Agenda

• CAS Climate Change Committee Update
• NAIC Disclosure Update
• Potential Impacts of Climate Change on the P&C Industry
• Sustainability/Green Products
• Questions and Discussion
CAS Climate Change Committee Update
The CAS Climate Change Committee was created to respond to the emerging risk of climate change.

- To recommend, support, and perform research on climate change and assess the potential risk management implications for the insurance industry.
- It is our actuarial professional responsibility to understand the latest in climate change science and develop actuarially sound approaches to managing the potential implications of climate change risk factors.
• Initial areas of focus
  ➢ Identify future climate scenarios and explore implications for our profession
    • Insurance products/services, reserving practices, contingency planning, and corporate strategy
  ➢ Have a significant role in climate change modeling
    • Model development, assumptions, uncertainty, sensitivity, robustness, appropriate application, and interpretation of results
  ➢ Understand reporting and disclosure requirements
  ➢ Address public relations and policy issues that arise from climate change
    • Recommend position of CAS and how to work with other actuarial organizations around the world
  ➢ Educate our membership
    • Facilitate background training for our membership to understand issues and implications
Climate Index Working Group

• The Actuaries’ Climate Index has been developed by Climate Index Working Group (CIWG) to help raise awareness of the potential risks associated with climate change and the risk management implications within North America and globally.

• Phase 1 completed: a synthesis of the extensive and rapidly growing body of knowledge on climate change as it relates to possible impacts on human society.

“Determining the Impact of Climate Change on Insurance Risk and the Global Community. Phase 1: Key Climate Indicators” (Nov 2012)

• Phase 2 in progress:
  – The CIWG finished developing the Actuaries’ Climate Index (ACI)
    » Essays on the Impact of Climate Change on the Insurance Industry were published in February 2014.
    » The final formulation of the ACRI was completed in December 2015.
Phase 1 Report

The report reviewed recently published scientific research in specific areas

1. The review laid the foundation for the development of an Actuaries Climate Index (ACI)
   - Various indices were constructed, using carefully vetted data or model projections, which adequately reflect changes in the underlying climate variables.
   - A composite index, carrying information from many individual climate variables and standardized with respect to climate variability, was formulated to suit the needs of both actuaries and the public at large. This is termed the Actuaries Climate Index™ (ACI™). This index carries information regarding the occurrence of climate extremes, as well as more gradual changes in mean quantities.
     - The index has been defined for individual regions, provided sufficient high-quality data are available.
     - Finally, by adding socioeconomic damage data, the ACI was extended to form the basis of a more targeted index to reflect the risk to populations and capital due to climate change (the Actuaries Climate Risk Index™, or ACRI™).

Source: “Determining the Impact of Climate Change on Insurance Risk and the Global Community. Phase 1: Key Climate Indicators”
Phase 1 Report: Climate Change

Observed rate of Arctic sea ice decline more than expected

Source: “Determining the Impact of Climate Change on Insurance Risk and the Global Community. Phase 1: Key Climate Indicators”
Phase 1 Report: Climate Change

Rising Sea Level – an instrumental record of 150 years

Source: “Determining the Impact of Climate Change on Insurance Risk and the Global Community. Phase 1: Key Climate Indicators”
Climate Index Development Structure

Climate Change Committee

Climate Index Working Group

Actuaries from the CAS, AAA, SOA & CIA
Actuaries Climate Index - Goals

• Create an objective index that measures changes in climate over recent decades
• Educate the insurance industry and the general public on the impact of climate change
• Easy to understand, but not simplistic
• Promote our profession
ACI Basics (1)

- The indices focus on the “frequency of severity” aka “f-s”
  - “How often is the temperature in a given month at or above the 90th percentile?”
  - Other indices tend to focus on change in the average over time, but it is the frequency of extreme weather that matters to us

- Indices are weighted averages of six “f-s” variables
  - High temperature
  - Low temperature
  - Heavy precipitation
  - Lengthy drought
  - High wind
  - Elevated sea level (for ocean coast only)

- The 90th percentile is based on the 1961-1990 reference period
ACI Basics (2)

- Granularity of data – each variable is available for each $2.5^\circ$ grid (275km x 275km at equator) in North America
  - While indices can be computed at this granularity, they would be volatile
- Grid indices are averaged across 12 natural regions
- Also averaged to produce indices for US, Canada and total US/Canada

Region Map Example from prototype website for March 2012

Source: Overview of Actuaries Climate Index Research Project, presented to CIPR, 10/7/2014
ACI – additional details

- Initial focus US and Canada
  - Hope to gradually add other parts of world where good data is available – Mexico, Europe, Australia...
  - Publish index and related information on web
- Focus on measuring frequency and intensity of extremes rather than averages
  - Express changes as standardized anomalies, e.g.,
    \[ X' = \frac{X - X_{ref}}{\sigma_{ref}(X)} = \frac{\Delta X}{\sigma_{ref}(X)} \]
Extreme Temperatures Indices

• Global Historical Climatological Network (GHCN) – global, land station-based, gridded dataset, daily from 1950-present (GHCN-Daily)

• GHCNDEX indices* based on the above:
  o TX90 = 90%ile warm days
  o TN90 = 90%ile warm nights
  o TX10 = 10%ile cold days
  o TN10 = 10%ile cold nights

• The average of % anomalies relative to the 1961-1990 reference period for T90 and T10:
  o Standardized anomaly (T10’ similar): $T90' = ΔT90 / \sigma_{ref}(T90)$

• Produced as part of the CLIMDEX project by the Climate Change Research Centre, at The University of New South Wales, Australia.
Standardized T90 and T10, US and Canada
Extreme Precipitation Indices

• GHCNDEX monthly maximum five-day precipitation data
  o Heavy precipitation index, $P' = \Delta Rx5day / \sigma_{ref}(Rx5day)$

• GHCNDEX, consecutive dry days (CDD) = Max days per year with <1mm precipitation
  o Drought index = 1 value of CDD/year
  o Linear interpolation to obtain monthly
  o $D' = \Delta CDD / \sigma_{ref}(CDD)$
Wind Power Index

- Index derived from NOAA Earth System Research Laboratory data:
  - Daily mean wind speeds
  - \( WP = \frac{1}{2} \rho \cdot w^3 \)
    - Where \( \rho \) is air density, \( w \) is daily mean wind speed
- \( W' = \frac{\Delta WP_{90}}{\sigma_{ref}(WP_{90})} \)
  - Where \( WP_{90} \) is the monthly frequency of the 90\(^{th}\) percentile or higher of daily wind power
At tide gauge stations along US and Canada coast

- Data provided by Permanent Service for Mean Sea Level (PSMSL), part of the UK’s National Oceanography Center
- Data matched to grids used for other variables
  - Index reflects portion of each region represented by coastal grids
- Land movements removed from tide gauge measurements to produce index reflecting sea movements only
  - $S' = \Delta S / \sigma_{ref}(S)$
ACI Precipitation, Wind and Sea Level Components
Composite ACI Index

- Unweighted average of standardized anomalies
  \[ ACI = \frac{T90' - T10' + P' + D' + W' + S'}{6} \]
Composite ACI – Latest Decade by Season

Seasonal Standardized Combined Mean Index USC Decade

Year: 2004 to 2014

Standardized Index
“sea level rise is a proxy for global temperature… [and] is a better measure of global warming than temperature”

Paul H. Carr, PhD Rising Seas and Solutions, slideshare 3/12/2015

“A hockey stick isn’t a surprising result.” – David Appell

Source: “And Then There’s Physics” 2/26/2016 - Credit: Kopp et al. (2016)
Selected components of ACI that can be compared to damage information

Using linear regression, significant relationships between economic losses by peril and climate variables were found in

- SHEL DUS data for economic losses, mortality and morbidity in the US
- Canadian Disaster Database, compiled by Public Safety Canada

These findings are being packaged in a risk index especially useful to the insurance industry
Actuaries Climate Risk Index - Methodology

• Regression analysis of damages and ACI components by region looked at:
  o Mortality and morbidity vs. heat
  o Flood damages vs. maximum 5-day precipitation
  o Crop damages vs. consecutive dry days
  o Wildfire damages vs. consecutive dry days
  o Wind damages vs. wind power

• Each of these became a historical impacts index (HII)
  o Scaled to an index ranging from 1-10

• Proxies or no index were used in a few regions with no finding of statistically significant relationships

• These are blended together to become the ACRI
SHELDUS Data Summary 1960-2011

MONETARY & HUMAN LOSSES BY HAZARD TYPE

Losses ($2011 Billion)
- Wildfire: $18 billion, 3%
- Volcano: $6 billion, 1%
- Tsunami, Seiche: $2 billion, <1%
- Tornado: $48 billion, 9%
- Severe Storms: $30 billion, 6%
- Lightning: $3 billion, <1%
- Hurricane, Tropical Storm: $142 billion, 26%
- Winter Weather: $22 billion, 4%
- Wind: $27 billion, 5%
- Landslide, Avalanche: $11 billion, 2%
- Earthquake: $57 billion, 11%
- Flooding: $97 billion, 18%
- Hail: $23 billion, 4%
- Fog: $0 billion, <1%

Fatalities
- Wildfire: 143, <1%
- Volcano: 58, <1%
- Tsunami, Seiche: 226, 1%
- Earthquake: 3,694, 12%
- Flooding: 3,647, 12%
- Tornado: 4,328, 14%
- Severe Storms: 2,220, 7%
- Lightning: 3,647, 12%
- Heat, Drought: 4,722, 16%
- Coastal: 893, 3%
- Landslide, Avalanche: 565, 2%

Phase 2 – Stage V - Regression

- A linear regression analysis was performed for all regions for the following damage categories: Flood, Wind, Heat, Drought and Wildfire.
- The example here is for Flood in which Rx5day precipitation was regressed against Sheldus monetary damages (in Billions US$2007)
- Relationships like this, together with their 95th confidence limits, were evaluated by hazard and region.

Source: Climate Index Work Group, *Stage V Summary*
Linear regression results for U.S. and Canadian regions. Best-fit slopes (a) and intercepts (C0) from linear regression of estimated damages versus physical exposure PE (a; RPE2), climate hazard only (aH; RH2), and climate hazard and population together (aH, aP; C0; RHP2) as predictors of economic damage.

Statistically significant correlations were found for 6 out of 7 U.S. regions in the Flood category (Rx5day). Far fewer statistically significant relationships were found using the Canadian data: only 1 of 4 regions displayed significant relations for Flood, The Canadian Arctic region, CAR, was omitted from the analysis due to lack of damage data.

<table>
<thead>
<tr>
<th>Flood</th>
<th>PE</th>
<th>H alone</th>
<th>Both H &amp; P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
<td>C0</td>
<td>RPE²</td>
</tr>
<tr>
<td>CEA</td>
<td>4.3</td>
<td>4.3</td>
<td>0.19</td>
</tr>
<tr>
<td>CWP</td>
<td>1.8</td>
<td>3.7</td>
<td>0.21</td>
</tr>
<tr>
<td>MID</td>
<td>3.6</td>
<td>4.5</td>
<td>0.19</td>
</tr>
<tr>
<td>SEA</td>
<td>4.2</td>
<td>4.3</td>
<td>0.22</td>
</tr>
<tr>
<td>SPL</td>
<td>3.4</td>
<td>4.1</td>
<td>0.30</td>
</tr>
<tr>
<td>SWP</td>
<td>2.1</td>
<td>4.8</td>
<td>0.15</td>
</tr>
<tr>
<td>NPL</td>
<td>1.5</td>
<td>6.2</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Source: Climate Index Work Group, *Stage V Summary*
Phase 2 – Stage V - Relationships

Entries marked “-” do not show a statistically significant relationship.

Entries in blue are proxies, equal to the mean value in all regions within either US-only or Canada-only having a significant relationship.

Source: Climate Index Work Group, *Climate Index Relationships*
ACI and ACRI Roll Out

- Complete formulation of ACI is Done
- Prototype website was built by Solterra Solutions
- ACI website is being built; launching May/June 2016
- Building the ACRI portion of actual website will follow
- Quarterly index releases in tandem with ACI
- Periodic articles in actuarial magazines
- Call for papers
Jeff Stahler’s View…

This drought is really getting bad.

Index Resources

- Solterra Solutions, Determining the Impact of Climate Change on Insurance Risk and the Global Community, Phase I: Key Climate Indicators, November 2012. Available at: www.casact.org/research/ClimateChangeRpt_Final.pdf

- Data sources:
  - GHCNDEX: www.climdex.org
  - GHCN-Daily: www.ncdc.noaa.gov/oa/climate/ghcn-daily/
  - Sea Level: www.psmsl.org/data/obtaining/
  - Wind: www.esrl.noaa.gov/psd/data/gridded/datancep.reanalysis.html
Outside Reading (Homework)

- Al Gore, An Inconvenient Truth
- James Hansen, Storms of my Grandchildren
- James Hansen, Ice Melt, Sea Level Rise and Superstorms
- Robert Henson, The Rough Guide to Climate Change
- Elizabeth Kolbert, The Sixth Extinction
- Michael Mann & Lee Kump, Dire Predictions
- Roger Pielke, Jr., The Rightful Place of Science: Disasters & Climate Change
- Henry Pollack, A World Without Ice
- Henry Pollack, Uncertain Science… Uncertain World
- Matt Ridley, The Rational Optimist
- Andrew Weaver, Generation Us
NAIC Disclosure Update
NAIC Disclosure Survey Timeline

NAIC teamed with CERES and insurance representatives in developing disclosures

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>NAIC Climate Change Task Force formed</td>
</tr>
<tr>
<td>2007</td>
<td>Drafting of survey questions</td>
</tr>
<tr>
<td>2008</td>
<td>NAIC approves Disclosure Survey</td>
</tr>
<tr>
<td>2009</td>
<td>Individual States adopt own rules</td>
</tr>
<tr>
<td>2010</td>
<td>Task Force dissolved CA, WA, NY (and PA) keep the survey. Working Group formed</td>
</tr>
<tr>
<td>2011</td>
<td>CT, MN join the multi-state initiatives</td>
</tr>
<tr>
<td>2012</td>
<td>IL, MD, and NM join the multi-state initiatives</td>
</tr>
<tr>
<td>2013</td>
<td>CA, WA, NY, CT and MN: &gt;100M DWP PA: &gt;300M DWP</td>
</tr>
<tr>
<td>2014</td>
<td>CA, WA, NY, CT and MN: &gt;100M DWP PA: &gt;300M DWP</td>
</tr>
</tbody>
</table>

Mandatory and public reporting for insurer groups with DWP >500M

Voluntary and confidential

Mandatory and public reporting for individual companies who write >300M DWP in one of CA, WA and NY. For PA: Mandatory for insurer groups with DWP >300M
# NAIC Disclosures Survey – State Disclosure Actions

<table>
<thead>
<tr>
<th>Participating in Disclosures</th>
<th>Not Participating</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>State</strong></td>
<td><strong>Mandatory?</strong></td>
</tr>
<tr>
<td>California</td>
<td>Yes</td>
</tr>
<tr>
<td>New York</td>
<td>Yes</td>
</tr>
<tr>
<td>Washington</td>
<td>Yes</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>Yes</td>
</tr>
<tr>
<td>Minnesota</td>
<td>Yes</td>
</tr>
<tr>
<td>Connecticut</td>
<td>Yes</td>
</tr>
<tr>
<td>Maryland</td>
<td>Yes</td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>Yes</td>
</tr>
<tr>
<td>Florida</td>
<td>No</td>
</tr>
<tr>
<td>Illinois</td>
<td>No</td>
</tr>
<tr>
<td>New Jersey</td>
<td>No</td>
</tr>
<tr>
<td>Oregon</td>
<td>No</td>
</tr>
<tr>
<td>Alabama</td>
<td>No</td>
</tr>
<tr>
<td>Colorado</td>
<td>No</td>
</tr>
<tr>
<td>Louisiana</td>
<td>No</td>
</tr>
<tr>
<td>Michigan</td>
<td>No</td>
</tr>
<tr>
<td>Missouri</td>
<td>No</td>
</tr>
<tr>
<td>Nebraska</td>
<td>No</td>
</tr>
</tbody>
</table>
NAIC Disclosures Survey

**Adopted Disclosure Survey – 8 Questions**

**Disclosure 1**
Does the company have a plan to assess, reduce or mitigate its emissions in its operations or organizations? If yes, please summarize.

CDP: Performance Q21

**Disclosure 2**
Does the company have a climate change policy with respect to risk management and investment management? If yes, please summarize. If no, how do you account for climate change in your risk management?

CDP: Risk & Opportunities Q1-3

**Disclosure 3**
Describe your company’s process for identifying climate change-related risks and assessing the degree that they could affect your business, including financial implications.

CDP: Risk & Opportunities Q1-3

**Disclosure 4**
Summarize the current or anticipated risks that climate change poses to your company. Explain the ways that these risks could affect your business. Include identification of the geographical areas affected by these risks.

CDP: Risk & Opportunities Q1-3

**Disclosure 5**
Has the company considered the impact of climate change on its investment portfolio? Has it altered its investment strategy in response to these considerations? If so, please summarize the steps you have taken.

CDP: Risk & Opportunities Q3 “Other Risks”
Q6 “Other Opportunities”

**Disclosure 6**
Summarize steps the company has taken to encourage policyholders to reduce the losses caused by climate change-influenced events.

CDP: Risk & Opportunities Q4-6

**Disclosure 7**
Discuss steps, if any, the company has taken to engage key constituencies on the topic of climate change.

CDP: Governance Q24, 26, 27

**Disclosure 8**
Describe actions your company is taking to manage the risks climate change poses to your business including, in general terms, the use of computer modeling.

CDP: Risk & Opportunities Q1-3
NAIC Disclosure Scoring Methodology

**Scoring Framework**

Thematic organization of the scoring approach is as follows:

- **Theme 1**: Climate Governance
- **Theme 2**: Enterprise-Wide Climate Risk Management
- **Theme 3**: Climate Change Modeling & Analytics
- **Theme 4**: Stakeholder Engagement
- **Theme 5**: Internal Greenhouse Gas Management
- **Theme 6**: Quality of Climate Risk Disclosure & Reporting

**Rated Results**

Ceres uses a four-tier approach for rating insurers’ responses to survey questions:

- **Top Quartile Rated Insurers** = Leading Practices
- **Second Quartile Rated Insurers** = Developing Practices
- **Third Quartile Rated Insurers** = Beginning Practices
- **Fourth Quartile Rated Insurers** = Minimal Information

---

**CLIMATE RISK MANAGEMENT RATINGS HIERARCHY**

**Minimal**

The insurer provided only a limited amount of detail, omitted answers to survey questions, or survey responses indicated a disregard for the risks climate change presents to the company’s lines of business.

**Beginning**

Survey responses indicate a basic understanding of climate change, but a lack of a comprehensive strategy to address the myriad risks and opportunities.

**Developing**

Survey responses indicate a solid understanding of climate change and the company has started to develop and implement comprehensive strategies in selected functions.

**Leading**

Survey responses indicate a comprehensive and deep understanding of climate change risks and opportunities and the company has implemented relevant strategies, monitors and measures progress, and has developed accountable climate risk governance at both senior management and board levels.

NAIC 2014 State Disclosures Survey Results

For the 2014 reporting year:

- Survey generated 330 distinct insurer responses, representing 87% of the U.S. insurance market
- The 2014 survey revealed that most of the companies responding to the survey reported a profound lack of preparedness in addressing climate-related risks and opportunities.
- Using a 100-point scale, only 4% of the P&C Segment surveyed earned an overall “Leading” rating (75 points or higher) while vast majority of insurers, 76%, earned “Beginning” or “Minimal” ratings (50 points or below)
- Nearly half of P&C insurers have taken positive steps in Climate Change Modeling & Analytics
- Link to survey database as of December 31, 2014
  - [https://interactive.web.insurance.ca.gov/apex/f?p=201:1:0::NO](https://interactive.web.insurance.ca.gov/apex/f?p=201:1:0::NO)
NAIC 2014 State Disclosures Recommendations

Develop Climate Risk Oversight at the Board and C-Suite Levels:
• Insurers’ senior-level leadership will need to understand and align company policies with the risks associated with climate change.

Issue a Comprehensive, Public Corporate Policy on Climate Risk:
• All insurers should develop and issue a public climate risk management policy for the benefit of their shareholders, policyholders, and employees.

Integrate Climate Risk into ERM Frameworks:
• Incorporating climate change as an emerging risk will help insurers catalyze more effective responses across their enterprises.

Improve Climate Change Scenarios and Impact Assessments:
• Large-scale climate scenario project software and insurer underwriting data synergy will promote loss scenario developments that will directly feed into insurer product offerings and pricing.

Evaluate Climate Risks and Opportunities in Investment Portfolios:
• To remain competitive, companies will need to understand and invest in new opportunities such as green bonds which provide attractive returns and opportunities for diversification.

Engage with key Stakeholders on Climate Risk:
• Efforts include advocating for investments in resilient public infrastructure and climate research, educating policyholders regarding how they can mitigate climate risks in their homes and businesses, and promoting climate-smart insurance products.

Provide Comprehensive Climate Risk Disclosure to Regulators:
• In the interests of transparency and supporting evaluations of each specific insurance company’s management of its climate risks, insurers should make every effort to provide comprehensive information publicly.

Participate in Joint Industry Initiatives on Climate Risk:
• Ceres’ INCR, United Nations (UNEP FI PSI), ClimateWise.
Potential Impacts of Climate Change on the P&C Industry
How might the Actuaries Climate Index impact Property & Casualty actuarial work?
P&C Actuaries will need to

- Learn & follow measures of changing climate.
- Distinguish between changes in climate from changes in weather.
- Follow changes of climate over time and estimate how risk distributions change.
- Estimate changes in risk distributions
- Translate global risk distribution changes into their impact on local situations.
- Estimate the impacts of change on exposures at risk in various locations.
Measure change in extreme climate over time
ACI is a risk lever measurement of Climate Extreme multipliers

"Climate change is a ‘threat multiplier’ making worse the problems that already exist."
- Senator John Warner, in testimony before the Senate Foreign Relations Committee as quoted by John Kerry, Secretary of State at Old Dominion University.
WHAT THE ACI DOES:
ITS COMPONENTS : INCREASE IN MEAN
MEASURE AND VARIANCE

Source: Solterra Solutions: Determining the Impact of Climate Change on Insurance Risk and the Global Community
Phase 1: Key Climate Indicators
Summer Temperatures Have Shifted

1951 – 1980

1991 – 2001

Frequency of Occurrence

Deviation from Mean

0 1 2 3 4 5

Cooler than average

Average

Warmer than average

Baseline (1951 - 1980) mean

Extremely hot

The "extreme" temperature events used to cover 0.1% of the Earth. Now they cover 10%.
Current Estimated Storm Surge Extent – by risk level
Current estimated MAXIMUM Storm Surge Risk Extent

Source: CoreLogic Storm Surge Report, 2013
Estimated maximum surge risk extent after 1 foot Sea-Level Rise

Source: CoreLogic Storm Surge Report, 2013
Estimated maximum surge risk extent after 2 foot Sea-Level Rise

Source: CoreLogic Storm Surge Report, 2013
Estimated maximum surge risk extent after 3 foot Sea-Level Rise

Source: CoreLogic Storm Surge Report, 2013
Storm Surge Risk extension by Sea-Level Rise of 1 foot, 2 feet & 3 feet

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

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

Source: CoreLogic Storm Surge Report, 2013
Potential additional Residences at risk of Sea-Level Rise

<table>
<thead>
<tr>
<th>Area Name</th>
<th>Properties Affected</th>
<th>1 foot</th>
<th>2 feet</th>
<th>3 feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York</td>
<td>447,428</td>
<td>16,487</td>
<td>32,238</td>
<td>49,023</td>
</tr>
<tr>
<td>Miami</td>
<td>239,910</td>
<td>207,986</td>
<td>218,109</td>
<td>223,485</td>
</tr>
<tr>
<td>Virginia Beach</td>
<td>305,943</td>
<td>3,457</td>
<td>7,925</td>
<td>11,075</td>
</tr>
<tr>
<td>Tampa</td>
<td>301,045</td>
<td>2,992</td>
<td>4,105</td>
<td>8,794</td>
</tr>
<tr>
<td>New Orleans</td>
<td>238,919</td>
<td>2,026</td>
<td>2,864</td>
<td>3,592</td>
</tr>
<tr>
<td>Houston</td>
<td>187,560</td>
<td>11,666</td>
<td>19,686</td>
<td>28,434</td>
</tr>
<tr>
<td>Mobile</td>
<td>27,515</td>
<td>1,527</td>
<td>3,043</td>
<td>6,718</td>
</tr>
</tbody>
</table>

Source: CoreLogic Storm Surge Report, 2013
What has been accomplished?

• By focusing carefully and thoughtfully on the past, the Climate Change Committee has finished a solid foundation of extreme climate risk data for the future.

• The ACI is a carefully curated index data that can be thought of as the footings of a new analytic home.

• The ACRI could be thought of as the solid foundation of a new home.
Carefully curated Indices:  
ACI & ACRI

Actuaries Climate Index: Solid footings!

Actuaries Climate Risk Index: A Solid foundation!
What will the ACRI do?

- Economic damage data was gathered
  - (SHELDUS data in the US and a similar Canadian dataset).
- Historical relationships, Historical Hazard Indices were quantified between economic damages and population data and the ACI

**Blending these predictive relationships is the ACRI, the Actuaries Climate Risk Index**

- The resulting ACRI will quantify changing level(s) of risk to economic assets and human population due to aspects of climate change described in the ACI, over the same North American (Canada-U.S.) domain.
Benefits of Actuarial/Scientist Collaboration using the ACI/ACRI

Opportunity to Build the 1st Floor!

Future Projects will then be ready to weather storms and stand firm!
Potential Uses, Further R & D

• Potential uses
  o Inform the debate
  o Compare weather and climate
  o Analysis of data

• Adding regions
  – Will actuarial organizations elsewhere take lead?
  – Had preliminary talks recently with IFoA in UK
  – Could link or add to our website

• Call paper program after launch
• Funded research
Benefits of Collaborative Refinement

• A refined ACI could be constructed for the US, by state and/or county. 3 benefits & A Big Result would follow:
  • BETTER GRANULARITY: It could improve the ACI giving Property Casualty with work by State. Further, the county detail would give necessary coastal reference points for measuring climate extreme impacts of Seal Level Rise (SLR).
  • BETTER USE OF DATA: Actuaries could help make best use of the wealth of data gathered to solve SLR problems
  • BETTER SCIENCE The analysis could be enhanced with expert modeling skills of NOAA scientists and others.
• Refined Climate Adaptation Cost Models
Composite indexes by product line could be created based on an understanding of the relative impact of various climate driven natural hazards.

Examples:

- **Property Climate Risk** = \( f(\text{Floods, Tropical Cyclone, Extra-tropical Cyclone Indices, Sea Level Rise}) \)
- **Crop Climate Risk** = \( f(\text{Floods, Heat waves and Drought}) \)
Sustainability/Green Products
"Just as the industry has historically asserted its leadership to minimize risks from building fires and earthquakes, insurers have a huge opportunity today to develop creative loss-prevention solutions and products that will reduce climate change-related losses for consumers, government, and themselves."

— E. Mills, Ph.D.,
CERES “From Risk to Opportunity Insurer Responses to Climate Change”
Sustainability/Green Products

• Sustainable products are those products that provide environmental, social and economic benefits while protecting public health and the environment over their whole life cycle, from the extraction of raw materials used to produce the product until their final disposal.

• Sustainable and green insurance products are those that cover the design, production and use of sustainable products, or the liability associated with their production and use.

• They also indemnify against the environmental consequence of potential climate change decisions (or indecisions) made by executives in Directors & Officers coverage.

• Also broadly covered in this definition of sustainable/green products would be policies where certain features promote sustainable or green behavior.
Sustainability/Green Products

Personal
(Household, Auto)
1. Green Property Rebuilding
2. Property Renewable Energy Reimbursement
3. Property Loss Mitigation Device Discount
4. Pay As You Drive/ Low Mileage Discount
5. Fuel Efficient/Low Emission Vehicle Discount

Commercial
(Property, Fleet, Operations, Publicity)
1. Upgrade to Green Commercial Fleets
2. Insurance for Renewable Energy Projects
3. Insurance for Renewable Energy Property, Equipment and Loss of Use
4. Insurance for Green Building
5. Energy Savings Insurance
6. Insurance for Carbon Capture & Storage/ Emission Reduction Projects
7. Green Building Coverage Against Adverse Publicity
8. Perishable Food Reduction Products
9. Global Weather Insurance
10. Political Risk Insurance for Carbon-Trading

Specialty
(Environmental Liability, Professional Liability)
1. Insurance for Pollution/ Environmental Liability
2. Directors & Officers Insurance
3. Architects & Engineering Professional Liability Insurance
4. Discount for Building Commissioning
5. Professional Liability Insurance for Raters and Home Energy Survey Professionals
# Green Product Offerings: Personal Lines

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Property Rebuilding</td>
<td>Repair and replace with more energy-efficient and sustainable materials, equipment or appliances</td>
</tr>
<tr>
<td>Property Renewable Energy Reimbursement</td>
<td>In case of power outage from the alternative-energy system, indemnify for loss of income generated, costs to purchase replacement electricity and re-connection costs</td>
</tr>
<tr>
<td>Property Loss Mitigation Device Discount</td>
<td>Premium credits are offered to homeowners who install mitigation devices or choose storm-resistant construction techniques</td>
</tr>
<tr>
<td>Pay As You Drive/Low Mileage Discount</td>
<td>Give incentives to drive less which leads to less pollution that may be contributing to global warming</td>
</tr>
<tr>
<td>Fuel Efficient/Low Emission Vehicle Discount</td>
<td>Provide discounts for hybrid or electric passenger vehicles</td>
</tr>
</tbody>
</table>
ISO Green Upgrades Coverage (HO 06 31 01 14)

1. Green Upgrades Property Coverage

The coverage is available for the increased cost due to green upgrades and is based on a percentage of the amount of the loss. This percentage is selected by the client (at the time the endorsement is added) with options of 10%, 20%, 30%, 40%, or 50% available.

One green option that is gaining popularity is a vegetated roof—also known as a green roof, a living roof, or an eco roof. The increased cost to upgrade to a vegetated roof is not automatically covered by this endorsement.

2. ISO Green Upgrades Related Coverage

Coverage is provided up to the limit shown in the Schedule for those expenses that are related to a loss covered under the Green Upgrades Property Coverage. Covered expenses are those incurred for:

- Waste Reduction and Recycling,
- Design And Engineering Professional Fees,
- Certification Fees And Related Equipment Testing, and
- Building Air-out And Related Air Testing.
Green Product Offerings: Personal Lines Example 2

Green Property Rebuilding

After a covered loss, it pays for the use of:
• Environmentally friendly or more energy-efficient materials when making repairs
• More energy efficient equipment or appliances.

For those policyholders who are already green, discounts are sometimes offered on their insurance premiums.
QUESTIONS & DISCUSSION
Potential Uses – Rate Making & Risk Management

• Integrate AC(R)I as parameters into predictive models
  • Capture climate sensitivity in underlying hazard
  • Capture both historical and projected trends explicitly

• ACRI can complement catastrophe risk models

• ACRI parameters can be used to create and assess future robust
decision making scenarios

• ACRI can be used to calculate the Climate Change “Uncertainty or
Ambiguity” load in pricing and capital management

• Regional and line of business ACRI can be used for portfolio
diversification and strategic decisions
How Can We Leverage This Work?

• What significant issues does the insurance industry face due to climate change?
  o Varies for property, liability, life, health
  o Incorporating new trends into pricing
  o Incorporating higher risk into pricing and ERM
  o Coverage & availability
  o Underwriting, investment and claim strategy

• Timetable and urgency of mitigation, remediation

• Managing climate change risk using the ACI & ACRI
  o Education
  o Data analysis
It is our actuarial professional responsibility to understand the latest in climate change science and develop actuarially sound approaches to managing the potential implications of climate change risk factors.