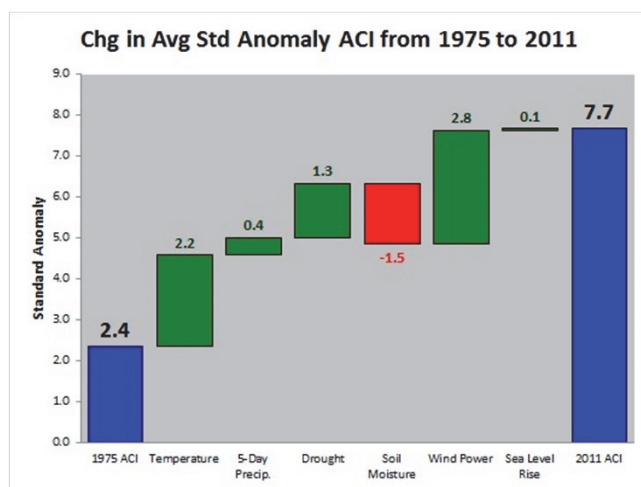
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Measure change in extreme climate over time



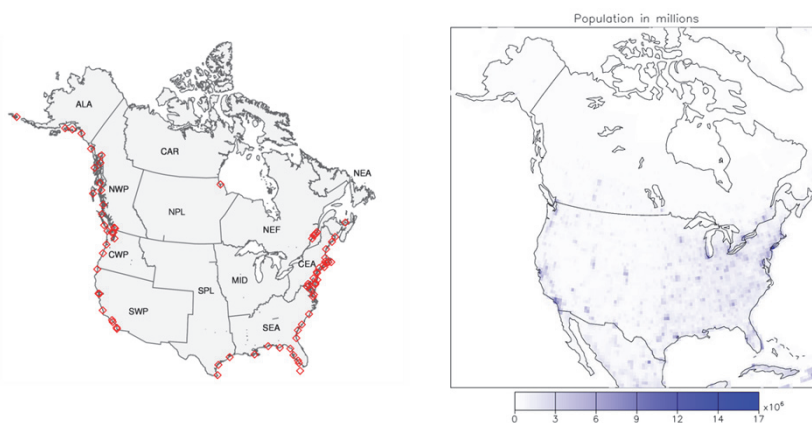
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## Measure change in extreme climate by component



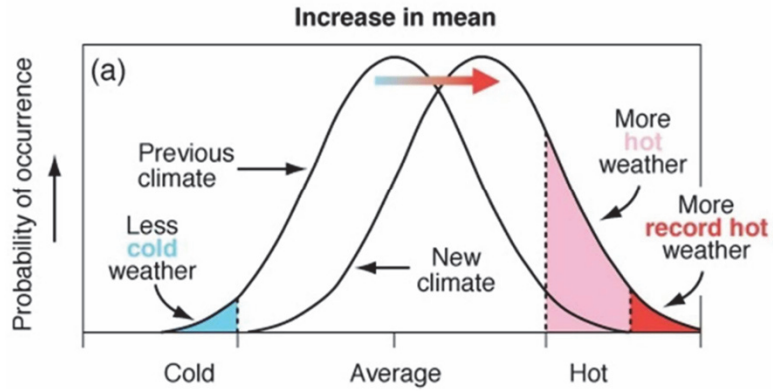
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## Use ACI region data and ACRI exposure measures



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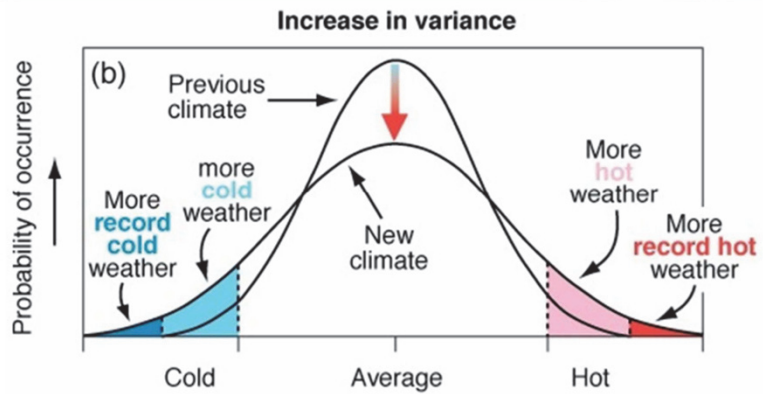
## Climate Impact #1: INCREASE IN MEAN



Source: North American Climate Change Committee Report: *Climate Determining the Impact of Climate Change on Insurance Risk and the Global Community Phase 1: Key Climate Indicators*

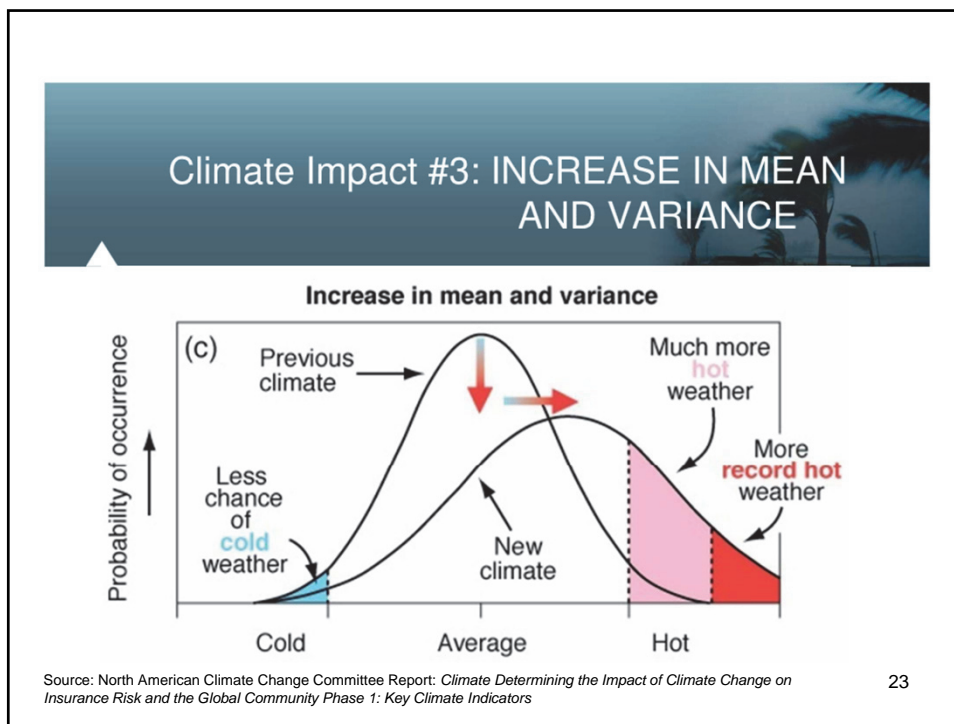
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## Climate Impact #2: INCREASE IN VARIANCE



Source: North American Climate Change Committee Report: *Climate Determining the Impact of Climate Change on Insurance Risk and the Global Community Phase 1: Key Climate Indicators*

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## Extreme Events & Climate Change: Berkeley Earth – 9/23/14 Newsletter

# Know the facts

A skeptic's guide to climate change

Is the extreme weather we see today really caused by global warming?

These days, climate change is being blamed for everything, from Hurricane Sandy to tornadoes in Missouri. Claims are made that push beyond what science can tell us. Attributing cause-and-effect to individual weather events is fiendishly difficult.

This chart provides a quick assessment of which extreme weather events are not likely linked to global warming, which events might be linked, and which events have demonstrated (though often exaggerated) links.

| Extreme weather event | No global warming link | May change with global warming but amount not established | Evidence of some global warming link |
|-----------------------|------------------------|---|--------------------------------------|
| Hurricanes            |                        | X   |                                      |
| Tornadoes             | X                      |   |                                      |
| Droughts              |                        | X   |                                      |
| Forest fires          |                        | X   |                                      |
| Heatwaves             |                        |   | X                                    |
| Coastal floods        |                        |   | X                                    |
| Earthquakes           | X                      |   |                                      |
| Floods                |                        | X   |                                      |

## Extreme Events & Climate Change: Berkeley Earth -

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| Floods                |                        | X   |                                      |

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## From An Infrastructure Study of the Gulf Coast

"While the focus of this project is on a portion of the U.S. Gulf Coast, the intent is to develop a conceptual framework that lays the groundwork for an assessment that links climate change and transportation and to focus this nexus by using a specific case as an illustration."

*-Impact of Climate Change and Variability on Transportation Systems and Infrastructure: [Gulf Coast Study](#), Phase I*

- ▶ The 2008 Conceptual Framework for Assessing Potential Impacts on Transportation reviewed:
  - ▶ Exposure
  - ▶ Vulnerability
  - ▶ Resilience, and
  - ▶ Adaptation

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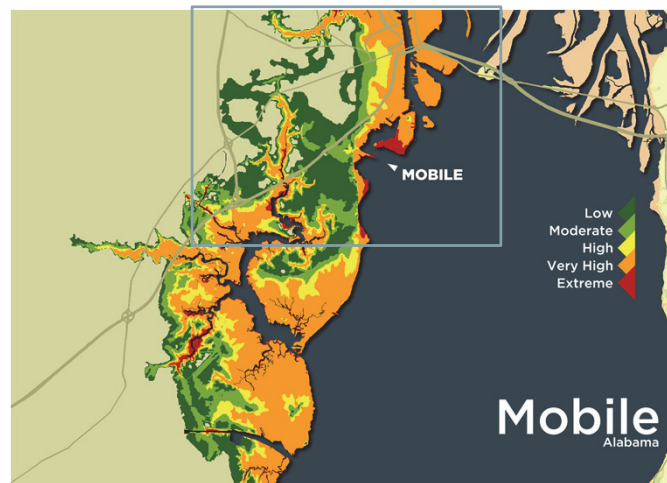
- ▶ The 2008 Conceptual Framework for Assessing Potential Impacts on Transportation reviewed:

- ▶ **Exposure**
- ▶ **Vulnerability**
- ▶ Resilience, and
- ▶ Adaptation

**Here is where the ACTUARIES' CLIMATE INDEX (The ACI) and the ACTUARIES' CLIMATE RISK INDEX (The ACRI) can add value**

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## Current estimated Storm Surge Extent – by risk level



Source: CoreLogic Storm Surge Report, 2013

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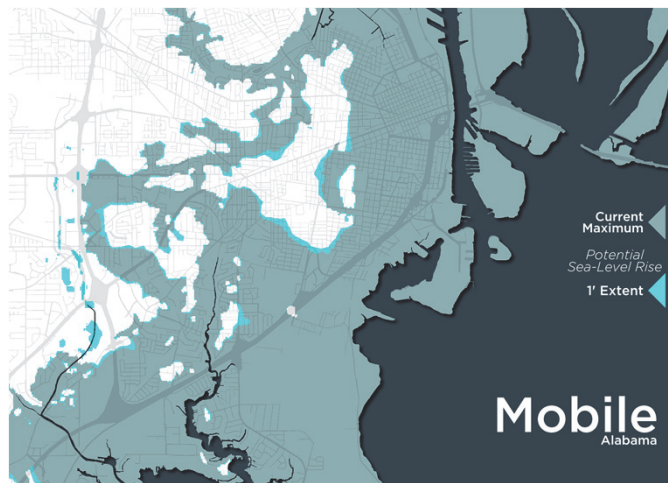
## Current estimated MAXIMUM Storm Surge Risk Extent



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Source: CoreLogic Storm Surge Report, 2013

## Estimated maximum surge risk extent after 1 foot Sea-Level Rise

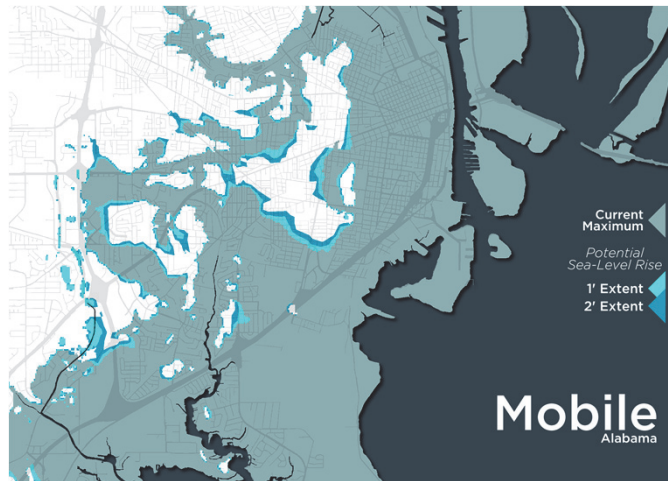


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Source: CoreLogic Storm Surge Report, 2013



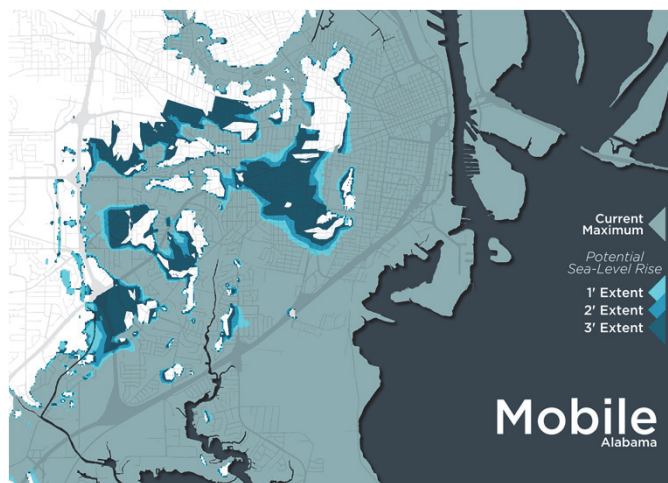
## Estimated maximum surge risk extent after 2 foot Sea-Level Rise



Source: CoreLogic Storm Surge Report, 2013

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## Estimated maximum surge risk extent after 3 foot Sea-Level Rise

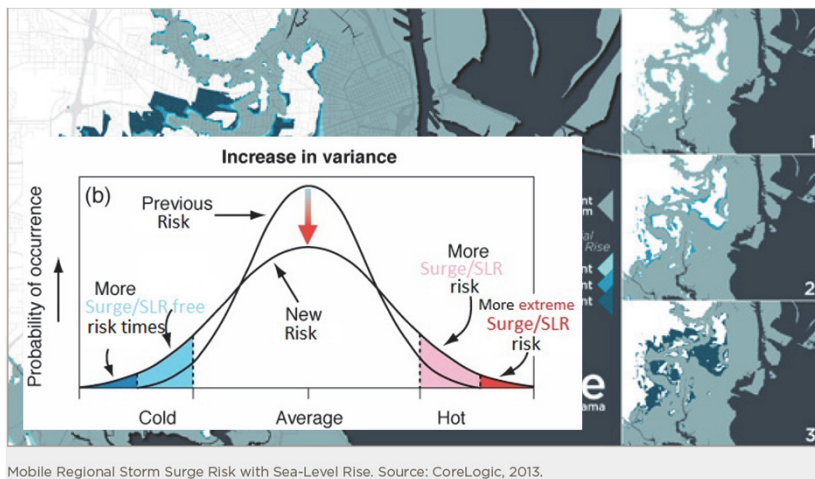


Source: CoreLogic Storm Surge Report, 2013

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## Storm Surge Risk extension by Sea-Level Rise of 1 foot, 2 feet, & 3 feet



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### Residential Property Counts & Values at risk of Storm Surge

| Rank | Area Name      | Properties Affected | Total Structure Value | Property distribution by Surge Risk Level |
|------|----------------|---------------------|-----------------------|---|
| 1    | New York       | 447,428             | \$205,712,837,261     |   |
| 2    | Miami          | 239,910             | \$100,132,133,476     |   |
| 3    | Virginia Beach | 305,943             | \$73,033,753,064      |   |
| 4    | Tampa          | 301,045             | \$55,073,950,288      |   |
| 5    | New Orleans    | 238,919             | \$43,728,316,068      |   |
| 12   | Houston        | 187,560             | \$29,032,620,030      |   |
| 42   | Mobile         | 27,515              | \$3,231,380,600       |   |

Source: CoreLogic Storm Surge Report, 2013

CoreLogic

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## Overview of Actuaries Climate Index Research Project



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