GEONET NEWS
EXPLORING THE GEONET PROJECT ISSUE TWELVE – JAN 2010

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GeoNet's deployment to the Kermadec Islands

International Collaboration
Australian Tsunami Warning System

Dusky Sound
New Zealand's biggest earthquake for 80 years

GeoNet

GNS SCIENCE TE PŪ AO

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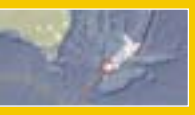

www.geonet.org.nz

GeoNet is a non-profit project operated by the Institute of Geological & Nuclear Sciences Limited (GNS Science) with core funding from the Earthquake Commission. It involves GNS Science building and operating a modern geological hazards monitoring system for New Zealand.

GeoNet is a 10 year project which started in 2001. It will provide real-time monitoring and data collection for rapid response to and research into earthquakes, volcanic eruptions and landslides. Data collected by GeoNet are available free of charge. Visit www.geonet.org.nz for more information.

GEONET: EDITORIAL

THE NEXT DECADE

KEN GLEDHILL
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Over the last year the Earthquake Commission (EQC) and GNS Science have been considering the future of GeoNet. This process began in October 2008 with the international strategic review of the project by a panel of six New Zealand and overseas experts. Amongst its findings, the panel reported that GeoNet data are supporting world-class research in New Zealand and that EQC's approach to long-term funding has provided a platform that is leveraging funding from other parties for their specific needs. The panel proposed a number of extensions to GeoNet to strengthen its ability to detect or respond to major events, plus a broader set of technical and relationship enhancements to expand dialogue and investment.

The GeoNet review process continued during 2009 with a study of the value of GeoNet to EQC and New Zealand, and the formulation of a long-term strategic plan to ensure GeoNet's contribution to New Zealand's natural hazard research, response and preparedness is maintained and enhanced. The plan takes into account the review panel recommendations and retains the concept of a fit-for-New Zealand and cost-effective approach to integrated geological hazards monitoring. After receiving these reports and planning documents, EQC reaffirmed its commitment to the GeoNet project for another 10 years. Just before Christmas 2009, EQC and GNS Science signed a new 10 year agreement which will commence in July 2010.

One of our largest undertakings during the last year, the installation of a variety of sensing network technologies at Raoul Island (pages 4 & 5), is an example of the leveraging of the core GeoNet infrastructure for the benefit of New Zealand. The sensors at Raoul Island monitor volcanic activity, earthquakes, tsunami and movement of the Earth's tectonic plates. This was very much a joint endeavour involving GNS Science, Land Information New Zealand (LINZ), the Department of Conservation (DoC) and EQC with logistical support from the New Zealand Defence Force among others. By combining the requirements of the LINZ-funded tsunami gauge project with the need for enhanced volcano monitoring (funded by DoC), it was possible to cost-effectively achieve better surveillance of a number of natural hazards using GeoNet know-how and capability.

We have come a long way since GeoNet's inception in July 2001: networks have been modernised, coverage has been targeted to help answer the big questions and the spread of the internet has facilitated the take-up of data and information. The recent commitment by GNS Science and EQC to GeoNet ensures the momentum will not be lost, and you will continue to see new and enlightening information on New Zealand's natural hazards!

UP CLOSE

DAVID BAGULEY
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DAVID BAGULEY

Field Operations Technician

After serving an apprenticeship in fitting, turning and machining in Hamilton, his home town, David moved to Lower Hutt in November 1959, and joined the Dominion Physical Laboratory, in what was then the Department of Scientific and Industrial Research (DSIR). He started work in the Tool Room, working on milling machines and making parts for various projects around the lab, and then moved into the Grinding Room doing surface grinding, tool and cutter grinding and thread grinding.

A while later David got an opportunity to do some development work. First was a new technology for shaping sheet metal – Explosive Forming, where a sheet of metal was blown into a one piece die by detonating a small amount of high explosive under water. "Great fun!" David found several applications for this technique and later, on the basis of this work, won a Technicians Travel Award and spent a year (1964/65) being a part-time student, part-time staff member of the College of Aeronautics in Bedfordshire, England. "It was a very rewarding experience and it broadened my horizons."

Back in New Zealand at the DSIR, David continued development work with a number of projects including electrochemical machining, plasma cutting and the design, assembly and testing of New Zealand's first CO_2 laser. While demonstrating the laser (in front of the Director and Divisional heads), David achieved a certain notoriety by leaning forward and lighting a cigarette from the invisible beam.

Towards the end of 1979 David joined the Engineering Seismology Section, which was about to get the first digital strong-motion earthquake recorders. "I had come full circle in a way. One of my jobs in the early days in the Tool Room was making parts for an analogue computer – for Engineering Seismology."

David has continued working with strong-motion recorders through the transformation to GNS Science and finally GeoNet. He says, "The people and the culture here make this a great place to work. It has been 50 years of learning and this has been stimulating and very enjoyable".

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MATTHEW STEVENS
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MATTHEW STEVENS

Data Centre Technician

Matthew joined GNS Science in February 2009, and is part of the team of technicians in the GeoNet Data Management Centre where he analyses the data from New Zealand's network of seismograph stations, helping to locate more than 15,000 earthquakes in New Zealand each year.

Matthew completed his Bachelor degree at Victoria University in 2006 and this year submitted his MSc under the disciplines of volcanology and geochemistry. Prior to joining GNS Science Matthew worked at Geosphere Ltd in Lower Hutt, where he prepared well summaries of onshore/offshore New Zealand wells, digitised well logs and constructed composite well logs using well summaries and digitised log data.

Matthew also replies to public queries via the GeoNet info email and gives presentations to visiting groups outlining GeoNet's role in monitoring natural hazards in New Zealand. He is enjoying being part of the GeoNet team, "There is much variety in my role, making each day different and I am looking forward to the learning and challenges that are waiting for me".

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RAOUL ISLAND

In April 2009 a small team of GeoNet technicians travelled to Raoul Island to install a variety of tsunami, earthquake and volcano monitoring equipment. Raoul Island is the largest island in the Kermadec chain of islands, which lie 750 - 1000 km north-north-east of New Zealand. These islands are a volcanic island arc, formed at the convergent boundary where the Pacific Plate subducts under the Australian Plate. Raoul and nearby Curtis islands are active volcanoes, while the other islands are inactive. The islands are uninhabited, except for Raoul, which has a team of Department of Conservation staff to carry out weed eradication work and make meteorological observations. New Zealand declared these islands a nature reserve in 1937, and the sea around them a marine reserve in 1990. All the islands are scientific reserves for the protection of flora and fauna.

Top: Technician working on Mount Moumoukai.
Bottom: Divers installing tsunami monitoring equipment.

The volcano monitoring equipment included a real-time volcano web camera, a broadband seismometer, and water level and temperature sensors for the crater lakes to improve the safety of personnel on the island, as well as assist in building a long-term history of the characteristics of this volcano. Of most interest will be the webcam mounted on nearby Mount Moumoukai, showing a view towards the north-west encompassing the crater lakes, Green Lake and Blue Lake. Unlike the more well-known volcanoes, this will be a new sight for most people.

The team of four GeoNet technicians, Daniel Whitaker, Todd Chandler, Andrew Cowie and Richard Johnson, along with two divers from New Zealand Dive and Salvage, set off to Raoul Island on 28 April 2009 for the month-long trip. The journey took three days on the chartered boat *Braveheart*, the majority of equipment having already been transported via Navy boats and helicopters. Among other supplies, an Air Force Hercules dropped cement on the island during a training exercise. A helicopter from Tauranga was on the island for 10 days to assist in unloading the vessel, as well as to help move equipment around the steep and mountainous terrain.

On 15 May, project leader Andrew Cowie was injured in a boat-related accident and required evacuation by a mercy helicopter, leaving the three remaining technicians to complete site installation and commissioning and fix any 'teething problems' with the sites.

The Raoul Island installation trip was very successful with all sites fully operational. The sites installed included:

- Tsunami gauges at *Boat Cove* (RBCT) and at *Fishing Rock* (RFRT)
- A broadband seismic station *Raoul Island* (RIZ), a continuous GPS station *Raoul Island* (RAUL) and satellite telemetry at the meteorological station
- Two temperature sensors, a water level sensor and a broadband seismic station at *Green Lake* (GLKZ) in the volcano
- A camera on Mount Moumoukai which monitors the Green Lake crater area, together with a communications repeater.

Raoul Island also adds a vital location into the global network of seismographs and GPS receivers, as well as its tsunami gauges confirming whether or not a tsunami may be en route to the New Zealand mainland. The new stations played an important role in the detection of the recent Samoan earthquake and tsunami. This long-planned mission is now complete and we look forward to the data collected by these instruments contributing to a greater understanding of the New Zealand region's natural hazards.

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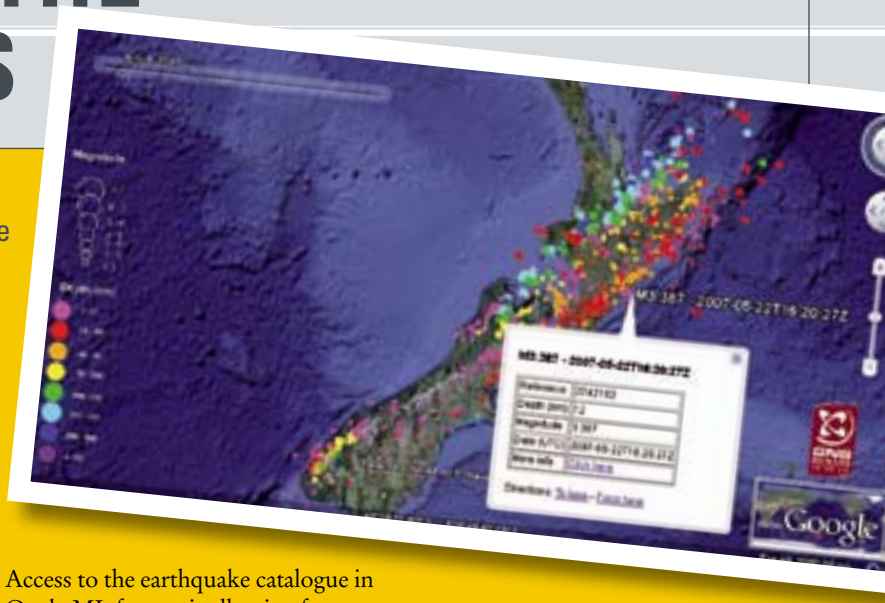
Right: View from the Raoul Island webcam.
Far right: Running the cable down a cliff for the Boat Cove tsunami site.
Background: Helicopter lowering gear into the Green Lake crater.

SUPPORTING THE RESEARCHERS

GeoNet has recently completed a collaborative project with Victoria University of Wellington (VUW) to provide their researchers with more ready access to New Zealand's seismic data using the high speed KAREN network, thereby improving both teaching and research in geoscience.



Above: Google Earth can be used to display New Zealand's seismicity with further information about each earthquake available at the click of a button.

One of the functions of GeoNet is to monitor earthquake activity throughout New Zealand. Currently, around 4 gigabytes per day of continuous high-quality seismic time-series data are collected and archived, about the same amount as a single DVD can hold. These data are regularly used by teachers and researchers at VUW, throughout New Zealand and around the world. Using KAREN, these data can now be delivered at lightning speed using technology that is designed both to integrate into modern systems and to be easy to use.

In addition to time-series data, GeoNet maintains a catalogue of earthquake information, currently over 400,000 quakes. Web services deliver these data in standard formats such as QuakeML and KML. By providing ready open access to these data in standard formats, researchers and educators around the world can obtain and understand these data and use tools such as Google Earth to visualise and study these events.

The main achievements of the project were as follows:

1. Educators at VUW prepared a teaching module in which students were able to locate earthquakes. Students could download earthquake information and plot the quakes on a map using Google Earth. At the click of a button they could download the time-series data recorded at each sensor around New Zealand for a particular event and go on to locate that event.
2. GeoNet's seismic data services have been integrated into the VUW Grid, supporting group-to-group communications to allow distributed processing of large volumes of continuous time-series data as part of an ambient seismic noise tomography study. This analysis is providing greater understanding of the structure beneath our feet.
3. Access to the earthquake catalogue in QuakeML format is allowing forecasters to predict the likelihood of earthquake aftershock occurrence.
4. Access to the earthquake catalogue in KML format is helping researchers interested in earthquake swarm activity, such as that around Matata in the Bay of Plenty. The animation feature of Google Earth allows them to simply visualise the changes in earthquake location and depth over time.

The one-year project was completed successfully in June 2009 and was funded by the Research and Education Advanced Network New Zealand (REANNZ), a Crown-owned company established to administer KAREN.

GeoNet has also established a waveform database for the continuously recorded data streams produced by the seismograph and tsunami gauge networks. A Java client, which runs in many operating systems, will allow the researcher to query the entire GeoNet holdings and receive data in the seismological formats SAC and SEED, and also in plain text. Please see **http://www.geonet.org.nz/resources/basic-data/waveform-data/** for the latest descriptions and software.

These recent developments greatly improve researchers' ability to integrate GeoNet's data resources into their own applications. We will continue to work with the research community to ensure we produce widely accepted methods and formats that meet their data requirements.

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AUSTRALIAN TSUNAMI WARNING SYSTEM

Following the December 2004 Indian Ocean tsunami, the Australian Government announced a $68.9 million programme to develop the Australian Tsunami Warning System (ATWS). The system's major objectives were to provide a comprehensive tsunami warning system for Australia, support international efforts to establish an Indian Ocean tsunami warning system and contribute to the facilitation of tsunami warnings for the South-West Pacific.

Over the four year implementation, Geoscience Australia has upgraded existing seismic stations, built new seismic stations (within Australia and overseas) and accessed real-time digital seismic data from new and existing international seismic networks, including six from the GeoNet network. They have also established a 24 hour seismic monitoring and analysis capability to compute and advise of any earthquakes in their region that have the potential to cause a tsunami, within 15 minutes of the earthquake's rupture occurring.

The Bureau of Meteorology has upgraded existing tide-gauge sea level stations, built new tide-gauge stations within Australia and overseas, and installed new tsunameter buoys located in deep ocean locations near subduction zones. The Bureau has also developed a 24 hour tsunami warning service, with a tsunami monitoring and analysis capability, advising of potential tsunami impacts at least 90 minutes before a tsunami generated from undersea earthquakes reaches the Australian coastline.

The Australian Tsunami Warning Centre Operations Hub at Geoscience Australia was launched on 1 December 2006. The Hub detects earthquakes in the region and determines whether or not they are likely to cause a tsunami. The Bureau of Meteorology has also developed world-class tsunami warning bulletins, and pre-computed tsunami wave height and propagation models, used to develop tsunami forecast impact levels to better inform emergency managers about likely tsunami effects in coastal zones.

The completed warning service was launched in October 2008 with the official designation of the Joint Australian Tsunami Warning Centre (JATWC), reflecting the joint operations of Geoscience Australia (Canberra) for its seismic monitoring and alerts, and the Bureau of Meteorology (Melbourne) for its sea level monitoring and tsunami warning role within the Australian Tsunami Warning System.

Between July 2007, when the system progressed from an alert system to a warning service, and October 2009 there have been 125 earthquakes assessed as having the energy and mechanism to generate tsunami – one of these earthquakes was the 'Dusky Sound' earthquake on 15 July 2009.

Following that magnitude 7.8 earthquake located in Fiordland, New Zealand, the centre issued tsunami warnings for NSW and large parts of the east coast of Australia. Emergency services were put on alert and people on Lord Howe Island were evacuated to higher ground. The warnings were later downgraded to a marine threat and warnings of unpredictable currents at beaches. Tsunami were detected, with the tide gauge at Jackson Bay, near Haast, recording a wave of 1 metre, as well as small tsunami detected in southern Tasmania and south of Sydney.

International cooperation is vital for the development of effective tsunami warning systems; the GeoNet project works with Geoscience Australia to exchange data and information, and support each other's hazard monitoring work.

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Above, top to bottom: A seismic station located at Geoscience Australia; Staff working at the Joint Australian Tsunami Warning Centre in Canberra.
Below: Daniel Jaksa from Geoscience Australia shows GeoNet's Kevin Fenaughty the ATWS control desk.

EARTHQUAKE

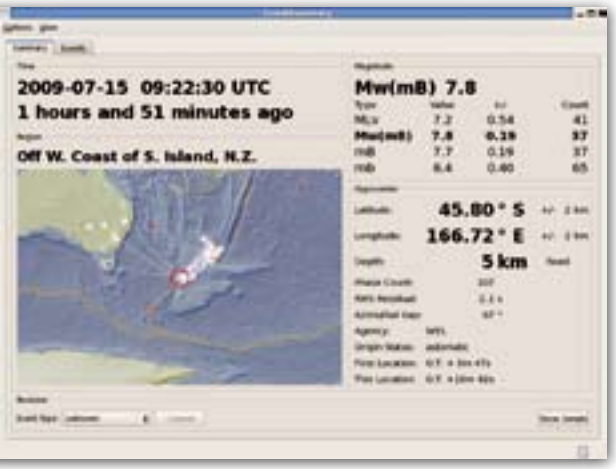
DUSKY SOUND

Dusky Sound hosts New Zealand's biggest earthquake for 80 years.

At 9:22 pm on Wednesday 15 July, a magnitude 7.8 earthquake ruptured the crust upwards and southwards from a depth of 30 km underneath Dusky Sound in the south-west of New Zealand. Despite a magnitude comparable with the earthquakes affecting Buller in 1929 and Hawke's Bay in 1931, damage was comparatively light.

This earthquake is the latest in a series of large shallow quakes in the Fiordland region. Many people felt the magnitude 7.0 event on 22 August 2003, and were puzzled that the most recent earthquake, although having a greater magnitude, was felt much less strongly. This was also borne out by the lower number of landslides observed near the epicentre.

Scientists at GNS Science have been able to build their understanding of this earthquake faster and more thoroughly than ever before thanks to the availability of GeoNet's seismic and GPS data streams. Their immediate assessment is that the shock was a large reverse faulting (or thrust) mechanism resulting from the Australian Plate pushing (subducting) beneath the Pacific Plate upon which Fiordland lies. As this is now the largest and one of only very few examples of this type of earthquake in New Zealand, it will be very important for our understanding of hazards here.



The deformation of the crust caused by the Dusky Sound earthquake resulted in the movement of the south-west part of the South Island towards the west-south-west (in a direction somewhat to the south of Australia). The largest motion was 350 mm of displacement at Puysegur Point in south-west Fiordland. This fact caused much mirth on both sides of the Tasman, with comments about airline flights becoming shorter and greener!

The GNS Science Duty Officer located the Dusky Sound earthquake within 20 minutes and posted the details to the GeoNet website. Behind the scenes, GeoNet has been testing and refining an automated earthquake system called SeisComP. It has been developed by GeoForschungsZentrum (GFZ), Germany's research agency for earth sciences, and is the basis for a tsunami warning system in Indonesia.

SeisComP settled on its location of the Dusky Sound earthquake after only 10 minutes, together with an accurate estimate of the 7.8 magnitude. As this system proves itself through extensive testing in the New Zealand environment, GeoNet will be pursuing greater automation of earthquake information and in future will be able to make website updates much more quickly. This will give vital extra minutes to emergency agencies organising their response after a major damaging earthquake.

In recent times New Zealand has been fortunate that its large earthquakes have been in remote areas or at too great a depth to cause significant disruption to the community; this will not always be the case. On a positive note, each occurrence has been an opportunity to add to our knowledge of New Zealand's hazards environment, and has allowed the GeoNet systems to be exercised and refined for the day when they will make an essential contribution.

Contact: Kevin Fenaughty
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Lead organisation in the GeoNet project

COMING UP...

EMERGENCY MANAGEMENT SUMMER INSTITUTE
When: 15 - 19 March 2010
Where: Massey University Campus, Wellington
Contact: Daryl Barton
Email: d.barton@gns.cri.nz

4TH AUSTRALASIAN HAZARDS MANAGEMENT CONFERENCE
When: 10 - 13 August 2010
Where: Te Papa, Wellington
Contact: ahmc@hazards-education.org
Web: www.hazardseducation.org/ahmc/2010

CITIES AT RISK
When: 13 August 2010
Where: Te Papa, Wellington
Web: www.hazardseducation.org/ahmc/2010

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