Climate drivers and seasonal outlook for the Wellington Region

Winter 2023 summary

Spring 2023 outlook

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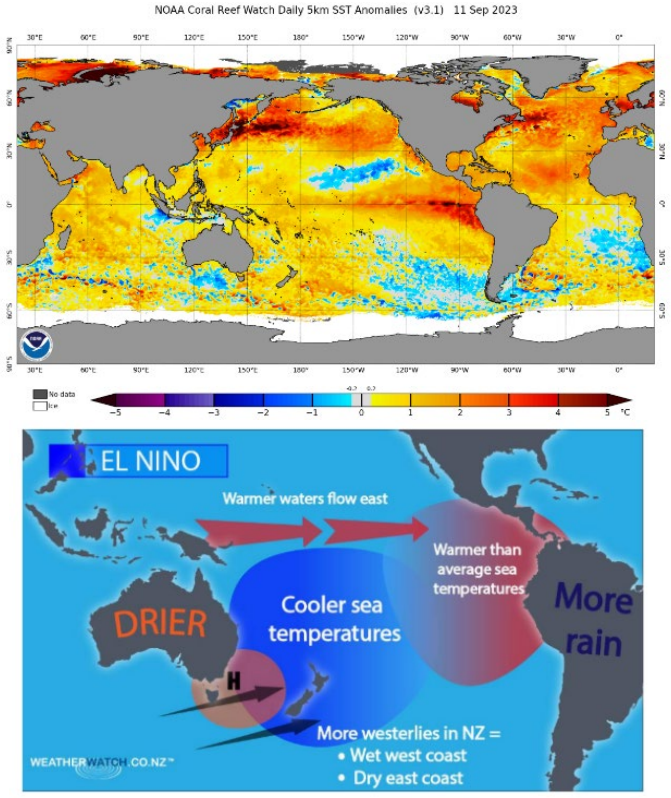
Knowledge and Insights



The Sea Surface Temperature anomalies for 11 September (map on top) show a developing El Niño/Southern Oscillation (ENSO), with warmer than normal surface oceanic water for most of the globe. In the Northern Hemisphere, El Niño helps amplify the global warming signal (see warm equatorial blob in the Eastern Pacific). In Australia and New Zealand, El Niño tends to bring cooler sea temperatures and drier conditions, with an area of high pressure developing over the Tasman Sea (see chart on bottom). If the El Niño turns out to as be strong, we can expect heavier rain in the Southern Alps and a dry signal on the east coast including the Wairarapa. Credits: NOAA/USA and Weather Watch.

Overview

Winter 2023

Winter 2023 was a mixed bag starting with record warmth in June-July progressively turning to colder than average in August. This transition marked a gradual shift from a residual La Niña (with easterly flows) back towards a south-westerly flow regime. Rainfall anomalies were also variable, starting from wet in the east and dry in the west in June-July evolving to dry in the east in August. The total winter rainfall was below average in the west, which helped areas around the capital to recover a little from last year's erosion and slips. Fewer weather extremes affected the region compared to the preceding La Niña winters. Thunderstorms with strong winds and hail started forming from late July and well into August when a colder flow replaced the more stagnant air masses. Very cold daytime temperatures developed around 10 August, with near record low maximum temperatures sitting between 6 and 7 degrees for most of the Wairarapa on that day. The late-winter polar outbreaks were mostly short lived because of the relatively warm ocean, which acts to moderate the Antarctic influences.

Climate drivers

The La Niña phenomenon has now dissipated. For three consecutive years, La Niña has been contributing to marine heatwaves and an unprecedented number of atmospheric river events affecting New Zealand. This has caused countless slips, floods, and much disturbance throughout the country. Climate models are now predicting that the current El Niño could potentially be strong, and with widespread global impacts. For New Zealand, strong El Niño tends to bring persistent south-westerly flows. For our region, the original incoming flow normally often manifests as strong north-westerlies, funnelled and modified by the Tararua ranges.

Climate outlook for spring 2023

With an strengthening El Niño, this season is expected to progress with a strong westerly flow. The incoming winds should induce wetter than average conditions on the west coast and drier conditions east of the ranges. Air and marine temperatures should be closer to the seasonal average west of the ranges, compared to the large warm temperature anomalies and subtropical humidity levels observed during the last few seasons under La Niña. At the same time, the chances of dry heat waves are now increased for the Wairarapa.

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 develop into a potentially strong El Niño. For the spring season, this shift should take us back to persistent westerly and south-westerly flows, which could lead to a progressive drying east of the ranges. After three years of above average rain, some limited drying could help stabilise areas affected by erosion and slips.

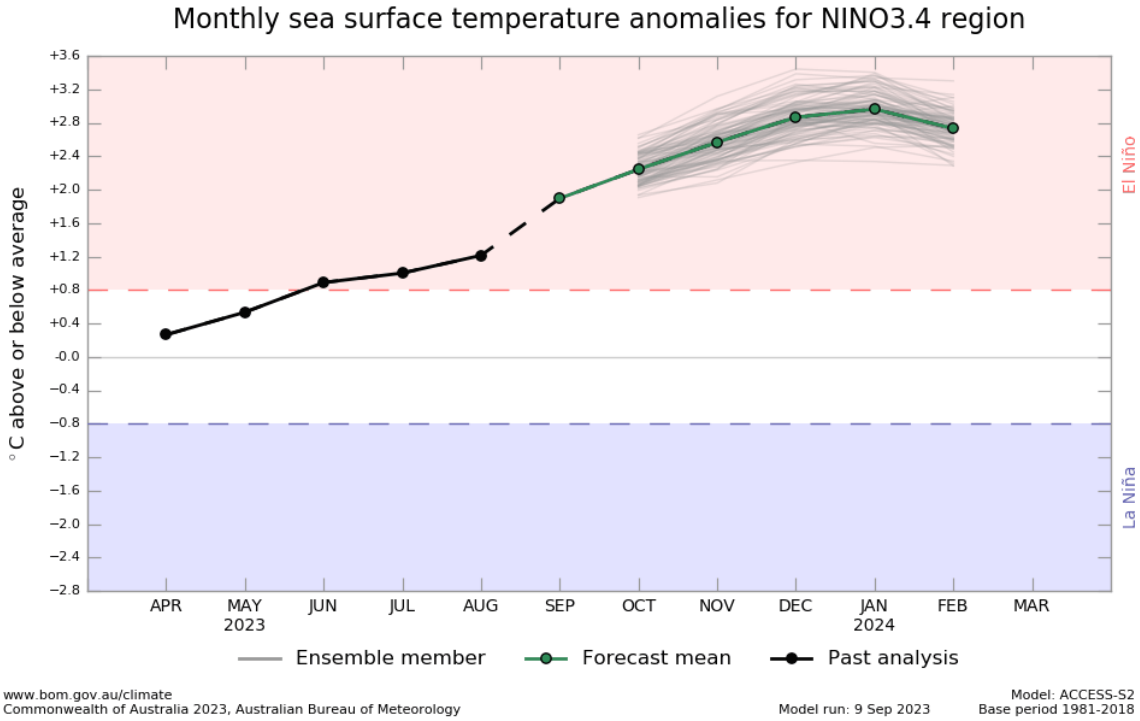


Figure 1.1: Average modelled projections (in green) show that the ENSO phenomenon is expected to develop into a potentially strong El Niño by the end of the year. Source: Australian Bureau of Meteorology.

1.2 Sea Surface Temperature (SST) anomalies

The SST anomalies and the total Sea Ice Extent (SIE, in white) are shown in Figure 1.2, as of 11 September 2023.

The overall pattern shows an increasing El Niño in the Equatorial Pacific (warm water expanding towards the Peruvian coast) with a very warm background ocean surface in the northern Hemisphere. The excess evaporation produced by the warm waters in the Northern Hemisphere is contributing to severe weather events in many countries. Meanwhile, the Sea Ice Extent around Antarctica (in white) remains at the lowest on record for this time of the year.

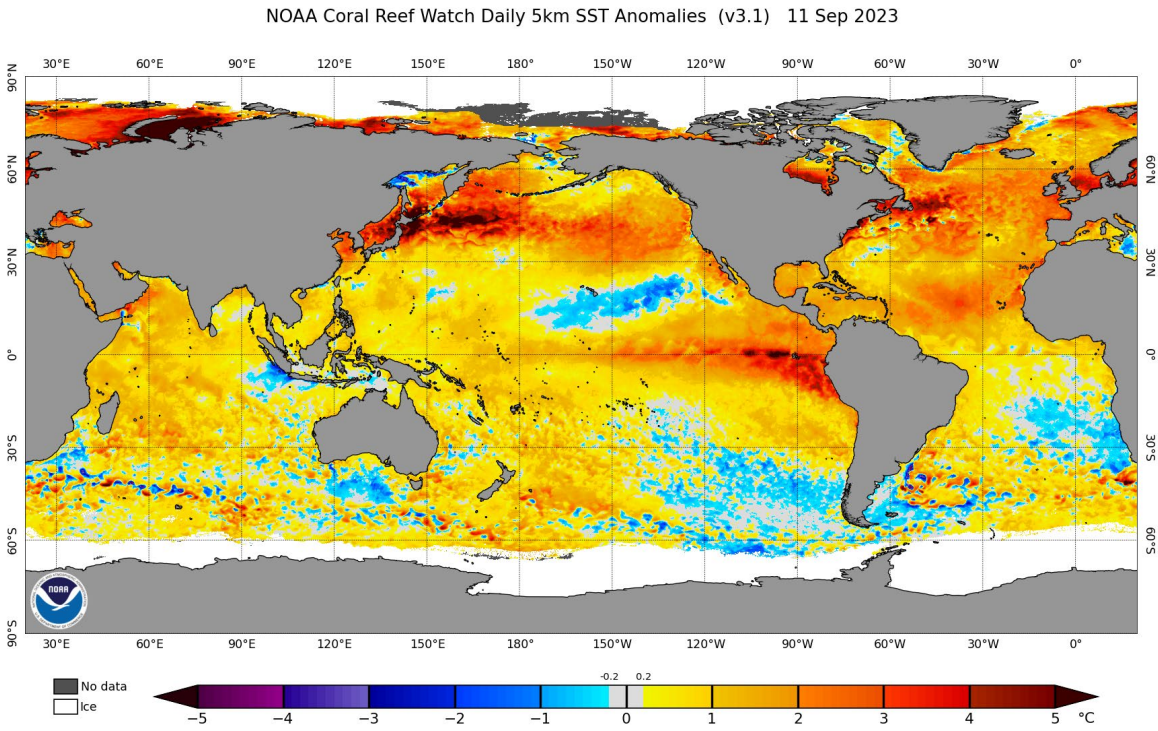


Figure 1.2: Sea Surface Temperature (SST) anomalies as of 11 September 2023. Sea ice coverage is shown in white. The Equatorial Pacific (ENSO) is showing a developing El Niño, with very warm waters for most of the Northern Hemisphere. The Sea Ice Extent remains at the lowest on record for this time of the year, which is typically the time of maximum expansion. 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. During El Niño summers, the SAM tends to become neutral or negative, with a prevailing south-westerly flow around New Zealand. However, when a strong El Niño coincides with a positive SAM, the chances of drought may increase further.

The SAM has been predominantly positive in the long run, even though it has started to oscillate more often between negative and positive since the beginning of the year. Overall, the SAM pattern seems to indicate that the atmosphere is breaking away from the prolonged La Niña pattern of the last three years.

Figure 1.3 shows the winter sea level pressure pattern transitioning towards the return of a prevailing westerly flow, with higher-than-normal pressure developing over the Tasman and lower pressure developing over the Southern Ocean south-west of New Zealand. The largest blocking anticyclone to the bottom-right corner of the map has been moving progressively away from New Zealand.

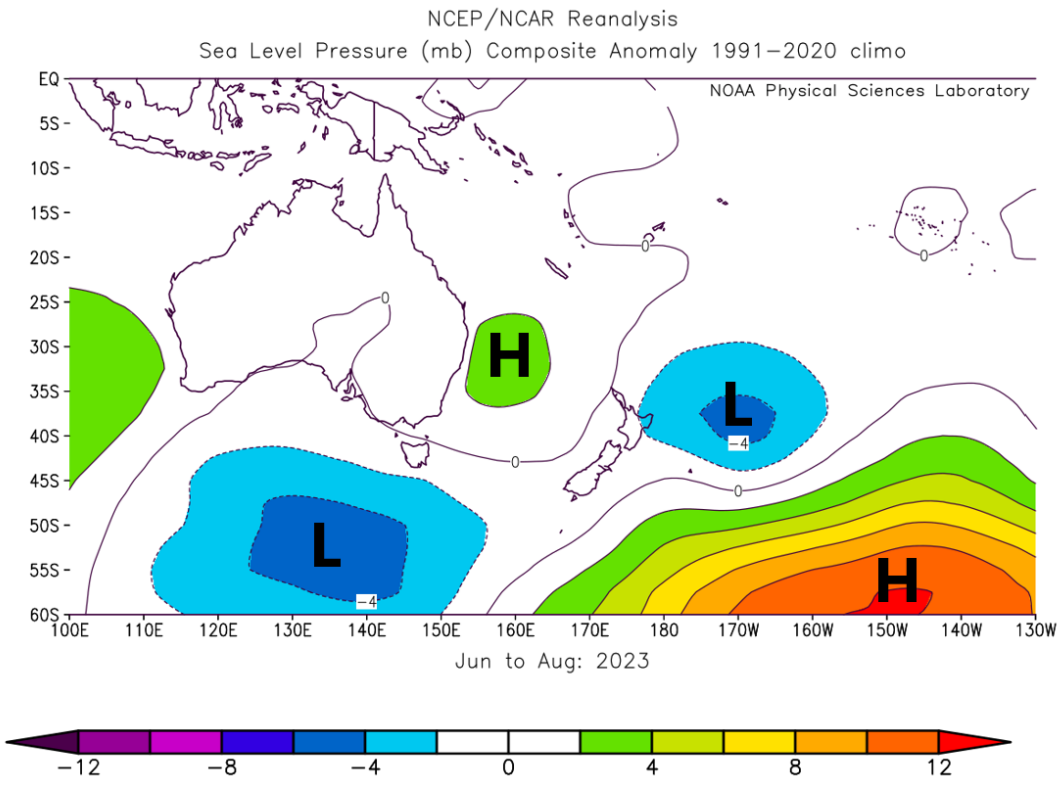


Figure 1.3: Mean Sea Level Pressure anomaly map (hPa) for winter 2023. The 'H' is the centre of the anomalous blocking high pressure area to the south-east of New Zealand (now moving away), and the 'L' shows the anomalous unstable low-pressure areas with colder air. This pattern was associated with a diminishing La Niña and a variable Southern Annular Mode, shifting towards an increased westerly flow. Higher than normal pressure is starting to develop over the Tasman Sea. This will help strengthen the westerlies. Source: NCEP Reanalysis.

2. Seasonal variability and outlook

2.1 Trend analysis

The graphs below (Figure 2.1) 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 and does not allow for an analysis of trends.

The red and blue bars show the extreme years of the entire measurement period. Red indicates seasons that were warmer, drier, sunnier and less windy than average (i.e., extreme hot/dry), and blue indicates seasons that were colder, wetter, cloudier and windier than average (i.e., extreme cold/wet). The reference climatological average (1981-2020) is shown by a horizontal bar where available.

An analysis of linear trends associated with climate change is plotted onto the graph only when the trends are statistically different from zero at the 99% confidence level.

The climate change and variability summary for winter 2023 is as follows:

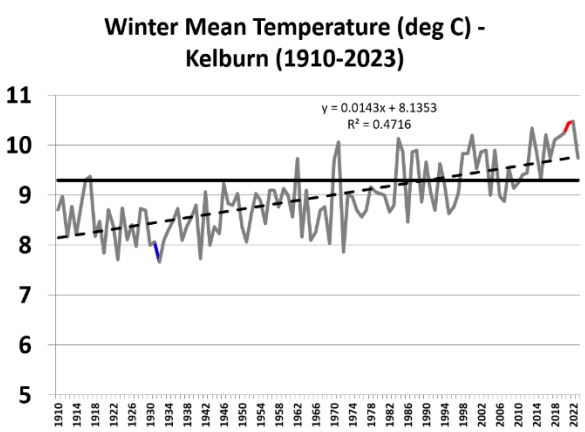
- Statistically significant trends are seen only for temperature, meaning that winter is getting significantly warmer due to ongoing climate change. The long-term warming trend is about 1.4 degrees per century for both Wellington and Masterton.

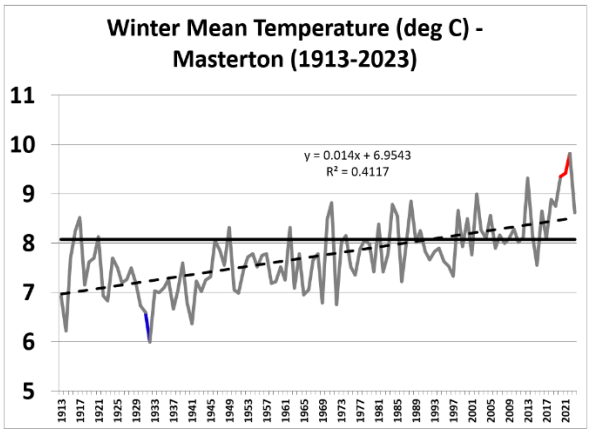
- Winter 2023 temperatures were above average for both Wellington and the Wairarapa, but not as anomalous as last year. The last time the winter temperature was average or colder than average in our region was in 2015.

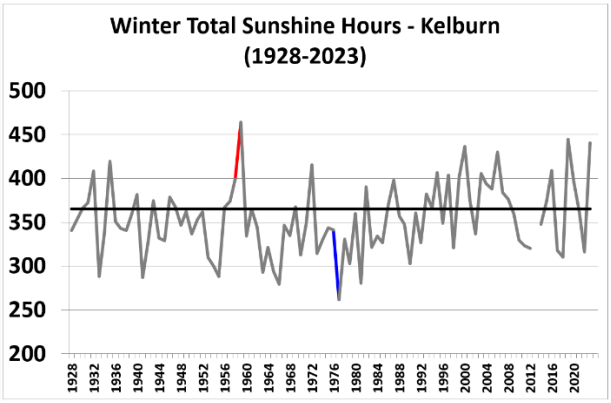
- Sunshine hours were above average, and the seasonal average wind speed was well below average, for Wellington.

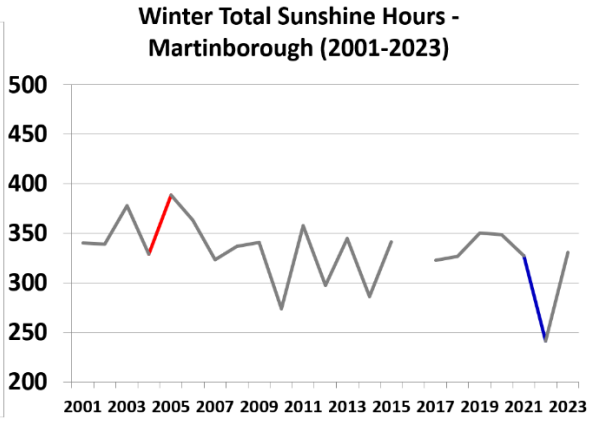
- Rainfall was below average in Wellington, and average in the Wairarapa.

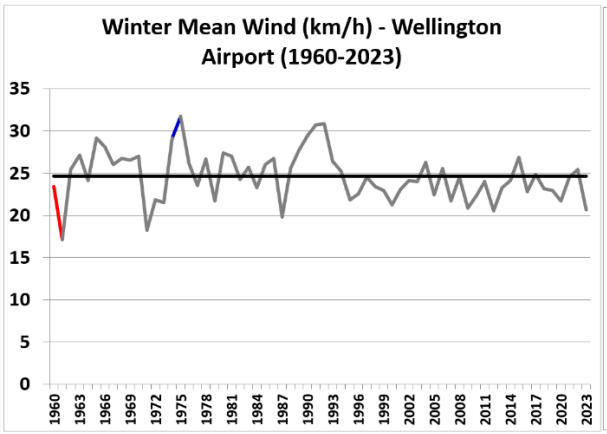
- Rain days were near average for both Wellington and Wairarapa.

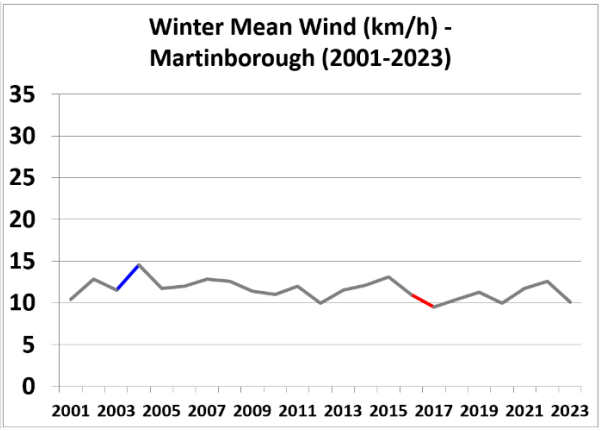

Winter Mean Temperature (deg C) - Kelburn (1910-2023)
y = 0.0143x + 8.1353
R² = 0.4716


Winter Mean Temperature (deg C) - Masterton (1913-2023)
y = 0.014x + 6.9543
R² = 0.4117


Winter Total Sunshine Hours - Kelburn (1928-2023)


Winter Total Sunshine Hours - Martinborough (2001-2023)


Winter Mean Wind (km/h) - Wellington Airport (1960-2023)


Winter Mean Wind (km/h) - Martinborough (2001-2023)

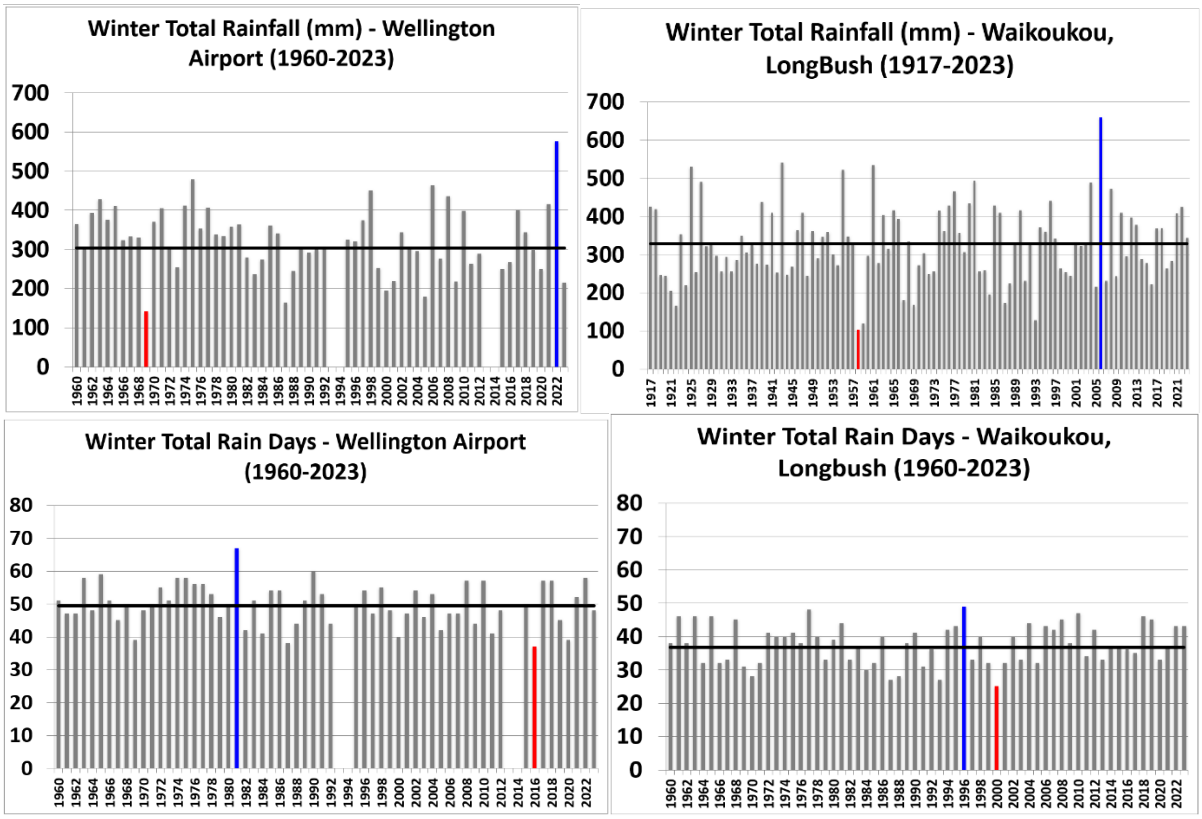


Figure 2.1: Climate change and variability graphs for winter in Wellington and the Wairarapa. The thick horizontal line shows the 1981-2010 average (where available), and the dashed line shows the linear trend. Trends are plotted only when statistically significant at 99% confidence level. For all graphs, 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 season.

2.2 Seasonal Outlook

- A warm Equatorial Pacific evolving to a potentially strong El Niño. Progressive strengthening south-westerly flows for New Zealand.
- Local Sea Surface Temperatures returning to closer to average in response to the strengthening westerlies.
- Wetter on the west coast and drier east of the ranges, with high likelihood of extreme rainfall events.
- Average or above average temperatures, but cooler west of the ranges and less 'tropical' compared to the La Niña experience of the last few years.
- Higher than normal chance of heat waves in the Wairarapa.

Whaitua*	Variables	Climate outlook for spring 2023**
Wellington Harbour & Hutt Valley	**Temperature:**	Average or above average
	Rainfall:	Near average with low confidence. High chance of extreme rainfall and westerly gusts
Te Awarua-o-Porirua	**Temperature:**	Average or above average
	Rainfall:	Near average with low confidence. High chance of extreme rainfall and westerly gusts
Kāpiti Coast	**Temperature:**	Average or above average
	Rainfall:	Average or above average with moderate confidence. High chance of extreme rainfall and westerly gusts
Ruamāhanga	**Temperature:**	Above average
	Rainfall:	Below average with moderate confidence. Stronger westerly flow
Wairarapa Coast	**Temperature:**	Above average
	Rainfall:	Below average with moderate confidence. Stronger westerly flow

*Whaituas are the whole catchment areas (https://www.gw.govt.nz/environment/freshwater/protecting-the-waters-of-your-area/).

**Refer also to the drought monitor for our catchments: https://www.gw.govt.nz/environment/environmental-data-hub/climate-monitoring/drought-check/

Appendix 1 – Seasonal temperature and wind anomalies for selected stations

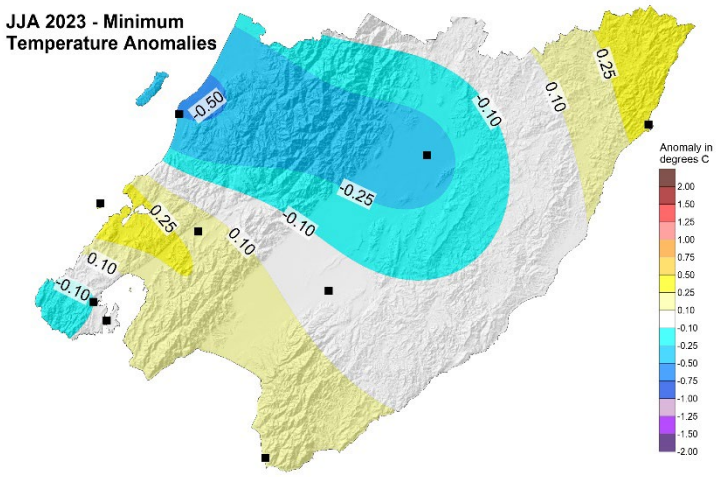
Jun-Jul-Aug 2023	Min T	Max T
Castlepoint	**0.3**	**0.4**
Kelburn	**-0.1**	**0.5**
Masterton	**-0.3**	**0.2**
Ngawi	**0.2**	**0.9**
Paraparaumu	**-0.5**	**0.9**
Wellington Airport	**0.0**	**0.7**
Martinborough	**0.0**	**0.8**
Mana Island	**0.4**	**0.9**
Upper Hutt	**0.2**	**0.8**
Greta Point	**0.5**	**0.8**

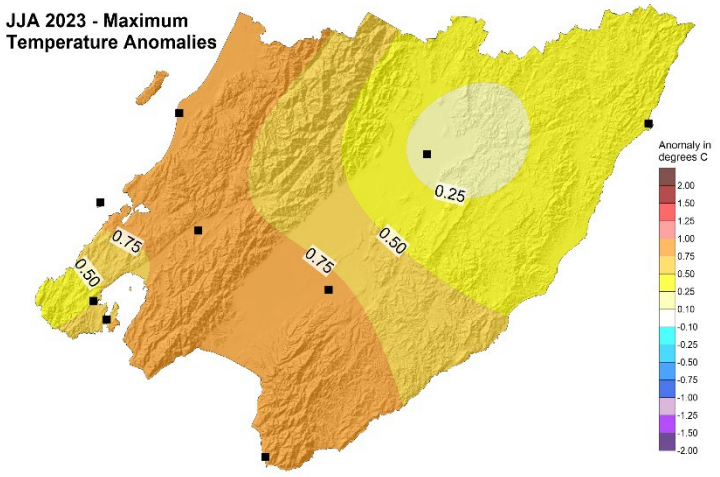
Table 1: Temperature anomalies (°C) for winter (JJA) 2023 relative to the 1991-2020 climatology. Positive and negative anomalies (greater than 0.5°C magnitude) are highlighted in red (warmer than average) and blue (colder than average).

Jun-Jul-Aug 2023	Wind %
Castlepoint	**-6.5**
Masterton	**-16.3**
Ngawi	**-11.6**
Paraparaumu	**-16.7**
Wellington Airport	**-16.3**
Martinborough	**-15.3**
Baring Head	**-13.9**

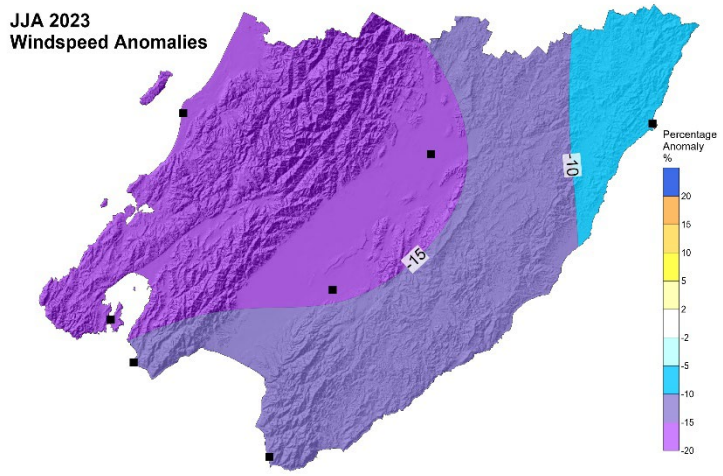
Table 2: Wind anomalies (%) for winter (JJA) 2023 relative to the 1981-2010 climatology. Strong positive and negative anomalies (greater than 10%) are highlighted in red (calmer than average) and blue (windier than average).

Appendix 2 - Seasonal anomaly maps relative to the long-term average (1991-2020)

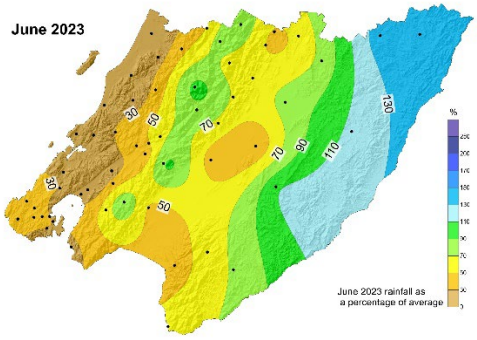


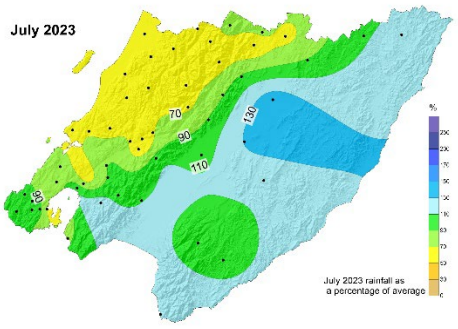


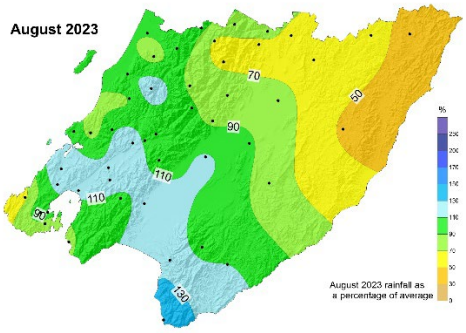
Min and Max Temperature anomalies (°C)

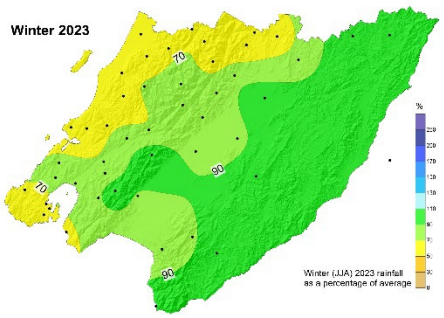


Wind anomalies (%)









Rainfall anomalies (%)

GWRC's climate tools

- **Seasonal climate hub**
  https://www.gw.govt.nz/environment/environmental-data-hub/climate-monitoring/

- **Daily climate maps**
  graphs.gw.govt.nz/#dailyClimateMaps

- **Drought Monitor**
  https://www.gw.govt.nz/environment/environmental-data-hub/climate-monitoring/drought-check/

- **Climate change impacts (reports and mapping tools)**
  https://www.gw.govt.nz/environment/climate-change/impacts-on-our-region/