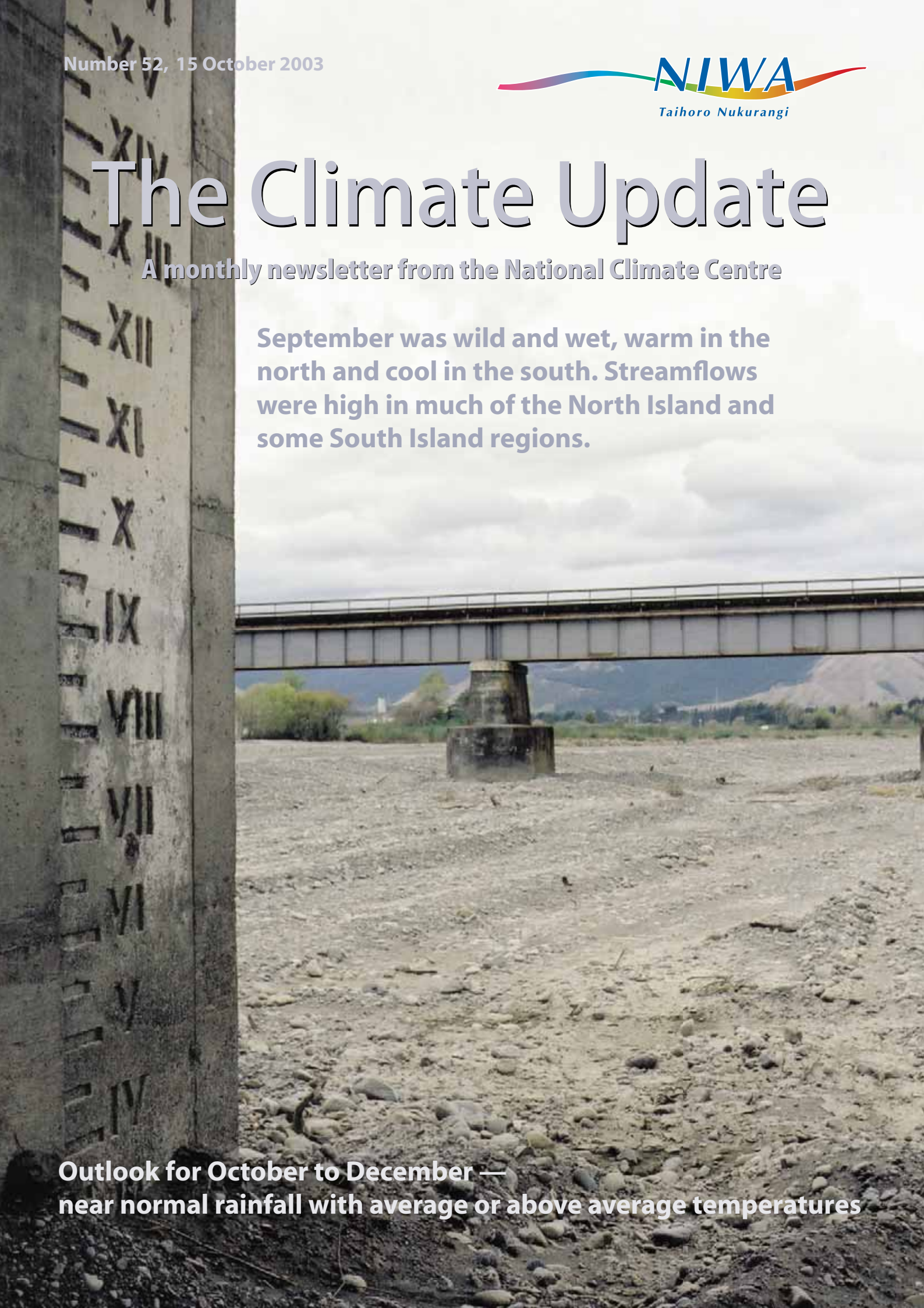
Number 52, 15 October 2003

NIWA
Taihoro Nukurangi

The Climate Update

A monthly newsletter from the National Climate Centre

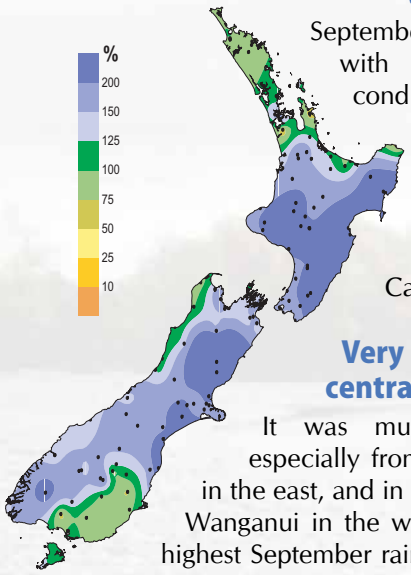
September was wild and wet, warm in the north and cool in the south. Streamflows were high in much of the North Island and some South Island regions.



Outlook for October to December — near normal rainfall with average or above average temperatures

New Zealand climate in September 2003

Rainfall



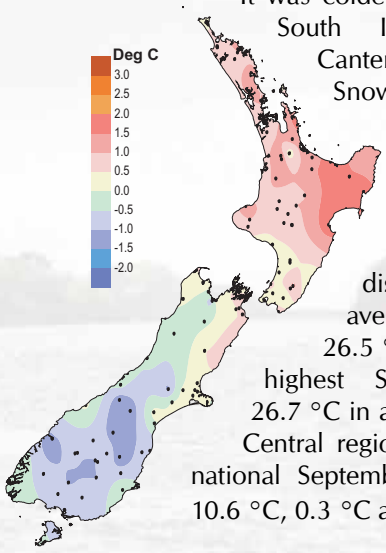
A stormy start to spring

September was a month of extremes with stormy and unsettled conditions throughout the country. There were frequent days of westerly gales with a top wind gust of 176 km/h on 18 September at South West Cape, Stewart Island.

Very wet, especially in central and eastern districts

It was much wetter than normal, especially from Gisborne to north Otago in the east, and in Taranaki, King Country, and Wanganui in the west. Wanganui recorded its highest September rainfall since records began in 1890. In contrast, near normal rainfall occurred in eastern Southland, parts of Otago, and in the far north of the country.

Mean air temperature



Warm in the north, cold in the south

It was colder than average in the lower South Island, especially inland Canterbury and Central Otago. Snow to low levels in Canterbury at the end of the month brought stock losses, particularly among new-born lambs. Northern and eastern North Island districts were warmer than average, with Napier reaching 26.5 °C on 26 September. Its highest September temperature is 26.7 °C in a record going back to 1868. Central regions were near average. The national September mean temperature was 10.6 °C, 0.3 °C above average.

Above and left: Percentage of average rainfall (above left) and the difference from the average air temperature in degrees Celsius (above). Dots indicate recording sites.

Sunshine

Sunshine totals were below average in Northland, Gisborne, Central Otago, Westland, and Fiordland, and near normal in most other regions. Queenstown had its second lowest September sunshine total since records began in 1930.

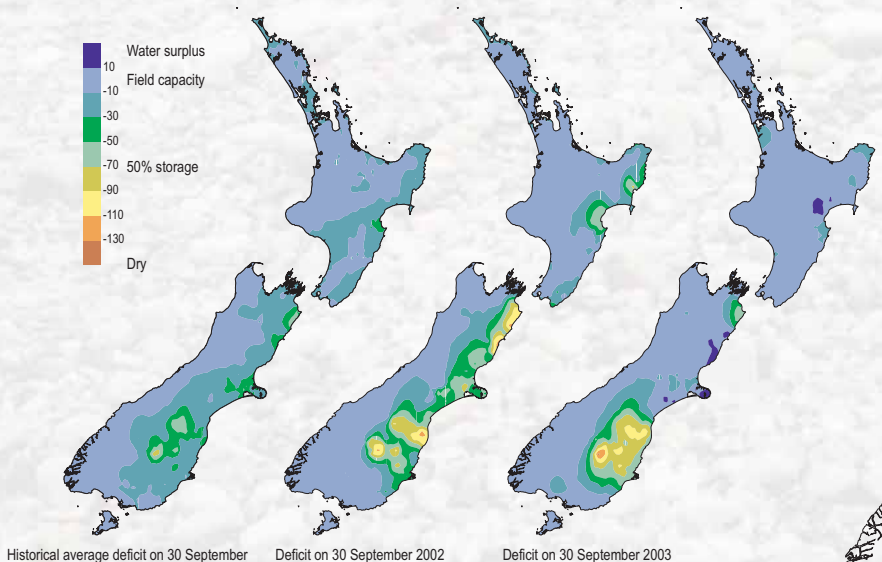
River flows

Flows were above normal for all North Island rivers, apart from some streams in Northland, Coromandel, and Bay of Plenty. South Island streamflows were above normal in Nelson, Buller, north and mid Canterbury, and western Southland. They were below normal in eastern Southland and south and Central Otago, and normal elsewhere.

Soil moisture levels at field capacity in most places

Soils were generally at field capacity, and in some eastern areas, there were water surpluses. Soil moisture deficits remained in South Canterbury and North and Central Otago, but conditions improved in coastal Marlborough.

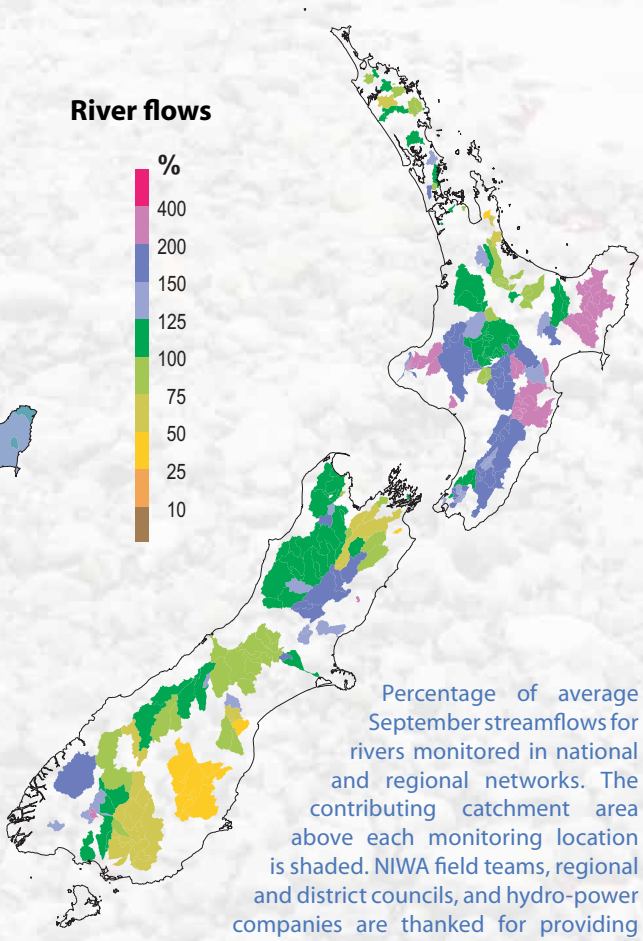
Soil moisture deficit



Historical average deficit on 30 September | Deficit on 30 September 2002 | Deficit on 30 September 2003

Soil moisture deficit in the pasture root zone at the end of September (right) compared with the deficit at the same time last year (centre) and the long-term end of September average (left). The water balance is for an average soil type where the available water capacity is taken to be 150 mm.

River flows



Percentage of average September streamflows for rivers monitored in national and regional networks. The contributing catchment area above each monitoring location is shaded. NIWA field teams, regional and district councils, and hydro-power companies are thanked for providing this information

Checkpoint

From July to September, temperatures were near or below average in most regions, which was lower than expected. The expected cold snaps, snow, and inland frosts eventuated with a very frosty July.

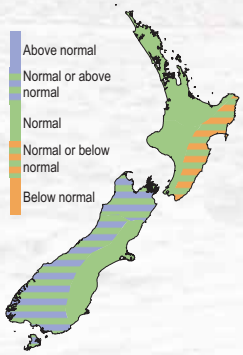
Rainfall was as expected in most areas, but it was wetter in the eastern North Island and drier in the northern South Island and Waikato.

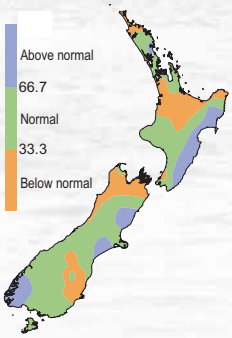
River flows were lower than expected in the west of the North Island and the north of the South Island, and higher than expected in the east of the North Island. Elsewhere they were much as expected.

Outlook — What we said

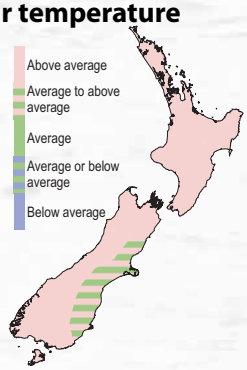
Outcome — What actually happened

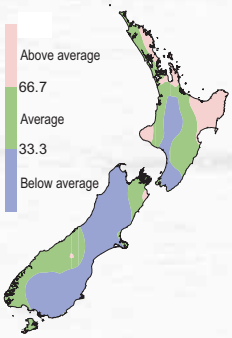
Rainfall



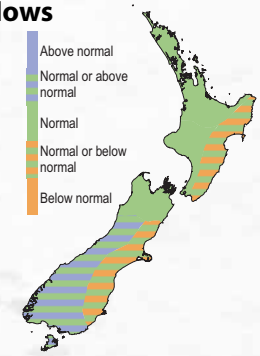


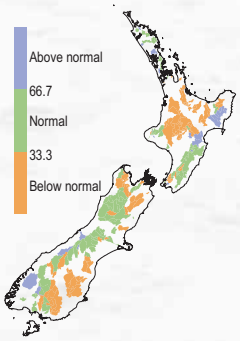
Mean air temperature





River flows





The three outcome maps (right column) give the tercile rankings of the rainfall totals, mean temperatures, and river flows that eventuated for July to September 2003. Terciles were obtained by dividing ranked July to September data from the past 30 years into three groups of equal frequency (lower, middle, and upper one-third values) and assigning the data for the present year to the appropriate group. As an approximate guide, middle tercile rainfalls (33.3 to 66.7%) often range from 80 to 115% of the historical average. Middle tercile air temperatures typically occur in the range of the average plus or minus 0.5 °C. The upper, middle, and lower tercile ranges are indicated in the maps by the terms Above normal, Normal, and Below normal, respectively.

Outlook

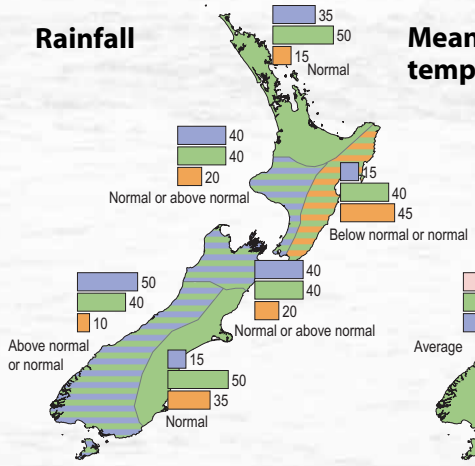
October to December

Late spring is expected to be mild, with average or above average temperatures in all districts. Normal rainfall is expected in the upper North Island and eastern South Island, with normal or above normal rainfall in all western areas and the north of the South Island, and normal or below normal rainfall in the east of the North Island.

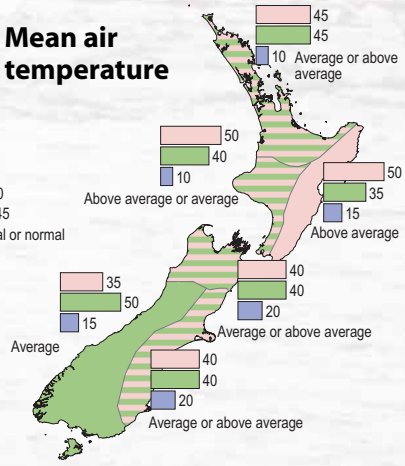
Soil moisture levels and river flows are expected to be normal or above normal, except for the east of the South Island, where normal or below normal river flows are likely.

Local circulation patterns are expected to favour below average mean sea-level pressures and enhanced westerly-quarter winds. The tropical Pacific has moved into a neutral state and is expected to remain neutral (no El Niño or La Niña) through to the end of summer 2003–04.

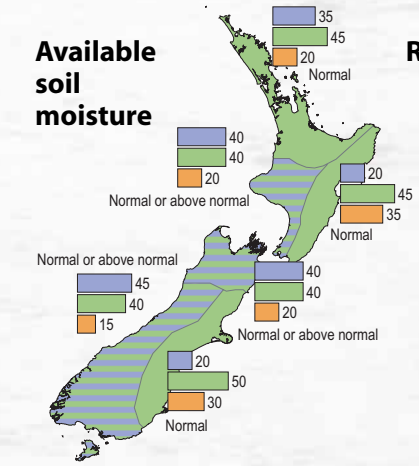
Rainfall



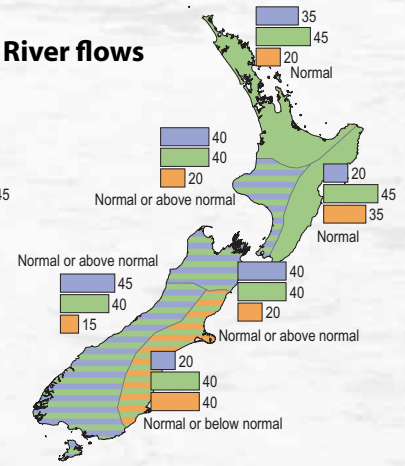
Mean air temperature



Available soil moisture



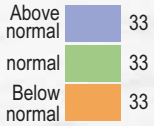
River flows



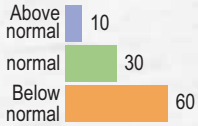
Key to maps (example interpretation)

In example A, climate models give no strong signals about how the climate will evolve, so we assume that there is an equal chance (33%) of the climate occurring in the range of the upper, middle, or lower third (tercile) of all previously observed conditions. In example B there is a relatively strong indication by the models (60% chance of occurrence) that conditions will be below normal, but, given the variable nature of climate, the chance of normal or above-normal conditions is also shown (30% and 10% respectively).

A
No strong climate signal



B
Strong expectation of below normal



A drought index based on river flows

Roddy Henderson, NIWA
Catchment Processes and Water Resources

In contrast to natural hazards, such as floods and earthquakes, the onset of a drought is slow and unspectacular, but its effects can be severe, as with the effects over the last decade on urban water supply, energy generation, and the pastoral industry. Drought is by far the most costly natural hazard in New Zealand.

Recent droughts and their impacts include:

- winter 1992 in the hydro-electric catchments: reduced GDP by $1,000 million
- 1993–94 in Auckland water supplies: prompted construction of the Waikato pipeline at a cost of $171 million (2001)
- 1997–98 on North Island and South Island east coasts: reduced GDP by $618 million
- 1998–99 in North and Central Otago: reduced GDP by $539 million
- 2001 in South Island hydro-electric catchments: Natural Gas Corporation lost $302 million.

Droughts cover large areas and long time periods and are difficult to summarise succinctly and assess for severity in comparison with previous droughts. They affect different parts of the economy in different ways, and there are many different ways of characterising drought severity. A drought index based on river flow has the advantage of adding up the effects of low rainfall and soil moisture deficit over the area of a river catchment, and accounts for effects of enhanced evaporation caused by higher temperatures. It can be updated regularly, and normalised for comparison between rivers.

A drought can be defined as a period when the river flow is less than an expected value. During a drought, the index is increased by the amount of the flow deficit (the difference between the recorded flow and the flow expected for the time of year). The River Drought Index (RDI) indicates the severity of the drought. For example, an RDI of 3 indicates that flow was less than that expected for the time of year, by an amount exactly equal to the long-term expected value, for 3 months, or by half that amount for 6 months, etc. Growth of the RDI will provide an indicator of drought development. Monthly maps of the RDI using the flow data supplied for page 2 of *The Climate Update* can be developed to show drought growth in both intensity and spatial extent.

Examples of the RDI are provided in Figures 1 and 2 for the Selwyn River and for Lake Wanaka outflows respectively. In both figures the blue line is a six-month running-average of the river flow that actually happened month by month, and the green line is the expected monthly flow based on the historical record, repeated every year. When the blue line (averaged over the last 6 months) is below the green line, then a drought has begun. The red line shows the RDI, which grows until the six-month average of the blue line is above the green line again.

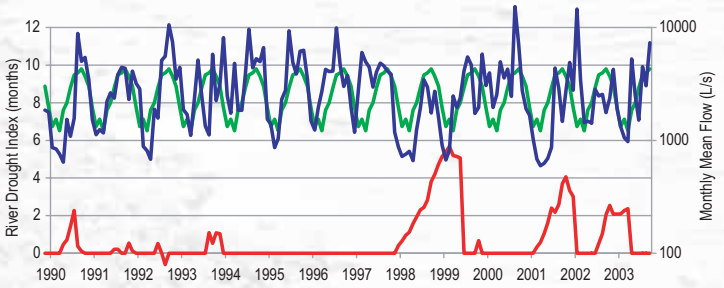


Figure 1: River flows for the Selwyn River in Canterbury, representative of the South Island east coast. The RDI reached a peak of almost 6 at the start of 1999, highlighting the major drought of 1998–99 and its relative severity.

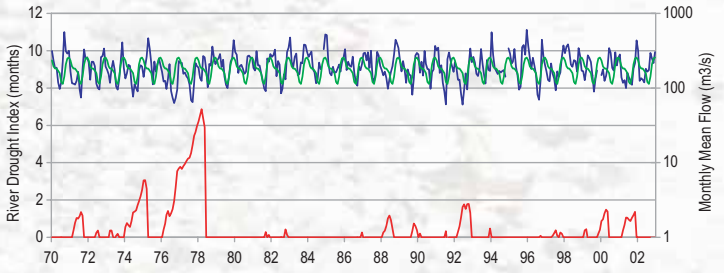
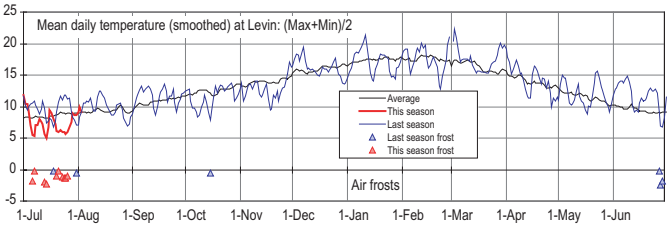


Figure 2: Flows from Lake Wanaka between 1970 and 2002, representative of flows through the major South Island hydro-electric stations. The 1992 hydro drought had a peak RDI value at Lake Wanaka of 2, but the peak RDI for the longer drought that ended in 1978 was more than 7. From 1945 to 1978 there were nine droughts at Lake Wanaka that had a higher RDI than the drought of 1992.

On line climate graphics

Climate maps and line plots of climate site observations are updated each week on the Climate Now website at www.niwa.co.nz/ncc/climatenow



Dry bed of the Otaki River, March 2003, as seen at the bridge west of SH1.

Cover photo:
Alan Blacklock.

The Climate Update is a monthly newsletter from NIWA's National Climate Centre for Monitoring and Prediction, and is published by NIWA, Private Bag 14901, Wellington. It is also available on the web. Comments and ideas are welcome. Please contact Alan Porteous, Editor
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