



SINGAPORE
ACTUARIAL
SOCIETY



SAS Actuarial Climate Index

ERM Conference – SAS Super Week

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“There is one issue that will define the contours of this century more dramatically than any other, and that is the **urgent threat of a changing climate.**”

Barack Obama on climate change

Former president of the United States of America

SAS Actuarial Climate Index

Introduction

1

Actuaries – spectators of the climate change

Trained to model the financial and demographic risks, most of the actuaries consider the climate risk as an ad-hoc risk and not as a transverse problematic. The long-term characteristic of the insurance business is also a drag on the reassessment of our existing business models and the future impacts of immediate actions.

2

From being a spectator to becoming a key player in the climate transition

The insurers' roles will broaden due to the natural risks as they will have to prepare their clients for climate change consequences and be an active player in order to help them to bounce back from a natural event. Actuaries will play a key role in terms of including these risks into a daily practice e.g. the pricing policy.

3

Working with available data and knowledge

Data availability, accuracy and consistency are essential for actuarial models but understanding the data is also critical in order to be able to interpret the results. The extreme nature of climate risks which involves a lack of historical data and a lack of scientific knowledge and expertise create some challenges for actuaries.

4

Actuaries - synergies with geographers, meteorologists and climatologists

Using a solid scientific historical data basis from climate science experts, actuaries can translate these risks into a financial impact in view of the portfolio exposure.

Multiple climate science projects have seen actuaries working with these experts such as the Actuarial Climate Index.



SAS Actuarial Climate Index

Background

Actuaries Climate Index (ACI)
Developed by North American actuarial bodies and released in November 2016, it is intended to provide a useful monitoring tool - an objective indicator of the frequency of extreme weather and the extent of sea level change.



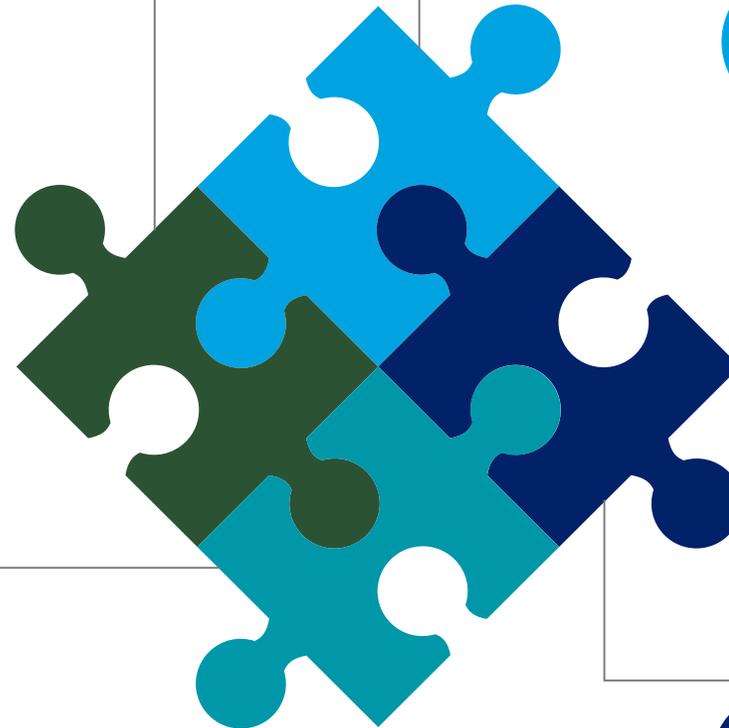
Australian Actuaries Climate Index (AACI)
Inspired by ACI, it has been developed with a similar objective and released in November 2018.



Purpose
Both are designed to provide an easy to interpret and valuable metric for actuaries, policy decision-makers and the general public to refer to when monitoring changes in climate.



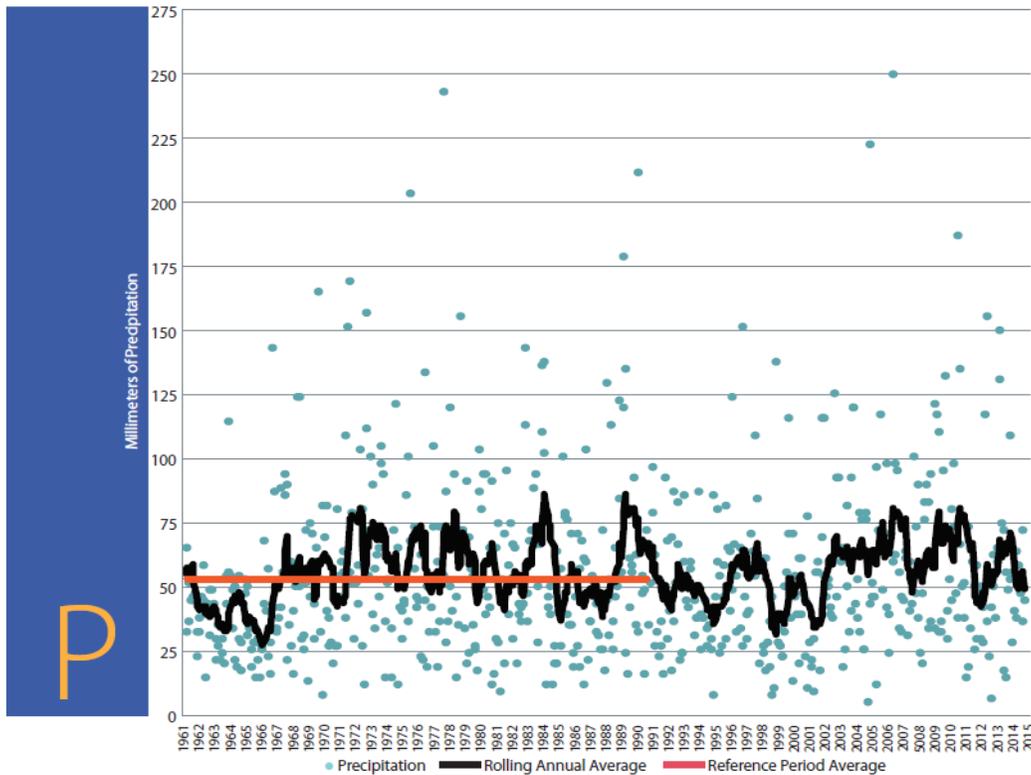
SAS Climate Index
We endeavour to develop a Singapore specific climate index in 2021.



SAS Actuarial Climate Index

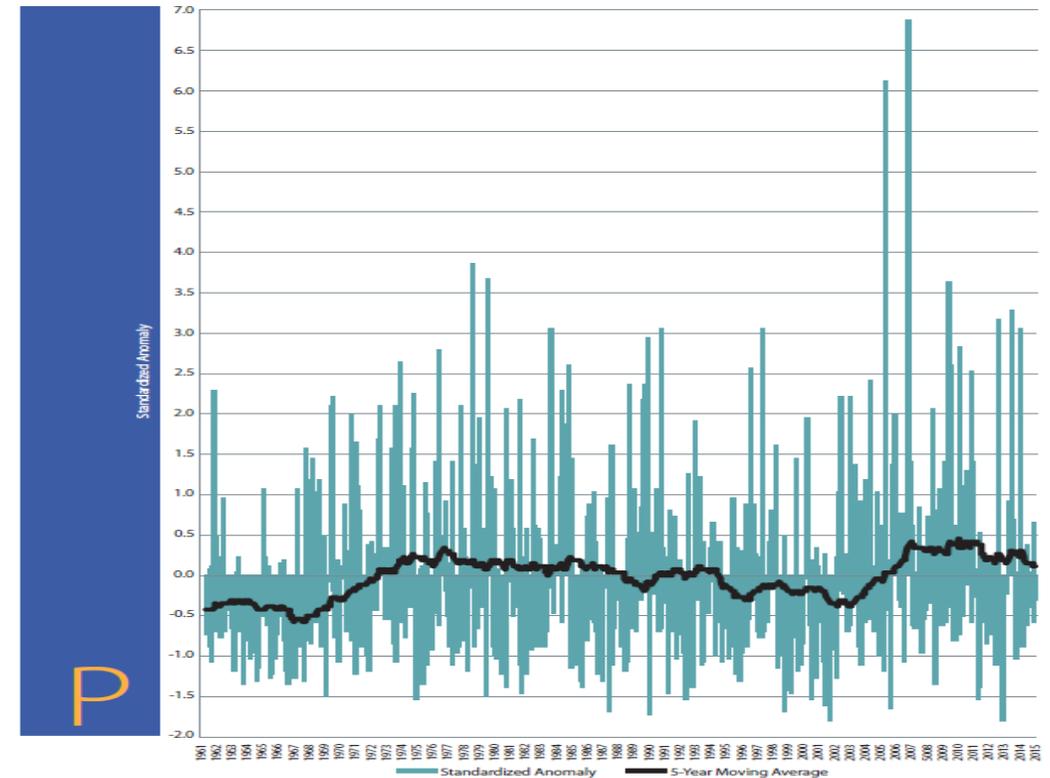
Methodology – Precipitation example in NYC, USA

Monthly reference values – Precipitation



Reference period data provides the monthly reference values i.e. mean and standard deviation for the precipitation measure

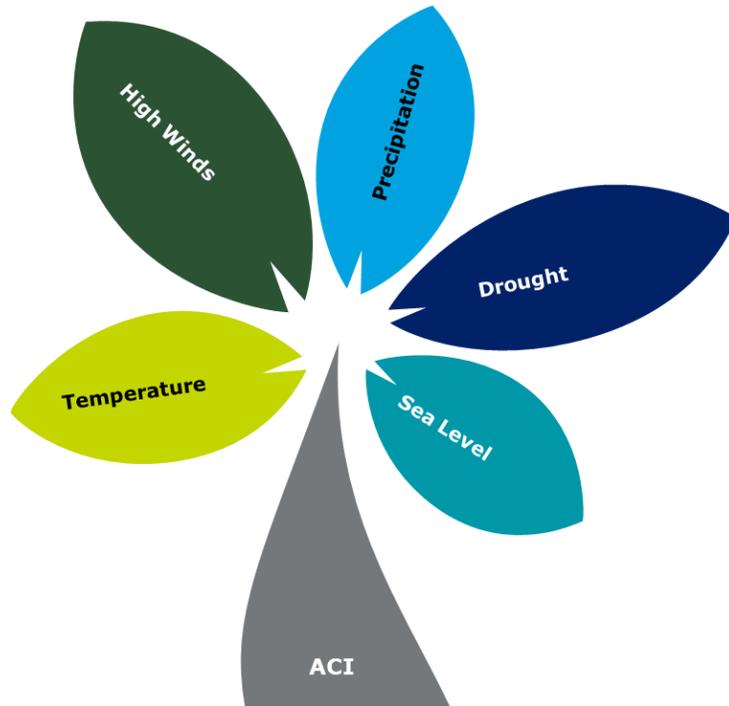
Standardised Anomalies – Precipitation



Measure of the extent of deviation of current frequency of extreme events in terms of the parameters of the reference data distribution

SAS Actuarial Climate Index

Components and Climate Index



Temperature

Frequency of temperatures above 90th percentile and below 10th percentile

Precipitation

Maximum 5 day precipitation

Sea Level

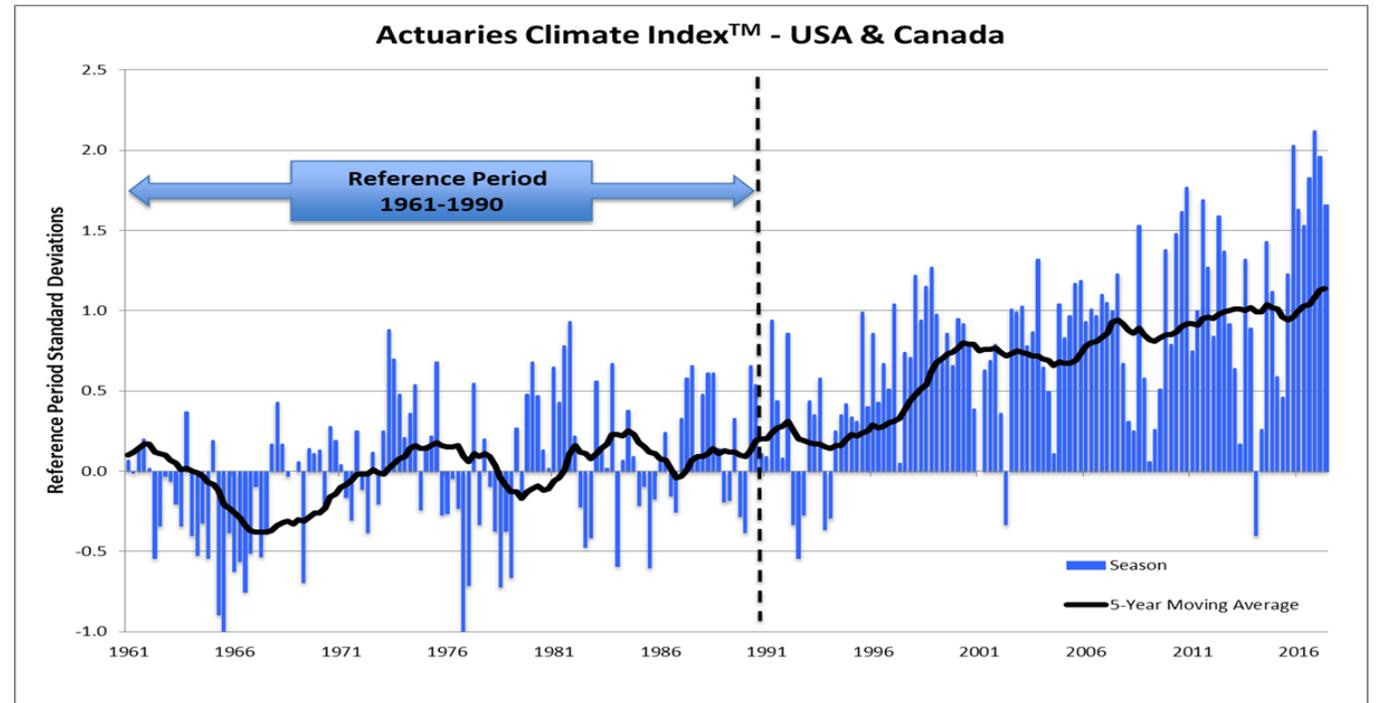
Standardised changes in sea level

High Winds

Frequency of strongest wind power

Drought

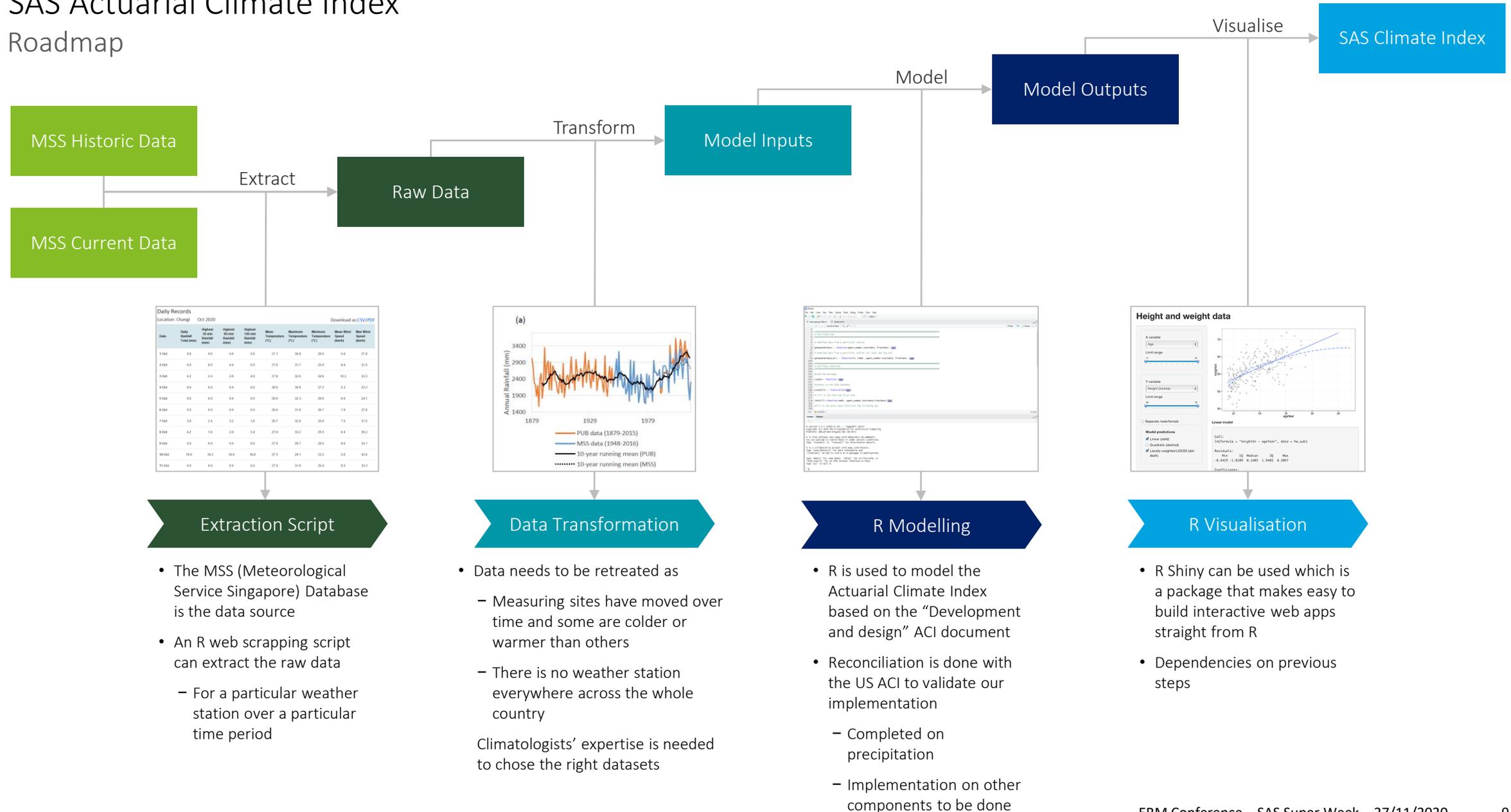
Maximum consecutive dry days (< 1mm)



- ACI is defined as the average standardised anomalies of the following components:
 - $ACI = \text{mean}(T_{90_{std}} - T_{10_{std}} + P_{std} + D_{std} + W_{std} + S_{std})$
- Standardisation is with respect to the reference data 1961-1990

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SAS Actuarial Climate Index Roadmap



- The MSS (Meteorological Service Singapore) Database is the data source
- An R web scraping script can extract the raw data
 - For a particular weather station over a particular time period

- Data needs to be retreated as
 - Measuring sites have moved over time and some are colder or warmer than others
 - There is no weather station everywhere across the whole country
- Climatologists' expertise is needed to chose the right datasets

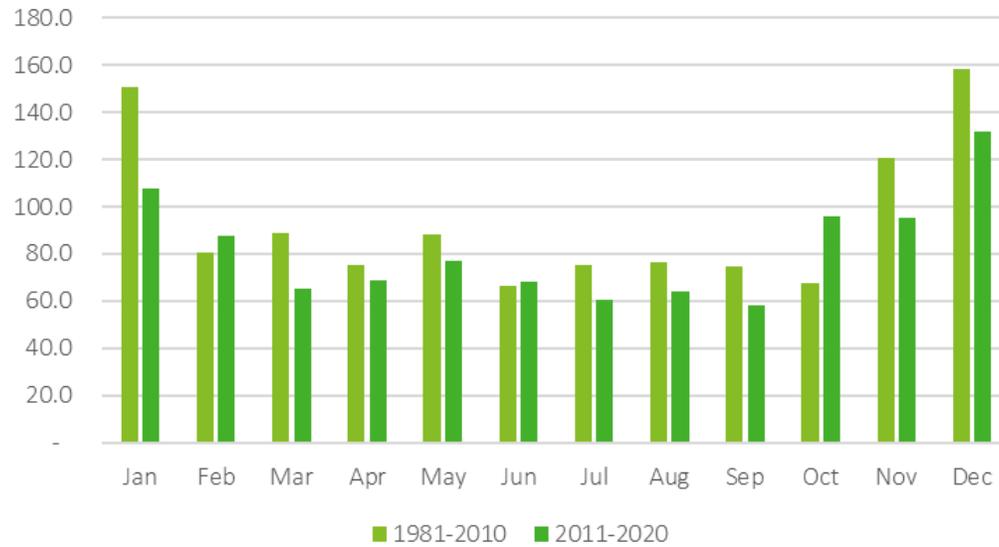
- R is used to model the Actuarial Climate Index based on the "Development and design" ACI document
- Reconciliation is done with the US ACI to validate our implementation
 - Completed on precipitation
 - Implementation on other components to be done

- R Shiny can be used which is a package that makes easy to build interactive web apps straight from R
- Dependencies on previous steps

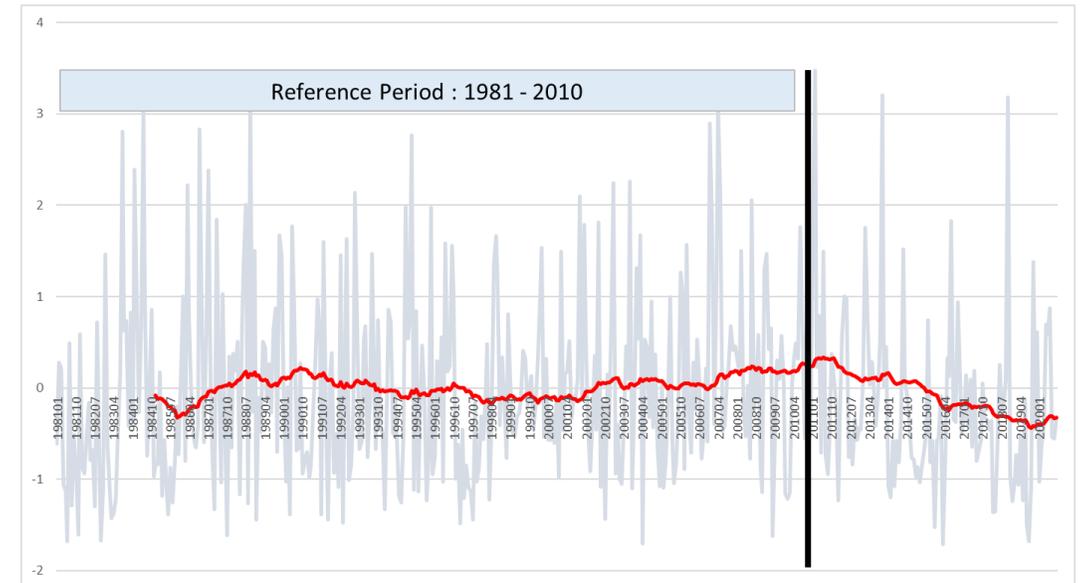
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Precipitation example – Changi airport

Monthly reference values – Precipitation



Standardised Anomalies – Precipitation



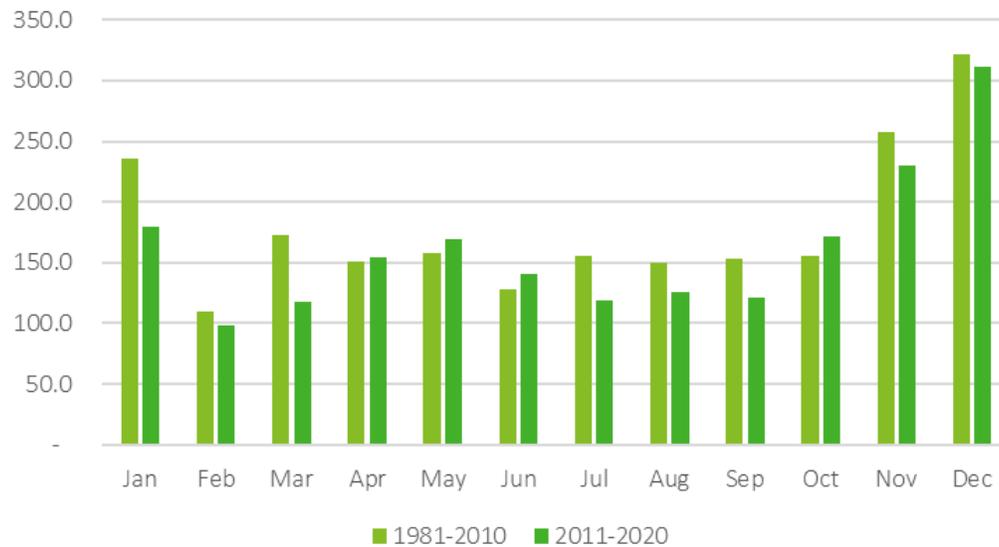
Reference period data provides the monthly reference values i.e. mean and standard deviation for the precipitation measure

Measure of the extent of deviation of current frequency of extreme events in terms of the parameters of the reference data distribution

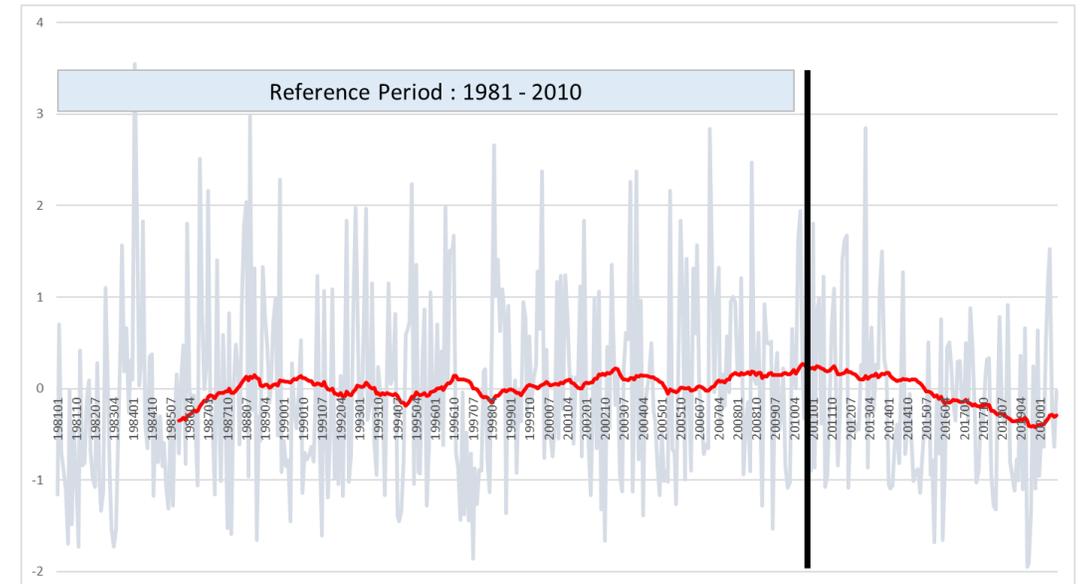
SAS Actuarial Climate Index

Precipitation example – total monthly rainfall

Monthly reference values – Precipitation



Standardised Anomalies – Precipitation

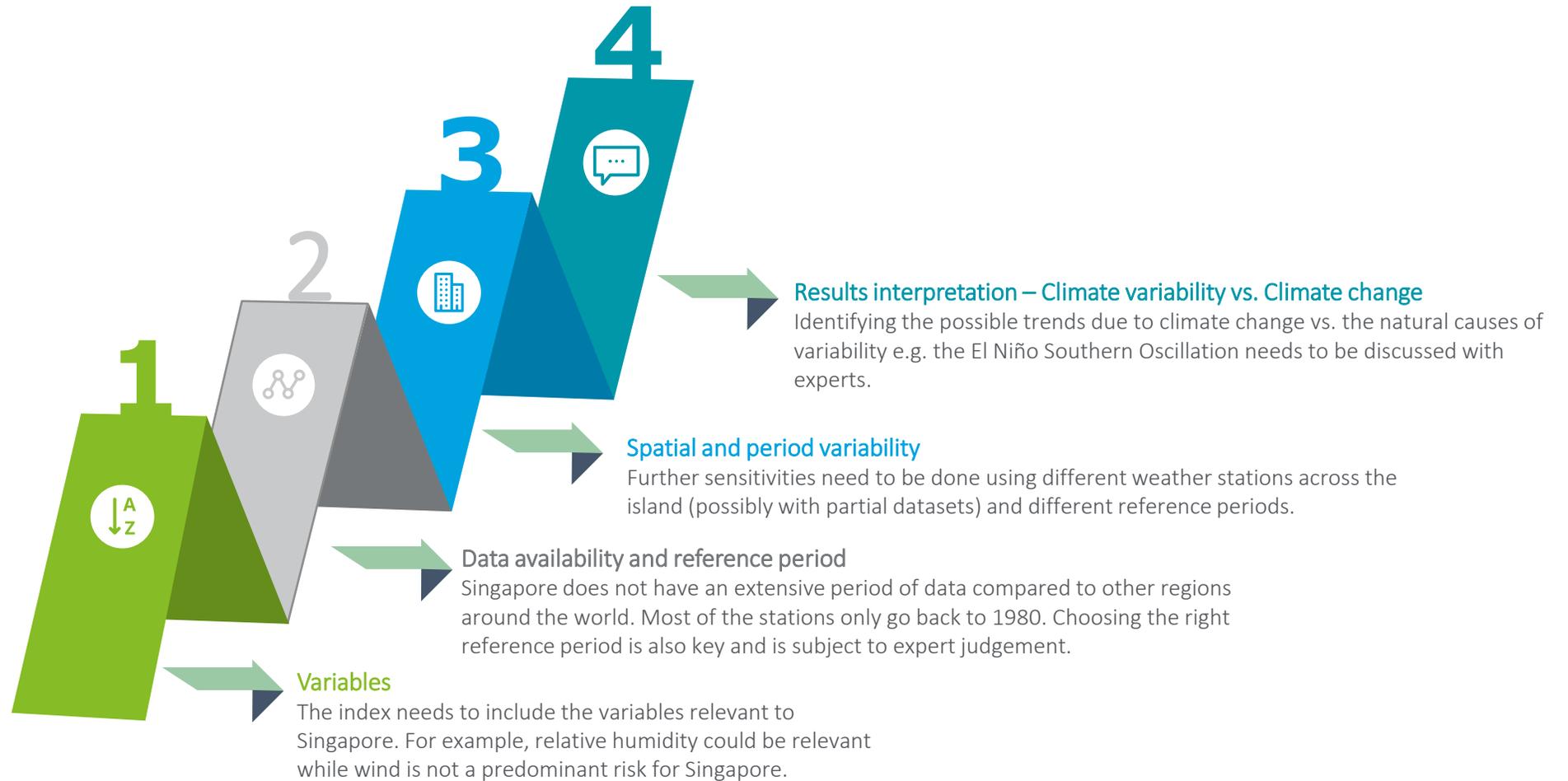


Reference period data provides the monthly reference values i.e. mean and standard deviation for the precipitation measure

Measure of the extent of deviation of current frequency of extreme events in terms of the parameters of the reference data distribution

SAS Actuarial Climate Index

Key points and challenges



“We have to wake up to the fierce urgency of the now.”

Jim Yong Kim on climate change
Former president of the World Bank

SAS Actuarial Climate Index

Conclusion

1

Early stage of the project

The SAS Actuarial Climate Index is still at its early stage. The framework in terms of data, methodology/model, resources is still to be refined as it needs to be relevant and specific to Singapore.

2

Key involvement of experts from diverse backgrounds

Climate and actuarial science have similarities in terms of methodology but expertise and knowledge is essential to be able to interpret the results. The right experts need to be involved to make sure that the message is relevant.

3

Raising awareness in the industry

Climate change is not a priority for most of the market players. Impact of climate change will have tremendous consequences as it affects directly the underlying of the whole (re)insurance market. All players from actuaries, climate scientists, policy makers need to work together.

4

Next steps

After implementing the SAS Actuarial Climate Index, including projections, extending the index to other countries of the SEA region and ultimately measuring the financial impact of climate change are possible next steps.