

# THE ACTUARIES CLIMATE INDEX

PRESENTED TO THE INTER-AGENCY FORUM  
ON CLIMATE CHANGE IMPACTS AND ADAPTATIONS

JIM MACGINNITIE, MAAA, FCAS, FSA  
SENIOR CASUALTY FELLOW  
AMERICAN ACADEMY OF ACTUARIES



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# Measuring Climate Extremes and Climate Risk: An introduction to the Actuaries Climate Index and the Actuaries Climate Risk Index



ACTUARIES CLIMATE INDEX  
INDICE ACTUARIEL CLIMATIQUE

# Goals of the Actuaries Climate Index (ACI) and the Actuaries Climate Risk Index (ACRI)

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- Create indices that reflect an actuarial perspective; are objective; and are easy to understand without being overly simplistic
- Create one index that measures changes in climate extremes; and a second index that relates those climate extremes to economic and human losses
- Use the indices to inform policymakers, insurers and the general public on the impact of climate change
- Promote the actuarial profession, by contributing constructively to the climate change debate

## *Research sponsors:*



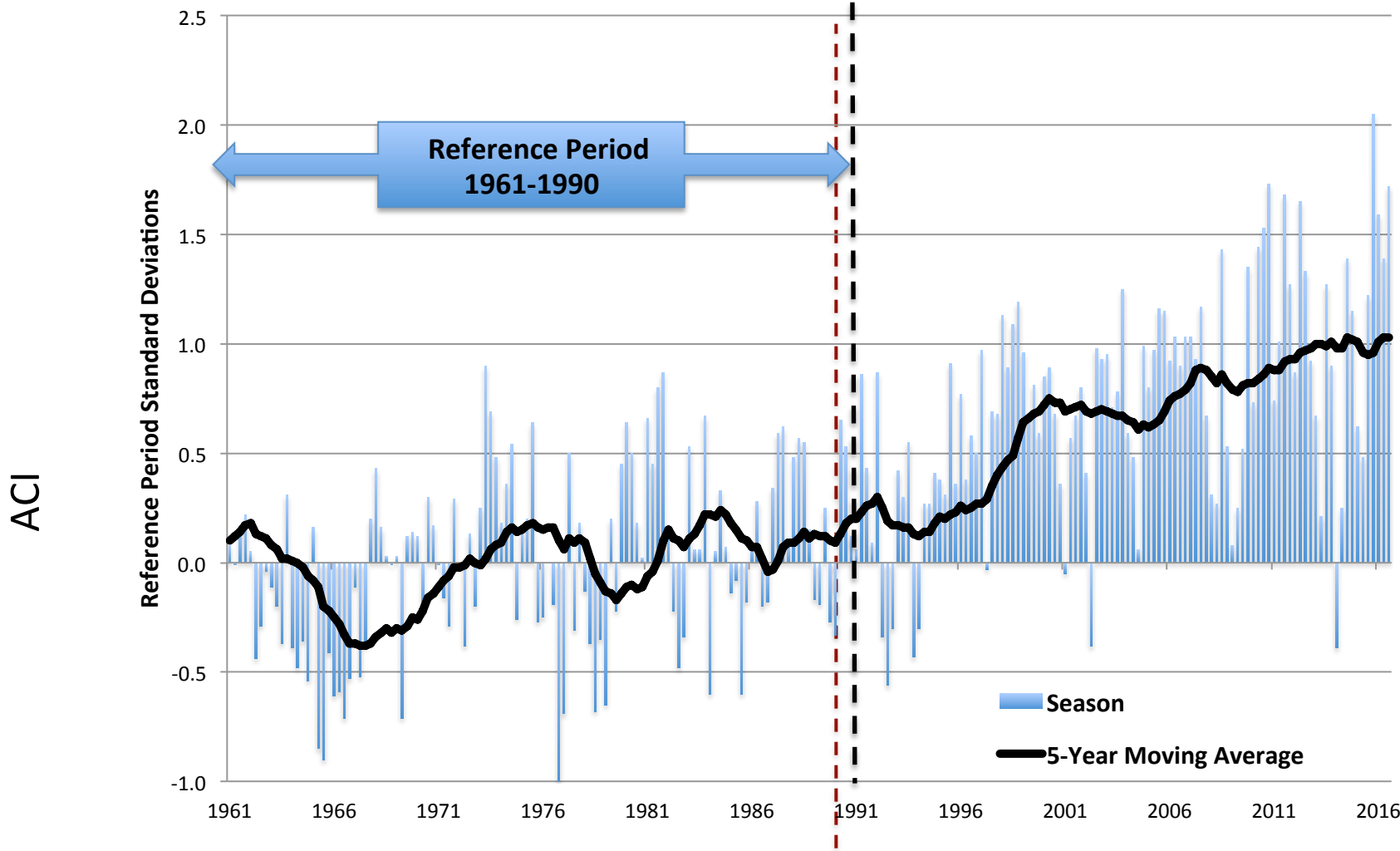
# The Actuaries Climate Index (ACI) focuses on the frequency of severe weather

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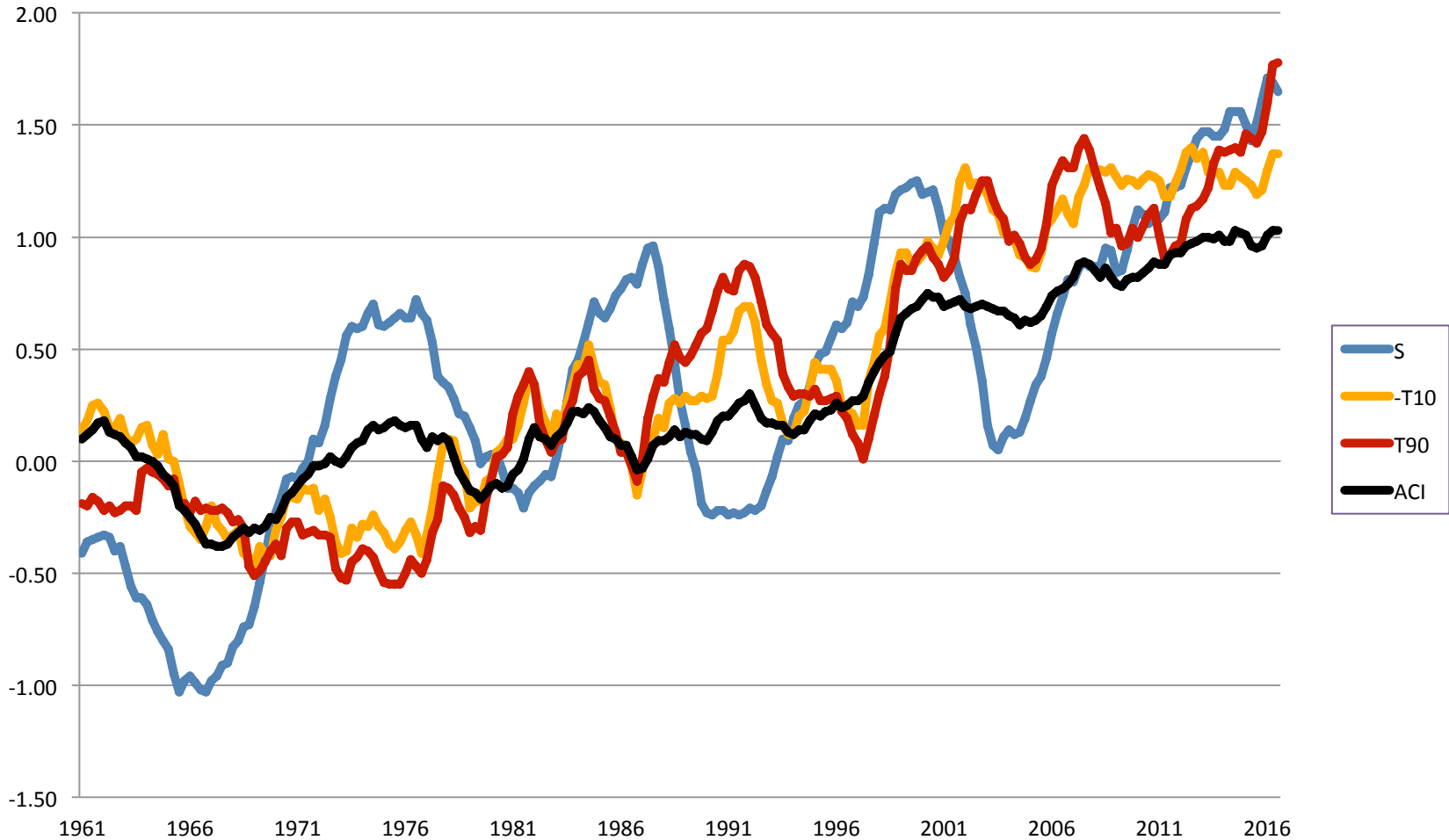
- Example: “How often is the temperature in a given month at or above the 90<sup>th</sup> percentile?”
- The 90<sup>th</sup> percentile is based on the 1961-1990 base reference period
- Average of six component sub-indices for hot temperatures, cold temperatures, high precipitation, drought, high wind, and coastal sea level
- $ACI = (\Delta T_H - \Delta T_C + \Delta P + \Delta D + \Delta W + \Delta S) / 6$
- ACI Components are of the form:

$$(x - \mu_{ref}) / \sigma_{ref}$$

# Actuaries Climate Index™ - USA & Canada

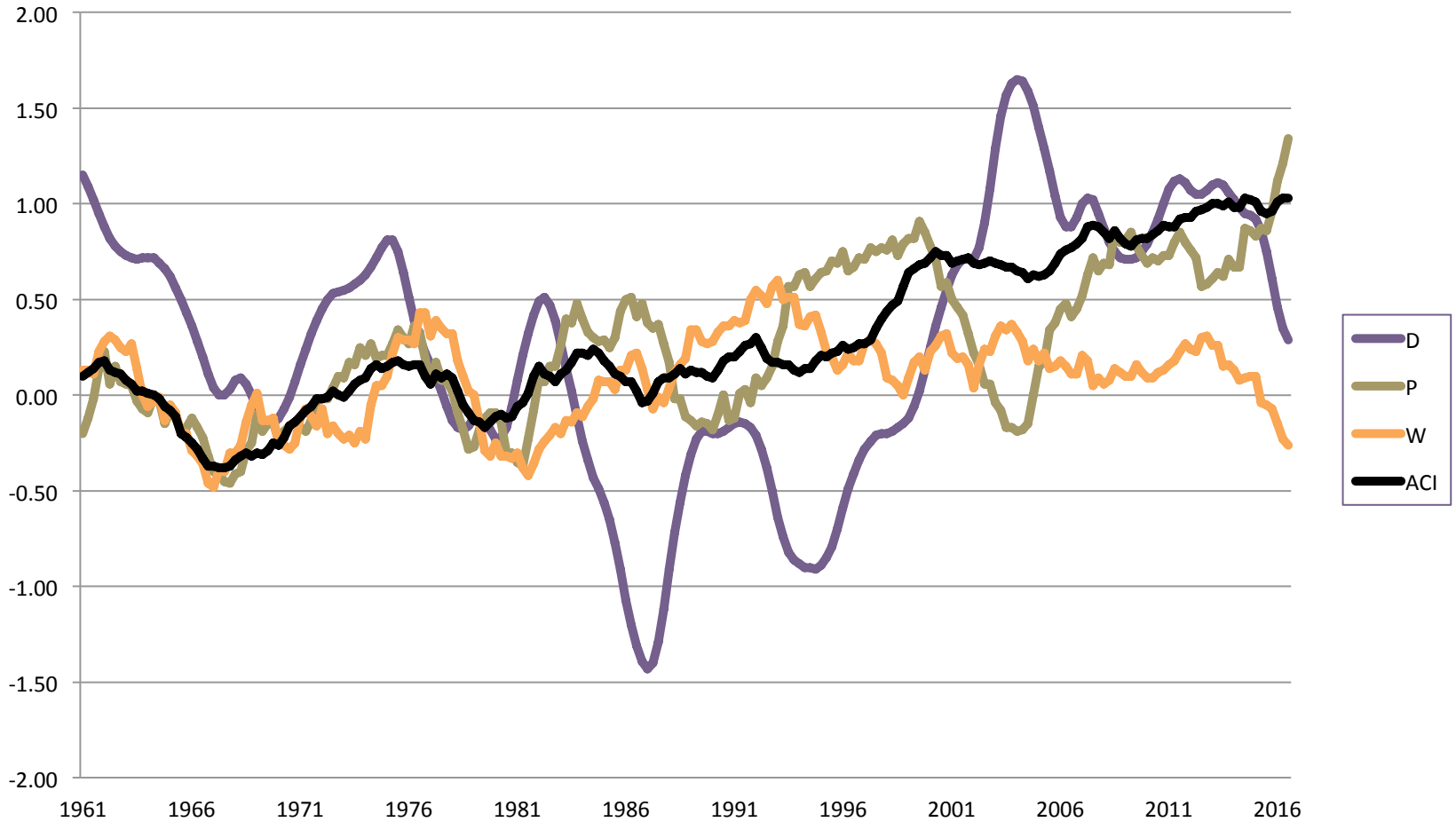


# Temperature and Sea Level Components - USA and Canada



← *Baseline reference period* →

# Wind Power, Precipitation and Drought - USA and Canada



← Baseline reference period →

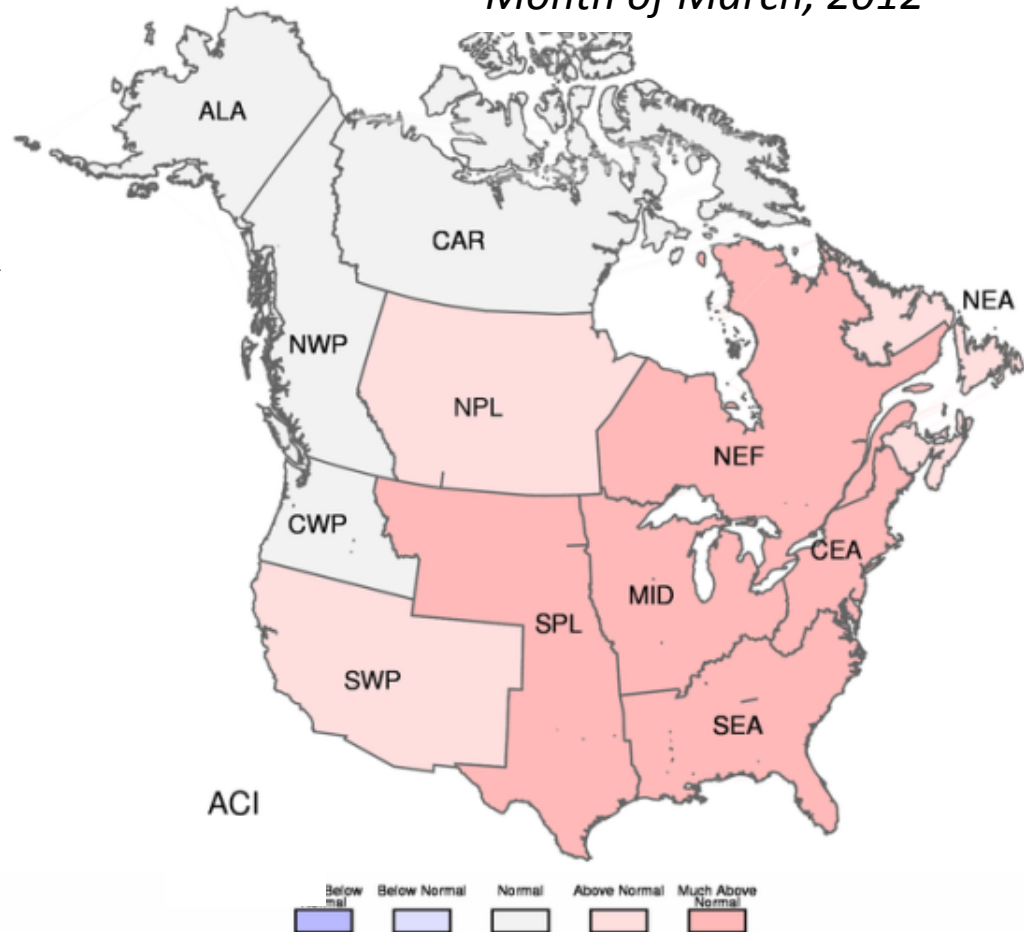


# ACI data is constructed for geographic grids, then summarized to regions, countries, and in total

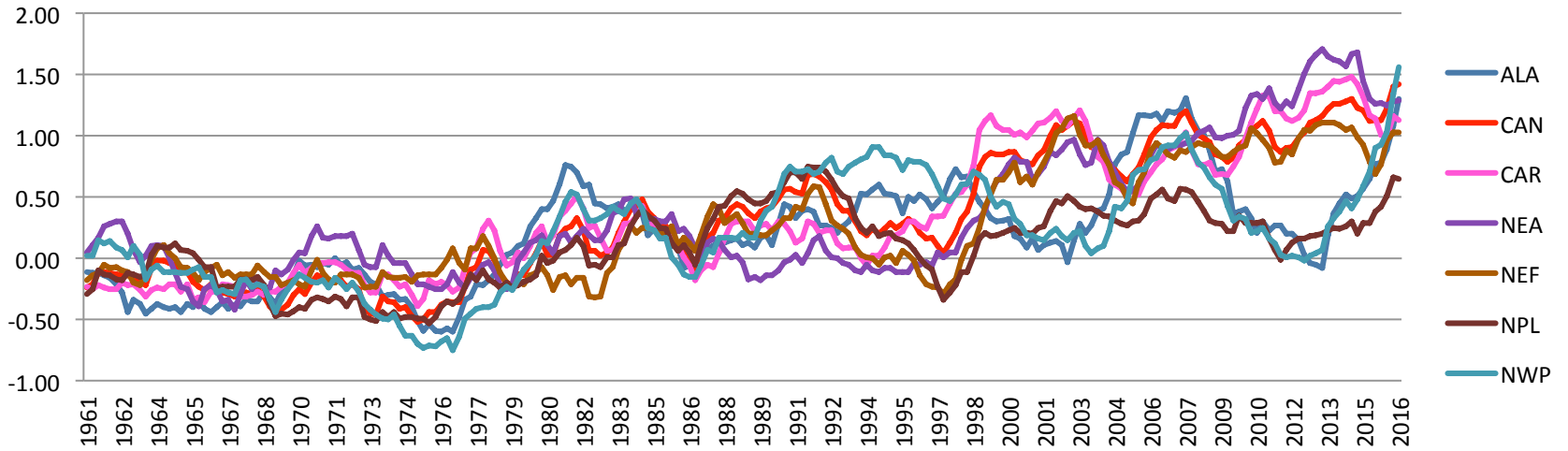
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- ACI components are constructed in a uniform 2.5° grid across the USA and Canada
  - 275km by 275km at equator
- Grid components for each climate variable are summarized into indices for 12 natural regions, two countries and U.S and Canada in total
- Summarized indices are unweighted averages of grid components
  - Each climate change component is equally important

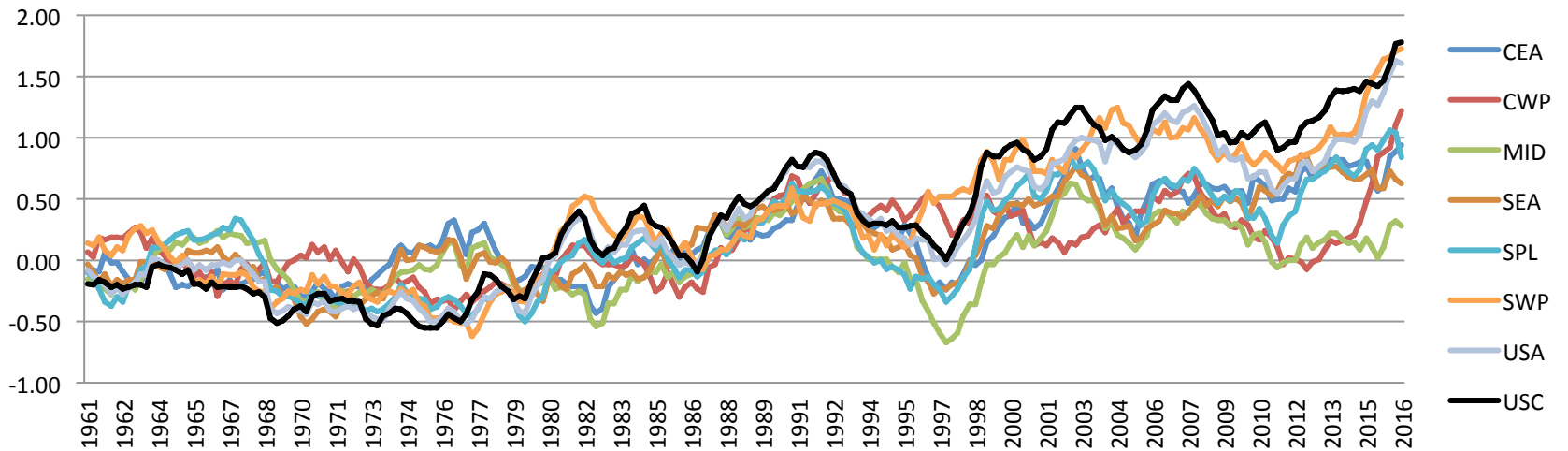
*Frequency of Extreme Temperatures  
Month of March, 2012*



### 5-Year T90 Northern Regions

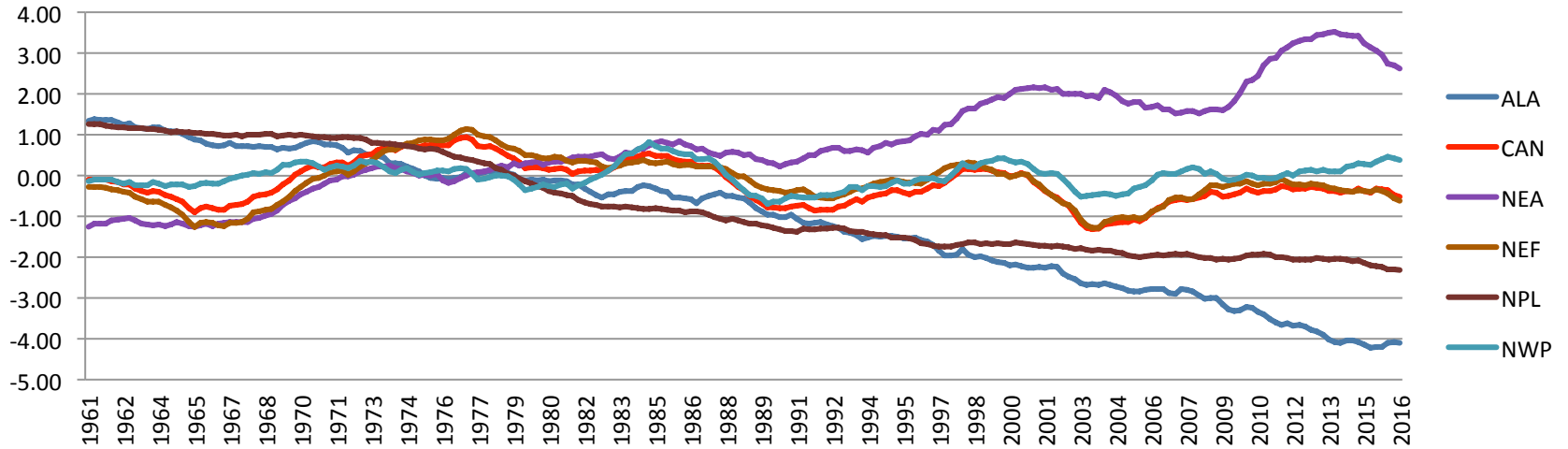


### 5-Year T90 Southern Regions

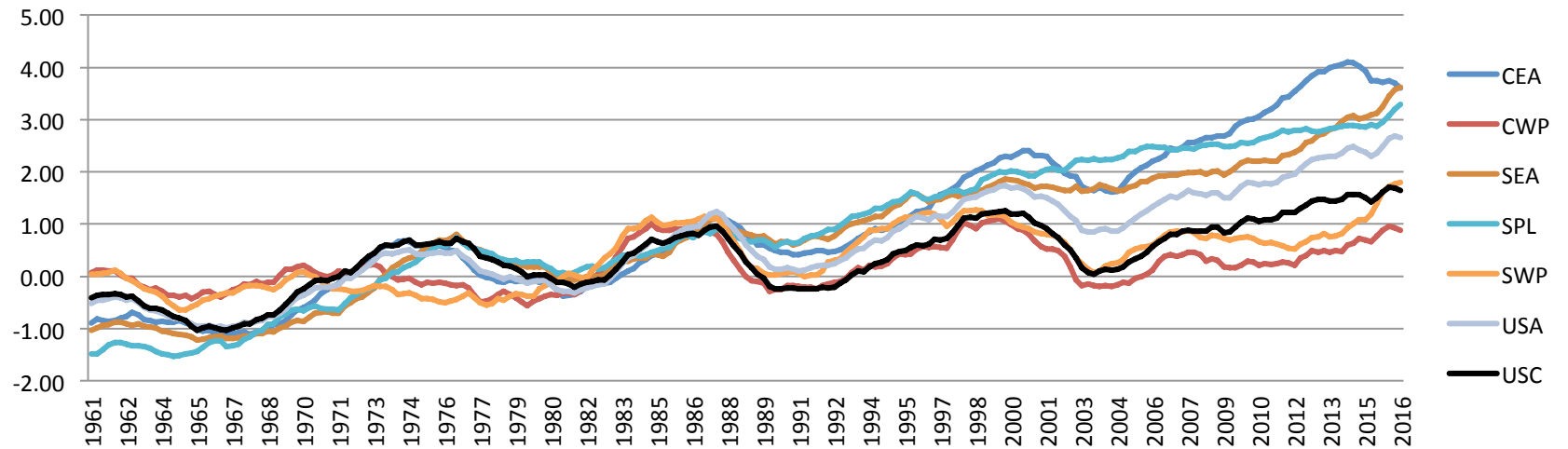




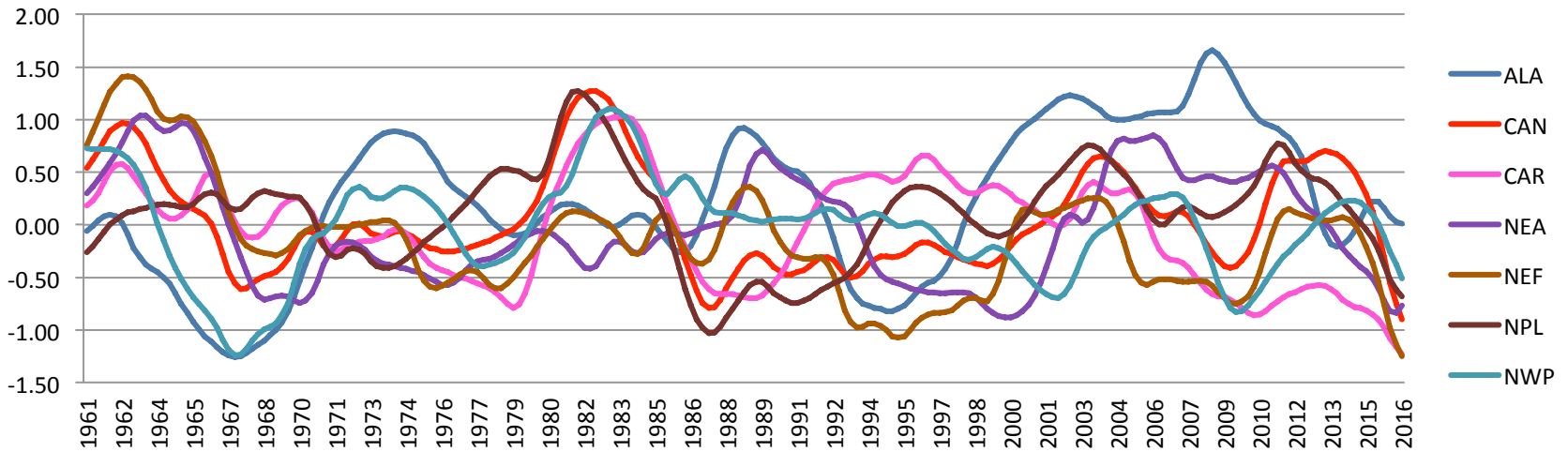
## 5-Year Sea Level Northern Regions



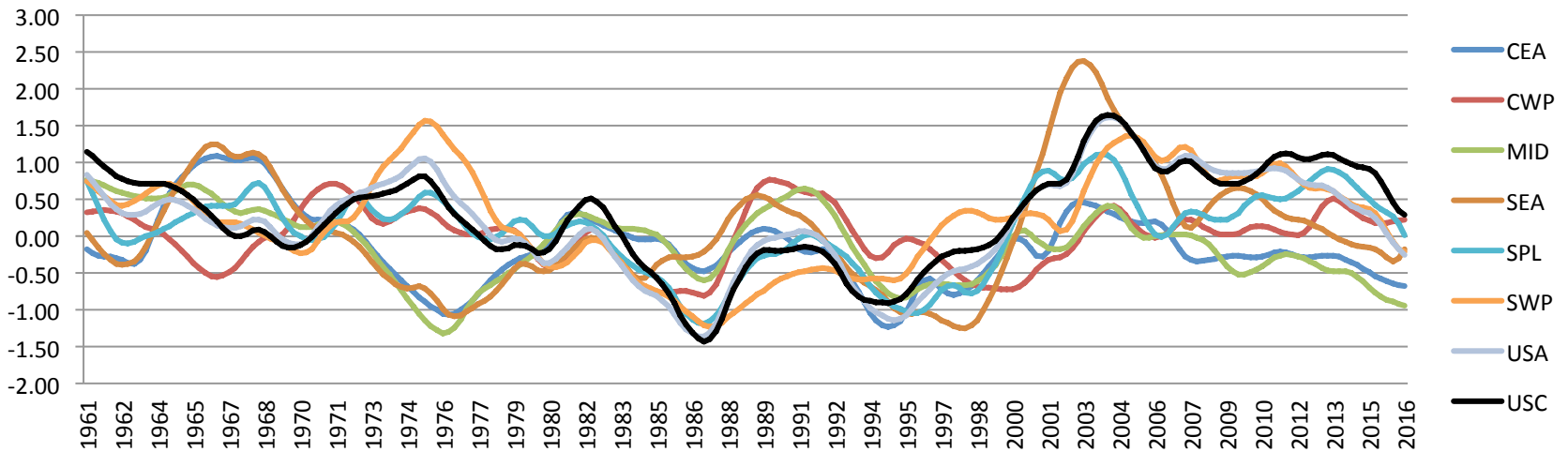
## 5-Year Sea Level Southern Regions



## 5-Year Drought Northern Regions

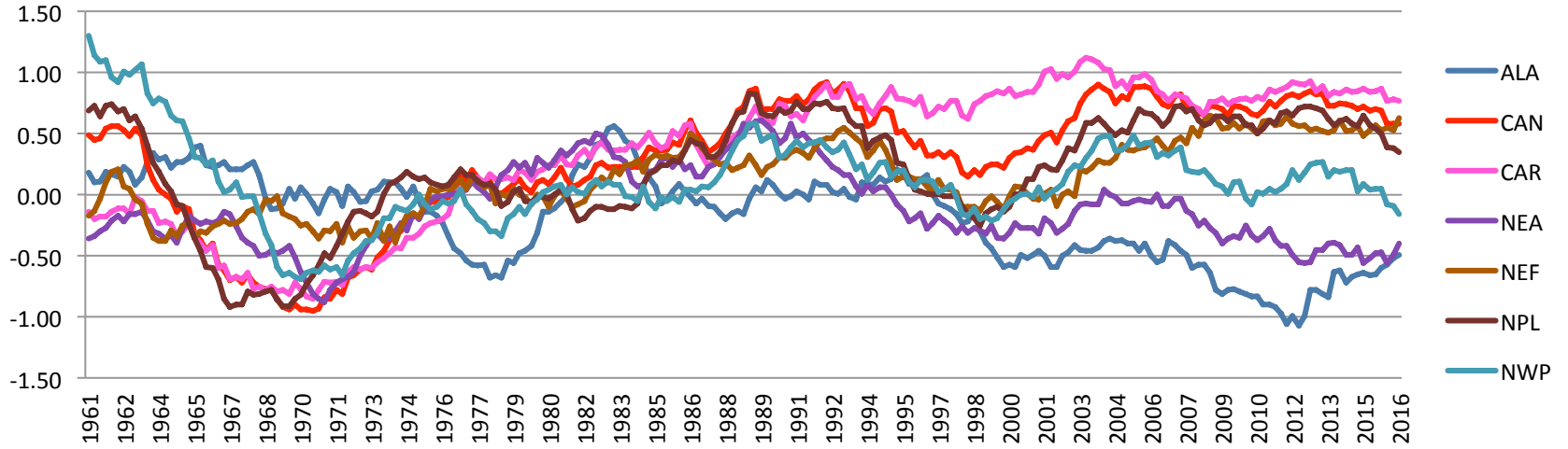


## 5-Year Drought Southern Regions

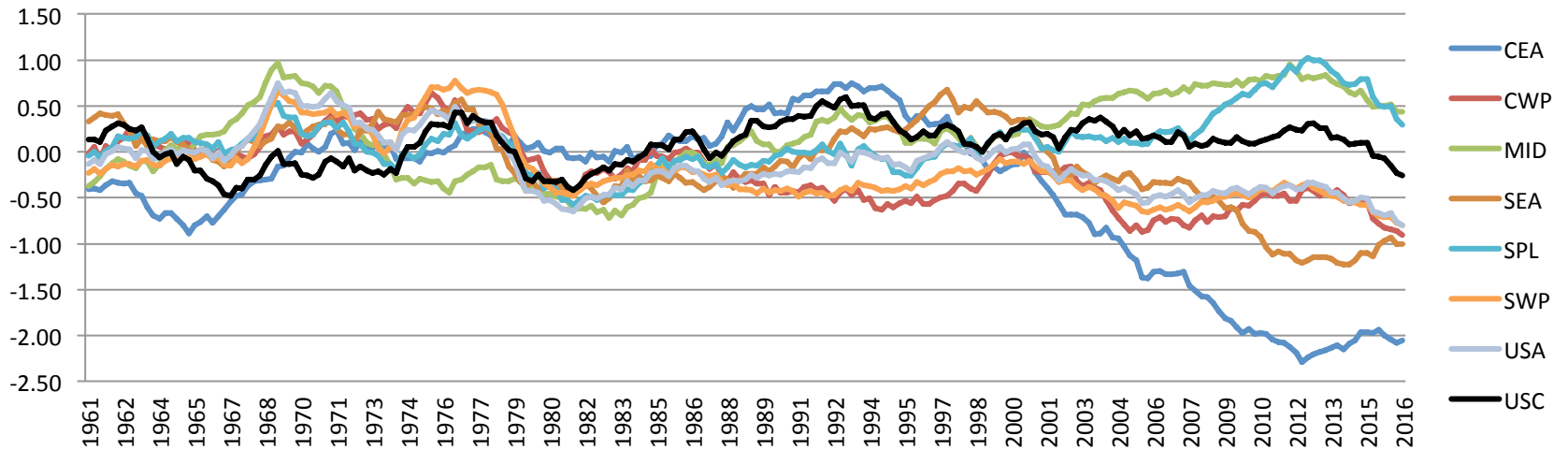


# Wind Power

## 5-Year Wind Northern Regions

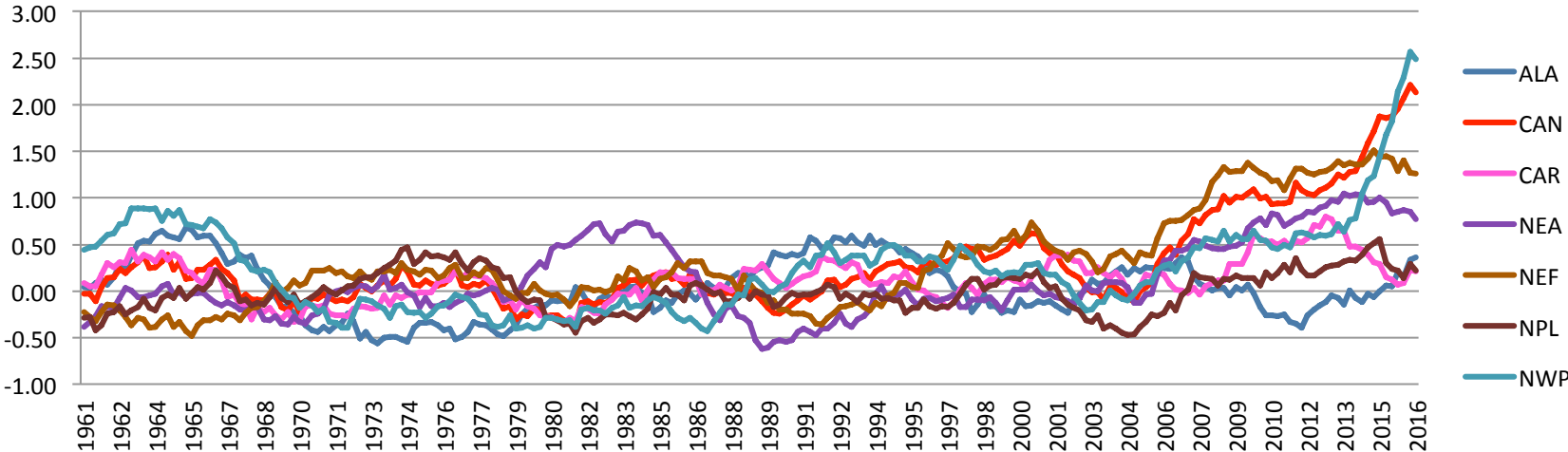


## 5-Year Wind Southern Regions

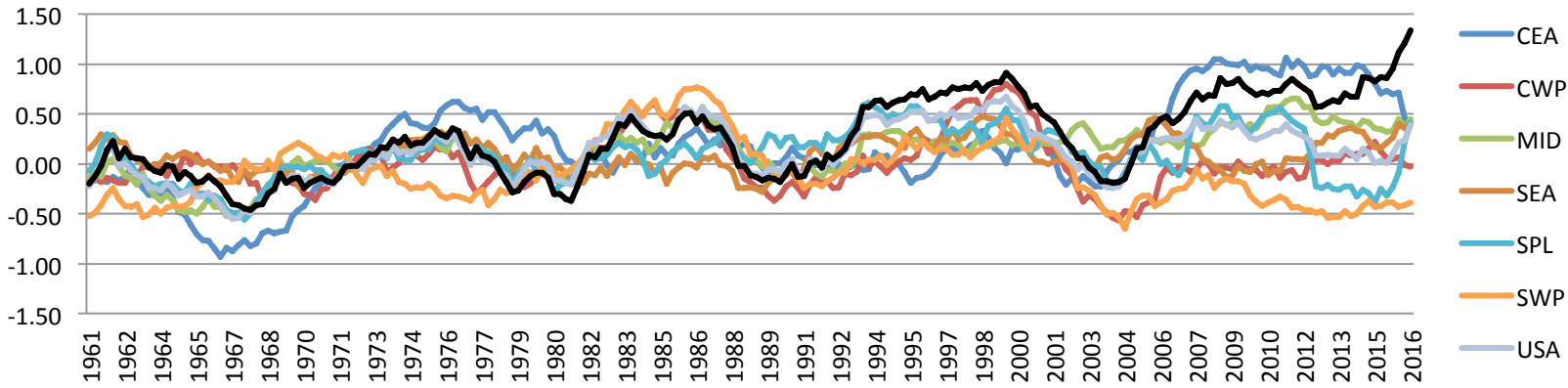


# Precipitation

## 5-Year Precipitation Northern Regions



## 5-Year Precipitation Southern Regions



# Actuaries Climate Risk Index (ACRI)

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Shifts the question from “Is climate change happening?” to “Is it happening where there are people and property?”

- Goal is to produce an index especially useful to policymakers, regulators and insurers

ACRI is based on the historical correlations of economic losses, mortality and morbidity to monthly ACI data by region

- Correlations are measured by component
- Results used where statistically significant

For country totals, regional ACRI's are weighted by population



# Plans for ACI and ACRI

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- ACI and ACRI information will be publicly available on a new website, as a resource for use in further research
  - [www.actuariesclimateindex.org](http://www.actuariesclimateindex.org)
  - [www.indiceclimatiqueactuaries.org](http://www.indiceclimatiqueactuaries.org)
  - Website includes commentary, documentation, charts of index components, maps showing variation by region, index data for download, and links to other information
  - Commentary provided in English and French
  - ACI and ACRI data will be updated quarterly on the website, based on data for each meteorological season (3 months ending February, May, August and November)
- Quarterly press releases announcing the results of each update, with commentary

# Potential Uses and Further Research

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- Potential uses
  - Educate actuaries, policymakers and insurers
    - Relevant to property, liability, life, health
    - Need to incorporate climate trends into pricing
    - Need to reflect higher risk into risk management
    - May need to reconsider coverage and availability
  - Inform the public debate
- Potential further research
  - Further analysis of ACI component data; what else does it tell us?
  - Addition of other regions beyond US and Canada.
  - Further research focusing on linkage of insurance claims to ACI components; ACRI uses economic losses, many would be interested in losses specific to insurance

# Index Resources

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- Donat, M. G., et al. 2013. Global land-based datasets for monitoring climatic extremes. *Bulletin of the American Meteorological Society*, July, 997-1006, doi:10.1175/BAMS-D-12-00109.1.
- Hansen J., et al. 1998, A Common Sense Climate Index: Is Climate Changing Noticeably? *PNAS*, 95, 4113-4120.
- Peduzzi, P., et al. 2009, Assessing global exposure and vulnerability towards natural hazards: the Disaster Risk Index. *Natural Hazards and Earth System Sciences*, 9, 1149-1159.
- 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](http://www.casact.org/research/ClimateChangeRpt_Final.pdf)
- Data sources:
  - GHCNINDEX: [www.climdex.org](http://www.climdex.org)
  - GHCN-Daily: [www.ncdc.noaa.gov/oa/climate/ghcn-daily/](http://www.ncdc.noaa.gov/oa/climate/ghcn-daily/)
  - Sea Level: [www.psmsl.org/data/obtaining/](http://www.psmsl.org/data/obtaining/)
  - Wind: [www.esrl.noaa.gov/psd/data/gridded/datancep.reanalysis.html](http://www.esrl.noaa.gov/psd/data/gridded/datancep.reanalysis.html)
  - Economic Losses: [http://webra.cas.sc.edu/hvriapps/sheldus\\_setup/sheldus\\_login.aspx](http://webra.cas.sc.edu/hvriapps/sheldus_setup/sheldus_login.aspx)  
<http://www.publicsafety.gc.ca/cnt/rsrscs/cndn-dsstr-dtbs/>

# For More Information

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actuariesclimateindex.org

Marc Rosenberg

Academy Senior Casualty Policy Analyst

(202) 785-7865; [rosenberg@actuary.org](mailto:rosenberg@actuary.org)