greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

Climate and Water Resources Summary for the Wellington Region

Autumn 2018 summary

Winter 2018 outlook

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Wellington after a very cold hail storm on the morning of 28 May 2018.
Photo: Dominion Post

Overview

Autumn 2018

Autumn 2018 was marked by very unsettled weather patterns, starting very wet and warm and leaning more towards a normal pattern in the second half of the period. March was the second warmest on record in the far south around Ngawi, still responding to the above normal warm waters that had prevailed since December. Then on the 10th of April the region all of a sudden experienced a very strong blast of cold Antarctic air that was very early in the season, with places like Upper Hutt having the lowest April day time (maximum) temperature on record. The burst of cold air was a shock to the system, even more so after the exceptional hot summer months. Also in contrast to summer, the region was windier than normal, and a few notable gusts were recorded both on the western hills and Wairarapa coast, including 143km/h in Castlepoint. There were additional cases of flooding, heavy wind and lightning strikes causing adverse impacts throughout the entire season, including a heavy hail shower in Wellington (technically called 'graupel') on 28th May.

Climate drivers

The El Niño - Southern Oscillation (ENSO) phenomenon was in a neutral phase, therefore, any prior La Niña influences over summer progressively reduced as the new season advanced. This helps explain why the season progressively changed from warmer anomalies to a normal pattern, even though the early cold burst in April was exceptionally intense. The Southern Annular Mode (SAM) has been variable as expected, but with a shift towards the negative phase. This helps explain the more unsettled atmosphere compared to summer. An anomalous area of low pressure southwest of the country formed as a consequence, leading to slightly windier conditions than average for the entire region.

Climate outlook for winter 2018

The ENSO phenomenon is expected to remain neutral during winter (i.e., neither El Niño nor La Niña in the Equatorial Pacific). The local sea surface temperatures are now close to normal range around New Zealand, but remain anomalously warm to the east and southeast of the country. This pattern is statistically associated with above normal rainfall and soil moisture, particularly in the eastern part of the Wairarapa. As a result, we expect a winter with near normal temperatures and normal to above rainfall, with increased probability of significant easterly rainfall events.

Live regional climate maps (updated daily): Real time climate maps for regional rainfall and soil moisture (updated daily) are provided online from GWRC's environmental data webpage (graphs.gw.govt.nz/#dailyClimateMaps)

Contents

1. Climate drivers

1.1 El Niño – Southern Oscillation (ENSO)

La Niña is finished, with atmospheric indicators now showing that the equatorial and subtropical wind belts over the Pacific Ocean are consistent with neutral ENSO conditions. Most climate models are predicting that ENSO will remain neutral for most of winter, but now there is an increased likelihood (50% chance) that a new El Niño may form during spring. However, it is still early to know how intense the event will be in case it eventuates.

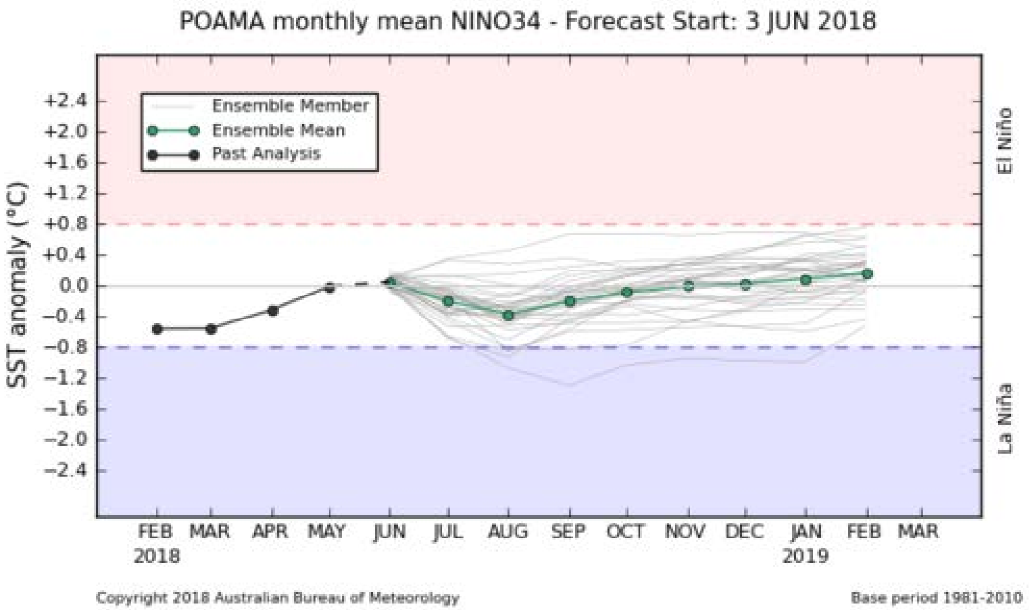


Figure 1.1: ENSO projections (in green) show ENSO is expected to remain neutral during winter. Source: Australian Bureau of Meteorology.

1.2 Sea Surface Temperature anomalies

The Sea Surface Temperature (SST) anomalies and the total sea ice extent (in white) are shown in Figure 1.2 for 7 June 2018. The pattern shows normal or slightly cooler than normal waters southwest of New Zealand, and warmer than normal waters to the east. The local sea surface temperature anomalies have been progressively cooling since the beginning of the year, coinciding with the demise of the La Niña conditions that prevailed during summer.

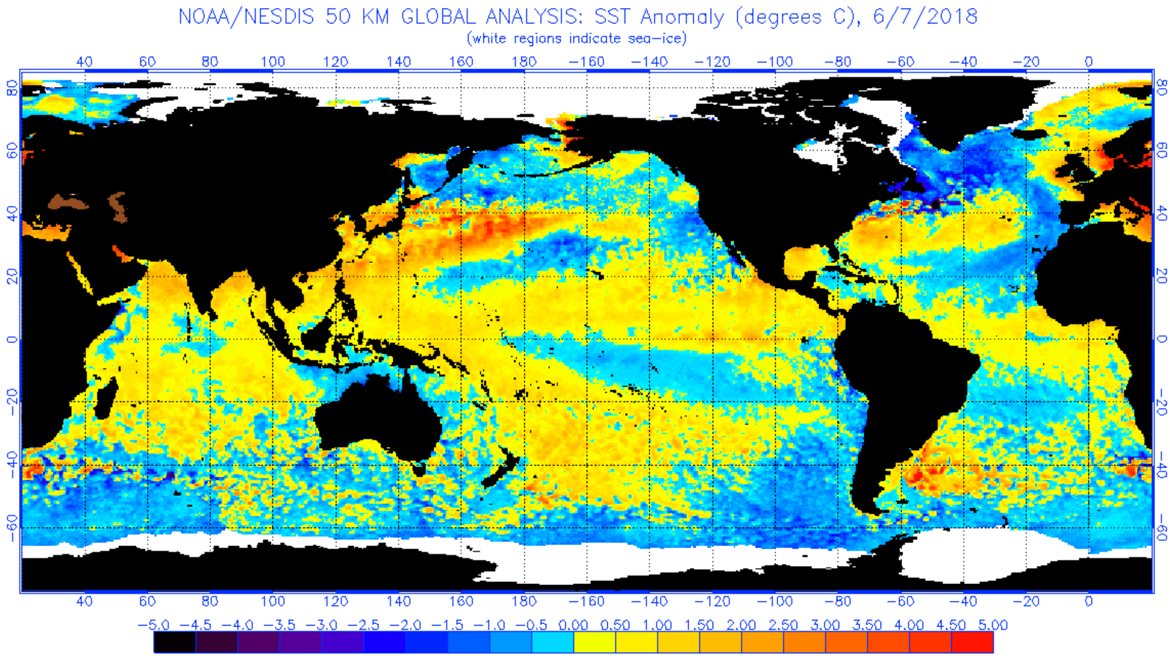


Figure 1.2: Sea surface temperature (SST) anomalies for 7 June 2018. Sea ice coverage is shown in white. Waters around New Zealand have cooled significantly, and are now around normal. The Equatorial Pacific is in the neutral phase (neutral ENSO). Source: NOAA.

1.3 Southern Annular Mode (SAM)

The SAM is the natural pressure oscillation between mid-latitudes and the Antarctic region. Normally positive SAM is associated with high pressures around the North Island, keeping the weather stable and dry/cloud-free (especially in summer), whereas the opposite is expected when the SAM is in the negative phase. Figure 1.3 shows the blocking high that formed during spring 2017 moved further away from New Zealand, and was replaced by an anomalous area of low pressure to the southwest of the country. This pattern explains the progressive change in weather patterns becoming more variable, with windier and more unsettled conditions leading to an unseasonably early cold outbreak in April

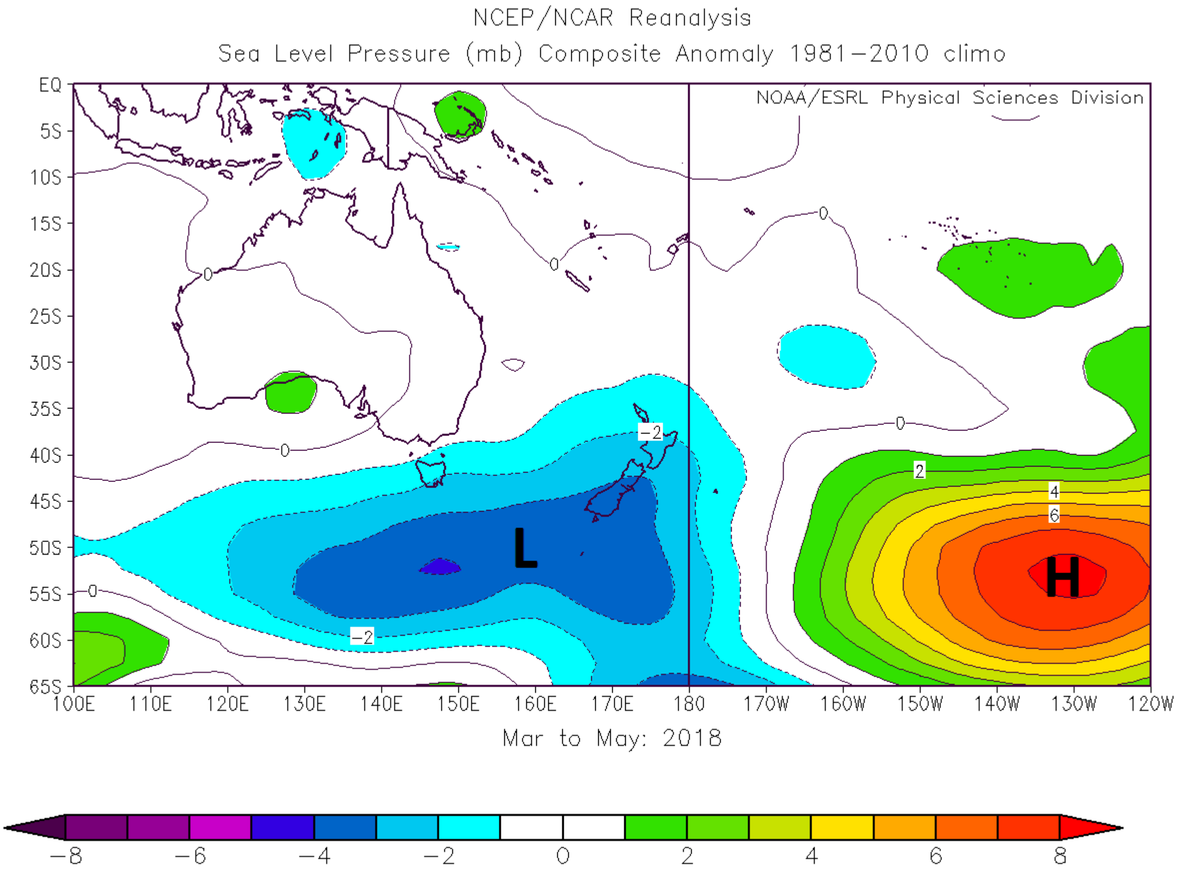


Figure 1.3: Mean sea level pressure anomaly (hPa) for Mar-May 2018. The 'H' indicates the area of blocking high pressure that has now moved away from New Zealand, replaced by an area of lower than average pressure bringing more westerlies over New Zealand during autumn. Source: NCEP Reanalysis, map courtesy of NIWA.

2. What is the data showing?

2.1 Regional temperature

Figure 2.1 shows the minimum and maximum temperature anomalies (against the 1981-2010 reference period) for the region based on all monitoring sites available from GWRC, NIWA, MetService and New Zealand Rural Fire Authority (all meteorological stations indicated by dots).

We can see that warmer than average temperatures prevailed for the most part, especially for the minimum temperatures. The excessive cloud cover and humidity contributed to this pattern, with fewer clear nights meaning less radiative cooling (heat lost into space under clear skies) kept temperatures from dropping. For maximum temperatures, parts of the Wairarapa had slightly lower than average anomalies, especially southwest of Martinborough towards the Aorangi ranges, possibly due to excessive daytime cloud cover over the ranges.

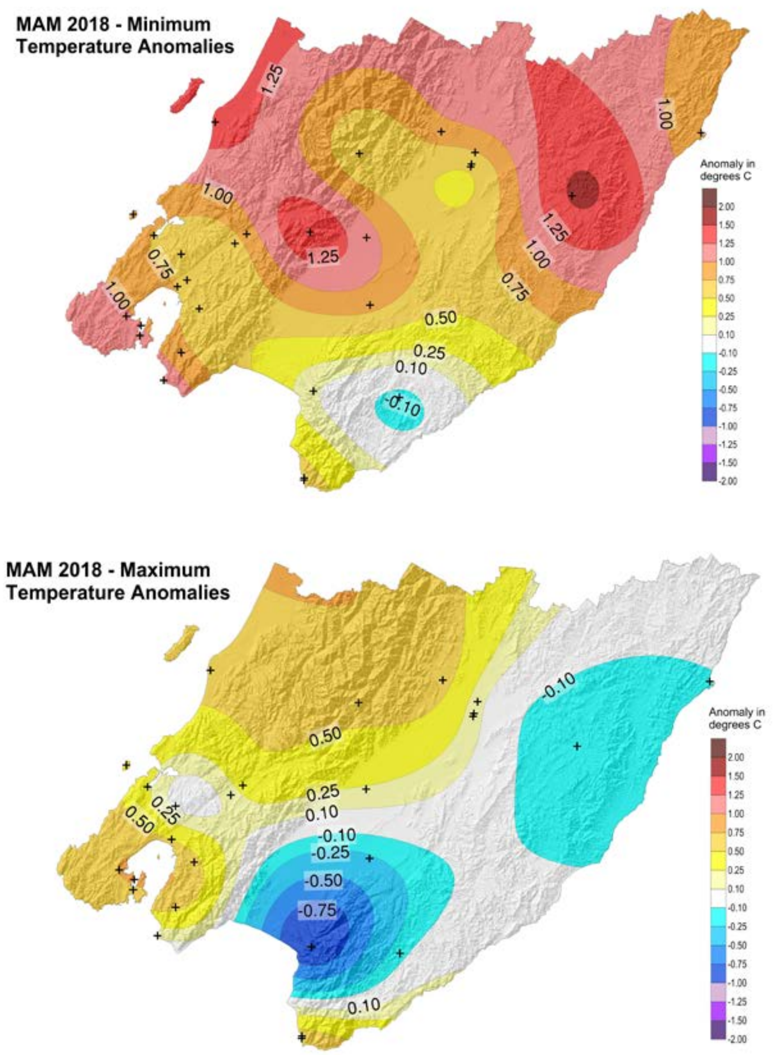


Figure 2.1: Daily Average Min and Max temperature anomalies for MAM 2018. All anomalies calculated against the 1981-2010 reference period. Source: GWRC, using station data from the GWRC, NIWA, MetService and NZ Rural Fire Authority networks.

2.2 Regional wind

Figure 2.2 shows the mean wind anomalies (against the 1981-2010 reference period) based on a smaller network of stations than for temperature. We can see that most of the region had a pattern of higher than normal wind speeds, especially in the east, in connection with the negative SAM and low pressure anomaly southwest of New Zealand discussed above.

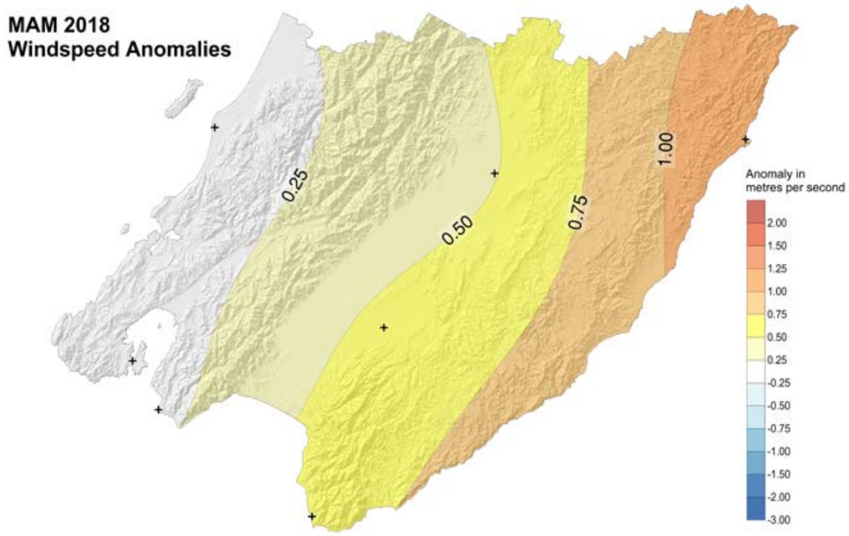


Figure 2.2: Daily mean wind anomalies (in m/s) for MAM 2018. All anomalies calculated against the 1981-2010 reference period. Source: GWRC, using station data from NIWA and MetService.

2.3 Regional soil moisture

Figure 2.3 shows the 30 day soil moisture anomaly map for the region as at the beginning of winter. Most of the region shows around or above normal soil moisture levels – a pattern consistent with positive rainfall anomalies observed over summer and autumn.

Live regional climate maps (updated daily): Real time climate maps for regional rainfall and soil moisture (updated daily) are provided online from GWRC's environmental data webpage (graphs.gw.govt.nz/#dailyClimateMaps)

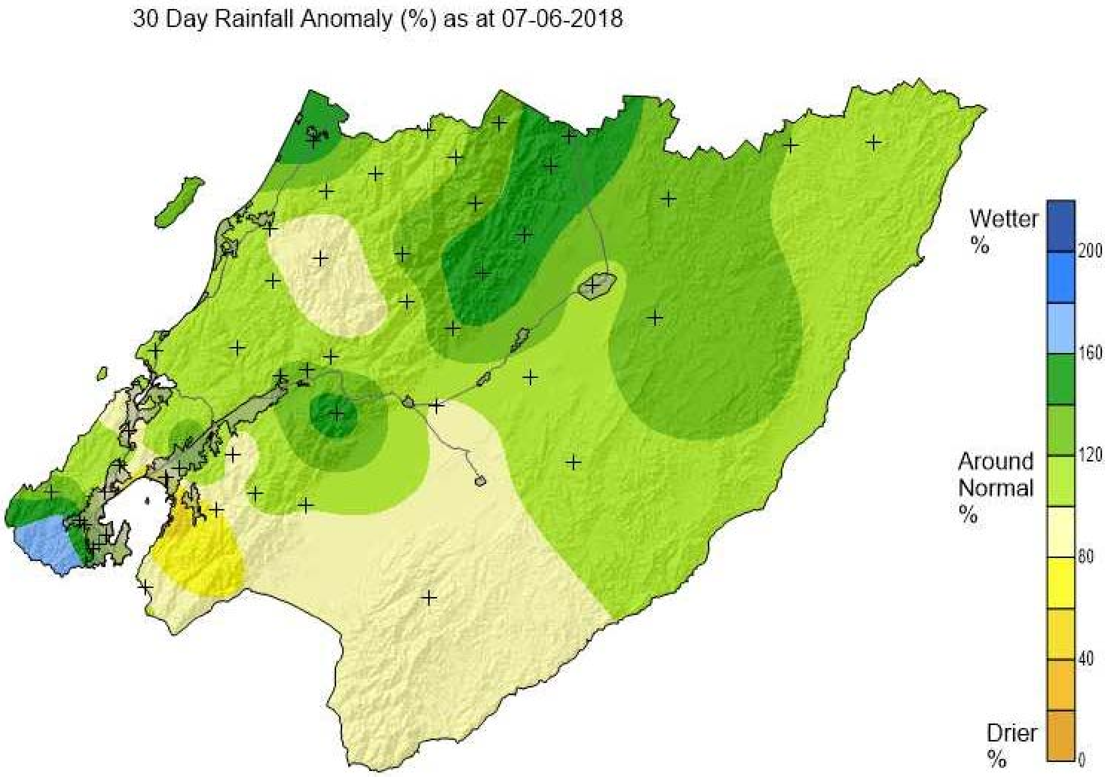


Figure 2.3: Thirty day Soil Moisture Anomaly ending 7 June 2018. Moisture levels show normal or above normal conditions for most of the region. Source: GWRC, using selected Virtual Climate Station Network (VCSN) data kindly provided by NIWA. Note that this data is indirectly calculated by modelling and interpolation techniques, and does not necessarily reflect the results obtained by direct measurements. This map should only be used for a general indication of the spatial variability.

2.4 Regional rainfall

Figure 2.4 shows the regional month by month (and autumn) rainfall expressed as a percentage of the long-term average. We can see that March and April were very wet, especially in the Wairarapa, with more normal conditions in May. The overall autumn pattern was of above average rainfall especially over the northern half of the region.

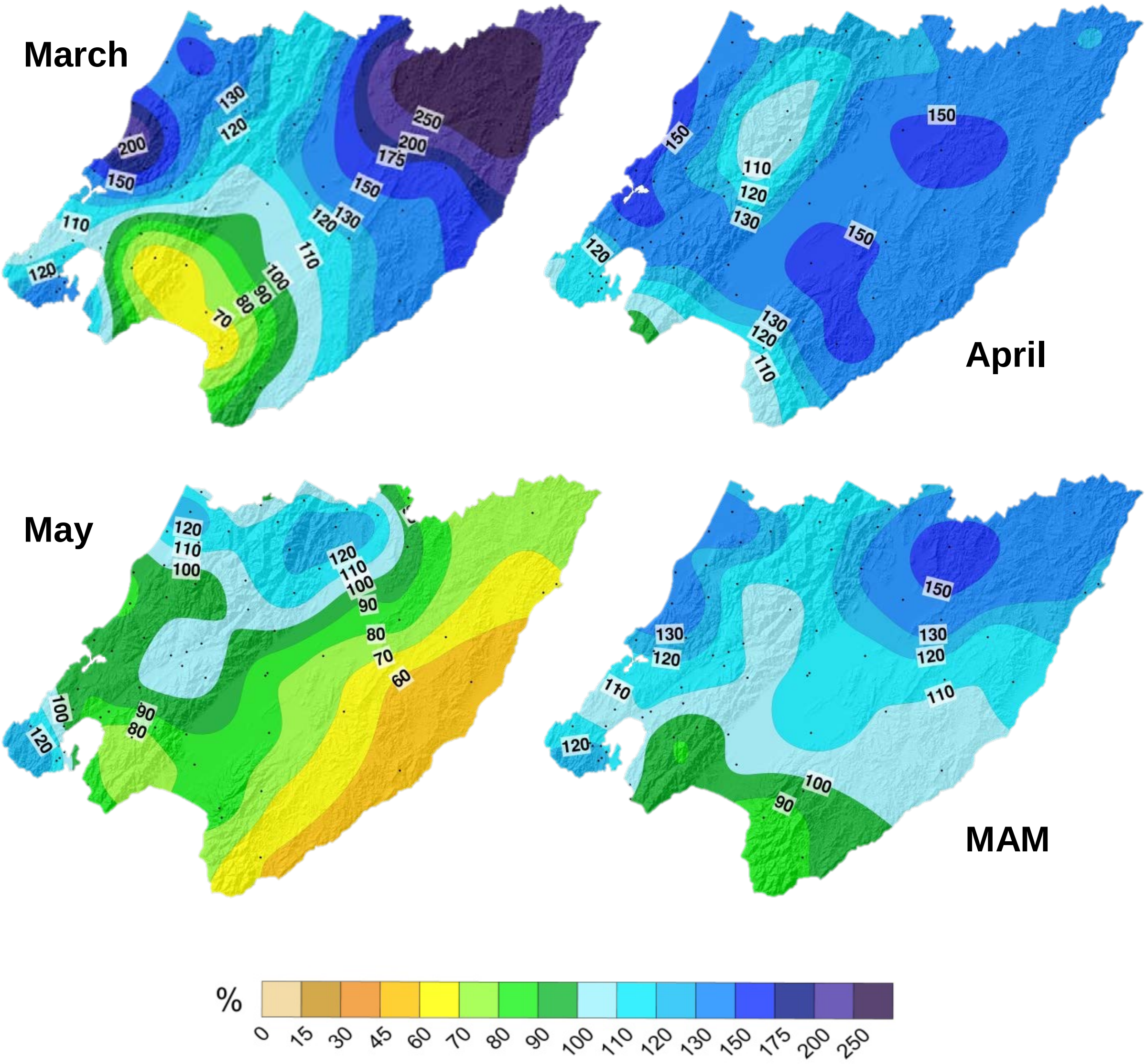


Figure 2.4: Rainfall for March, April, May and MAM 2018 as a percentage of the long-term average. Rainfall was predominantly above average during the entire season, except the eastern Wairarapa coast in May. Source: GWRC and NIWA.

2.5 Climate change and variability indicators

The graphs below (Figure 2.5) show summaries of seasonal climate change and variability for Wellington and the Wairarapa using reference climate stations, chosen based on length of data record and availability.

The key climate variables shown are: mean temperature, total sunshine hours, mean wind, total rainfall and total number of rain days (above 0.1 mm). Temperature measurements go back to the 1910s, allowing for a meaningful analysis of climate change trends. Most other variables also have long periods of measurement greater than 50 years, except sunshine hours and wind for the Wairarapa; these are only available for less than two decades, which is a very short period climatologically speaking and doesn’t allow for an analysis of trends.

The red and blue bars indicate the extreme years during the entire recorded period. Red is used for warmer, drier, sunnier and less windy than average (a sense of extreme hot/dry), and blue is used for colder, wetter, cloudier and windier than average (a sense of extreme cold/wet). The reference climatological average (1981-2010) is indicated by a horizontal bar where available.

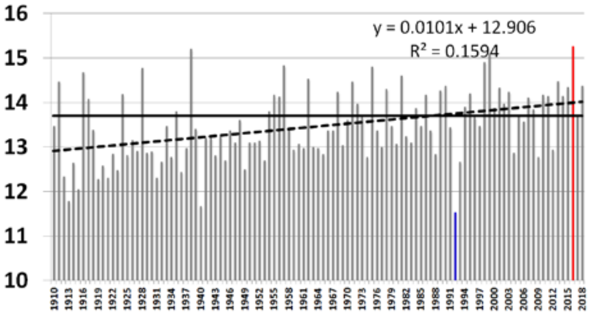
All maps are grouped together for convenience of style, using the same scale between Wellington and Wairarapa whenever possible (except for wind which is much lower over the Wairarapa). The last bar in all graphs is the season covered in this report; unless there are data missing (in this case a blank space is shown).

An analysis of linear trends associated with climate change is plotted onto the graph only when the trends are statistically significant at 99% level according to the t-Student test. To see further nuances and details we invite the reader to use the zoom function of your browser.

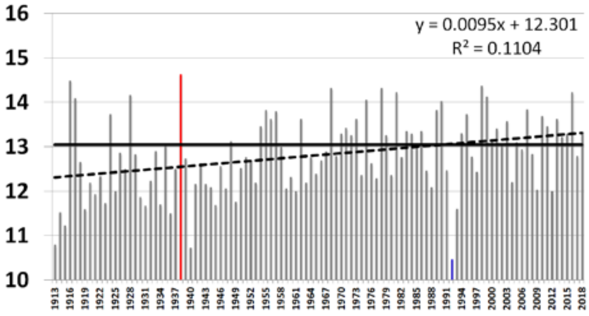
The climate change and variability summary for autumn is:

- Statistically significant trends are seen only for temperature. There is a significant warming trend of about 1^{o}C per century in both Kelburn and Masterton over the period 1910-2018;
- Autumn 2018 was warmer than average for both Wellington and the Wairarapa, proportionally more so for Wellington;
- Sunshine hours were relatively low for both Wellington and Wairarapa during autumn 2018. Wind was around average, and rainfall and rain days were above average, more so in Wellington;

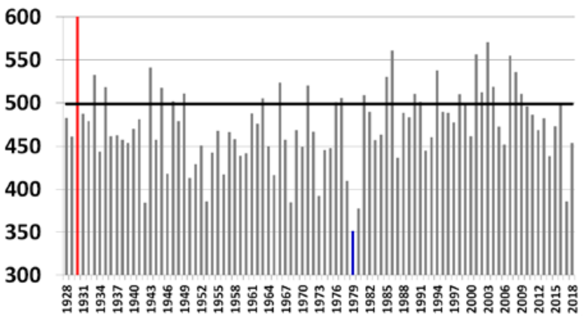
Autumn Mean Temperature (deg C) - Kelburn (1910-2018)



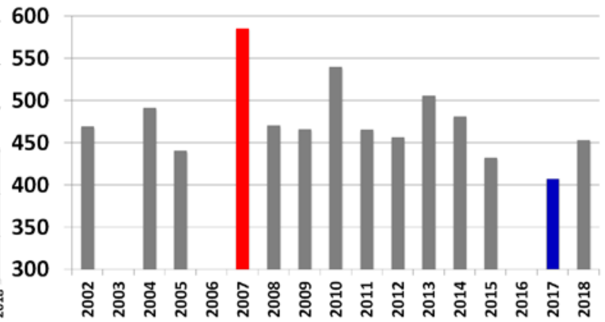
Autumn Mean Temperature (deg C) - Masterton (1913-2018)



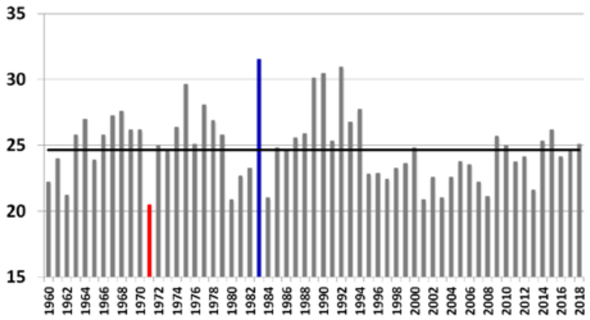
Autumn Total Sunshine Hours - Kelburn (1928-2018)



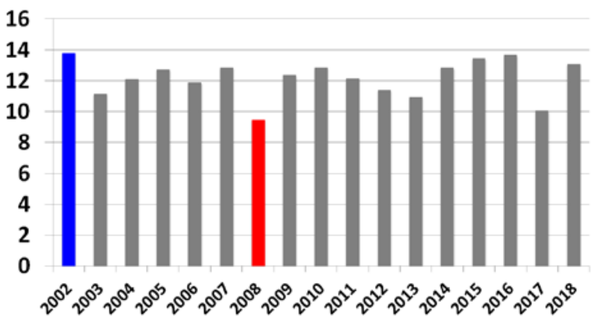
Autumn Total Sunshine Hours - Martinborough (2002-2018)



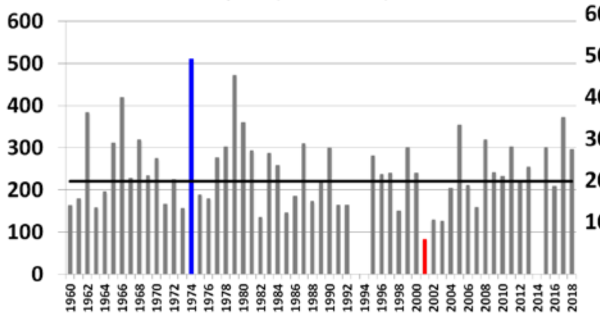
Autumn Mean Wind (km/h) - Wellington Airport (1960-2018)



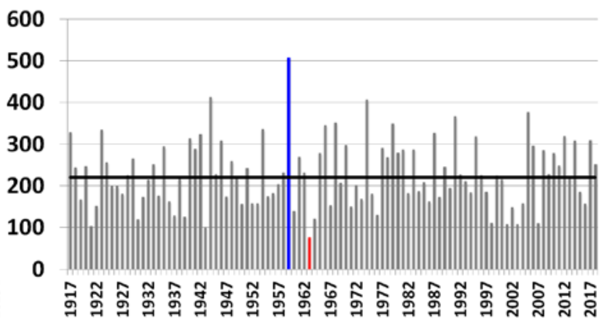
Autumn Mean Wind (km/h) - Martinborough (2002-2018)



Autumn Total Rainfall (mm) - Wellington Airport (1960-2018)



Autumn Total Rainfall (mm) - Waikoukou, LongBush (1917-2018)



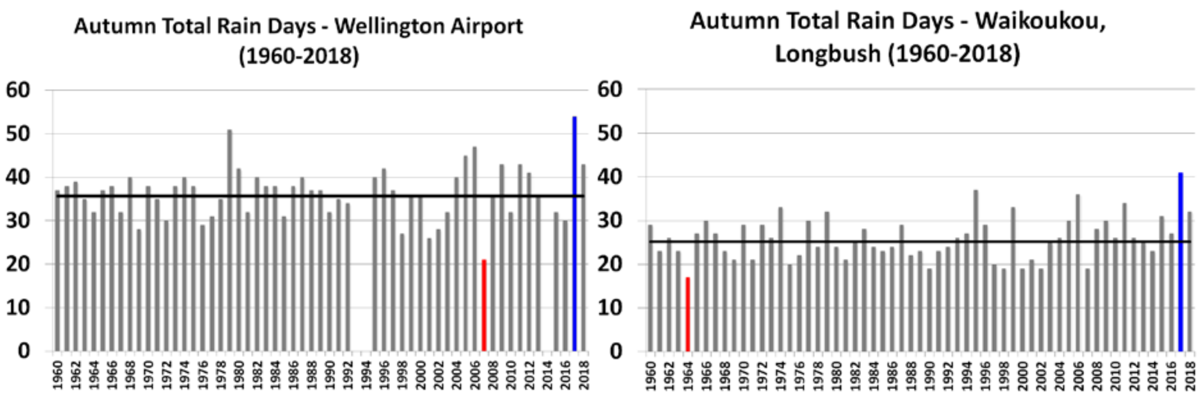


Figure 2.5: Climate change and variability graphs for autumn in Wellington and the Wairarapa. The thick horizontal line shows the 1981-2010 average (when available), and the dashed line shows the linear trend. Trends are plotted only when statistically significant at 99% confidence level. For all graphs, the bright red and blue bars show the extreme min and max values for each time series (red for warm, dry, sunny and calm and blue for cool, wet, cloudy and windy). The key variables shown are: mean temperature, total number of sunshine hours, mean wind speed, total rainfall and total number of rain days (>0.1mm). Missing bars means that no reliable mean seasonal data was available for that particular year. The last bar of each graph shows the last available data for the currently analysed season, unless there are missing data.

2.6 Observed rainfall and soil moisture conditions for selected sites

Figure 2.6 shows the location of selected GWRC rainfall and soil moisture monitoring sites. Plots of accumulated rainfall and soil moisture trends are provided in the following pages.

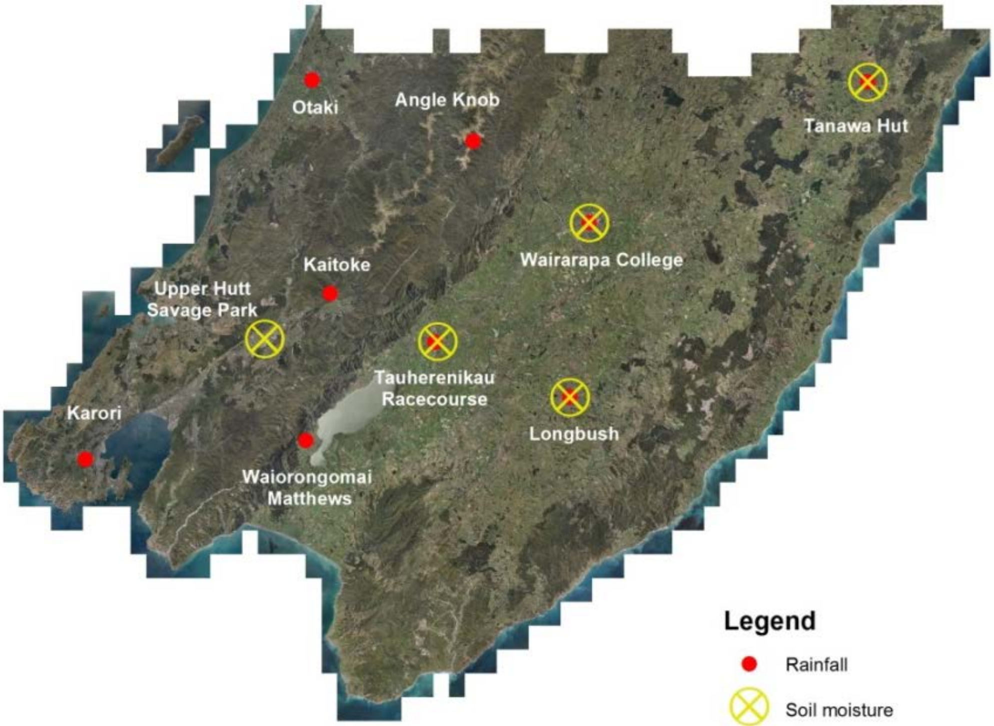


Figure 2.6: Map of GWRC rainfall and soil moisture monitoring locations

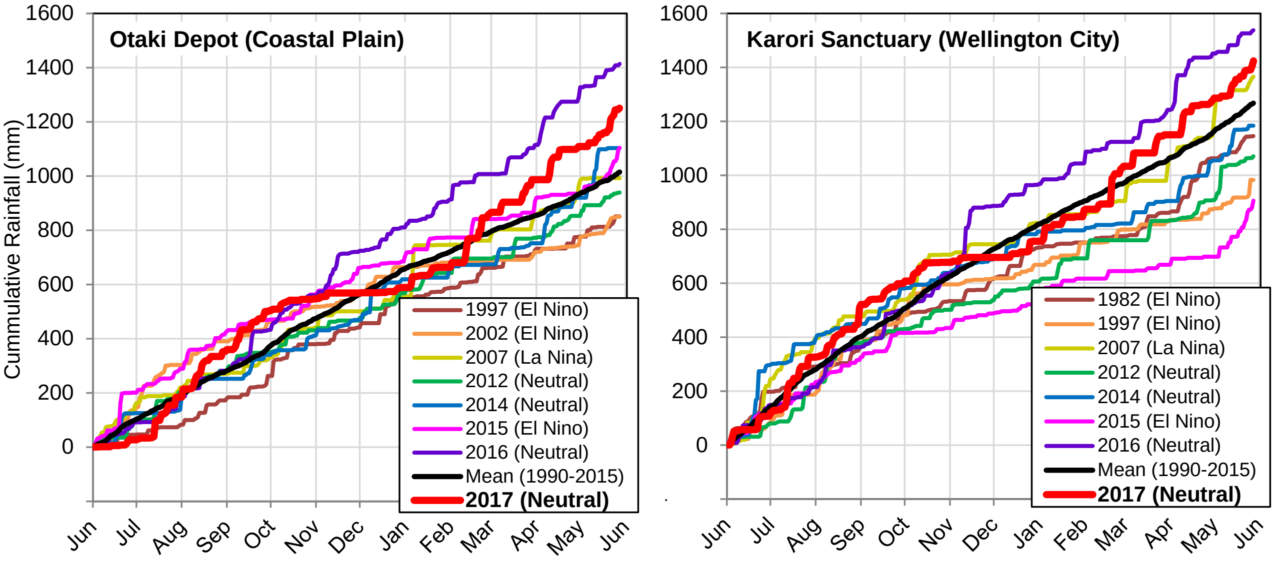
2.6.1 Rainfall accumulation for hydrological year (1 June to 31 May)

The following rainfall plots show total rainfall accumulation (mm) for the hydrological year at several locations. For comparative purposes, cumulative plots for selected historic years with notably dry summers have been included as well as the site average.

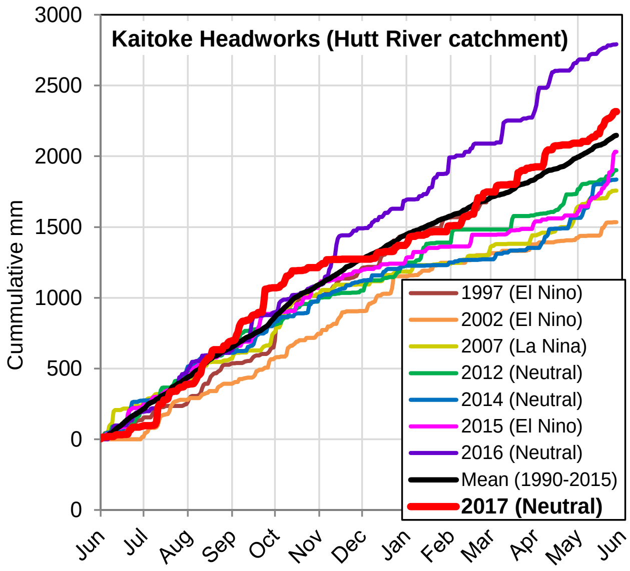
Many of the GWRC telemetered rain gauge sites in the lower lying parts of the Wairarapa (i.e., not Tararua Range gauges installed for flood warning purposes) have only been operating since the late 1990s so the period of data presented is limited to the last two decades. For each historical record plotted, an indication of ENSO climate state (El Niño, La Niña or neutral) at that time is also given. GWRC does not operate a rain gauge in the southern-most parts of the Wairarapa Valley that is suitable for presenting data in this report. This means that we cannot be confident that the rainfall patterns seen elsewhere extend to this part of the region other than the satellite and VCN data already presented.

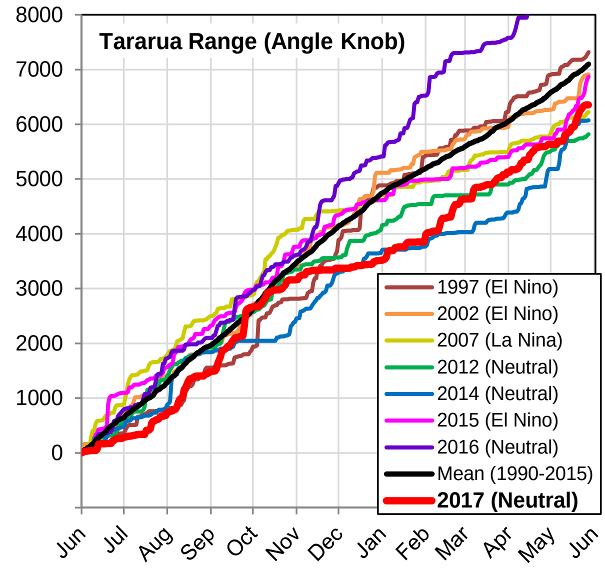
Overall, rainfall accumulations for the year starting in June 2017 (labelled 2017 on the plots) ended about or above average for most of the monitored sites. For most Wairarapa and Hut Valley sites, the year started with very low accumulations, which were replenished during late summer and autumn with copious amounts of rain concentrated in a few events. The exception was Kaitoke Headworks and Waikoukou at Longbush, which never fell substantially below average rainfall during the period. For the Kāpiti Coast and Wellington, the accumulation has been predominately above average for most of the hydrological year, falling only slightly below average at the start of summer. For these western sites the total accumulation for the hydrological year ended up being significantly above average, especially for the Kāpiti Coast.

Kāpiti Coast and Southwest (Wellington city)

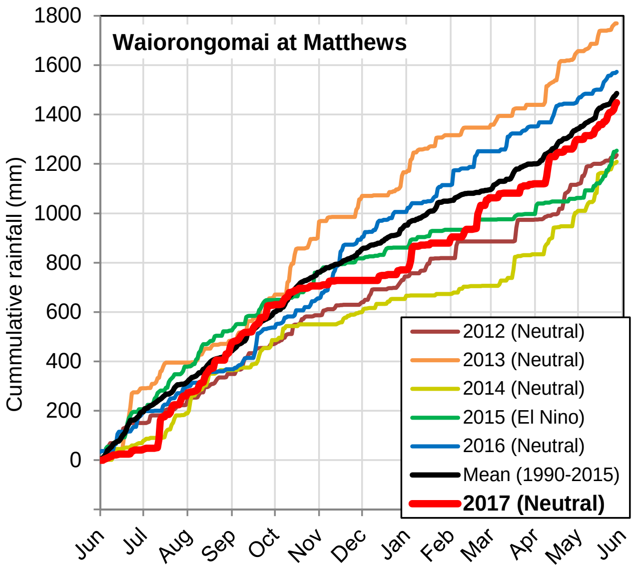


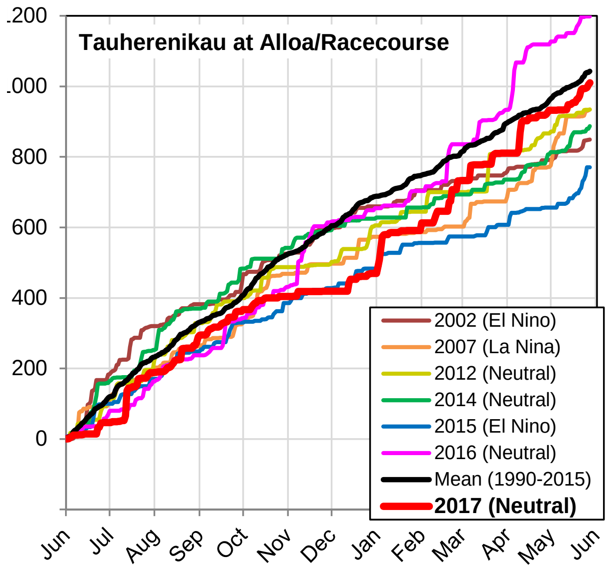
Hutt Valley and Tararua Range

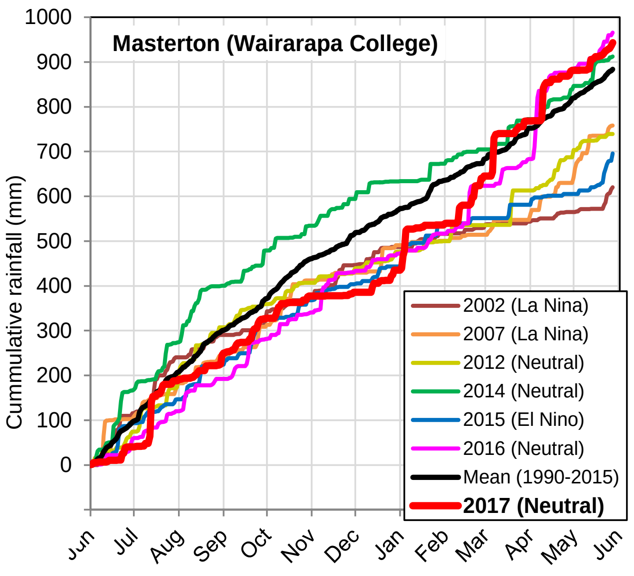


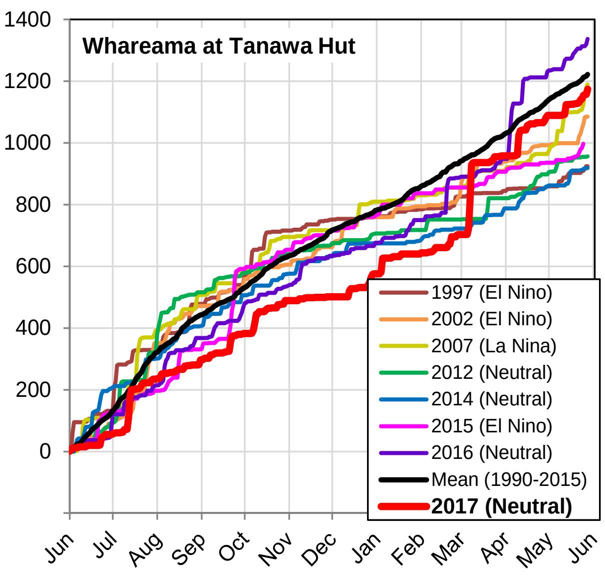


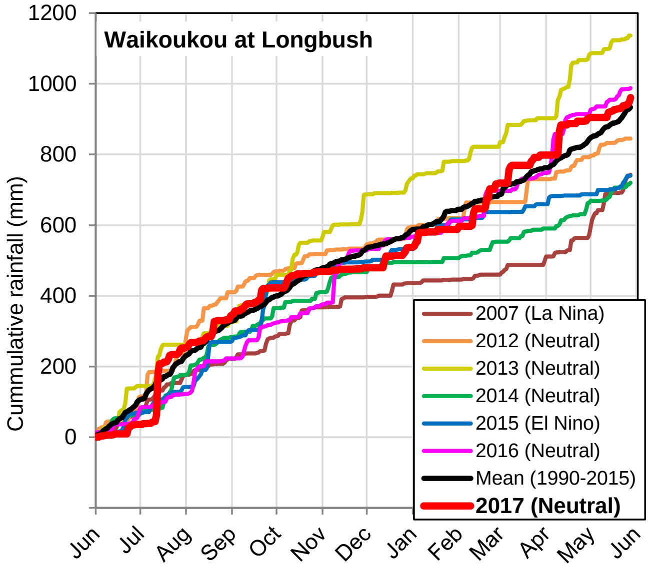
Wairarapa











Live cumulative plots (updated daily): Real time graphs for cumulative rainfall are available online from GWRC's environmental data webpage (http://graphs.gw.govt.nz/). Select a rainfall monitoring site, then choose *Cumulative Historic* from the *Interval* selector, then optionally change the period from the last 12 months to the hydrological year (July – June) as required.

2.6.2 Soil moisture content (since 1 June 2017)

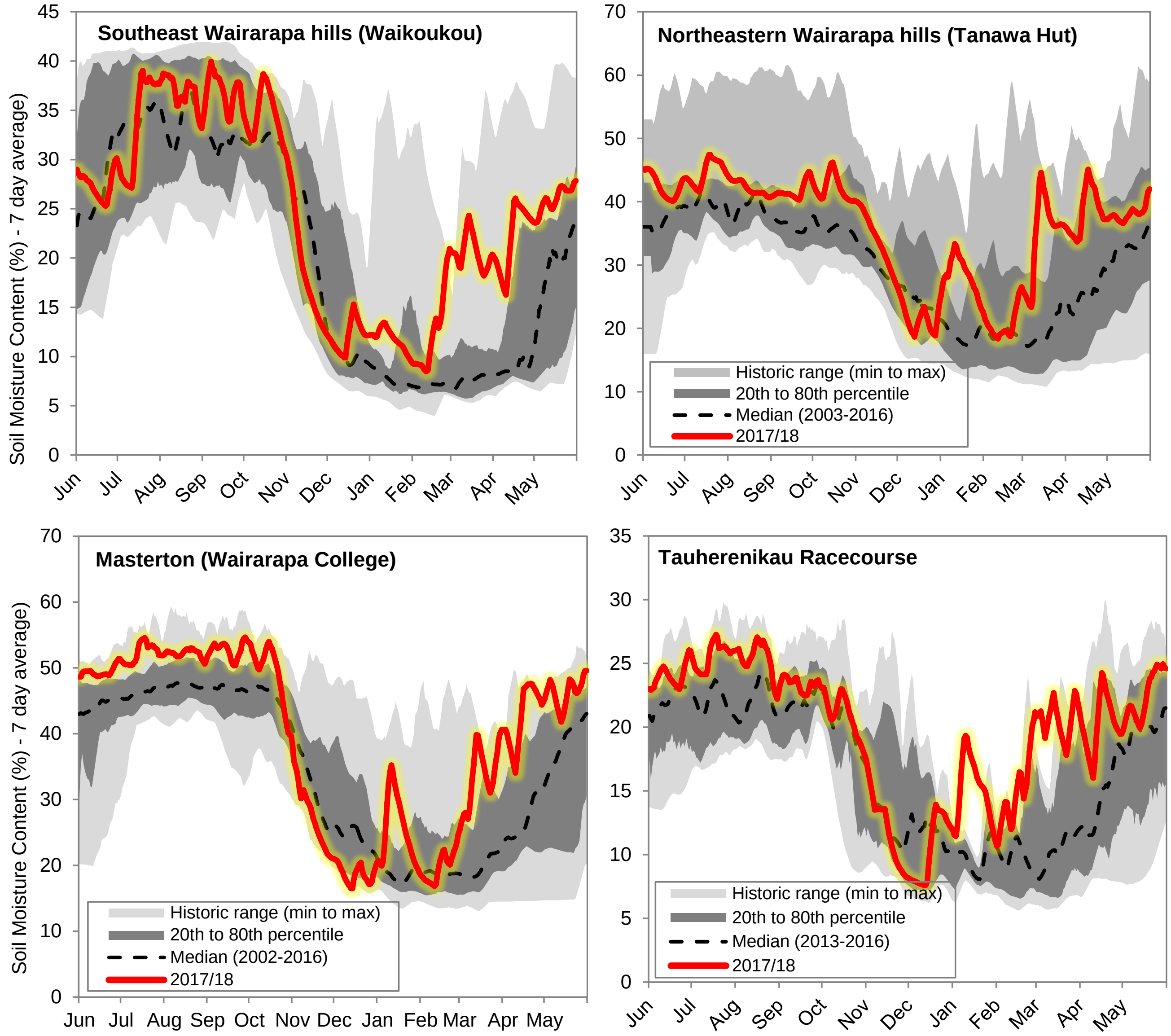
The following soil moisture graphs show the seven day rolling average soil moisture content (%) since 1 June 2017. This is plotted over an envelope of the range of historic recorded soil moisture data (and the median) at the site to provide an indication of how the current soil moisture compares with that for a similar period in past years.

While the soil moisture plots are useful for tracking change within the current season and comparing relative differences between years, the absolute moisture content (%) for any given site and date should not be considered accurate. Many of the GWRC soil moisture sites have not yet been fully calibrated to provide accurate absolute measures of soil moisture.

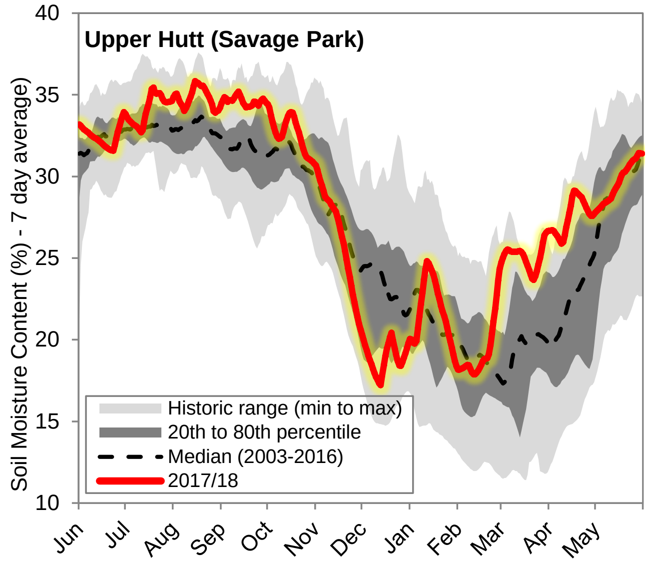
The soil moisture behaviour at all sites has been one of above average levels for most of the period, except a short low spike at the beginning of summer, especially in the Hutt Valley. For the southeast Wairarapa hills (Kaikoukou at Longbush), moisture levels remained average or above even during the dry spell in December.

What is the Data Showing?

(a) Wairarapa



(b) Hutt Valley



Live soil moisture plots (updated daily): Real time "envelope" graphs for soil moisture are available online from GWRC's environmental data webpage (http://graphs.gw.govt.nz/). Select a soil moisture monitoring site, then choose *Envelope Graph* from the *Interval* selector, then optionally change the period from the last 12 months to the hydrological year (July – June) as required.

3. Outlook for winter 2018

- Neutral Equatorial Pacific, but chance of El Niño forming later in the year;
- Sea Surface Temperature cooling off to normal around New Zealand;
- Frequent south-easterlies in June, changing to a more south-westerly regime later in the season;
- Long mild and settled periods likely in the west, interrupted by vigorous cold outbreaks later in the season;
- Rainfall: average to above, heavy easterly events likely;
- Temperatures: normal in the west, normal to below in the Wairarapa;
- Wet soils with fewer frosts than average, but increasing frost risk later in the season

Whaitua*	Variables	Climate outlook for winter 2018
Wellington Harbour & Hutt Valley	Temperature:	About average, long mild periods interrupted by abrupt cold spells later in the season.
	Rainfall:	Average to above.
Te Awarua-o-Porirua	Temperature:	Average to above, long mild periods interrupted by abrupt cold spells later in the season.
	Rainfall:	Average to above.
Kāpiti Coast	Temperature:	Average to above, long mild periods interrupted by abrupt cold spells later in the season.
	Rainfall:	Average to above.
Ruamāhanga	Temperature:	Average to below, turning colder later in the season with abrupt cold spells.
	Rainfall:	Average to above.
Wairarapa Coast	Temperature:	Average to below, turning colder later in the season with abrupt cold spells.
	Rainfall:	Average to above.

*See http://www.gw.govt.nz/assets/Environment-Management/Whaitua/whaituamap3.JPG for whaitua catchments

Note: Statistical rainfall projections for central Wairarapa via climate analogues is not shown for this report due to the lack of reliable climate analogues for the current configuration of the climate drivers.

Acknowledgments

We would like to thank NIWA for providing selected VCSN data points for the calculation of the regional soil moisture map and for supplementing the rainfall percentage maps in data sparse areas.

Plot your own maps in real time (past, current and future climate change prediction)

GWRC Climate mapping tools online

Daily Climate Maps

For real time daily climate anomaly maps (rainfall and soil moisture), go to:

http://graphs.gw.govt.nz/#dailyClimateMaps

Interactive climate change maps

For interactive climate change maps, go to:

1. GIS version

https://mapping1.gw.govt.nz/gw/ClimateChange/

2. Story map version

https://mapping1.gw.govt.nz/GW/ClimateChange_StoryMap/#