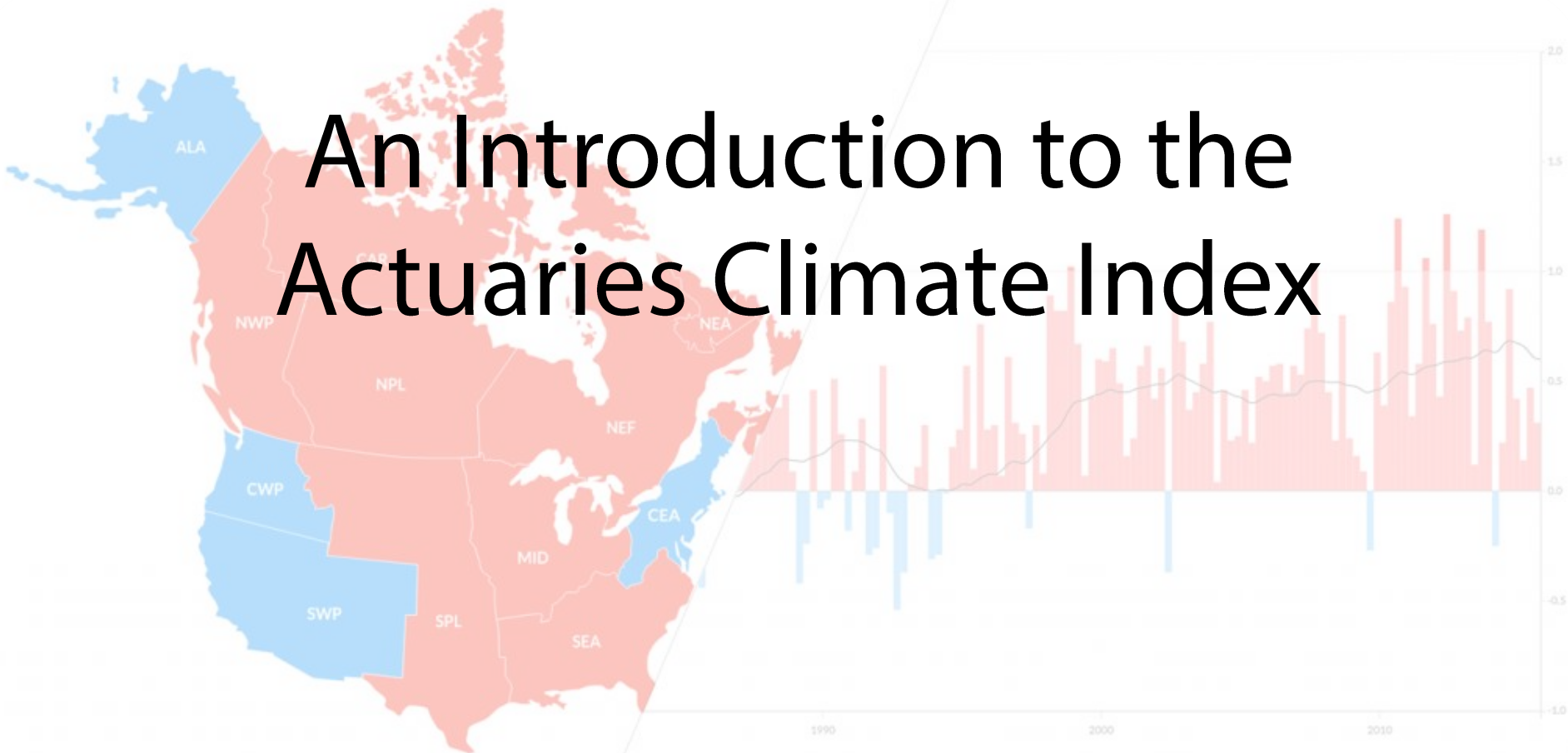


# An Introduction to the Actuaries Climate Index



April 23, 2019



ACTUARIES CLIMATE INDEX  
INDICE ACTUARIEL CLIMATIQUE

# Ronora Stryker, ASA, MAAA

**SENIOR PRACTICE RESEARCH ACTUARY**

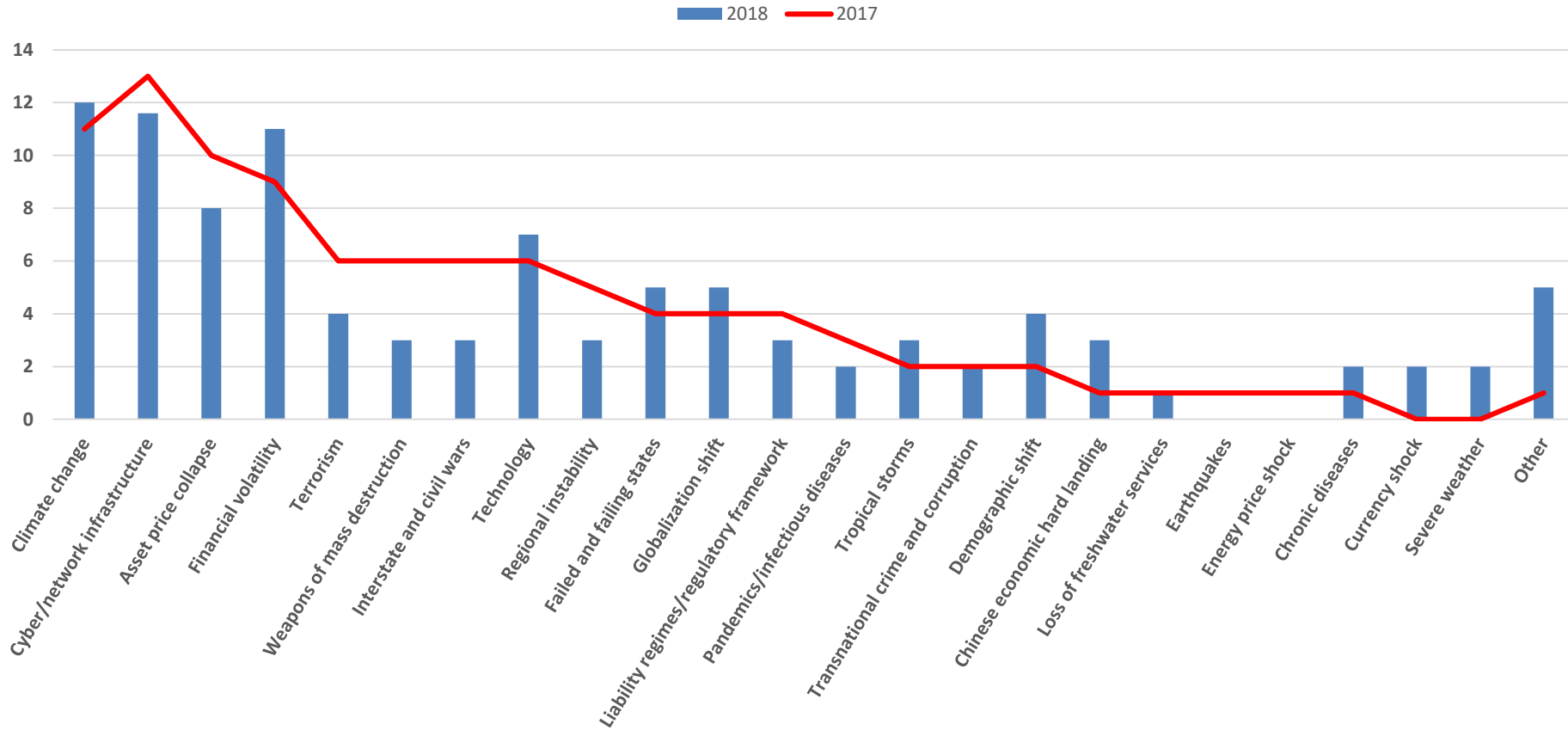
**Society of Actuaries**

[rstryker@soa.org](mailto:rstryker@soa.org)



# 12<sup>th</sup> Annual Survey of Emerging Risks

## Top Current Risk, Year-Over-Year



# Hudson - Lake Bloomington

---

Month	TMAX			TMIN			PRCP		
	1961-1990	1991-2018	Diff	1961-1990	1991-2018	Diff	1961-1990	1991-2018	Diff
JAN	31.58	33.28	1.70	15.92	18.41	2.50	1.49	1.91	0.42
FEB	36.02	38.29	2.27	19.58	21.90	2.32	1.77	2.15	0.38
MAR	48.54	50.49	1.95	30.09	31.16	1.06	2.75	2.48	-0.27
APR	62.47	63.97	1.51	40.68	41.35	0.68	3.85	3.94	0.08
MAY	73.48	74.48	1.00	50.78	52.59	1.81	3.83	4.58	0.75
JUN	82.83	82.60	-0.23	60.22	61.78	1.56	3.76	4.91	1.15
JUL	85.29	84.64	-0.65	63.84	64.49	0.65	3.77	4.42	0.65
AUG	83.11	83.34	0.23	61.45	62.59	1.13	3.63	4.01	0.38
SEP	77.41	78.36	0.95	54.87	55.05	0.18	3.35	3.35	0.00
OCT	64.76	65.65	0.89	43.60	44.64	1.04	2.62	3.37	0.75
NOV	50.32	50.25	-0.07	33.82	33.47	-0.35	2.82	2.97	0.14
DEC	36.13	37.73	1.60	21.67	23.91	2.24	2.48	2.13	-0.34
ALL	61.07	62.06	0.99	41.45	42.74	1.29	3.01	3.36	0.35

# Presentation Outline

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- Overview and Goals
- Components
- Results
- Website
- Potential Uses and Future plans

# Actuaries Climate Index (ACI) Overview



ACTUARIES CLIMATE INDEX  
INDICE ACTUARIEL CLIMATIQUE

# Goals of the Actuaries Climate Index (ACI)

---

- 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.
- Use the indices to inform policymakers, insurance professionals, and the general public on the incidence and impact of extreme events.
- Promote the actuarial profession by contributing constructively to the climate change debate

## *Research Sponsors:*



# Evolution of the Actuaries Climate Index (ACI)

---

- Several years in the making
- Sponsoring organizations determined the need for the actuarial profession to communicate to the public the actuarial aspects of climate risk
- Multiple work groups on Development, Design, and Communications with representatives from each of the organizations meet weekly via conference calls
- Work with outside vendors and peer reviewers on climate science, economic data, and design features



## Evolution of the Actuaries Climate Index (ACI)

---

- The Actuaries Climate Index (ACI) was launched November 2016.
- It does not address debate over associated climate change factors
- It does not forecast future frequency of extreme weather events and sea level changes.

# Evolution of the Actuaries Climate Index (ACI)

---

- Website – [ActuariesClimateIndex.org](http://ActuariesClimateIndex.org)
  - Latest data and results

# Actuaries Climate Index Components And Development



ACTUARIES CLIMATE INDEX  
INDICE ACTUARIEL CLIMATIQUE

# The Actuaries Climate Index (ACI)

## Basics

---

- Measures change in frequency of extreme climate events by comparing recent climate extremes to historical events
- Six components/sub-indices
- ACI components are of the form:
$$(x - \mu_{\text{ref}}) / \sigma_{\text{ref}}$$
- Base/Reference Period: 1961-1990

# The Actuaries Climate Index (ACI) Basics

---

- Six Components/Sub-Indices:
  1. Temperature Highs ( $T_{90}'$ )
  2. Temperature Lows ( $T_{10}'$ )
  3. Precipitation ( $P'$ )
  4. Drought ( $D'$ )
  5. Wind ( $W'$ )
  6. Sea Level ( $S'$ )
- Actuaries Climate Index = Average of six component sub-indices
- $ACI = (T_{90}' - T_{10}' + P' + D' + W' + S') / 6$

# The Actuaries Climate Index (ACI)

## Basics

---

- Data based on measurements from meteorological stations and taken over a  $2.5^\circ$  by  $2.5^\circ$  grid (275km x 275km at equator)
- All data is publicly available
- Initially Canada and U.S. focus
- Examine countries separately or together
- 12 subregions

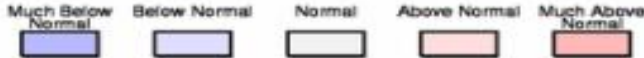
# The Actuaries Climate Index (ACI) Basics

---

Extreme Temperature



ACI  
2012 03



*Frequency of  
Extreme  
Temperatures:  
March 2012*

# The Actuaries Climate Index (ACI)

## Data Sources - Temperature

---

- GHCNDEX indices\* based on NOAA's
  - Global Historical Climatological Network (GHCN-Daily)
    - TX90 = 90%ile warm days
    - TN90 = 90%ile warm nights
    - TX10 = 10%ile cold days
    - TN10 = 10%ile cold nights

\* Produced as part of the CLIMDEX project by the Climate Change Research Centre, at The University of New South Wales, Australia.



# The Actuaries Climate Index (ACI)

## Data Sources – Precipitation and Drought

---

- GHCNDEX indices\* based on NOAA's
  - Global Historical Climatological Network (GHCN-Daily)
    - Rx5day = monthly maximum five-day precipitation data
    - CDD = Max days per year with <1mm precipitation

\* Produced as part of the CLIMDEX project by the Climate Change Research Centre, at The University of New South Wales, Australia.

# The Actuaries Climate Index (ACI)

## Data Sources – Wind Power

---

- Wind Power is calculated as the 90<sup>th</sup> percentile of the average Wind Speed from the National Centres for Environmental Protection (NCEP)
- Wind Power is equal to a constant x Wind Speed<sup>3</sup>
- Wind Power is used, as damages have been found to be proportional to Wind Power

# The Actuaries Climate Index (ACI)

## Data Sources – Sea Level

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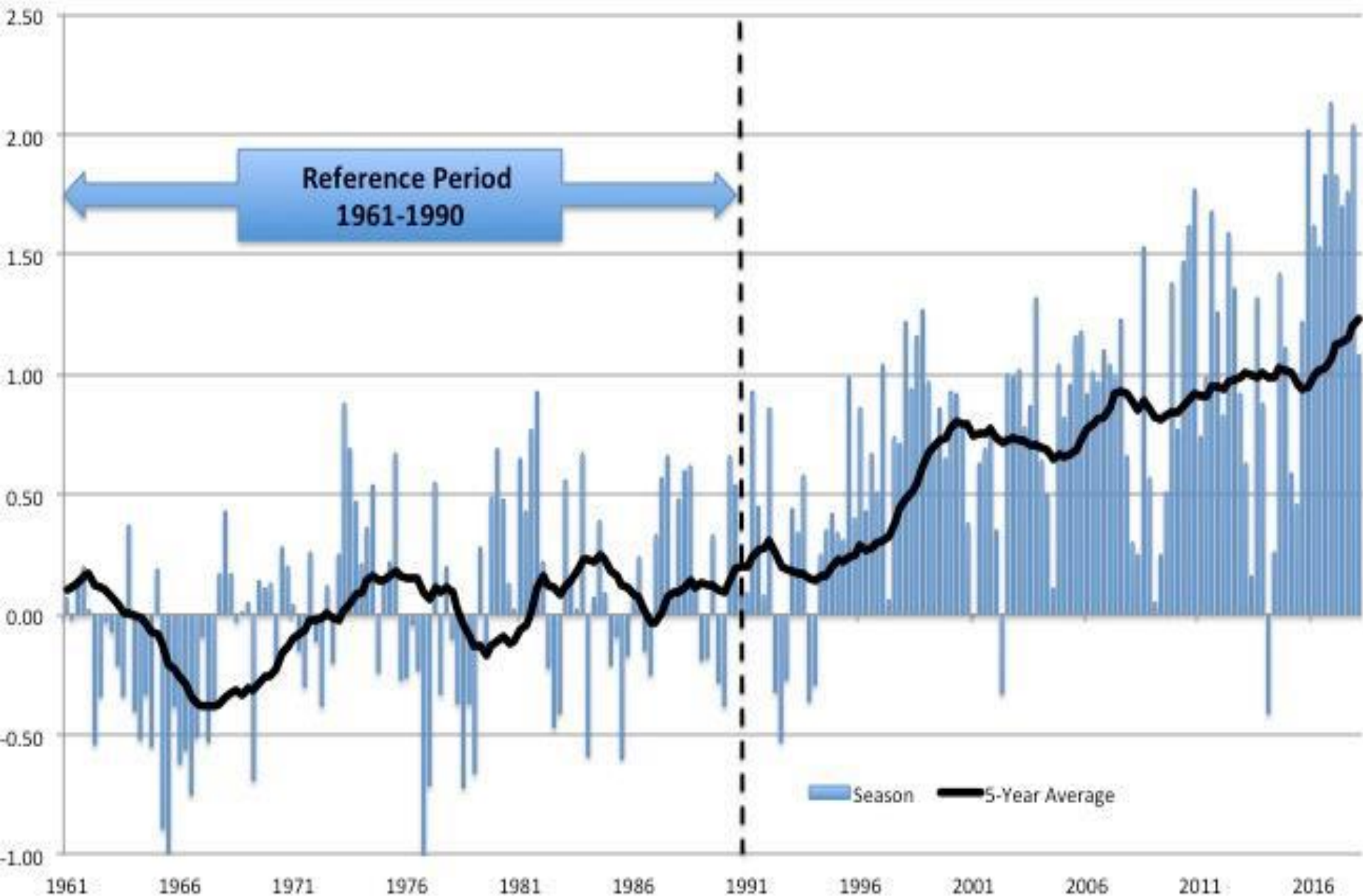
- Sea Level is our only component that is not based on a gridded dataset
- It comes from a worldwide database (Permanent Service for Mean Sea Level)
- Based on mean monthly Sea Level at 76 coastal tidal stations; the stations within each region are averaged to produce a regional result

# Actuaries Climate Index Results

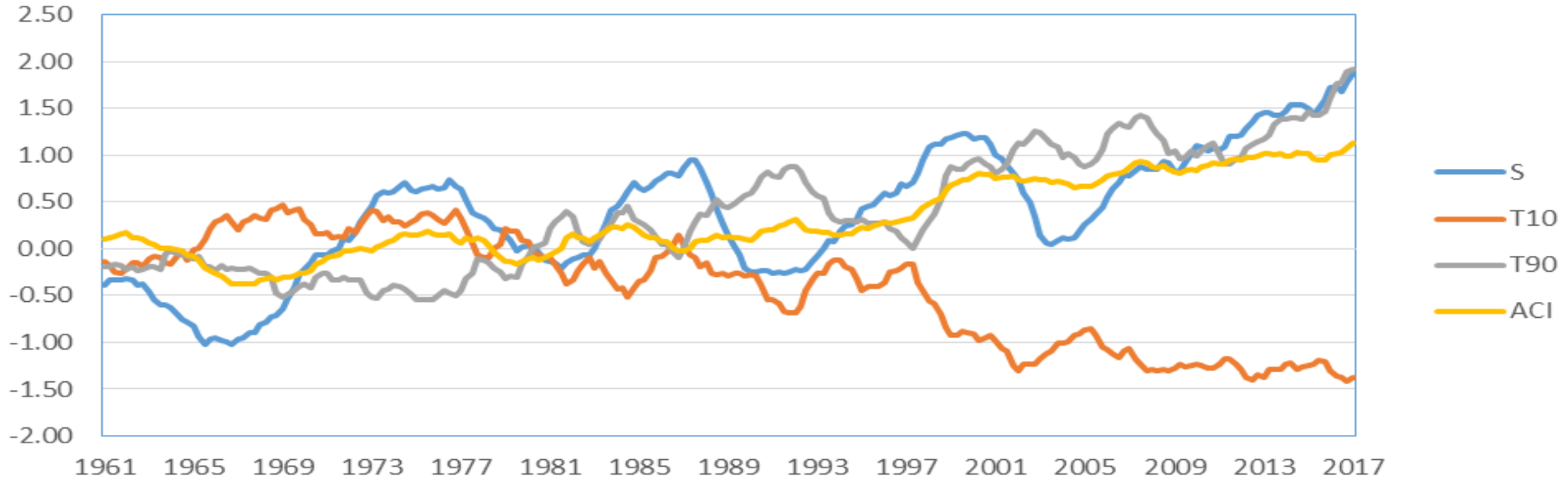


ACTUARIES CLIMATE INDEX  
INDICE ACTUARIEL CLIMATIQUE

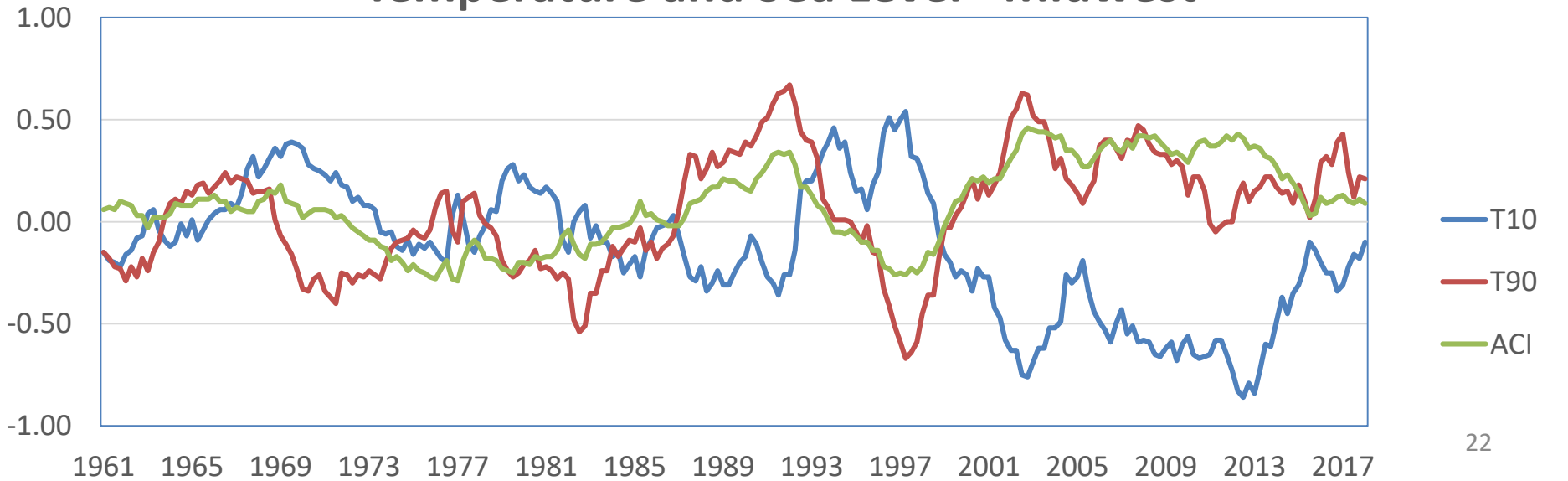
# Actuaries Climate Index™ - USA & Canada



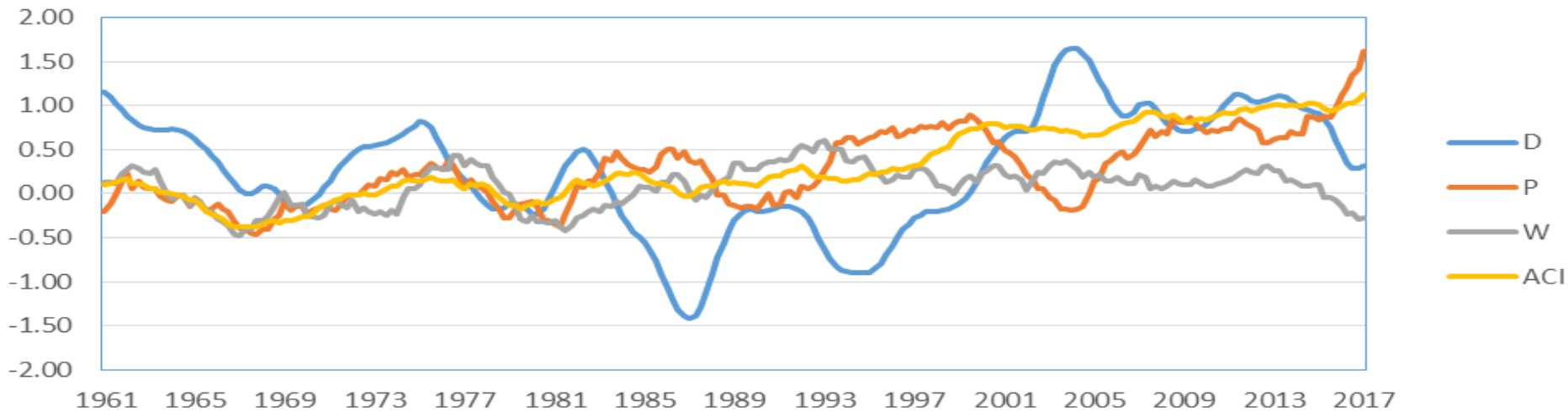
# Temperature and Sea Level - USA and Canada



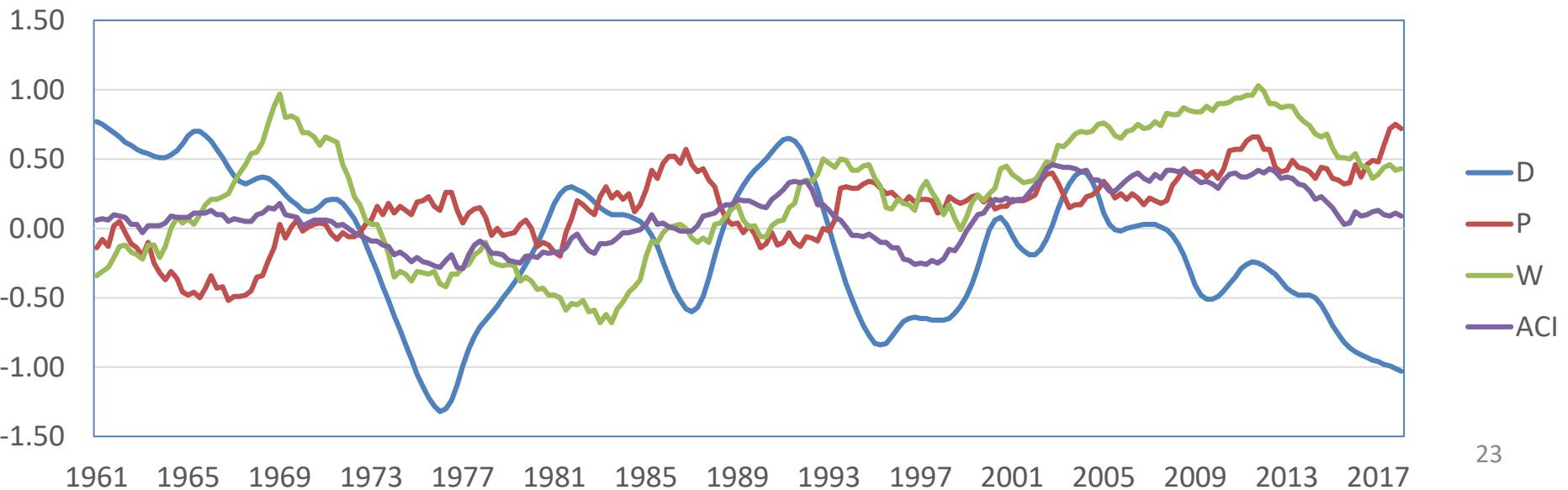
# Temperature and Sea Level - Midwest



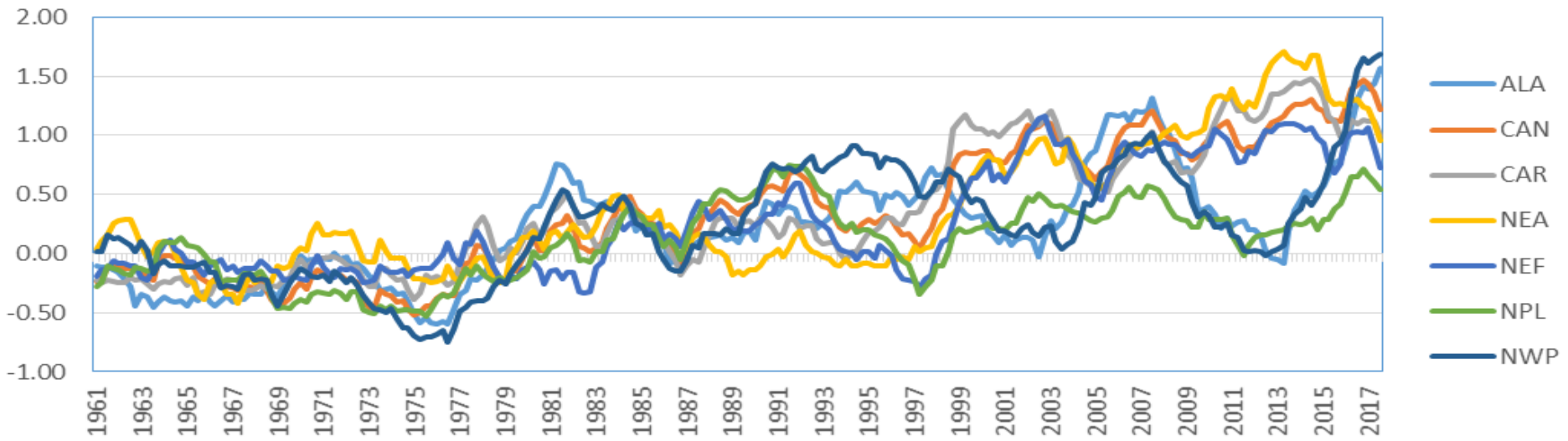
# Wind Power, Precipitation, and Drought - USA and Canada



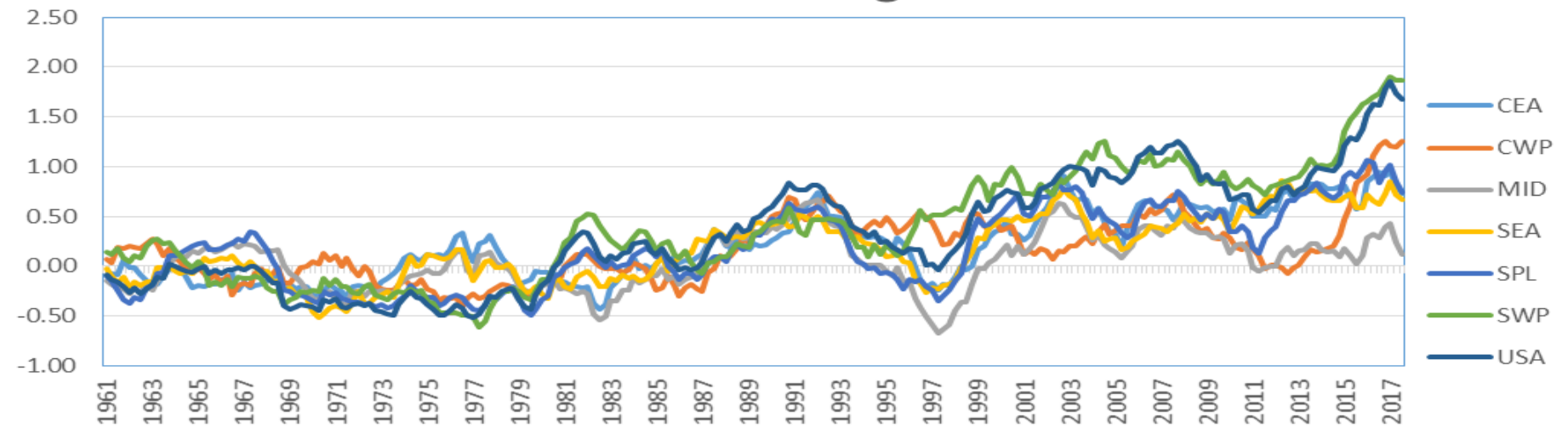
# Wind Power, Precipitation, and Drought - Midwest



## 5-Year Average Warm Temperatures Northern Regions



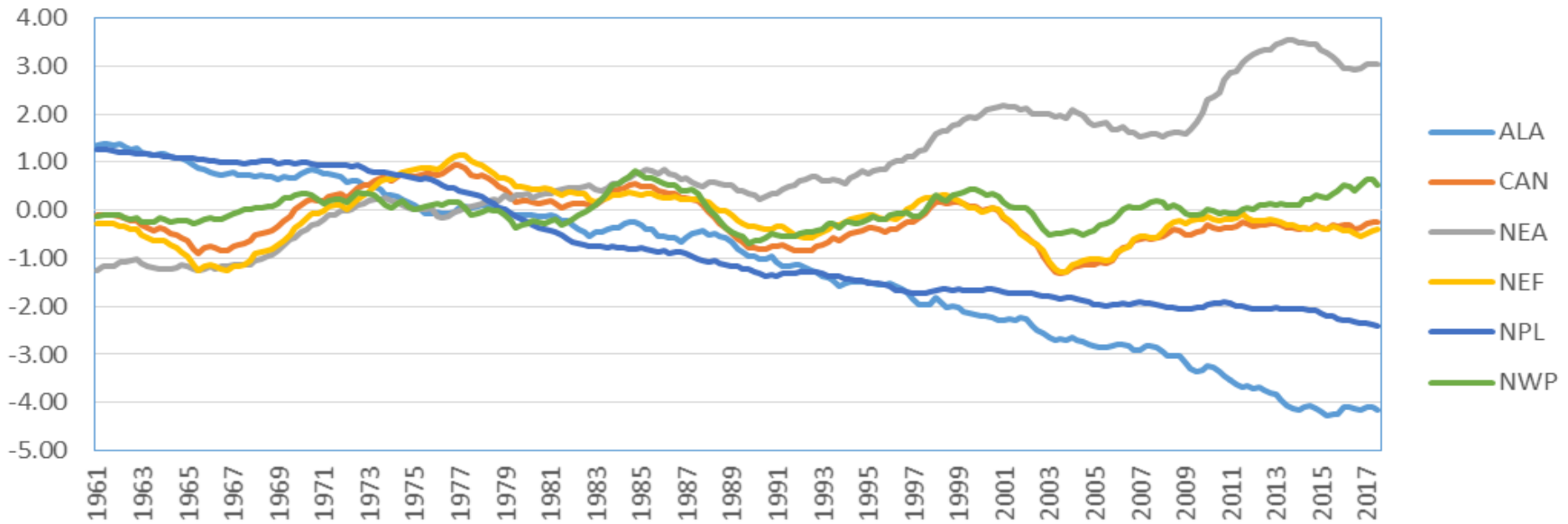
## 5-Year Average Warm Temperatures Southern Regions



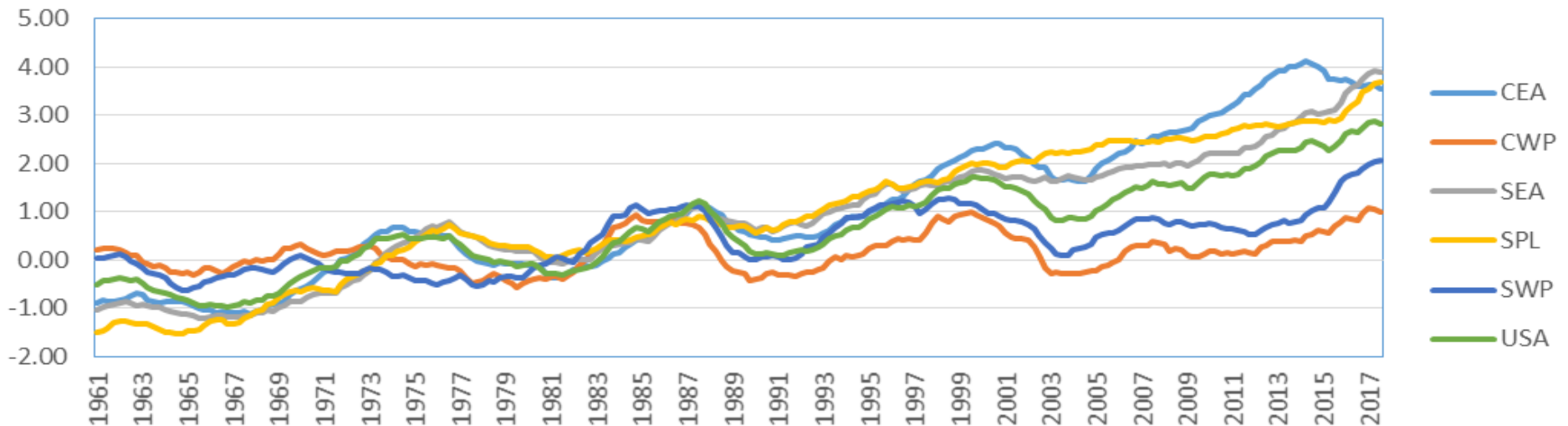




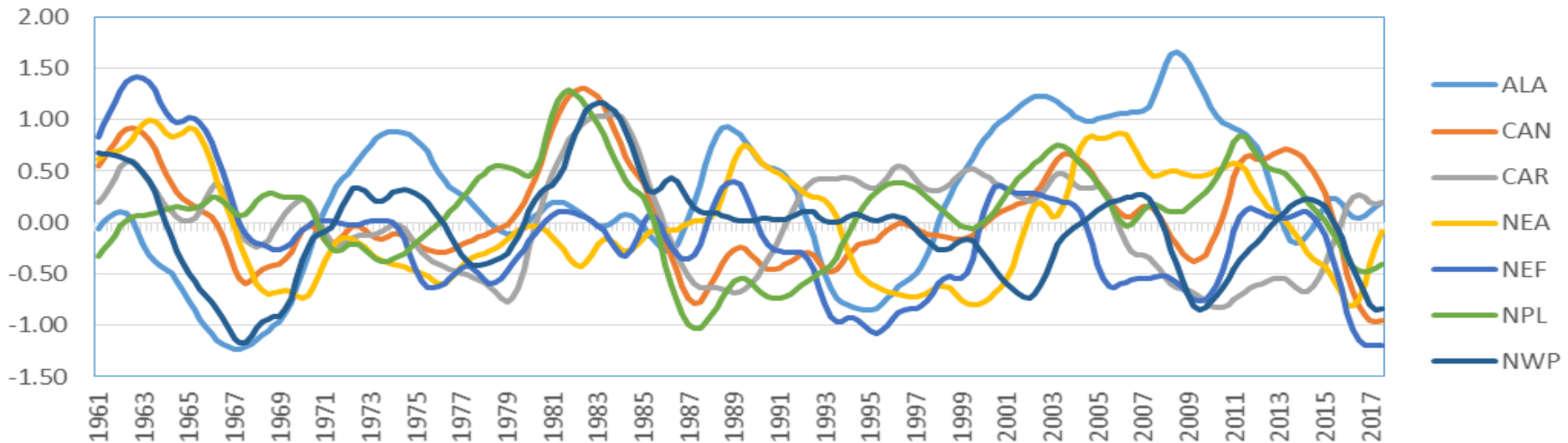
## 5-Year Sea Level Northern Regions



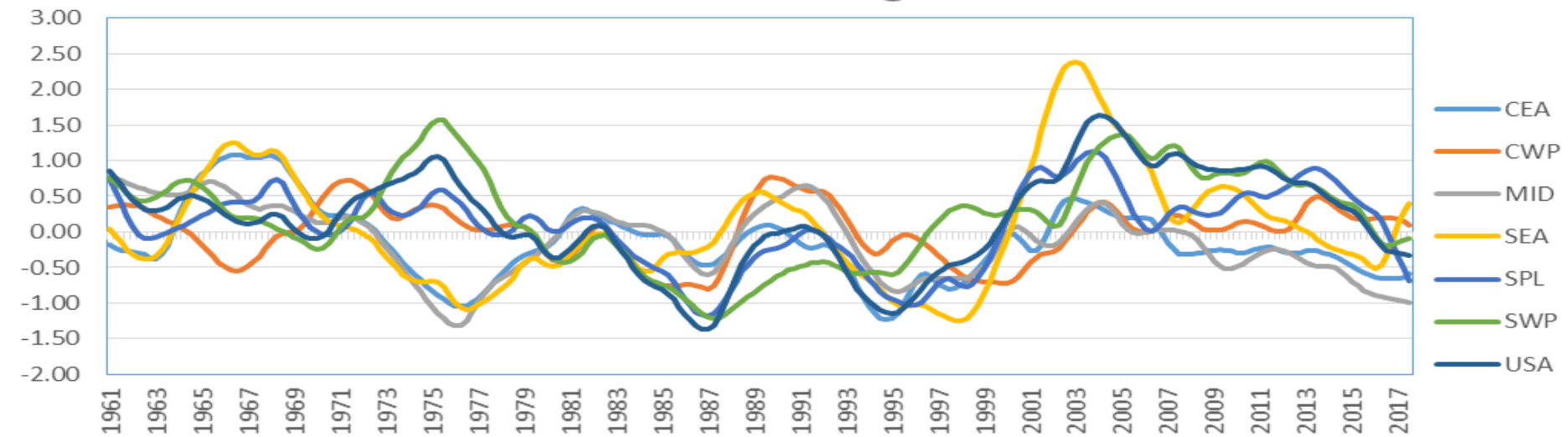
## 5-Year Average Sea Level Southern Regions



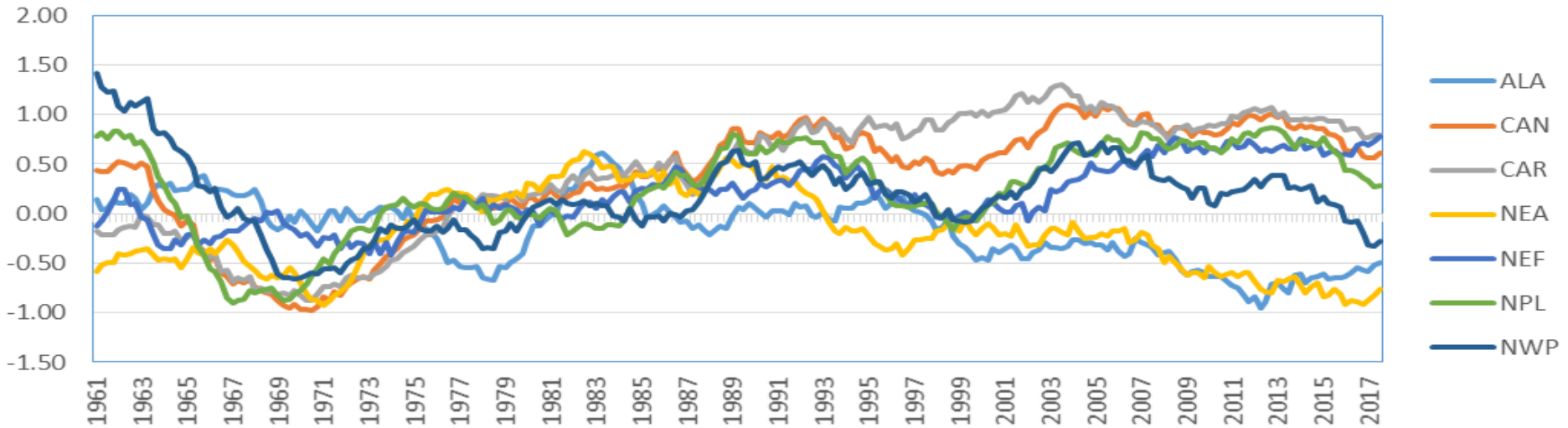
## 5-Year Average Consecutive Dry Days Northern Regions



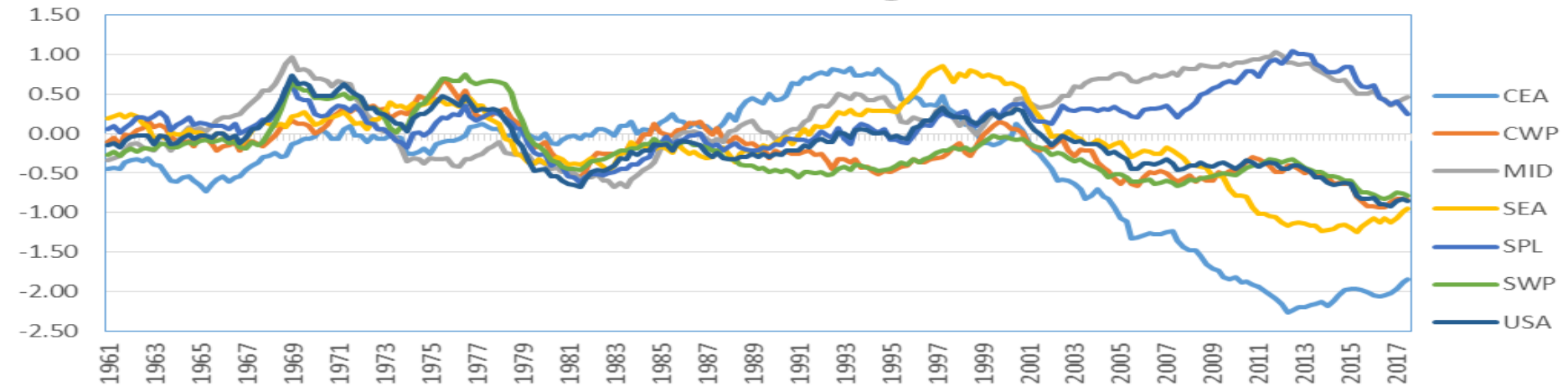
## 5-Year Average Consecutive Dry Days Southern Regions



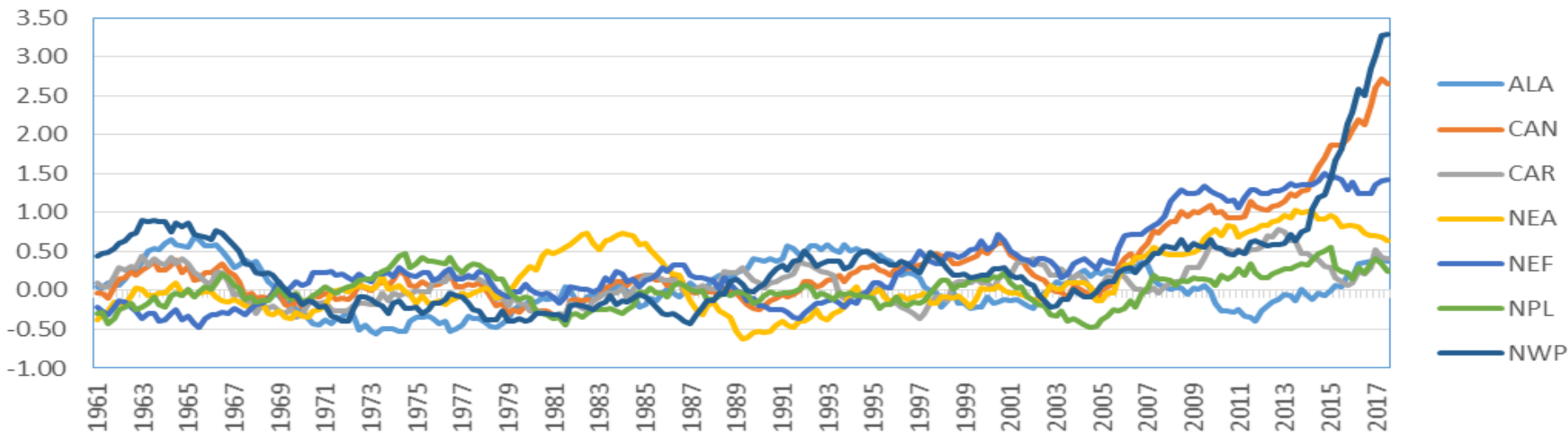
## 5-Year Average WP90 Days Northern Regions



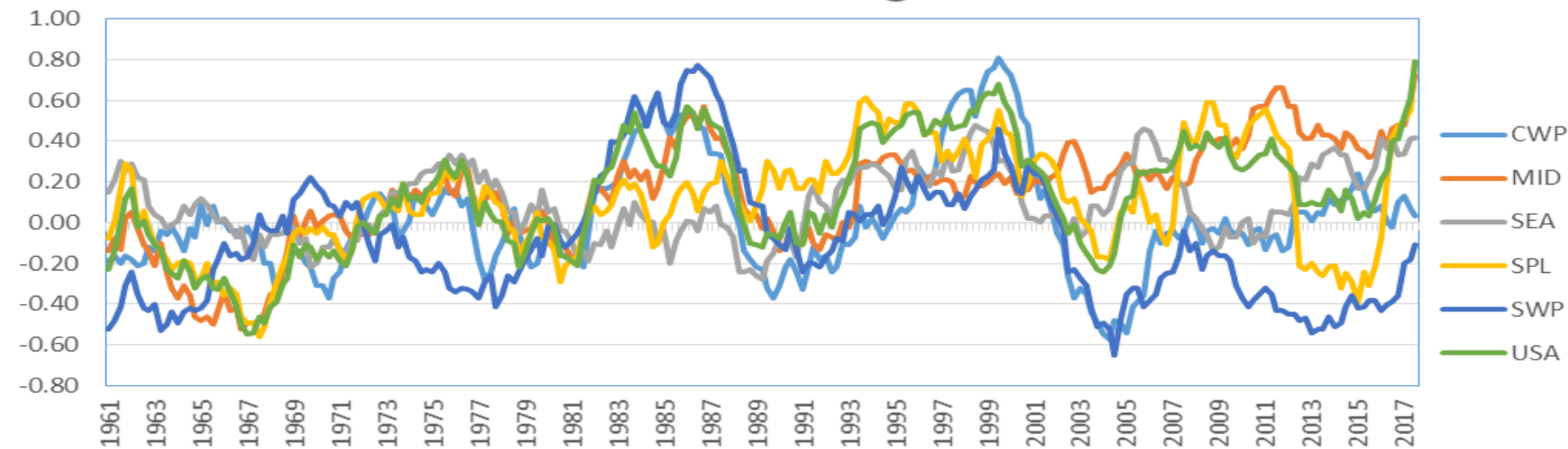
## 5-Year Average WP90 Days Southern Regions



## 5-Year Average Rain x5 Days Northern Regions



## 5-Year Average Rain x5 Days Southern Regions



# Actuaries Climate Index Website



ACTUARIES CLIMATE INDEX  
INDICE ACTUARIEL CLIMATIQUE

## Website

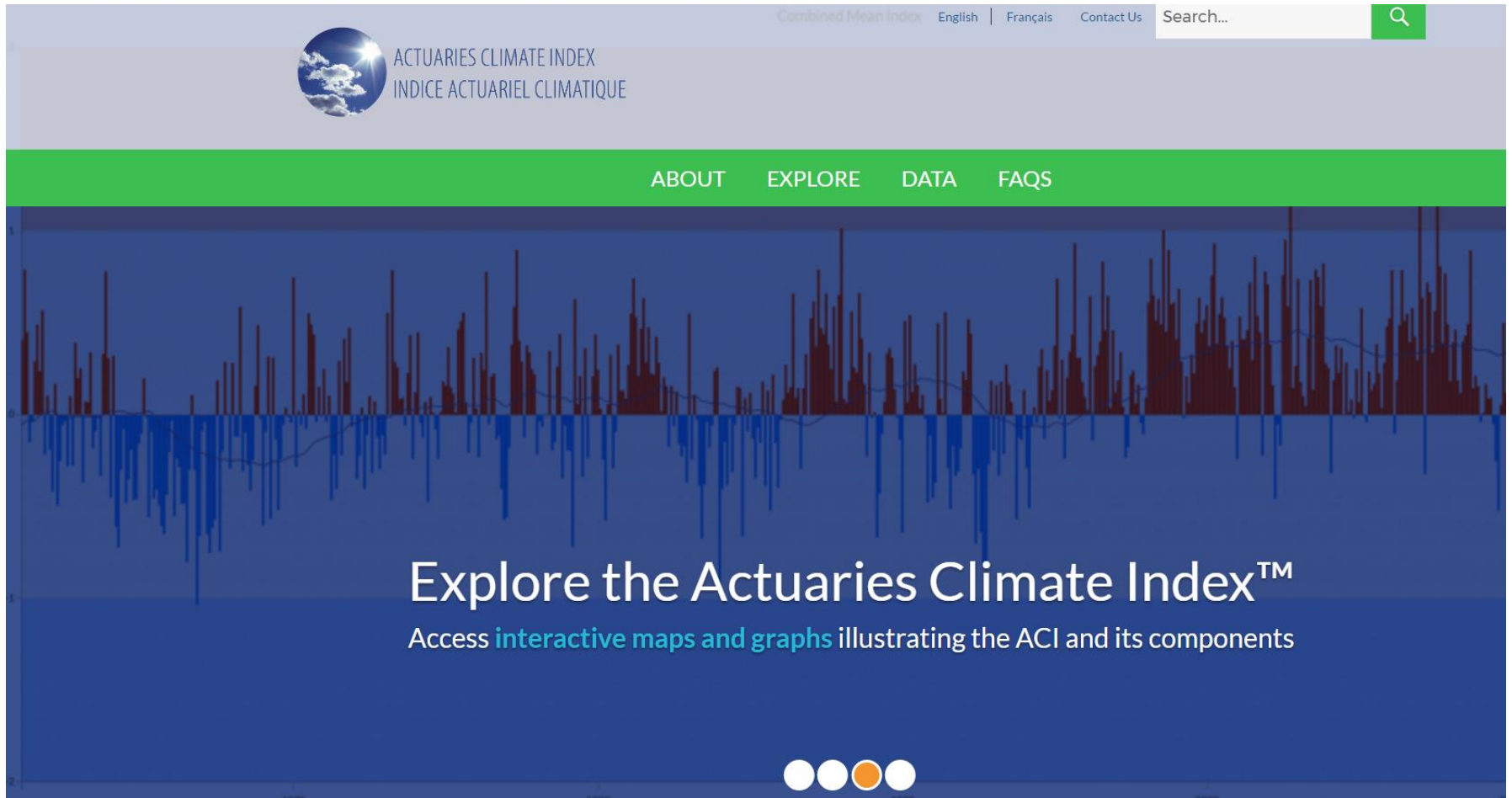
---

- 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
- We send out a news release with each new update
- Since launch, more than 30,000 visitor sessions from 120 countries have been tracked, and more than 2,000 data downloads have been made

# Website

[www.actuariesclimateindex.org](http://www.actuariesclimateindex.org)

[www.indiceactuarielclimatique.org](http://www.indiceactuarielclimatique.org)



The screenshot shows the homepage of the Actuaries Climate Index website. At the top left is the logo, a globe with a sun and clouds, next to the text "ACTUARIES CLIMATE INDEX" and "INDICE ACTuariEL CLIMATIQUE". To the right of the logo is a navigation bar with "Combined Mean Index", "English | Français", and "Contact Us". A search bar with a magnifying glass icon is also present. Below the navigation bar is a green horizontal bar with the menu items "ABOUT", "EXPLORE", "DATA", and "FAQS". The main content area features a large, dark blue background with a complex, multi-colored line graph (red, blue, and white) representing climate data. Below the graph, the text reads "Explore the Actuaries Climate Index™" and "Access interactive maps and graphs illustrating the ACI and its components". At the bottom center, there are four circular icons: three white and one orange.



# Website - About

[www.actuariesclimateindex.org](http://www.actuariesclimateindex.org)

ABOUT

EXPLORE

DATA

FAQS

## About the Actuar

The Actuaries Climate Index (ACI) is intended to be an objective indicator of the frequency of extreme weather events. This website provides graphics and data for download. The ACI is currently available for the United States and Canada. The ACI is based on an analysis of data for each meteorological variable (months ending February, May, August, and November).

The six components of the Actuaries Climate Index are:

1. High temperatures;
2. Low temperatures;
3. Heavy rainfall;

About the Actuaries  
Climate Index

Sponsoring  
Organizations

Executive Summary

Development and  
Design

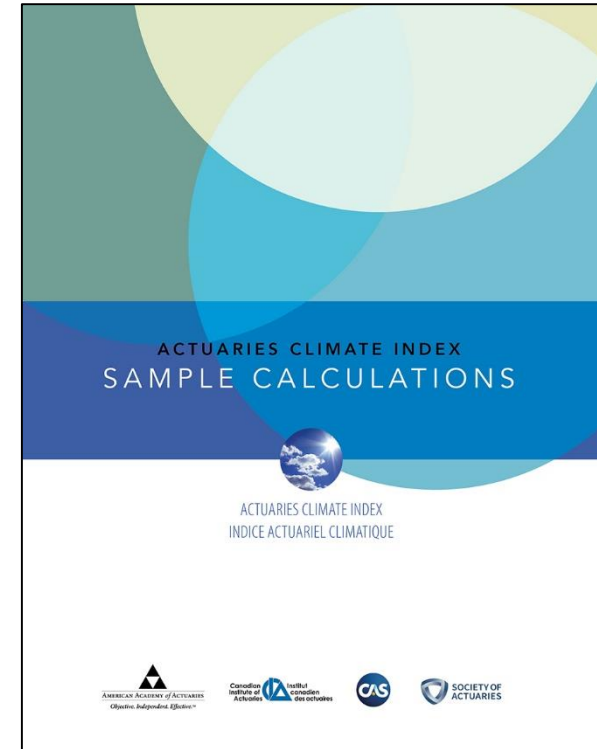
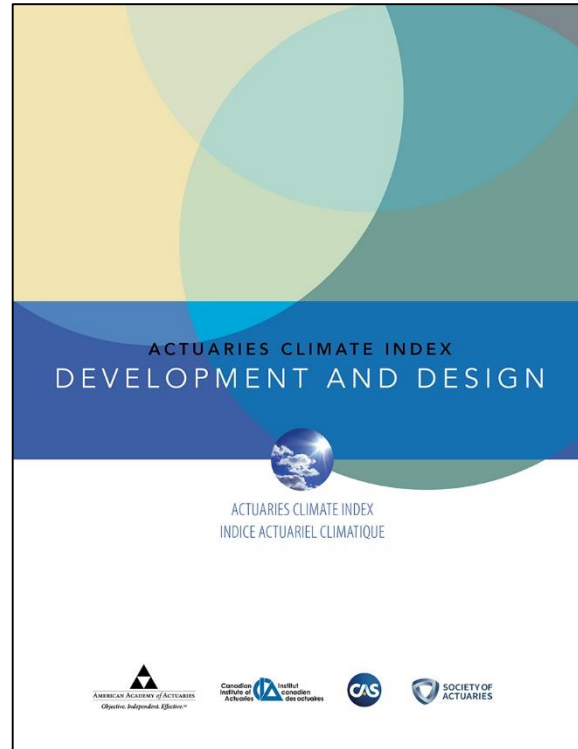
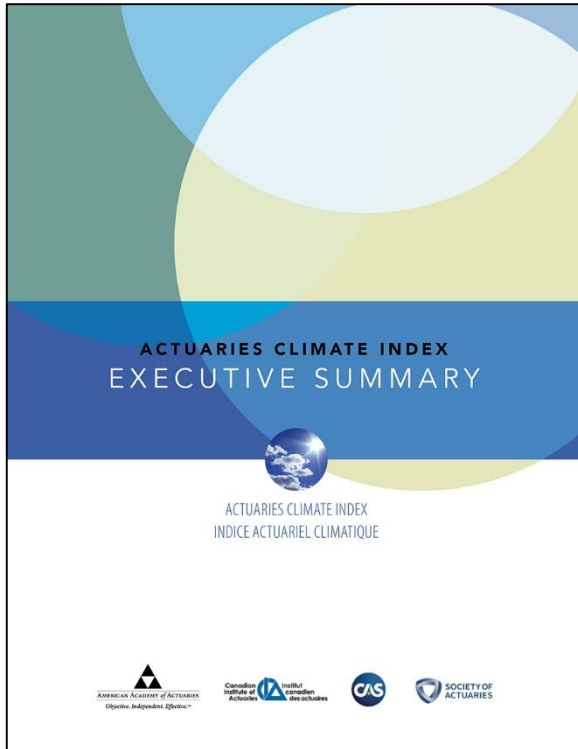
Sample Calculations

News Releases

## Actuar

...ing tool—an objective  
...el change. This website  
...he Index. The ACI is  
...nd will be released when  
...onthly and a seasonal basis

# Three Foundational Documents on the ACI Website



# Website - Explore

[www.actuariesclimateindex.org](http://www.actuariesclimateindex.org)

The screenshot displays the website's navigation bar with four green buttons: 'ABOUT', 'EXPLORE', 'DATA', and 'FAQS'. A mouse cursor is hovering over the 'EXPLORE' button, which has opened a green dropdown menu. The menu items are: 'Actuaries Climate Index At a Glance', 'Guided Tour', 'Regional Graphs' (highlighted in bold), 'Component Graphs', and 'Maps'. Below the navigation bar, the page content includes the heading 'Regional Graphs', a filter bar with 'Select a region', 'Select a component', and a checked 'Seasonal' checkbox, and the main heading 'The Actuaries Climate Index'. A light blue footer bar contains the text: 'Use the wheel on your mouse to zoom in and out of the graphs. Click, hold and move left or right to scroll back and fourth.'

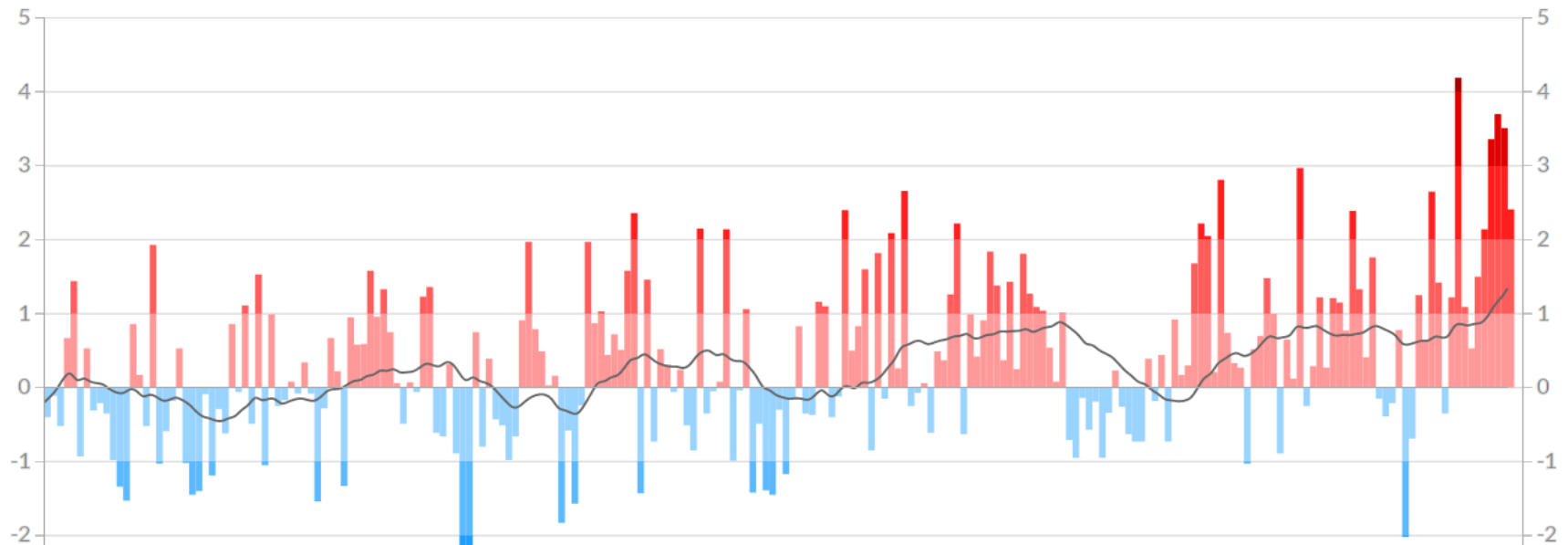
# Website – Explore – Component Graphs

[www.actuariesclimateindex.org](http://www.actuariesclimateindex.org)

## Extreme Precipitation Index

Use the wheel on your mouse to zoom in and out of the graphs. Click, hold and move left or right to scroll back and fourth. ✕

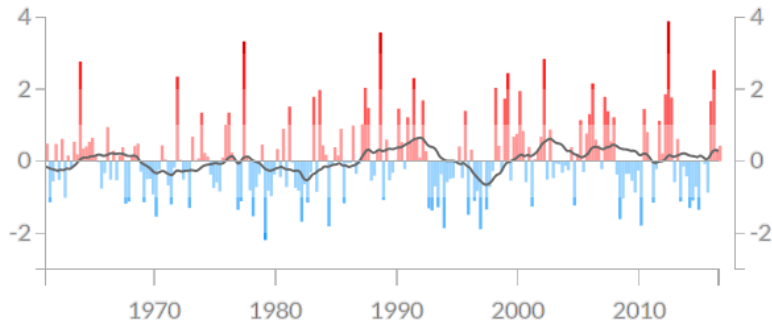
USA and Canada Combined



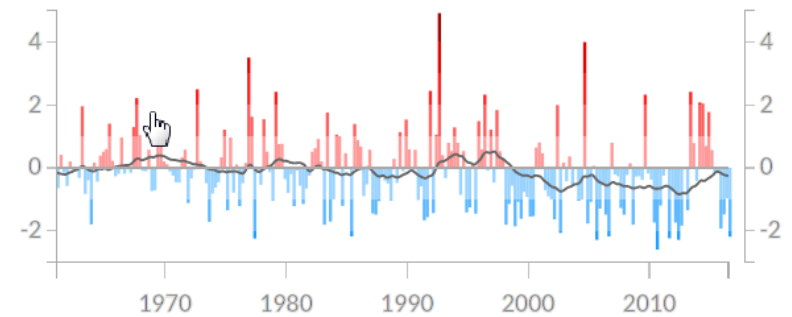
# Website – Explore – Component Graphs

[www.actuariesclimateindex.org](http://www.actuariesclimateindex.org)

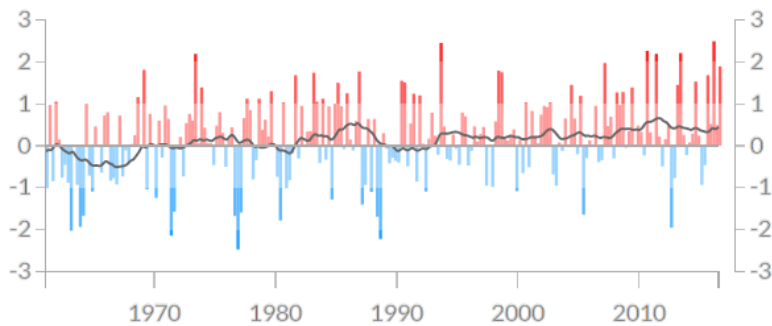
Warm Temperature Index



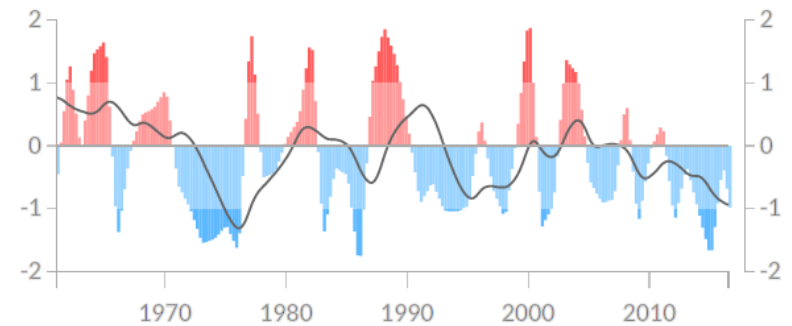
Cool Temperature Index



Extreme Precipitation Index



Consecutive Dry Days Index



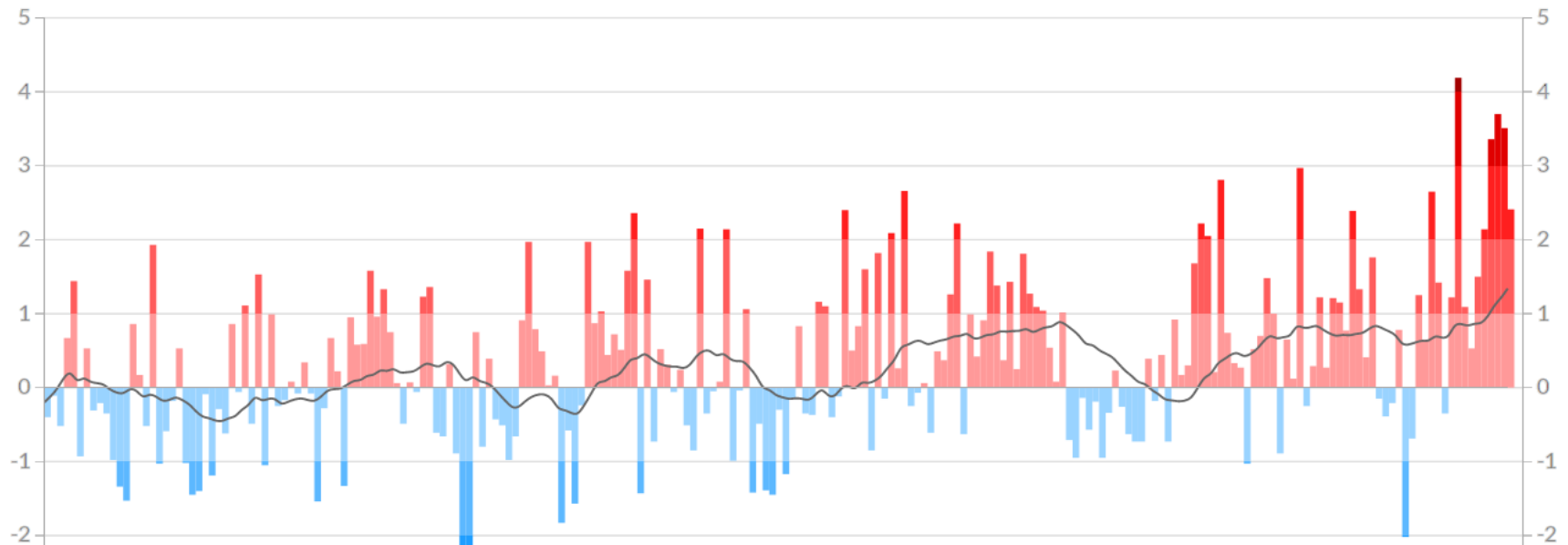
# Website – Explore – Regional Graphs

[www.actuariesclimateindex.org](http://www.actuariesclimateindex.org)

## Extreme Precipitation Index

Use the wheel on your mouse to zoom in and out of the graphs. Click, hold and move left or right to scroll back and fourth. ×

USA and Canada Combined

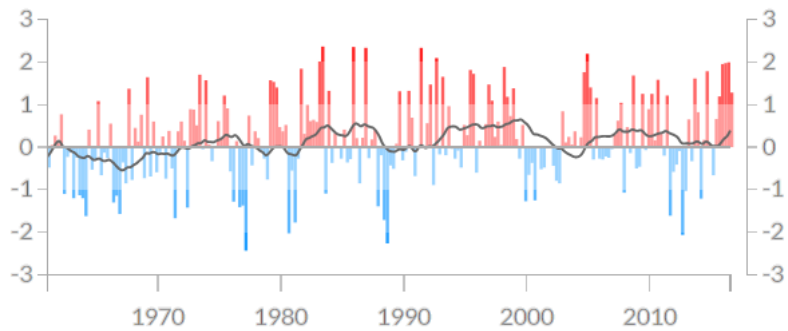


# Website – Explore – Regional Graphs

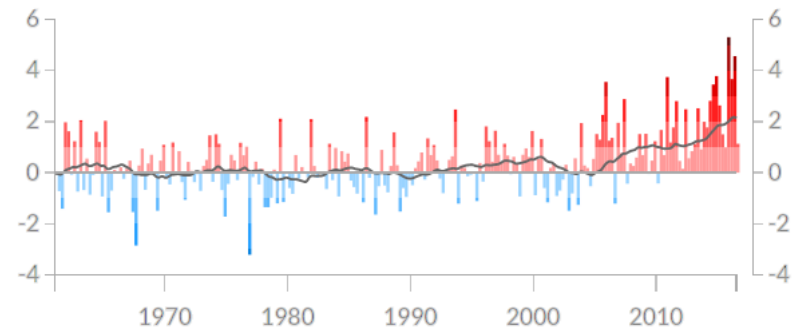
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[www.actuariesclimateindex.org](http://www.actuariesclimateindex.org)

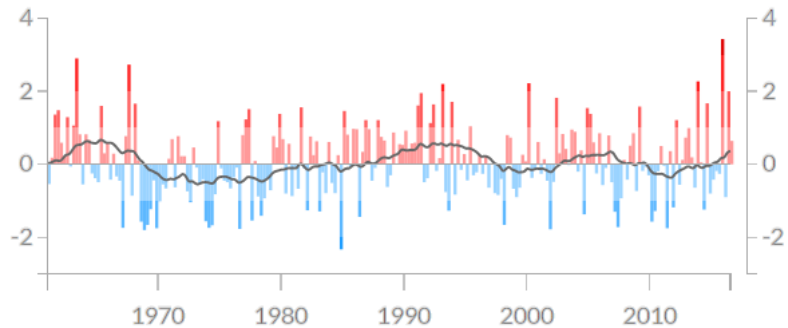
Contiguous USA



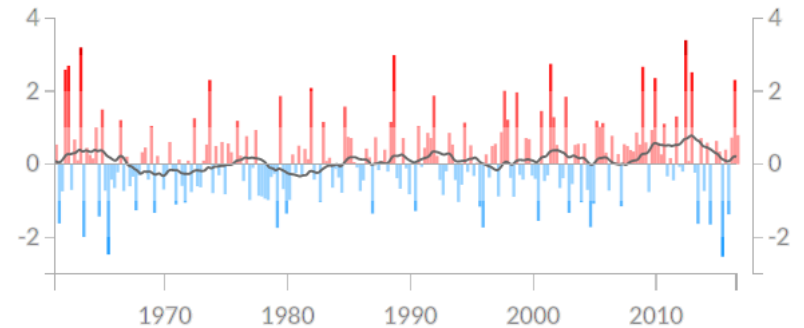
Canada



Alaska

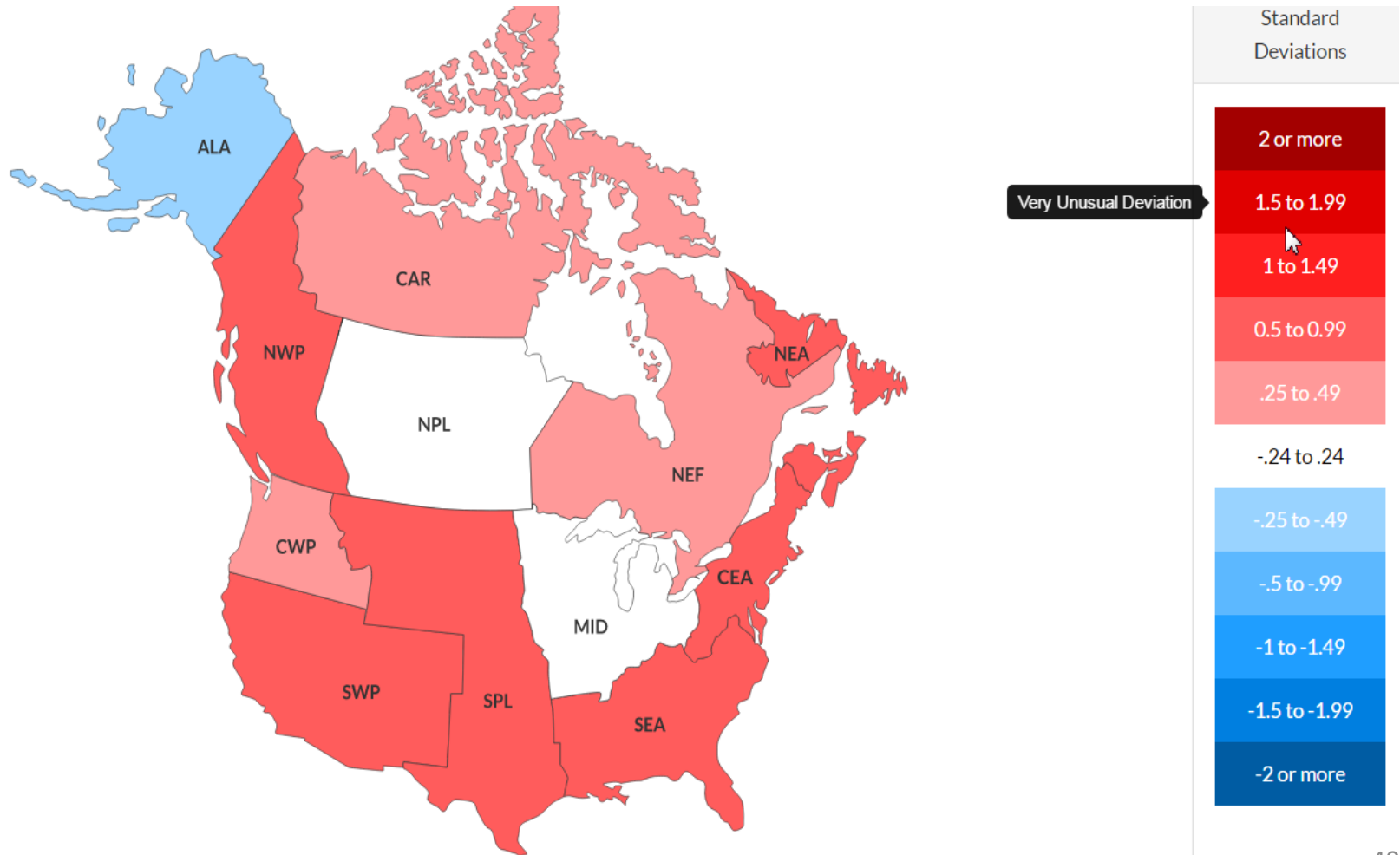


Central Arctic



# Website – Explore – Maps

[www.actuariesclimateindex.org](http://www.actuariesclimateindex.org)





# Website - Data

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[www.actuariesclimateindex.org](http://www.actuariesclimateindex.org)

ABOUT

EXPLORE

DATA

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## Data Downloads

Actuaries Climate Index data is available for download. Data is currently available for 2016 (Summer 2016). The **Excel® workbook** contains monthly and seasonal component.

Meteorological seasons are defined as follows:

Winter = December, January, February

Data Downloads

Component Definitions

Region Definitions

Links and References

Data Disclosure

Terms of Use

Actuaries Climate Index

# Website - FAQs

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[www.actuariesclimateindex.org](http://www.actuariesclimateindex.org)

ABOUT

EXPLORE

DATA

FAQS



## FAQs

Frequently Asked Questions about the Actuaries Climate Index

**1. WHAT IS THE ACTUARIES CLIMATE INDEX?** The Actuaries Climate Index (ACI) is an objective measure of changes in extreme weather and changes in sea level relative to the base period of 1961 through 1990. The Index is an educational tool designed to help inform actuaries, public policymakers, and the general public on changes in these measures over recent decades. We intend to update the index quarterly, as data for each meteorological season is available. We also intend to publish a second index, the Actuaries Climate Risk Index (ACRI), based on the historical correlations of economic losses, deaths and injuries to the ACI data.

**2. WHY ARE ACTUARIES WEIGHING IN ON CLIMATE CHANGE DISCUSSIONS?** Actuaries are experienced in the assessment and mitigation of financial consequences of risks and in the

# Website - Data

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[www.actuariesclimateindex.org](http://www.actuariesclimateindex.org)

ABOUT

EXPLORE

DATA

FAQS

## Data Disclosure

Data Disclosure for the Actuaries Climate Index™

In performing the work for this project, the American Academy of Actuaries (Academy), Casualty Actuarial Society (CAS), Canadian Institute of Actuaries (CIA), and Society of Actuaries (SOA) relied upon data and information provided by Solterra Solutions and a number of publicly available data sources: the National Oceanic and Atmospheric Administration (NOAA), CLIMDEX\*, and Permanent Service for Mean Sea Level. We reviewed the data and information provided for reasonableness but did not perform detailed audits. We have, therefore, relied upon each of these sources to provide accurate and complete data and information.

# Actuaries Climate Index Website Uses and Next Steps



ACTUARIES CLIMATE INDEX  
INDICE ACTUARIEL CLIMATIQUE

# Potential Uses of the Actuaries Climate Index (ACI)

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- Inform the Public Debate
- Educate Actuaries, Insurance Professionals, and Others
  - Identify extreme weather and sea level trends
  - Relevant to insured risk
  - Reflect higher risk into risk management practices and pricing
  - Strategic planning purposes

# Future Research of the Actuaries Climate Index (ACI)

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- Currently working on the Actuaries Climate Risk Index – New index that incorporates risk by looking for correlations between the climate variables in the ACI, to economic losses, mortality and morbidity.
- New smaller regions
- New data sources
- Further analysis of ACI data



**SOCIETY OF  
ACTUARIES®**