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Climate and Water Resources Summary for the Wellington Region

Autumn 2019 summary

Winter 2019 outlook

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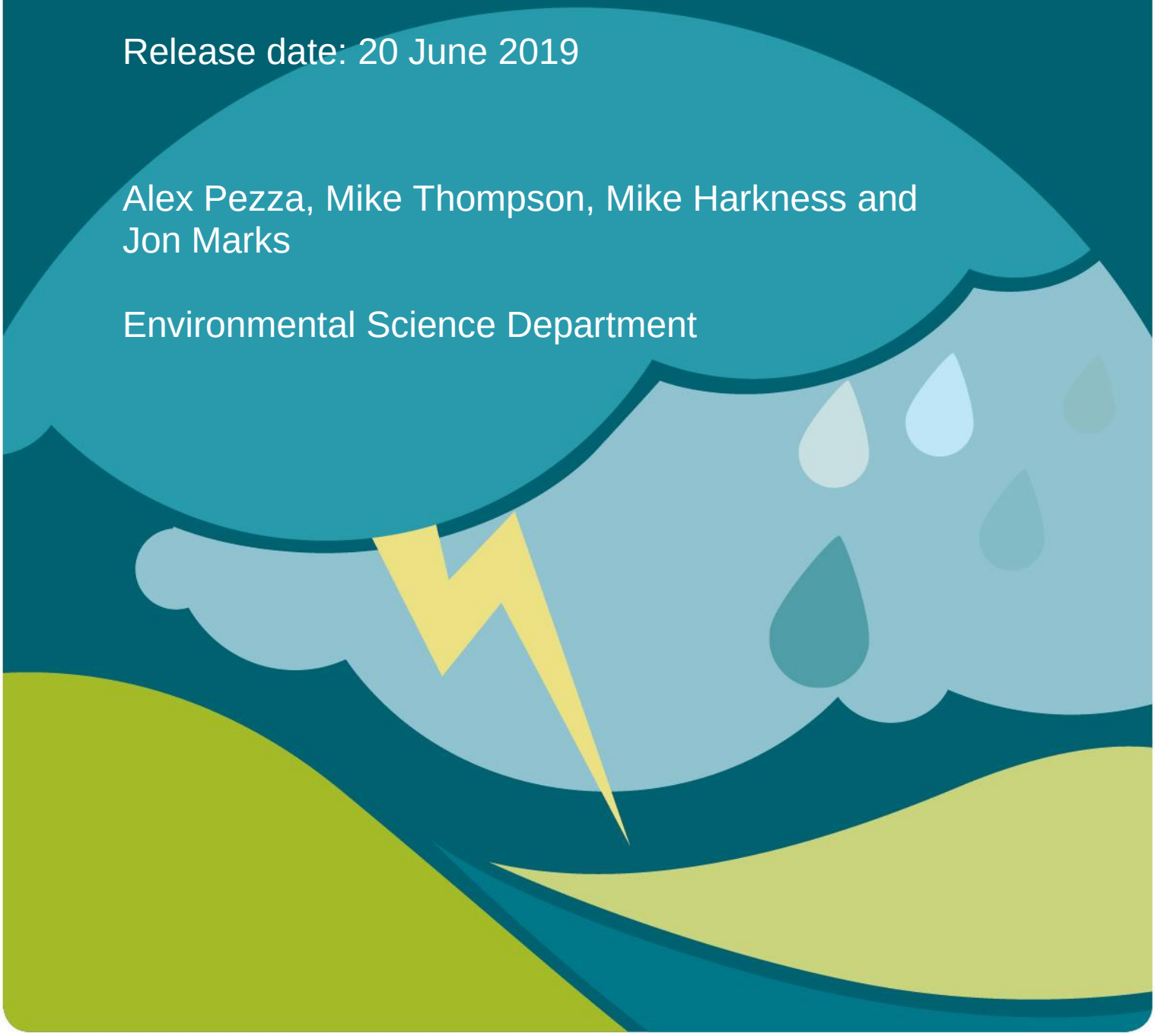

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A fabulous view of a lenticular cloud formation over the Wellington Harbour looking east, on 4 June 2019 at 7:32am. The base of the cloud was illuminated by indirect sunlight as the photo was taken about six minutes before sunrise. Photo credit: Dr. Alex Pezza

Overview

Autumn 2019

Autumn was once again a very warm season for the Wellington Region, with anomalies greater than one degree Celsius for most of the region. Most of the region was also slightly less windy than normal during this season. Rainfall was extremely variable, with March being severely dry in the east and wet in the west, April being very wet, and May being a mixed bunch. Several near-temperature records were observed in March (second hottest on record in some areas) and May (hottest to second hottest on record) throughout the region. April greatly contrasted with the overall warming, with below average temperatures associated with a persistent southerly flow. In fact, the average temperature in May for Wellington was warmer than that of April. The total rainfall of 247mm accumulated in Kelburn in April was the 4th highest on record since 1928.

Climate drivers

A weak El Niño - Southern Oscillation (ENSO) has persisted in the background state, without satisfying all criteria imposed by different international monitoring centres. Different centres use different activation thresholds. As such, the Bureau of Meteorology in Australia is still regarding the equatorial Pacific as being borderline neutral. Based on several models, the phenomenon is expected to continue unchanged during the upcoming three-month period, possibly weakening later in the year. Coastal waters around New Zealand have cooled down slightly, but remain above average for this time of the year for the most part. The Southern Annular Mode (SAM) has been predominantly in the positive phase, helping divert many fronts south of New Zealand.

Climate outlook for winter 2019

In light of the climate drivers, the expectation is that the remaining of winter will be relatively closer to average, compared to the very substantial warming pattern that has been observed up to now. Even then, the warmer than normal water temperatures around New Zealand should decrease the chances of extreme cold events, and/or moderate such events so they lose intensity relatively quickly. A more westerly regime may continue to be associated with variable month-to-month rainfall, tending to wetter on the west coast and drier in the east.

Live regional climate maps (updated daily): Daily updated climate maps of regional rainfall and soil moisture are provided on GWRC's environmental data webpage (graphs.gw.govt.nz/#dailyClimateMaps).

Interactive climate change maps: This webpage provides easy to plot climate change mapping that illustrates the predicted future impacts of climate change in the Wellington Region. Maps are available for every season, for mid (2040) and late century (2090). A total of 21 climate variables can be plotted, for every greenhouse gas emission scenario modelled by the IPCC. Dynamical downscaling has been provided by NIWA(https://mapping1.gw.govt.nz/gw/ClimateChange/).

Contents

1. Climate drivers

1.1 El Niño – Southern Oscillation (ENSO)

The ensemble projections of the Australian climate model below show that the ENSO phenomenon is predicted to remain borderline between El Niño and neutral over the next few months. At this time of the year the ENSO impacts on the Wellington Region are statistically significant, but only for events that are well within the El Niño threshold. The fact that the event is also concentrated in the central Pacific area, as opposed to the normal eastern Pacific behaviour, means that traditional impacts such as drought are less likely to be felt.

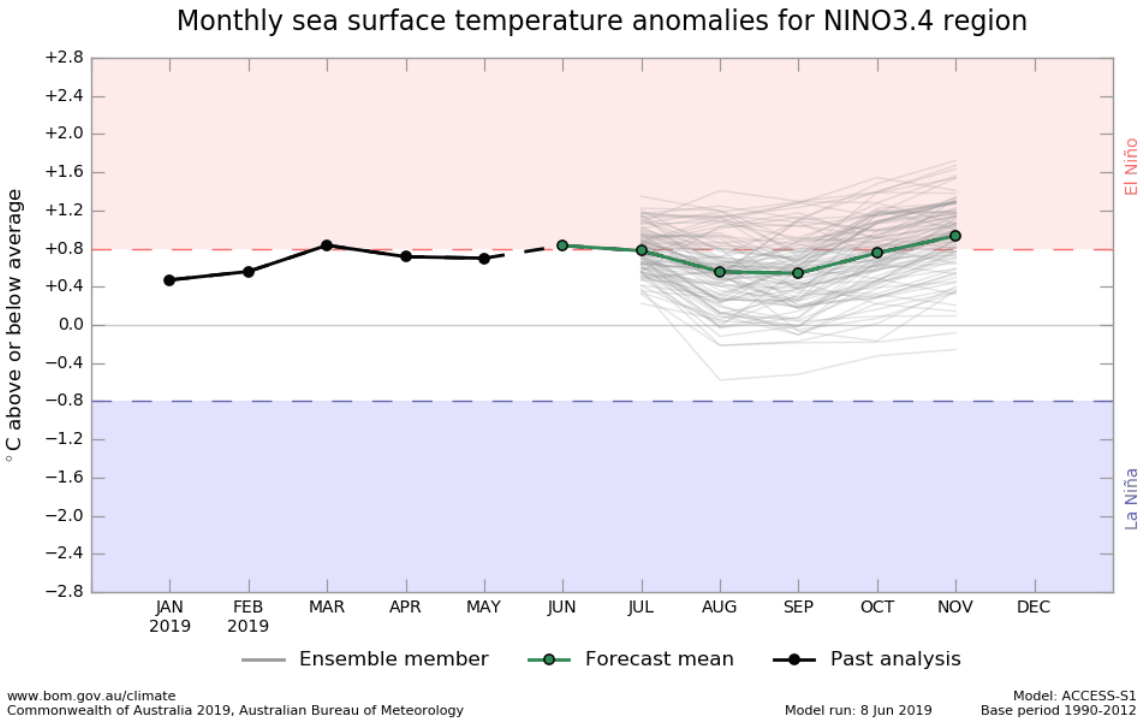


Figure 1.1: Averaged modelled projections (in green) show ENSO is expected to remain in a weak El Niño phase during the next few months. Source: Australian Bureau of Meteorology.

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 as of 17 June 2019. The pattern shows warmer than normal waters around New Zealand (especially to the east), cold water south and north of Australia, and a lower than normal sea ice cover around Antarctica (in white). The warm patch east of New Zealand increases the chance of heavy rainfall events during the next three months, while the El Niño warming in the Equatorial Pacific works against rainfall odds for us, so they might cancel each other out.

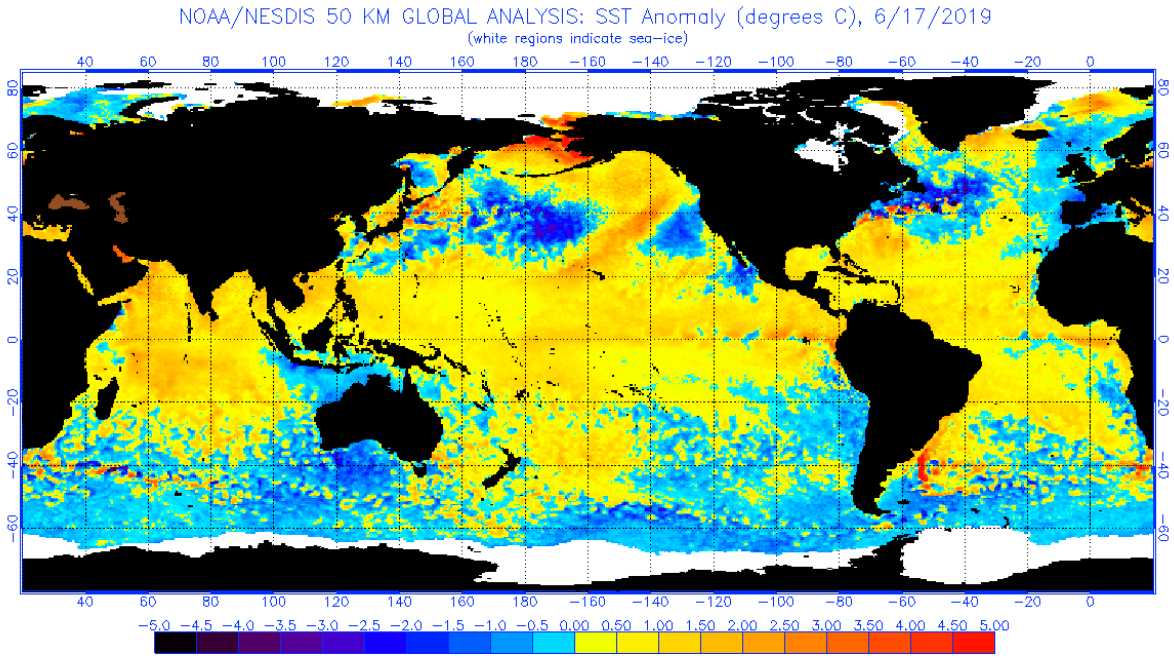


Figure 1.2: Sea surface temperature (SST) anomalies as of 17 June 2019. Sea ice coverage is shown in white. Waters around New Zealand remain warmer than average to the east. The Equatorial Pacific is currently borderline between El Niño and neutral, and is expected to remain so over the next few months. 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 that the SAM was predominantly positive during the autumn season, with a blocking high pressure to the northeast of New Zealand contributing to create the northerly flow associated with the very mild autumn just observed.

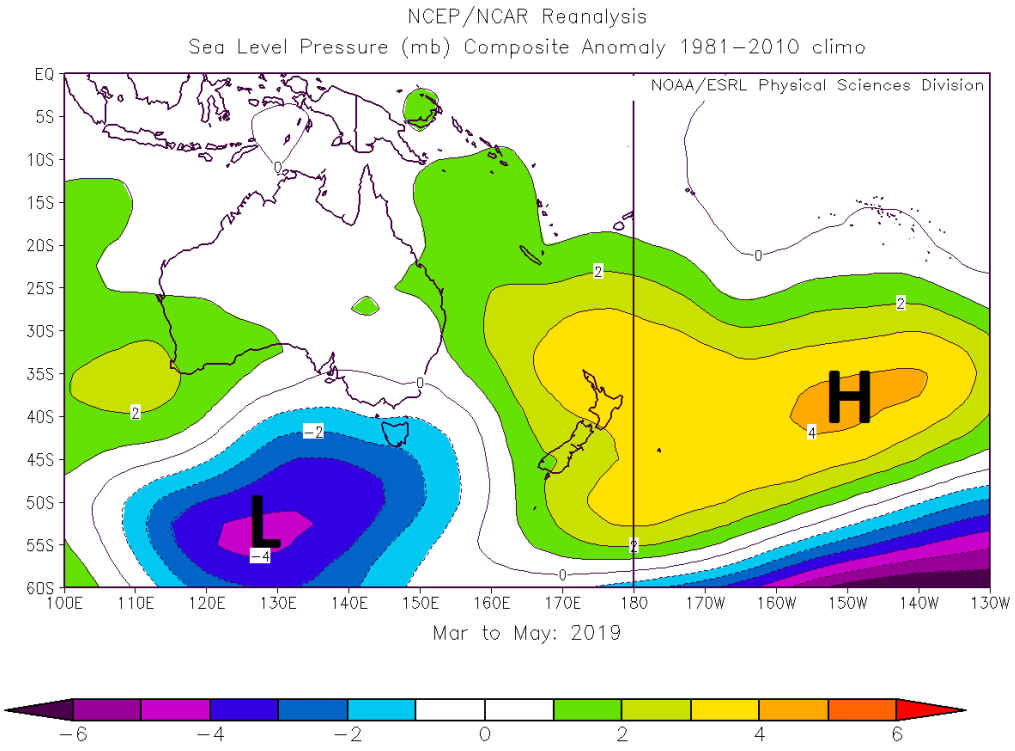


Figure 1.3: Mean sea level pressure anomaly (hPa) for MAM 2019. The 'H' indicates the position of the blocking high east of New Zealand, and the 'L' indicates the average low pressure south of Australia. This pattern was associated with the positive phase of the Southern Annular Mode, with most fronts moving south of the country, explaining the mild autumn pattern. The northerly flow is given by the counter-clockwisely rotation around the high-pressure cell.
Source: NCEP Reanalysis.

2. What is the data showing?

2.1 Regional temperature

Figure 2.1 shows the seasonal 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 once again prevailed for the entire region, without exception. The magnitude of the anomalies was greater for the maximum daytime temperatures, except around Wellington where the minimum overnight temperatures had a greater departure from average.

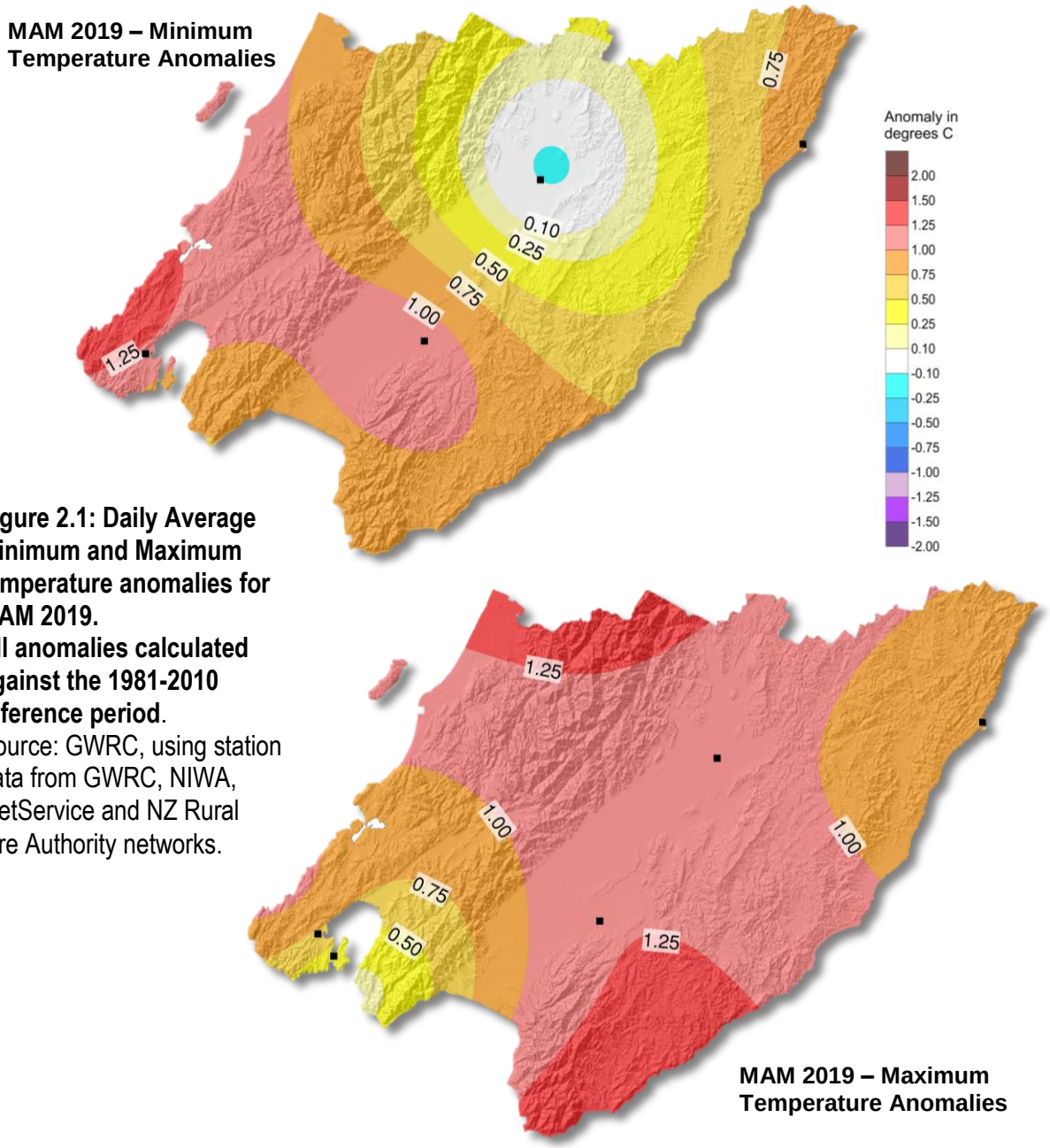


Figure 2.1: Daily Average Minimum and Maximum temperature anomalies for MAM 2019.
All anomalies calculated against the 1981-2010 reference period.
Source: GWRC, using station data from GWRC, NIWA, MetService and NZ Rural Fire Authority networks.

2.2 Regional wind

Figure 2.2 shows the mean seasonal wind anomalies (against the 1981-2010 reference period) based on a smaller network of stations than for temperature. We can see that the region had a pattern of lower than normal wind speeds over the season, except around the southern coast, where the anomalies were slightly positive (ie, slightly windier than normal).

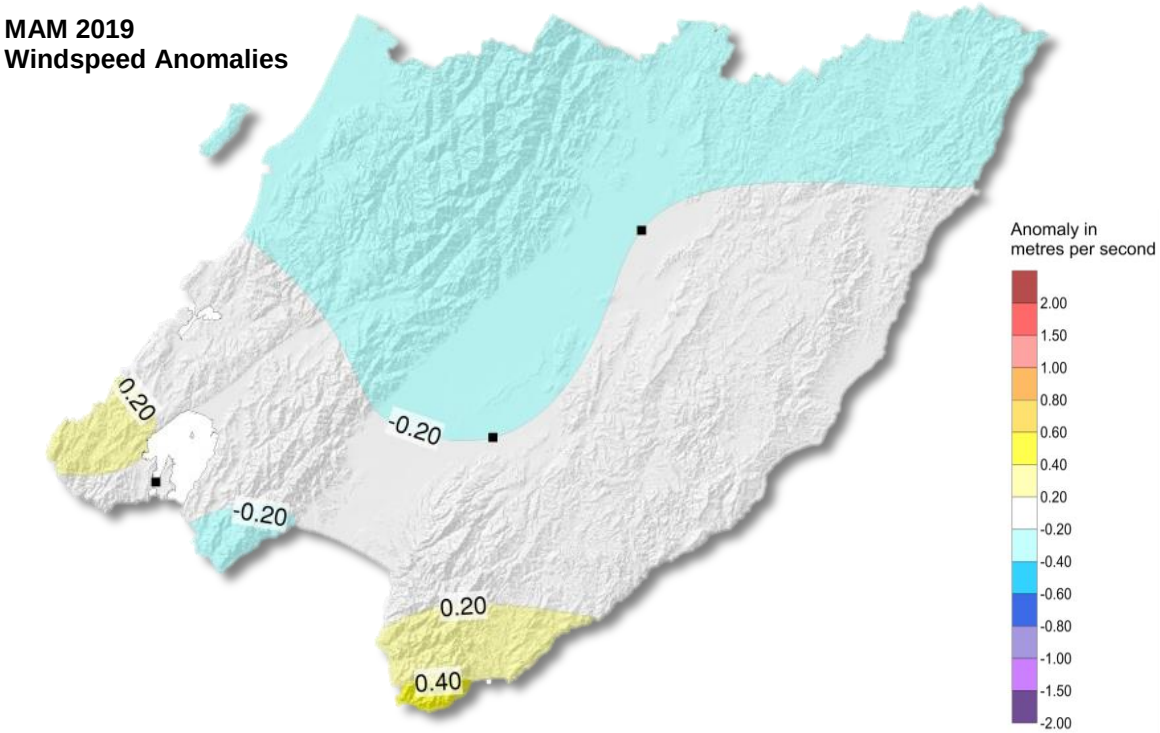


Figure 2.2: Daily mean wind anomalies (in m/s) for MAM 2019. All anomalies calculated against the 1981-2010 reference period.
Source: GWRC, using station data from NIWA and MetService.

2.3 Regional soil moisture

Figure 2.3 shows the autumn 2019 soil moisture anomaly map for the region, ranging from higher than normal in the west to drier than normal in the east. Station data (see section 2.5.2) and the New Zealand drought index from NIWA confirm that the Eastern Wairarapa is starting to appear as only slightly dry, still far away from reaching any thresholds of concern.

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

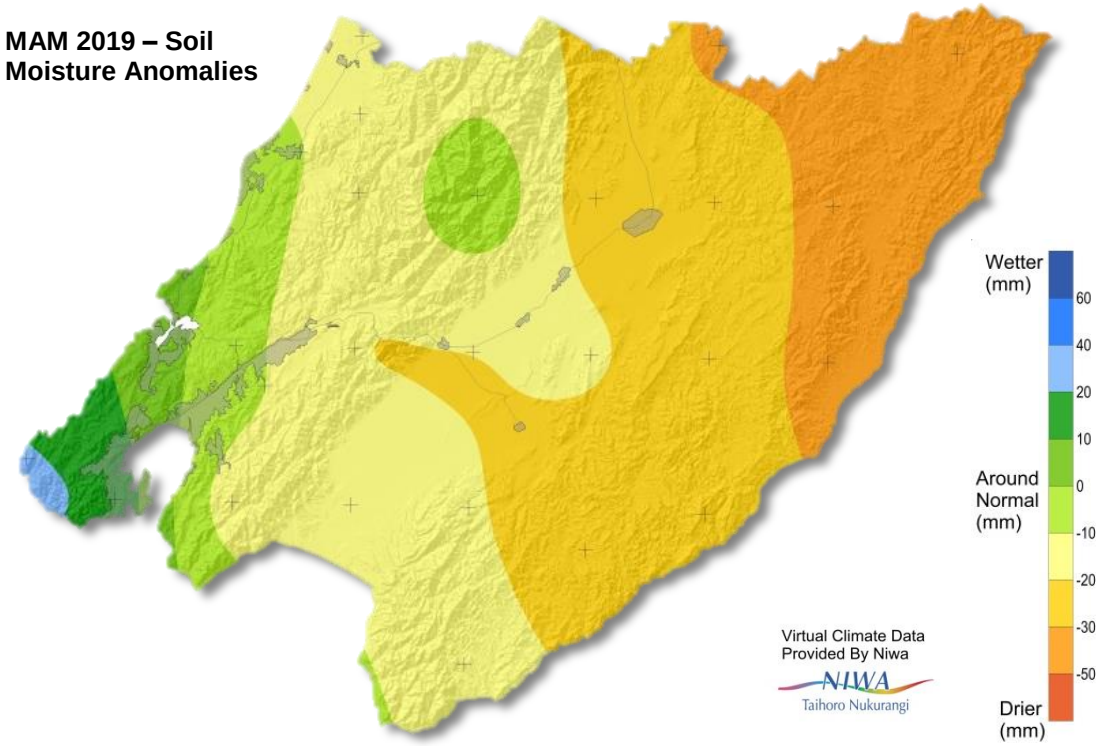


Figure 2.3: Autumn (MAM 2019) soil moisture anomaly. Moisture levels show slightly below normal over the east to slightly above normal conditions over the west of the region. Source: GWRC, using selected Virtual Climate Station Network (VCSN) data kindly provided by NIWA. ***Note that this data is indirectly 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 monthly autumn rainfall expressed as a percentage of the long-term average. The observed pattern was variable from month to month. March saw well below average rainfall across the Wairarapa and east coast, while April stands out in sharp contrast as a very wet month over the entire region. Southern areas received up to 200% of normal rainfall dring April. May saw a return to below average rainfall for most of the region except the Tararua Range.

Rainfall over the entire autumn season period ranged from slightly below average (around 70%) in the east to around average in the west.

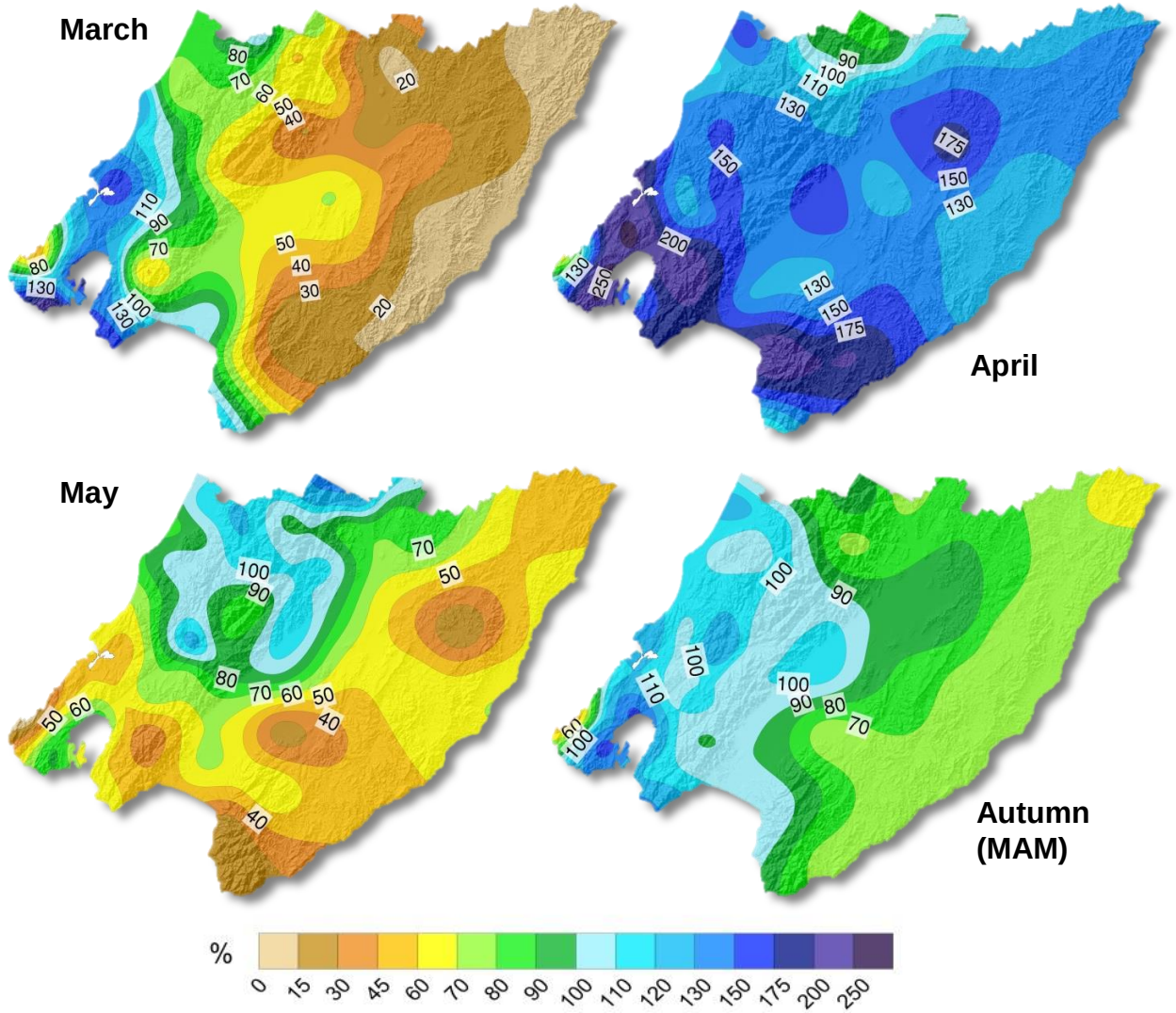


Figure 2.4: Rainfall for March, April, May and MAM 2019 as a percentage of the long-term average. Rainfall was quite variable between the months. March and May were below average for most areas while April was wetter than normal everywhere. Autumn (MAM) as a whole ranged from below average in the east to average in the west. Source: GWRC and NIWA.

2.5 Observed rainfall and soil moisture conditions for selected sites

Figure 2.5 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.

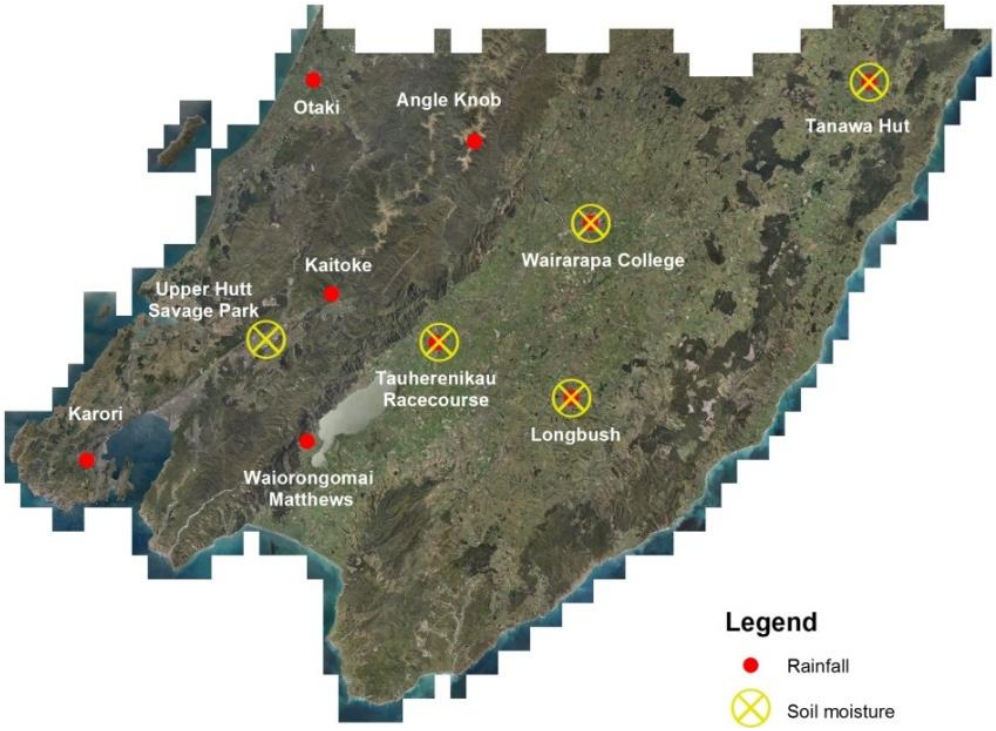


Figure 2.5: Map of GWRC rainfall and soil moisture monitoring locations

2.5.1 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.

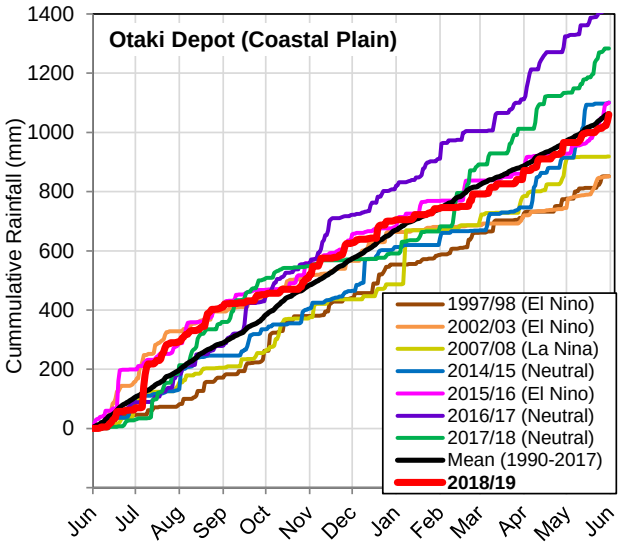
Many of the GWRC telemetered rain gauge sites in the lower lying parts of the Wairarapa have only been operating since the late 1990s so the period of data presented is limited to the last two decades. For each historical record plotted, an indication of ENSO climate state (El Niño, La Niña or neutral) at that time is also given.

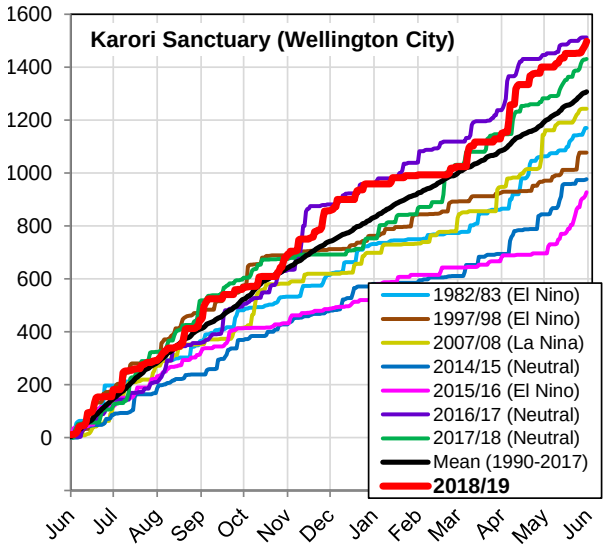
GWRC does not operate a rain gauge in the southern-most parts of the Wairarapa Valley that is suitable for presenting data in this report. This means that we cannot be confident that the rainfall patterns seen elsewhere extend to this part of the region other than the VCSN data already presented.

Overall, rainfall accumulations for the year June 2018 to May 2019 have ended around average to above average.

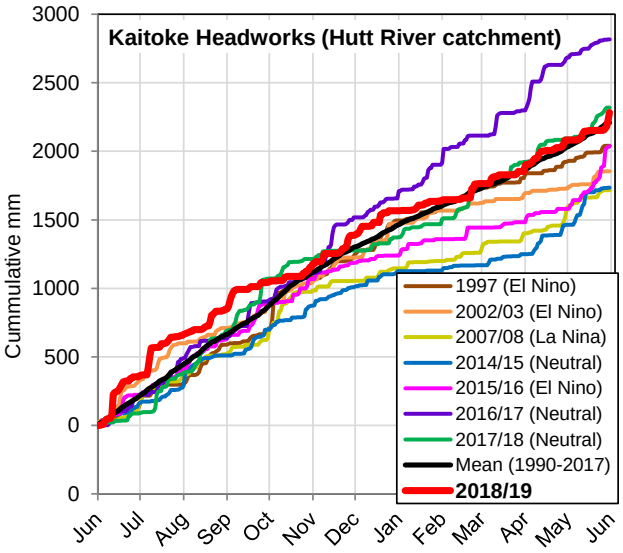
Rainfall at Tanawa Hut in the northeastern Wairarapa was about 200mm greater than normal. The very wet period during November and December 2018 is evident in the graph.

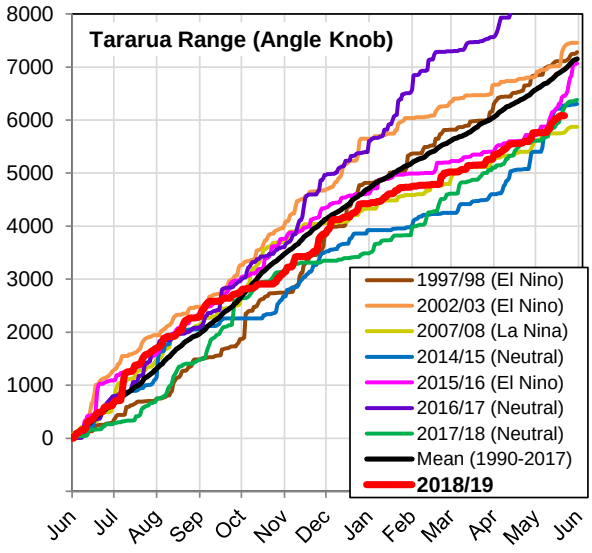
Kāpiti Coast and Southwest (Wellington city)



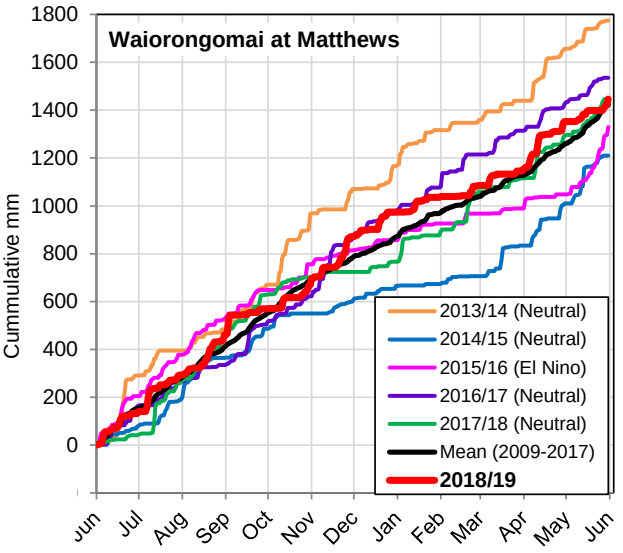


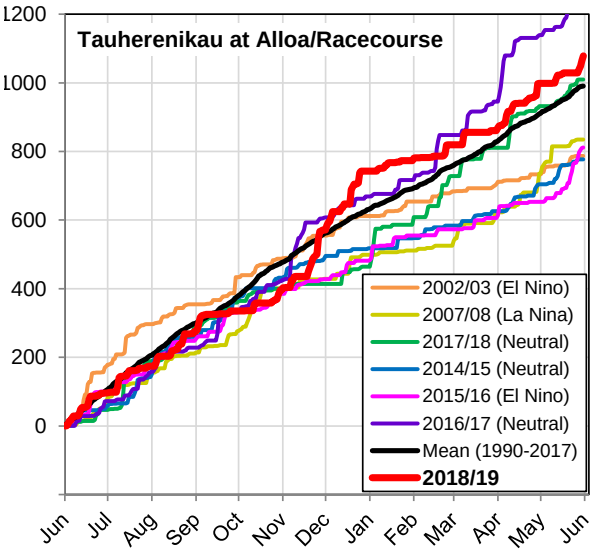
Hutt Valley and the Tararua Range

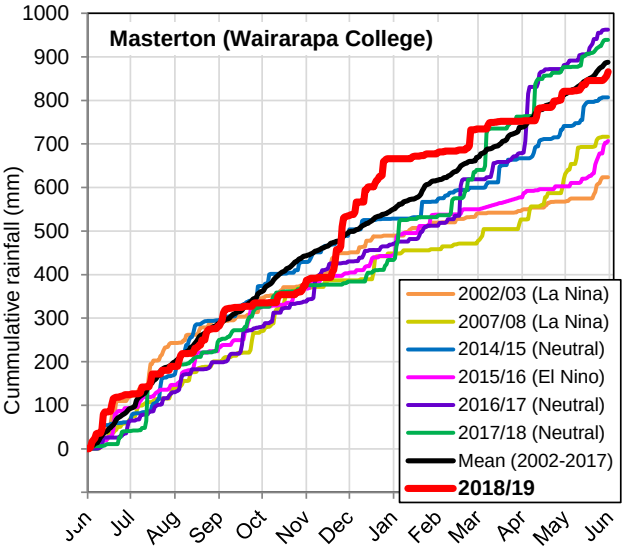


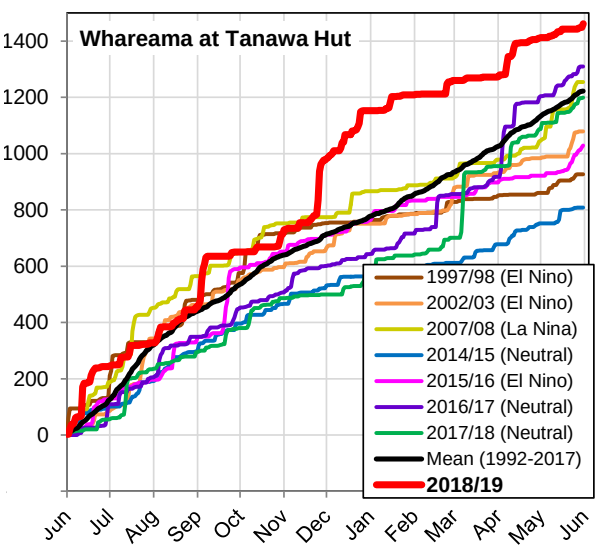


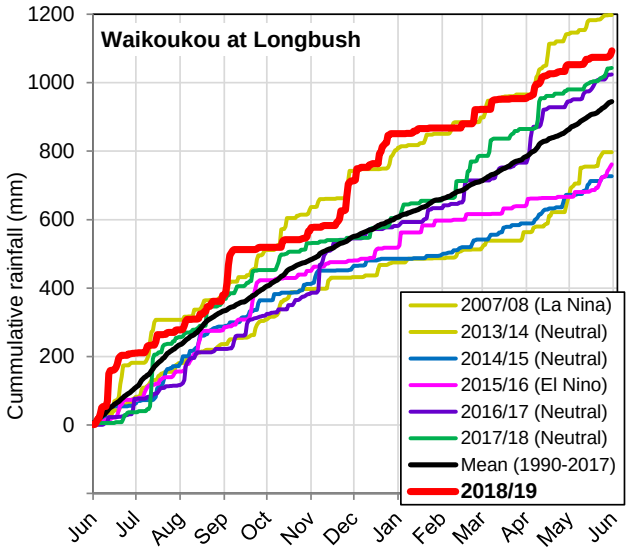
Wairarapa











Live cumulative plots (updated daily): Real-time graphs for cumulative rainfall are available online at 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.

2.5.2 Soil moisture content (since 1 June 2018)

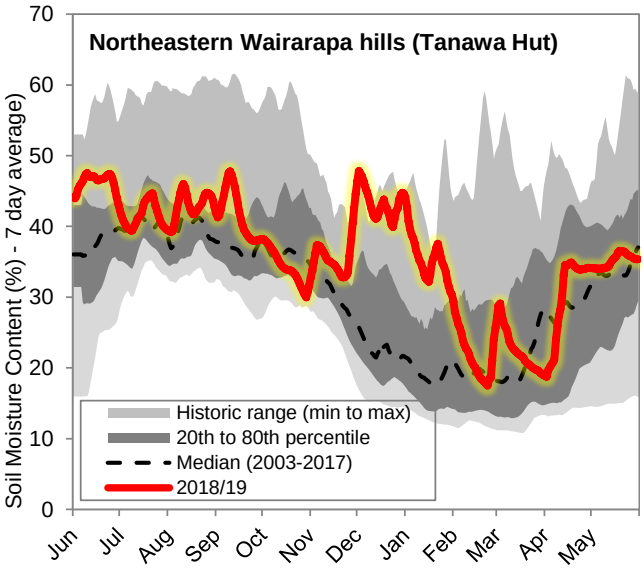
The following soil moisture graphs show the seven day rolling average soil moisture content (%) since 1 June 2018. This is plotted over an envelope of the range of historic recorded data (and the median) at the site to provide an indication of how the current soil moisture compares with that for a similar period in past years.

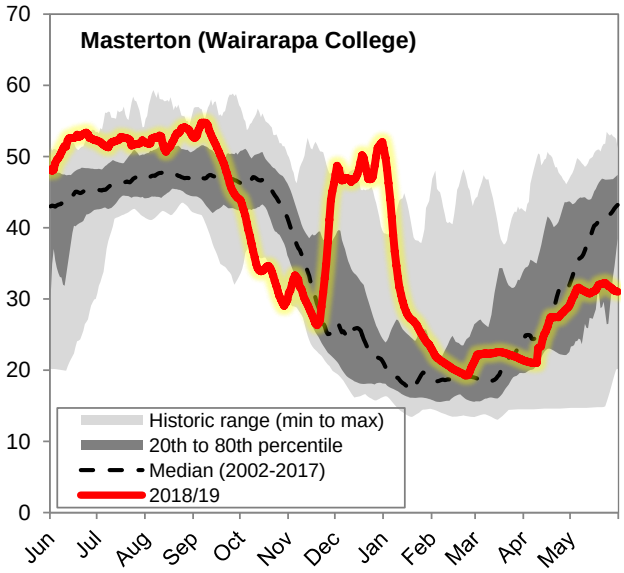
While the soil moisture plots are useful for tracking change within the current season and comparing relative differences between years, the absolute moisture content (%) for any given site and date should not be considered accurate. Many of the GWRC soil moisture sites have not yet been fully calibrated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

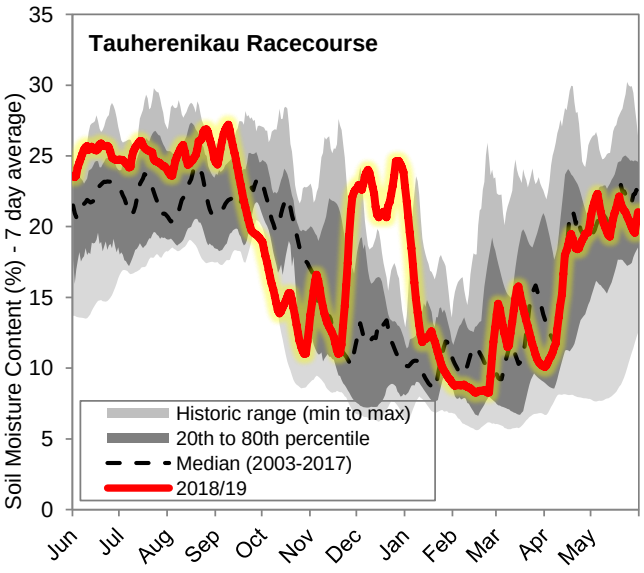
The soil moisture behaviour at the four sites in the Wairarapa started to show an early decline into low soil moisture levels in October 2018 but the very wet period from late November and through December brought the levels back to well above average.

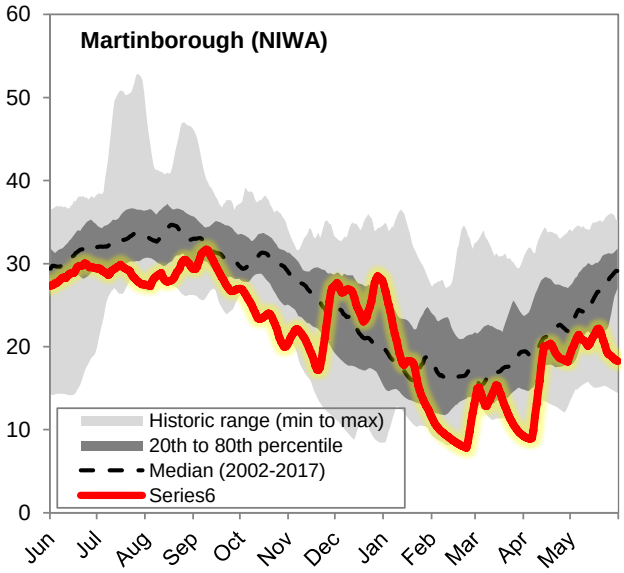
Levels at Martinborough (a NIWA operated site) reached low extremes in late February and early April.

(a) Wairarapa

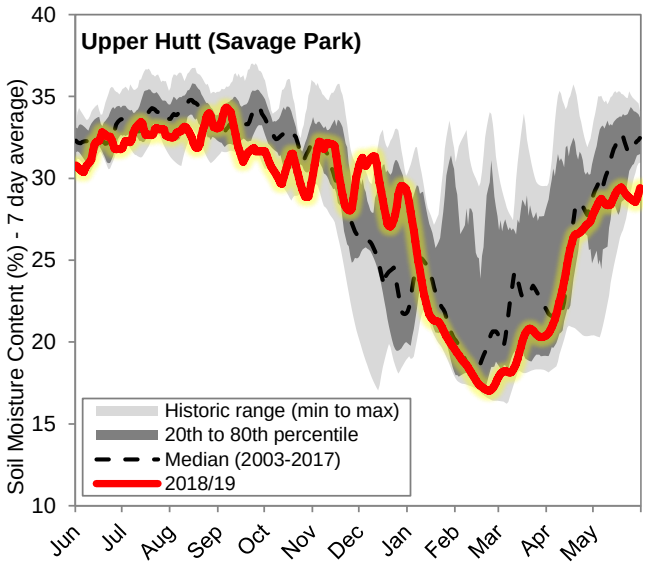








(b) Hutt Valley



Live soil moisture plots (updated daily): Real-time "envelope" graphs for soil moisture are available online at 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 2019

- ENSO likely remaining **borderline between El Niño and neutral**;
- Sea Surface temperatures around New Zealand remaining above average, although not as anomalous as during the previous seasons;
- **A mild season**: Temperatures normal to above, less snow and fewer frosts;
- Mixed **westerly/easterly regime at first, tending to prevailing westerlies later in the season;**
- **Variable rainfall**: High month to month variability, more likely wetter in the west, drier in the east (low confidence for rainfall totals);

Whaitua*	Variables	Climate outlook for winter 2019
Wellington Harbour & Hutt Valley	**Temperature:**	Average to above.
	Rainfall:	Very variable month to month. Low confidence for average totals. Heavy rainfall events likely.
Te Awarua-o-Porirua	**Temperature:**	Average to above.
	Rainfall:	Very variable month to month. Low confidence for average totals. Heavy rainfall events likely.
Kāpiti Coast	**Temperature:**	Average to above
	Rainfall:	Average to above. Very variable month to month. Low confidence for average totals. Heavy rainfall events likely.
Ruamāhanga	**Temperature:**	Average to above.
	Rainfall:	Average to below. Very variable month to month. Low confidence for average totals.
Wairarapa Coast	**Temperature:**	Average to above.
	Rainfall:	Average to below. Very variable month to month. Low confidence for average totals

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

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.

Appendix

GWRC online climate mapping tools

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

Drought check: http://www.gwrc.govt.nz/drought-check/

Interactive climate change maps: Easy to plot climate change mapping, available for every season, for mid and late century. A total of 21 climate variables can be plotted, for every greenhouse gas emission scenarios modelled by the IPCC. Dynamical downscaling provided by NIWA: https://mapping1.gw.govt.nz/gw/ClimateChange/

GWRC Climate change webpage

http://www.gw.govt.nz/climate-change/

GWRC Seasonal climate variability and water resources webpage

http://www.gw.govt.nz/seasonal-climate-and-water-resource-summaries-2/

Reports

Main climate change report (NIWA 2017)

http://www.gw.govt.nz/assets/Climate-change/Climate-Change-and-Variability-report-Wlgtn-Regn-High-Res-with-Appendix.pdf

Main climate drivers report (Climate Modes) (NIWA 2018)

http://www.gw.govt.nz/assets/Our-Environment/Environmental-monitoring/Environmental-Reporting/GWRC-climate-modes-full-report-NIWA-3-Sep-2018-compressed.pdf