NZASE scientist profile

Peter Russell

Born where and when

Ngāpuhi, Ngāti Manu, Te Mahurehure. Born in 1965 in Watford, UK "on Mum and Dad's hikoi" (journey); grew up in Whanganui.

Schools and subjects

Aranui and St Johns Hill Primary; Whanganui Intermediate; Whanganui Collegiate. "I studied Physics, Biology, and Chemistry. In seventh form I was last in the school at maths - I was never good at maths until I had a use for it."

How he got into science

"Pulling apart and fixing things, plus science TV like Jacques Cousteau and David Attenborough. I grew up beside the ocean at Castlecliff and my earliest memories are of a small creek that drained a coastal swamp into the sea just down from our whare (house). One day this creek was full of inanga (whitebait)."

"The black iron-sand beach got so hot we had to sprint across the beach to the sea or get burnt feet, but the creek provided a cool path through the burning sand. Experiences like this made me ask 'why' from an early age."

Training and jobs

BSc in Physics, **MSc** in Electronics, **PhD** in Oceanography, all at the University of Otago.

Researcher, He Pātaka Waiora project, Ngāi Tahu; **Teaching Fellow** in Marine Science, **Māori Post Graduate Advisor** and **Research Fellow** in Physics, all at the University of Otago.

Fields of science

Oceanography (the physical properties of water and its movement), Marine Science, Limnology (fresh water environments) and sea ice research.

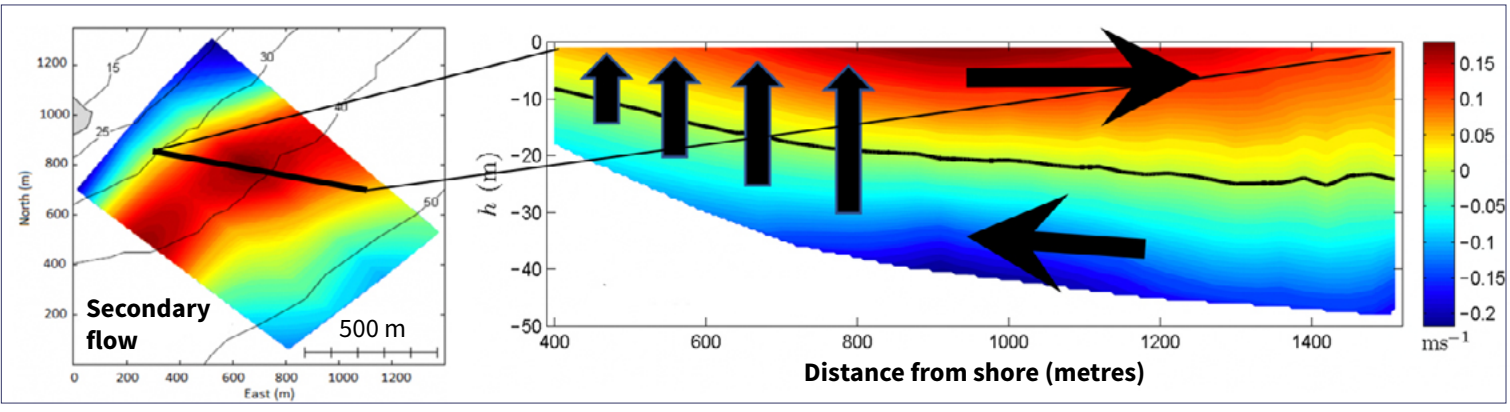
Research topics

- How tidal currents flow around coastal headlands and cause upwelling of nutrients; how water flows around river bends and erodes the banks.
- Marine productivity after tropical cyclones.
- Surveys of kaimoana (seafood) in customary fisheries.

He Pātaka Wai Ora

This six-year ongoing project was the first to be led by a hapū, Kāti Huirapa of Puketeraki Marae in Karitāne. It monitors the Waikouaiti

Peter with a survey pole at the Waikouaiti River in 2016, as part of the He Pātaka Wai Ora project. Photo: Ben Russell.



Secondary currents off Cape Saunders, Otago Peninsula. The cross section shows landward flow near the bottom and seaward flow near the surface connected by upwelling.

River, as part of the hapū's 200-year plan to restore the awa (river).

Scientists studied nine mahinga kai (food gathering) sites from the sea to the hills every fortnight for a year, measuring water quality for agricultural chemicals such as nitrogen, phosphorous and ammonia; temperature and conductivity; as well as annual ecological surveys of the river banks and beds. Monitoring continues each season.

Super-cooled water under an ice shelf

This project aims to understand how much ice is melting under the Ross Ice Shelf as the planet warms. At the grounding line, where the 700-metre shelf hits the land, the water is saltier than the ice and dissolves it. That fresh meltwater is more buoyant than seawater and floats to the surface. Releasing pressure super-cools it and it vents from under the sea ice in McMurdo Sound.

How he finds things out

"In oceanography, when you drop an instrument over the side of a boat, consider it lost - if you get it back that's a bonus!" Peter has lost a bit of gear over the years, the latest a brand new Go-pro in Abrahams Bay, Rakiura.

He uses basic visual methods such as a water clarity tube, where you measure how far down a black and white disk becomes invisible – "If it's muddy, you lose sight of it in a few centimetres."

He also uses temperature and conductivity sensors, which indicate how many ions are in the water. "Pure water has no ions and won't conduct electricity; fresh water conducts a little from dissolved rock minerals, but with nitrates, phosphates, and ammonium ions from agricultural runoff, water becomes increasingly conductive."

Acoustic current velocity profilers measure the speed of water currents from the sea surface to the ocean floor, by measuring the echo of a sound pulse and calculating the Doppler shift. This shift is why a motorbike travelling towards you has a much higher pitch than one moving away. Surface water echoes arrive immediately – lower echoes take longer.

Chemical analysers measure the amount of different chemicals in the sea. He also downloads hundreds of satellite images each year to study ocean temperature and colour, for chlorophyll and sediment. They are free online from NASA and the US National Oceanic and Atmospheric Administration (NOAA).

"You can do oceanography with just a computer and an internet connection. This all generates numerical data which are analysed with computer software."

NASA Landsat image of Otago Peninsula and the East Otago Taiāpure in 2001. Image download by Hamish Bowman.

Most valuable results

1 Currents around headlands

Peter's PhD measured the up-welling of water in secondary currents around a coastal headland. "Scientists knew about it, but this was the first detailed measurement. It could be adapted for other headlands with a computer model. This up-welling supports photosynthesis in the marine food chain. The combined upwelling of headlands around the world potentially supports a huge amount of marine life."

2 Evidence for the environment

Peter used satellite images to support Ngāi Tahu's opposition to the dumping of dredge spoil from the Otago Harbour. The image below shows how variable the currents are in the East Otago Taiāpure (customary fishery) on any given day.

""The lighter blue areas are water carrying

coastal sediment in all different directions, some in spirals," says Peter. "It didn't look like Port Otago's computer model, and we didn't have to look hard to find these images."

Port Otago's modelling concluded the sediment would just flow north off shore. The Environment Court allowed the dredging, but said that Port Otago had to stop dumping if some of the spoil drifted to the Taiāpure.

"A few hapū have come across the issue of challenging computer modelling" says Peter. "Computer models can be used to stop debate because those opposed don't understand enough to question it."

Mātauranga Māori

Peter points to the captains of waka hourua (double-hulled voyaging vessels) like Hoturoa Barclay-Kerr, Tainui, as pre-eminent Māori oceanographers, with extensive knowledge of oceans and weather. Mātauranga about fishing and collecting kaimoana is directly related to maramataka and tidal currents of coasts and river estuaries.

Peter says physical oceanography is just beginning research with Māori that in the climate field produced valuable posters summarising mātauranga Māori about weather tohu (signs), in two languages.

With other scientists, Peter has promoted a plan for the pūtahitanga (intersection) of Mātauranga Māori and western science about the oceans.

It includes compiling Māori intergenerational knowledge about climate changes; connecting Māori ocean knowledge with that of other decolonising indigenous peoples; developing shared terms for physical aspects of the oceans; ensuring Māori control of their data; and training a group of Māori scientists who can lead the field in the future.

What he likes about science

"Getting to do interesting and challenging work with great people in outstanding natural places like Rakiura and Fiordland. Spending time on the ocean and in rivers and being close to water."

Peter in Fiordland on the University of Otago research vessel, R.V. Polaris II. Photo: Niall Pearson.

Links

- Peter's video talk about his Antarctic ice research (52 mins).
- He Pātaka Wai Ora project summary (14 pages).
- Craig Stevens, Kura Paul-Burke & Peter Russell, 2020. Pūtahitanga: The intersection of western science and mātauranga Māori in the context of Aotearoa/NZ physical oceanography. *NZ Journal of Marine and Fresh Water Research* (15 pages).

Ngā Kupu

Au o te moana - Open sea, current
Huki - Extra high or king tide
Mātai aumoana - Oceanography
Maramataka - Maori lunar calendar
Parumoana - Seabed
Pēhanga - Pressure
Totetote - Salinity
Waipara - Sediment
Whakaihu - Headland
Whitianga - Voyage, crossing.

Te Aka Maori Dictionary and Paekupu