Climate drivers and seasonal outlook for the Wellington Region

Autumn 2022 summary

Winter 2022 outlook

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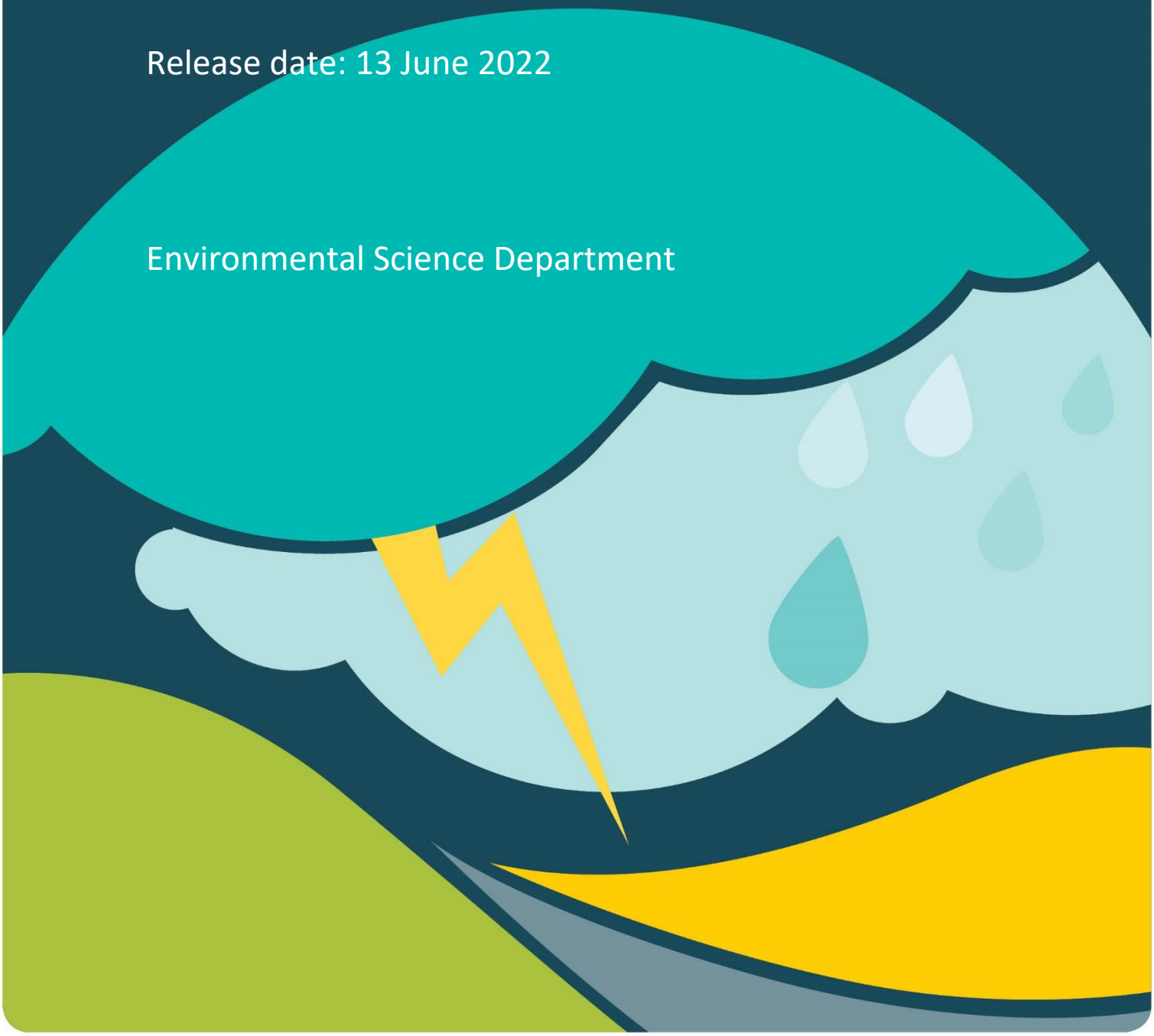
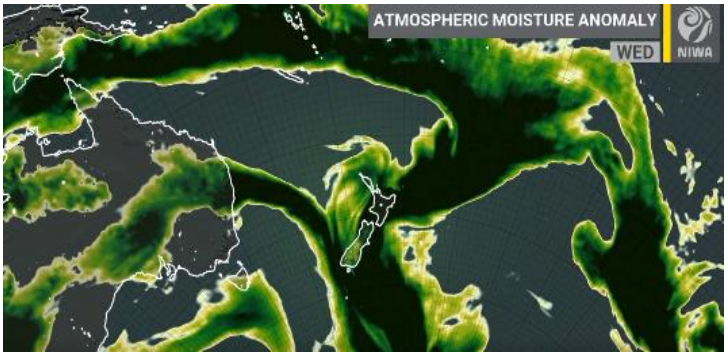
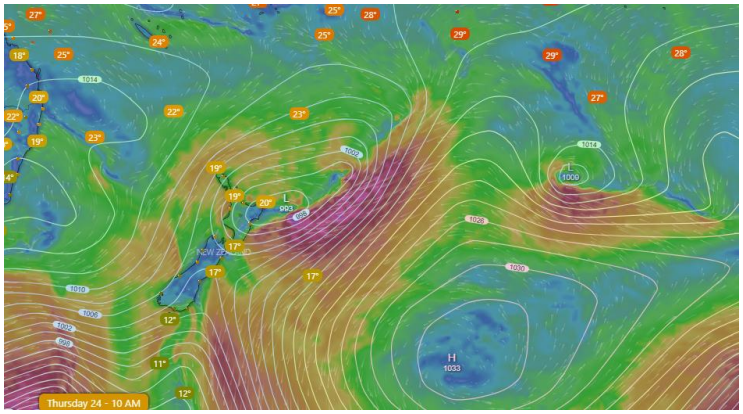
Environmental Science Department







Atmospheric river pattern seen on 23 and 24 March. The bottom panel shows the intense north-easterly moisture transport (in red) associated with the low pressure near East Cape. Over 100 mm of rainfall fell within 24 hours in the north-eastern Wairarapa near Castlepoint. Top panel image courtesy of NIWA. Bottom image from windy.com

Overview

Autumn 2022

Autumn 2022 was second equal hottest on record for New Zealand, and the hottest on record for the eastern coast around Castlepoint. The season was once again marked by a predominant easterly La Niña flow, with balmy sub-tropical air making significant incursions mostly during north-easterly flows. Warm Sea Surface Temperatures (SST) helped moderate the climate, and Castlepoint had May temperatures that were closer to those expected in December. An atmospheric river event late in March brought over 100 mm of rainfall within 24 hours to the same Castlepoint area. In May, some exceptionally high humidity levels (dew point close to 20 degrees Celsius) created balmy conditions once again on the east coast, resembling closer to what would be expected for Brisbane at this time of the year. A series of unprecedented heat anomalies around the South Pole were also observed in March and May, highlighting how climate change is impacting the Southern Ocean. Ex-Tropical Cyclone Fili just missed the region in April, and so further flooding was mostly confined around Gisborne. A very active band of thunderstorms also crossed the region from north to south on the 22 March, with some spectacular displays both in the Wairarapa and Wellington. Rainfall was generally below average south of Masterton, as the region missed out on most of the rain events further north. April was the second driest on record for Masterton and Martinborough.

Climate drivers

The La Niña phenomenon continues to weaken slowly, and the Bureau of Meteorology in Australia is predicting favoured odds for a negative Indian Ocean Dipole over winter. These combined drivers increase the likelihood of near normal to above normal rainfall for the region.

Climate outlook for winter 2022

Most international climate models are predicting that winter in our region will be warmer than average, with SST expected to remain above the climatological normal values around New Zealand. Rainfall is expected to be normal to above in the west, and normal to below in the east. There is a high chance that extreme weather events will continue to batter the region, both westerly and easterly events, as the oceanic waters remain anomalously warm.

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 continue to oscillate between La Niña and neutral. The influence of the La Niña easterly flow, with warmer than average waters around New Zealand, however, should continue to impact the region over winter, even though we have already experienced a return to a more westerly pattern.

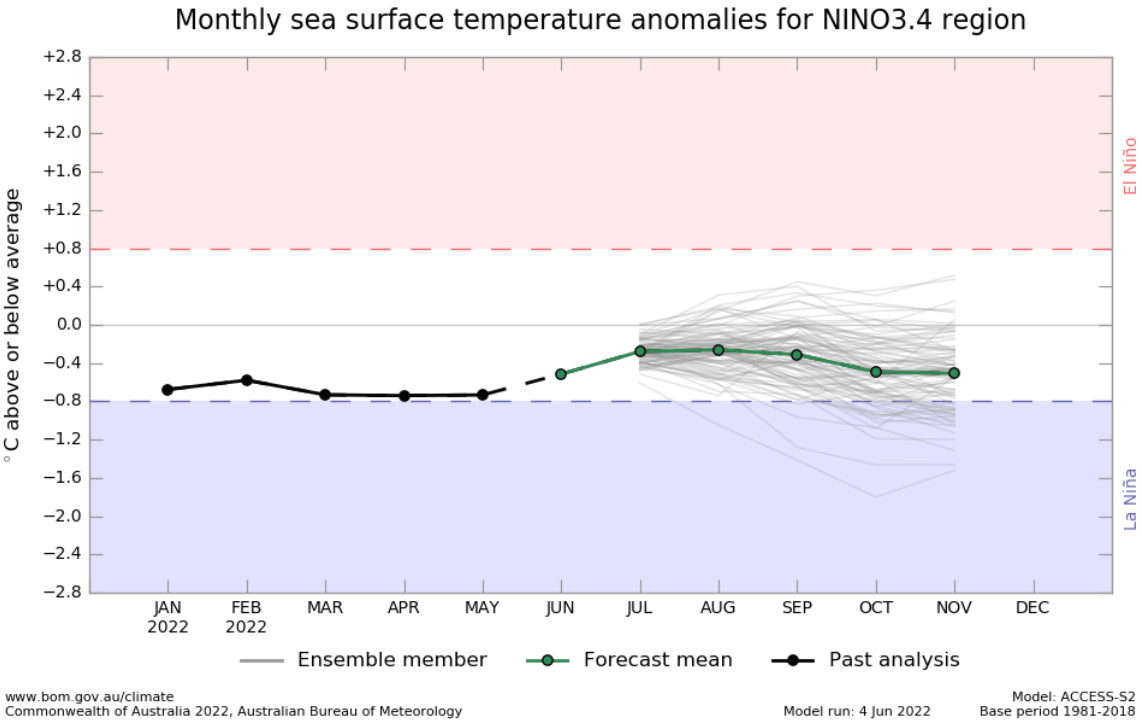


Figure 1.1: Averaged modelled projections (in green) show that the current cold phase of the ENSO phenomenon is expected to slowly return to near normal, or oscillate between La Niña and neutral. Source: Australian Bureau of Meteorology.

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 6 June 2022.

The pattern shows a residual La Niña in the Equatorial Pacific (cold tongue), and warmer than average SST around New Zealand. The SIE (in white) is still relatively small for this time of the year, and has been about two standard deviations below the long-term average.

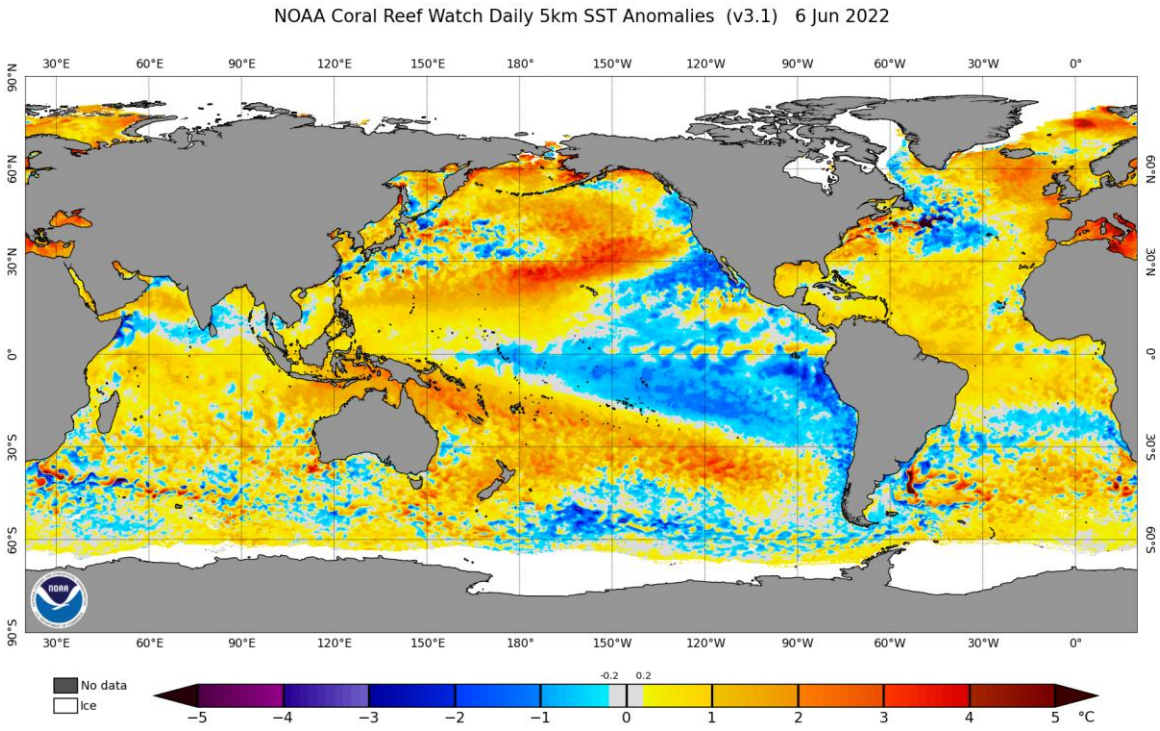


Figure 1.2: Sea Surface Temperature (SST) anomalies as of 6 June 2022. Sea ice coverage is shown in white. Water temperatures around New Zealand are well above average. The Equatorial Pacific (ENSO) is showing a residual La Niña pattern (cold equatorial waters). The Sea Ice Extent (in white) has been consistently below the long-term average. 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.

The SAM has been predominantly positive, as normally expected for a La Niña year. The prevailing north-easterly flow coupled with a marine heatwave around New Zealand meant that there was significant atmospheric moisture available for heavy rainfall events to develop, even though ex-Tropical Cyclone Fili just missed the region in April, and rainfall was mostly below average. Additional atmospheric river events also formed in late May, with heavy rainfall or markedly humid subtropical weather affecting predominantly the north-eastern Wairarapa coast.

Figure 1.3 shows that the autumn sea level pressure pattern was characterised by a combination of high pressures to the east of New Zealand, and a fierce monsoonal subtropical low over eastern Australia. This La Niña pattern continued to bring a substantial north-easterly flow into the country, creating very humid conditions favouring the development of atmospheric river events.

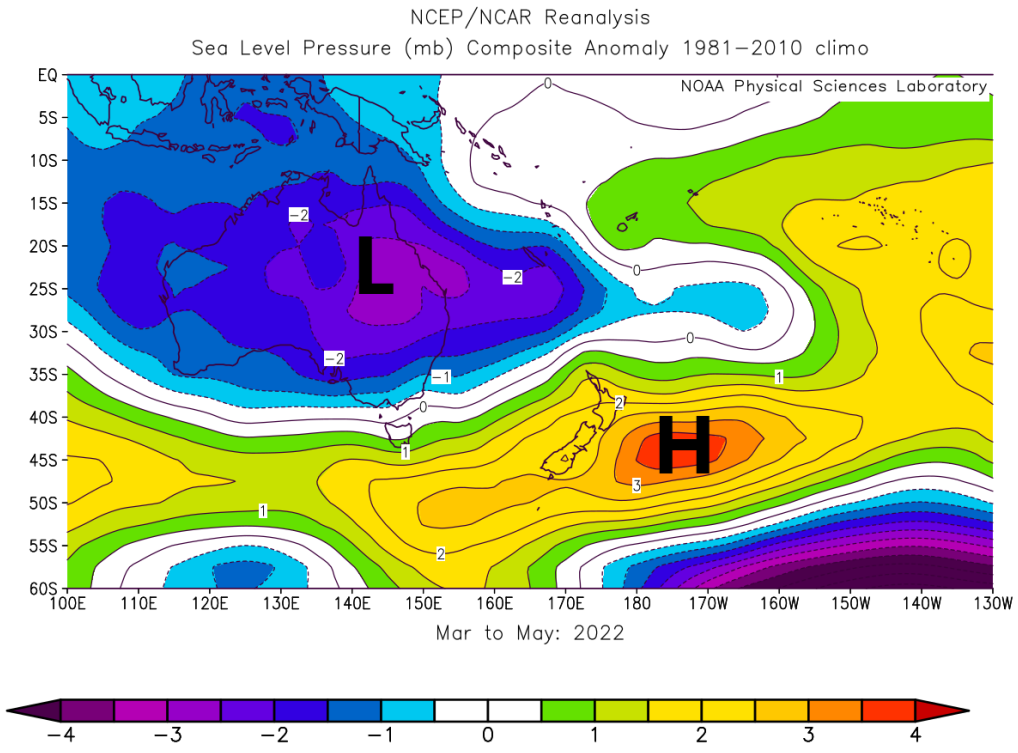


Figure 1.3: Mean sea level pressure anomaly map (hPa) for autumn 2022. The 'H' indicates the centre of the anomalous high pressure areas and the 'L' indicate the anomalous low pressure areas. This pattern was associated with a positive Southern Annular Mode, and a predominant warm and moist north-easterly flow over New Zealand. The very active subtropical 'monsoon' is seen by low pressure dominating virtually the whole of Australia, with anomalous easterly winds prevailing in the Tasman Sea. 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.

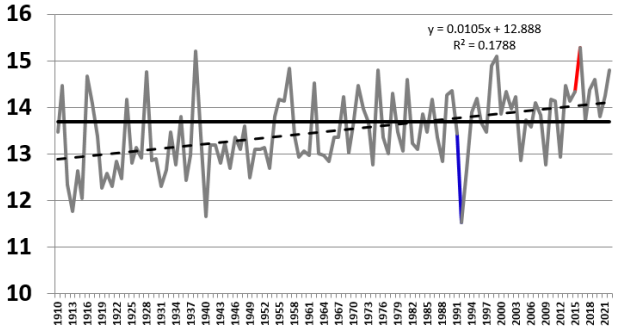
The red and blue bars show the extreme years of the entire measurement period. Red indicates seasons that were warmer, drier, sunnier and less windy than average (i.e., extreme hot/dry), and blue indicates seasons that were colder, wetter, cloudier and windier than average (i.e., extreme cold/wet). The 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.

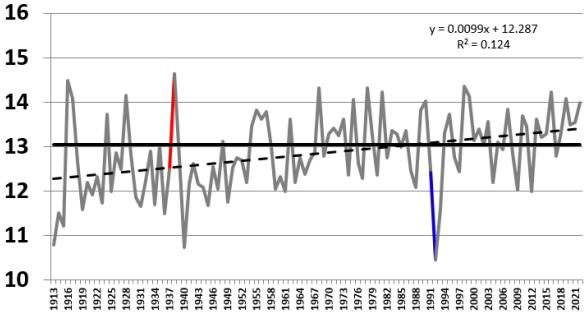
The climate change and variability summary for autumn is as follows:

- Statistically significant trends are seen only for temperature, meaning that autumn is getting warmer as a result of ongoing climate change. The long-term warming trend is about one degree per century for both Wellington and Masterton;
- Autumn 2022 temperatures were well above average for both Wellington and the Wairarapa;
- Sunshine hours were about average;
- Seasonal average wind speed was well below average;
- Seasonal rainfall was below average, and rain days were about average in Wellington.

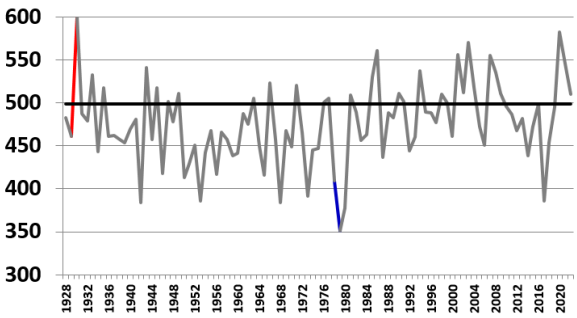
Autumn Mean Temperature (deg C) - Kelburn (1910-2022)



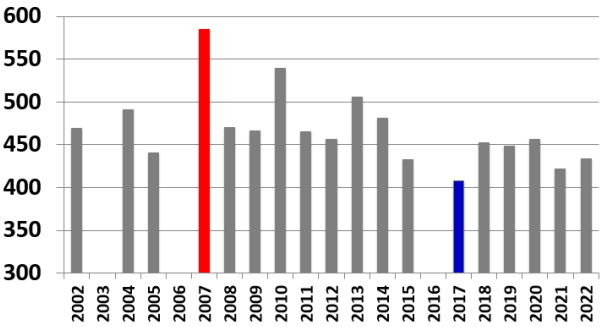
Autumn Mean Temperature (deg C) - Masterton (1913-2022)



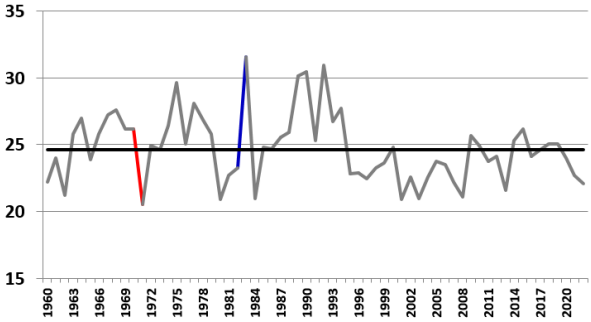
Autumn Total Sunshine Hours - Kelburn (1928-2022)



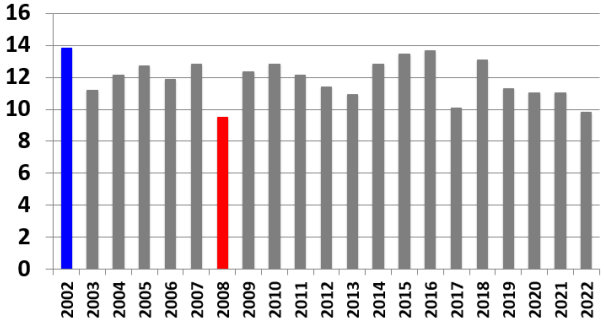
Autumn Total Sunshine Hours - Martinborough (2002-2022)



Autumn Mean Wind (km/h) - Wellington Airport (1960-2022)



Autumn Mean Wind (km/h) - Martinborough (2002-2022)



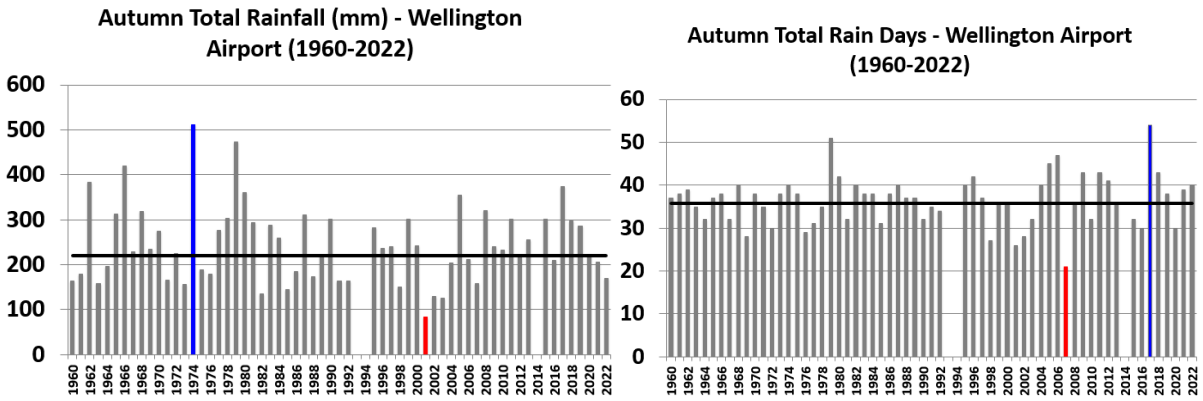


Figure 2.1: Climate change and variability graphs for autumn in Wellington and the Wairarapa. The thick horizontal line shows the 1981-2010 average (where available), and the dashed line shows the linear trend. Trends are plotted only when statistically significant at 99% confidence level. For all graphs,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

- La Niña is expected to continue to influence the weather patterns, alternating between easterly and westerly flow;
- Sea Surface Temperatures are predicted to remain warmer than average around New Zealand, providing greater moisture input for extreme rainfall events;
- Total seasonal rain normal to above average in the west, and about average for the rest of the region (low confidence);
- Above average temperatures, with cold events more likely penetrating as south-easterlies.

Whaitua*	Variables	Climate outlook for winter 2022
Wellington Harbour & Hutt Valley	**Temperature:**	Above average; cold events surging mostly as south-easterlies.
	Rainfall:	Average to above, with low confidence for the total seasonal accumulation. High chance of extreme rainfall events.
Te Awarua-o-Porirua	**Temperature:**	Above average; cold events surging mostly as south-easterlies.
	Rainfall:	Average to above, with low confidence for the total seasonal accumulation. High chance of extreme rainfall events.
Kāpiti Coast	**Temperature:**	Above average; cold events surging mostly as south-easterlies.
	Rainfall:	Above average, with low confidence for the total seasonal accumulation. High chance of extreme rainfall events.
Ruamāhanga	**Temperature:**	Above average; cold events surging mostly as south-easterlies.
	Rainfall:	About average, with low confidence for the total seasonal accumulation.
Wairarapa Coast	**Temperature:**	Above average; cold events surging mostly as south-easterlies.
	Rainfall:	About average, with low confidence for the total seasonal accumulation.

*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

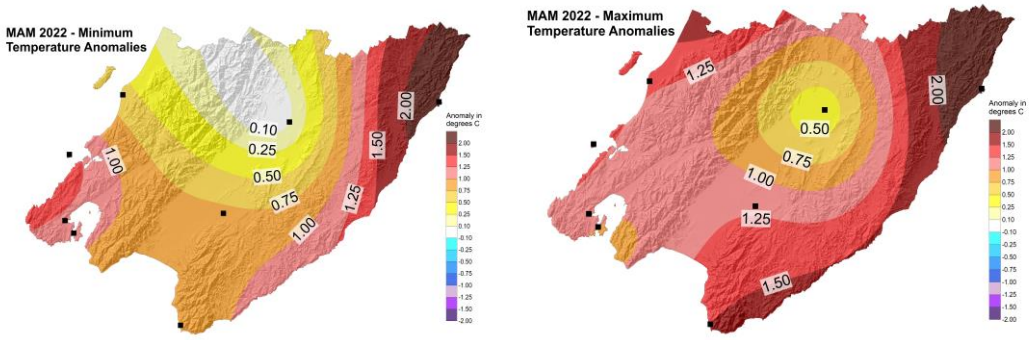
	MAM	MAM
	Min T	Max T
Castle Point	+2.5	+2.6
Kelburn	+1.2	+1.1
Masterton	+0.1	+0.4
Ngawi	+0.9	+1.5
Paraparaumu	+0.6	+1.3
Wellington Airport	+1.1	+1
Martinborough	+0.8	+1.2
Mana Island	+1.3	+1.3

Table 1: Temperature anomalies (°C) for MAM 2022 in relation to the 1981-2010 climatology. Significant positive and negative anomalies (greater than 0.5C magnitude) are highlighted in red (warmer than average) and blue (colder than average).

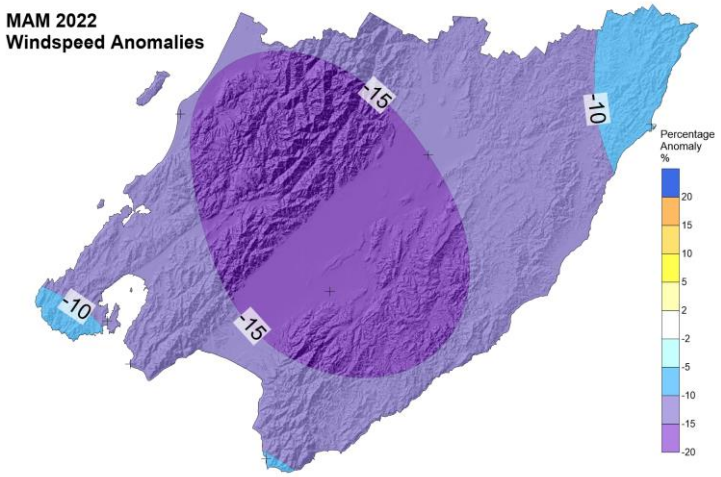
	MAM
	Wind %
Castle Point	-8.8
Masterton	-15
Ngawi	-9.8
Paraparaumu	-14.8
Wellington Airport	-10.2
Martinborough	-18.5
Baring Head	-10.1

Table 2: Wind anomalies (%) for MAM 2022 in relation to the 1981-2010 climatology. Significant positive and negative anomalies (greater than 10%) are highlighted in red (calmer than average) and blue windier than average).

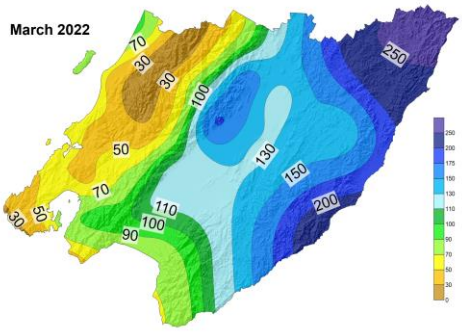
Appendix 2 - Seasonal anomaly maps in relation to the (1981-2010) long-term averages

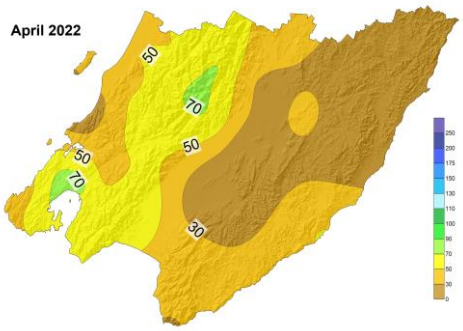


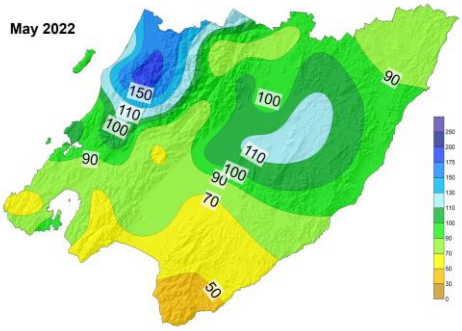
Min and Max Temperature anomalies (°C)

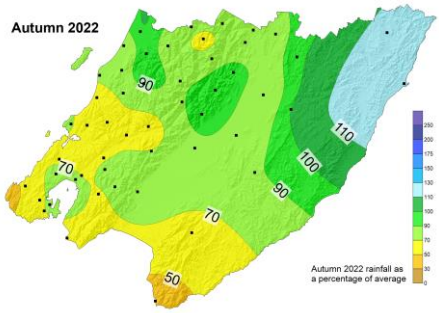


Wind anomalies (%)









Rainfall anomalies (%)

Acknowledgements

We would like to thank NIWA for providing selected VCSN data points for the calculation of the regional soil moisture map and for supplementing the rainfall percentage maps in data sparse areas.

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/