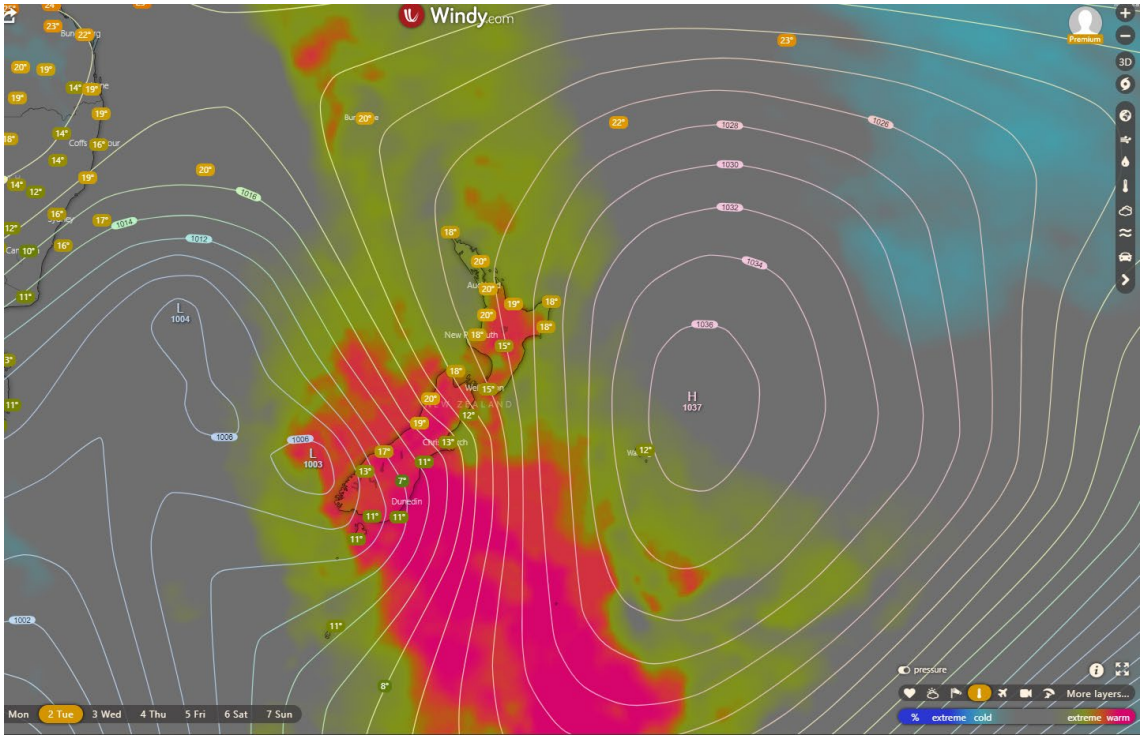
Climate drivers and seasonal outlook for the Wellington Region

Autumn 2023 summary

Winter 2023 outlook

Release date: 27 June 2023

Knowledge and Insights



While March and April were relatively uneventful in our region, May was the warmest on record for New Zealand as a whole and for both Wellington and the Wairarapa separately. An unseasonal warm spell at the beginning of May saw a blocking anticyclone pushing subtropical warm air towards the region and the South Island, with Martinborough hitting almost 24 degrees on 8 May. On the map, courtesy of windy.com, one can see the extreme unseasonal warm temperatures marked in red for 2 May, with the anticyclone to the east of the country.

Overview

Autumn 2023

Autumn 2023 was wet and balmy in most of the region, but especially in the west. It was the second warmest autumn on record for both Paraparaumu and Ngawi. The autumn night-time mean temperatures in Masterton were the highest on record for data since 1906, with an impressive near three degrees above average. The constant inflow of moist easterly air kept a thick layer of cloud cover active for most days in the Wairarapa, preventing the minimum temperatures to drop to near seasonal levels. A warm spell in the first half of May produced summer-like temperatures, with 23 degrees in the Kāpiti Coast and 24°C in the Wairarapa. The total seasonal rainfall was the third highest on record for the Kāpiti Coast.

Climate drivers

The La Niña phenomenon has now dissipated. For three consecutive years, La Niña has been contributing to marine heatwaves and an unprecedented abundance of atmospheric river events affecting New Zealand. International climate models are now predicting a somewhat abrupt shift to El Niño, even though the atmosphere has still been 'locked' into blocking patterns bringing north-easterly flows and moist warm air masses typical of La Niña years for New Zealand.

Climate outlook for winter 2023

With the imminent formation of a new El Niño, the atmosphere should progressively re-adjust back to south-westerly flows, with the slow return of sea surface temperatures to closer to normal values by early spring. Most international climate models are currently diverging in how quickly this change will play out, and winter should continue to see a mixture between easterly and westerly flows. Based on the various drivers, we are expecting average to above normal temperatures and near normal rainfall for winter, with low confidence for the rainfall totals.

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

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 shift from residual La Niña/neutral to El Niño. For the winter season, this shift implies a gradual adjustment of the atmosphere back to cooler conditions, with a return of drier westerly and south-westerly flows.

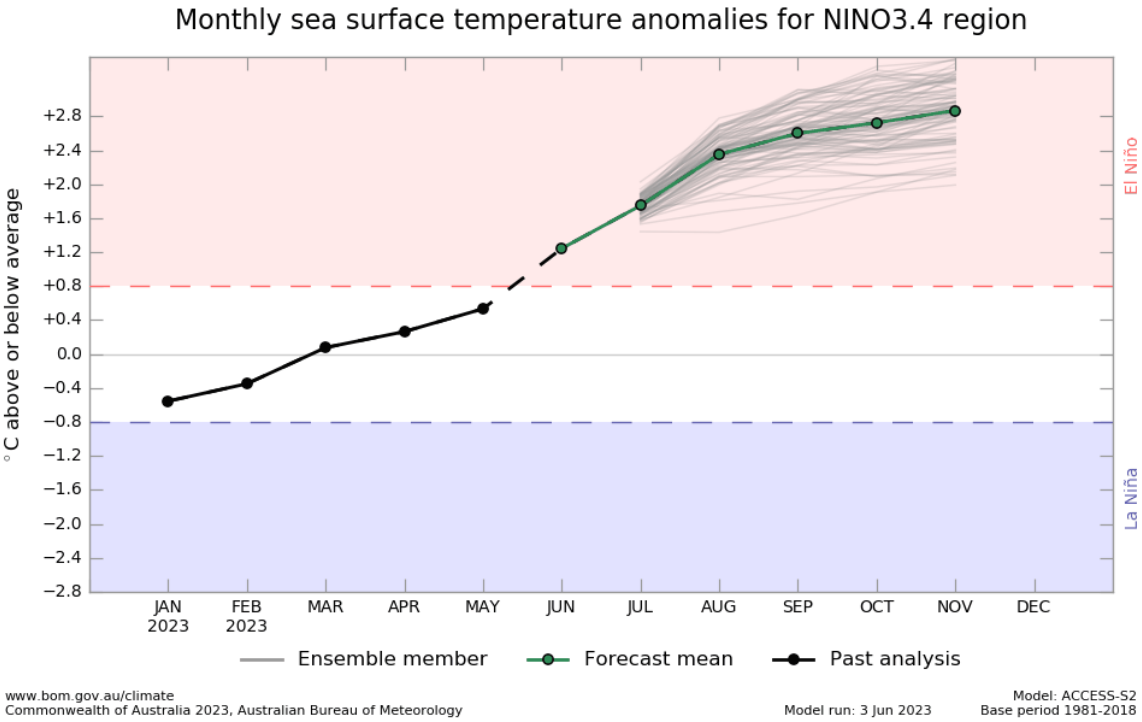


Figure 1.1: Average modelled projections (in green) show that the ENSO phenomenon is expected to progressively shift towards the positive phase by the second half of the year.
Source: Australian Bureau of Meteorology.

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 18 June 2023.

The overall pattern shows an emerging El Niño in the Equatorial Pacific (warm tongue expanding westwards from the Peruvian coast). Meanwhile, the waters remain warmer than average around New Zealand, even though El Niño will tend to induce cooler waters for New Zealand. The SIE (in white) remains at the lowest on record levels for this time of the year.

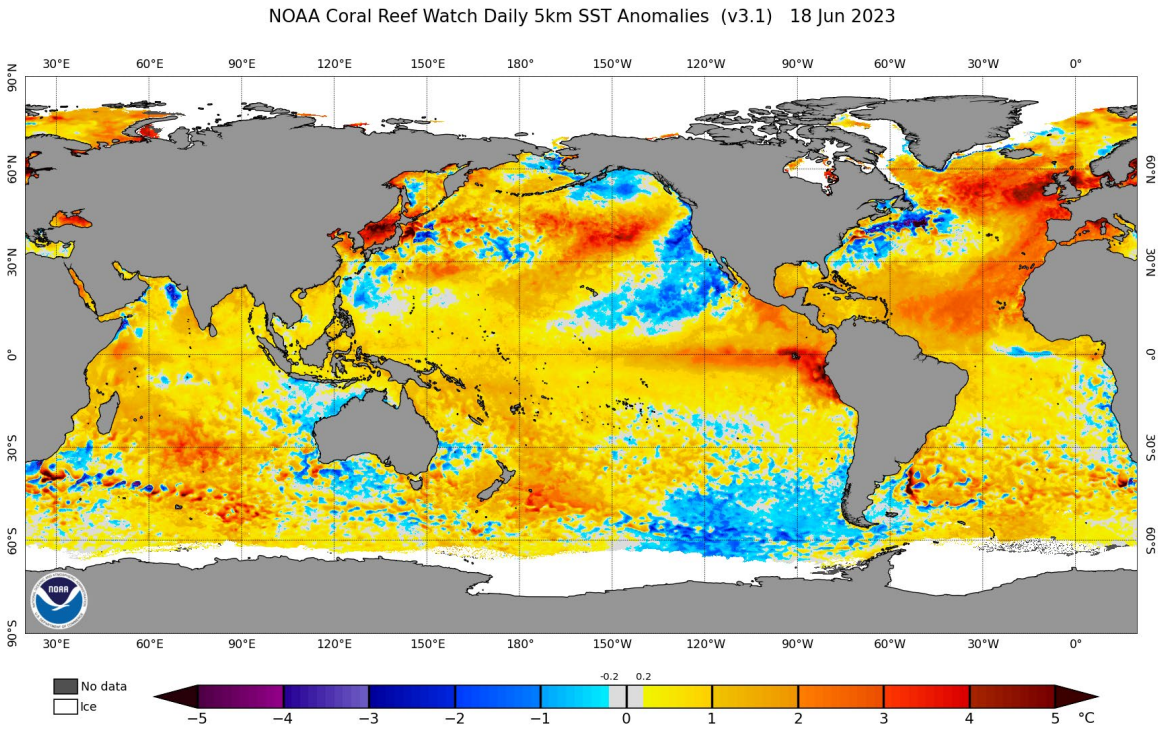


Figure 1.2: Sea Surface Temperature (SST) anomalies as of 18 June 2023. Sea ice coverage is shown in white. Water temperatures east of New Zealand are well above average. The Equatorial Pacific (ENSO) is showing a developing El Niño. The Sea Ice Extent (in white) remains at the lowest on record for this time of the year. 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 La Niña summers, the dryness associated with the positive SAM phase tends to be centred most strongly to the west of the South Island.

The SAM has been predominantly positive in the long run, even though it started to oscillate more between negative and positive over autumn, perhaps hinting that the atmosphere is slowly starting to break away from the prolonged La Niña easterly pattern. The combination of a positive SAM and La Niña, with background global warming escalating the ocean temperatures and the likelihood of marine heatwaves around New Zealand, has created perfect conditions for ongoing record-breaking warmth. May was the warmest on record and autumn was the second warmest on record for our region.

Figure 1.3 shows that the autumn sea level pressure pattern was characterised by a combination of an anomalous low pressure to the south-west and a high-pressure centre to the south-east of New Zealand. This pattern saw the beginning of a slow transition towards the return of a more westerly flow, even though it reverted to a La Niña blocking pattern with easterly flows in June.

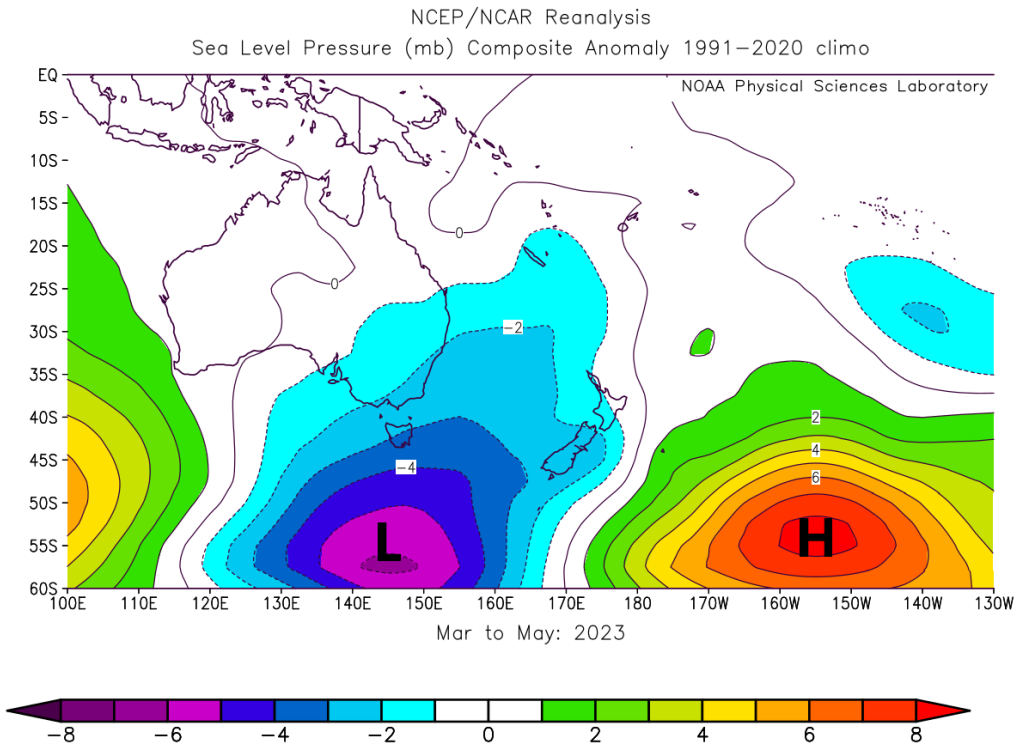


Figure 1.3: Mean Sea Level Pressure anomaly map (hPa) for autumn 2023. The 'H' indicates the centre of the anomalous blocking high pressure area to the south-east of New Zealand, and the 'L' indicates the anomalous unstable low-pressure area to the south-west. This pattern was associated with a diminishing La Niña and a variable Southern Annular Mode, with a predominant warm and moist north-easterly flow over New Zealand. 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 autumn 2023 is as follows:

- Statistically significant trends are seen only for temperature, meaning that autumn is getting significantly warmer due to ongoing climate change. The long-term warming trend is about 1.1 and 1.0 degree per century for Wellington and Masterton respectively

- Autumn 2023 temperatures were well above average for both Wellington and the Wairarapa. The last time autumn was cooler than average was in 2017 for the Wairarapa and in 2012 for Wellington

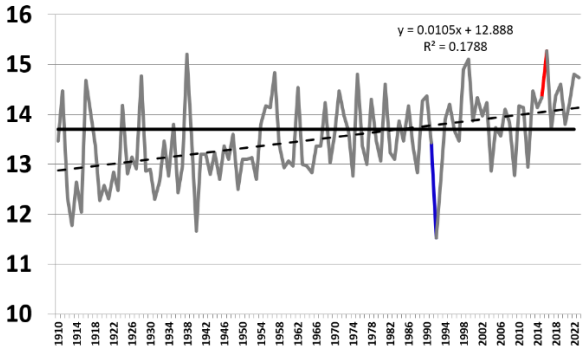
- Sunshine hours were below average for both Wellington and the Wairarapa. This was more marked in the Wairarapa, as a result of the easterly flow maintaining a thick cloud layer during most of the time

- Seasonal average wind speed was below average in Wellington

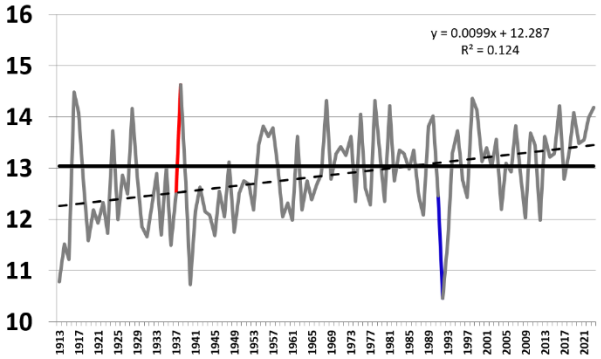
- Rainfall was well above average in Wellington, and above average in the Wairarapa

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

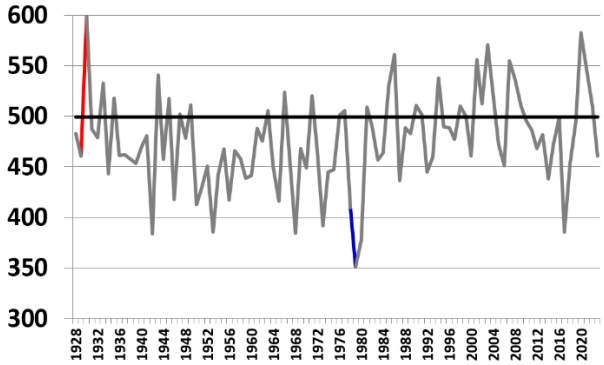
Autumn Mean Temperature (deg C) - Kelburn (1910-2023)



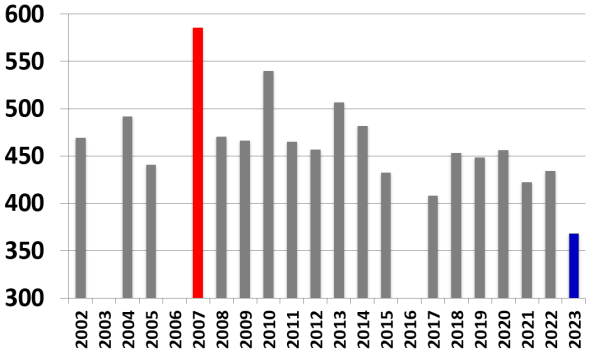
Autumn Mean Temperature (deg C) - Masterton (1913-2023)



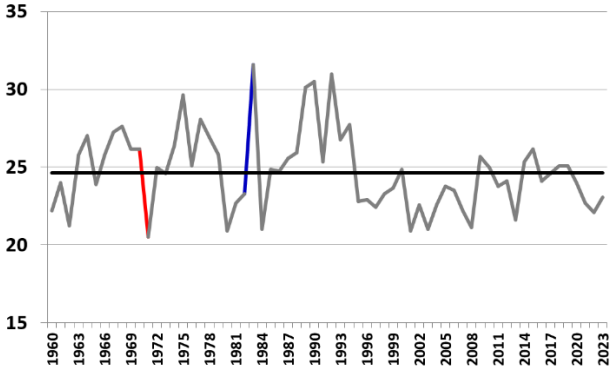
Autumn Total Sunshine Hours - Kelburn (1928-2023)



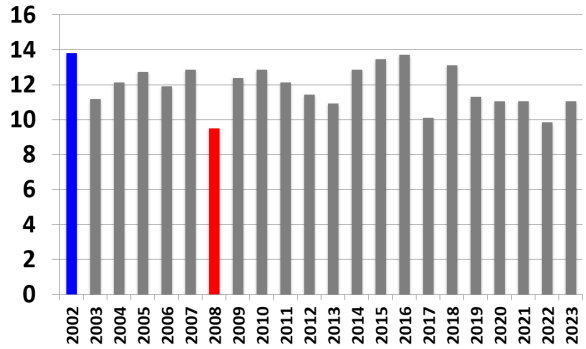
Autumn Total Sunshine Hours - Martinborough (2002-2023)



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



Autumn Mean Wind (km/h) - Martinborough (2002-2023)



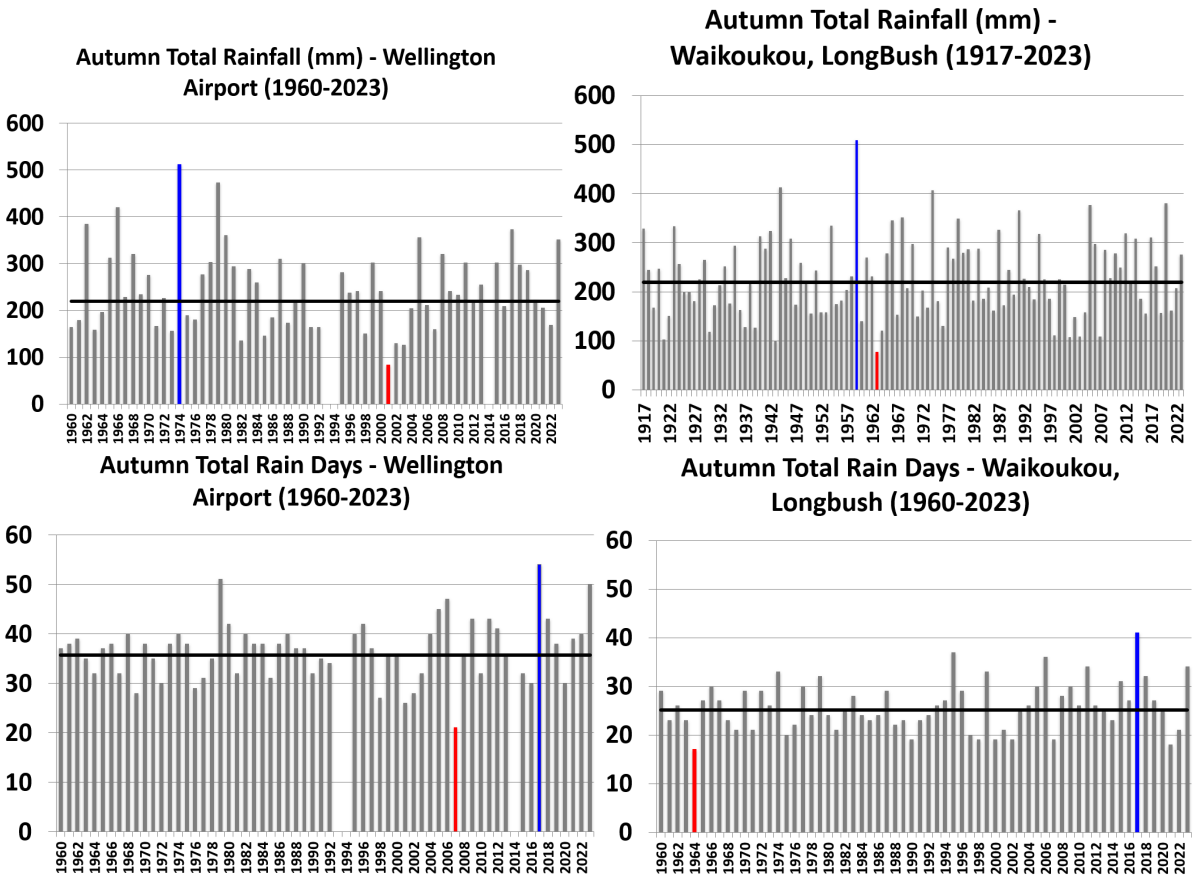


Figure 2.1: Climate change and variability graphs for autumn in Wellington and the Wairarapa. The thick horizontal line shows the 1981-2010 average (where available), and the dashed line shows the linear trend. Trends are plotted only when statistically significant at 99% confidence level. For all graphs, 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 year. The last bar (or data point) of each graph shows the last available data for the currently analysed season, unless there are missing data.

2.2 Seasonal Outlook

- A positive ENSO evolving to El Niño, with a progressive return of cooler westerly and south-westerly flows as winter progresses
- Sea Surface Temperatures remain warmer than average for now, but will likely start to return to a more normal range towards spring
- Closer to average seasonal rainfall, with high likelihood of extreme rainfall events (low confidence for total seasonal accumulation)
- Average to above normal temperatures, with colder outbreaks more likely occurring later in the season

Whaitua*	Variables	Climate outlook for winter 2023
Wellington Harbour & Hutt Valley	**Temperature:**	Average to above.
	Rainfall:	About average with low confidence. High chance of extreme rainfall events.
Te Awarua-o-Porirua	**Temperature:**	Average to above.
	Rainfall:	About average with low confidence. High chance of extreme rainfall events.
Kāpiti Coast	**Temperature:**	Average to above.
	Rainfall:	About average with low confidence. High chance of extreme rainfall events.
Ruamāhanga	**Temperature:**	Average to above.
	Rainfall:	About average with low confidence. High chance of extreme rainfall events.
Wairarapa Coast	**Temperature:**	Average to above.
	Rainfall:	About average with low confidence. High chance of extreme rainfall events.

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

Appendix 1 – Seasonal temperature and wind anomalies for selected stations

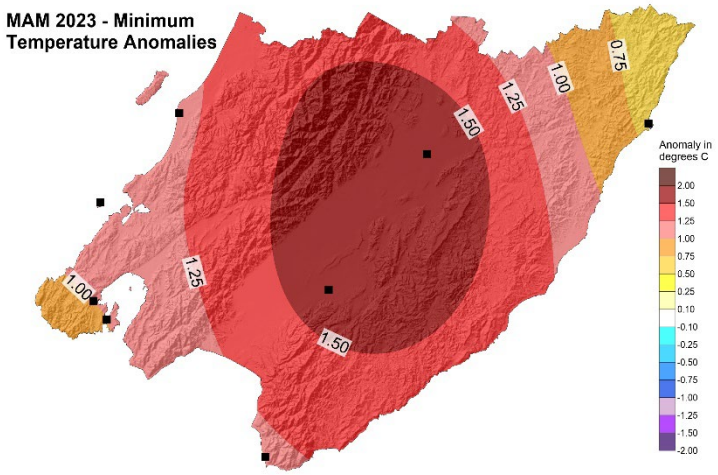
Mar-Apr-May 2023	Min T	Max T
Castlepoint	**0.7**	**0.3**
Kelburn	**1.0**	**0.8**
Masterton	**1.7**	**-0.1**
Ngawi	**1.2**	**1.1**
Paraparaumu	**1.2**	**1.2**
Wellington Airport	**1.0**	**0.9**
Martinborough	**1.6**	**0.6**
Mana Island	**1.1**	**1.3**

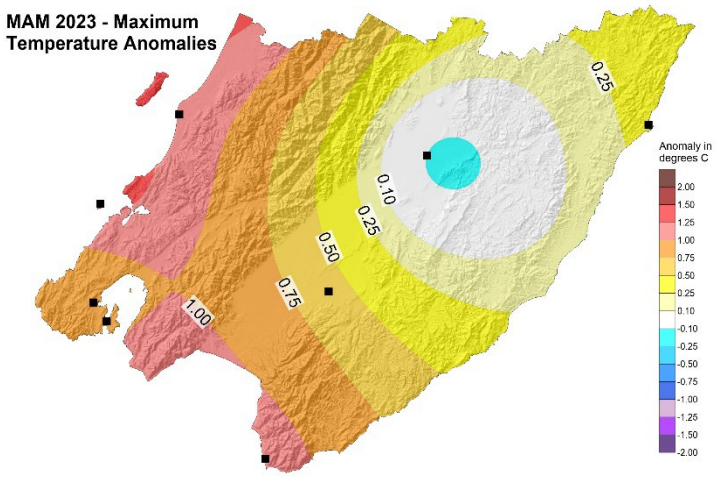
Table 1: Temperature anomalies (°C) for autumn (MAM) 2023 relative to the 1991-2020 climatology. Relevant positive and negative anomalies (greater than 0.5°C magnitude) are highlighted in red (warmer than average) and blue (colder than average).

Mar-Apr-May 2023	Wind %
Castlepoint	**-7.2**
Masterton	**4.7**
Ngawi	**8.1**
Paraparaumu	**-6.0**
Wellington Airport	**-6.3**
Martinborough	**-8.5**
Baring Head	**-10.1**

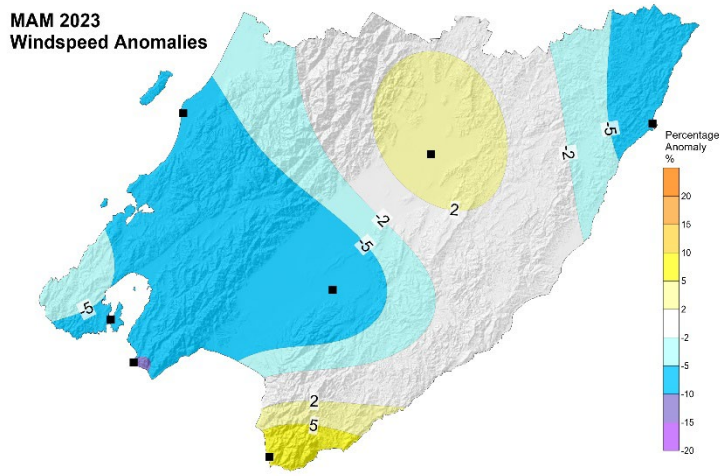
Table 2: Wind anomalies (%) for autumn (MAM) 2023 relative to the 1981-2010 climatology. Strong positive and negative anomalies (greater than 10%) are highlighted in red (calmer than average) and blue (windier than average).

Appendix 2 - Seasonal anomaly maps in relation to the (1991-2020) long-term averages

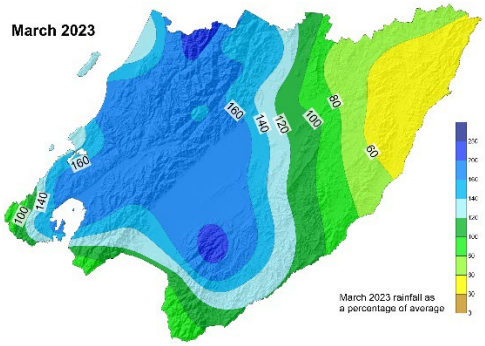


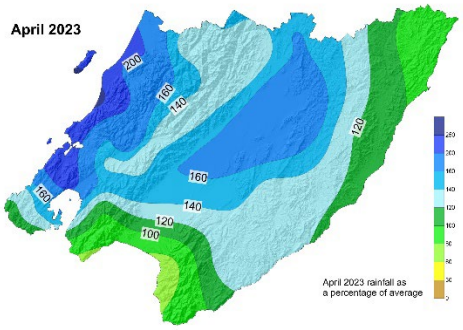


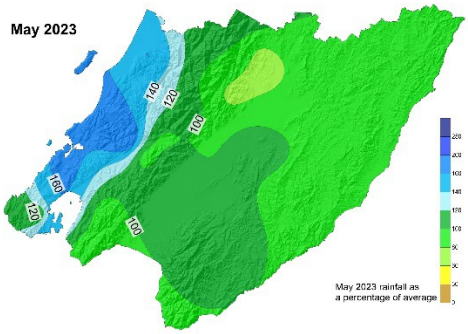
Min and Max Temperature anomalies (°C)

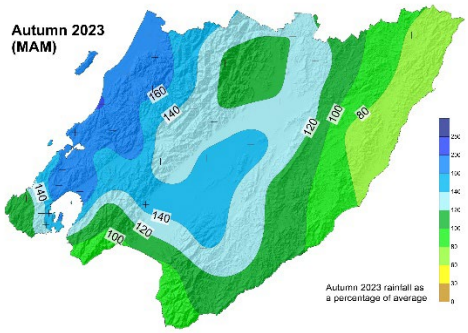


Wind anomalies (%)









Rainfall anomalies (%)

Online resources

GWRC online climate mapping tools:

- **Live regional climate maps and rainfall tables (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:** https://www.gw.govt.nz/environment/environmental-data-hub/climate-monitoring/drought-check/
- **Interactive climate change and sea level rise 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 provided by NIWA: https://mapping1.gw.govt.nz/gw/ClimateChange/

Key Reports:

- **Main climate change report (NIWA 2017)**

https://www.gw.govt.nz/assets/Documents/2017/06/Climate-Change-and-Variability-report-Wlgtn-Regn-High-Res-with-Appendix.pdf

- **Main climate drivers report (Climate Modes) (NIWA 2018)**
  https://www.gw.govt.nz/assets/Documents/2021/10/GWRC-climate-modes-full-report-NIWA-3-Sep-2018-compressed.pdf

- **Climate change extremes report (NIWA 2019)**

https://www.gw.govt.nz/assets/Documents/2021/11/GWRC-NIWA-climate-extremes-FINAL3.pdf

Climate Portals

- **GWRC Climate change impacts webpage**

https://www.gw.govt.nz/environment/climate-change/impacts-on-our-region/

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