Simulating future climate change

Alan Blacklock, NIWA

This year, NIWA produced the first climate change simulations using a regional climate model for New Zealand.

Until now, we have used statistical downscaling from global models. This technique is reasonably robust, and requires less time and computing power, but has limitations; for instance, it may underestimate extreme events.

One of the beauties of a regional climate model is that it provides daily or even hourly data – essential for looking at short, sharp events like intense downpours, where we want to know how the return periods may be changing.

We used a moderately high and a moderately low greenhouse gas emission scenario to span a reasonable range of possible futures, and ran the model for the 30-year period 2071–2100 inclusive.

The results are still being analysed but temperatures rise, heavy rain increases, and snow cover shrinks under both scenarios. We can feed climate change model results into riverflow models, notably NIWA's Topnet, to look at the downstream implications including flood frequency and intensity, and the amount and timing of water available for irrigation and hydro-generation.

The research is funded by the Foundation for Research, Science & Technology.

NIWA snow & ice specialist, Dr Jordy Hendrikx, describes the monitoring network to a TV3 film crew on Panorama Ridge, near the Godley Glacier at the head of Lake Tekapo. This site is owned by Meridian Energy.

Clint Miles, Tekapo Helicopters

Snow & ice monitoring gets underway

Surprising perhaps, but no one knows how much snow we've got in New Zealand.

NIWA has started a national snow and ice monitoring network. The first three sites are now operating – at Mt Cook village, Arthur's Pass, and the Château at Ruapehu – and up to another nine are planned.

There's intense interest in this work. Changes in winter precipitation and earlier snowmelt under climate change would be advantageous for electricity generation (assuming current demand patterns are unchanged), but undesirable for irrigators and tourism/skifield operators.

The monitoring data on snow extent and thickness, combined with our advanced model capabilities, will allow NIWA to better understand seasonal snow in New Zealand and assist with calculating glacier mass balance throughout the Southern Alps. Network maintenance is being scheduled to coincide with glacier field measurements, where possible, to assist university researchers.

The sites are mainly in the South Island and have been selected to achieve maximum coverage across New Zealand alpine areas and compliment other research.

Tony Bromley, NIWA

On the farm: better greenhouse gas measurement

FarmGas 2006, an international experiment on a North Canterbury dairy farm, proved the usefulness of high tech approaches to measuring nitrous oxide (N_2O) emissions.

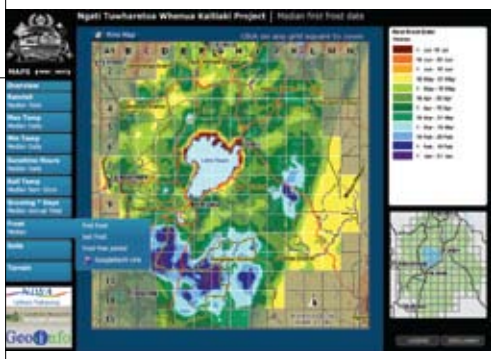
N_2O is 296 times more powerful as a greenhouse gas than carbon dioxide. Almost all of it comes from the breakdown of nitrogen in agricultural soils by bacteria, including urine-soaked patches.

N_2O emissions are notoriously hard to measure. NIWA's work here matters because:

- we need to test the real-life effectiveness of measures to limit N_2O emissions;
- emission estimates in New Zealand's greenhouse gas inventory determine our liability under the Kyoto Protocol;
- we have an obligation to report emissions as accurately as possible.

For FarmGas 2006, NIWA joined forces with a Canadian federal government agency (Agriculture and Agri-Food Canada) and Landcare Research to field test a 'tunable diode laser' alongside other techniques. In the largest method comparison for N_2O emission ever conducted in New Zealand, the team demonstrated the advantages of laser precision in measuring emissions around the clock in real farm conditions.

FarmGas 2006 was supported by the Foundation for Research, Science & Technology. We thank Medcroff Dairy Farm.



Caring for the land: new tool for Ngāti Tuwharetoa

When Ngāti Tuwharetoa wanted a web-based tool to help them make informed resource-use decisions, they came to NIWA. We worked with Geo Info, a Northland company, to produce a fast, simple, user-friendly web tool which provides detailed information about the land and climate. Now it is easy for any iwi member to identify, for example, where might be the most suitable places to grow frost-tender crops.

Tina Porou of Ngāti Tuwharetoa says "This tool provides a key part in understanding our environment and how we can adapt to it rather than having our land-use try to change the environment. The final stage will be to connect information and expert advice through online interaction, making the tool relevant and useful to our people."

The Ngāti Tuwharetoa Whenua Kaitiaki Project includes maps derived from observations in the National Climate Database of rainfall, temperature, sunshine, soil temperature, frost, and growing degree days. Data on soils came from Landcare Research, and terrain information from Land Information New Zealand. Maps can be downloaded and added as a layer to Google Earth.

Case study: climate change (under fold)

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Making a difference

Public awareness of climate change has shifted over the past year, in part because of high profile events such as Al Gore's Inconvenient Truth and the Stern Report.
But it is the increasingly clear scientific evidence that lies behind this sea change in public opinion. And it is in building this evidence that NIWA has made a significant contribution.

Over the last few years, NIWA has made a huge commitment to the Intergovernmental Panel on Climate Change (IPCC) and its latest assessment round on the current state of scientific knowledge on climate change.

The release of the IPCC's three working group reports in the first half of 2007 provided the clearest evidence yet of the impact of human activity on the rate of global warming. The IPCC will release an overall 'Synthesis Report' in November 2007.

Dr David Wratt, NIWA's General Manager, Climate Change and sole New Zealander on the IPCC Bureau (or steering committee), says the scientific evidence left no doubt.

"We can see it's not all in the lap of the gods," says David, "which means that what we do will influence what happens in the future. What's come out is that if we want to keep global temperatures within two to two and a half degrees of pre-industrial times, then we must reduce emissions substantially over coming decades. New Zealand can't turn global climate change around on its own – we need to be part of an international effort."

David has been involved with the IPCC from the outset. The process has engaged more than 1200 scientific authors and 2500 expert reviewers from more than 130 countries. He's helped select the authors and has worked closely with them to ensure the integrity of the final reports.

Three other NIWA scientists were lead authors: Dr Jim Renwick and Dr Dave Lowe for the first report on the physical science of climate change (released in February 2007); while Dr Jim Salinger was lead author for the New Zealand/Australia chapter in the second report on impact, vulnerability, and adaptation. The third report, on mitigation, involved other New Zealand scientists and had NIWA input.

The process was rigorous and impartial.

Dave Lowe says: "I have never in my entire scientific career had my written work subjected to such an exhaustive multi-level review process. It was incredibly rigorous and has resulted in what I think is a remarkable report."

The working groups dealt with a vast amount of information. The second group alone looked at more than 29 000 sets of data on observed changes in natural processes.

Jim Salinger says: "We are now seeing physical and natural systems responding to warming, such as bird species laying their eggs and migrating earlier, trees budding earlier, and glacial lakes expanding in size and number."

In some areas, adaptation is already occurring to combat observed climate change. However, ongoing vulnerability is demonstrated by substantial economic losses caused by droughts, floods, tropical cyclones, and hail, across the globe.

The third report, on mitigation, outlined a range of measures that could be taken worldwide over the next two to three decades to reduce or at least stabilise the amount of greenhouse gas in the atmosphere.

The reports are about 1000 pages long and include details pertinent to New Zealand as well as the rest of the world. Distilled summaries have been released for policymakers.

In New Zealand, the impact of regional climate change is already evident in increasing stresses on water supply and agriculture, changed natural ecosystems, reduced seasonal snow cover, and ongoing glacier shrinkage.

Jim Renwick says: "With further global warming, New Zealand's climate will get a bit harsher: the winds will get stronger, wet areas will get wetter, dry areas will get drier. It won't happen overnight, and farmers will adapt. For city dwellers, energy will be the big issue, although the demand for more electricity to cool houses may be offset by the lower demand in winter."

David Wratt adds: "A consistent research result is that climate change is likely to lead to an increased frequency of very heavy rainfall events, and potentially of flooding, as the century progresses. For New Zealand, we also expect to see more drought in some eastern and northern regions, and some increases in coastal

Alan Blacklock, NIWA

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hazards. NIWA is currently updating guidance material for councils to help them plan for such changes, in a project for the Ministry for the Environment".

Producing the scientific evidence is only half the challenge. The other half is getting the information out to the policymakers and public, and acting on it.

NIWA scientists have briefed central and local government politicians, officials, and the media on the IPCC findings. They've also held public seminars throughout New Zealand and in the Pacific.

They're joining forces with organisations such as the Institution of Professional Engineers New Zealand, BRANZ, and the Resource Management Law Association to run workshops on how those involved in designing and building infrastructure, such as roads, buildings, bridges, and stormwater drains, can factor in climate change.

NIWA staff are also updating guidelines for local government about identifying and adapting to climate change based on the latest IPCC projections.

Meanwhile, the research continues. NIWA has a range of climate-related projects underway, including tracking climate changes, looking at how climate change will affect existing weather patterns such as El Niño and La Niña, using climate change models for particular regions, and collaborating with other researchers on issues such as the impact of climate change on Māori land use and health.

NIWA's National Centre for Climate-Energy Solutions is also looking at how New Zealand can reduce emissions substantially and at manageable cost in line with IPCC findings.

The role of NIWA in helping New Zealanders (and the global community) get to grips with climate change is significant, and its value cuts across many groups, from householders to horticulturalists to hydroelectricity providers.

As for the IPCC, Dave Lowe sums up the feelings of those involved:

"What a privilege and an honour it was to work with the world's best scientists on this report. It was a remarkable experience, and as well as contributing, we learned a huge amount. I certainly don't regret all the hard work. It was a chance to make a difference with a problem that will affect all of us. We have to change now."

The participation of New Zealand scientists from NIWA and other organisations as lead authors was supported by the Ministry for the Environment and the Foundation for Research, Science & Technology.

The IPCC was set up in 1988 by the United Nations Environment Program (UNEP) and the World Meteorological Organization (WMO) to provide assessments of scientific, technical, and socio-economic information on climate change issues relevant to policymakers. Every six years it produces a full assessment of the current state of knowledge on climate change.

The plenary is based on three working groups: the first focuses on the physical science of climate change (how and why global warming occurs), the second focuses on the impact of global warming, adaptation, and vulnerability, and the third focuses on mitigation, or what might be done to stall global warming.