update

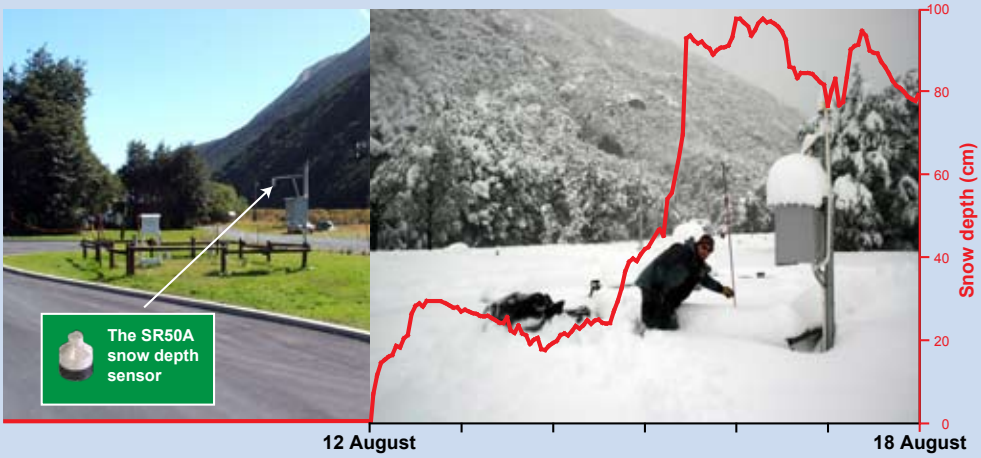
NIWA
Taihoro Nukurangi

Instrument Systems

collecting data, delivering solutions

Snow & Ice Network records big snow

New Zealand's new Snow & Ice Network faithfully recorded the extraordinary snow storm of 14–16 August 2008. The storm brought large snowfalls to parts of the Southern Alps and the higher areas of the North Island. The network is being established to record such events and also for longer-term monitoring of the snow resource.



Arthur's Pass station, one of five recently-established NIWA Snow & Ice Network stations, recorded one metre of snow between 12–18 August 2008. [Photos: left: Bob Newland, NIWA; right: Sarah Tammik]

In New Zealand snow is a valuable but poorly quantified resource. Until recently we did not have a national monitoring network. Now, five sites are established, and up to 12 in total are planned, covering all major alpine areas. In time, advanced modelling of long-run data produced by the Snow & Ice Network will allow NIWA to more accurately understand the nature of seasonal snow throughout New Zealand, assess any climate change impacts, and assist with calculating glacier mass-balance throughout the Southern Alps.

Measuring snow depth

The network climate stations measure snow depth with an ultrasonic sensor, along with other regular climate parameters such as temperature, wind, and rain.

The snow depth sensor works by transmitting ultrasonic pulses towards the ground, measuring the time it takes for the echoes to return from the closest surface, and using the measurement to determine the distance to it. As snow falls, this distance decreases, so the sensor measures the total height of the snow as it accumulates. The sensor has a range of 0.5–10 metres and an accuracy of 0.4%.

Measuring the weight of snow

We also install snow pillows at key locations to record the total weight of the snow. When we know the height and weight of the snow, we can calculate its density, and this tells us how much water is stored in the snowpack. We are currently trialing a snow pillow at the Mount Hutt ski field in Canterbury. The pillow is three metres in diameter and filled with an antifreeze solution that transmits the pressure from the weight of the snow to an electronic pressure sensor. The pressure is recorded by a Neon Remote Terminal data logger and transmitted to a Neon server. From here the data can be accessed via the internet.

The snow pillow site being constructed alongside the 'quads' chairlift at Mount Hutt. [Photo: Shane Rodwell, NIWA]

Measuring up – overhaul for the National Hydrometric Network

New Zealand's National Hydrometric Network is undergoing a significant instrument upgrade. The network is made up of about 300 monitoring stations measuring water level in lakes and rivers around the country. NIWA manages most of the network; we install and maintain the instruments and manage the data generated.

State-of-the-art systems built around selected instruments, including several manufactured by both Unidata and Design Analysis Associates (USA), are replacing the aging Aquitel systems, installed in the 1980s. The upgrade aims to standardise the configuration of sites, and improve routine maintenance efficiency.

One of the standard options in the upgraded hydrometric network – a gas bubbler system with GPRS (cellular-based) telemetry. [Photo: Mark Crump, NIWA]

[Graphic: James Sturman, NIWA]

NIWA's climate & water monitoring stations, central North Island. ◒ – water level and flow monitoring stations. Other symbols – other types of monitoring stations including rainfall, climate, and water quality.

We measure water level either with a rotary encoder (an electromechanical instrument which when coupled to the water surface outputs a digital signal proportional to the water level), or a gas bubbler system which measures the pressure of the water and derives the level from this.

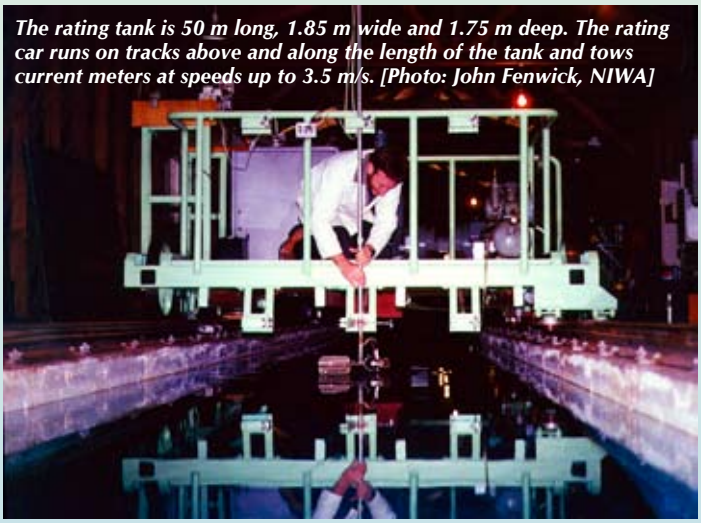
Data recorded on data loggers are then transmitted to the NIWA Flosys Server via radio, cellular, or satellite telemetry. The data are widely used and available via the internet. Visit http://edenz.niwa.co.nz/ for an overview of near real-time & long-run water resource data from open monitoring stations.

Measuring water flow – not as simple as it sounds

In rivers, flow rate is usually a more useful measurement than water level. Flow is difficult to measure because it depends on many variables, whereas water level is relatively easy to measure. By creating a relationship between water level and flow, we can determine the flow by measuring the water level.

To obtain the data needed to create the water level-to-flow relationship, NIWA hydrologists gauge each river. This involves measuring the water velocity at specific depths and intervals across the river, on several occasions, over the full range of water levels, using a water current meter. Meter types range from the standard electromechanical meters to the newer Acoustic Doppler Current Profiling (ADCP) instruments.

When the meter is taken out to gauge a river, we use the assigned calibration equation to convert the current meter output to velocity at each sampled point. To do this we use software such as NIWA's TdGauge, which combines the gauging data to calculate the actual river flow in cubic metres per second (or litres per second).



The rating tank is 50 m long, 1.85 m wide and 1.75 m deep. The rating car runs on tracks above and along the length of the tank and tows current meters at speeds up to 3.5 m/s. [Photo: John Fenwick, NIWA]

Calibrating current meters: NIWA's unique rating tank

First, though, we need to individually 'rate', or calibrate, each current meter. This is where we determine the mathematical relationship between water velocity and current meter output. NIWA owns and operates New Zealand's only rating tank, at Kainga, just north of Christchurch.

To calibrate a meter, we tow it through still water, over a range of accurately controlled speeds, while recording its output on a laptop computer mounted on a towing vehicle known as 'the rating car'. We then calculate a calibration equation, which is linked to each current meter by its serial number.

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