

The changing climatic environment for New Zealand's land-based sectors

In 2013 the Intergovernmental Panel on Climate Change (IPCC) released the latest Working Group Report concluding once again that warming of the climate system is unequivocal. It is now considered extremely likely (>95% chance) that more than half of the observed increase in global average surface temperature is due to human activity.

For New Zealand's primary sector managers, considering the impacts and risks of climate change, as well as determining appropriate response and adaptation strategies, are important tasks ahead. Reliable information on change in the regional climate system as well as a range of plausible future climate scenarios will be vital. Notwithstanding the dynamic nature of the climatic system, objective estimates of current and future variability in the New Zealand region are now available that can assist decision making.

Climate variability in New Zealand

New Zealand has a maritime climate with sources of variability dominated by changes in latitude, topography and sea temperature. The major climate drivers are mid-latitude westerly winds and subtropical highs which move north and south seasonally. Localised variations also occurs across the country due to factors such as aspect, landscape shape and vegetation (Figure 1). In spite of this climatic variability there is a degree of 'certainty' about the reliability of our climate patterns

A large and constant supply of moisture from the surrounding

ocean means that less rainfall is sourced by evaporation from the land surface. This contrasts with the aridity and desertification typically observed on continental land masses.

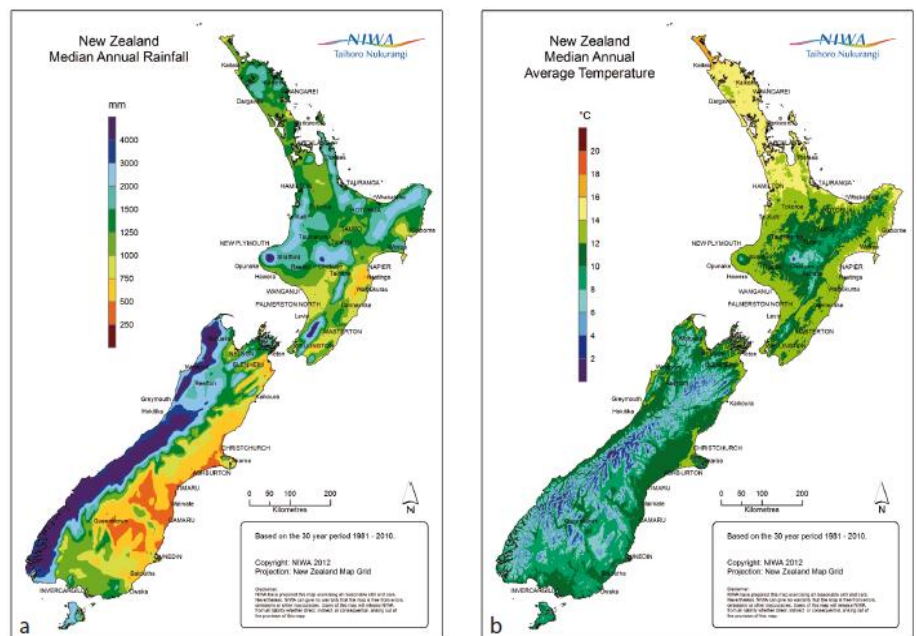


Figure 1: General climatology of New Zealand for the period 1981–2010 showing median annual values of variables (a) Rainfall (b) Temperature.

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Observed Changes

Temperature

Records compiled from 7 representative sites around New Zealand show that there is a significant rise in temperature consistent with global warming of around 0.9°C since 1909 (Figure 2). More detailed modelling that removes data bias and takes local climatic processes into account affirms that the 50-year trends in New Zealand temperature cannot be explained by natural variability alone. An increase in southerly flow since about the 1960's has meant the observed temperature increase has been lower than expected, leading to a dampening of the influence of global warming in the New Zealand region.

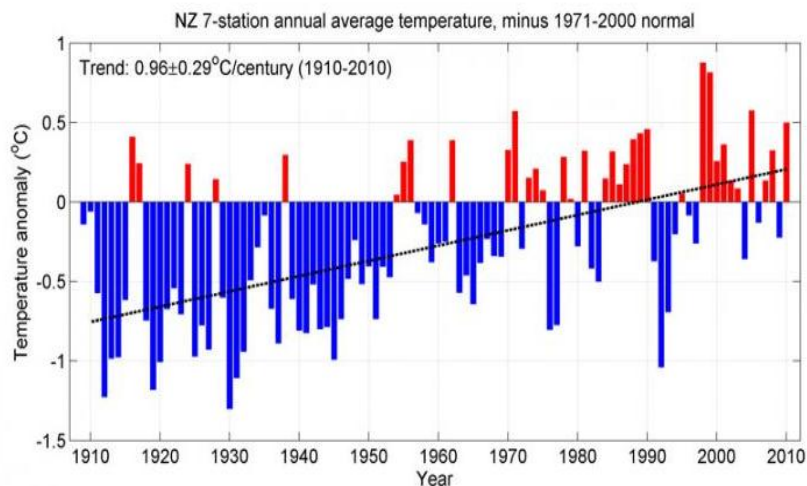


Figure 2. Mean annual temperature for New Zealand, calculated from NIWA's 'seven-station' series. The blue and red bars show the difference from the 1971-2000 average. The black dotted line is the linear trend over 1910 to 2010 (0.96°C/100 years).

Rainfall

Rainfall regimes in New Zealand are typically dominated by a west-east gradient, with greater between-year variability observed in eastern areas in lee of the ranges. These patterns are an important influence on primary production. A recent study looking at trends across New Zealand has shown large changes in the last 30 years, with increases (and decreases) of up to 4% for different areas of the country per year (Figure 3). These observations provide a glimpse of the changes possible for the regional climate system in the future and indicate seasonal differences in rainfall change across regions.

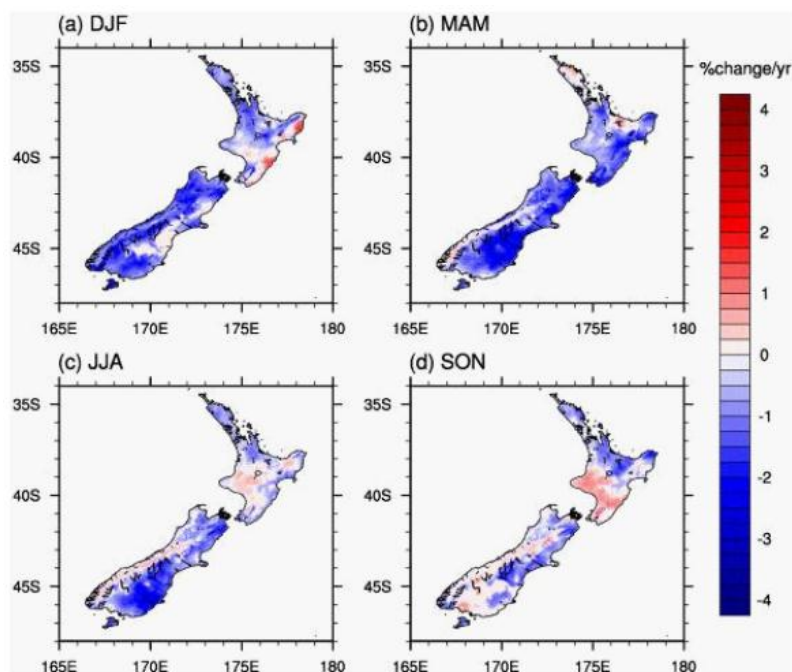


Figure 3. Trends in daily precipitation amount (percentage of long-term average per year) for New Zealand for the period 1970–2007. (a) Summer. (b) Autumn. (c) Winter. (d) Spring.

Notwithstanding the comparatively small climate monitoring network in New Zealand, land management professionals can freely access NIWA's High Intensity Rainfall Design System (HIRDS) and perform calculations to estimate rainfall frequency at any location in New Zealand (<http://hirds.niwa.co.nz>)

Regional Scenarios of Climate Change

National Projections

Global projections of the earth's temperature are derived from Atmosphere Ocean General Circulation Models (AOGCMs) that are set up to simulate climate over 100 years or more. National projections for New Zealand have been developed by downscaling the climate information derived from global models. Based on a mid-range emission scenario, New Zealand temperature projections track at around 0.25-0.5°C below the global average because of the buffering effect of the surrounding oceans. Under this emission scenario global average surface temperature is expected to rise by around 1.4°C by 2040 and around 2.8°C by the end of the 21st century, when compared to the 1990's. A consistent signal from global climate model forecasts is for an increase in the westerly wind circulation over New Zealand. As a result, an increase in annual mean precipitation in western regions of New Zealand is projected along with a decrease in rainfall in the east of the country. The ranges for annual precipitation changes however show that there are some large differences depending on the AOGCM used.

Primary Sector Adaptation Scenarios (PSAS)

To provide practical scenarios for primary sector adaptation analysis a more streamlined climate scenario design has been developed. The PSAS provides a mid to high end temperature change when considering the full range of national projections. They also cover the broad range of seasonal and locational changes in rainfall (see the full report listed on page 4 for more information). Scenarios are simplified to “high and low” and represent two plausible climate futures within the broader range of outcomes expected for New Zealand (Figure 4).

- The **high scenario ('A2')** has a +1.2°C change by 2040 (2030–49) starting from a 1980–99 baseline. National rainfall change is -1.8%; the regional pattern is a plausible but less likely outcome for New Zealand.
- A **low scenario ('B1')** has a +0.89°C change by 2040 with a National annual rainfall change of +2.8%. The regional pattern is consistent with the more likely outcome in the nationally consistent projections for New Zealand, with drier eastern and northern summers.

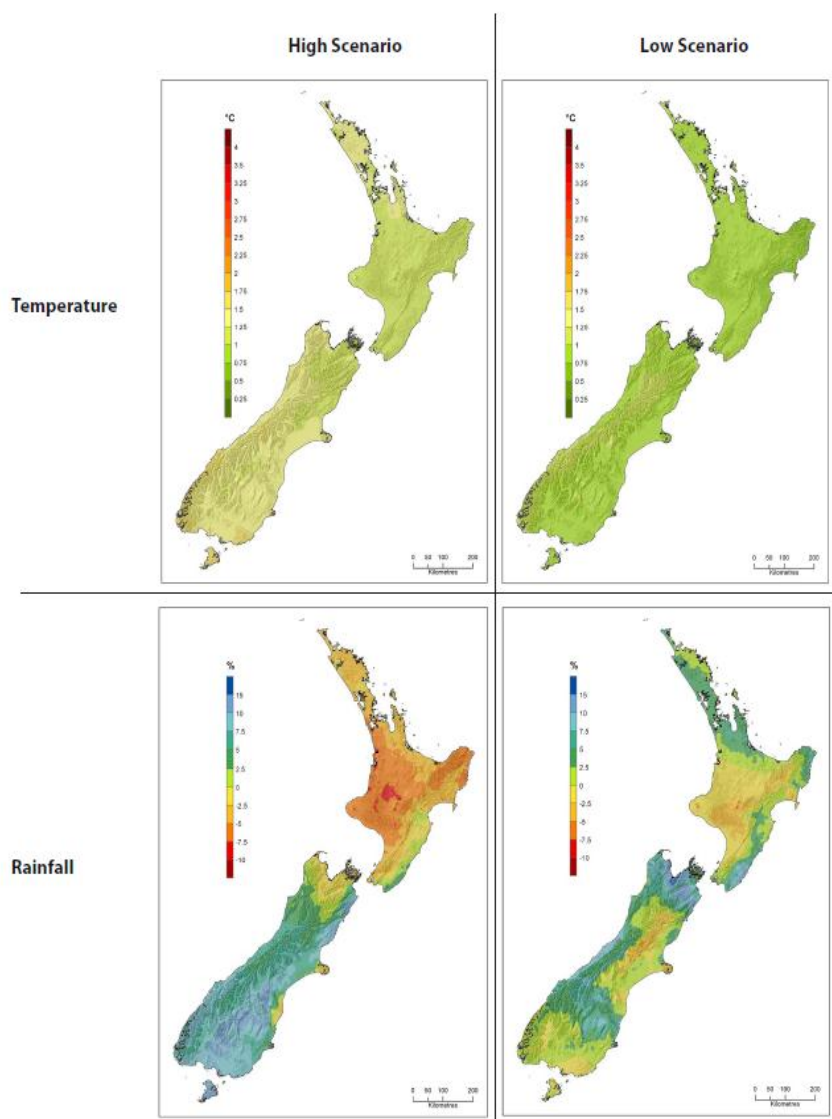


Figure 4. Spatial pattern of change for mean annual temperature (°C) and rainfall (percentage) in the high (A2) and low (B1) adaptation analysis scenarios at 2030–2049.

Climate Science for Adaptation

The impact that climate has on different sectors, systems and groups is the complex result of climate exposure, sensitivity and adaptive capacity. Climate science can provide important information around baseline exposure as well as insights into what changes are occurring and what this may mean in the future. Successful adaptation strategies for New Zealand's primary sector will need to consider a range of alternative climate futures. The best guidance will always be a collection of plausible predictions, not one certain outcome. This type of 'what-if' planning has been used successfully to prepare for other phenomena where there are uncertainties, in a way that utilises the full suite of available scientific and management knowledge.

Further Information

The full technical report, Impacts of climate change on land-based sectors and adaptation options: Chapter 2 Climate, can be downloaded from <http://www.mpi.govt.nz/news-resources/publications>. Additional chapters relating to dairy, sheep and beef, broad acre cropping, horticulture, forestry and water resources are also available by following this link. These chapters provide more specific information and adaptation strategies for the relevant land based activity.

A sector-by sector guide to adaptation can be found at: <http://www.mpi.govt.nz/environment-natural-resources/climate-change/resources-and-tools/climate-change-resources-bysector>

Additionally, a practical online adaptation toolbox to help guide you through key decisions is available at: <http://www.mpi.govt.nz/environment-natural-resources/climate-change/resources-andtools/adaptation-toolbox.aspx>

At <http://www.niwa.co.nz/our-science/climate/publications> you can find seasonal climate summaries, outlooks and updates, plus NIWA's State of the Climate report, published every two to three years.

To download climate data for New Zealand you can access NIWA's climate database at <http://cliflo.niwa.co.nz>

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