Climate Change

IPCC Fourth Assessment Report

Impacts: New Zealand & the South Pacific

The Intergovernmental Panel on Climate Change (IPCC) has released an authoritative report on climate change impacts, adaptation, and vulnerability. This leaflet highlights some of its key findings for New Zealand, Australia, and the South Pacific.

The report of Working Group II of the IPCC was released (subject to final edits) in April 2007. It contains chapters on regional climate change including for the New Zealand/Australia region and small islands.

The Fourth Assessment

The IPCC was formed in 1988 to provide reliable scientific advice on climate change. Approximately every six years, it has produced a full assessment of the current state of scientific knowledge on climate change and what it means for us. These reports synthesise evidence and analyses published either in peer-reviewed journals or other credible sources.

The IPCC Fourth Assessment Report comprises four volumes:

- Working Group I: The Physical Science Basis
- Working Group II: Impacts, Vulnerabilities, and Adaptation
- Working Group III: Mitigation of ClimateChange
- Synthesis Report

The process involved over 1200 scientific authors and over 2500 expert reviewers from more than 130 countries.

More data, more certainty

The IPCC's previous (third) assessment was published in 2001.

Since then, there has been:

- more extensive documentation of observed changes to natural systems as a result of warming. (Over 29,000 data series of observations were used in the report as a whole.)
- major advances in understanding potential future climate changes and impacts
- more attention to the role of planned adaptation in reducing vulnerability
- new assessment of key risks and benefits
- advancement in research on assessing vulnerability to future climate change

Regional climate change has already occurred

Since 1950, there has been 0.3–0.7 °C warming across the Australia/NZ region as a whole, with more heat waves, fewer frosts, more rain in southwest New Zealand, less rain in northeastern New Zealand, and a rise in sea level of about 70 mm.

We are already experiencing the impacts of climate change

The report states with "high confidence" that impacts of regional climate change are now evident in increasing stresses on water supply and agriculture, changed natural ecosystems, reduced seasonal snow cover, and ongoing glacier shrinkage.

Adaptation is already occurring to combat observed climate change: examples come from sectors such as water, natural ecosystems, agriculture, horticulture, and coasts. However, ongoing vulnerability to extreme events is demonstrated by substantial economic losses caused by droughts, floods, fire, tropical cyclones, and hail.

Adaptation can have immediate benefits

A portfolio of adaptation and mitigation measures can diminish the risks of climate change. Even if we shut off greenhouse gas emissions today, the world is committed to a 0.6 °C rise in global average surface temperature by 2100. In addition, because of lags in the climate system, the report says there is unlikely to be any noticeable climate effect from reducing greenhouse gas emissions (mitigation) until at least 2040. The benefits of adaptation, by contrast, can be immediate, especially when they also address climate variability. Adaptive measures can be implemented at all levels now with local benefit, without the need for global agreements. However, over the long run, adaptation alone cannot deal with all the projected effects of climate change if temperatures continue to rise. Eventually adaptation measures will be insufficient. Vulnerability to climate change will increase as impacts worsen.

New Zealand: future climate projections

During the 21st century, New Zealand's climate is "virtually certain" [more than 99% probability] to be warmer, with noticeable changes in extreme events:

- Heat waves and fire risk are virtually certain to increase in intensity and frequency.
- Floods, landslides, droughts, and storm surges are very likely to become more frequent and intense, and snow and frost are likely to become less frequent.
- Large areas of eastern New Zealand are likely to have less soil moisture, although western New Zealand is likely to receive more rain.

New Zealand: the impacts

Some beneficial effects initially

- Up to about 2050, enhanced growing conditions from higher carbon dioxide concentrations, longer growing seasons and less frost risk are likely to benefit agriculture, horticulture, and forestry over much of New Zealand provided adequate water is available. But by 2050, agriculture and forestry production is likely to be reduced over parts of eastern New Zealand due to ncreased drought and fire.
- Reduced energy demand is very likely in winter.
- Flows in New Zealand's largest rivers are likely to increase, benefiting hydroelectricity generation and irrigation supply.

These benefits are limited to specific sub-sectors and sub-regions, and are for a global average temperature increase of about 1–2 °C.

The potential impacts of climate change are likely to be substantial without further adaptation. The most vulnerable sectors for New Zealand are natural ecosystems, water security, and coastal communities.

Natural ecosystems

The structure, function, and species composition of many natural ecosystems are very likely to alter. Some of these are within World Heritage sites.

The impacts of climate change are likely to be significant by 2020, and are virtually certain to:

- exacerbate existing stresses such as invasive species and habitat loss;increase the probability of species extinctions;
- degrade many natural systems;
- reduce ecosystem services for tourism, fishing, forestry, and water supply.

The projected rates of climate change are very likely to exceed rates of evolutionary adaptation in many species, and habitat loss and fragmentation are very likely to limit species migration in response to shifting climatic zones.

By 2080, 200–300 New Zealand indigenous alpine plant species may be extinct due to climate change. Little research exists on climate change impacts for New Zealand species or ecosystems outside the alpine zone and some forested areas.

The report says that actions to reduce non-climatic stresses such as water pollution, habitat fragmentation, and invasive species can enhance the resilience of many ecosystems.

Water security

Projections show that drought events are likely to increase in both frequency and severity in the eastern lowlands of New Zealand. Ongoing water security problems are very likely to increase by 2030 in those parts of eastern New Zealand that are distant from major rivers.

The report says increasing demand for water has already exceeded supply in some catchments but "ongoing and proposed adaptation strategies are likely to buy some time."

Coastal development

Ongoing coastal development is very likely to exacerbate the future risk to lives and property from sea-level rise and storms:

- Sea level is virtually certain to rise.
- By 2050, there is very likely to be increasing loss of high-value land, faster road deterioration, degraded beaches, and loss of landmarks of cultural significance.

The report says tighter planning and regulation are likely to be required if continued rates of coastal development are to remain sustainable.

Hotspots

By 2050, vulnerability is likely to be high in a few identified hotspots.

In New Zealand, the hotspots are:

- **Northland to Bay of Plenty:** ongoing coastal development is very likely to exacerbate the future risk to lives and property from sea-level rise and storms.
- **Eastern lowland regions:** water security problems from increased drought and rising demand where irrigation is unavailable.
- **Alpine zones (Southern Alps):** loss of plant and animal species, increase in shrubs at expense of herb fields. Glacier shrinkage and reduction in snow cover. Threats to built environment from increased flooding, erosion, and landslides.

These hotspots were chosen based on the following criteria: large impacts, low adaptive capacity, substantial population, economically important, substantial exposed infrastructure, and subject to other major stresses (e.g., continued rapid population growth, ongoing development, ongoing land degradation, ongoing habitat loss, threats from rising sea level).

Infrastructure

Risks to major infrastructure are likely to increase markedly. These risks include failure of flood protection and urban drainage/ sewerage systems, and more storm damage to buildings. The present design criteria for extreme events are very likely to be exceeded more frequently by 2030. Risks to large structures such as dams and bridges will need reassessment in light of future climate threats.

Tourism

Changes in seasonal snow cover are likely to have a significant impact on the ski industry. The snow line is likely to rise by 120–270 m based on scenarios for the 2080s, but tourist flows from Australia to New Zealand might grow as a result of the relatively poorer snow conditions there. Noticeable glacier shrinkage and retreat are very likely for even small temperature rises, and likely to reduce visitor flows through tourism-dependent towns such as Fox and Franz Josef.

Pastoral farming

In cool areas of New Zealand, annual pasture production is very likely to increase by 10–20% by 2030, although gains may decline thereafter. Subtropical pasture species with lower feed-quality are likely to spread southwards, reducing productivity, particularly near Waikato.

The range and incidence of many pests and diseases are likely to increase. Water security problems are likely to make irrigated agriculture vulnerable. Less cold-stress is likely to reduce lamb mortality.

Horticulture

Areas suitable for particular crops are projected to change. For example, production of current kiwifruit varieties is likely to become uneconomic in Northland by 2050 because of lack of winter chilling, but more areas in the South Island are likely to become suitable. New Zealand is likely to be more susceptible to the establishment of new horticultural pests.

Forestry

In the south and west, growth rates of economically-important plantation forests (mainly *Pinus radiata*) are likely to increase, but tree growth reductions are likely for the east of the North Island.

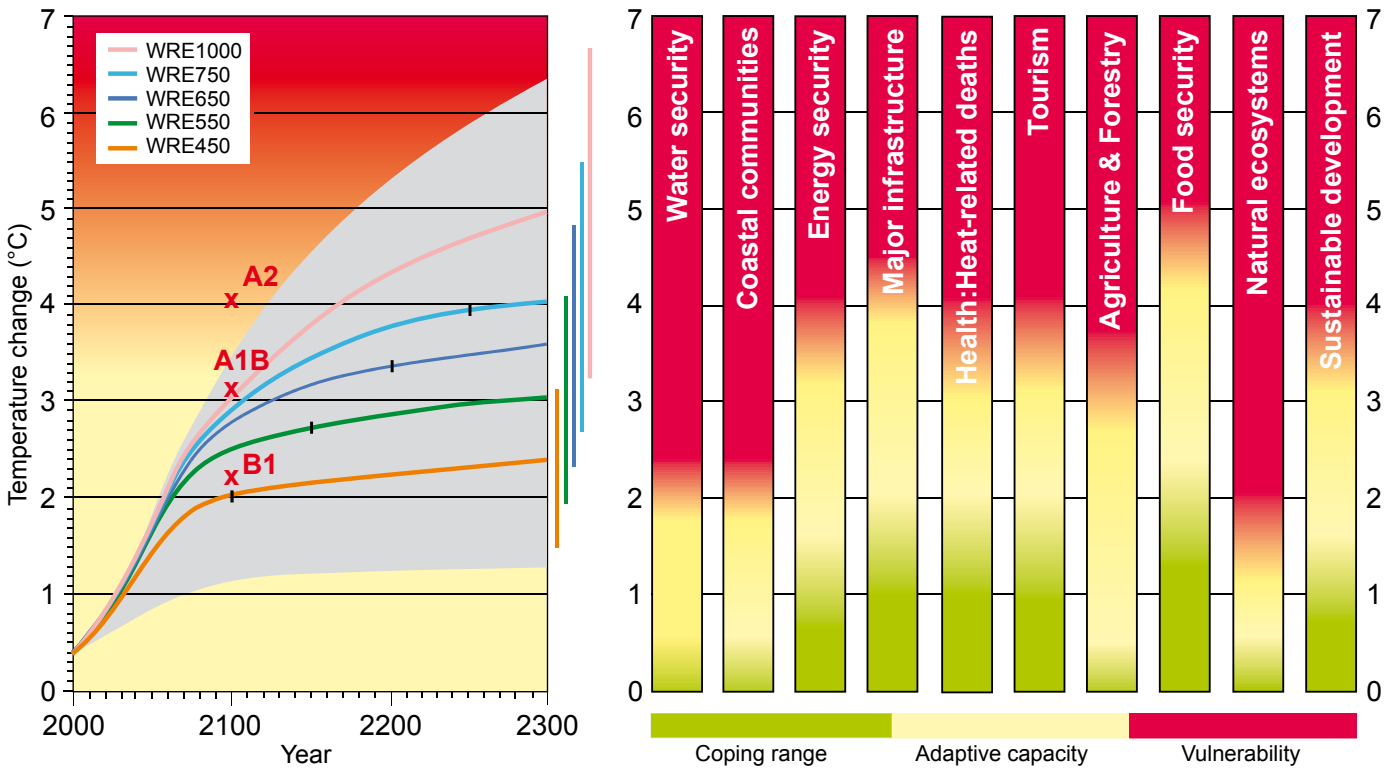
Fisheries

Few climate change impact studies have been undertaken, but impacts are likely to be greater for temperate endemic species than for tropical species, and on coastal and demersal fisheries relative to pelagic and deepsea fisheries.

New Zealand: vulnerability

Ecosystems, water security, and coastal communities of the region have a narrow coping range. They become vulnerable if the global temperature rises by 1.5–2 °C even with adaptive measures.

Energy security, health, agriculture, and tourism have considerable coping ranges and adaptive capacity, but they become vulnerable if global warming exceeds 3.0 °C.



Vulnerability to climate change aggregated for key sectors in the Australia and New Zealand region. Right-hand panel is a schematic diagram assessing relative coping range, adaptive capacity, and vulnerability. Left-hand panel shows global temperature change taken from the Third Assessment Report. The coloured curves in the left-hand panel represent temperature changes associated with stabilisation of CO_2 concentrations at 450 ppm, 550 ppm, 650 ppm, 750 ppm, and 1000 ppm. Year of stabilisation is shown as black dots. It is assumed that emissions of non-CO_2 greenhouse gases follow the SRES A1B scenario until 2100 and are constant thereafter. The shaded area indicates the range of climate sensitivity across the five stabilisation cases. The narrow bars show uncertainty at the year 2300. Crosses indicate warming by 2100 for the SRES B1, A1B, and A2 scenarios.
[Source: IPCC WGII Fourth Assessment Report, chapter 11, figure 11.4]

Australia: the drying continent

This section contains just a few examples of Australian impacts of interest to New Zealanders. For more detail, refer to chapter 11 of the full report.

Water security

By 2030, water security problems are very likely to be exacerbated over large areas of southern and eastern Australia. Their largest river system, the Murray-Darling Basin, currently accounts for about 70% of irrigated crops and pastures, and water allocations already exceed supply. Annual streamflow in the basin is likely to fall 10–25% by 2050 and 16–48% by 2100.

In southern Australia, agricultural production is likely to be reduced due to increased droughts and fires, and cropping is likely to become unviable at the dry margins.

Natural ecosystems: Great Barrier Reef

By 2050, 97% of the Great Barrier Reef could be bleached every year. By 2080, the picture is one of "catastrophic mortality" of coral species each year, with a 95% decrease in the distribution of Great Barrier Reef species.

Human health: dengue fever

Dengue fever represents a "substantial threat" to Australia. Projected climate changes, combined with population growth, are likely to increase the number of people living in areas capable of supporting *Aedes aegypti*, the major mosquito vector of the dengue virus.

The South Pacific: small islands, big impact

Working Group II identifies small islands, including those in the South Pacific, as one of four regions of the world likely to be especially affected by climate change. (The other three regions are: the Arctic, Africa, and Asian megadeltas.)

Sea-level rise

Sea-level rise is likely to exacerbate inundation, storm surge, erosion, and other coastal hazards, thus threatening vital infrastructure, settlements, and facilities. Some studies suggest sea level rise could lead to possible reduction in island size, particularly in the Pacific, whilst others show a few islands are morphologically resilient and expected to persist.

Port facilities at Suva (Fiji) and Apia (Samoa) are likely to experience overtopping, damage to wharves, and flooding of the hinterland following a 0.5 m rise in sea level combined with waves associated with a 1-in-50 year cyclone.

Coral reefs, fisheries, and other marine-based resources

The impact of climate change is likely to be heavy here. The following factors are very likely to affect the health of coral reefs and other marine ecosystems which sustain small island fisheries:

- increasing sea surface temperature and sea level;
- increased turbidity, nutrient loading, and chemical pollution;
- damage from tropical cyclones;
- possible decreases in growth rates due to ocean acidification.

Such impacts will exacerbate non-climate change stresses on coastal systems. It is likely that these changes would in turn negatively affect the attraction of small islands as premier tourism destinations.

Pressure on water resources

There is strong evidence that under most climate change scenarios, water resources in small islands are likely to be seriously compromised. A 10% reduction in average rainfall by 2050 would lead to a 20% reduction in the size of the freshwater lens on Tarawa Atoll, Kiribati. Reduced rainfall coupled with sea-level rise would compound this threat.

Human health effects

There is growing concern that climate change is likely to adversely affect human health. Many small islands are located in regions whose weather and climate are already conducive to the transmission of diseases such as malaria, dengue, filariasis, and food- and water-borne diseases. Increasing temperatures and decreasing water availability are likely to increase diarrhoeal and other infectious diseases on some islands.

Economic impact

Without adaptation, by 2050, agricultural economic costs from climate change are likely to reach between 2–3% of 2002 GDP on high terrain islands (e.g., Fiji) and 17–18% of 2002 GDP on low terrain islands (e.g., Kiribati). These figures are for mid-range climate change scenarios.

Costs & benefits of adaptation

Studies so far suggest that adaptation options for small islands are likely to be limited and the costs high relative to GDP. Despite this, "exploratory research" indicates prudent adaptation strategies can generate other benefits as well. For example, the use of waste-to-energy and other renewable energy systems can promote sustainable development, while strengthening resilience to climate change.

This leaflet was produced by the NIWA National Climate Centre, in collaboration with the Royal Society of New Zealand. It was reviewed by B. Fitzharris (University of Otago), P. Lefale (MetService), J. Salinger (NIWA), and D. Wratt (NIWA).

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