

Zone 1: Regional snapshot of projected climate changes and hazards

Upper North Island (Te Ika ā Māui) – extends to Mōkau on the west coast and Lottin Point (Wakatiri) in eastern Bay of Plenty, and the northern part of Lake Taupō.

Hazard	RCP 4.5	RCP8.5	Extra information
Higher mean temperatures: air and water	2040: Annual average air temp to increase 0.7-0.9°C; Coastal sea-surface temps to increase ~0.8°C.	2040: Annual average air temp to increase 0.8-1.1°C; Coastal sea-surface temps to increase ~1.25°C (6% change).	<ul style="list-style-type: none"> - Summer air temperature to warm the most; Spring air temperature the least. - Daily maximum air temperature is expected to increase faster than overnight daily minimum temperature.
	2090: Annual average air temp to increase 1.3-1.4°C; Coastal sea-surface temps to increase ~1.25°C (5.5% change).	2090: Annual average air temp to increase 2.8-3.1°C; Coastal sea-surface temps to increase ~2.85°C (13% change).	
Heatwaves: increasing frequency and magnitude	2040: Increase of 10-20 more hot days/year (>25°C).	2040: Increase of 15-20 more hot days/year (>25°C)	<ul style="list-style-type: none"> - No data available yet for <i>Heatwaves >25°C (3 consecutive days)</i> or <i>Extreme Heatwaves >30°C (3 consecutive days)</i>. - Largest temperature increase projected in Northern NZ
	2090: Increase of 25-30 more hot days/year (>25°C).	2090: Increase of 50-70 more hot days/year (>25°C).	
More and longer dry spells and droughts	2040: 0-8 more dry days/year. Increase in 3-9 days/year for Auckland. Increased Potential Evapotranspiration Deficit (PED) of 60-100mm. Low river flow thresholds reached earlier in the year.	2040: 3-9 more dry days/year, larger increase for dry days in spring (3-6days). PED increase (60-100mm). Low river flow thresholds reached earlier in the year. Drought conditions projected to become more frequent.	<ul style="list-style-type: none"> - The frequency of dry days (<1mm precipitation) increases with time and RCP. - Climate drought severity is projected to increase. - Time spent in drought in eastern and northern New Zealand is projected to double or triple by 2040 (RCP4.5, ~2050).
	2090: 5-10 more dry days/year. Increase in 6-12 dry days/year for most of Auckland. Increase in PED of 60-100mm.	2090: 10-20 more dry days/year. Increase in PED of 100-150mm. Low river flow thresholds to be reached earlier in the year (>40days earlier than present). Drought probability up 50-70%. Time spent in drought to increase 5-20%.	
Changes in climate seasonality with longer summers and short winters	2040: Warming greatest in summer and autumn. Warming least in winter and spring.	2040: Warming greatest in summer and autumn. Warming least in winter and spring.	<ul style="list-style-type: none"> - Spring and autumn frost-free land to at least triple by 2080 (RCP8.5, ~2100). - Up to 60 more hot days (>25°C) by 2090 (RCP8.5, ~2100)
	2090: Warming greatest in summer and autumn. Warming least in winter and spring.	2090: Warming greatest in summer and autumn. Warming least in winter and spring.	
Increasing fire-weather conditions: harsher, prolonged season	2040: Increased fire risk. Increase in days with very high and extreme fire danger index from around 0-400%. <i>Seasonal Severity Rating:</i> Auckland and Northland, increase of <20%.	2040: Increased fire risk. Increase in days with very high and extreme fire danger index. <i>Seasonal Severity Rating:</i> Most North Island areas, increase of +30-50%. Eastern Bay of Plenty and Coromandel, increase of <30%. <i>Very High + Extreme Fire Danger:</i> Potential for significantly increased number of days of fire risk.	<ul style="list-style-type: none"> - Fire season length to increase (RCP4.5 & RCP8.5, ~2100). - Fire season to start earlier and/or finish later (RCP4.5 & RCP8.5, ~2100). - Fire climate severity is likely to rise significantly with climate change in many parts of the country as a result of increases in temperature, wind speed and lower rainfall and/or humidity.
	2090: Increased fire risk. Increase in days with very high and extreme fire danger index from around 0-700%. <i>Seasonal Severity Rating:</i> Central North Island areas, increase of +20-40%. Northland decrease of -20%. <i>Very High + Extreme Fire Danger:</i> Central and eastern areas, increase of +50%.	2090: Increased fire risk. Increase in days with very high and extreme fire danger index. <i>Seasonal Severity Rating:</i> Central North Island, western Auckland and Northland, increase of +50%. <i>Very High + Extreme Fire Danger:</i> Most areas, increase of >150% (East Cape, increase of <50%).	
	2040: 0-2% decrease in extreme wind. Intensity of	2040: 0-2% decrease in extreme wind. The most severe	<ul style="list-style-type: none"> - Decreases in extreme wind.

Increased storminess and extreme winds and rainfall	(ex)tropical cyclones projected to increase. Rainfall events see righthand additional information column.	ex-tropical cyclones are expected to be stronger. Rainfall events see righthand additional information column.	<ul style="list-style-type: none"> - Larger than national average increases in rainfall intensity projected. - Moderately extreme daily precipitation (99th percentile of wet days) increases; except for parts of Northland. Very extreme daily precipitation increases in frequency. - Short duration (1-in-100-year, 1hour duration) extreme rainfalls increase +13.6% for every 1°C increase. Long duration rainfall events (1-in-2-year, 120hour duration) increase +4.8% for every 1°C increase.
	<p>2090: 1-4% decrease in extreme wind. Frequency of extreme winds is likely to increase in winter and decrease in summer.</p> <p>Mean westerly flow of wind to increase ~20% in spring and ~70% in winter; decrease by ~20% in summer and autumn.</p> <p>Intensity of (ex)tropical cyclones projected to increase.</p> <p>Rainfall events see righthand additional information column.</p>	<p>2090: 2-4% decrease in extreme wind. Frequency of extreme winds is likely to increase in winter and decrease in summer.</p> <p>The most severe ex-tropical cyclones are expected to be stronger.</p> <p>Intensity of (ex)tropical cyclones projected to increase.</p> <p>Occurrence conditions conducive to storm development is projected to increase by 3-6%, relative to the period 1970-2000.</p> <p>Increased frequency of consecutive days of heavy rainfall (>40mm).</p>	
Change in mean annual rainfall	2040: Minimal change in annual rainfall. Reduction in rainfall in winter and spring, and small increases in summer.	2040: Seasonal rainfall will increase or decrease by <5%. Spring has largest rainfall decrease; autumn has largest rainfall increase.	<ul style="list-style-type: none"> - The largest rainfall changes by ~2100 will be seasonal rather than annually.
	2090: Minimal change in annual rainfall. Seasonal rainfall will increase or decrease by <5%. Spring has largest rainfall deduction (5%).	2090: Decrease in rainfall, particularly in Northland (5-10%), smaller decreases for southern parts of region. Largest rainfall decrease in summer (15-20%). Increased rainfall in autumn/winter.	
Reducing frost, snow and ice cover	2040: Decrease of 10-25 of frost days.	2040: Decrease of 10-25 of frost days.	<ul style="list-style-type: none"> - Much of NZ (outside of alpine areas) to become frost-free under RCP8.5, ~2100 scenario. - Number of frost days decrease is greatest in the coldest regions. - No information about snow water equivalent/snow amounts is available yet from IPCC AR5 downscaling yet.
	2090: Decrease of 10-25 of frost days.	2090: Decrease of 25-50 frost days for central North Island. Many areas frost-free.	
Increasing hail severity or frequency	<ul style="list-style-type: none"> - No information available on hail. MfE suggest a potential increase in storm intensity, local wind extremes and thunderstorms. - See also information above for <i>Increased storminess and extreme winds and rainfall</i>. 		
River and flow changes in frequency and magnitude in rural and urban areas	2040: Mean annual flood occurrence decreases for most areas; increases for Waikato.	2040: Mean annual flood occurrence increases.	<ul style="list-style-type: none"> - Lower river flows in summer will raise water temperature and exacerbate water quality problems, such as increased algae growth (all RCPs and time frames). - No research yet on changes to large flood flows and return periods – highly uncertain at this point (all RCPs and time frames). - Increases in Mean Annual Flood occurrence affect most agricultural areas, with only slight reductions in other areas. Percentage increases tend to be greater for the more extreme RCPs (i.e. RCP8.5) and late century (i.e. ~2100).
	2090: Mean annual flood occurrence decreases in most areas.	2090: Mean annual flood occurrence increases everywhere except the Far North. Significantly large increases for south Auckland to west Waikato.	
Coastal and estuarine flooding: increasing persistence, frequency and magnitude	2040: 0.24m SLR	2040: 0.28m SLR; 0.37m under RCP8.5+ (allows for ice sheet instability).	<ul style="list-style-type: none"> - Rising sea levels are expected to cause salinization of groundwater and coastal wetlands. - Exposure to extreme storm tides will increase with further sea-level rise. - Extreme sea levels that are expected to be reached once every 100 years (on average) at present-day MSL, will
	2090: 0.55m SLR	2090: 0.79m SLR; 1.05m under RCP8.5+ (allows for ice sheet instability).	

			occur at least once per year or more (on average) by 2050-2070 and will occur earlier in areas with smaller tidal ranges.
Sea-level rise and salinity stresses on brackish and aquifer systems and coastal lowland rivers	2040: SLR trends as per above.	2040: SLR trends as per above.	- No information about projections for salinization of aquifers, except that this will increase under higher levels of SLR. - Changes to salinity will also depend on rainfall and runoff patterns.
	2090: SLR trends as per above.	2090: SLR trends as per above.	
Increasing coastal erosion: cliffs and beaches	<ul style="list-style-type: none"> - Land subsidence will exacerbate the effects of SLR. - Highly variable erosion, depends on geology, tidal range, geomorphology and exposure. - Areas with small tidal range more sensitive to erosion than large tidal range. Eastern coasts more sensitive than western coasts. 		
Increasing landslides and coastal erosion	<ul style="list-style-type: none"> - Increase in landslides and erosion with increasing rainfall intensity. Increased fire risk will exacerbate soil erosion. - Increased risk of earthflow erosion. Increased rainfall and temperature (impacting evapotranspiration) may affect earthflow erosion. - Increased risk of gully erosion (exacerbated by increased rainfall) - Increased risk of sheet erosion (exacerbated by increased rainfall and runoff) - Bank erosion may increase with increasing river flows. - Wind erosion may increase in susceptible areas, particularly in areas which will become drier and windier. 		
Marine heatwaves: more persistent high summer sea temperatures	2040: Southwest Pacific summer sea temperature (SST) increases by ~0.8°C.	2040: Southwest Pacific SST increases by ~1.0°C.	<ul style="list-style-type: none"> - Marine heatwaves projected to increase in frequency and intensity with ongoing atmospheric and ocean warming (i.e. RCP4.5 & RCP8.5 for ~2050 & ~2100). - Proportional SST warming of 16-20% for most New Zealand marine areas. - Warming lowest in southern waters.
	2090: Southwest Pacific Sea SST increases by ~1.1°C. Tasman Sea SST exceeds ~3.0°C.	2090: Southwest Pacific Sea SST increases by ~2.5°C. Tasman Sea SST exceeds ~3.1°C.	
Ocean chemistry changes: nutrient cycling and pH change	2040: pH: 7.98 for SW Pacific (decrease of 0.12). No significant decrease in surface macronutrient concentrations and net primary production. Particle flux change: -3.1%	2040: pH: 7.93 for SW Pacific (decrease of 0.18). No significant decrease in surface macronutrient concentrations and net primary production. Particle flux change: -7.8%	<ul style="list-style-type: none"> - Reduction in surface mixed layer depth, macronutrients, net primary production, chlorophyll-a. Reductions increase with time and RCP. - Largest macronutrient declines in the eastern Chatham Rise and sub-Antarctic waters. - Largest increase in dissolved iron in subtropical waters.
	2090: pH: 7.98 for SW Pacific (decrease of 0.12). Mixed layer depth to decrease by a mean of 6m. Significant decrease of surface macronutrient concentrations. Net primary production to decrease ~1.2%. Particle flux change: 11.1%.	2090: pH: 7.77 for SW Pacific (decrease of 0.33). Decreases in surface mixed layer depth (15%), macronutrients (7.5-20%), net primary production (4.5%), and particle flux (12%). Particle flux change: -23.6%	
International influences	<p>Findings from Royal Society report on Climate Change Implications for NZ (non-specific timeframes, region or RCP)</p> <ul style="list-style-type: none"> - All aspects of food security are potentially affected by climate change, including food access, utilisation, and price stability. - Climate change over the 21st Century is projected to increase the displacement of people. - Climate change can indirectly increase risks of violent conflicts in the form of civil war and intergroup violence by amplifying well-documented drivers of these conflicts such as poverty and economic shocks. - The impacts of climate change on critical infrastructure and the territorial integrity of many states are expected to influence national security policies. - While NZ agriculture could benefit from increasing global commodity prices in the long term, there are many negatives. - We gain significant revenue from long-haul tourism which could be reduced if the acceptability of long-haul travel, and costs of fossil fuels, are affected by climate change. 		
<p>Useful resources:</p> <p>Auckland Region climate change projections and impacts (Pearce et al. 2018)</p> <p>Northland climate change projections and impacts (Pearce et al. 2017)</p>			