

3 Climate change

This chapter lists the questions about climate change that we would like addressed. We present a summary of the analysis of the official data that addresses those questions. We then outline the initiatives to address our climate change information needs.

The world's climate is influenced by many factors interacting in very complex ways. Even measuring global temperatures over time is complex. But there is a general agreement that the world is experiencing an overall warming trend (with year-to-year fluctuations superimposed). This warming trend over the 50 years from 1956 to 2005 is nearly twice that for the 100 years from 1906 to 2005 (Intergovernmental Panel on Climate Change (IPCC), nd).

Most of the world's climate scientists consider it very likely, based on several lines of evidence, that the current warming trend is of human origin and is associated with increased production of the so-called 'greenhouse gases' as a result of fossil fuel use, agriculture, and deforestation.

Climate change questions

This section presents the enduring questions and the supplementary enduring questions on climate change.

Enduring questions

Climate change is an unusual topic area, in that four enduring questions were identified, along with five supplementary questions.

How is New Zealand's¹ climate changing?

How are New Zealand's greenhouse gas levels² changing?

How are we adapting to the physical impact³ of climate change?

Which environments are most likely to be affected by climate change?

Notes

1. Includes the Ross Dependency and the Chatham Islands.

2. Refers to emissions and sinks.

3. Includes physical impact on sea temperature, sea level, ocean currents, river flows, and winter snow cover.

Supplementary enduring questions

A. Where and how are New Zealand's climate and atmospheric composition changing?

B. Where and how are New Zealand's anthropogenic greenhouse gas emissions, and removals, changing?

C. What and where is the impact of climate change on Māori and Māori-owned assets?

D. Where and how are ecosystems⁴, people, and New Zealand institutions most affected by changes to climate and atmospheric composition, and how are they adapting?

E. What greenhouse gas mitigation technologies and practices are we adopting?

Note

4. Includes terrestrial, aquatic, and marine ecosystems.

Gap analysis

Table 5 summarises the analysis of how well official information (including Crown research institute data) informs the supplementary enduring questions on climate change. See appendix 3 for details of the analysis process.

Table 5

How well official data informs supplementary enduring questions on climate change

Supplementary enduring question (SEQ)	Question topic	Level at which official data informs SEQ
A	Atmospheric composition changing	High
B	Greenhouse gas emissions and removals	High
C	Impacts on Māori	Medium
D	Impacts on ecosystems, people, and New Zealand institutions	Medium
E	Greenhouse gas mitigation technologies	Medium

Four datasets scored highly for informing the supplementary enduring questions:

- New Zealand's national communication under the United Nations Framework Convention on Climate Change
- National land use and land-use change mapping
- New Zealand's Greenhouse Gas Inventory
- Agricultural production censuses/surveys.

Climate change initiatives

Initiatives to address the issues highlighted by the gap analysis were identified at an expert workshop. These initiatives were grouped into clusters and sub-clusters, and were prioritised by voting. The participants were given five votes that could be registered for a cluster or for individual initiatives. In most other topic workshops, participants only voted for individual initiatives.

The climate change initiatives were grouped into three major clusters: impacts, adaptation, and mitigation. The impacts and adaptation clusters were further split into three and two sub-clusters, respectively.

The impacts clusters received 19 votes overall, adaptation received 14, and mitigation 7. These results showed that the gaps in information lie in and around the impacts of climate change and the necessary adaption to those changes, rather than around the volume and reduction of greenhouse gas emissions.

Of the sub-clusters, the first impacts cluster had 10 votes (either for the entire cluster, or for individual initiatives within the cluster). Ideas in the first impacts cluster include developing information on the impacts of climate change on ecosystem services,

obtaining laser imaging detection and ranging (LIDAR) data as a base for sea level change projections, and developing information on the impacts of climate change on Māori. The first adaptation cluster had seven votes, as did the sole mitigation cluster, with the second adaptation cluster having six votes, as did the third impacts cluster. The second impacts cluster had three votes.

CC.A1.1 Gather information on national climate change adaptation responses

This is the highest-ranking individual initiative. It suggests surveying and researching the various adaptation responses around the country, and compiling these to measure adaptation response across New Zealand. As councils are mostly responsible for adaptation response (planning, reducing risks, and managing assets) this initiative needs close cooperation with them. Other organisations undertaking adaptation include major asset and infrastructure managers, such as New Zealand Transport Authority, Ministry of Transport, Transpower, and energy companies.

In recent years, the Ministry for the Environment undertook partial assessments of adaptation responses across the country (unpublished). This initiative recommends a more comprehensive assessment with results published widely.

Information on adaptation responses will help us know how resilient we are to our climate and its expected changes. It will also align New Zealand's approach with those of other countries, such as the United Kingdom and Australia, who have conducted coordinated national risk assessments and have national adaptation programmes.

CC.i1.1 Assess national climate change impacts on ecosystem services

This is the second-highest individual initiative. It recognises that climate change will likely affect the services provided by the environment:

- supporting services – supports primary production
- provisioning services – provides food, water, and energy (hydropower, biomass fuels)
- regulating services – decomposes and detoxifies waste, purifies water and air
- cultural services – recreational experiences (including ecotourism).

There is no comprehensive analysis of the scale and magnitude of the impacts of climate change on these services. A project under this initiative would look at the biophysical impacts (such as increases in temperature, changes in rainfall, flooding) and assess the impacts on the services the environment provides. This information will be made available to those making decisions that rely on ecosystem services (such as those in agri-businesses, fisheries and aquaculture, and councils making decisions on water flows).

CC.i1.2 Gather national infrastructure topography data – use laser imaging detection and ranging for projecting sea-level change

To assess the impact of rising sea levels on our coasts, particularly in assessing likely disruption on our infrastructure, we need details about our terrain height. LIDAR (laser imaging detection and ranging — using laser observations from aircraft to assess terrain height within +/- 15 cm, at horizontal resolutions of less than a metre) can provide the necessary data. For some parts of the country, mainly around big cities, LIDAR data is available and provides the level needed to make a useable assessment. However, much of the country remains unmapped at this high resolution. The data can be useful for other purposes, such as accurate flood modelling, corridor mapping, wireless network planning, road and engineering design, power line mapping, hazard clearance, natural resource assessment, demographic profiling, and urban planning.

Land Information New Zealand keeps LIDAR data, but councils or private companies own them, and data are largely not referenced nationally.

CC.A2.1 Develop a map of projected sea level rise around our coasts

Much of New Zealand's key infrastructure lies around our coasts, be it major roads, substations, and cities. Sea-level rise could significantly affect this infrastructure and our coastal environment and ecosystems. Along with initiative CC.i1.2, this initiative will provide key information on the impacts of climate change. This information will be used for planning around the coasts – namely, creating detailed maps of scenarios of sea-level rise. The maps will plan 25, 50, and 100 years into the future, and may follow several greenhouse gas emission scenarios. Maps like these will enable comprehensive risk analysis that would lead to quality planning and asset management.

CC.i1.3, CC.i1.4 Assess the impacts of climate change on Māori

These initiatives will assess the impacts of climate change on Māori and Māori enterprises now and in the future. The second initiative (CC.i1.4) will specifically develop and implement an approach to assess the integrated impacts of climate change on Māori – that is, not just on the environment, but the cultural, economic, and social aspects. This initiative should be done in consultation with Māori to ensure representative conclusions and rapid uptake of the information and knowledge developed.

Initiative CC.i3.1 looks at the need for information, processes, and frameworks for assessing the risks from climate change. To undertake this assessment, we will need information on the probability of change and the associated costs (economic, environmental, social and cultural) of the impacts of those changes. Frameworks are also needed to make good use of that information.

With current levels of mitigation not yet beginning to reduce the emissions of greenhouse gases, the chances of staying within a global increase of 2 degrees Celsius are becoming more remote. Initiative C.i3.2 looks at the impacts to New Zealand of a global change of 4 degrees Celsius. The Ministry for Primary Industries has commissioned research in this area – this initiative will extend that work to give more relevant information.

CC.A.1.2 Assess the options for adaptation

Investigate the full range of possible future options (including looking internationally) for adapting to climate change. We will then classify these options and compare them with current adaptation activities in New Zealand. The aim would be to define global best-practice adaptation approaches for a New Zealand context. Like CC.A1.1, this will align our approach with that of other countries.

CC.A1.3 Identify opportunities for step-changes in adaptation

Investigate the possibilities of doing things differently to past practice. This initiative aims to find the tactical, strategic step-changes that could be made, particularly in agriculture. One source that could be useful in determining the possibilities is the Agricultural Production Census. Adding more questions to the survey about adaptation may also provide more useful information.

CC.A.2.2 Develop tools for local government

Further develop tools that will allow all of local government to access the best planning information in a way that fits with their current systems. This information will include the downscaling of relevant current climate data and future projections from national to local levels. The National Institute of Water and Atmospheric Research's (NIWA's) adaptation toolbox is a step towards this direction.

CC.M.1.1 Evaluate adaptation and mitigation options

Assess the impact and effectiveness of current adaptation and mitigation approaches or technologies in New Zealand. This assessment will be benchmarked against the efforts of other countries.

CC.M1.2 Survey current climate change activities

Survey current climate change mitigation and adaptation activities (ie who is doing them and what they are doing). The Agricultural Production Census could be used to survey farmers.

CC.i1.5 Develop current climate impacts Index

Build an index that can reflect the current impacts of climate change.

CC.i1.6 Develop a national assessment of climate change impacts

Develop a national assessment of the environment, social, cultural, and economic impacts of climate change.

CC.i1.7 Develop better small-scale climate data

Information on the current climate at the smallest scales (micro/meso) could be improved in quality, resolution, and availability.

CC.i1.8 Link climate-change projections with asset data and social data

Look at climate change projection with other economic and social data programmes, such as the Climate Change Impacts and Implications Programme funded by Ministry of Business, Innovation and Employment's Science, Skills and Innovation Group. This programme could progress on these aims (see [New Zealand climate changes, impacts, and implications](#)).

CC.i2.1, CC.i2.2 Assess cost and benefits of climate change

Get information on the costs and benefits of climate change, including the impacts of unmitigated climate change and several policy response scenarios. We need sector-specific information that measures 'costs' across the social, cultural, and economic domains.

CC.i3.3 Continue developing projections 1 (sea level rise, temperature, etc.)

Continue the work on the physical phenomena of climate change, such as temperature and sea-level rise and rainfall changes. It will provide the input for the two initiatives above and the one that follows below.

CC.i3.4 Assess implications of the impacts

Look at the physical projections and review the integrated impacts across all sectors and domains, that is, from weather to social impacts to the flow-on effects.

CC.A2.3 Develop mapping and GIS front-ends to data

Ask for easy access to information interfaces such as GIS, which are now commonly used for many applications. This will follow work under way at research institutes that provide information in a format suitable for GIS input.

CC.A2.4 Develop tools to access climate data

Provide tools and access to current climate data for end users, such as asset owners. We need more user-friendly tools than those that are currently available.

CC.A2.6 Present information that is publicly usable

CC.A2.6 would take the CC.A2.4 one step further by providing the information in a form more useful to the public.

CC.A2.5 Develop information with a regional focus

Enhance the currently available information for local government at a city, town, or farm level.

CC.M1.3 Develop a database of soil carbon

Extend the current information to a more widely available database on soil carbon.

CC.M1.4 Review of mitigation technology in agriculture

Review the current use of mitigation, for example, through data mining, or data reuse, of existing information in, the Agricultural Production Census.

CC.M1.5 Assess new generation technologies/practices

Review technologies that are nearing availability and assess their applicability to New Zealand's challenges.

CC.M1.6 Assess current mitigation practices

Assess activities/sectors with a wider coverage than that of CC.M1.4. For example, it will assess a range of sectors, such as local government, agriculture, transport.

Climate change initiatives table

At the climate change workshop we gathered the initiatives into clusters, then prioritised both the clusters and the individual initiatives. We assessed the complexity of implementing each of these initiatives. Table 6 shows the relationship between the three climate change areas of impacts, adaptation, and mitigation, and the arrangement of the clusters of initiatives within those areas.

Table 6

Initiatives by cluster and climate change area

Climate change area	Cluster	Initiatives – Area.(initiative number)
Impacts	I1	I1.(1–8)
	I2	I2.(1–3)
	I3	I3.(1–4)
Adaptation	A1	A1.(1–3)
	A2	A2.(1–6)
Mitigation		M1.(1–6)

Table 7 lists each of the climate change initiatives by priority, estimates of their complexity, and the questions they address.

Table 7

Climate change initiatives by priority, complexity, and supplementary enduring question (SEQ) addressed

Cluster	Initiative number	Initiative name	Priority			Complexity (highly complex, complex, moderate, low)	Helps inform which SEQ
			Rank of entire area	Rank of cluster	Rank of initiative within cluster		
Impacts clusters			1				
Impacts cluster 1				1			
	CC.i1.1	Assess climate change impacts on ecosystem services			1	Highly complex	D
	CC.i1.2	Gather national infrastructure topography data – LIDAR for sea-level change projections			2	Moderate	C, D

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Table 7 continued

Climate change initiatives by priority, complexity, and supplementary enduring question (SEQ) addressed

Cluster	Initiative number	Initiative name	Priority			Complexity	Helps inform which SEQ
	CC.i1.3	Assess the impacts of climate change on Māori			3=	Highly complex	C
	CC.i1.4	Assess the impacts of climate change on Māori			3=	Highly complex	C
	CC.i1.5	Develop current climate impacts index			5=	Moderate	C, D
	CC.i1.6	Develop a national assessment of CC impacts			5=	Highly complex	C, D
	CC.i1.7	Develop better small-scale climate data			5=	Moderate	C, D
	CC.i1.8	Link climate change projections with asset data and social data			5=	Highly complex	C, D
Impacts cluster 2				6			
	CC.i2.1	Assess cost and benefits of climate change (unmitigated climate change)			1=	Highly complex	C, D
	CC.i2.2	Assess cost and benefits of climate change			1=	Complex	C, D
	CC.i2.3	Assess cost and benefits of climate change			1=	Complex	C, D
Impacts cluster 3				4=			
	CC.i3.1	Risk assessments – probability of change, associated costs			1=	Complex	D
	CC.i3.2	Global 4-degree Celsius impacts			1=	Moderate	C, D
	CC.i3.3	Continue developing projections 1 (sea-level rise, temperature rise, rainfall changes)			3=	Moderate	C, D
	CC.i3.4	Assess implications of the impacts			3=	Highly complex	C, D

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Table 7 continued

Climate change initiatives by priority, complexity, and supplementary enduring question (SEQ) addressed

Cluster	Initiative number	Initiative name	Priority			Complexity	Helps inform which SEQ
Adaptation clusters			2				
Adaptation cluster 1				2=			
	CC.A1.1	Gather information on national climate change adaptation responses			1	Moderate	D
	CC.A1.2	Assess the options for adaptation			2=	Moderate	D
	CC.A1.3	Tactical/strategic/step change adaptation – make more use of information from the Agricultural Production Census			2=	Moderate	D
Adaptation cluster 2				4=			
	CC.A2.1	Develop a map of projected sea-level rise around our coasts			1	Moderate	C, D
	CC.A2.2	Develop tools for local government			2	Moderate	D
	CC.A2.3	Develop mapping and GIS front-ends to data			3=	Moderate	C, D
	CC.A2.4	Develop tools to access climate data			3=	Moderate	C, D
	CC.A2.5	Develop information with a regional focus			3=	Moderate	D
	CC.A2.6	Present information that is publicly usable			3=	Moderate	C, D
Mitigation			3				

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Table 7 continued

Climate change initiatives by priority, complexity, and supplementary enduring question (SEQ) addressed

Cluster	Initiative number	Initiative name	Priority			Complexity	Helps inform which SEQ
				2=			
Mitigation cluster 1				2=			
	CC.M1.1	Evaluate adaptation and mitigation options			1=	Complex	C, D, E
	CC.M1.2	Survey current climate change activities			1=	Moderate	D, E
	CC.M1.3	Develop a database of soil carbon			3=	Moderate	
	CC.M1.4	Review of mitigation technology in agriculture			3=	Moderate	E
	CC.M1.5	Assess new generation technologies/practices			3=	Moderate	E
	CC.M1.6	Assess current mitigation practices			3=	Moderate	E