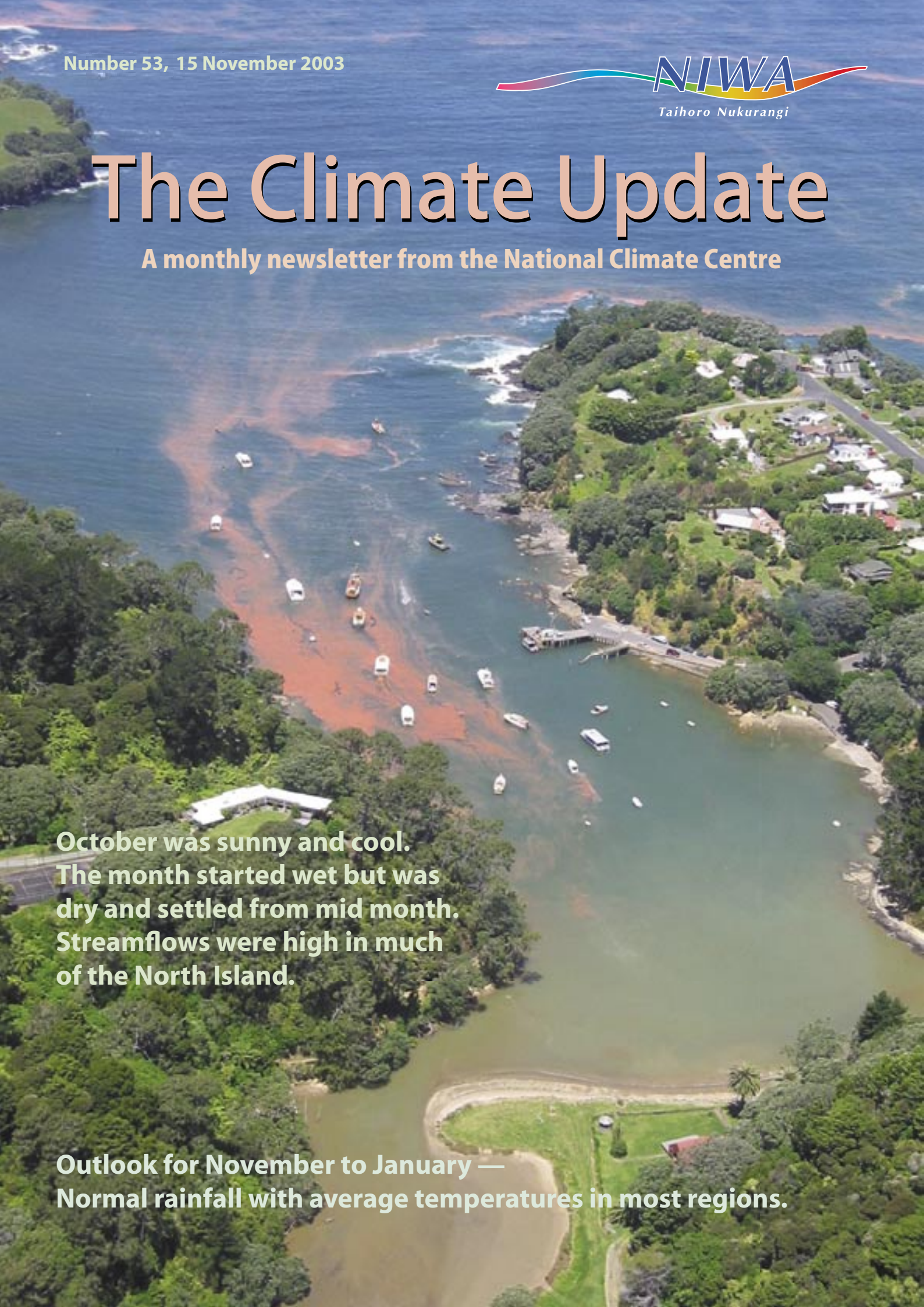
Number 53, 15 November 2003

NIWA
Taihoro Nukurangi

The Climate Update

A monthly newsletter from the National Climate Centre

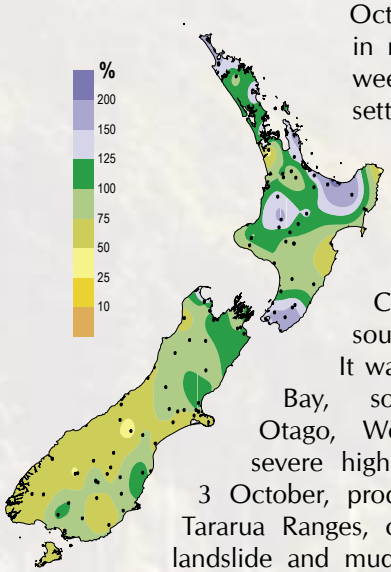


October was sunny and cool. The month started wet but was dry and settled from mid month. Streamflows were high in much of the North Island.

Outlook for November to January — Normal rainfall with average temperatures in most regions.

New Zealand climate in October 2003

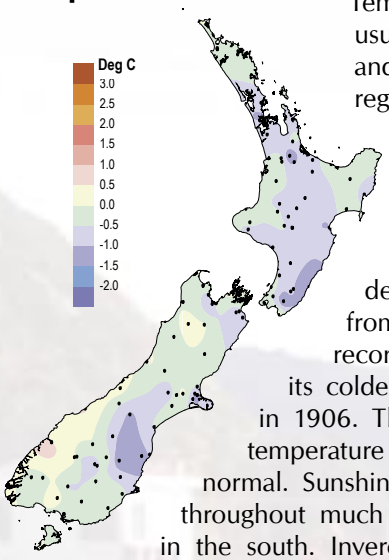
Rainfall



A month of two halves

October was wet and unsettled in many areas for the first two weeks, and mainly dry and settled for the rest of the month. Westerly winds were less frequent than usual. Rainfall was well above average in some areas, particularly Northland, Coromandel, Bay of Plenty, south Wairarapa, and Wellington. It was below average in Hawke's Bay, south Canterbury, Central Otago, Westland, and Fiordland. A severe high intensity rainfall event on 3 October, producing 200–300 mm in the Tararua Ranges, contributed to a devastating landslide and mudslide at Paekakariki, closing SH1 and isolating Wellington for some hours.

Mean air temperature



Cool but sunny

Temperatures were lower than usual in many North Island and eastern South Island regions, and near average elsewhere. Some Bay of Plenty and Marlborough orchards were affected by frosts, and late snow in Canterbury caused the deaths of thousands of lambs from exposure. Hanmer Forest recorded –5.5 °C on 6 October, its coldest night since records began in 1906. The October national average temperature was 11 °C, 0.3 °C below normal. Sunshine totals were above average throughout much of New Zealand, especially in the south. Invercargill had its third sunniest October since 1932.

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

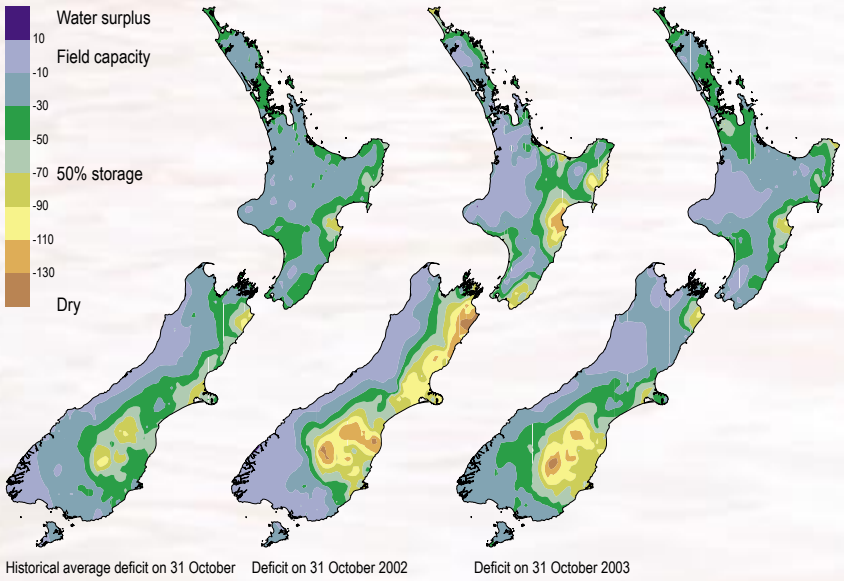
Soil moisture levels near average

For most of New Zealand, soil moisture levels were near the historic average. However, at the end of the month, much of Otago had less than 50% of normal storage. Some parts of Central Otago were particularly dry, with conditions similar to those of October 2002.

River flows

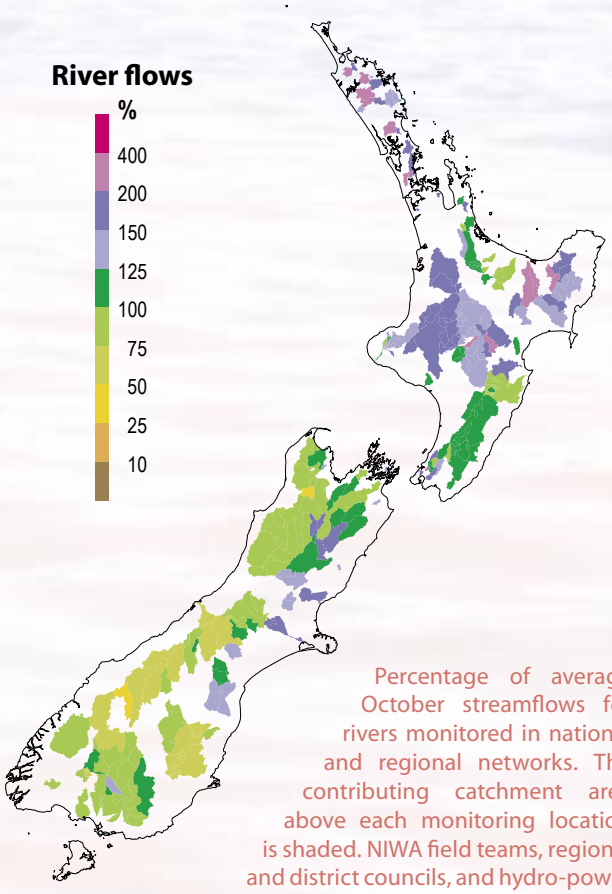
October streamflows were above average for many North Island rivers, apart from some streams in the Bay of Plenty and southern Hawke's Bay. South Island streamflows were near average in Nelson, Buller, Marlborough, south Canterbury and North Otago; above average in north and mid Canterbury; and tended to be below average in central Otago and the west and south of the South Island.

Soil moisture deficit



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

River flows



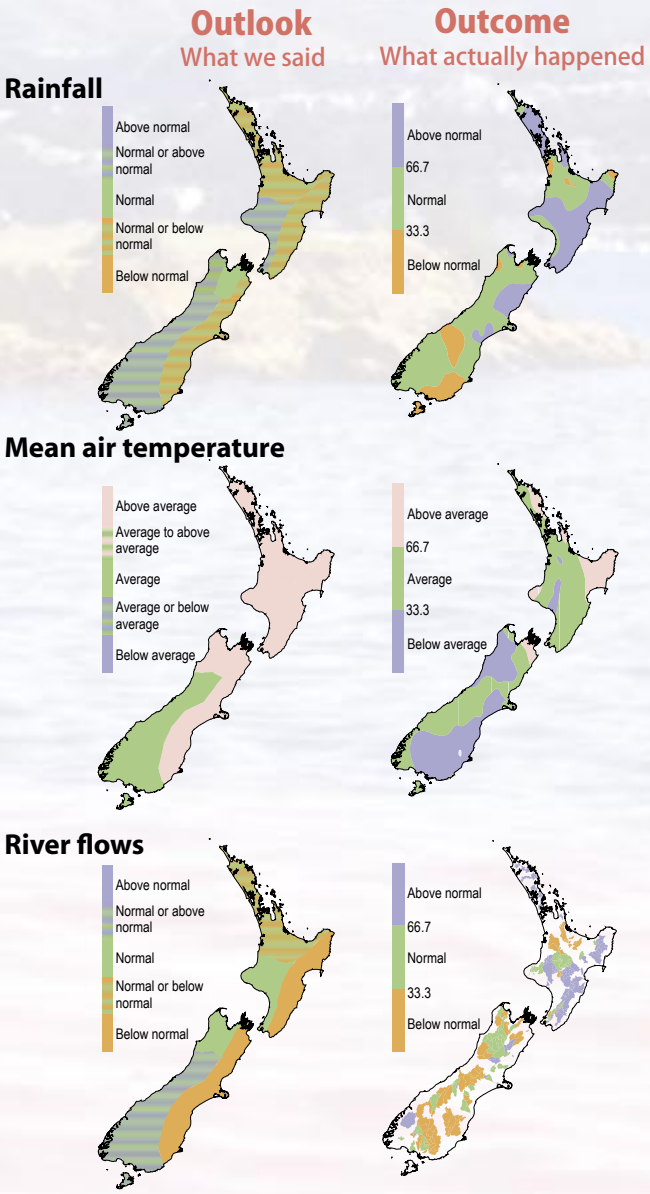
Percentage of average October streamflows for rivers monitored in national and regional networks. The contributing catchment area above each monitoring location is shaded. NIWA field teams, regional and district councils, and hydro-power companies are thanked for providing this information

Checkpoint

Temperatures were lower than expected in most districts. East Cape, Westland, and Fiordland recorded temperatures close to those predicted in the outlook.

Rainfall was higher than expected in the eastern and northern North Island, and much of the eastern South Island. It was drier than expected in eastern Southland. Elsewhere it was mostly as predicted.

River flows were higher than expected in most North Island regions. In the South Island, flows were as expected in the northern region, but were higher than predicted in the east and lower than predicted in the west.



The three outcome maps (right column) give the tercile rankings of the rainfall totals, mean temperatures, and river flows that eventuated for August to October 2003. Terciles were obtained by dividing ranked August to October 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.

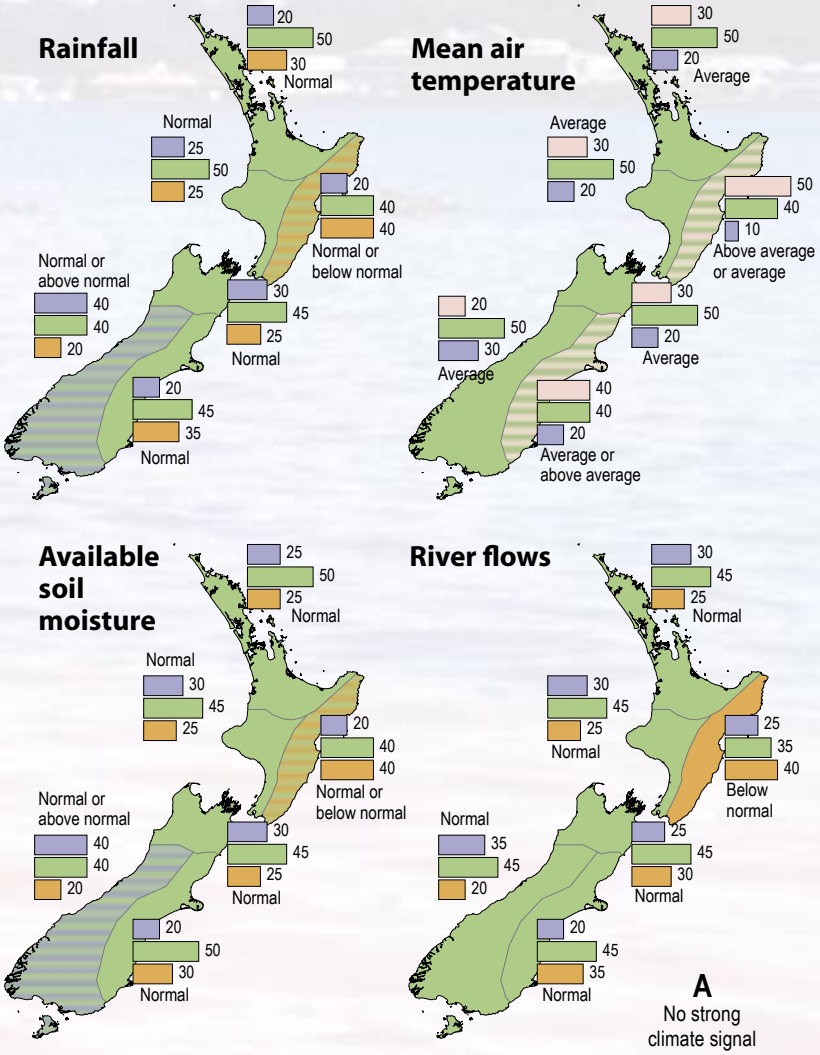
Outlook

November to January

Rainfall is expected to be normal or below normal for the eastern North Island, and normal or above normal for the western South Island, with normal rainfalls elsewhere. Average or above average temperatures are likely in eastern regions of both Islands, with average temperatures expected elsewhere.

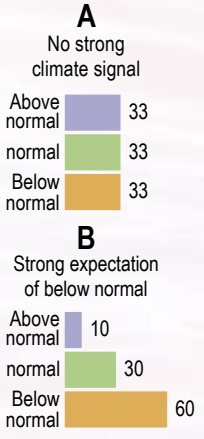
Soil moisture levels and river flows are expected to be below normal or normal for the southeastern North Island, normal or above normal for the west and south of the South Island, and normal elsewhere.

The tropical Pacific is in a neutral state (no El Niño or La Niña) and is expected to remain so through to the end of summer 2003–04.



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).

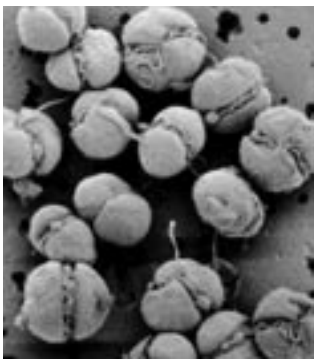


Backgrounder

Occurrence of major harmful algal blooms in New Zealand: is there a link with climate variations?

Hoe Chang and Brett Mullan, NIWA, Greta Point, Wellington

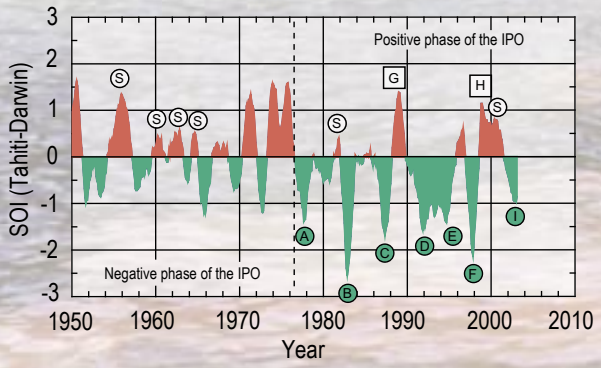
Marine algae grow rapidly under conditions of high light intensity, plentiful nutrients, and favourable water temperatures. When microalgae build up to massive numbers they are said to form blooms (collectively termed 'red-tides' in the past). In winter, although nutrients are plentiful, the deep mixing caused by winds and turbulence generally inhibits algal growth. As the ocean mixed-layer shoals in spring, microalgae close to the surface waters become exposed to higher light intensity and reasonably high nutrients. This provides the conditions for rapid growth, and typically diatoms are the first to take advantage of this change and form strong blooms in coastal waters around New Zealand. In summer, as the surface waters become warmer, and thus more stable, nutrients become scarce, and so algal blooms are generally not expected.



Electron microscope photo of the dinoflagellate, *Karenia brevisulcata*, responsible for mass marine life mortality and contributing to human respiratory syndrome during the 1998 toxic episodes in Wellington Harbour.

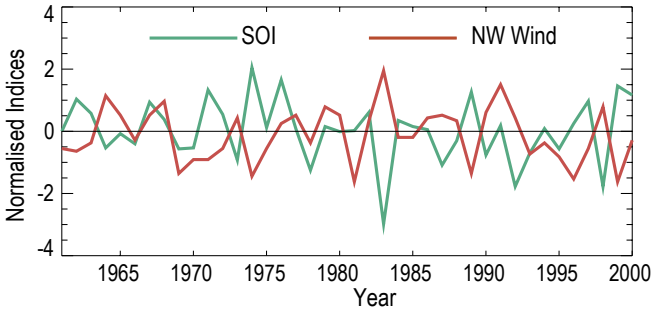
However, in the last five decades a relatively large number of irregular, but widespread, harmful algal blooms (HAB) were recorded in summer. Many of these blooms, dominated by dinoflagellates (left), were very noticeable, particularly to the general public, through their effects such as visible discoloration of the water, foam/slime production, fish or marine fauna kills, or poisoning to humans through seafood consumption.

It is now clear that almost all major HAB recorded in the last 50 years coincided with El Niño Southern Oscillation (ENSO) events. Between 1950 and 1977, four nuisance "slime" events were reported in New Zealand, mainly during La Niña events in the negative phase of the Interdecadal Pacific Oscillation (IPO). From 1978 to 2002, twelve major HAB outbreaks were reported, most on the North Island northeast coast during El Niño events in the positive phase of IPO (see graph below). It is thus possible that the IPO is modulating algal bloom activity around New Zealand.



Major harmful algal blooms (HAB) recorded from 1950 to 2002: S, nuisance "slime" events; A–I, other major harmful algal events. IPO phases are marked. (See *The Climate Update*, May 2000 and October 2000, for discussion of the IPO.)

A relatively high proportion of these blooms, particularly those recorded during the El Niño events from 1978 to 2002, caused widespread fish and marine fauna kills. On some occasions these toxic episodes also posed human health risks – either direct food poisoning through shellfish consumption or human respiratory syndrome through exposure to toxic 'aerosol' generated by the blooms. The question arises from observations of these mostly summer HAB events during ENSO: what is driving these "unseasonal" and very widespread major blooms in summer in New Zealand?



Variation of SOI and northwesterly wind on northeast coast of North Island in summer seasons, 1961–2000.

Wind records collected in New Zealand over many years clearly show the strengthening during El Niños of northwesterlies on the North Island northeast coast (above), and of southwesterlies on the South Island northwest coast. Along-shore winds produce a transport of water to the left of the wind (in the southern hemisphere), and therefore offshore for these two coastline segments. Strengthening of local winds during El Niño in summer thus leads to an increase of upwelling intensity and surface nutrient enrichment in these regions. The cold, nutrient-rich waters brought up from the deep in these areas in summer, in particular off the North Island northeast coast when nitrate nutrient is normally undetectable, have been suggested to promote growth and eventually lead to the build-up of the very widespread, strong HAB events.

Thus, wind changes during El Niño summers can generate a sustained nutrient supply during a season that is normally nutrient poor, and encourage the development of harmful algal blooms around New Zealand.

Stunning "red tides" can be seen clearly in this aerial photo taken near Langs Beach on the east coast between Auckland and Whangarei on 1 December 2002.

Cover photo: *Miriam Godfrey.*

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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