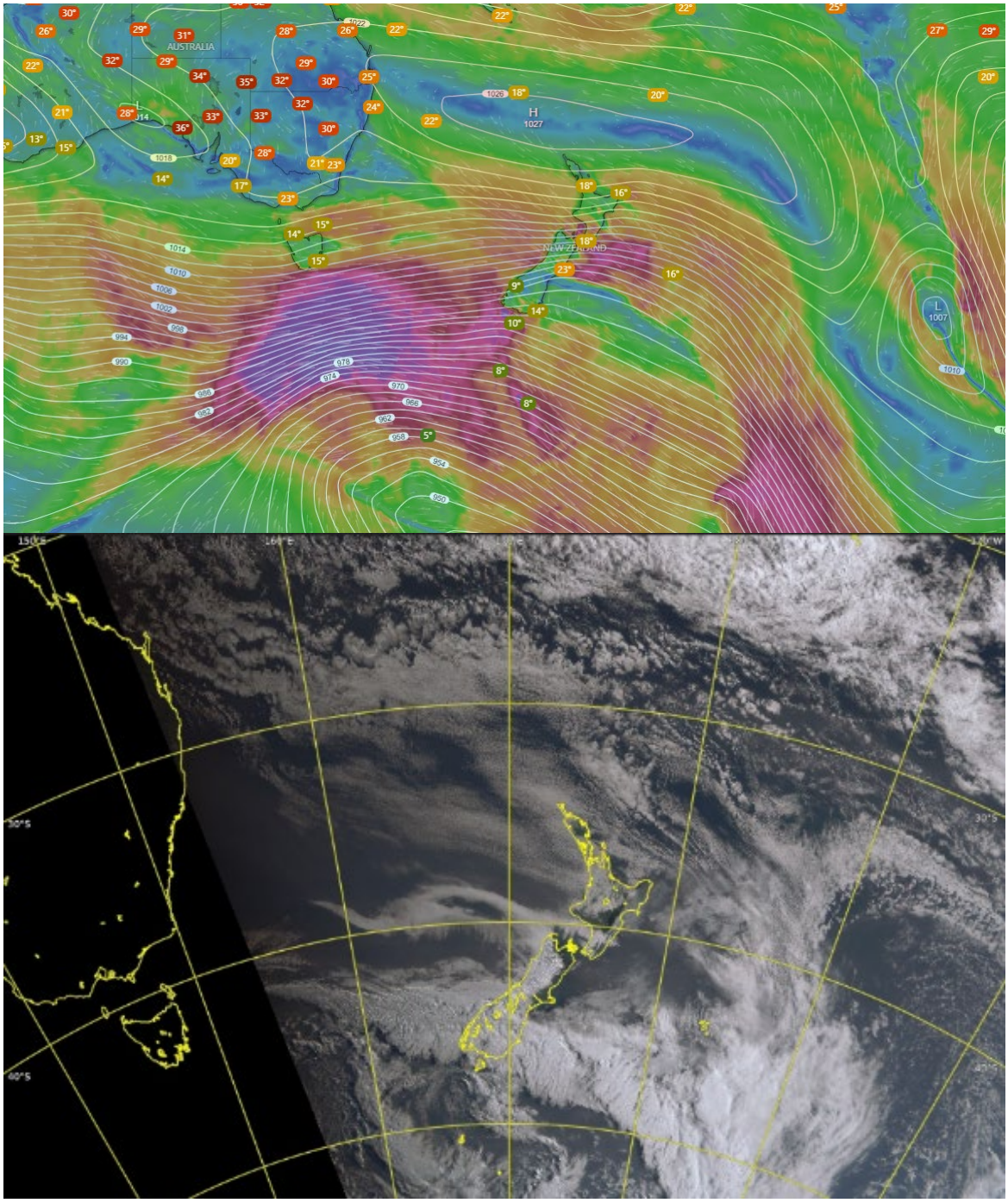
Climate drivers and seasonal outlook for the Wellington Region

Spring 2023 summary

Summer 2023-2024 outlook

Release date: 11 December 2023

Knowledge and Insights



With the arrival of El Niño, the large-scale atmospheric circulation finally shifted to a more westerly regime. Just before the Equinox, fierce westerly winds associated with a large north-south pressure gradient (upper panel) brought smoke from the Sydney bushfires, as seen on the satellite photo shown on the bottom panel. Credits: Surface wind, pressure and temperatures for 1pm on Sunday 17 September 2023 by Windy.com (top) and visible channel satellite image for 8am on 17 September 2023 by MetService.

Overview

Spring 2023

Spring 2023 was a mixed bag for the region, alternating between strong westerly flow typical of El Niños and north-easterly rain events typical of La Niñas. Total rainfall accumulations were generally drier in the west and wetter in the east, which is opposite to what one would expect during an El Niño. Paraparaumu had the second driest spring on record, with about only half of the average rainfall. Even then, less rainfall was welcome for many after the La Niña floods, giving the opportunity for the soil moisture levels to stabilise with fewer slips around the capital. Late-season cold snaps continued to affect the region (mostly short lived), with the mean seasonal temperatures sitting near average.

Climate drivers

The current El Niño has now matured and is expected to last at least until the end of autumn. Although the phenomenon is causing widespread global impacts, for us this is shaping as a non-traditional El Niño with a mixed weather pattern. For New Zealand, strong El Niño tends to bring persistent south-westerly flows, often manifesting as strong north-westerlies funnelled and modified by the Tararua Ranges. However, as the oceanic heat in the western Equatorial Pacific is higher than normally observed during El Niños, we can expect non-traditional impacts in our region with a much more mixed climate signal than in previous strong El Niño years.

Climate outlook for summer 2023-2024

As a result of the non-traditional El Niño, we expect a mixed summer season with a little bit of everything, including colder periods and heavy rainfall events. Temperatures should be about average or slightly above, and rainfall is expected to be average or below. Considering the mixed signal from the climate drivers, there is low confidence in model predictions for the total rainfall accumulation compared to the long-term average, and where the driest areas will develop.

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 likely to remain in the El Niño phase until at least the end of autumn.

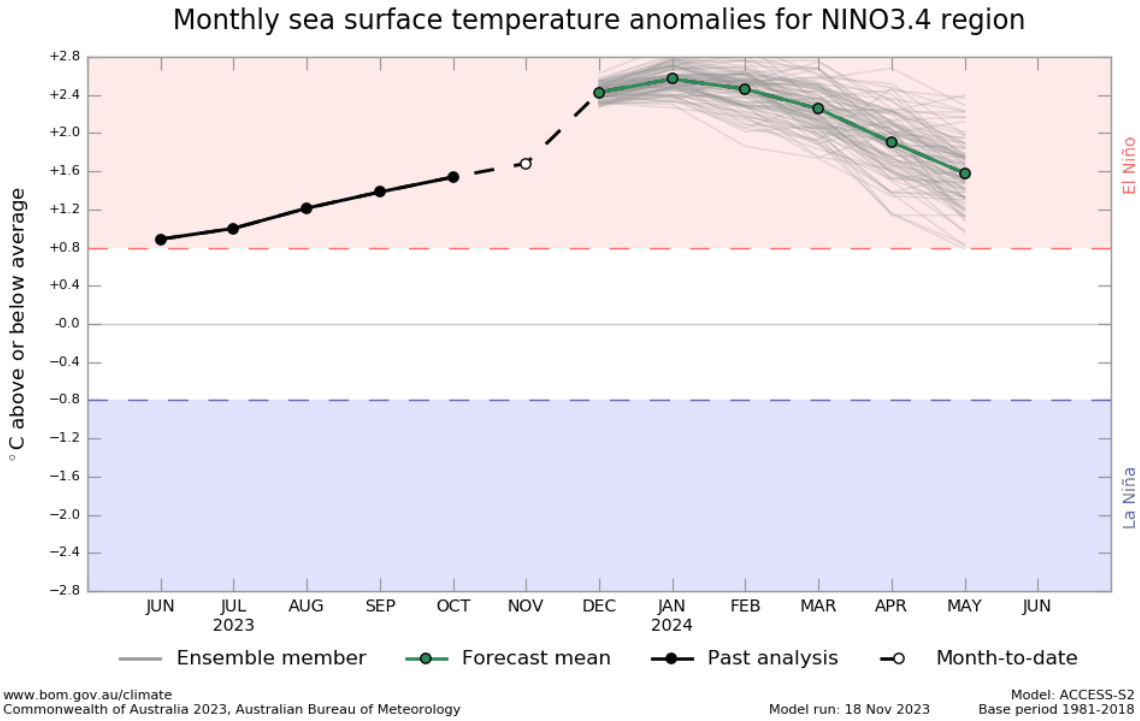


Figure 1.1: Average modelled projections (in green) show that the El Niño is expected to peak by January 2024, and slowly start to decline towards autumn. Source: Australian Bureau of Meteorology.

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 28 November 2023.

The overall pattern shows a mature El Niño in the Equatorial Pacific (warm water expanding from the Peruvian coast) with a warm background ocean surface in the North Atlantic and anomalously cold waters towards the southern tip of South America. Over the Tasman, signs of a possible marine heatwave are also seen between Sydney and Tasmania. Meanwhile, the Sea Ice Extent around Antarctica (in white) remains at below average levels for this time of the year.

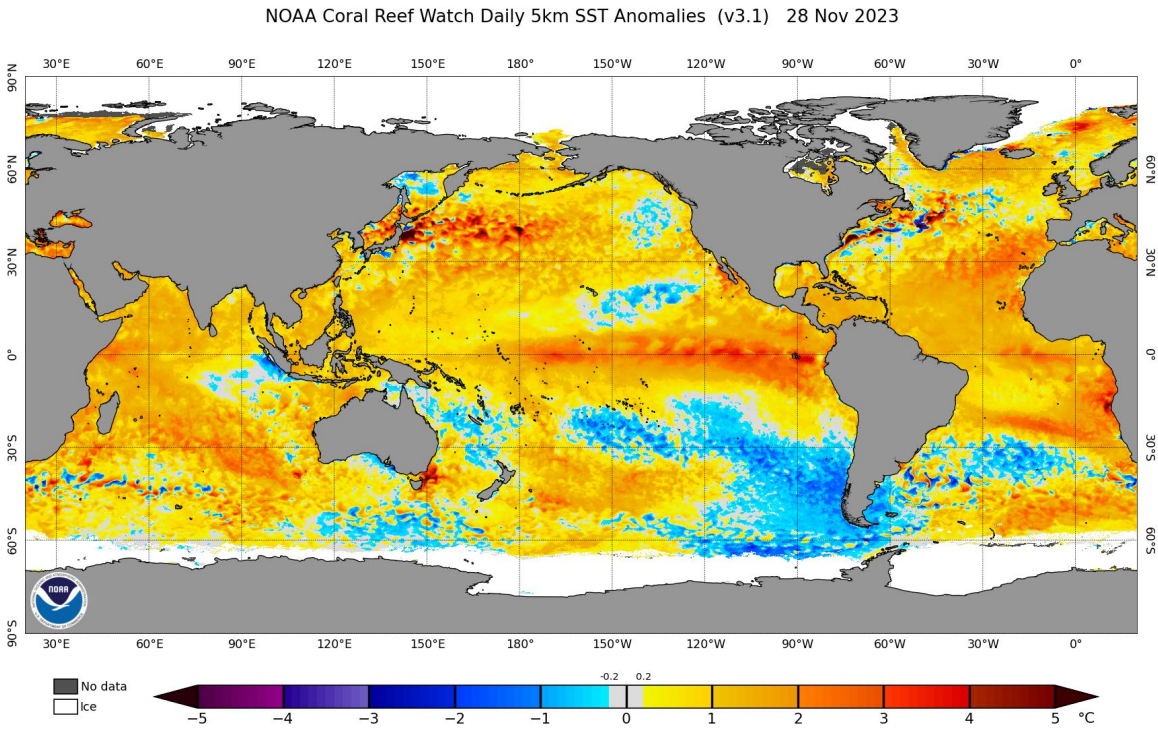


Figure 1.2: Sea Surface Temperature (SST) anomalies as of 28 November 2023. Sea ice coverage is shown in white. The Equatorial Pacific (ENSO) is showing a mature El Niño. Locally, we see a small patch of very warm water between Sydney and Hobart with potential for development into a marine heatwave. The Sea Ice Extent remains at below average levels 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 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 frequently 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, albeit slowly.

Figure 1.3 shows the spring sea level pressure pattern transitioning towards the return of a prevailing westerly flow under high pressure anomalies over the Tasman, but still clashing with higher-than-normal pressure also to the east of New Zealand. The "competing" flow between the anticyclones to the west and east of New Zealand helped create mixed weather patterns associated with what NIWA has called a non-traditional El Niño.

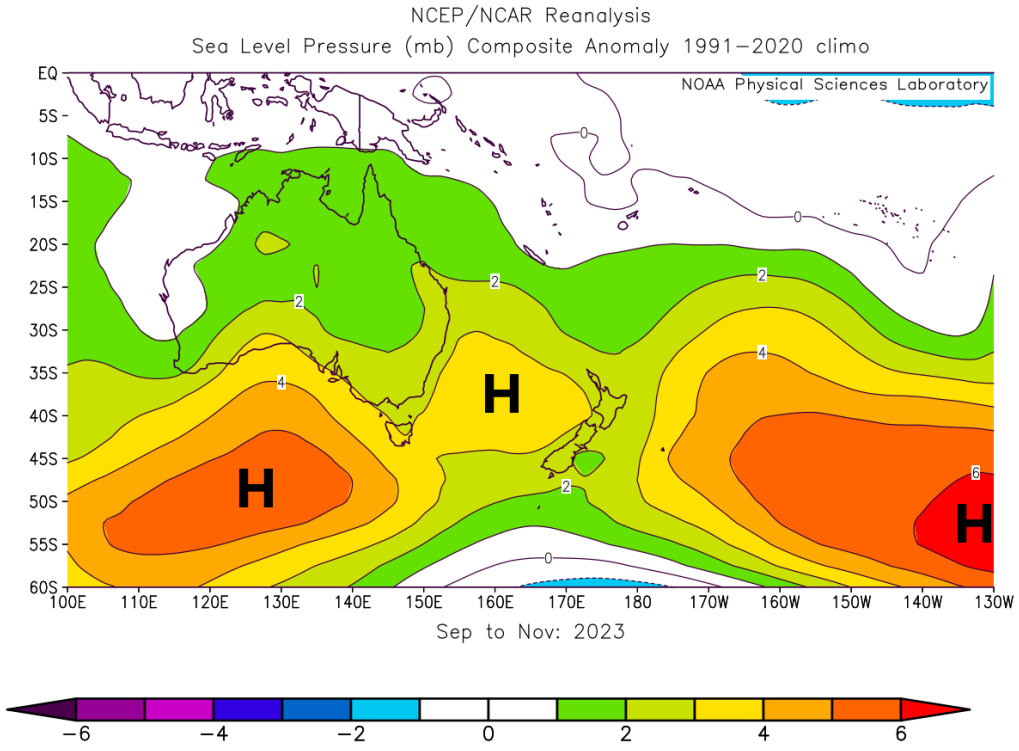


Figure 1.3: Mean Sea Level Pressure anomaly map (hPa) for spring 2023. The 'H' is the centre of the anomalous blocking high pressure areas to the west and south-east of New Zealand (now moving away). No significant anomalous areas of unstable low-pressure were observed for the seasonal average. Source: 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 graphs only when the trends are statistically different from zero at the 99% confidence level.

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

- Statistically significant trends are seen only for temperature and wind, meaning that spring is getting significantly warmer and less windy due to ongoing climate change. The long-term warming trend is about 0.6 degrees per century in Wellington and 0.5 degrees in Masterton (spring is the season with the least amount of historical warming). In the Wairarapa there seems to be a declining sunshine hours trend, but the time series is too short to be able to ascertain statistical significance.

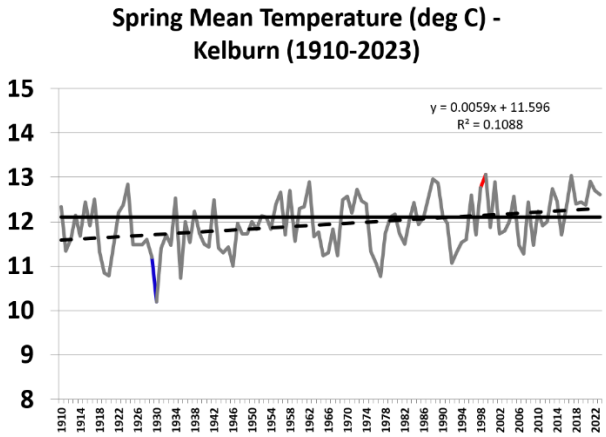
- Spring 2023 temperatures were above average for both Wellington and the Wairarapa, like last year.

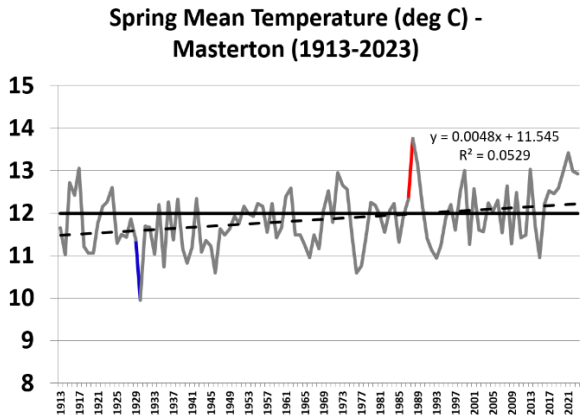
- Sunshine hours were about average in Wellington and on the lower end in the Wairarapa (where the time series is not long enough to determine a reliable long-term average as yet).

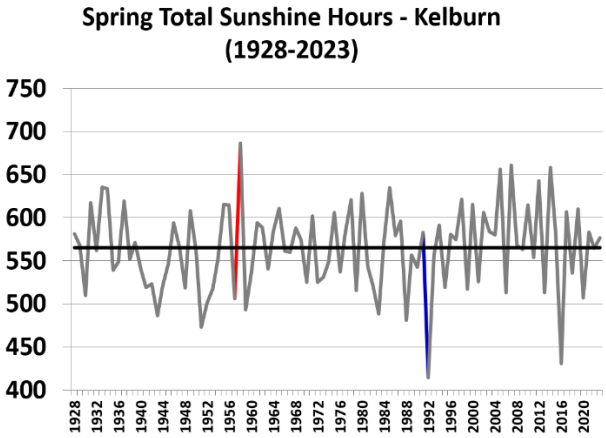
- Wind speed was about average.

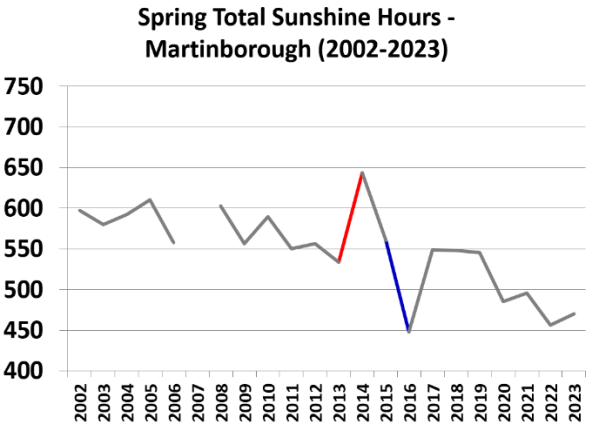
- Rainfall was below average in Wellington, and close to average in the Wairarapa.

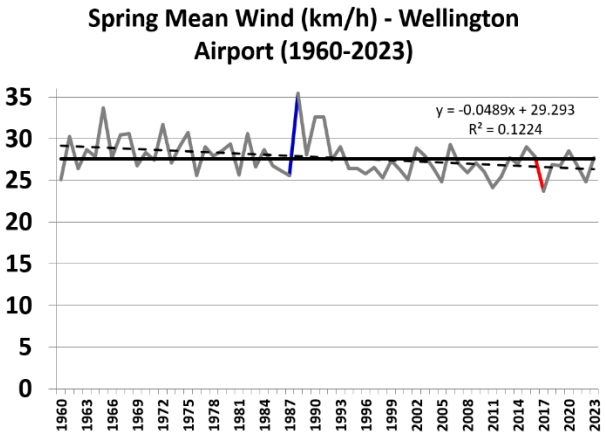
- Rain days were near average for both Wellington and Wairarapa.

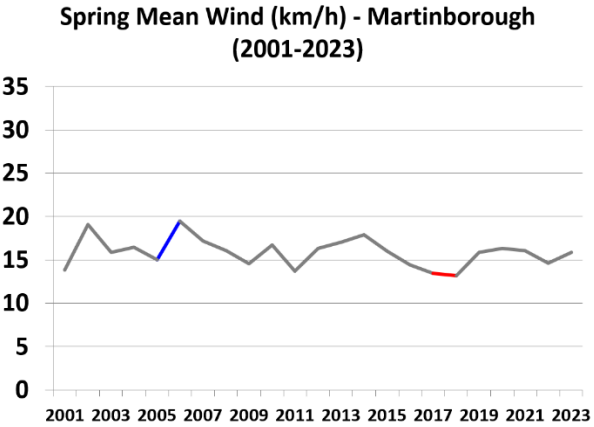

Spring Mean Temperature (deg C) - Kelburn (1910-2023)
y = 0.0059x + 11.596
R² = 0.1088


Spring Mean Temperature (deg C) - Masterton (1913-2023)
y = 0.0048x + 11.545
R² = 0.0529


Spring Total Sunshine Hours - Kelburn (1928-2023)


Spring Total Sunshine Hours - Martinborough (2002-2023)


Spring Mean Wind (km/h) - Wellington Airport (1960-2023)
y = -0.0489x + 29.293
R² = 0.1224


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

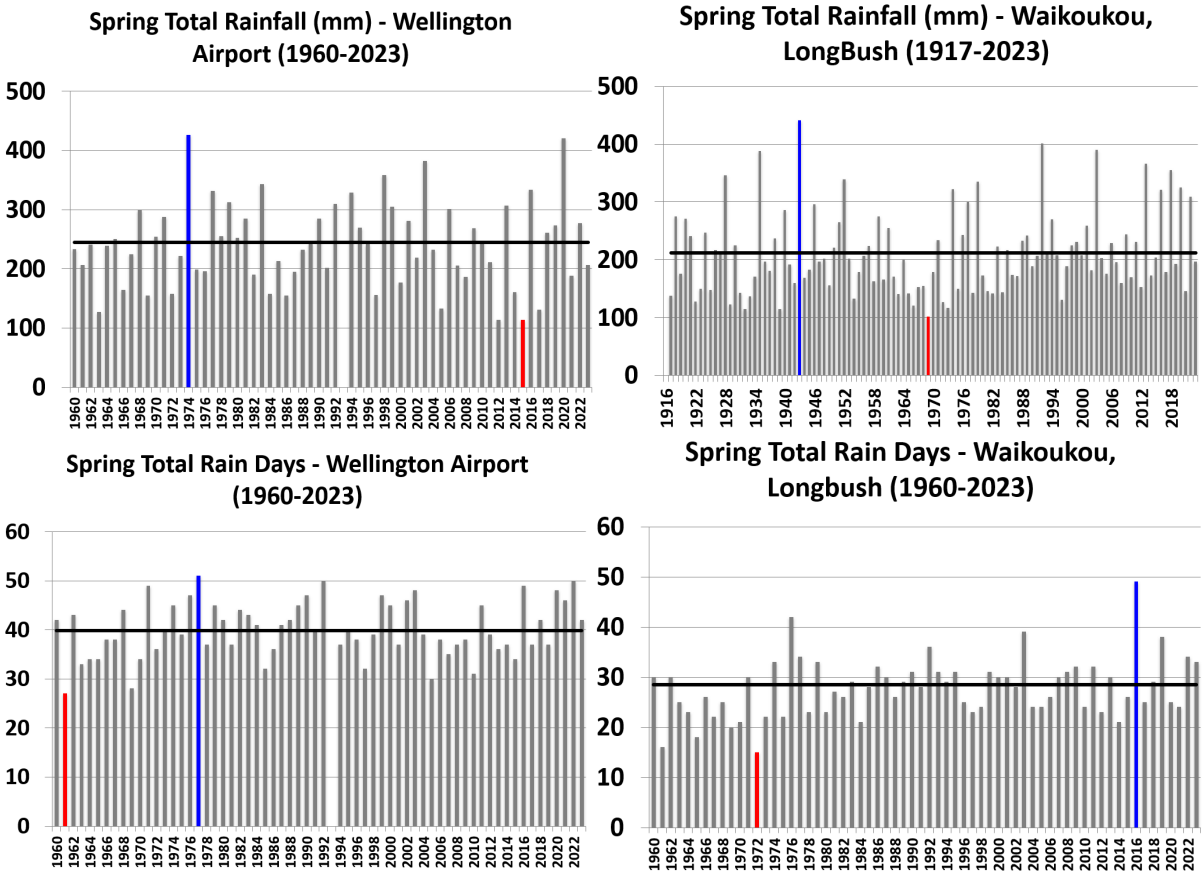


Figure 2.1: Climate change and variability graphs for spring in Wellington and the Wairarapa. The thick horizontal line shows the 1981-2010 average (where available), and the dashed line shows the linear trend. Trends are plotted only when statistically significant at 99% confidence level. For all graphs,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

2.2 Seasonal Outlook

- A non-traditional El Niño with both westerlies and southerly flows. Easterly weather events still possible but becoming progressively less likely.
- Oceanic temperatures remain warmer than average around New Zealand, even though cooler waters on the coast. Possibility of marine heatwave developing in the Tasman Sea.
- Temperatures: A mostly average summer around Wellington with higher variability than normal and cold days in the mix. Average to above elsewhere.
- Higher chance of heatwaves in the Wairarapa, but eastern coast likely still affected by some possible easterly flows during the first half of summer.
- Rainfall: average to below with low confidence for where the driest areas will develop considering a non-traditional El Niño

Whaitua*	Variables	Climate outlook for summer 2023-2024**
Wellington Harbour & Hutt Valley	**Temperature:**	Close to average: higher variability than normal and colder and windy periods likely
	Rainfall:	Below average with low confidence
Te Awarua-o-Porirua	**Temperature:**	Average to above, higher variability than normal
	Rainfall:	Below average with low confidence
Kāpiti Coast	**Temperature:**	Average to above, higher variability than normal with cooler periods likely
	Rainfall:	Below average with low confidence
Ruamāhanga	**Temperature:**	Average to above, higher variability than normal and higher chance of heatwaves
	Rainfall:	Below average with low confidence
Wairarapa Coast	**Temperature:**	Close to average, higher variability than normal and chance of sporadic easterly flow
	Rainfall:	Below average with low confidence. Possible easterly rain events, becoming progressively less likely

*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

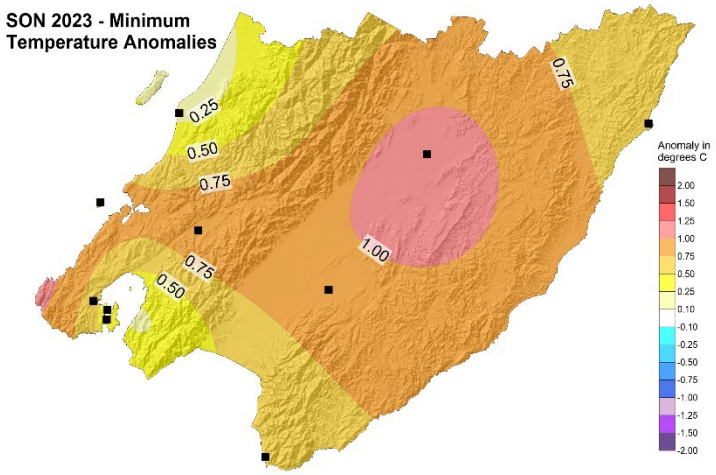
Sep-Oct-Nov 2023	Min T	Max T
Castlepoint	0.6	0.5
Kelburn	0.6	0.5
Masterton	1.1	0.3
Ngawi	0.6	0.7
Paraparaumu	0.2	0.6
Wellington Airport	0.4	0.6
Martinborough	0.9	1.0
Mana Island	0.9	0.8
Upper Hutt	0.9	0.9
Greta Point	0.4	0.9

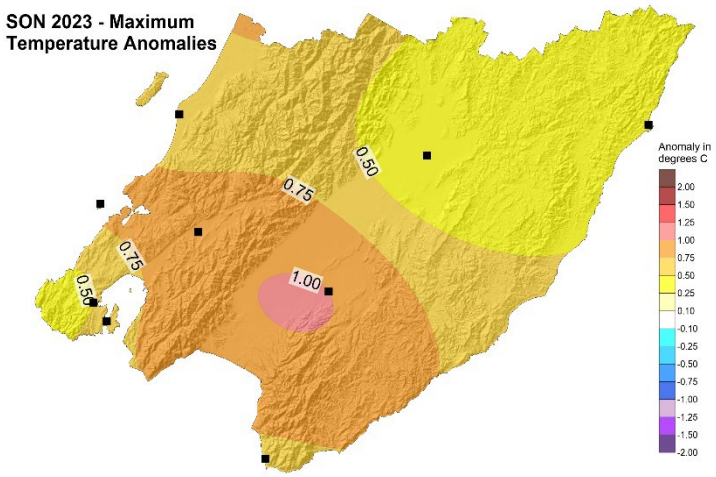
Table 1: Temperature anomalies (°C) for spring (SON 2023 relative to the 1991-2020 climatology. Positive and negative anomalies (greater than 0.5°C magnitude) are highlighted in red (warmer than average) and blue (colder than average).

Sep-Oct-Nov 2023	Wind %
Castlepoint	3.8
Masterton	-3.3
Ngawi	1.6
Paraparaumu	-4.2
Wellington Airport	0.6
Martinborough	-2.0
Baring Head	-0.4

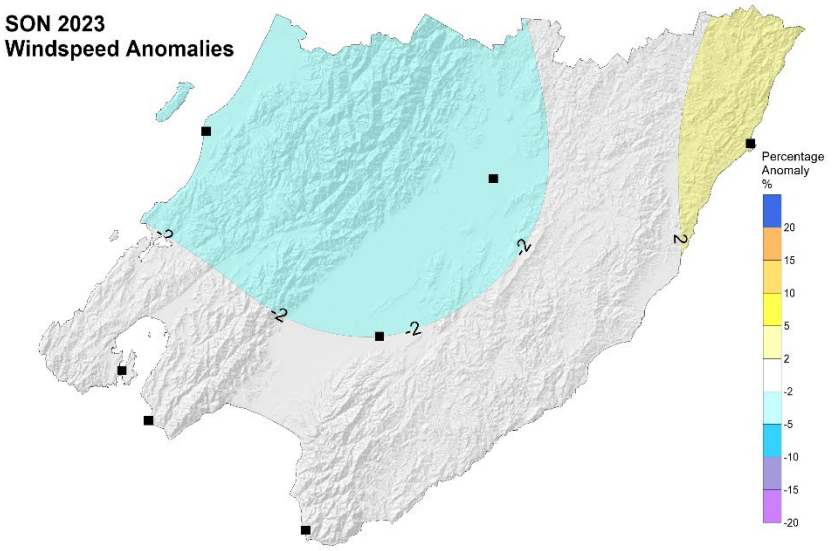
Table 2: Wind anomalies (%) for spring (SON) 2023 relative to the 1981-2010 climatology. Strong positive and negative anomalies (greater than 10%) are highlighted in red (calmer than average) and blue (windier than average).

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

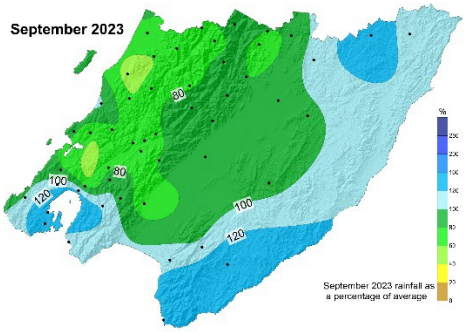


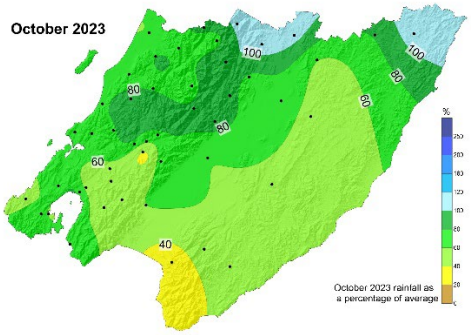


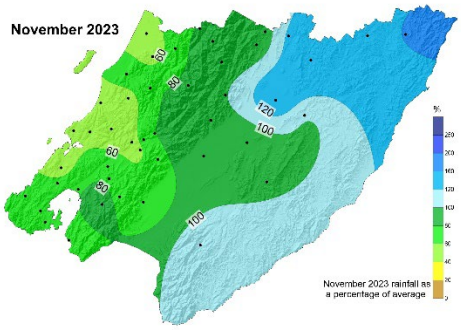
Min and Max Temperature anomalies (°C)

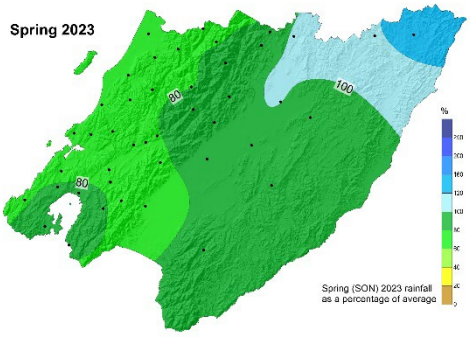


Wind anomalies (%)









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/