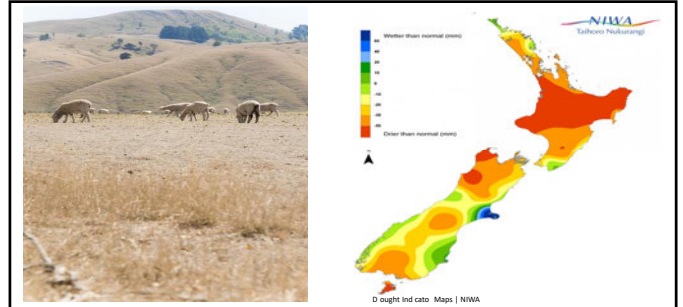




Storm in Wellington South Coast. Credit Dave Allen NIWA.

Floodwaters surround farmhouse. Credit Alan Blacklock NIWA.

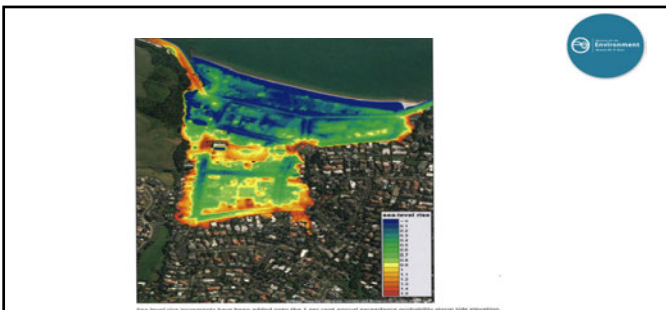
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Wapiti sheep drought. Credit Dave Allen NIWA.

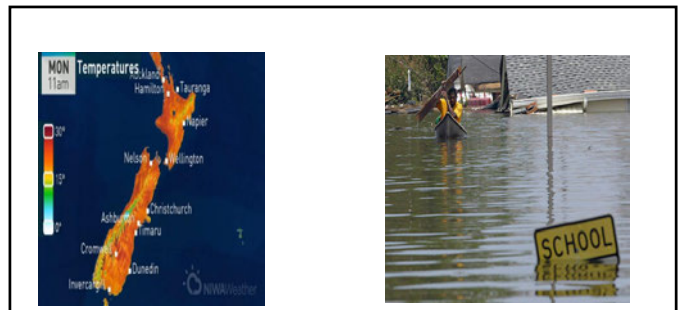
Drought Indicators Maps | NIWA

Climate, Freshwater & Ocean Science



Sea level rise projections have been updated since 2014, and now include the possibility of extreme high sea levels, which may be reached in the next 100 years. Source: NIWA, based on the International Working Group on Coastal and Estuarine Modelling (IWCEM) data. Source: NIWA, based on the International Working Group on Coastal and Estuarine Modelling (IWCEM) data. Source: NIWA, based on the International Working Group on Coastal and Estuarine Modelling (IWCEM) data.

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Episode two

The Water Cycle

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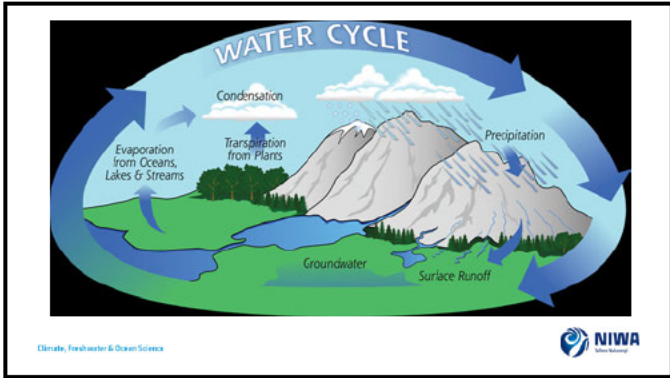
No Mass Transfer

Energy in → Closed System → Energy out

Earth is a closed system

Open System Closed System

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Episode Three

Waikato River

Climate, Freshwater & Ocean Science
NIWA

Waikato River Catchment

<http://www.waikato.govt.nz/>

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NIWA

How Climate Change can impact the Waikato River Water system?

- Modifying the availability of water
- Change in the pattern of precipitation
- Changes in the evaporation rate

www.waikato.govt.nz/

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River Flow

Low Turbidity → High Turbidity

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Water quality etc.

$CO_2 + H_2O = H_2CO_3$
Carbonic Acid

Acid Rain

Corrosion



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Water quality etc.


$CO_2 + H_2O = H_2CO_3$

Carbonic Acid

Acid Rain

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Conclusion


Impacts of climate change on the water cycle:

- Sources of water
- Exchange rate (rates of evaporation and precipitation)


It has got impacts on our lives:

- Losing jobs in a long run
- Losing our ecosystems, wildlife etc.
- Health problems, diseases
- Food scarcity
- ...

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Greta Thunberg



The first thing I have learnt is that you are never too small to make a difference

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More resources:

- <https://niwa.co.nz>
- <https://www.mfe.govt.nz/>
- <https://www.un.org/en/sections/issues-depth/climate-change/>
- <https://www.natgeokids.com/nz/discover/geography/general-geography/what-is-climate-change/>
- <https://www.facebook.com/gretathunbergsweden/>

Climate, Freshwater & Ocean Science




Kia mihi

#259179999

Climate, Freshwater & Ocean Science



From: [REDACTED]
Sent: Monday, 10 December 2018 3:01 PM
To: [REDACTED]
Subject: Kaimahi Christmas Collection -TOMORROW

Kia ora koutou, e Ngā Kaimahi,

Following on from [REDACTED] prior email announcement and while he is abroad at conference, this is a **reminder** email for the Kaimahi Christmas collection tomorrow Tuesday from 1100-1200hrs.

Any jingle-jangle or wads-of-wonga will be gratefully accepted.

An update on last year: a post-whistle \$50 donation from a perspicacious personage means that, divided equally, the actual final totals for 2017 were: **Wāhine**=\$637.60 and **Tāne**=\$412.40 (**Total** =\$1050). [REDACTED] City Mission hamper got \$250 while the Suzanne Aubert Compassion Centre Soup Kitchen was allotted \$800. As [REDACTED] has informed, combining his tax rebate on the Soup Kitchen donation with further funds lays a \$300 foundation for this year.....AND.....some anonymous person has left a bag of coins on my desk this morning.....I surmise you must be the same person who did it last year.....whoever you are, tēnā koe!

You may be aware that November 28th just past, was the 125th anniversary of Suffrage Struggle ~ Whakatū Wāhine, when womyn in Aotearoa first exercised their right to vote, well before other nations. This year's collection is thus a celebration of womyn: past, present and future. So to start, we have an all-wāhine Christmas collectors crew: [REDACTED] [REDACTED].....you can recognise them, they will be wearing the following lapel emblem with suffragette ribbons:



Last year was a thematic donations choice between Wāhine and Tāne, for this year which of the following youtube videos at the forefront of battling climate change do you think are the best, and womyn are central to both. So, please deposit a donation in either envelope #1 PATU or #2 ŌTI, with subtotals and total result to follow as for last year above:

- (1) He Patu (Collective Direct Action) @ <https://youtu.be/giN5ORKUJIQ>
- (2) Te Miraka Ōti (Oat milk -the howto video) @ <https://www.youtube.com/watch?v=d9b3JS4eIRI>

Our intrepid collectors: [redacted] will traipse the campus south while [redacted] will traverse the campus north, from 1100 to 1200hrs TOMORROW.

In their left hands will be an envelope labelled **PATU** and the following image:



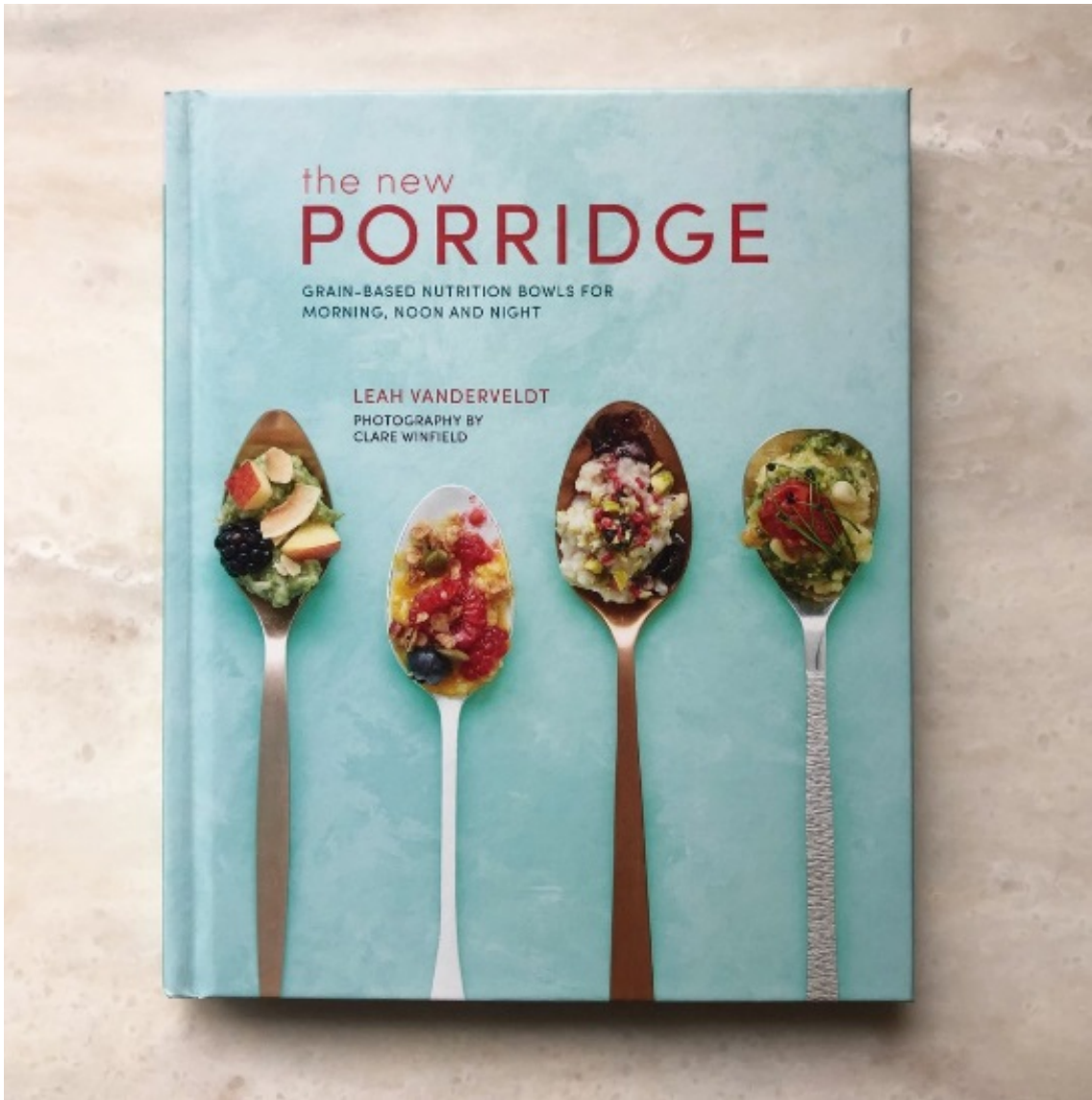
“School-Strike for Climate”: Greta Thunberg is leading a school strike and sits outside of the Swedish Parliament, in an effort to force politicians to act on climate change. Photograph: Michael Campanella for the Guardian

“Some say I should be in school. But why should any young person be made to study for a future when no one is doing enough to save that future? What is the point of learning facts when the most important facts given by the finest scientists are ignored by our politicians? The adults have failed us. And since most of them, including the press and the politicians, keep ignoring the situation, we must take action into our own hands, starting today.” • Greta Thunberg is 15 years old and lives in Stockholm, Sweden.

In their right hands will be an envelope labelled **ÖTI** and the following image:



A Hebridean Island womyn, stooking the oats circa 1920's. A self-sufficient, low-carbon, materially-simple lifestyle, based on a strong communal ethic of shared responsibility-cum-manākitanga with a vivid oral and musical culture. Oats, either as porridge or as cakes sustained her community and a nation. Perhaps oats and quinoa, northern and southern hemisphere heritage foods, will lay the foundation for a largely plant-based diet, as humanity heads toward a concerted collective effort to combat climate change. ***“Porridge has changed”*** -check out this recipe book as a stocking filler -“The New Porridge by Leah Vanderveldt, obtainable via *Moore Wilsons Books for Cooks* or orderable via *Unity Books*”:



Fraternally yours, in struggle,



PS: If the collectors miss you, please don't hesitate to approach them by Monday 17th.

[REDACTED]

From: [REDACTED]
Sent: Thursday, 3 October 2019 1:39 PM
To: [REDACTED]
Subject: Greta helpline

For a laugh ...

<https://mobile.twitter.com/markhumphries/status/1177178666402365440>

[REDACTED]
Sent from my iPhone

[REDACTED]

From: [REDACTED]
Sent: Friday, 20 September 2019 12:00 PM
To: [REDACTED]
Subject: FW: Climate change contact
Attachments: ClimateEducation [REDACTED].pdf

See below and attached – interesting.

From: [REDACTED]@niwa.co.nz>
Sent: Wednesday, 18 September 2019 2:44 p.m.
To: [REDACTED]@niwa.co.nz>; [REDACTED]@niwa.co.nz>; [REDACTED]
[REDACTED]niwa.co.nz>
Subject: FW: Climate change contact

Hi team,

I've been keeping in contact with [REDACTED] (I may have forwarded her last email to you?) she was a contact via [REDACTED] from Berkley.

Here she's linking us with [REDACTED] who has taken a year off teaching to focus on CC education. She has also pointed me to a research project which looks at all school groups and has done a fair bit of scoping:
<https://www.nzcer.org.nz/research/educational-policy-and-practice-changing-climate-what-are-options>

I have only scanned the list of reports produced so far, but there is one about student wellbeing that looks particularly good.

Just wanted to share and have it in our back pocket for later.

Cheers,

[REDACTED]

From: [REDACTED]
Sent: Thursday, 12 September 2019 9:22 AM
To: [REDACTED]@niwa.co.nz>
Subject: Climate change contact

Kia ora [REDACTED]

I wanted to connect you with [REDACTED]. [REDACTED] is a teacher in the Coromandel who is passionate about Climate Change and is doing some amazing work.

His email is: [REDACTED] and I have attached his article on Climate Change Education.

Kia pai tō rā,

Ngā mihi,

[REDACTED]
[REDACTED]
[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]



Tena koutou katoa, I'm [REDACTED]

I'm going to expand on [REDACTED] discussion about how NIWA is helping New Zealanders prepare for climate change.

I presented this talk in June at NIWA's inaugural climate change stakeholder meeting – Climate Matters.

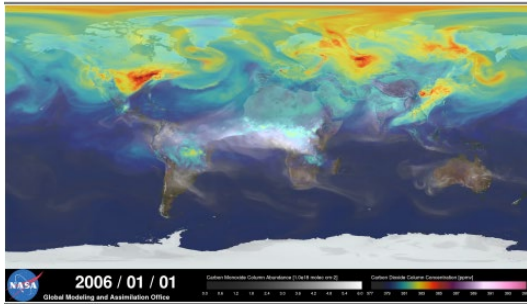
Many of you will be well-versed in this information already. Still, I hope you get out of it a sense of how our science is guiding climate change adaptation planning in New Zealand.



We all know that climate change is the most fundamental issue of our time. Over the past century we've experienced a degree of warming, 20 cm of sea level rise, and increasing extreme weather events.

So we can thrive in a changing climate, we first need to understand what we may be faced with. NIWA's climate research is helping New Zealanders better understand and prepare for this different future.

Today I'll address these questions - what's happening to our climate? How do we understand future changes? What might the impacts be? And how is NIWA helping others plan for climate change?



Concentrations of greenhouse gases in the atmosphere directly impact how our climate changes.

Higher concentrations of greenhouse gases like carbon dioxide and methane cause our atmosphere to warm faster with consequences for global rainfall patterns, extreme weather events, changes to ice sheets, ocean warming and acidification, among other widespread impacts.

Current carbon dioxide concentrations are the highest they have been in over 800,000 years.



So how do we go about predicting our future climate? We use computer models - mathematical reconstructions of our atmosphere that take into account things like atmospheric circulation, ocean currents, solar radiation, and of course greenhouse gases.

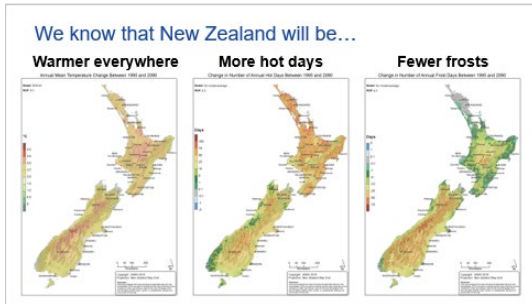
These simulations give us an idea of what climate might be like under different scenarios of future greenhouse gas concentrations, depending on what action the global community takes to reduce emissions.

[click]

Global climate models have a resolution of about 250 km, so we can't get much fine detail about what might be happening here in New Zealand.

We use NIWA's supercomputer to downscale those global climate models through a regional climate model with a 30 km resolution to finally get projections of rainfall, temperature and other climate variables at a much higher resolution of 5 km.

This means we can understand future climate changes at the national, regional and catchment scale.

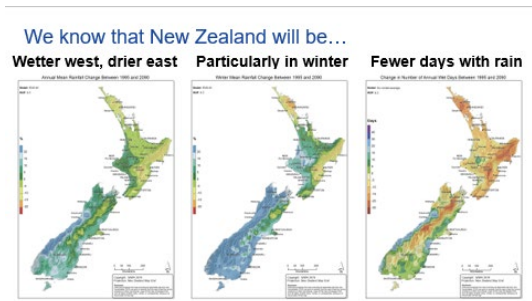


These are projections from the highest emission scenario, what we call the ‘business as usual’ scenario, or RCP8.5, if greenhouse gas emissions were to continue into the future at current rates.

It is projected that New Zealand will be warmer everywhere, with average yearly temperatures up to 3 degrees warmer than present by 2090.

There will be many more hot days (or days above 25 degrees), particularly in the North Island. A tripling in the number of hot days is projected for many parts of the country.

Consequently, New Zealand will experience declining numbers of frosts - much of the North Island and coastal South Island will likely be frost free by 2100 under this scenario.



In terms of rainfall, increasing westerly winds means that it’s likely to get wetter in the west and south of New Zealand, and drier in the east and north.

So, many of the already wet parts will get wetter, and some of the dry parts will get drier.

In particular, winter shows a strong signal of increased rainfall in the western South Island, with up to 40% more rainfall expected there.

For much of the country, the number of days with rainfall is likely to decrease, leading to longer dry spells and more drought conditions.



These changes to our climate are likely to have impacts on many sectors, environments and communities around New Zealand.

Changes to rainfall patterns, temperature and evapotranspiration will impact our natural environment, agriculture and other primary industries, with increasing drought severity having implications for water supply, irrigation, river flows, and wildfire.



Extreme rainfall is likely to increase in intensity due to more moisture being held in a warmer atmosphere.

This will potentially lead to changes in floods as well as slips and landslides, with significant impacts on urban drainage systems.

Ex-tropical cyclones are also likely to have heavier rain and stronger winds, and they may retain cyclone strength as they travel south towards New Zealand due to warmer ocean temperatures.



Our snow and ice reserves are diminishing - our glaciers lost around 30% of their volume in the past 40 years alone.

This affects seasonal river flows and lake storage, with implications for the tourism, ski, and hydropower industries.



Sea-level rise is a consequence of our warming planet and is projected to increase by half a metre to a metre by 2100, depending on the emission scenario.

We are locked in to several centuries of sea-level rise because of the time lag of the oceans responding to atmospheric warming.

Sea-level rise and coastal erosion will continue to impact many communities along our coasts. Just a few weeks ago residents in Port Waikato were forced from their homes due to encroaching seas.



Changes in the frequency and intensity of extreme weather events is likely to place much of our infrastructure at greater risk. We may see scenes like this, from the Waiho River on the West Coast earlier this year, much more often.



Much of what makes New Zealand unique in terms of wildlife, on land and in the water, may be under threat from climate change. This is through changes to food webs, shifting climate envelopes for habitats, and increased vulnerability to pests and predation.



The climate projections form a base upon which to understand future impacts and prepare climate change adaptation and mitigation strategies.

We apply this in research and with organisations like regional councils and businesses.

NIWA's projections are provided to the Ministry for the Environment and inform national decision making around climate change.



The Our Future Climate New Zealand website allows users to download maps and graphs of future climate change projections.

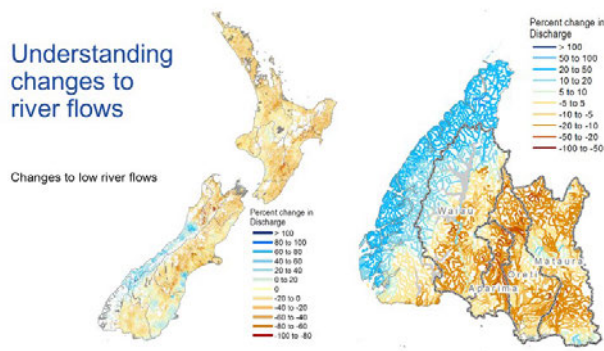
The maps are of New Zealand and the time series data are from different locations around the country.

You can select between different climate variables like hot days and wet days, different downscaled climate models, emission scenarios, time periods in the future and seasons.



So we've got these projections showing what our future climate could be like in New Zealand.

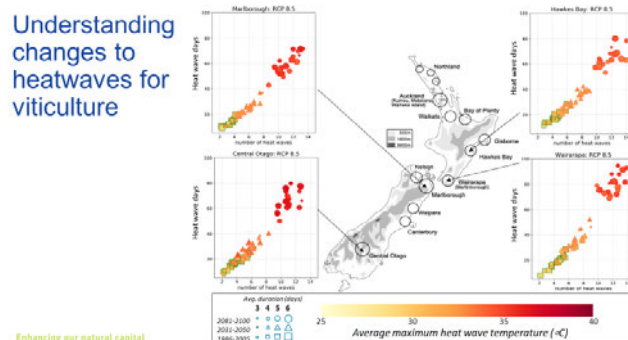
That's all very well but we need to understand what the impact of these changes might be - whether it be to our native biodiversity, infrastructure, health, or communities who live near the coast.



Our hydrologists are using the climate projections and the New Zealand water model to understand impacts on river flows and soil moisture, which is important for our primary sector.

Here you can see changes to annual low river flows which are projected to decline across much of the country.

This may have impacts on instream biodiversity and water available for use by other industries.



We can delve into more specifics - here we're trying to understand how heatwaves across New Zealand's wine regions may change.

The larger and deeper red the shapes, the longer and hotter the heatwaves are likely to get. The squares indicate the recent historic period.

You can see that there's a step-change in the number and duration of heatwaves between the middle of the 21st century, indicated by triangles, and the end of the century, indicated by circles, with Central Otago's heatwaves getting much hotter, shown by the deeper red colours in the bottom left.

We're working with the wine industry to understand what this may mean for grape growth and vineyard operations.



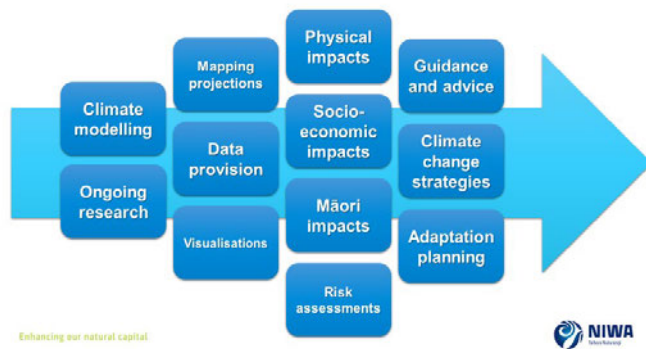
Both Auckland Council and Greater Wellington Regional Council have used visualisations that we have produced to communicate climate change to their stakeholders and communities.

This animation shows changes in hot days, or days above 25 degrees, over time in Auckland on the left and Wellington on the right.

At the moment, Auckland experiences about 20-30 hot days per year, but this may increase by 90 days under the business as usual scenario by early next century, having impacts on health, power consumption, and the natural environment.

Our climate change advice is being used by councils to inform their long term strategies and decision making processes.

We are also part of a consortium delivering the first national climate change risk assessment to central government next year.



This slide shows the range of services that our climate change projections feed into.

On the left we have climate modelling and ongoing research. Research feeds into improving the modelling, and the modelling feeds into research.

We can visualise the projections as maps or animations like I've shown, and we can also provide the model data as GIS layers or time series to end users.

The projections feed into impact and risk assessments for customers.

Finally, we provide guidance and advice to various organisations and the projections often form the baseline for climate change strategies and adaptation planning.

One recent example is a project with Horizons Regional Council. We have linked the climate change projections with socio-economic and environmental characteristics of the region, as well as the Risk Scape asset database, to understand the exposure of different sectors to climate change.

Here we have some feedback about how this information is being used within the council.



Starts automatically



I want to finish by quoting Greta Thunberg, the Swedish climate activist. She said: “I want people to unite behind the science – and that is what we have to realise, that is what we have to do right now. I’m not the one saying those things, I’m not the one we should be listening to. I say that all the time – I say we need to listen to the scientists.”

Climate change poses huge challenges to our way of life as we know it but there is also huge potential for new opportunities to do things differently.

NIWA’s climate research provides the scientific basis and guidance for what we may expect for New Zealand’s future, which can inform decision making processes across the country.

Our climate science – and how we communicate it - is crucial, now more than ever.