General Insurance Seminar

Transform the Future

12-13 November 2018 • Sofitel, Sydney

Actuaries Institute

Australian Actuaries Climate Index (AACI)

Presented by Tim Andrews

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Agenda

Description of the AACI

- North American Index
- Process in Australia
- Purpose of index

Some thoughts on extremes

- Significance of extremes
- Link to risk

Results

- High level results
- Comparison to North America
- Interesting findings

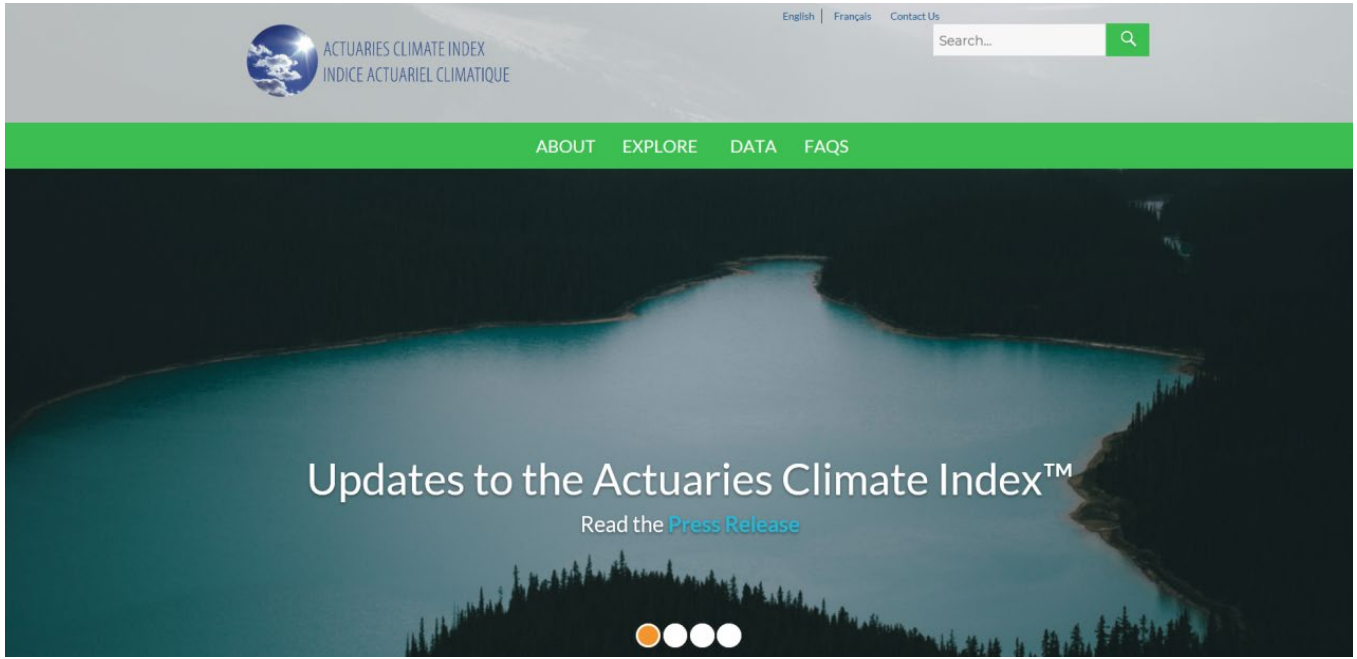
Description of the AACI

Purpose of the AACI

- The Australian Actuaries Climate Index (AACI) refers to a number of indices that provide objective measures of historical extreme weather and sea levels
- Designed to help inform actuaries, public policymakers, companies and the general public about climate trends in Australia
- Backwards looking, but structured to enable comparisons with forward projections
- A starting point
  - Extremes are linked to risk, but not explicit
  - Consider development of more explicit and specific risk measures in future
- Oversight from GIPC, CCWG, PPCC

We are not the first to do this

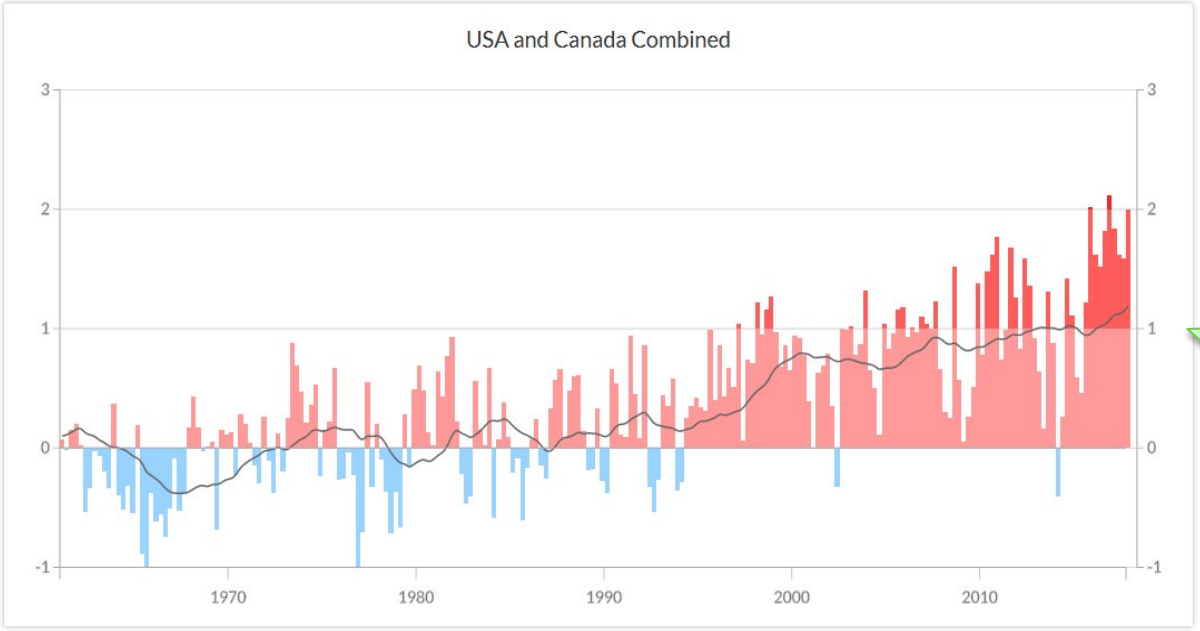
Actuaries Climate Index (ACI) – North America



- Tracks climate extremes, typically 90th percentile
- Available for six components across 12 regions

http://actuariesclimateindex.org/home/

Actuaries Climate Index (ACI) – North America



Since 1961-1990, extremes have increased by one standard deviation on average across each of component indices

Process we followed for AACI

- Review the ACI
- Meet with ACI actuaries, BoM, CSIRO, Universities
- Stage 1 report prepared to recommend index design

- Collect and analyse data, and generate index
- Discuss draft results with BoM, CSIRO, ACI actuaries, other scientists and various Institute committees

- November 2018, with quarterly updates

Individual component indices

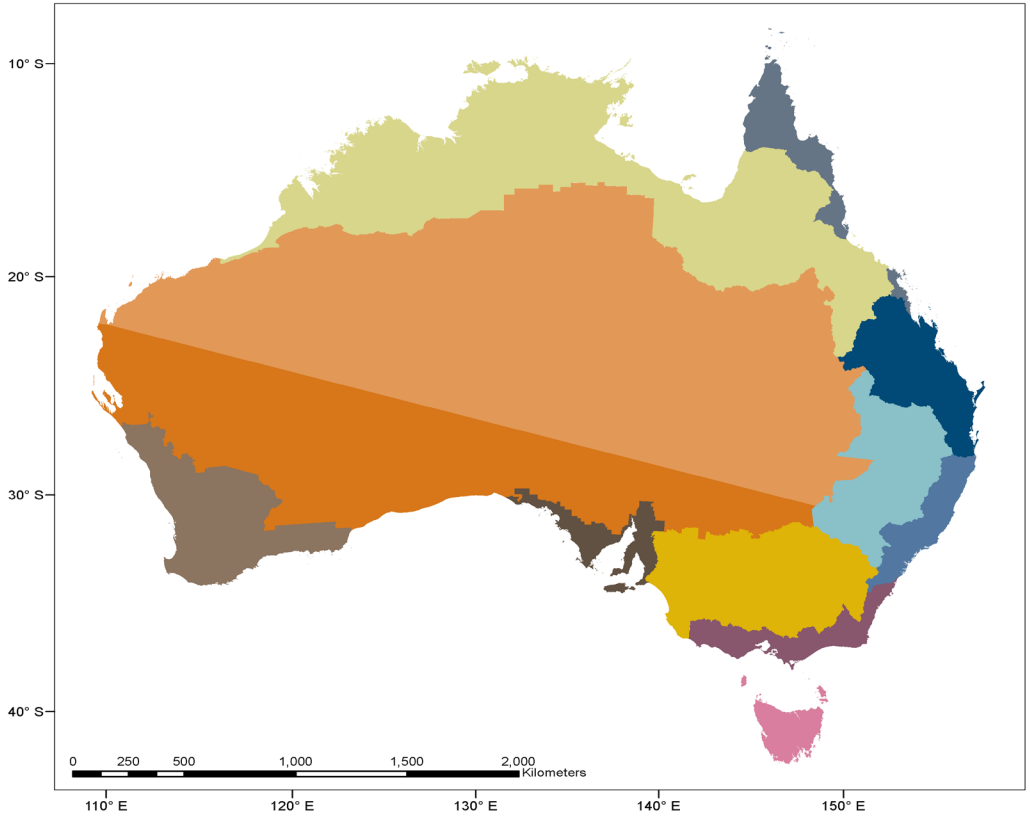
Component	Description
High Temperature	Monthly frequency of maximum and minimum temperatures above the 99th percentile
Low Temperature	Monthly frequency of maximum and minimum temperatures above the 1st percentile
Precipitation	Monthly frequency of 5 day consecutive rainfall above the 99th percentile
Wind	Monthly frequency of daily wind gust above the 99th percentile
Consecutive Dry Days	Annual maximum consecutive dry days
Sea Level	Monthly maximum sea level

- The wind gust data is only shown for the period post installation of the cup anemometers (typically around 1995).

The headline index is a composite index

- Combines the indices for three of the six components
- The components included are high temperature, rainfall and sea level
  - The wind data was excluded as data was not available back to 1981
  - The drought measure (consecutive dry days) was excluded as it shows a strong inverse correlation with the rainfall measure
  - The low temperature was excluded so that temperature was not overweighted in the composite index, noting that high temperature is included

Regions



Regions are based on CSIRO's 15 sub-clusters used for the "Climate Change in Australia" data, with some grouping

Key differences to North American index

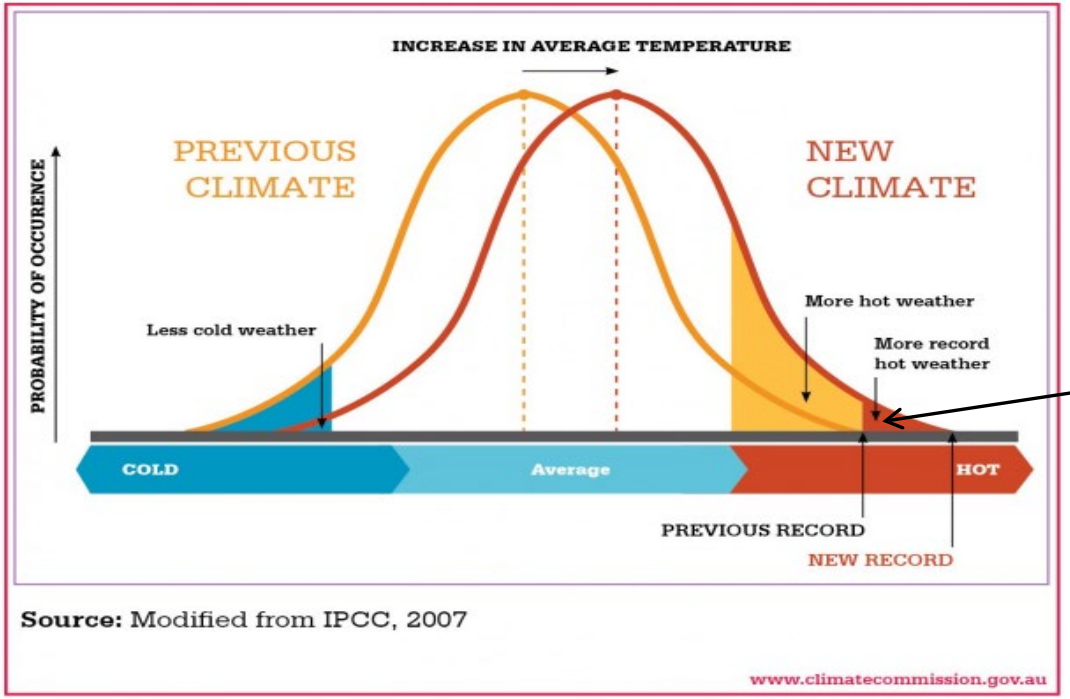
Element	Description
Reference period	1981 to 2010, whereas the ACI uses 1961 to 1990. A more recent period means better quality data and a more contemporary view of changes in risk
Definition of exceedance threshold	99^{th} (not 90^{th}) A more extreme threshold provides a better link to risk
Wind	Based on the maximum wind gust each day. The ACI uses the average wind speed over the 24 hours
Sea level	Based on the maximum sea level for the month whereas the ACI uses the mean
Composite index	Based on only three component indices, not all six

Sources of data

Component	Source
High and Low Temperature	112 ACORN-SAT BoM weather stations
Precipitation and Drought	Approx. 2,000 BoM weather stations that report on rain
Wind	38 BoM weather stations that the BoM considers more reliable measures, noting that wind data is more uncertain
Sea Level	16 tide gauges from Baseline Sea Level Monitoring project

Some comments on extremes

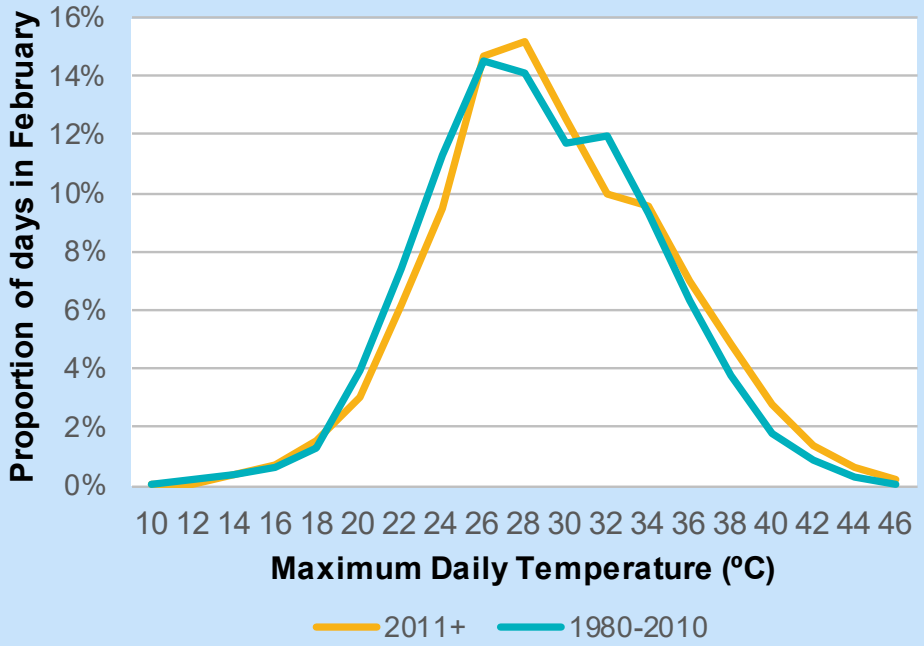
Extremes – in theory



Higher thresholds subject to proportionately greater increase

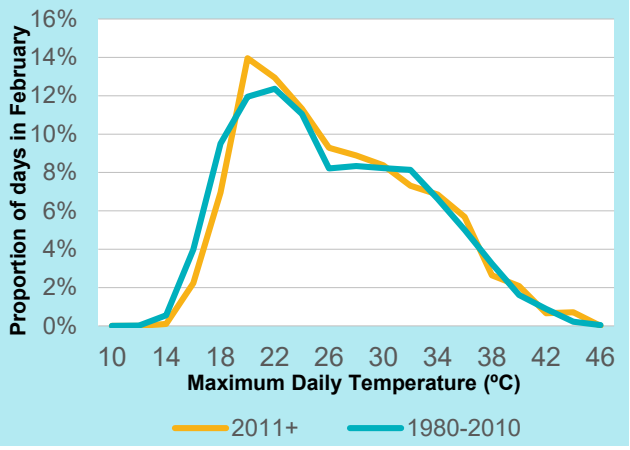
Extremes – in reality

NSW



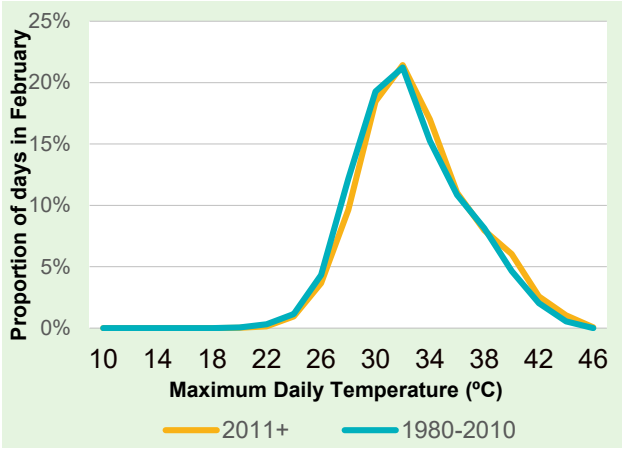
Temp. (ºC)	2011+	1980-2010	Relativity
20	97.2%	97.4%	100%
22	94.2%	93.4%	101%
24	88.1%	86.0%	102%
26	78.6%	74.7%	105%
28	63.9%	60.2%	106%
30	48.7%	46.0%	106%
32	36.2%	34.3%	106%
34	26.3%	22.4%	117%
36	16.8%	13.0%	129%
38	9.8%	6.7%	146%
40	5.0%	2.9%	169%
42	2.2%	1.2%	190%
44	0.8%	0.3%	314%
46	0.2%	0.0%	

VIC



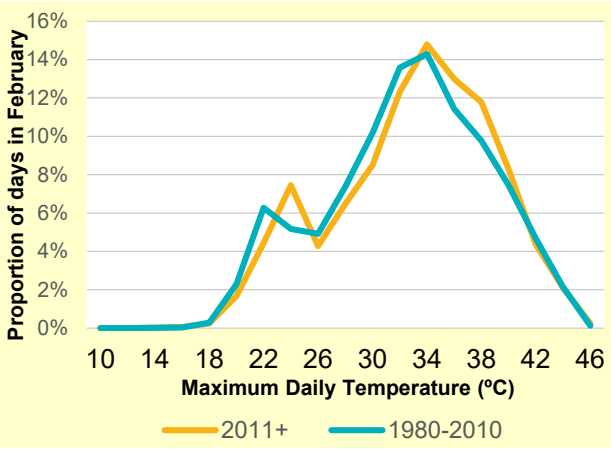
Temp. (ºC)	2011+	1980-2010	Relativity
20	90.7%	85.9%	106%
22	76.8%	74.0%	104%
24	63.8%	61.6%	104%
26	52.5%	50.6%	104%
28	43.2%	42.4%	102%
30	34.3%	34.0%	101%
32	25.9%	25.8%	101%
34	18.6%	17.7%	106%
36	11.8%	11.0%	107%
38	6.1%	6.0%	101%
40	3.5%	2.8%	125%
42	1.4%	1.2%	119%
44	0.7%	0.3%	268%
46	0.0%	0.0%	

QLD



Temp. (ºC)	2011+	1980-2010	Relativity
20	100.0%	100.0%	100%
22	100.0%	99.9%	100%
24	99.8%	99.6%	100%
26	98.9%	98.5%	100%
28	95.2%	94.2%	101%
30	85.6%	82.0%	104%
32	67.1%	62.7%	107%
34	45.7%	41.5%	110%
36	28.7%	26.2%	109%
38	17.7%	15.4%	115%
40	9.7%	7.2%	134%
42	3.7%	2.6%	143%
44	1.1%	0.5%	203%
46	0.1%	0.0%	

WA



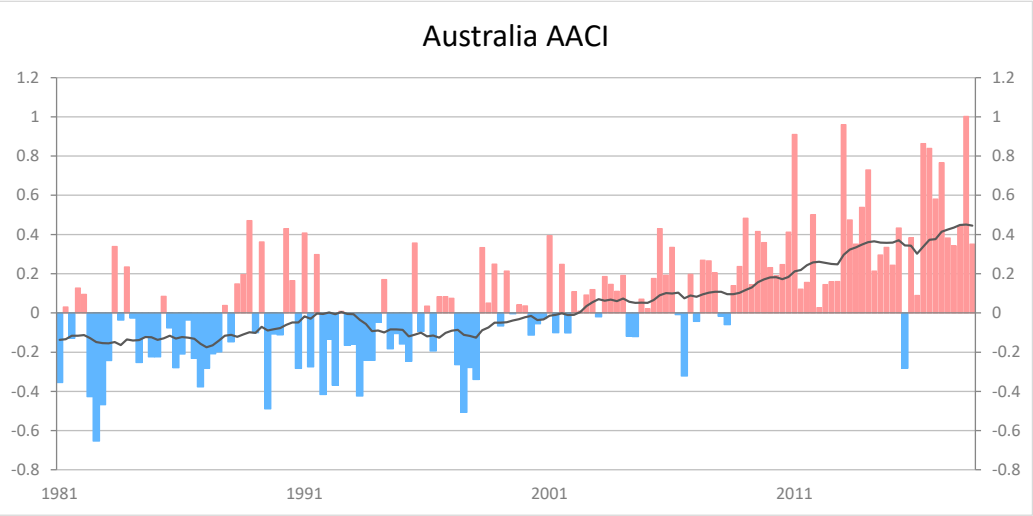
Temp. (ºC)	2011+	1980-2010	Relativity
20	99.7%	99.7%	100%
22	98.0%	97.4%	101%
24	93.6%	91.1%	103%
26	86.1%	85.9%	100%
28	81.8%	81.0%	101%
30	75.4%	73.6%	102%
32	66.9%	63.5%	105%
34	54.5%	49.9%	109%
36	39.8%	35.6%	112%
38	26.8%	24.2%	111%
40	15.0%	14.4%	104%
42	6.7%	6.9%	96%
44	2.3%	2.3%	103%
46	0.2%	0.1%	

Link between extremes and risk

Measure	Threshold at 99th percentile	Risk
Maximum Temperature	31-44 degrees celsius	Heat stress reflects a range of factors but temperature component typically 30 to 40 degrees celsius
Wind	70-93km/h	Property damage typically requires winds of 70 km/h or more
Rain	45-373 mm over 5 days	Flood …. it depends. eg Brisbane flood = 370mm.

Results

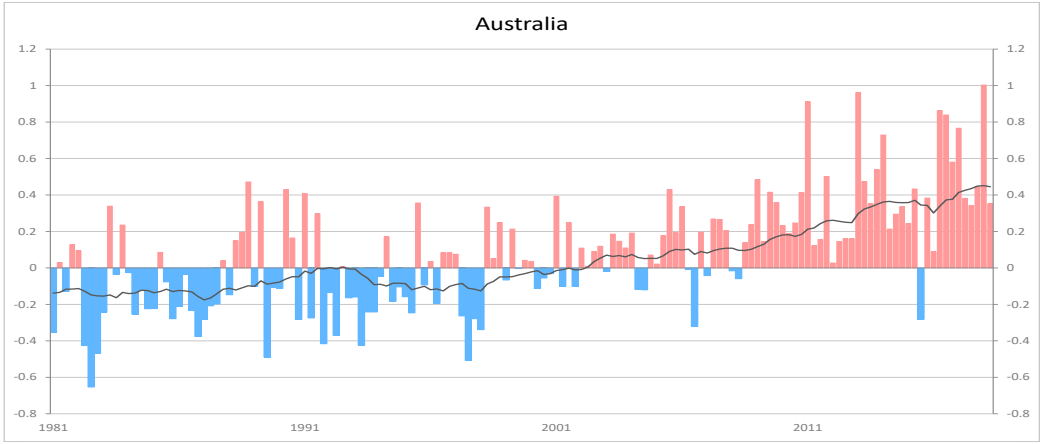
AACI - Composite index

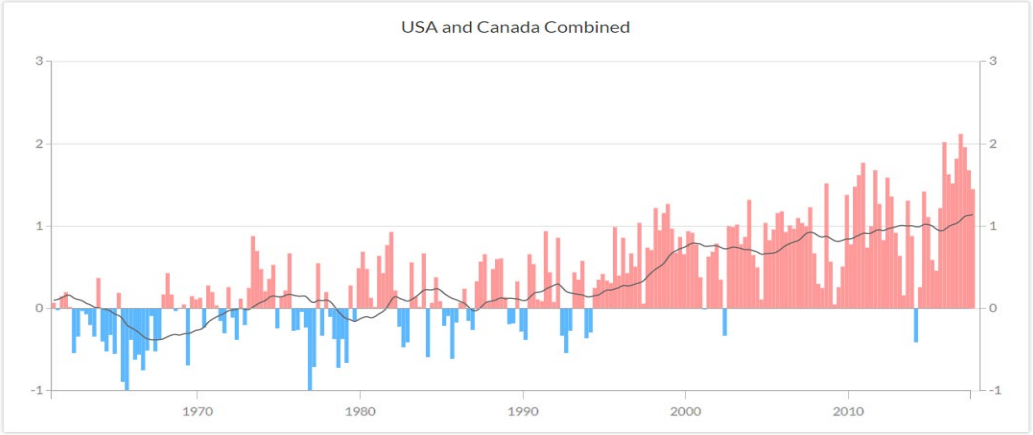


A positive value for the index represents an increase in the relevant climate extremes since 2010 relative to the reference period of 1981 to 2010.

The value is expressed as a standardised anomaly. This means that an index of 0.5 means the component indices have increased on average by 0.5 standard deviations

Comparison to North American Index



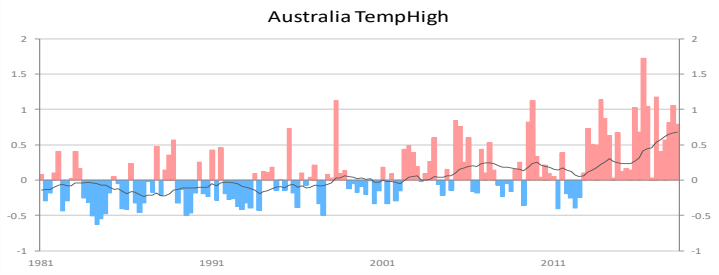


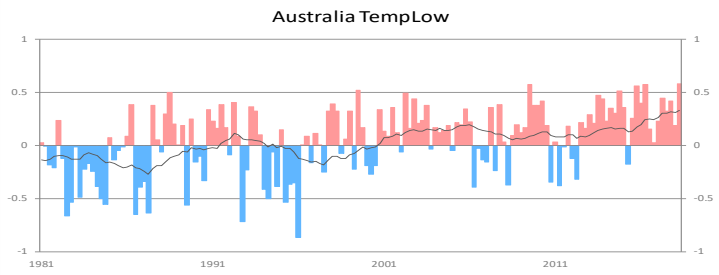
North American index has a higher value.

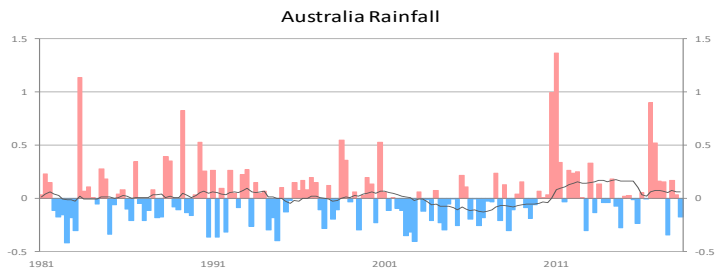
Not a like with like comparison noting that 8 years have elapsed since end of reference period in Australia vs 28 years in North America. Hence Australia would be expected to be lower.

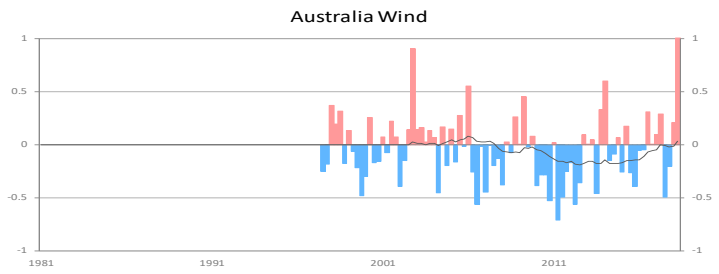
Also, component parts are different.

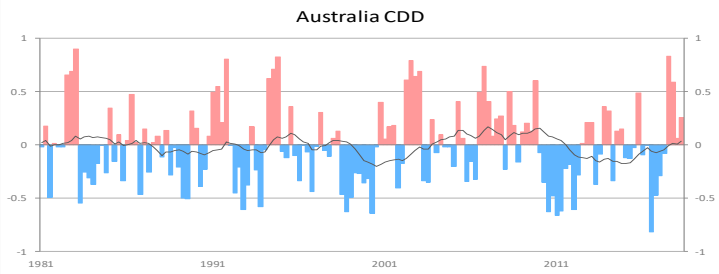
Component indices

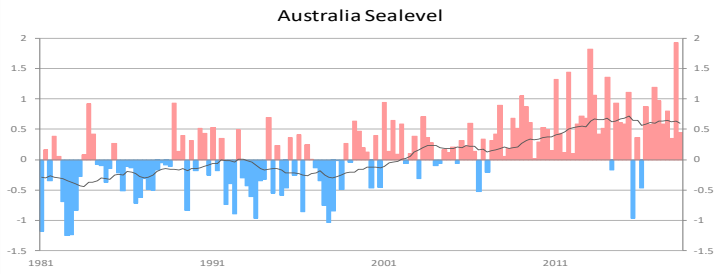






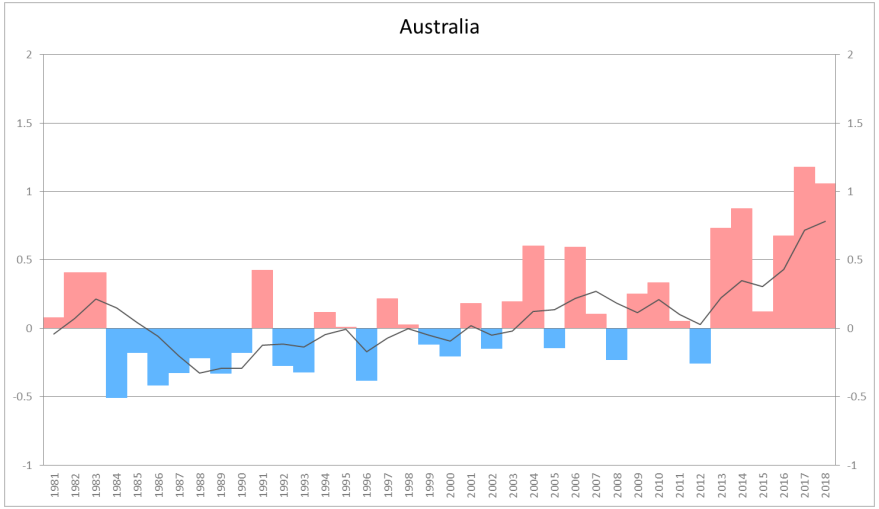




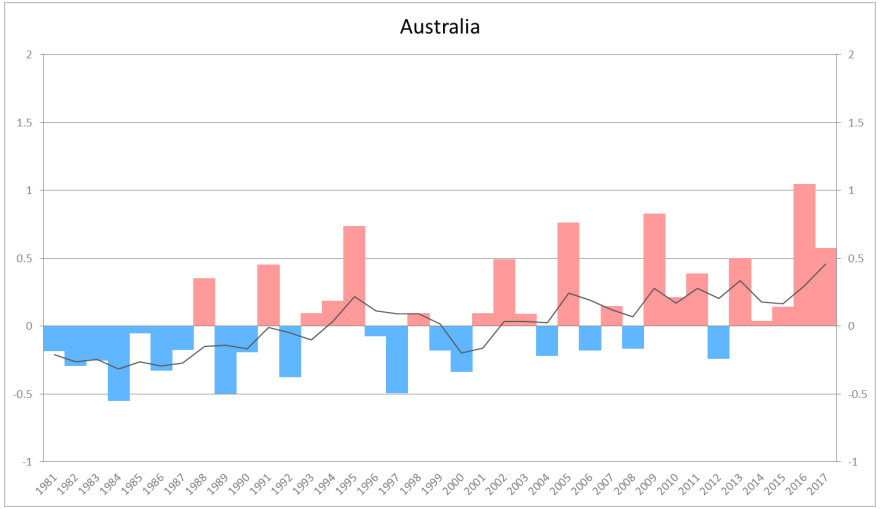


TempHigh - Australia

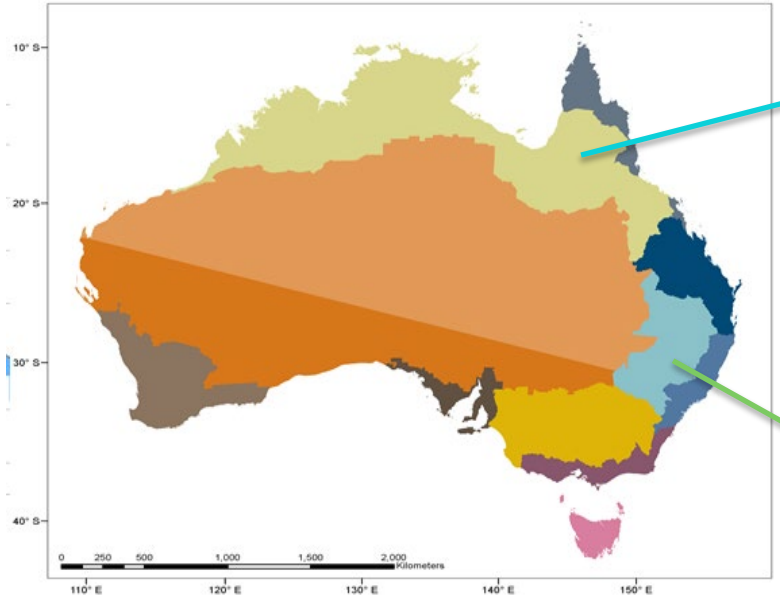
Summer



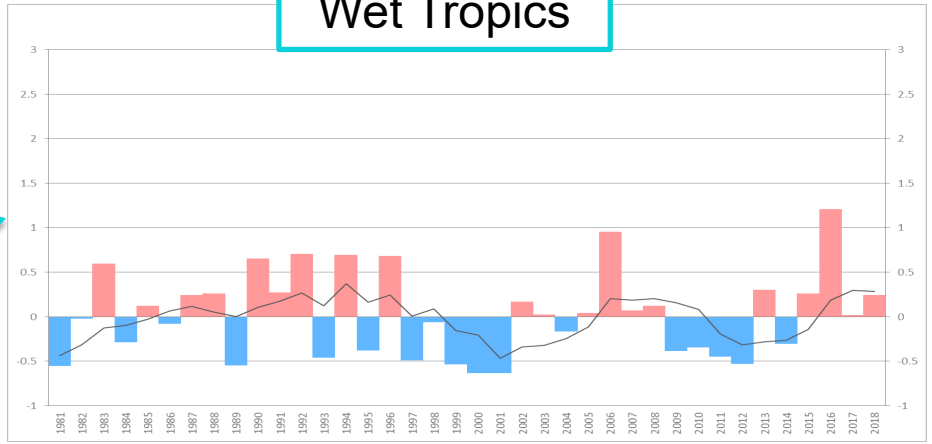
Winter



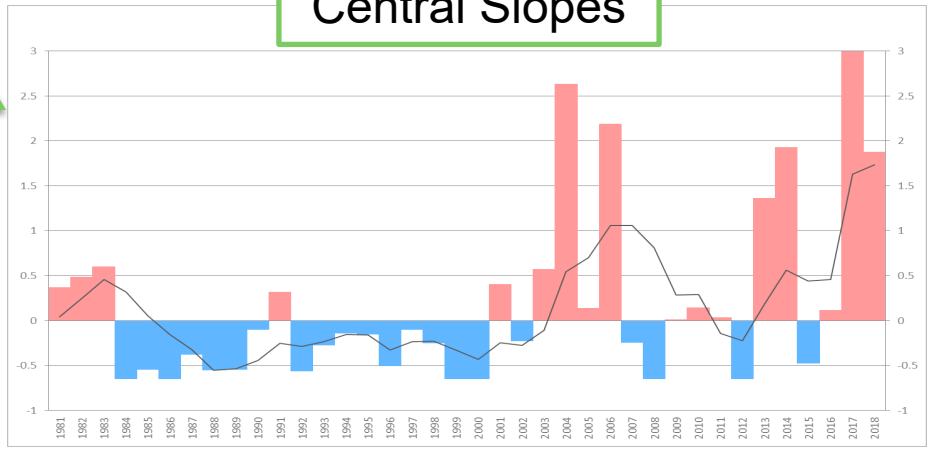
TempHigh - Summer



Wet Tropics

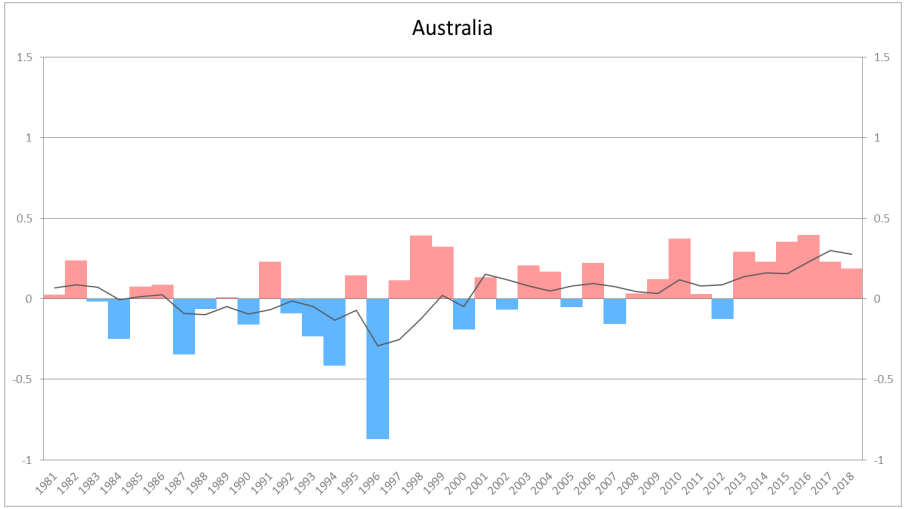


Central Slopes

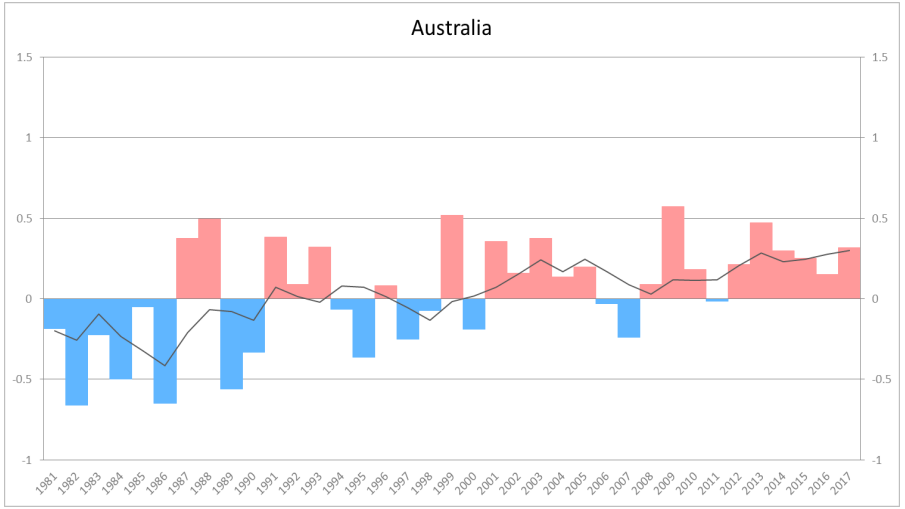


TempLow - Australia

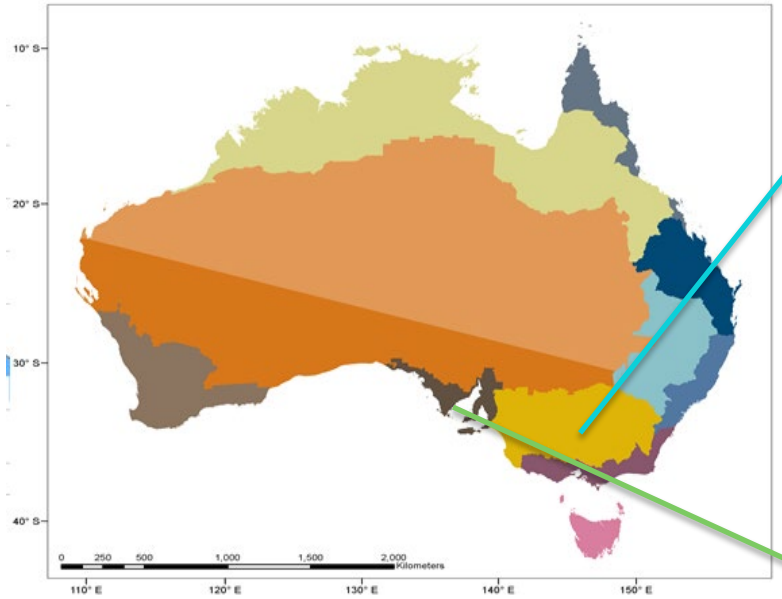
Summer



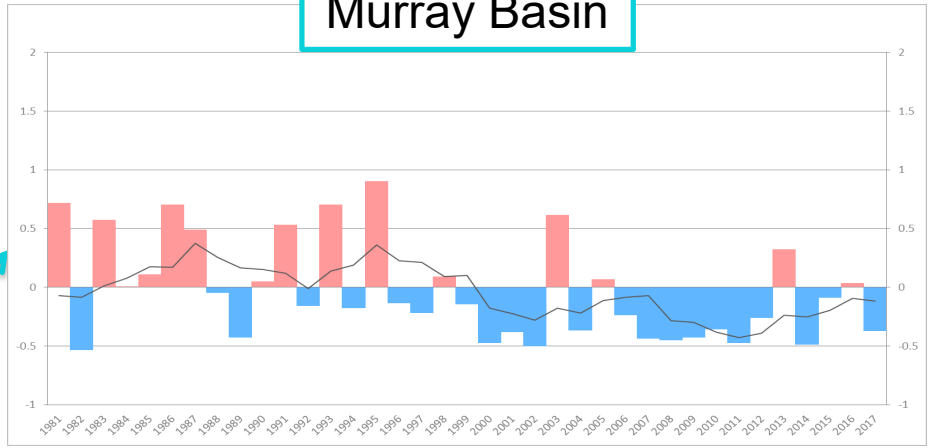
Winter



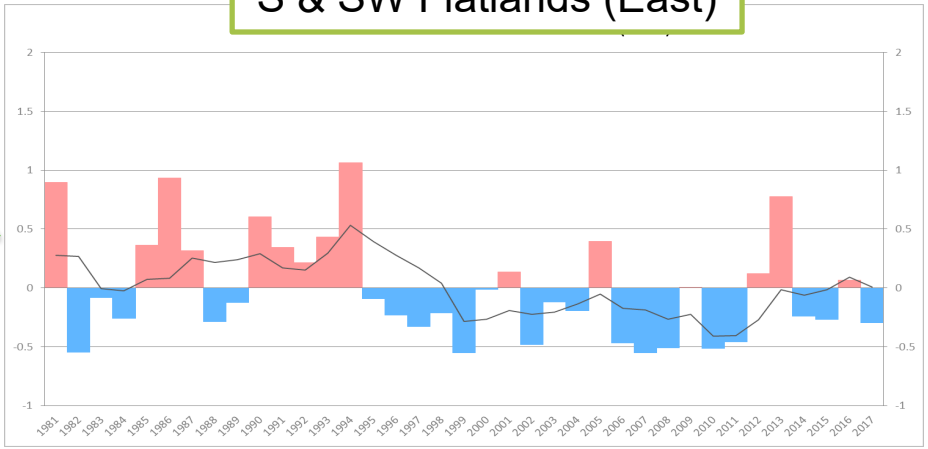
Rainfall - Winter



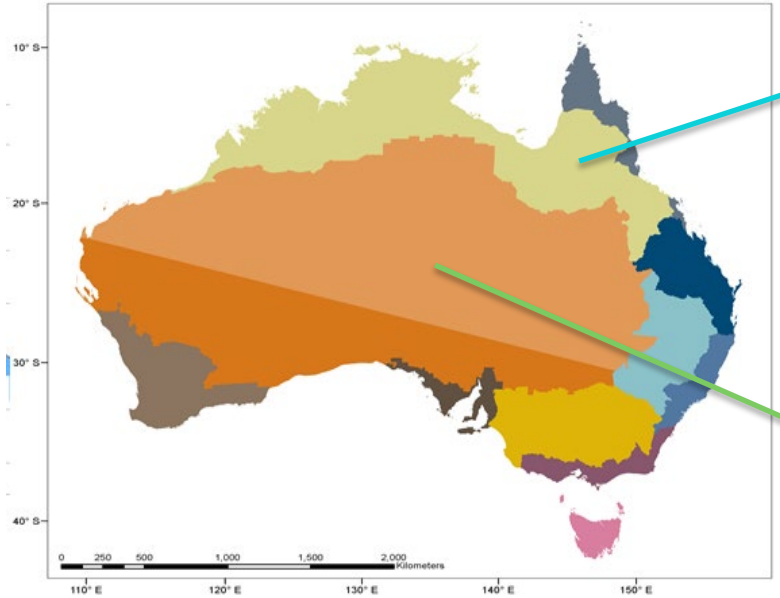
Murray Basin



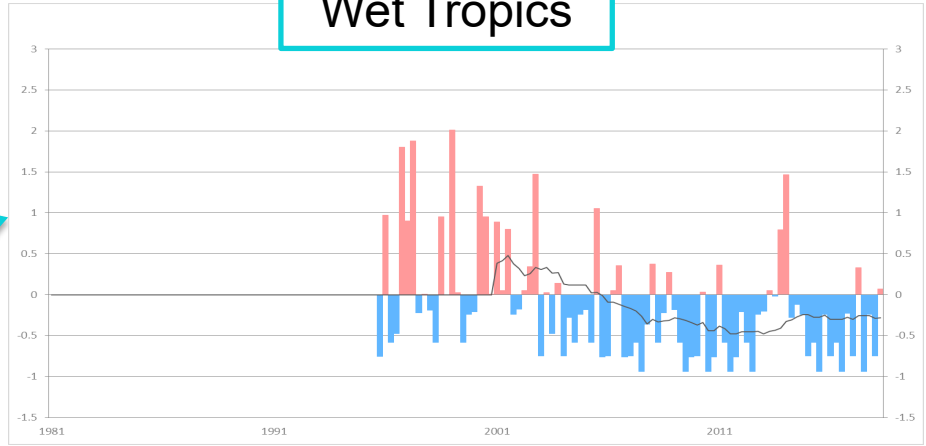
S & SW Flatlands (East)



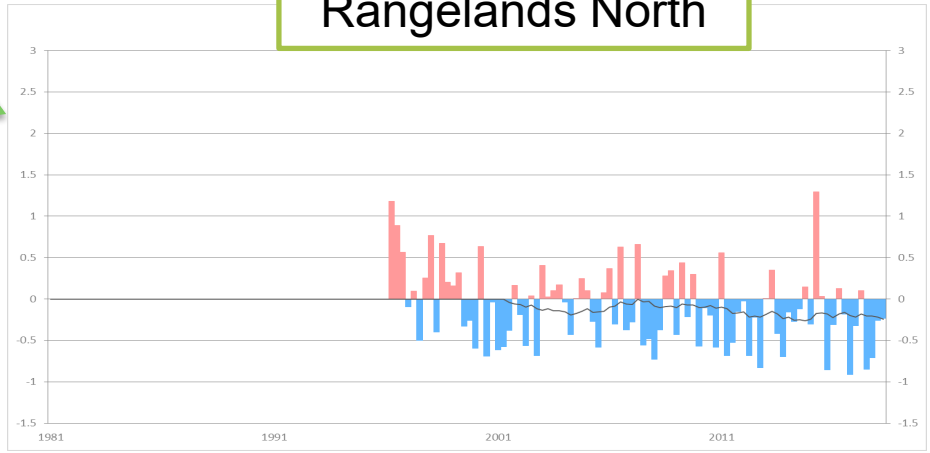
Wind



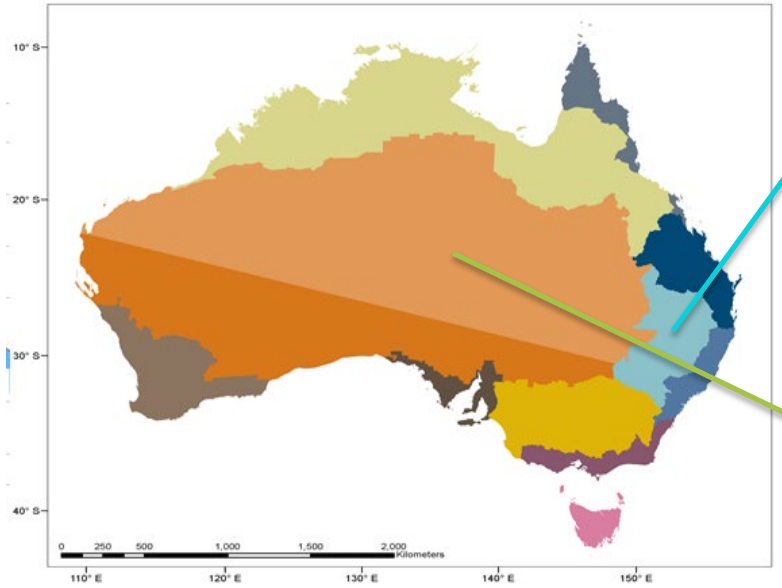
Wet Tropics



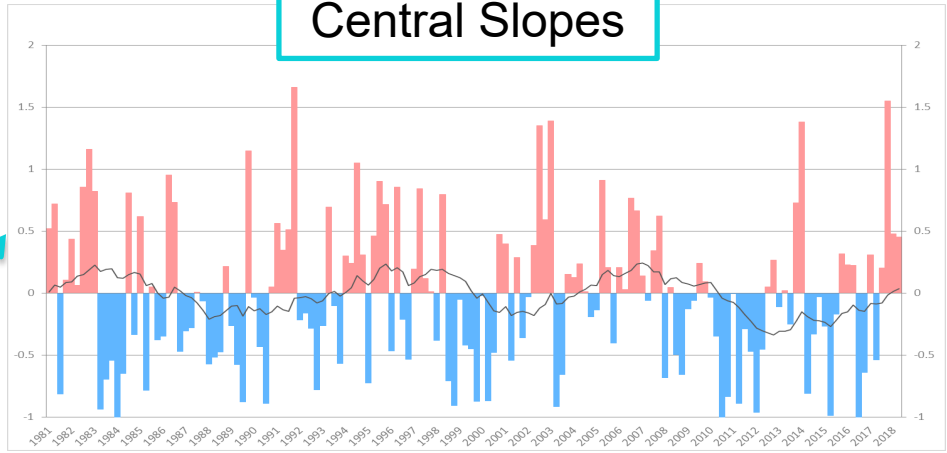
Rangelands North



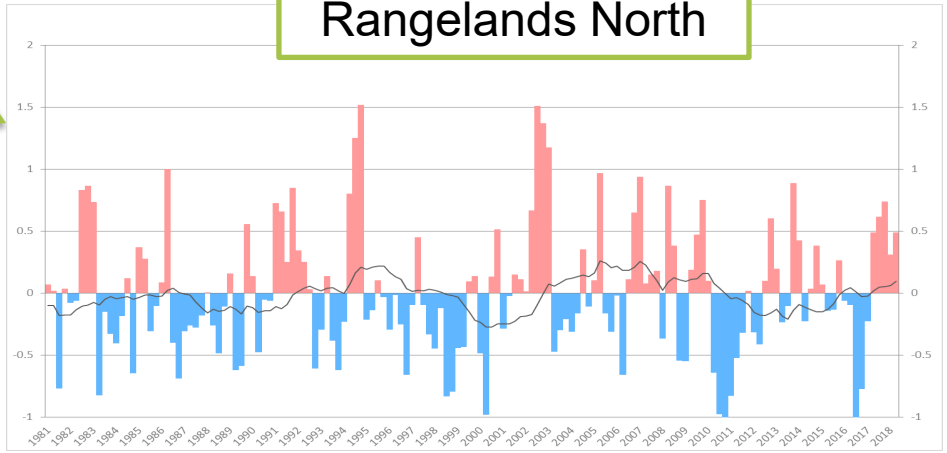
Dry Days



Central Slopes

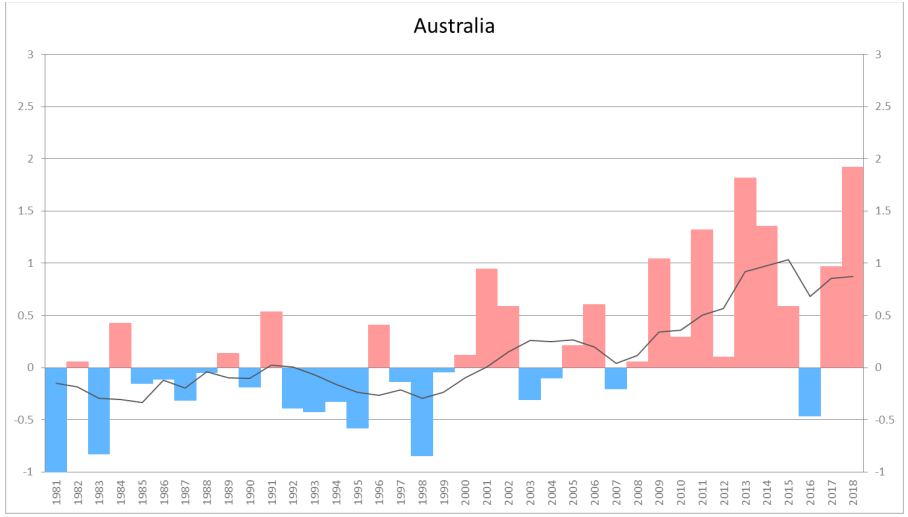


Rangelands North

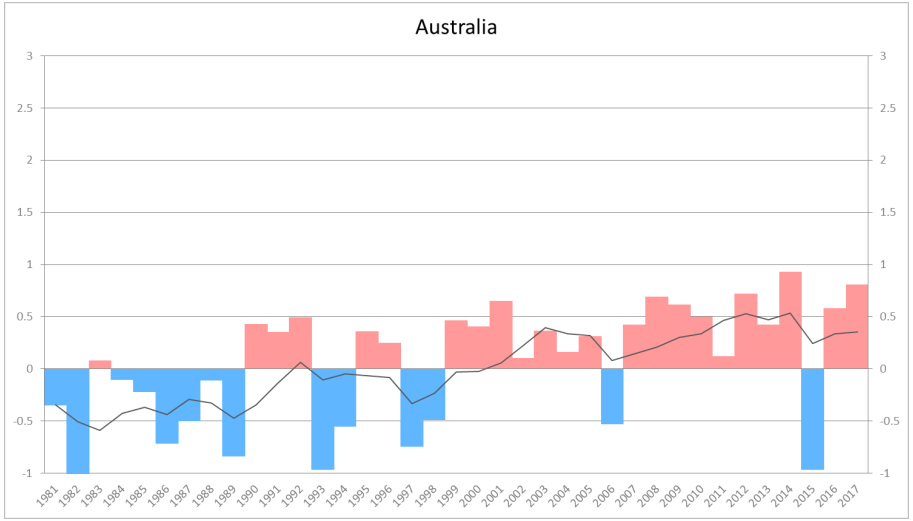


Sea Level - Australia

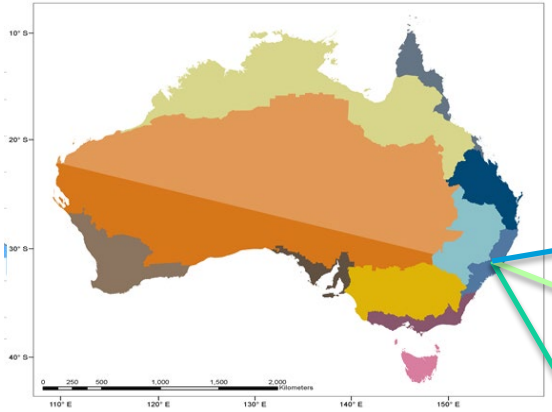
Summer



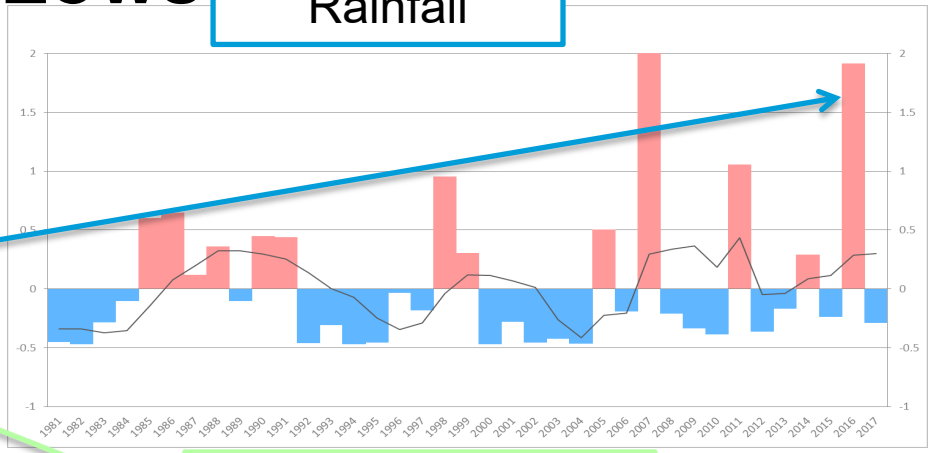
Winter



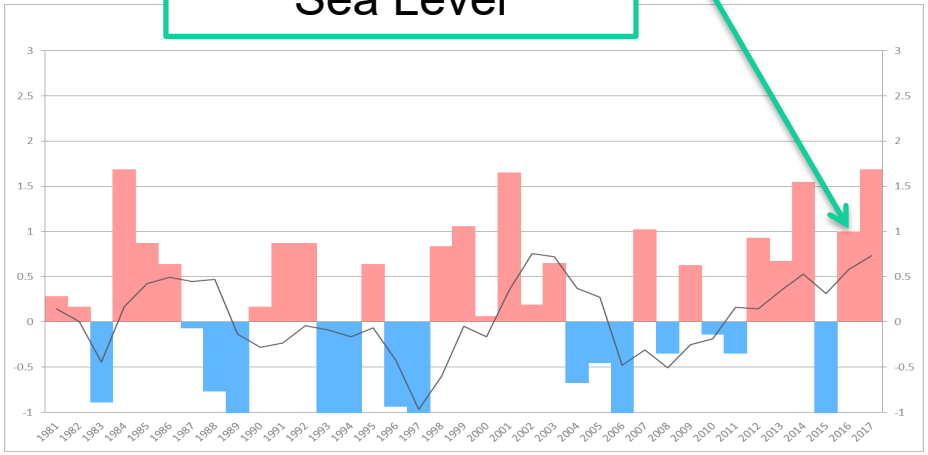
2016 Winter East Coast Lows



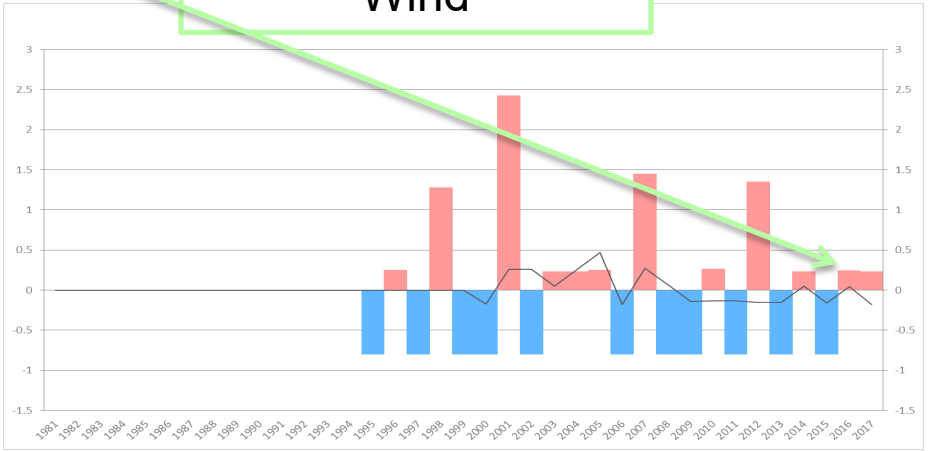
Rainfall



Sea Level



Wind



List of acronyms

Acronym	Full name
AACI	Australian Actuaries Climate Index
ACI	Actuaries Climate Index, produced by a number of actuarial societies in North America
ACORN-SAT	Australian Climate Observations Reference Network – Surface Air Temperature, being a dataset developed by BoM to monitor climate variability and change in Australia
BoM	Bureau of Meteorology
BSLM Project	Baseline Sea Level Monitoring Project. The project is designed to monitor sea level around the coastline of Australia in order to identify long period sea level changes
CCWG	Climate Change Working Group, a working group of the Actuaries Institute
CDD	Consecutive Dry Days
CSIRO	Commonwealth Scientific and Industrial Research Organisation
GIPC	General Insurance Practice Committee, a committee of the Actuaries Institute
IPCC	Intergovernmental Panel on Climate Change
PPCC	Public Policy Council Committee, a committee of the Actuaries Institute