Climate drivers and seasonal outlook for the Wellington Region

Autumn 2024 summary

Winter 2024 outlook

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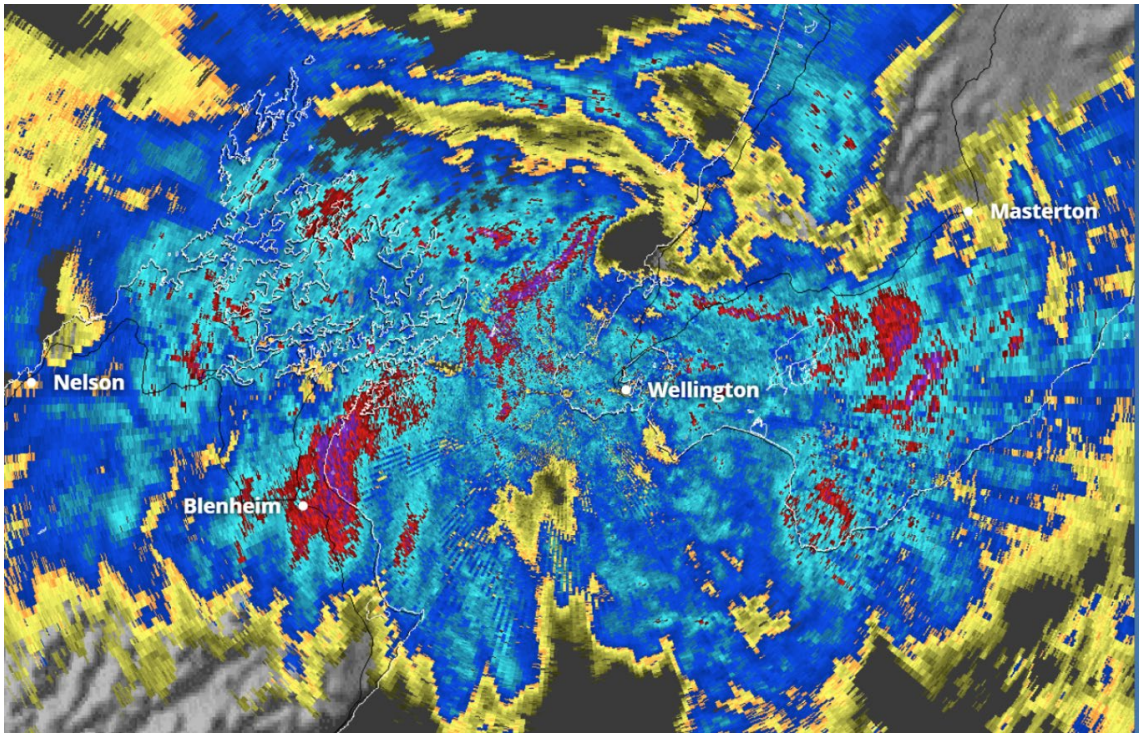
Knowledge and Insights



Even though the region had an overall dry summer and autumn, the weather patterns were very unusual compared to normal El Niños of the past. In both January and February, severe thunderstorms formed over the Tararua Ranges and Wairarapa. These thunderstorms helped prevent the overall dryness from becoming too extreme. Early in May, an upper-level westerly trough brought much needed rain for both Wellington and southern Wairarapa. Kelburn measured 82 mm in about 12 hours, with the daily total rainfall measured in the morning of 2 May being the third highest on record since 1928.

The map shows the radar image of the storm affecting Wellington and southern Wairarapa at 11:22pm on 1 May 2024. At that time, possible thunderstorms centred around Martinborough (in red). Source: MetService.

Overview

Autumn 2024

Autumn 2024 was still affected by El Niño impacts, with drier than normal conditions in most of the Wellington Region, especially towards the northern half of the region. Temperatures were below average in most areas in a surprisingly uniform pattern. Both Wellington and Wairarapa had the coldest autumn since 2012. Therefore, this was the coldest autumn in 12 years, by a relatively large margin. The drying effects from El Niño were unusual, and the Kāpiti coast, which normally doesn't get affected, had the second driest autumn on record. In relative terms, this anomaly was more remarkable than the Wairarapa, which greatly benefited from a significant easterly rainfall event in the second half of May.

Climate drivers

The El Niño has dissipated and a new La Niña is expected to emerge by late winter. It is still early to predict at this stage how strong La Niña will be, and if the impacts on New Zealand will lead once again to a pattern of slips and floods, as seen during the preceding La Niña. As the oceanic waters remain warmer than average to the north of New Zealand, overall, the atmosphere remains more conducive to extreme weather events.

Climate outlook for winter 2024

With a returning winter La Niña, the global atmosphere will now gradually undergo a considerable 're-adjustment'. However, the climate effects of this significant change will likely start manifesting only later in the year around New Zealand. Contrary to previous years, we are expecting winter patterns to be much closer to average, with a normal south-westerly flow alternating with a few possible easterly events. Both temperatures and rainfall should be close to the seasonal average, but the likelihood of extreme weather events and unseasonal spells remains higher than normal with a background of warm oceanic temperatures. There is a chance that rainfall will remain below average in the eastern Wairarapa, while the atmosphere gradually re-adjusts away from El Niño conditions.

Contents

1. Climate drivers

1.1 El Niño – Southern Oscillation (ENSO)

The ensemble projections of the Australian climate model below show that a new La Niña is expected to form during winter. However, as noted by the Australian Bureau of Meteorology, it's still too early to know if this event will be strong and impactful due to large model uncertainty.

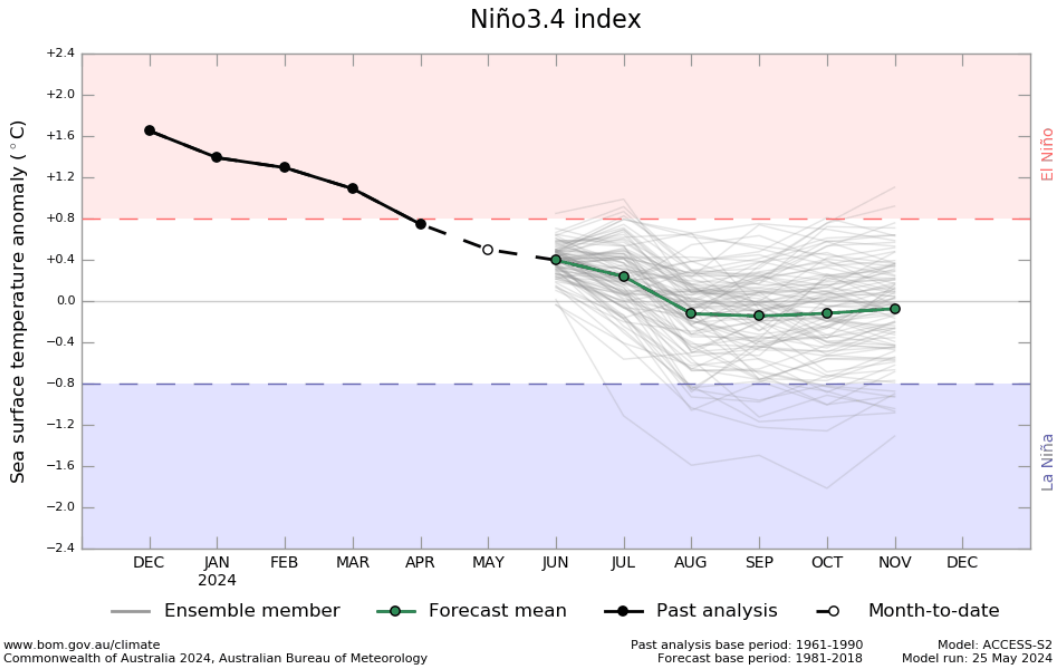


Figure 1.1: Average modelled projections (in green) show that the ENSO phenomenon is expected to turn to La Niña during winter. Source: Australian Bureau of Meteorology.

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 5 June 2024.

The overall pattern shows an emerging new La Niña, with a cold tongue now extending well into the central Equatorial Pacific. Meanwhile, the oceans remain warmer than average around New Zealand but colder to the south. The SIE (in white) remains below average, slightly less anomalous to what was observed last year.

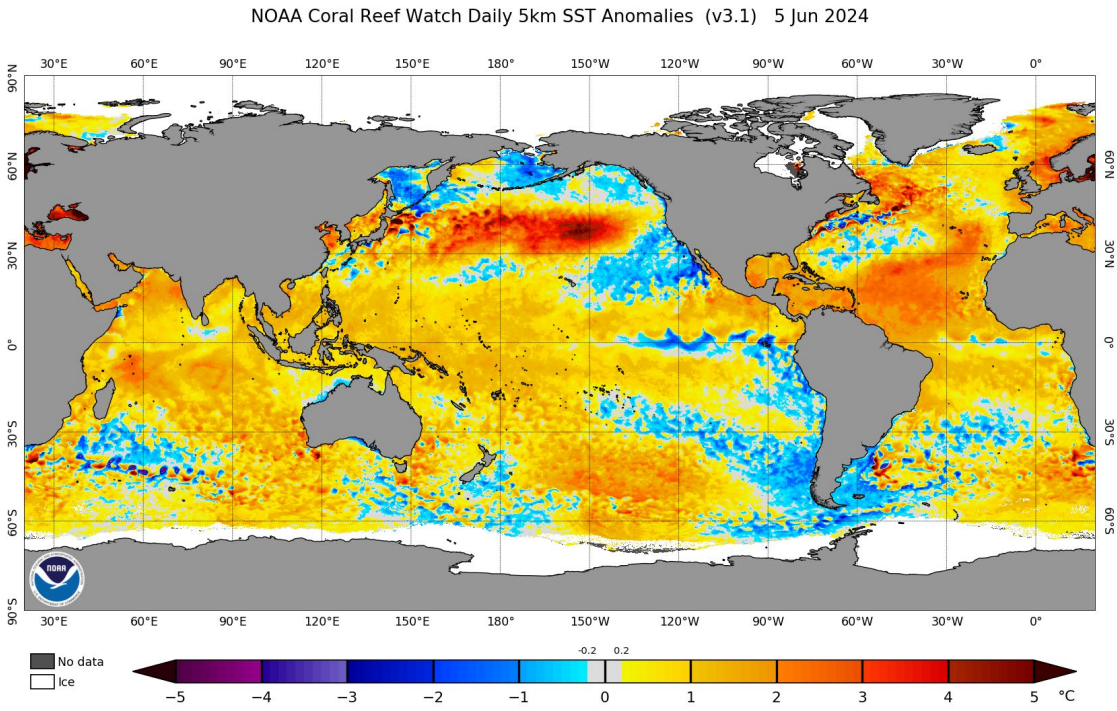


Figure 1.2: Sea Surface Temperature (SST) anomalies as of 5 June 2024. Sea ice coverage is shown in white. Water temperatures south of New Zealand are now colder than average, but warmer than average waters remain elsewhere around the country. The Equatorial Pacific (ENSO) shows an emerging new La Niña. The Sea Ice Extent (in white) reached very low levels once again at the end of the season. 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 negative.

The SAM has been predominantly positive over the warm season, which has contributed to the build-up of progressively drier conditions throughout our region. Figure 1.3 shows that the autumn sea level pressure pattern was characterised by an anomalous high pressure south of Australia. Although far from New Zealand, this pattern combined with lower pressure to the south and led to enhanced westerly flow particularly over the South Island.

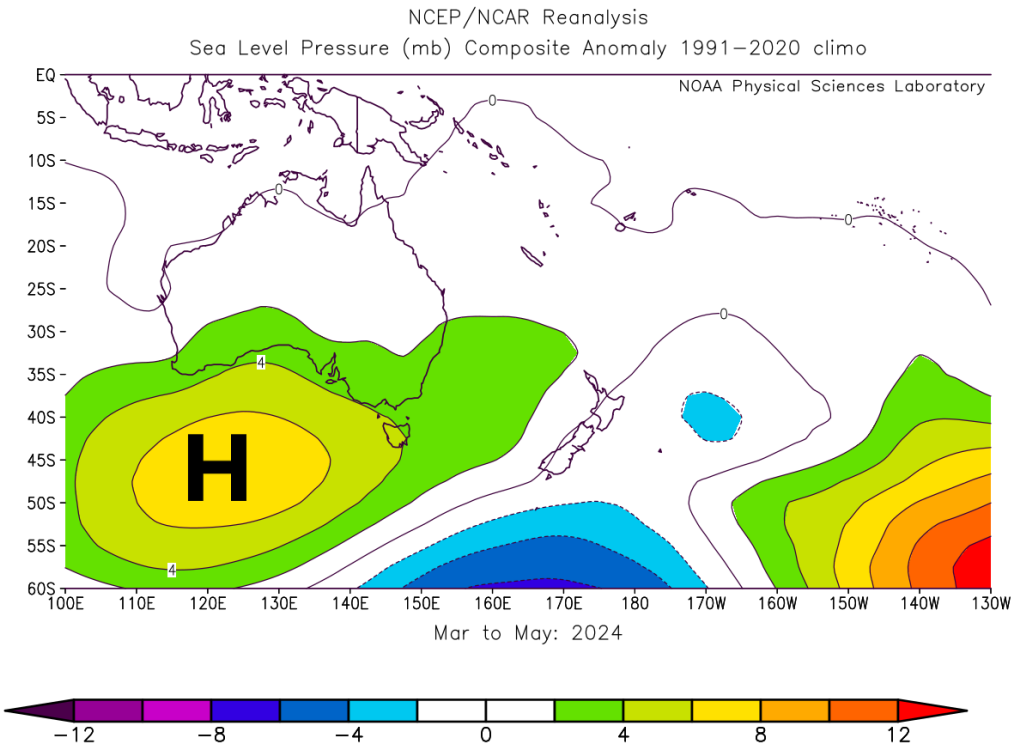


Figure 1.3: Mean sea level pressure anomaly map (hPa) for autumn 2024. The 'H' indicates the centre of the anomalous high pressures affecting the atmospheric flow around New Zealand. This pattern combined with lower pressure to the south to enhance the westerly flow mostly over the South Island. Source: 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.

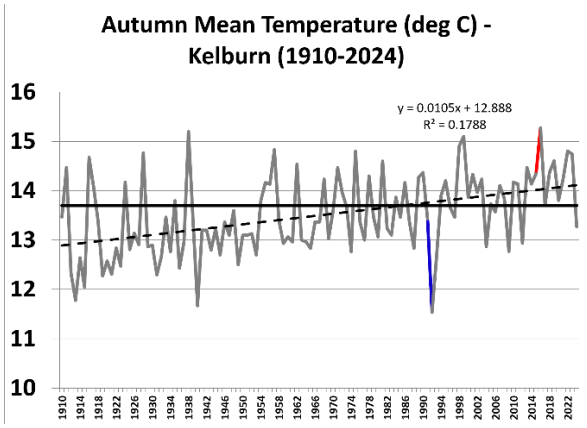
The key climate variables shown are mean temperature, total sunshine hours, mean wind, total rainfall and total number of rain days (above 0.1 mm). Temperature measurements go back to the 1910s, allowing for a meaningful analysis of climate change trends. Most other variables also have long periods of 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.

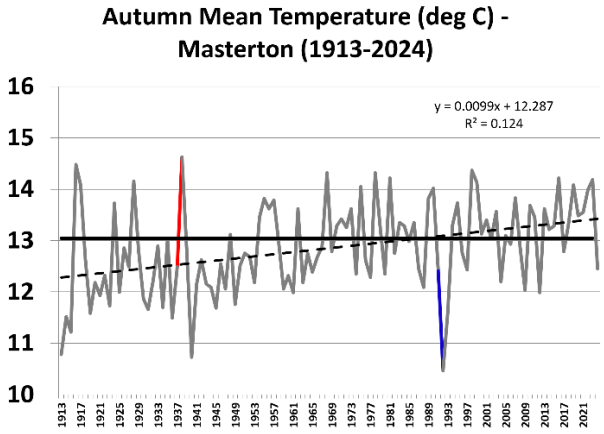
The red and blue bars show the extreme years of the entire measurement period. Red indicates seasons that were warmer, drier, sunnier and less windy than average (i.e., extreme hot/dry), and blue indicates seasons that were colder, wetter, cloudier and windier than average (i.e., extreme cold/wet). The reference climatological average (1981-2010) is shown by a horizontal bar where available.

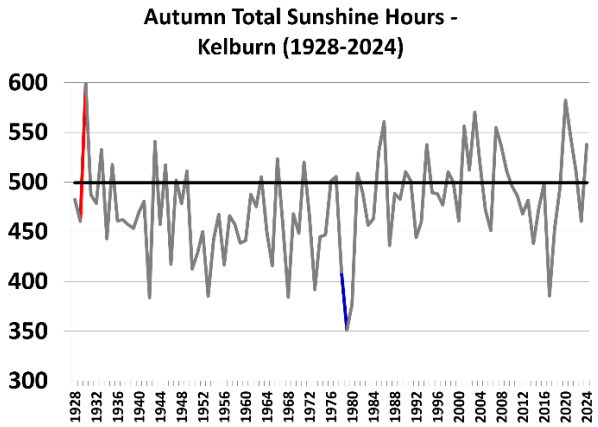
An analysis of linear trends associated with climate change is plotted onto the graph only when the trends are statistically different from zero at the 99% confidence level.

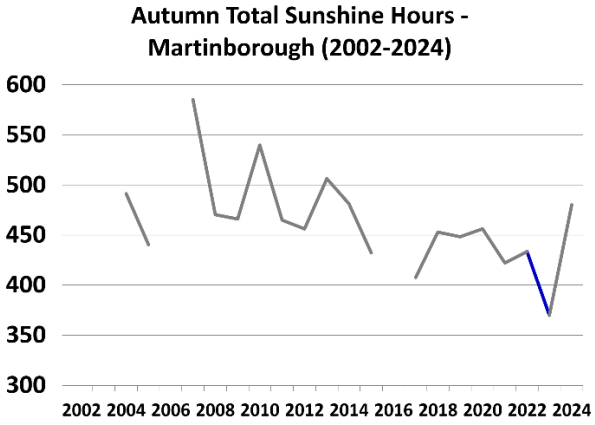
The climate change and variability summary for autumn 2024 is as follows:

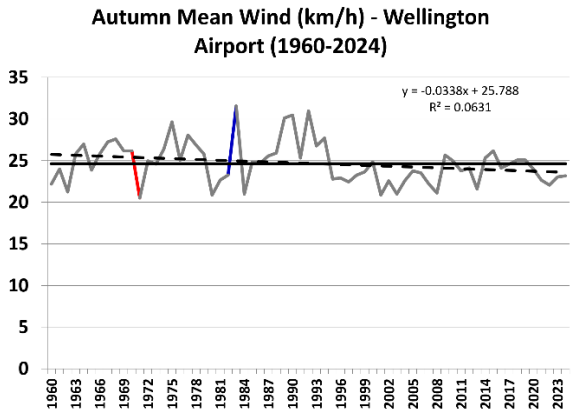
- Statistically significant trends are seen only for temperature and wind, meaning that autumn is getting warmer and less windy due to ongoing climate change. The long-term warming trend is about 1.1 and 1.0 degree per century for Wellington and Masterton respectively;
- Autumn 2024 temperatures were colder than normal for both Wellington and Wairarapa. This was the coldest autumn in 12 years;
- Sunshine hours were above average for Wellington and average for Wairarapa;
- Seasonal average wind speed was below average for both Wellington and Wairarapa;
- Total seasonal rainfall was average in Wellington and below average for Wairarapa (4th driest autumn on record for Masterton);
- Total seasonal rain days were near average for both Wellington and Wairarapa.

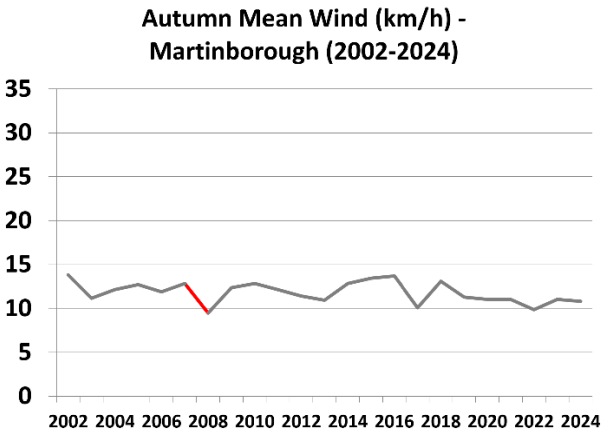

Autumn Mean Temperature (deg C) - Kelburn (1910-2024)
y = 0.0105x + 12.888
R² = 0.1788


Autumn Mean Temperature (deg C) - Masterton (1913-2024)
y = 0.0099x + 12.287
R² = 0.124


Autumn Total Sunshine Hours - Kelburn (1928-2024)


Autumn Total Sunshine Hours - Martinborough (2002-2024)


Autumn Mean Wind (km/h) - Wellington Airport (1960-2024)
y = -0.0338x + 25.788
R² = 0.0631


Autumn Mean Wind (km/h) - Martinborough (2002-2024)

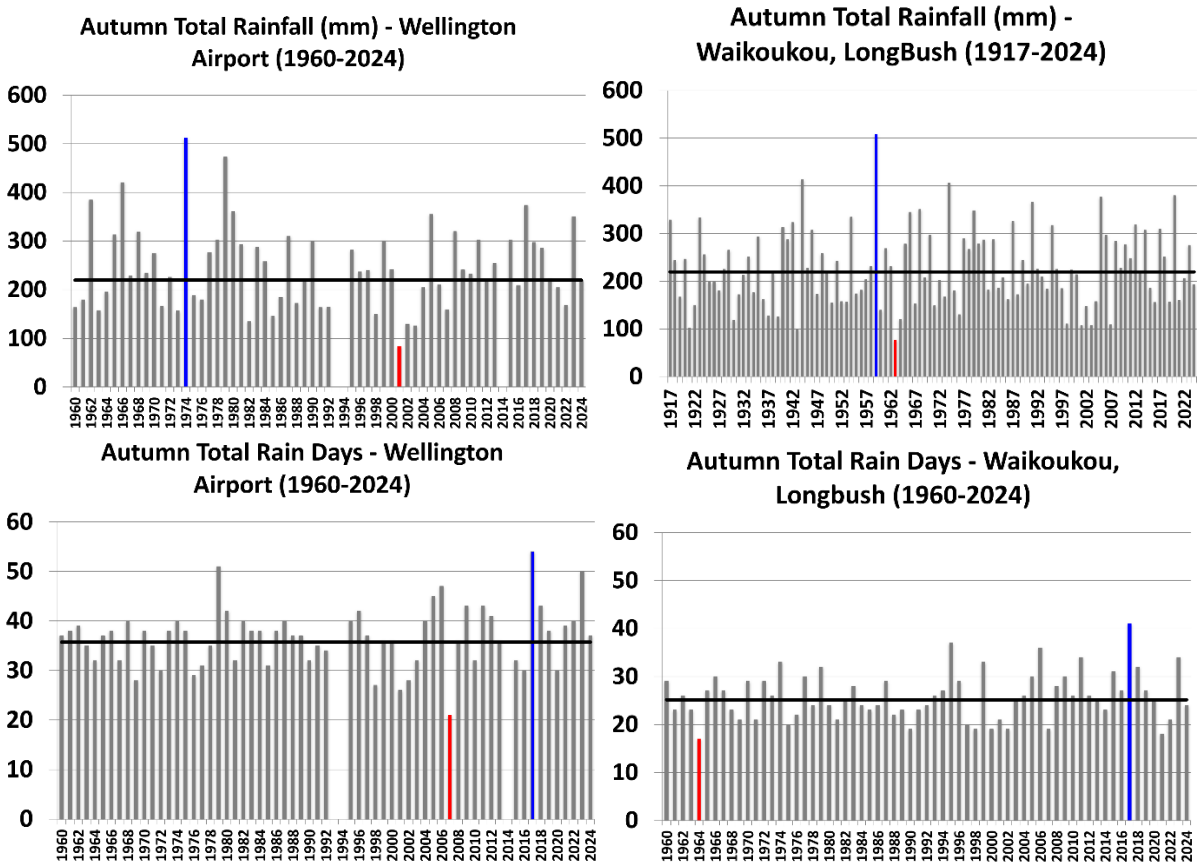


Figure 2.1: Climate change and variability graphs for autumn in Wellington and the Wairarapa. The thick horizontal line shows the 1981-2010 average (where available), and the dashed line shows the linear trend. Trends are plotted only when statistically significant at 99% confidence level. For all graphs, 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 for Wellington and > 1mm for Waikoukou). Missing bars means that no reliable mean seasonal data was available for that particular year.

2.2 Seasonal Outlook

- Emerging La Niña, but no major impacts expected in winter, except high climate variability. Increased chance of weather extremes, as oceanic temperatures remain warmer than average north of New Zealand and cooler to the south;
- More vigorous cold spells compared to previous years, and high chance of heavy rainfall events (both westerly and easterly);
- Seasonal rainfall normal in the west, possibly remaining below average in the eastern Wairarapa.

Whaitua*	Variables	Climate outlook for winter 2024*
Wellington Harbour & Hutt Valley	**Temperature:**	Near average, but high variability between mild and cold spells.
	Rainfall:	Near average. High chance of extreme weather events
Te Awarua-o-Porirua	**Temperature:**	Near average, but high variability between mild and cold spells.
	Rainfall:	Near average. High chance of extreme weather events
Kāpiti Coast	**Temperature:**	Near average, but high variability between mild and cold spells.
	Rainfall:	Near average. High chance of extreme weather events
Ruamāhanga	**Temperature:**	Near average, but high variability between mild and cold spells.
	Rainfall:	Near or below average. High chance of extreme weather events
Wairarapa Coast	**Temperature:**	Near average, but high variability between mild and cold spells.
	Rainfall:	Near or below average. High chance of extreme weather events

*Whaitua 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

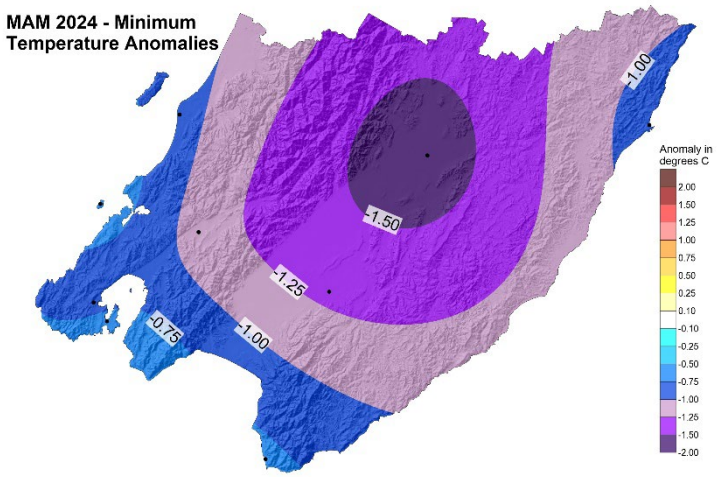
Mar-Apr-May 2024	Min T	Max T
Castlepoint	-0.9	-0.3
Kelburn	-0.8	-0.3
Masterton	-1.6	-0.3
Ngawi	-0.7	-0.2
Paraparaumu	-0.9	-0.2
Wellington Airport	-0.7	-0.2
Martinborough	-1.3	0.1
Mana Island	-0.6	0.2

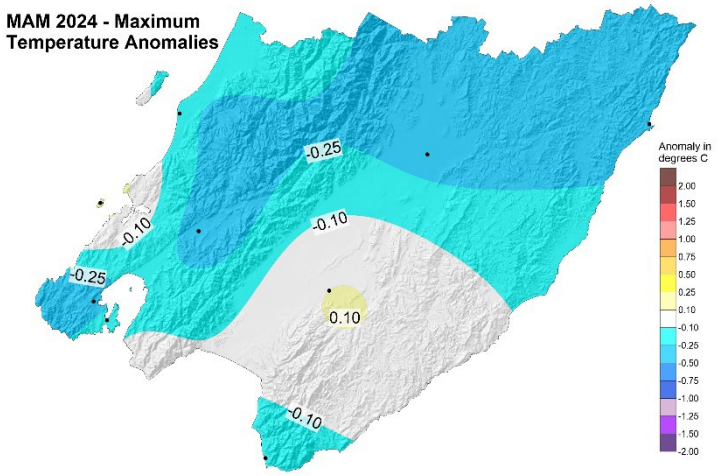
Table 1: Temperature anomalies (°C) for autumn (MAM) 2024 relative to the 1991-2020 climatology. Significant positive and negative anomalies (greater than 0.5°C magnitude) are highlighted in red (warmer than average) and blue (colder than average).

Mar-Apr-May 2024	Wind %
Castlepoint	-3.0
Masterton	-6.7
Ngawi	-5.7
Paraparaumu	-8.4
Wellington Airport	-5.9
Martinborough	-10.5
Baring Head	-8.3

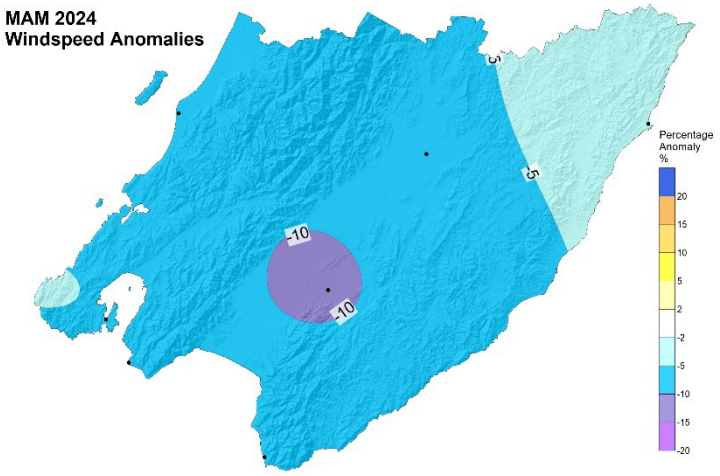
Table 2: Wind anomalies (%) for autumn (MAM) 2024 relative to the 1981-2010 climatology. Significant positive and negative anomalies (greater than 5%) are highlighted in red (calmer than average) and blue (windier than average).

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

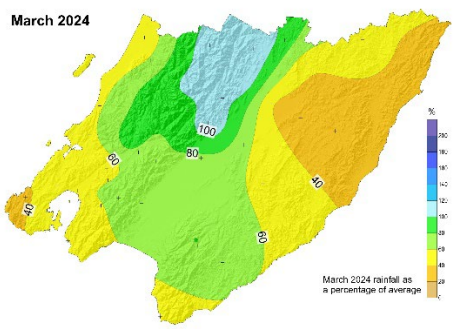


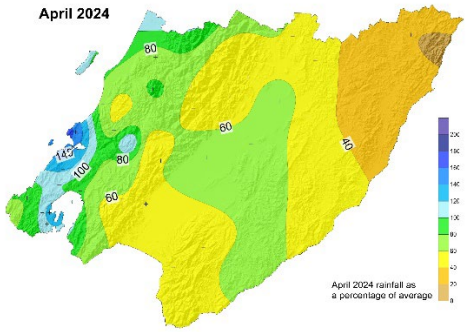


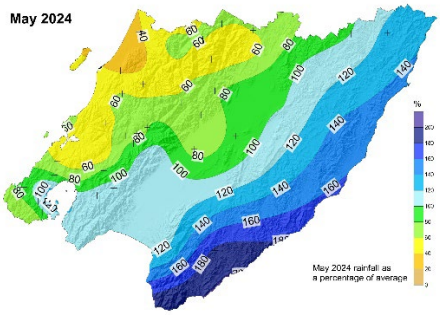
Min and Max Temperature anomalies (°C)

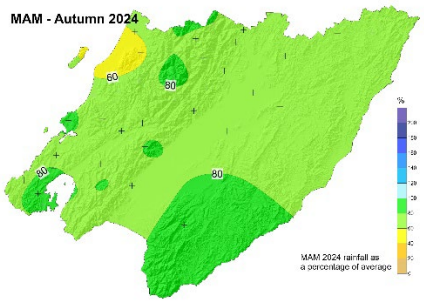


Wind anomalies (%)









Rainfall anomalies (%)

GWRC's climate science tools

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

- **Daily climate maps**
  https://graphs.gw.govt.nz/envmon/daily-climate-maps?view=rainfall-table

- **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/