Seeing Beyond Risk

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Welcome to the new issue of *Seeing Beyond Risk*, the quarterly electronic publication from the Canadian Institute of Actuaries (CIA). Each issue presents the latest actuarial thinking from experts.

In this issue, actuaries Caterina Lindman and Yves Guérard discuss the Actuaries Climate Index™, an online resource updated quarterly that provides data on changes in climate extremes and sea level in North America. We are sure you will find this article informative and thought-provoking, and we encourage you to distribute it among your friends and colleagues.

Actuaries Climate Index

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The Actuaries Climate Index™ (ACI) is an objective, quarterly, online measure of changes in climate extremes and sea level in North America relative to the 30-year period of 1961–1990. This educational tool and source of reference material can help inform actuaries, public policymakers, educators, and the general public on changes in these data over recent decades, to gain a better understanding of climate impacts beyond media references to global warming and 2° Celsius targets.

The ACI was developed by the four largest actuarial professional associations in North America: the American Academy of Actuaries, the Canadian Institute of Actuaries, the Casualty Actuarial Society, and the Society of Actuaries. The Climate Change Committee appointed by these organizations worked with climate scientists from Solterra Solutions, a consulting firm, to develop the ACI.

Actuaries are experienced in the assessment and mitigation of the financial consequences of risks and in the summarizing and presentation of complex data. Increased frequencies of severe weather events are having a financial impact on insurance consumers and the insurance industry, and actuaries are well-positioned to conduct deep analysis to map out what has been happening since 1961. Nevertheless, the ACI will not be of immediate interest for the calculation of insurance premiums but provides a deeper context for understanding the variety and variability of climate risks that are of great interest to the actuarial profession. The ACI will also help educate the public about the increased frequency of climate extremes in recent decades.

HOW IT WORKS

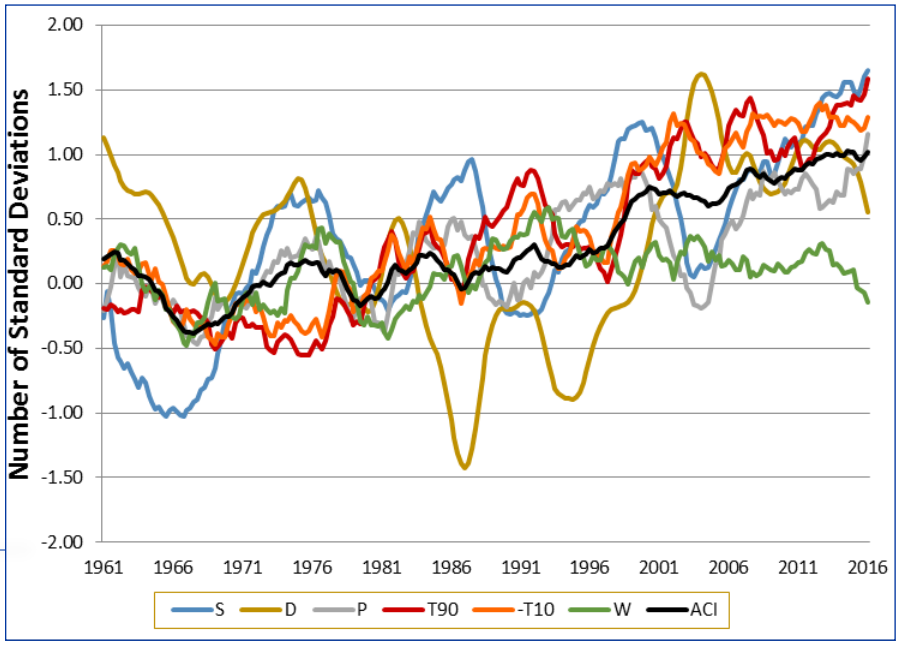
The ACI measures climate extremes in Canada and the United States based on data, updated quarterly, in the six different index components from 1961 to winter 2016 below:

- High temperatures;
- Low temperatures;
- Precipitation;
- Drought (consecutive dry days);
- High wind; and
- Sea level.

Each component is a measurement of the value today compared to the reference period of 1961 to 1990. A 30-year reference period is common in measuring climate, as it is long enough to exclude short-term trends. Higher index values point to an increase in the probability of extreme climate events by comparison with average frequencies during the 1961–1990 reference period. The index, with the exception of the sea level component, measures

extremes rather than averages because the increase in extremes is more relevant to climate risk.

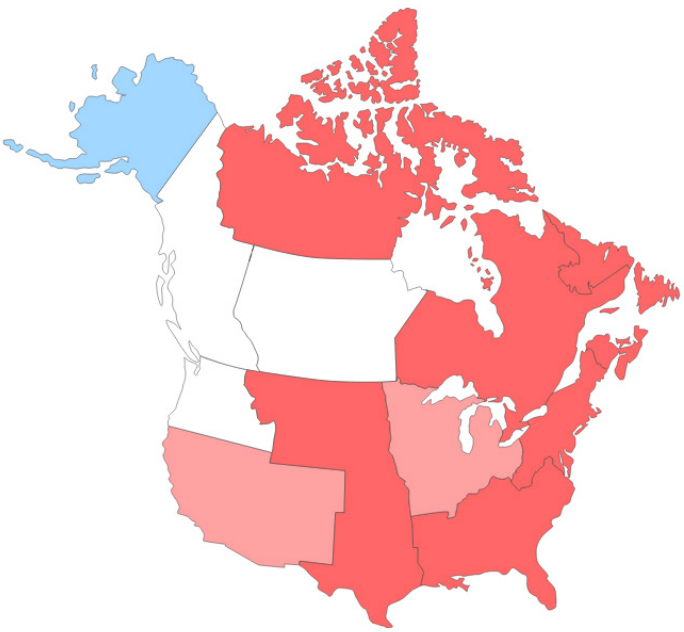
This index is complementary to other sources of information about the causes of climate extremes or projections of future global warming. It does not analyze causes and makes no assumptions about future years but is based on actual data going back to 1961 collected by a wide network of meteorological stations[1] plus 76 tidal stations.



ANOMALIES AND DEVIATIONS

In order to combine the information from the different components, it was necessary to create a dimensionless quantity referred to as a standardized anomaly. The standardized anomaly is the observed value less the mean during the reference period, divided by the standard deviation during the reference period. The ACI is the average of the standardized anomalies of the six components.

Canada and the United States are divided into 12 regions, and the ACI is calculated for each of those 12 regions, as well as the larger regions of 1) Canada, 2) the contiguous United States, and 3) all 12 regions, i.e., the whole of Canada, Alaska, and the contiguous United States. A very interesting feature of the website is an animated map showing the variations of the index over all seasons from 1961 to 2016 and across the 12 regions.



In the above illustration of ACI values, the five-year moving average, in black, is shown to help discern the emerging trend. S stands for sea level, D for drought, P for precipitation, T90 and -T10 stand for warm and cold extremes, and W for wind.

The methodology has been designed to produce an average of zero for the ACI over the reference period. A mean that is higher than zero after the reference period indicates an increase in the frequency of climate extremes. What does the recent evolution of the graph tell us? First of all, the graph shows a great variability, thus the need to look at climate over long periods to confirm trends, if any. Second, despite fluctuations, it is clear that the ACI has generally been increasing after the end of the reference period in 1990. The clearest trends are seen in the sea level, high temperatures (T90), and less frequent cool temperatures (-T10). The wind power, precipitation, and drought components are more erratic.

WHAT CAN WE LEARN?

According to this data analysis, the five-year moving average for the index is 1.02, which is the deviation from the average index value of zero during the reference period. This deviation far

exceeds any five-year moving average prior to the rapid rise in the index between 1995 and 1999. Each successive five-year period since the end of the reference period has shown an increase over the previous one, indicating a sustained increase in the frequency of climate extremes. These effects result from unusual frequencies of extreme temperatures, high winds, heavy precipitation and drought, as well as rising sea levels.

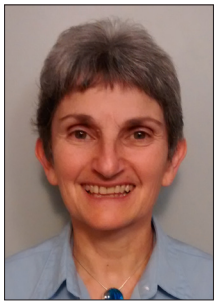
The ACI tells us that an increased frequency of climate extremes can impact us in a variety of ways, difficult to anticipate in the short term but to be taken seriously if we care about the long term. The precautionary principle of risk management implies that there is a social responsibility to protect the public from exposure to harm, when scientific investigation has found a plausible risk. These protections can be relaxed only if further scientific findings emerge that provide sound evidence that no harm will result.[2] Therefore, we should strive to adapt our behaviour to minimize the risks of a changing environment.

We encourage you to explore the Actuaries Climate Index, starting with the guided tour.

Endnotes:

[1] GHCN (Global Historical Climatology Network)-Daily is an integrated database of daily climate summaries from land surface stations across the globe. With the exception of sea level, each component is measured in grids. The grids each cover a surface area of 2.5 degrees longitude by 2.5 degrees latitude, 275 km by 275 km at the equator. The width of the grid cell gets smaller as one moves away from the equator, due to the curvature of the Earth's surface.

[2] "Precautionary Principle," Wikipedia, last modified January 12, 2017, https://en.wikipedia.org/wiki/Precautionary_principle



Caterina Lindman, FCIA, FSA, is recently retired after a 35-year career in the insurance industry. She chairs the Climate Index Working Group.

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