Climate briefing

Wellington region, January 2016

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1. Highlights

Rainfall has been persistently below average in parts of the Wellington region, especially the south and east coast, since the end of 2014. Figures vary, but according to one indicator produced by NIWA, the "Potential Evapotranspiration Deficit", which tells you how much additional irrigation may be needed for optimum crops growth, the calendar year 2015 in the Wairarapa has been comparable to the driest years on record (measured since 1940). This is largely because the previous summer and autumn were very dry. A strong El Niño has been present since April 2015. This El Niño is highly unusual compared to previous historical events, with dry and cool conditions interrupted by short duration heavy rainfall events.

The New Year has started with relatively good news for farmers. First, a major rainfall event on the 2nd and 3rd of January has provided some needed moisture input into the soil. Although in the long-run there is still considerable soil moisture deficit, this rainfall event helps alleviate the drought concerns for the time being. The second piece of good news is that the El Niño event appears to be losing intensity, as measured by oceanic (sub-surface water temperatures) and atmospheric (Southern Oscillation Index, SOI) indicators. The forecast remains, however, that the ENSO event will continue to influence the weather throughout summer and autumn, dissipating only in the second half of the year.

NIWA is predicting a 40% probability of a dry remaining summer and early autumn in the Wairarapa. In the absence of any forecast guidance there would be an equal likelihood (33% chance) of either dry, normal or wet conditions. This agrees well with statistical rainfall data collected by the Environmental Science Department, that shows that there is an increased probability of the occurrence of up to one in a 50-year dry summer in parts of the Wairarapa, particularly within the Ruamahanga and Wairarapa Coast Whaitua, during very strong El Niño years. However, as noted above this El Niño is highly unusual, and seems to be less dry than previous historical (strong) El Niños with the development of a few (short duration) heavy rainfall events.

Water conservation strategies for summer: In light of current El Niño conditions and the climate predictions, Wellington Water has already highlighted the need to enhance water conservation strategies this summer. For more information please refer to their website: http://wellingtonwater.co.nz/media-releases/get-set-for-a-dry-summer/

Seasonal Climate and Water Resources: The extended seasonal climate reports for the Wellington region produced by the Environmental Science Department can be found here: http://www.gw.govt.nz/seasonal-climate-and-water-resource-summaries-2/

2. El Niño – Southern Oscillation (ENSO)

2.1 Current status

The latest development of the current El Niño is seen in Figure 2.1, with fairly warm waters in the Equatorial Pacific Ocean extending all the way to South America as of 2 January 2016. The waters are cool on the eastern coast of New Zealand, which is a normal response of the oceanic circulation to El Niño events.

The cool waters around New Zealand help reduce the amount of moisture in the atmosphere over summer, favouring drought conditions on the east coast. To the west of Australia, the warm waters south of the equator in the Indian Ocean work to create more storms that may eventually reach New Zealand, as occurred in the New Year. These sporadic (heavy) rainfall events have helped alleviate the drought potential for the time being.

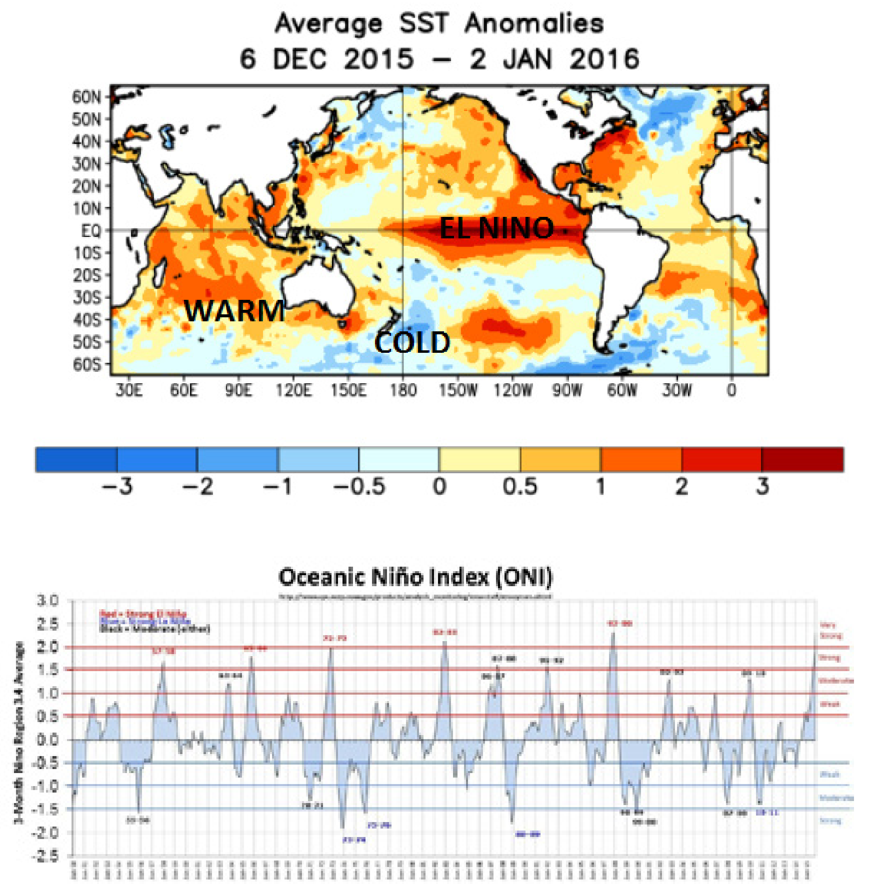


Figure 2.1: Latest water temperature anomalies (upper panel) and how the current El Niño sits in historical perspective. Source: NOAA/USA

In the bottom panel we can see that the current El Niño is “very strong”, comparable to the 1997-1998 event which was one of the strongest ever measured. However, this event seems to be less dry than previous strong El Ninos in terms of rainfall anomalies both in Australia and New Zealand.

Since our last briefing in December 2015, there has been very little change in the sea surface temperature anomalies around the globe (figure 2.1), but the waters underneath the surface have shown a marked cooling over the last couple of weeks. This, together with the fact that the SOI index has also become significantly less “El Nino-like”, tends to suggest that the current ENSO is already showing early signs of decay.

The next sequence of figures shows what has happened during past historical El Niño summers (nine events since the record 1983 El Niño). Figure 2.2 shows that a high pressure anomaly sits to the south of New Caledonia (northwest of New Zealand, in red) and a low pressure anomaly forms to the south-east of New Zealand during typical El Niño summers. This pressure differential is quite strong, changing the wind patterns and contributing towards droughts on the eastern part of New Zealand.

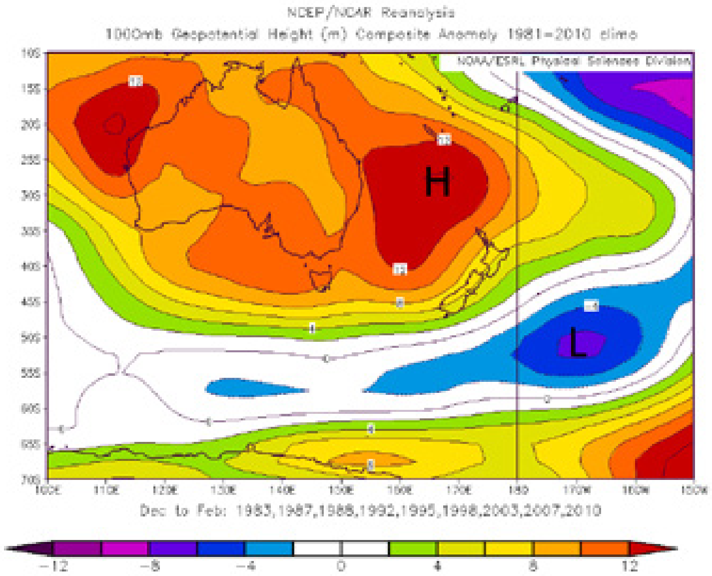


Figure 2.2: Pressure anomalies during typical El Niño summers. New Zealand is seen under the influence of high pressures (in red), which helps reduce the normal rainfall pattern. Source: NCEP Reanalysis/USA

2.2 New Zealand wide effects

As a result of the pressure changes, the westerly winds tend to increase all over New Zealand during El Niño summers (Figure 2.3, in red). We can see that this pattern is stronger in the northern part of the North Island and in the southern part of the South Island. Over the Greater Wellington Region this increase is not as pronounced (yellow tones), reflecting the fact that we sit in a transition area with variable effects.

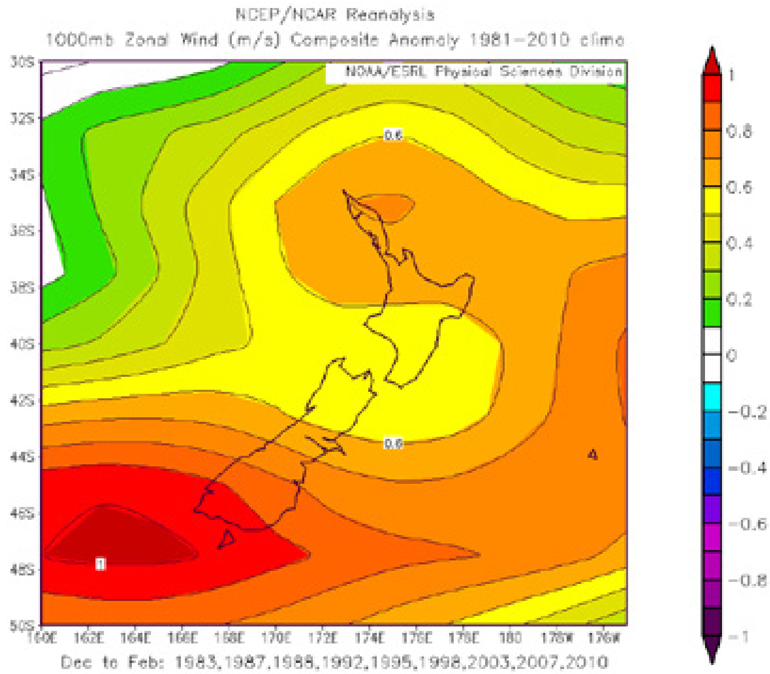


Figure 2.3: Change in the zonal wind (westerlies) observed during typical El Niño summers. A strengthening of the westerlies is seen all over New Zealand (in red). Source: NCEP Reanalysis/USA.

Figure 2.4 shows that the drying effect of summer El Niño events tends to concentrate on the northern part of the North Island and the southern part of the South Island (in red), following the proportionally greater increase of westerly winds in those areas, due to the drying effect of the winds. In the Greater Wellington Region there is a modest reduction of the relative humidity particularly on the northern Wairarapa coast.

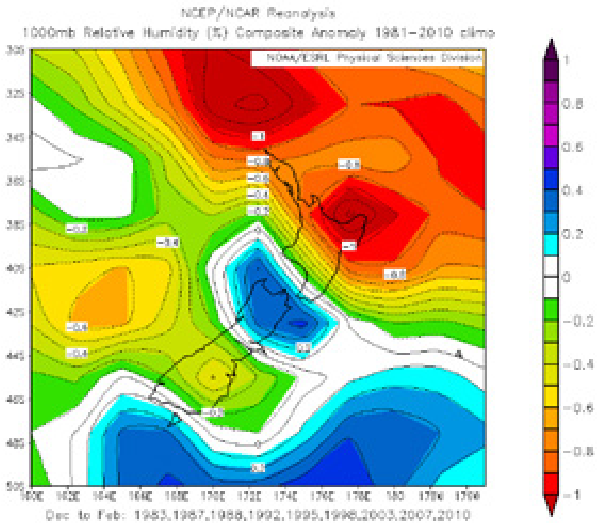


Figure 2.4: Change in the relative humidity observed during typical El Niño summers. Source: NCEP Reanalysis/USA.

During very strong El Niño events, the typical summer pattern is of drought on the whole eastern part of New Zealand, as shown in Figure 2.5. In the Greater Wellington Region the driest area tends to be the northern Wairarapa Coast, where it can rain less than half of the normally expected rainfall over summer.

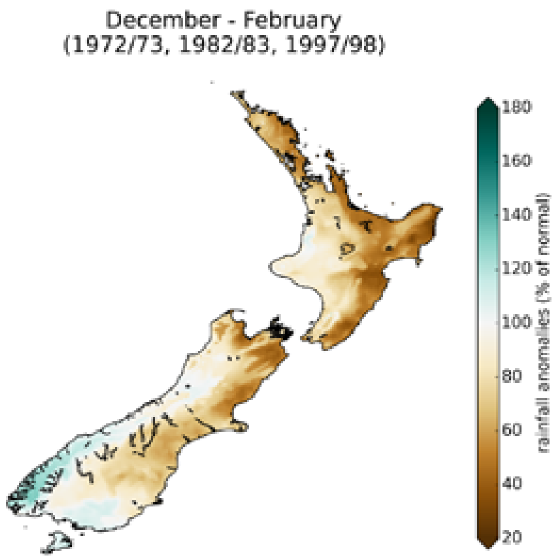


Figure 2.5: Rainfall anomalies during the three previous strongest El Niño on record. Source: NIWA.

2.3 Regional effects

Figure 2.6 shows that there is an increased probability of up to one in a 50-year dry summer, immediately after El Niño springs, for most of the Wairarapa (orange shading, left panel). This is not observed for neutral or La Niña years (middle and right panels).

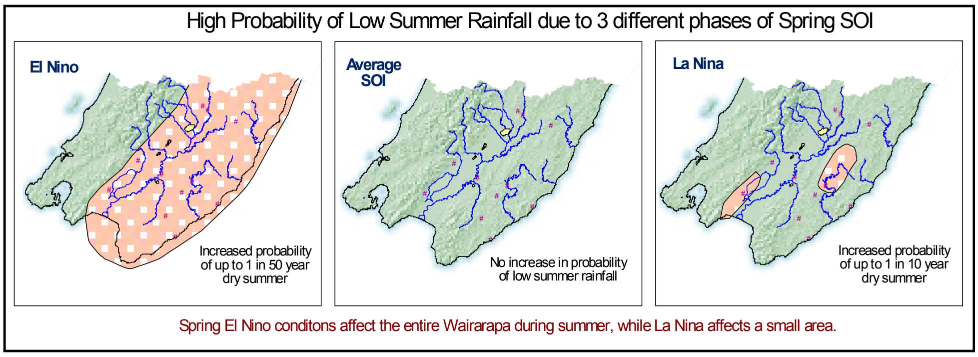


Figure 2.6: Probability of drought in summer associated with the ENSO phase during the preceding season. Source: Greater Wellington Regional Council.

3. Broad scale drought indicators

Although December 2015 was extremely dry in most of the Wellington region, a two day heavy rainfall event early in the New Year has provided some well needed soil moisture input, helping alleviate drought potential in the near term. On the long run, the Standardised Precipitation Index (SPI) for the last 60 days still indicates dry conditions over most of the Wellington region (Figure 3.1 – bottom right).

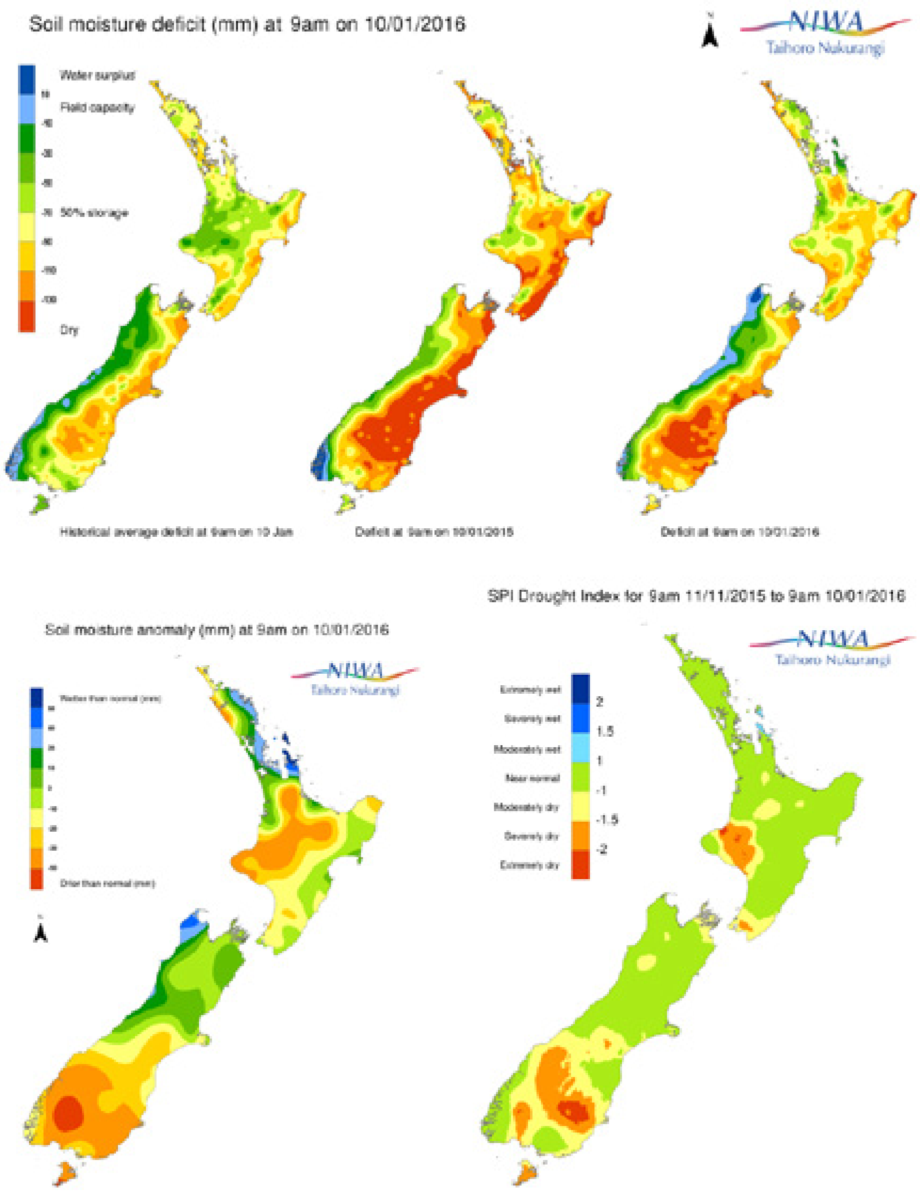


Figure 3.1: Soil moisture deficit (compared to historical average and same time last year) and soil moisture anomalies as of 10th Jan 2016 (upper panels and bottom left), and Standardised Precipitation Index for the last 60 days (bottom right). Source: NIWA Drought Monitor.

4. Observed rainfall and soil moisture conditions

4.1 Accumulated rainfall and soil moisture at selected sites

Figure 4.1 shows the location of a selection of representative GWRC rainfall and soil moisture monitoring sites. Plots of accumulated rainfall and soil moisture trends are provided in the following pages.

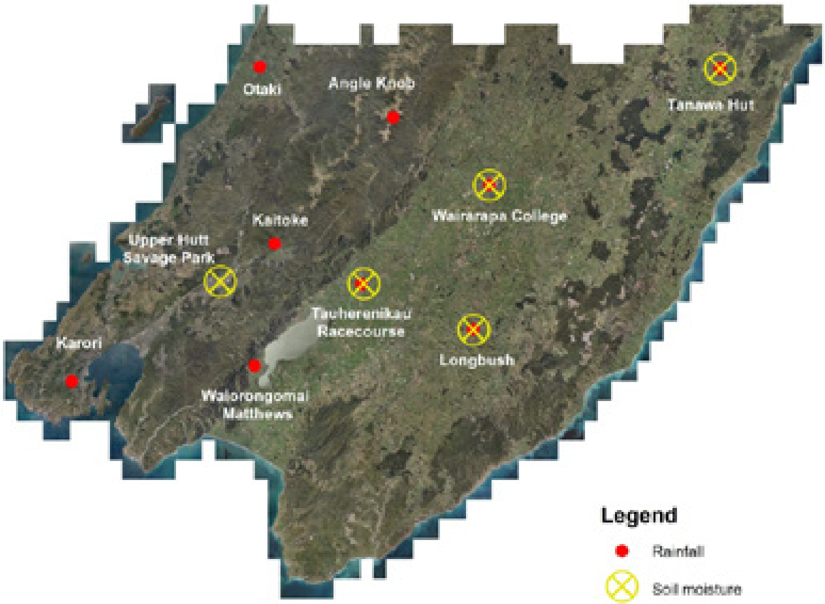


Figure 4.1: Map of rainfall and soil moisture monitoring locations

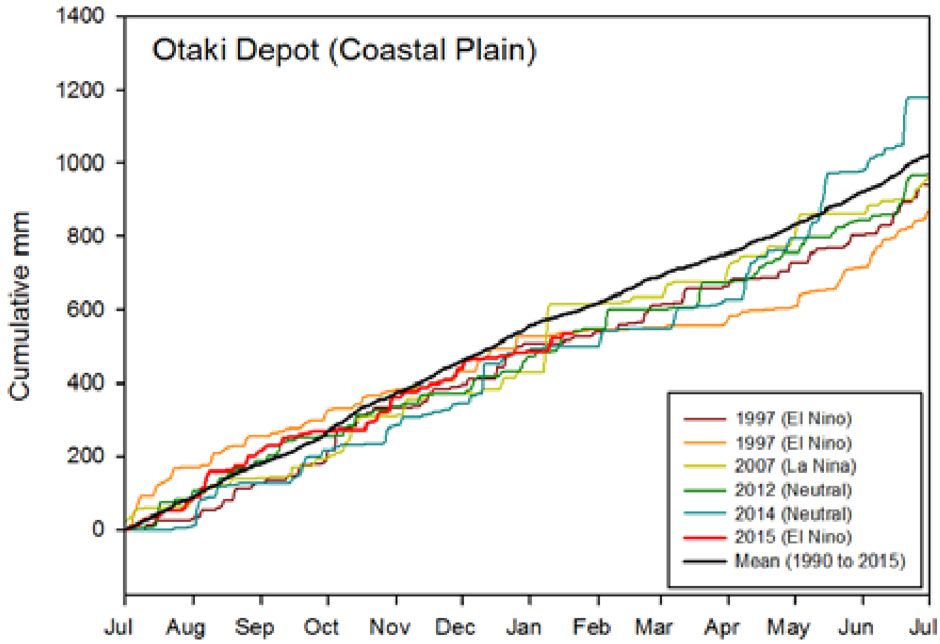
4.1.1 Rainfall –since 01 July 2015

The following rainfall plots show total rainfall accumulation (mm) since 01 July 2015. For comparative purposes, cumulative plots for selected historic years with notably dry summers in the Wairarapa have been included, as well as the site mean. Many of the GWRC telemetered rain gauge sites in the lower lying parts of the Wairarapa (ie, not Tararua Range gauges installed for flood warning purposes) have only been operating since the late 1990s so the period of data presented is somewhat constrained to the past 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.

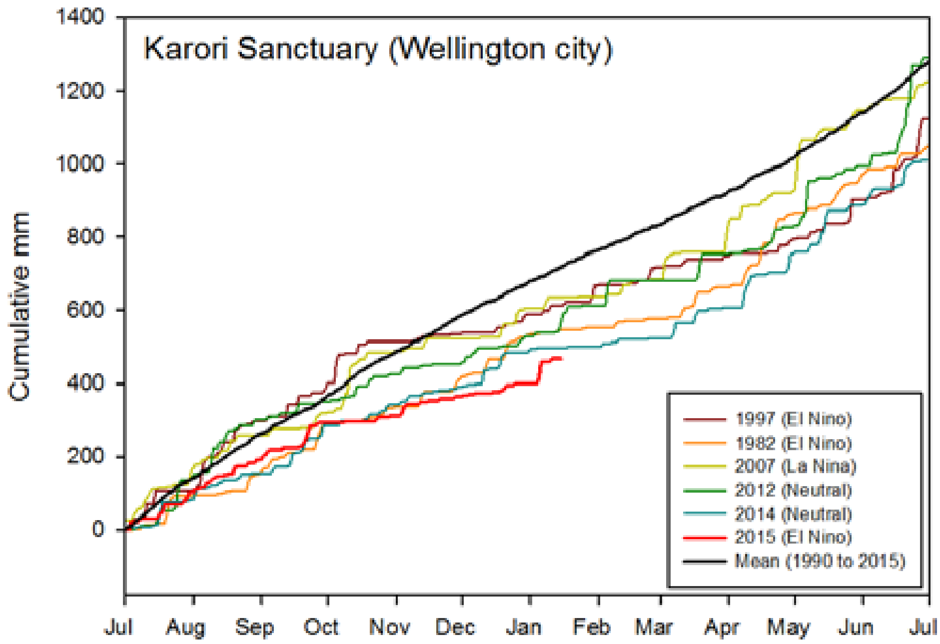
Generally speaking, rainfall accumulation since July 2015 has been below average across the region and significantly so in some areas (eg, the southwestern part of the region around Wellington city and the mid to southern Wairarapa Valley).. However, substantial amounts of rain fell across the region in the first week of January and brought some welcome relief. There was a widespread recovery in soil moisture levels with this rain, such that moisture status is now within the expected normal range for this time of year (mid-January).

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.

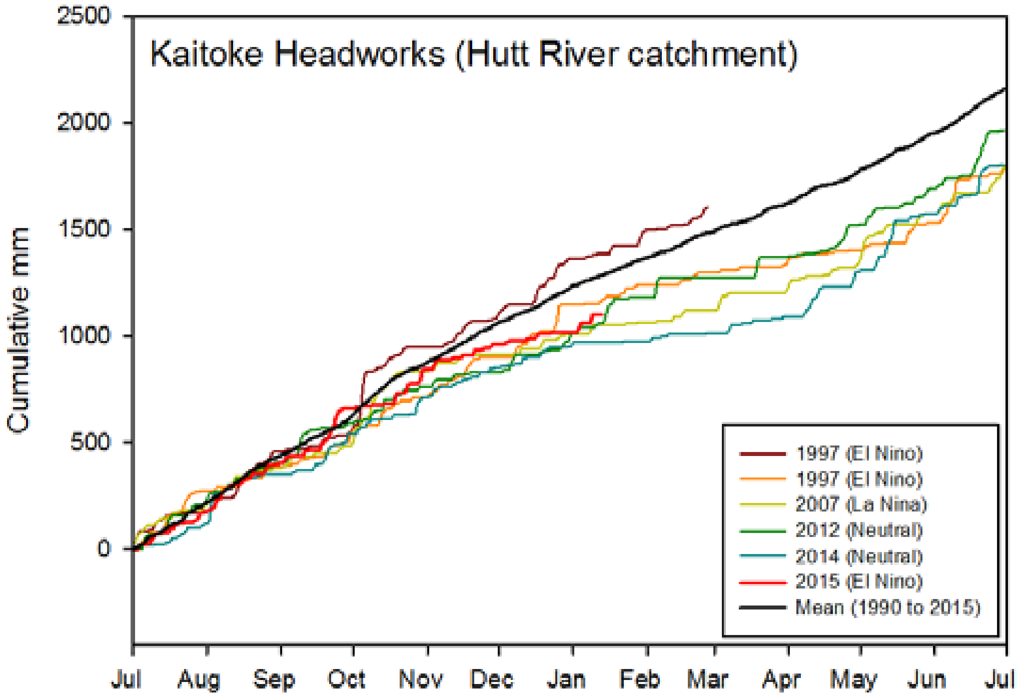
(a) Kapiti Coast

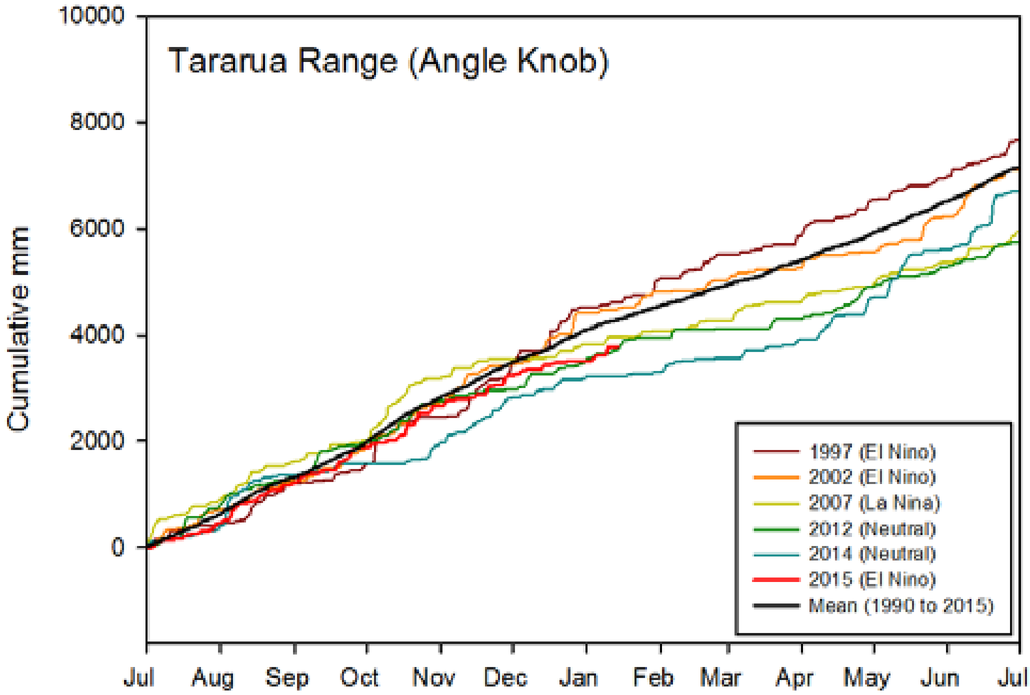


(b) Southwest (Wellington city)

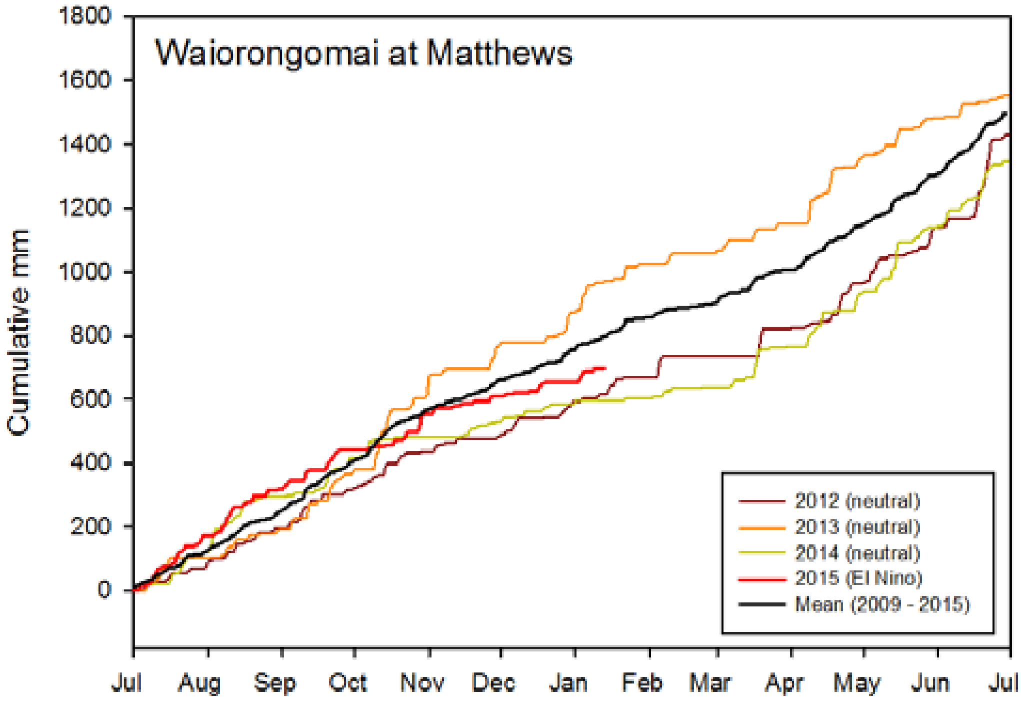


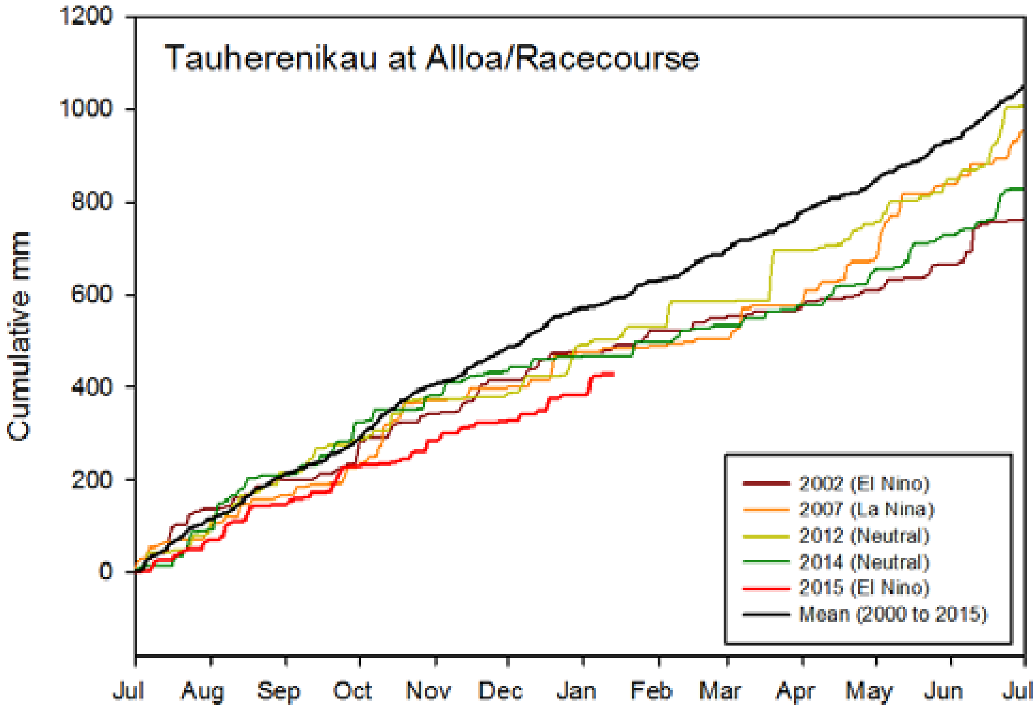
(c) Hutt and Tararua Range

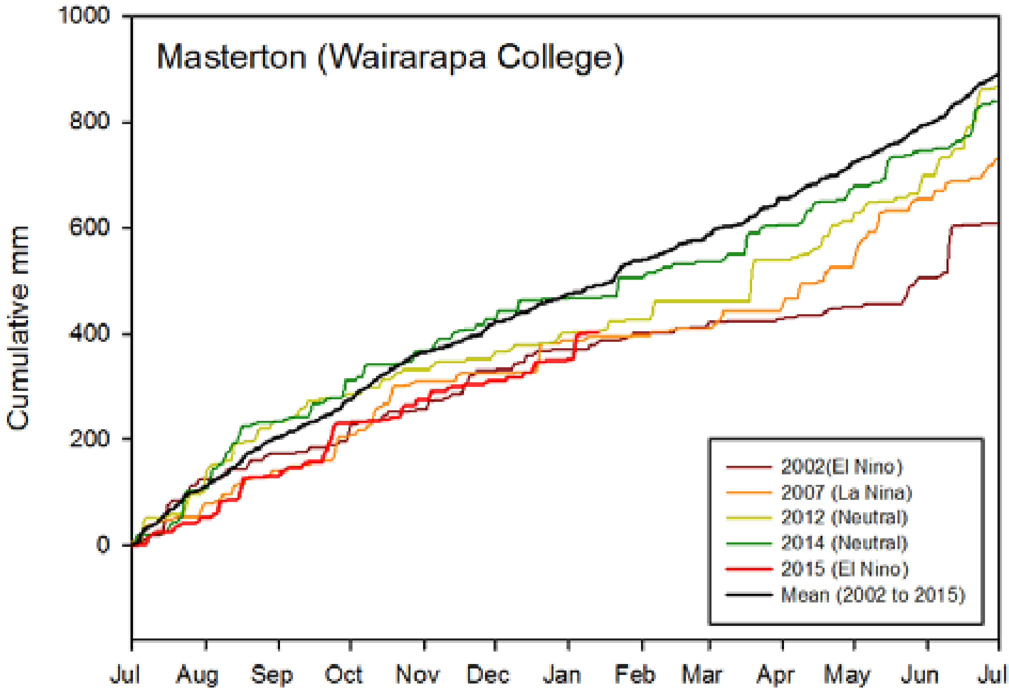


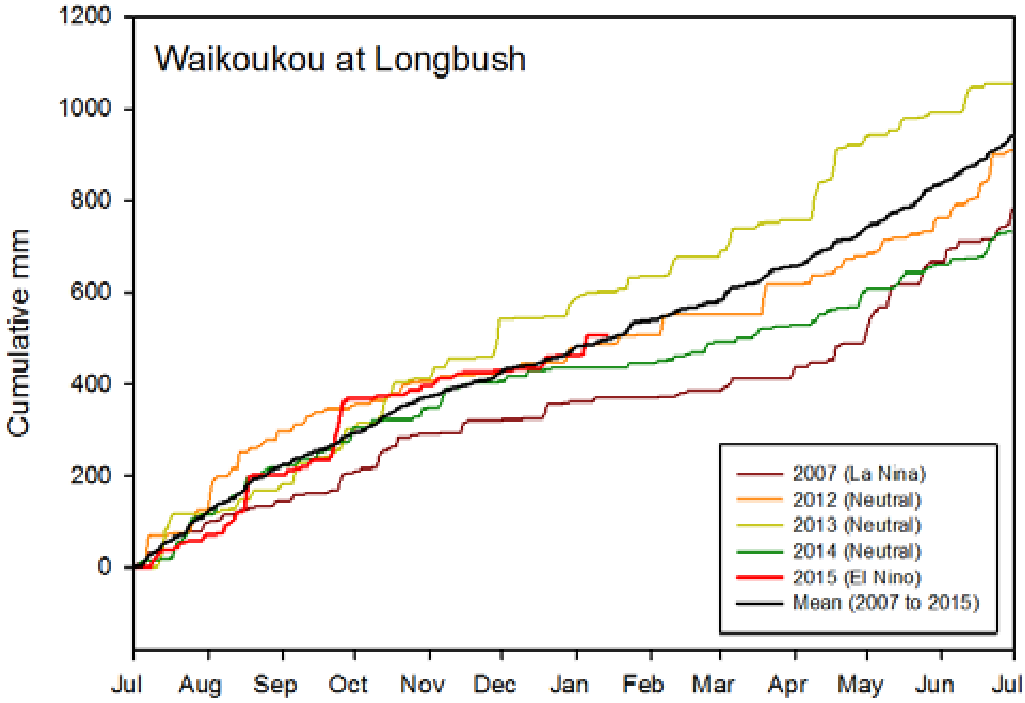


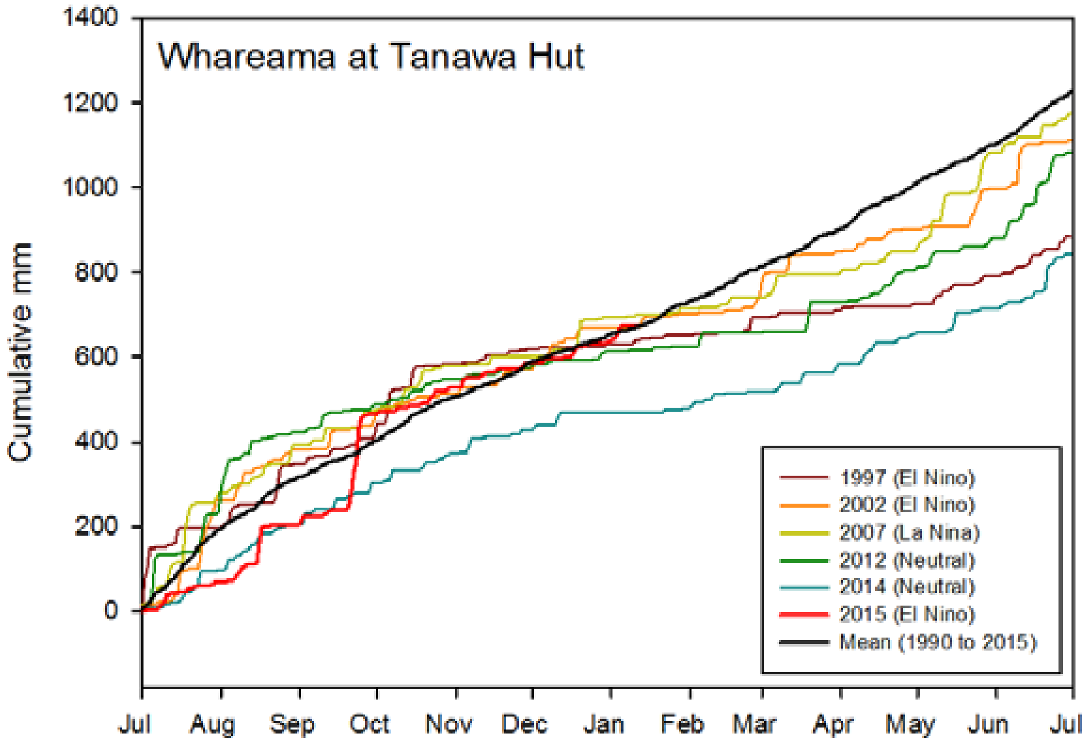
(d) Wairarapa


Waiorongomai at Matthews
Cumulative mm
1800
1600
1400
1200
1000
800
600
400
200
0
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2012 (neutral)
2013 (neutral)
2014 (neutral)
2015 (El Nino)
Mean (2009 - 2015)


Tauherenikau at Alloa/Racecourse
Cumulative mm
1200
1000
800
600
400
200
0
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2002 (El Nino)
2007 (La Nina)
2012 (Neutral)
2014 (Neutral)
2015 (El Nino)
Mean (2000 to 2015)


Masterton (Wairarapa College)
Cumulative mm
1000
800
600
400
200
0
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2002(El Nino)
2007 (La Nina)
2012 (Neutral)
2014 (Neutral)
2015 (El Nino)
Mean (2002 to 2015)


Waikoukou at Longbush
Cumulative mm
1200
1000
800
600
400
200
0
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2007 (La Nina)
2012 (Neutral)
2013 (Neutral)
2014 (Neutral)
2015 (El Nino)
Mean (2007 to 2015)

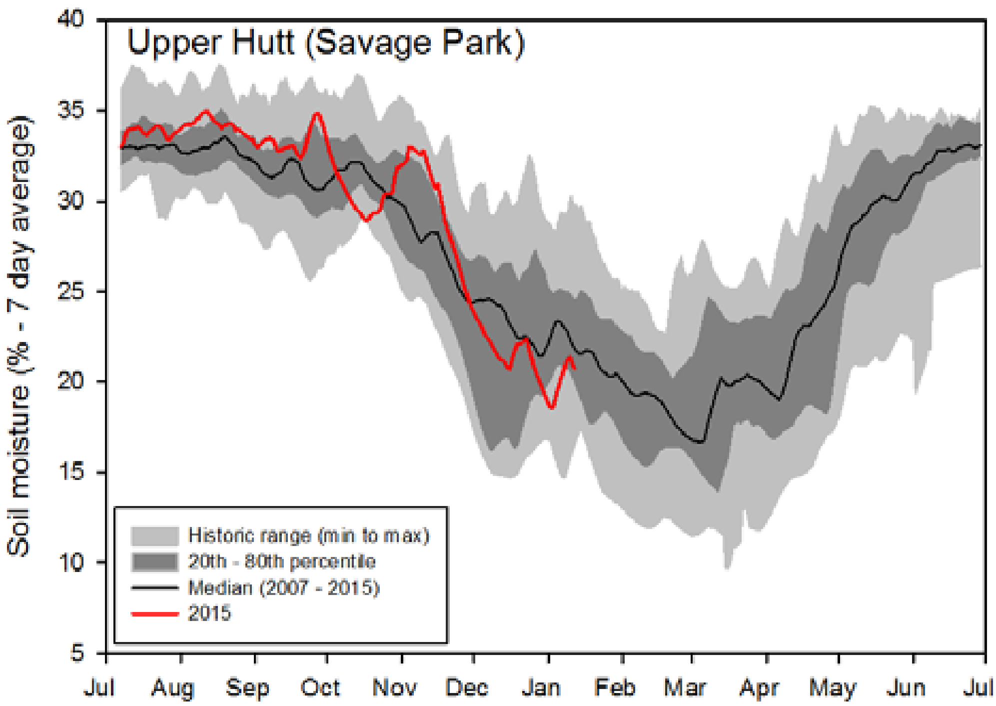

Whareama at Tanawa Hut
Cumulative mm
1400
1200
1000
800
600
400
200
0
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
1997 (El Nino)
2002 (El Nino)
2007 (La Nina)
2012 (Neutral)
2014 (Neutral)
2015 (El Nino)
Mean (1990 to 2015)

4.1.2 Soil moisture content –since 01 July 2015

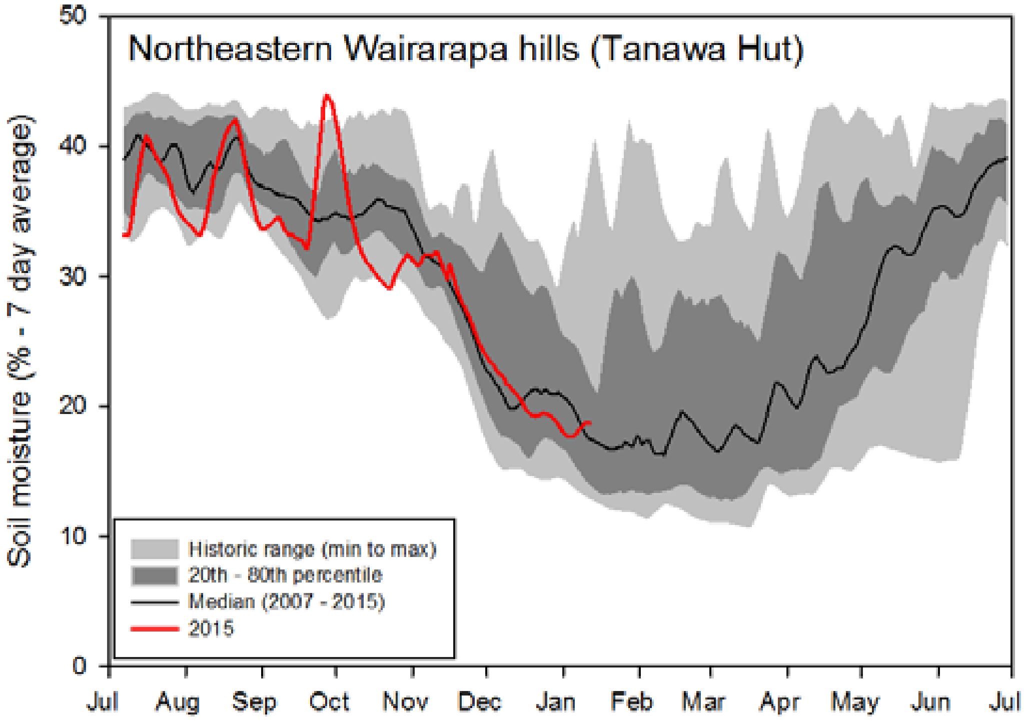
The soil moisture plots show seven day rolling average soil moisture (%) since 01 July 2015. An envelope plot of the historic range of data (and site mean) is also provided to give an indication of how the current soil moisture compares with that for a similar time of the season in past years. While 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.

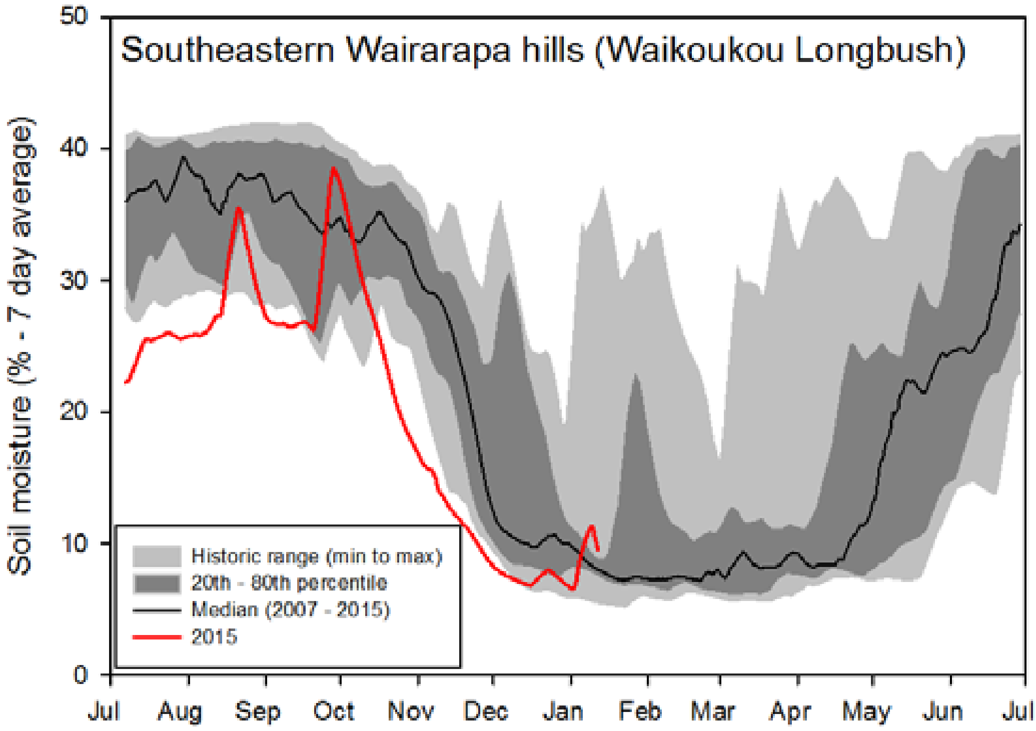
The soil moisture trends generally reflect the picture being generated by broad scale indicators (eg, Figure 3.1); the severe deficits apparent in late December have been somewhat alleviated by the very useful rainfall in the new year.

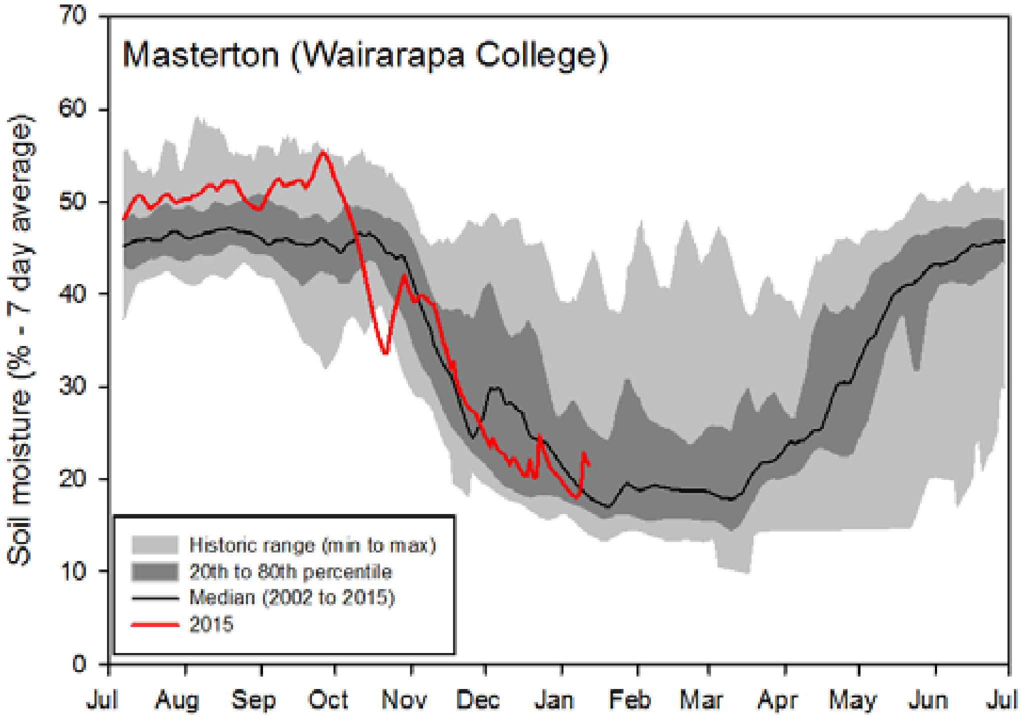
(a) Hutt Valley

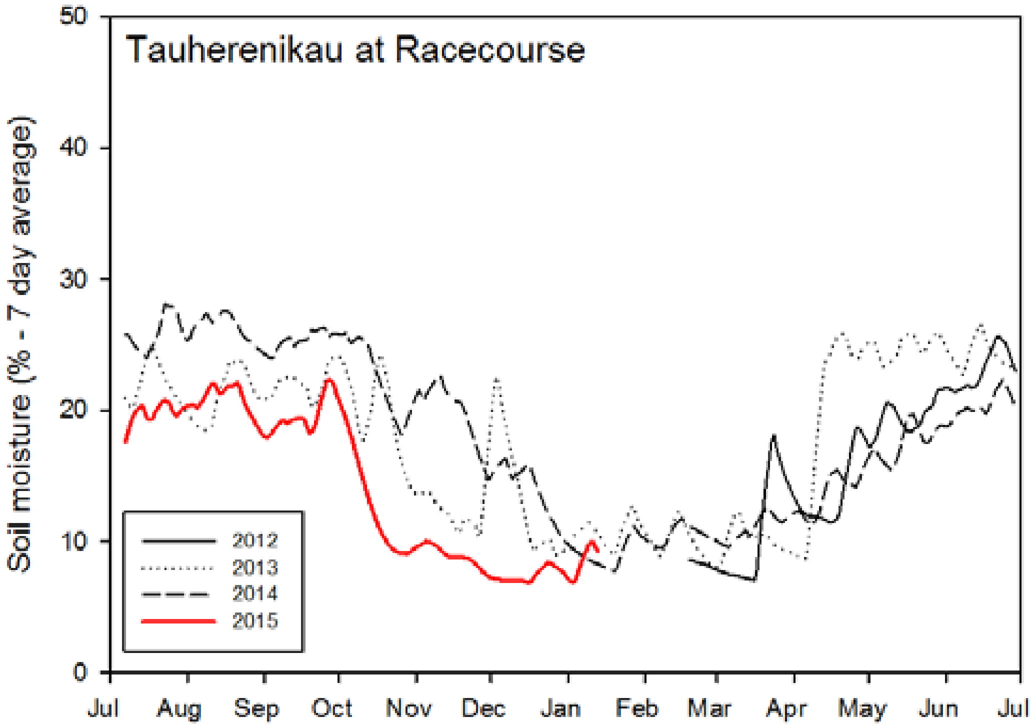


(b) Wairarapa


Northeastern Wairarapa hills (Tanawa Hut)
Soil moisture (% - 7 day average)
0
10
20
30
40
50
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Historic range (min to max)
20th - 80th percentile
Median (2007 - 2015)
2015


Southeastern Wairarapa hills (Waikoukou Longbush)
Soil moisture (% - 7 day average)
0
10
20
30
40
50
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Historic range (min to max)
20th - 80th percentile
Median (2007 - 2015)
2015


Masterton (Wairarapa College)
Soil moisture (% - 7 day average)
70
60
50
40
30
20
10
0
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Historic range (min to max)
20th to 80th percentile
Median (2002 to 2015)
2015


Tauherenikau at Racecourse
Soil moisture (% - 7 day average)
50
40
30
20
10
0
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2012
2013
2014
2015

5. Climate predictions

5.1 El Niño strength and decay

As shown by Figure 5.1, the current El Niño is expected to remain strong throughout summer (albeit losing intensity), before steadily declining until reaching normal conditions in June 2016. As mentioned earlier, the latest data suggests that the El Nino is already showing the early indications of losing intensity. Due to the inertia of the climate system, we expect the atmospheric effects of the strong phase of the El Niño to last at least until the middle of next winter, although progressively less severe. As each El Niño is different, and there are many opposing forces interacting to determine the final observed climate (e.g., more storms coming from the Indian Ocean), it is not possible to confidently predict how much it will rain in summer. For instance, parts of the Wellington region had a very wet start to the year, with about the monthly average falling within a two-day rainfall event.

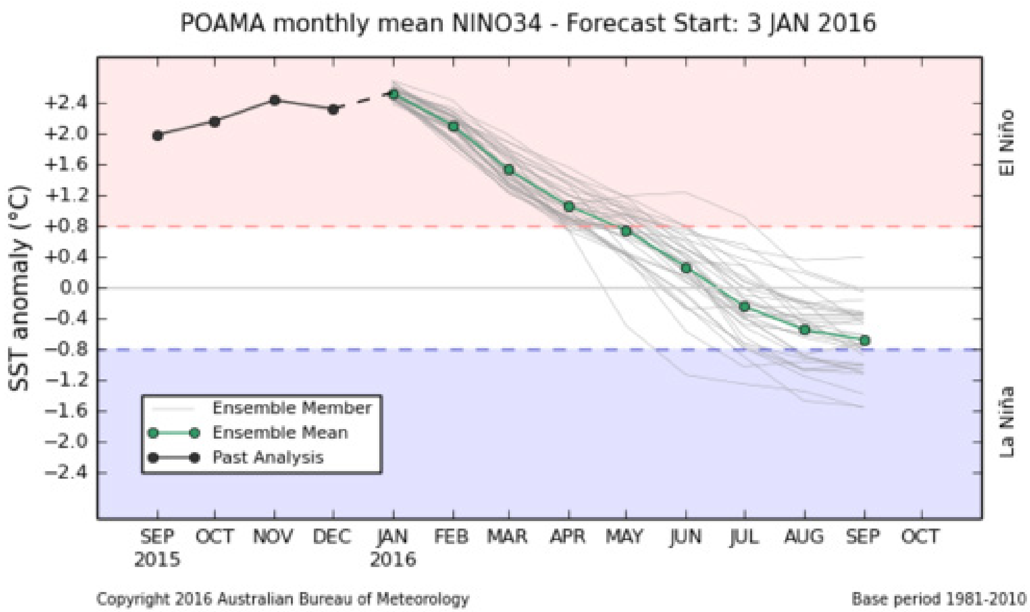


Figure 5.1: Climate projections for the evolution of the current El Niño. The projections show a progressive return to near normal conditions by winter 2016. Source: Bureau of Meteorology, Australia.

Figure 5.2 shows the rainfall anomalies observed in the Wellington Region during the two historical El Niño events with the most resemblance to the current episode. The latest guidance suggests that the ENSO is already showing signs of early decay, with further disruption from a very warm Indian Ocean which was not seen in the previous El Niño episodes causing short duration heavy rainfall events. Hence, the effects on rainfall this coming summer, although still strong, would likely be less severe than previous strong El Niños.

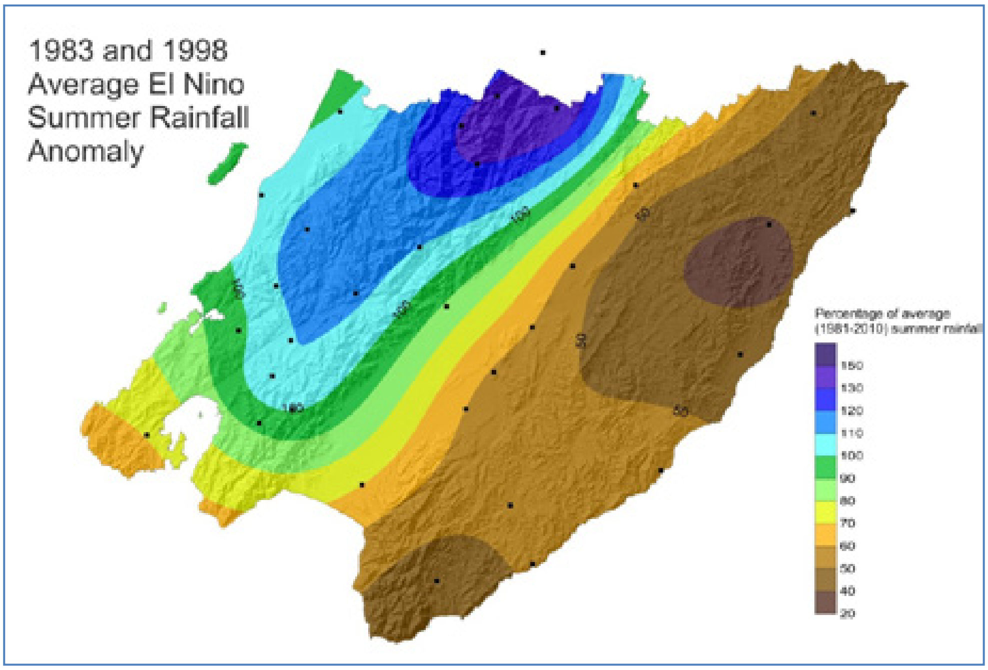


Figure 5.2: Rainfall anomalies observed over the Wellington Region during the previous two strong historical El Niño events (1983 and 1998) with strong resemblance to the current El Niño. As the current ENSO is already showing preliminary signs of decaying (coupled with a very warm Indian Ocean), it would be unlikely that the rainfall deficit for the coming summer would be as severe.

5.2 Summary outlook for summer 2016

Whaitua	**Climate outlook for summer 2016**
Wellington Harbour & Hutt Valley	Temperature: Normal to below normal, higher variability of cool and warm. Rainfall: Normal to below normal.
Te Awarua o Porirua	Temperature: Normal to below normal, higher variability of cool and warm. Rainfall: Normal to below normal
Kapiti Coast	Temperature: Normal to below normal, higher variability of cool and warm Rainfall: Normal
Ruamahanga	Temperature: Higher variability of cool and hot, greater diurnal amplitude Rainfall: Below normal, possibly sitting at one in a 50-year dry summer
Wairarapa Coast	Temperature: Higher variability of cool and hot, greater diurnal amplitude Rainfall: Below normal, possibly sitting at one in a 50-year dry summer

This climate outlook was prepared by the Air and Climate Team of GWRC based on our own expertise, and information provided by NIWA, MetService and international centres such as the International Research Institute for Climate and Society of Columbia university (http://iri.columbia.edu/our-expertise/climate/forecasts/seasonal-climate-forecasts/). This guidance is qualitative only, and GWRC takes no responsibility for the use or accuracy of this information. For more details on long-term climate forecasts at a national level the reader should refer to NIWA in the first instance (https://www.niwa.co.nz/climate/sco)