Auckland Region climate change projections and impacts:
Summary Report

Warming of the climate is unequivocal, with temperature increases already influencing the intensity and frequency of many extreme events across the globe.

Auckland Council and Council Controlled Organisations commissioned the National Institute of Water and Atmospheric Research (NIWA) to provide climate change projections, including high-resolution maps for the Auckland Region.

This work will help support greater resilience and sustainable decision-making under a changing climate. This summary presents some of the key findings of the full technical report and some of the potential impacts and opportunities for the Auckland Region.

Four future emissions scenarios, called Representative Concentration Pathways (RCPs), capture climate model uncertainty. Highlights are shown here for the "Business as usual" scenario (RCP8.5) where emissions continue unabated, and for a "Mid-range" scenario (RCP4.5) where future emissions stabilise.

Many different models are run using each RCP, and model outcomes can vary significantly. While the average of these outcomes is often treated as the most likely result, all outcomes within the range are plausible. More details on uncertainty estimates can be found on Page 6 and in the full technical report.

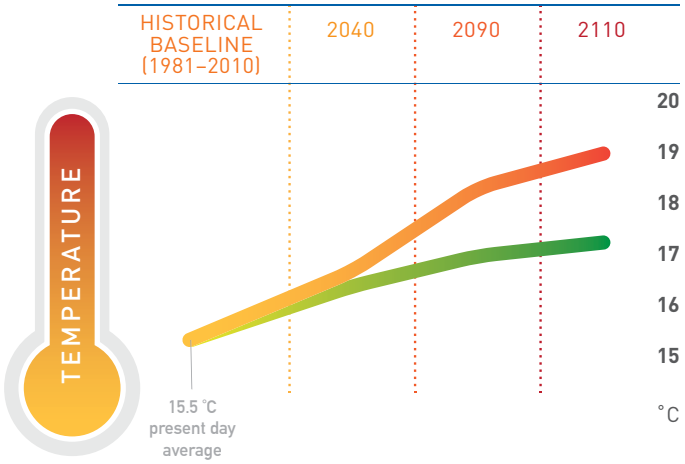
TEMPERATURE

Auckland Region mean annual temperature increased by about 1.6 °C over the past century. All climate change scenarios indicate temperatures will continue to warm across Auckland in the future. Mean annual and mean maximum temperatures are expected to increase through the 21st century. The frequency of warm extremes will rise, and the number of cold nights and frosts (days with minimum temperatures below 0 °C) will decline.

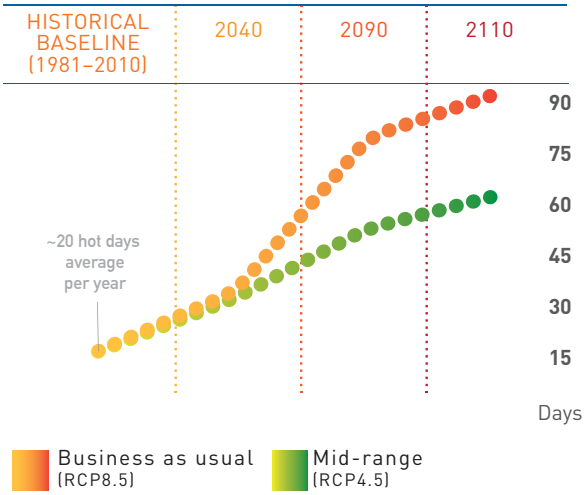
POTENTIAL IMPACTS FROM TEMPERATURE INCREASE

- Elevated mean temperatures through the year may extend warm season tourism and leisure opportunities.
- Increased potential for heat stress and other health impacts on people and on livestock. Greater energy needs for cooling.
- Changes to the diversity of crops able to be grown in Auckland, harvest times, and food security.
- Increased risks may arise to our health, ecosystems and biosecurity from new/emerging pests, diseases and invasive species.
- Considerable geographic variation for temperature changes is expected (and strongest for west Auckland).

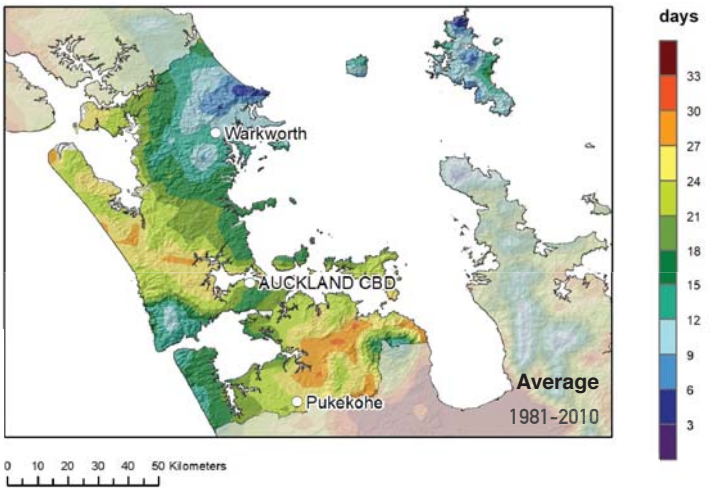
AVERAGE ANNUAL TEMPERATURE TREND



ANNUAL NUMBER OF HOT DAYS (>25°C)



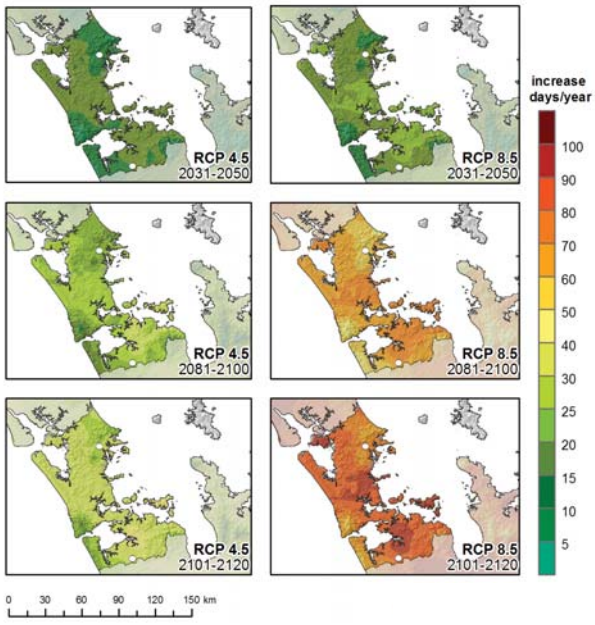
TYPICAL NUMBER OF CURRENT HOT DAYS



For Auckland, approximately 20 hot days (>25°C) occur each year on average based on observations between 1981-2010 (above).

Up to four times as many hot days per year across Auckland are expected by the end of the 21st century. The relative increase in days depends on the climate change scenario and location (right).

HOT DAY TRENDS



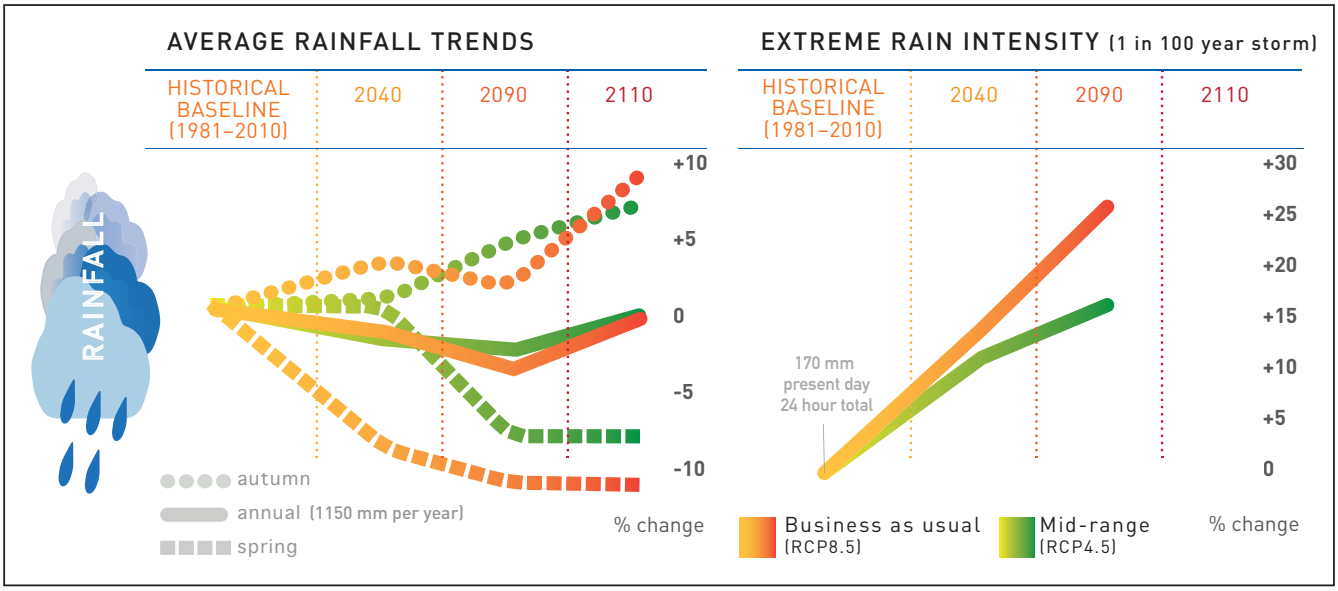
See Section 3 in the full technical report for more details about Auckland climate change temperature projections.

RAINFALL

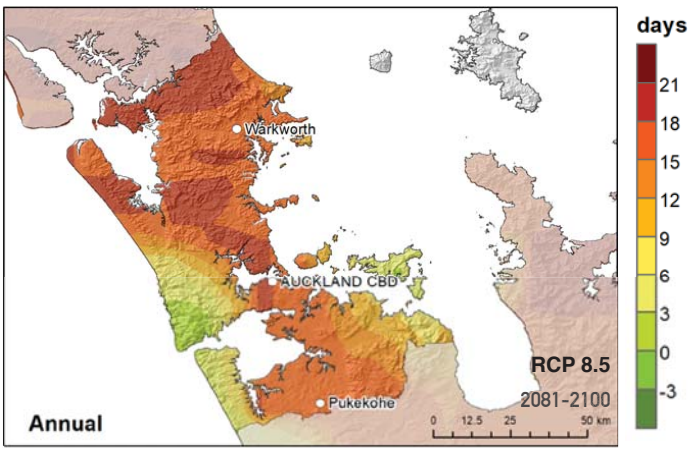
Seasonal rainfall patterns and extremes are expected to change for the Auckland region. Impacts on a wide range of natural environments, ecosystems and our urban areas are anticipated. Extreme rainfall intensity is likely to increase because a warmer atmosphere can hold more moisture. There is elevated risk of earlier and longer dry spells, with increased potential for development of drought.

POTENTIAL IMPACTS FROM RAINFALL CHANGES

- Challenges to water availability for urban, agricultural and industrial use will arise.
- Increased rainfall intensity will adversely impact the performance of all infrastructure (eg. stormwater drainage networks).
- Periods of low river flow may become longer and overall flows may decrease.
- High river flows (and floods) may become larger, placing communities and businesses in low-lying areas at greater risk.
- Periods of lower rainfall, along with warmer temperatures and stronger winds, will increase fire hazard.



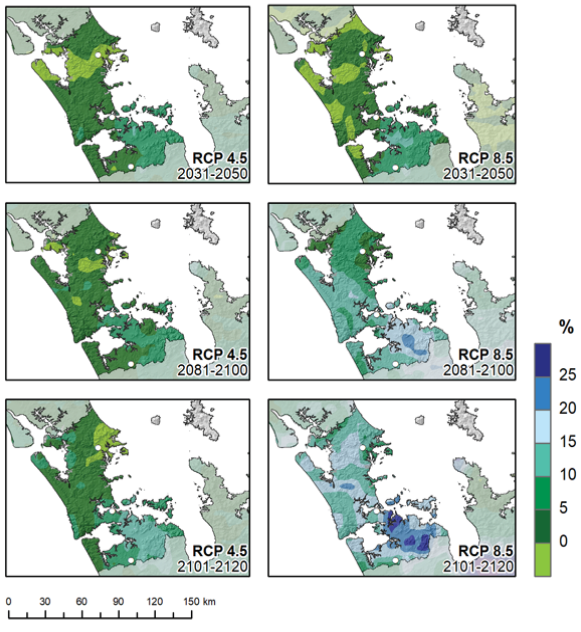
DRY DAY TRENDS



Wetter autumns and drier springtime conditions are expected by the end of the 21st century, but the annual rainfall total for Auckland is not anticipated to change greatly. An increase in dry days for northern and western areas is likely (RCP8.5, above).

The 99th percentile rain event corresponds to the top two wettest rain days each year. By 2110, these days will be 10-30% wetter than present (right) over southeast Auckland and the Hunua Ranges.

TRENDS FOR WETTEST RAIN DAYS



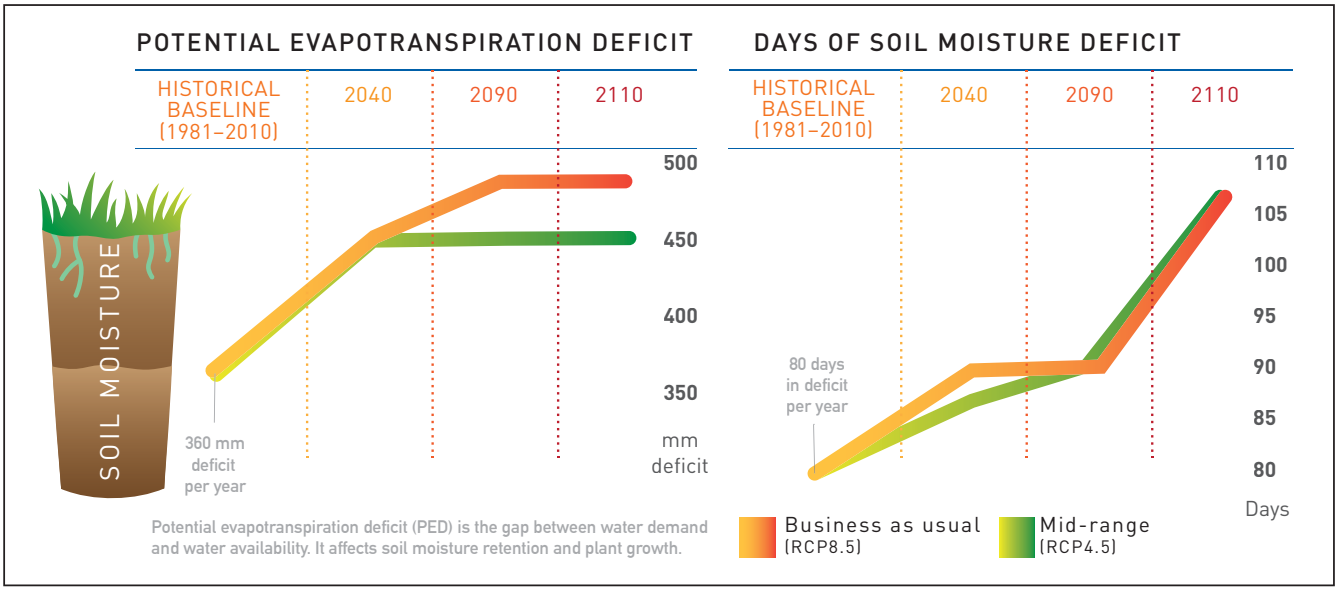
See Section 4 in the full technical report for more details about Auckland climate change rainfall projections.

SOIL MOISTURE

Auckland's soil moisture is projected to decline in the future from increased evaporation and changing rainfall patterns. The entire region is likely to become more drought prone, which can stress vegetation and soil microbial activity. These effects can also potentially compromise the functionality of our soils. Significant implications may arise for land stability, sedimentation, food security, ecosystems and climate change resilience.

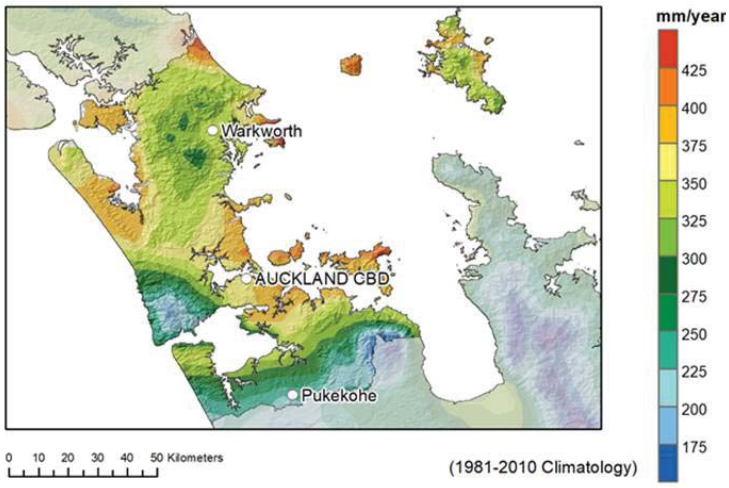
POTENTIAL IMPACTS FROM REDUCED SOIL MOISTURE

- Natural and engineered slopes may destabilise and be subject to more frequent slips.
- Minimum stream flows are likely to decline, causing increased incidence of water shortages.
- Need for irrigation to support horticulture, agriculture and livestock management is likely to increase.
- Elevated stress is likely on native forests, indigenous wetlands as well as other types of plant and animal life.
- Reduced rainfall coupled with increased soil moisture deficit may lead to landscape degradation and increased erosion.



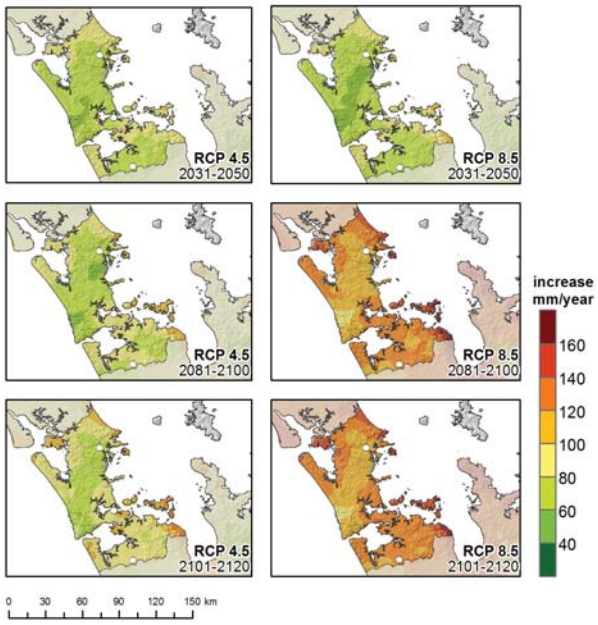
Potential evapotranspiration deficit (PED) is the gap between water demand and water availability. It affects soil moisture retention and plant growth.

POTENTIAL EVAPOTRANSPIRATION DEFICIT (PED)



Central Auckland currently experiences about 360 mm of PED per year (above). PED increases across all of Auckland are likely by the end of the 21st century. The strongest impacts (including increased drought) are expected for Waiheke Island and the southeast Auckland coastal area (see both RCPs, right).

TRENDS FOR WATER BALANCE



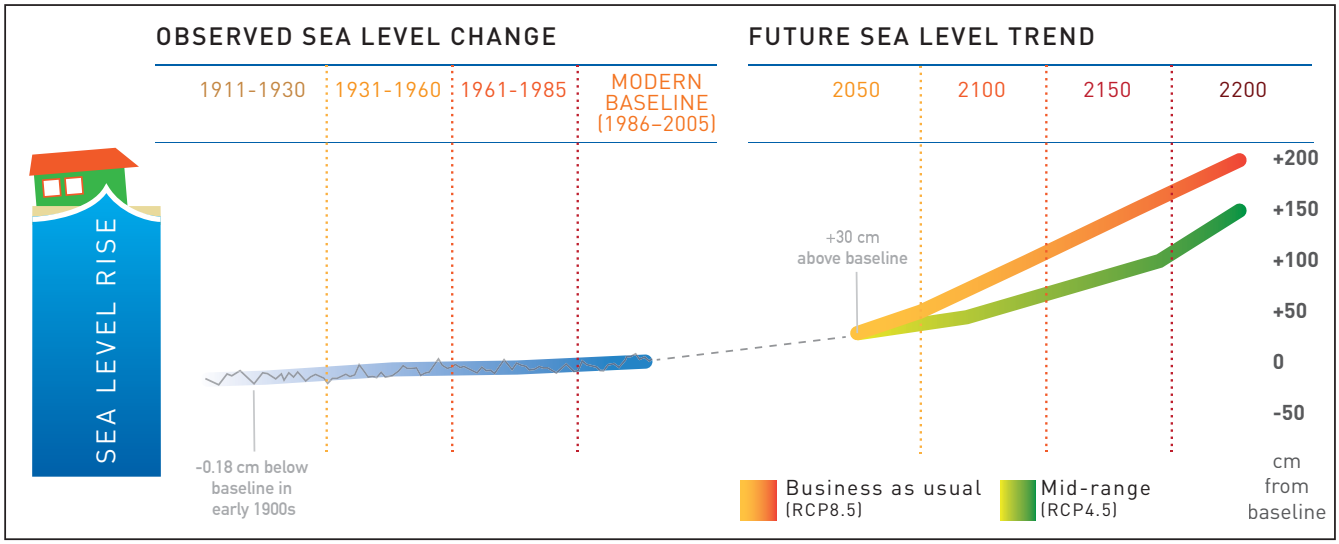
See Section 4 in the full technical report for more details about Auckland climate change soil moisture projections.

MARINE AND COASTAL CHANGE

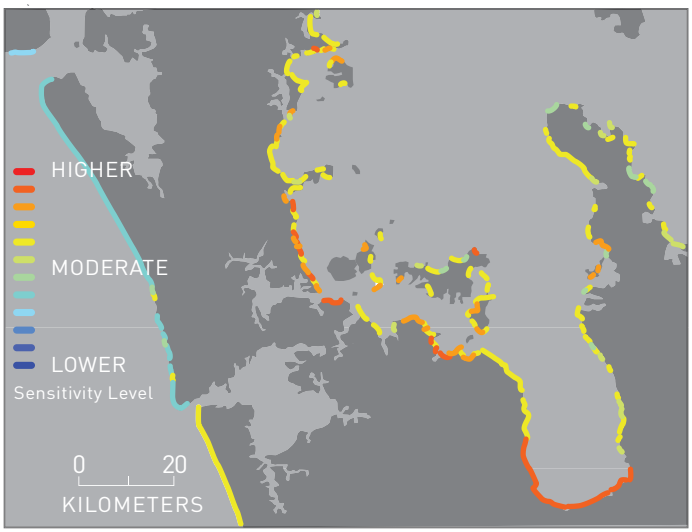
Sea level around Auckland has risen in the recent past, and this trend is expected to continue and possibly accelerate in the coming decades. Present high tide levels will be exceeded more frequently under a regime of continued sea level rise. Ocean acidification, loss of coastal habitats and marine ecosystems, and damage to dwellings are likely. Maintenance of developed coastal fortifications and structures is also expected to increase.

POTENTIAL IMPACTS FROM MARINE AND COASTAL CHANGE

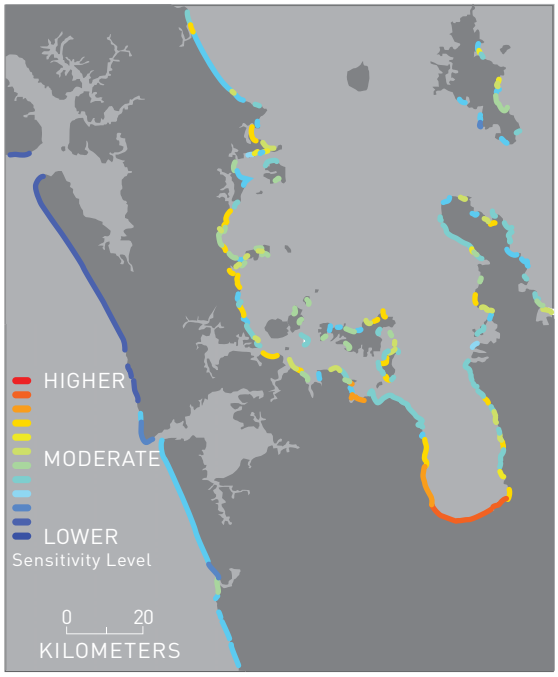
- Exacerbated coastal erosion, particularly for unstable cliffs, including frequent landslides.
- Amplified risk of damaging storm surge and flood impacts during extreme weather events (like ex-tropical cyclones).
- Increased frequency of inundation in low-lying coastal areas and saltwater incursions into lowland freshwater sources.
- Possible introduction of new pests or biosecurity threats due to elevated ocean temperature and current changes.
- Altered marine ecosystems, with diminished recreational and economic benefits, due to increased ocean acidification.



COASTAL SENSITIVITY TO EROSION



COASTAL SENSITIVITY TO INUNDATION



Auckland's coastline has a wide range of sensitivity to coastal change due to varying elevation, wave exposure, and sediment supply.

Erosion sensitivity under sea level rise is higher for Auckland's east coast (above). Greater sensitivity to inundation is anticipated for areas near estuaries where tidal ranges will be amplified (right).

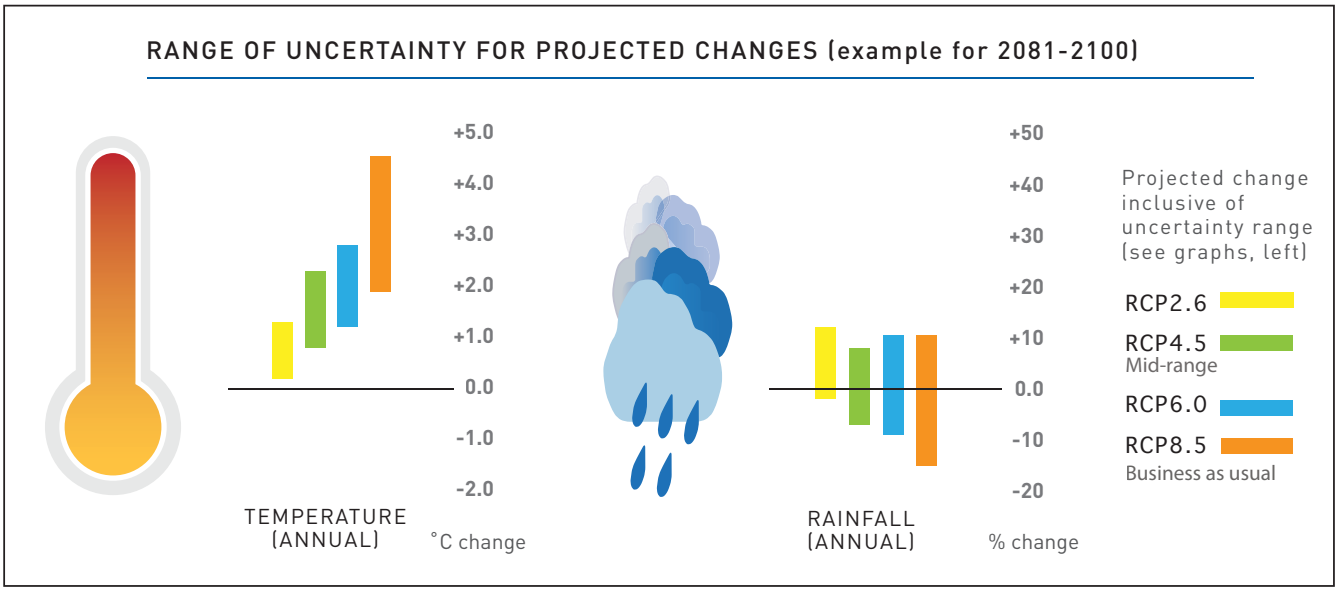
See Section 8 in the full technical report for more details about Auckland region coastal, marine and oceanic climate changes.

CLIMATE MODEL SELECTION AND UNCERTAINTY

Dozens of global climate models are used to produce future climate change scenarios under different greenhouse gas concentrations. NIWA scientists have evaluated these models and carefully selected six to produce detailed results for New Zealand. The six models were chosen because they effectively captured elements of the Southern Hemisphere climate and atmospheric circulation that are important to New Zealand.

CLIMATE MODEL UNCERTAINTY SOURCES

- Alternate trajectories for future global greenhouse gas emissions (eg. different RCPs).
- Differences between climate model simulations.
- Simplification of some complex climate processes in the models.
- Inherent natural climate variability that is not captured by model simulations.



IDENTIFYING CLIMATE CHANGE TRENDS USING MULTIPLE MODELS

Different climate models may produce outcomes that are in agreement, or significantly different, depending on the RCP and the climate variable that has been analysed (see annual temperature and rainfall, above).

Assessment of a collection of climate model outcomes can help capture a range of model uncertainty. That approach has been used by NIWA for New Zealand, and it lessens the reliance on interpreting future possibilities from only one model.

Climate scientists often run a wide range of models for future periods using different RCPs. This offers an opportunity to interrogate a suite of simulations. From that set of model outputs, common trends can be seen for many climate variables.

While some trends are clear, others may not be. When a majority of models trend in the same direction, it provides increased confidence in the projected change.

INTERDEPENDENCIES

As climate change will continue to affect the Earth, impacts from changes that occur outside of the region are likely. Expanding international trade and increased immigration will undoubtedly place more strain on resources and the capability to deal with climate changes. On a regional scale, for example, potential shifts in hydroelectricity generation from the Waikato Region could also impact on water resource availability for Auckland. Expected changes for Northland may also elevate regional biosecurity and health risks. In addition, climate change impacts on other New Zealand regions and abroad will have implications for Auckland's food security.

NEXT STEPS

The climate projections are part of a larger programme being delivered by Auckland Council and partners to address critical impacts from the changing climate. The projections will also underpin further work to better understand the array of risks and opportunities that will emerge for our communities, infrastructure, economy and environment.

ACCESS TO THE FULL TECHNICAL REPORT

To access the full report and for more information about how Auckland Council, the wider council family and District Health Boards are already addressing climate change visit: http://www.knowledgeauckland.org.nz

A video summarising the findings of the full techical report can be found at http://www.knowledgeauckland.org.nz

This report was commissioned by Auckland Council and Council Controlled Organisations, and supported by Auckland's three District Health Boards.

Auckland Council
Te Kaunihera o Tāmaki Makaurau

NIWA
Taihoro Nukurangi

Watercare
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