Welcome to the Soil News

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In this issue…

Your contributions are required - New Zealand Soil News is your newsletter

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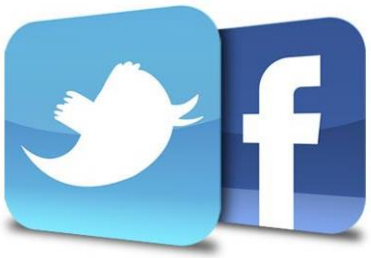

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Officers of the NZSSS 2019-2020

Editorial

Te Ao Māori: relationships with soil

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Introduction

Māori have had a long connection and understanding of soil reaching back centuries to Polynesian migration. The knowledge (mātauranga Māori, mōhiotanga, māramatanga, tohungatanga) is ancient, traditional, historic, and contemporary. Soils have provided cultural, spiritual, social, emotional, and economic sustenance to Māori (Asher & Naulls 1987; Harmsworth 2020; Hutchings & Smith 2020). The interconnections arise from whakapapa (ancestral lineage, layering) and start with the time of creation from the separation of the primordial parents, Papatūānuku (the earth mother), Ranginui (the sky father), and the emergence of light and reality (Te Ao Marama) as a dwelling place for humans, ecosystems, flora and fauna (Buck 1950; Harmsworth & Awatere 2013). The stories of interconnection and interdependency often start with the first woman, Hine-ahu-one or Hine-hau-one (the female element), who was formed from the soil (i.e. a clay red earth/red clay – onewhero, at the place of Kurawaka) from which human beings originated. It is also often said that at death humans return to the soil. When Māui (a demi-god) failed to convince Hine-nui-te-pō, goddess of the underworld, to let humans die like the moon (die and return), she told him, 'Me matemate-a-one' (let man die and become like soil) (Harmsworth 2020). Early Māori explorers who arrived on canoes from Polynesia were often interested in the cultivation qualities of soils in Aotearoa, as in 'te taro o te ora', meaning sustenance. There are many old Māori proverbs (whakataukī) that contain reference to soil, and the qualities and characteristics of soil (Harmsworth 2020; Roskruge 2020).

Māori names, describing soils, land – whenua

Over 100 traditional indigenous Māori names exist for soil; and most parts of the landscape are described in detail (Best 1925 Harmsworth & Roskruge 2014a,b; Roskruge 2020; Proctor & Harmsworth 2020), and with many descriptors (e.g. for degrees of wetness, stoniness, texture, colour).

Table 1. Selected examples of Māori soil names

Māori soil names and English description	Māori soil names and English description
Oneone – general name for soil	One-matua – typically loam

One-pū – sand One hunga – sea sand, sandy beach, sometimes mixed with mud One-pārakiwai – silt Parahua – silt Paru, paruparu – mud, dark mud Kere was used as a prefix for some types of clay, including keretū, onekeretū, kerematua, kerewhenua Kōtore, pākeho – white clay Keretū – heavy clay Kere whenua – yellow clay Kenepuru – sandy silt Uku – unctuous clay, white or bluish clay Uku whenua – plastic clay (old traditional name) Ūkui – wash, wipe away	Oneware, onemata – dark fertile soil One paraumu – very dark fertile soil, friable Oneware – greasy soil Onetakataka – a friable soil Onewawata – a lumpy soil Pūngorungoru – (soft spongy) A light, loose soil Rei – Peat Onekopuru – An organic soil found in wet situations Pungapunga (also purupuru) – pumice soils Pungarehu – ashes Onekōkopu – Gravel or very gravelly soil Tiapu, onetaipu – Fertile lands – especially sandy alluvial soils

Māori agriculture

Māori modified soils or Māori plaggen soils are extensive throughout Aotearoa-New Zealand (Best 1925; Singleton 1988; Harmsworth & Roskruge 2014a,b). Māori brought many warm tropical climate crops (e.g. taro, uwhi or yam, hue-gourde) to Aotearoa, and needed to manage the soils in the more temperate, colder climate in order for crops to grow well. Evidence of soil modification includes features such as re-deposited mixtures of sand and gravel; stones; shell fragments; middens; natural fertilisers, seaweeds, wood/ash and charcoal from fires; garden walls, terraces, and mounds; relative levels of organic matter and effects from mulching or burning; garden implements such as the wooden kō used for digging, garden pits; and structures for storage. In the Waikato region alone, Māori modified about 2,000 hectares of soil for growing crops, of which kūmara was the most important, with kūmara gardens located near rivers and on river terraces (Singleton 1988). Collective evidence provides insight into the past activities of indigenous Māori and indicates a progressive and developmental move towards gardening and horticultural practice, signalling an advancement in kaitiakitanga (guardianship) and maara kai (gardening). We know that gardening and cropping by Māori were significant around Māori communities and settlements (e.g. papakainga, marae, pā, maara kai, mahinga kai) in the 1700s and 1800s. Indeed, there is common belief among Māori that gardening practice and horticulture started when Māori arrived in Aotearoa and some evidence points to local gardens from the 1500s. Small garden plots are evidenced by large-scale modification of soils in many areas throughout Aotearoa-New Zealand. Building on this early knowledge, there has been re-emergence and strengthening of Māori knowledge and Māori values to underpin soil and food management (Hutchings et al. 2018; Hutchings & Smith 2020), showing the significance of soils as a taonga (treasured resource) particularly at the local and community level, with demonstrated links to soil security, food production, healthy foods, and human well-being (Hutchings et al. 2018; Hutchings & Smith 2020; Harmsworth 2020, Stronge et al. 2020).

Summary

Aotearoa-New Zealand has had a long, rich history in understanding and valuing its soils, and it is important to recognise the depth and richness of Māori knowledge/Te Ao Māori that existed before colonisation and modern science. We hope this short discussion piece will generate some interest among the soil science family in understanding Māori-soil relationships, and the role these relationships could play in safeguarding and managing our precious soils for the future.

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Also:
Soil health and growing kai, Maanu Paul speak to Radio NZ
https://www.rnz.co.nz/national/programmes/ninetonoon/audio/2018760512/soil-health-and-growing-kai-with-maanu-paul.
Takiura Episode one, with Teina Boasa-Dean
https://www.maoritelevision.com/shows/takiura/S01E001/takiura-series-1-episode-1

Letter from the correspondents

Last month the Soil News correspondents got together virtually to talk Soil News. Who are the Soil News Correspondents? We are a dedicated group of soil researchers across New Zealand from CRIs and Universities who have been coordinating local contributions to the Soil News for the past 1 month to 44 years (!). Lately we have noticed a drop off in the number of contributions and it is often a struggle to get news items. We know that our reminders come as one of many other emails into your inboxes, and it seems we are all pressed for time these days. We have asked ourselves: if people are reluctant to contribute, is Soil News becoming irrelevant?

But we also believe that the Soil News fills an important function in the NZSSS. Some of us read the Soil News even before stepping foot in New Zealand, and others have found it to be an important source of information to understand the soil science landscape in NZ. As Bruce Miller wrote in the very first issue of Soil News (August 1953) “Our aim is to give members material that is topical and interesting and at the same time useful in their work and reference”. We want to remain topical and interesting! The Soil News was conceived prior to the internet era, and we wonder if it's time to change how we communicate and make better use of modern information sharing platforms, or should we stick to tradition? There are lots of options!

So, to help us keep the Soil News a useful resource for all NZSSS members we would like you to please share your thoughts with us using the link below to access a survey. The results of this survey will only be used for the purposes of redesigning the Soil News and will not be shared outside the Soil News team or NZSSS committee. We will present a summary of the findings in the next Soil News in February. Please complete the survey **by Friday the 18th of December**. Any questions, please contact Soil News editor: Gina.Lucci@agresearch.co.nz

Thank you for your readership and contributions
The Soil News Correspondents

Complete the survey here!

From the President: Megan Balks

Nga mihi nui

What a year of changes it has been. Instead of a meeting in Cairns we are now looking forward to celebrating World Soils Day via regional webinars. I do hope you will join us at either Waikato Uni, Lincoln Plant and Food, or Manaaki Whenua Landcare Research in Palmerston North to support Carol Smith, this year's Norm Taylor lecturer, some face to face catch-up with soils people in your region, as well as to enjoy some interesting and thought-provoking webinar talks, and our exciting and prestigious NZSSS 2020 Awards (see notices elsewhere in this issue of Soil News). The NZ SSS is funding refreshments for these meetings. Never fear though the Cairns meeting is still planned to go ahead in June next year which will be a much nicer time of year to escape our winter and enjoy some good Aussie hospitality. We even have a fieldtrip planned that will include an opportunity to go snorkelling on the Barrier Reef!

In the face of Covid19 I think we can all feel grateful for the clear, rapid, response that New Zealand made which meant disruption here has been less than in many other parts of the world. We can also be thankful that our internet connections have generally stood up well to the extra strain of zoom meetings and on-line work. On the other hand the costs and effects are going to impact on us well into the future.

In the "post-covid" world the role of the NZ Society of Soil Science will be more important than ever in providing a link between members of the increasingly isolated NZ soil science community. It is unlikely that organisations will allow staff to travel any time soon so I think that local and regional events will need to become more common and more strongly supported. If you would like to get involved in organising some regional/local social/networking/professional events for your soil science community do get in touch with one of the NZSSS council members.

Look forward to seeing you all (including some of you in person) on Friday 4th December.

Cheers, Megan

Dr Megan Balks
NZSSS President.

Society News

Call for nominations for Council of NZSSS - opportunity to serve your profession as a member of the Council

Nominations are currently open for members of the Council of the New Zealand Society of Soil Science.

The present council of NZSSS would particularly like to encourage *PhD students and Early Career Researchers* to consider joining the Council of the Society. If you are interested in being nominated talk to any council member for information about

what membership of the council entails or contact the current president, megan.balks@earthbrooke.co.nz. A simple nomination form has been emailed to all society members, or you can request one from Megan.

We look forward to electing an enthusiastic and supportive council at our BGM on Dec 4th - see notice elsewhere in this issue of soil news.

Dr Megan Balks
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New Zealand Society of Soil Science Biennial General Meeting and award presentations

Call for nominations for Council of NZSSS

NZSSS /Soil Science Australia World Soils Day Celebrations

Norman H. Taylor Memorial Lecture 2020

1.30-5.00 Friday 4th December

You are invited to a zoom-linked event to celebrate World Soils day, in collaboration with our colleagues in Soil Science Australia followed by refreshments, then the NZSSS BGM and NZSSS award presentations. The link with Australia will include the 2020 Norman H. Taylor Memorial Lecture by Dr Carol Smith from Lincoln University. We will be having in-person gatherings at:

- Waikato University, Hamilton: Room MSB1.05
- Plant and Food Lincoln
- Manaaki Whenua - Landcare Research, Seminar Room, Riddet Road, Massey University Campus, Palmerston North
- or you can join us on Zoom (details below).

RSVP – for catering purposes if attending in person (we hope you will) please email:

- at Waikato tehnuka.ilanko@waikato.ac.nz
- at MWLCR Palmerston North roudierp@landcareresearch.co.nz
- at P&F Lincoln Brendon.Malcolm@plantandfood.co.nz

Zoom links for those not attending in person:

From 1.30-3.30 we will be joining a zoom link with the Australian Society of soil science. To register and then receive the Australian zoom link go to:
https://www.soilscienceaustralia.org.au/webinars/
At 3.30 we will break for afternoon tea, then continue from 3.30 – 5.00 using a New Zealand Zoom link:
https://waikato.zoom.us/j/99335753477?pwd=SzFGTVRPMkNrQTZoRVJEU3kzM21Sdz09

Please contact megan.balks@earthbroke.co.nz for further information and copies of nomination forms for NZSSS council members, Agenda for BGM, Treasurers report and audited accounts of NZSSS, minutes of previous BGM, and SGM.

Norman H Taylor Memorial Lecture 2020

Dr Carol Smith

"Learning is better by doing": pedagogy in a disruptive world

Teaching pedology and soil science in the field to students is one of my great joys. I have been fortunate to have met many colleagues on this journey who have inspired me and shared their passion for soils. But increasingly, there are pressures on what and how we teach, and external disruptors. We are under pressure to deliver our teaching in different ways, often with shrinking resources. This is compounded by outside disruptive forces which have included earthquakes and more recently, COVID-19. In my lecture I will focus on one approach we have researched and developed to teach pedology and field-based skills in more "effective" ways – via the soil judging framework. Then I will share some personal reflections on the impacts of disruption on our teaching of soil science; now and into a changing future world.

Carol is a senior lecturer in soil science at Lincoln University and is currently Head of the Department of Soil and Physical Sciences and the elected academic staff member on the Lincoln University Council. Carol spent her formative years in Britain, gaining a BSc(Hons) in Geographical Science from the University of Portsmouth, where her interest in soils was sparked by a passionate soils lecturer on an influential field trip to Wageningen and KU Leuven. A MSc. from the University of Reading in pedology and soil survey was followed by a PhD in soil science from the University of Aberdeen, which focused on critical loads of acid deposition to peat soils. She emigrated with her husband Ian to NZ in 1993 where she worked as a tutor in the Soil Science Department here at Lincoln University before moving a few years later to Sydney. A spell as a freelance environmental consultant followed, combined with raising a young family, before a move back across the Tasman. Two years as a contract lecturer in the Geography Department at the University of Otago

was followed in 2005 by a move back to Lincoln and her present role. Carol's eclectic research interests revolve around pedology, micromorphology, soils and landscapes (in particular Quaternary paleosols and loess), the role of carbon in rehabilitating degraded soils and Antarctic soils. Latterly, her research has focused on developing effective pedagogy for teaching field-based soils skills. In any spare time, Carol and her husband can be found cycling up and down the Port Hills or tramping in the mountains.

The 2020 NHT Memorial Lecture will be presented on Friday 4th December via webinar. For further details contact the President of NZSSS, Dr M. Balks, email megan.balks@earthbrooke.co.nz

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Congratulations to our own Woman of Influence: Trish Fraser!

Trish was honoured at an award ceremony at Auckland's Aotea Centre which was jointly presented by Westpac NZ and Stuff.
https://www.stuff.co.nz/business/farming/rural-women/123425469/south-island-soil-scientist-joins-stellar-lineup-of-women-of-influence

Notice

Bernard Simmonds

It is with much sadness that we write to inform you that our colleague and friend, Dr Bernard Simmonds, tragically passed-away on 26 September 2020 in a mountain-bike accident near Nelson. Below are recollections from some of Bernard's thesis supervisors and colleagues spanning his career progression.

Professor David Hamilton (supervisor of Bernard's MSc at the University of Waikato, 2010-11)

Bernard Simmonds was one of the 'real characters' amongst the students I have supervised during my academic career. He was very bright and highly dedicated to his Masters study. This dedication even extended to 'sleepovers' at his study lake, Okaro, south of Rotorua. We were interested in examining day-night changes in the distribution of algae in this lake. Not only did this work support Bernard's Masters thesis but it also contributed a nice paper that helped to resolve questions we had about the distribution of algae in the water column of small lakes:
Simmonds B, Wood SA, Özkundakci D, Hamilton DP. 2015. Phytoplankton succession and the formation of a deep chlorophyll maximum in a hypertrophic volcanic lake. Hydrobiologia 745 (1): 297-312.

Perhaps most memorable for me are some of the funnier incidents with Bernard. A group of students and staff from the University of Waikato attended the joint Australia-New Zealand freshwater conference in Brisbane in 2011. We stayed at an Airbnb in a Brisbane suburb. Going to and from our accommodation and the conference, Bernard would always walk about 20 meters behind the rest of us. It turned out that Bernard was terrified of snakes and wanted to make sure that our

larger group came across a snake before him. On one of our walks we were alerted by Bernard's calls – he had come across a 4-metre python in a garden beside the footpath – who would have believed it?

The other incident was when Bernard managed to run down a guy who had stolen his mountain bike from the university. There was no violence, just a benevolent bike handover that characterised the way that Bernard was with people; always a big smile and a friendly exchange.

It was such a pleasure to be Bernard's supervisor. I was shocked and very saddened to hear about Bernard's death; he had so much vitality and goodwill to contribute. I extend my sympathy to his family and friends.

Professor Richard McDowell (supervisor of Bernard's PhD at Lincoln University, 2012-16)

Bernard came to me from the University of Waikato and worked on contaminant leaching losses from peat soils in the Waituna catchment. Bernard had a great approach to his PhD. Nothing was ever that stressful and everything was permeated by humour and enthusiasm. Academically, he produced papers out of this PhD thesis (see below), but more importantly put them to good use in his role as a Land Officer at Tasman. I've heard many accounts of how he was able to get the message of good management practices out to those that could benefit.

Out of work, his enthusiasm for life was exemplified in a 100% effort to everything he pursued, be that his love for Mountain biking or Ultimate Frisbee – to which he fastidiously stuck to the rules (most of the time).

Here are a couple of papers he published from his PhD research.

Simmonds, B., McDowell, R.W., and Condron, L.M. 2017. The effect of soil moisture extremes on the pathways and forms of phosphorus lost in runoff from two contrasting soil types. Soil Research, 55, 19-27.

Simmonds, B.M., McDowell R.W., Condron L.M. and Jowett, T. (2015) Potential phosphorus losses from organic and podzol soils: prediction and the influence of soil physicochemical properties and management. New Zealand Journal of Agricultural Research, 58 (2), 170-180.

Dr Haydon Jones (Land Monitoring Forum Convenor)

Bernard became the Tasman District Council representative on the Land Monitoring Forum (LMF), a regional sector Special Interest Group (SIG), in 2016. With his cheerful and easy-going manner, and a keen interest in soil and land science, Bernard fitted into the LMF with total ease and we gained a trusted colleague. Being the extremely bright and enthusiastic chap that he was, Bernard very quickly became a highly valued and respected member of the group, contributing much to our work.

Bernard was always very prompt in providing an informative 'regional round-up' contribution on his work in the Tasman District over the previous six-month period. These covered topics such as soil mapping and nutrient studies on the Waimea plains, soil conservation and riparian protection, wetland mapping, catchment management, soil intactness/stability monitoring, afforestation and indigenous vegetation reversion, drought and high intensity rainfall events, and land fragmentation and productive land classification. However, Bernard was particularly

keen on collaborating within the group on the issue of protecting productive rural areas from fragmentation and made a significant contribution to our discussions on the proposed NPS for Highly Productive Land.

The LMF was stunned and deeply saddened to hear of Bernard's passing. It has been an absolute privilege to have known and worked with him. He will be greatly missed.

Brad Chandler (Bernard's colleague at Tasman District Council)

Bernard made an immediate positive impact when he joined the Environmental Investigations Team at Tasman District Council as the Soils and Land Use Resource Scientist. His background, enthusiasm and passion for the subject matter, along with his fantastic friendly nature, put him in great stead to settle into the role quickly and start tackling the tough challenges head on, as he did in his own very special and talented way.

While Bernard was at Tasman Council he was responsible for providing scientific expertise and advice on environmental aspects of land management to meet the Council's objectives in environmental monitoring, consent processing, policy development, and related resource management areas.

But Bernard didn't stop there, he took on the management of the nursery and got it to the great position it is in today and had plans in place to improve and expand it, which are happening at the moment. Bernard also managed the fencing fund to help farmers fence off waterways for stock exclusion and really enjoyed that on-farm interaction with the landowners to help them bring positive change to the environment. He managed the Hill Country Erosion Fund (HCEF) to plant 120 ha of iwi-owned erosion prone Separation Point Granite land in manuka, where there is now only 32 ha left to plant, but we all acknowledge "Kua hinga te Totara I te wao nui a Tane (The Totora has fallen in the forest of Tane)".

Another important piece of work for the Tasman District that Bernard completed was the mapping of all the nitrate levels for the Waimea Plains, a very complex and challenging task that Bernard completed with ease in a very timely manner and a smile on his face.

But hey, that was Bernard, always happy, fantastic to work with, easy going and a top guy to share time with. Whether it was for work or outside of work, Bernard had a real zest and energy for life, no matter what he was up to he could make it fun, and that positive vibe he gave off was infectious and will be sadly missed by everyone who had the pleasure of sharing time with Dr Bernard Simmonds, rest in peace buddy!!!

News from the Regions

Waikato/Bay of Plenty

AgResearch

A large team from the Environmental Research group at AgResearch Ruakura (**Mike Sprosen**, **Bill Carlson**, **Stuart Lindsey**, **Alec McGowan**, **Moira Dexter**, **Amanda Judge**, **Grant Rennie**, **Keren Ding** (PhD Student) and **Emma Noakes** from AgR Grasslands) have made a couple of trips to Taranaki. They've been installing ceramic cup samplers and soil lysimeters at the Dairy Trust Taranaki farm at Stratford. This is part of a Spikey® project which also includes ceramic cup samplers on a farm in the Rotorua catchment. Spikey® is a piece of equipment using spiked disks (hence the name) which is towed behind a tractor. These disks are electrodes which detect fresh urine patches. Spikey® then applies NitroStop™ to the fresh patches potentially increasing pasture growth and reducing nitrate leaching.

Some students from science and agriculture classes from the local Stratford College walked across the farm for a visit to see what we were doing and to reinforce some learnings that they'd had on Nitrogen and Spikey®.

And not a bad view while we were there.

There was excitement in mid September at Ruakura campus when **David Lowe** and **Tanya O'Neill** tuned up with their 2nd year soil science class to undertake an soil description of the Horotiu- Bruntwood-Te Kowhai complex in the paddocks immediately adjacent to the Ngahere building facility where all of the Ruakura based Soil Scientists are domiciled. Despite running many trials in these paddocks, we haven't until now had the luxury of a small digger to dig deep soil pits for evaluation of this world famous (well at least Waikato famous) soil intergrade that spans poorly to well drained soils within in a matter of tens of meters. An impromptu team meeting was called for during a coffee break for an inspection. The Horotiu uncovered was in fact more of a mottled silt loam variant and the Burntwood was more of a pale subsoil variant. However, the Te Kowhai silt loam did not disappoint with its classic poorly drained features and gleyed B and C horizons. The overall conclusion was that the team were grateful to still have grazed paddocks surrounding home base despite the increasing housing pressure surrounding the Ruakura neighbourhood. The team at Ruakura would now like to challenge other Soil science teams to go through a similar inspection exercise of the paddock closest to their office block and report back in a future edition of Soil News.

Plant & Food

PFR (**Brendon Malcolm** and **Paul Johnstone**) are contributing to a 3-year Sustainable Farming Fund (SFF) project, led by Genetic Technologies (Pioneer) based in the Waikato region to identify how catch crops could reduce environmental impacts following a maize silage or grain crop.

Four trials located on two commercially-operated properties of contrasting soils have been established in both maize silage and maize grain paddocks. These trials consider the inter-seeding of catch crops at the V5 stage, broadcasting at 25% senescence and post-harvest drilling. Species being tested include combinations or monocultures of perennial ryegrass, Italian ryegrass, plantain and oats, compared to fallow controls. Selections made for this first tranche of trials target species of high winter activity and/or their potential to influence nitrogen transformations in the soil, i.e. slowing the conversion ammonium into nitrate. From Year 2, direct measures of N leaching losses from maize-catch crop treatments will be obtained from an array of buried suction cups.

Of particular interest is how catch crops could be successfully implemented in maize grain rotations, given the challenges when dealing with significant amounts of surface residue post-harvest, combined with the cooler soil temperatures leading into winter. Here we are investigating direct drilling vs pre-drilling discing techniques as a means of sowing catch crops in these systems.

The SFF project is funded by the Ministry for Primary Industries, with support from Genetic Technologies, Waikato Regional Council, Foundation for Arable Research (FAR), Barenbrug, Plant & Food Research, Ballance Agrinutrients, Cranleigh Agribusiness and John Austin Limited.

Photos: Interseeding a catch crop (right), and a catch crop growing under maize (left).

University of Waikato

Aaron Wall and **Anne Wecking** (both supervised by Louis Schipper) have submitted their PhD theses. Aaron's included three published papers and was entitled "The

impact of maize silage production and supplementary feed use on the carbon balance of New Zealand dairy farms". Anne's thesis contained two published papers and was entitled "Paddock-scale nitrous oxide emissions from intensively grazed pasture: quantification and mitigation".

Emily McKay (supervised by Tanya O'Neill and funded by FAR) has completed her masters with first class honours and was entitled "The effects of varying intensity cultivation on soil quality in a maize cropping system". **Olivia Adamson** (supervised by Tanya O'Neill) has been awarded an Institute of Environmental Science and Research masters scholarship to investigate the role of native plantings to mitigate freshwater contamination at Lake Waikare near Huntly in the Waikato region.

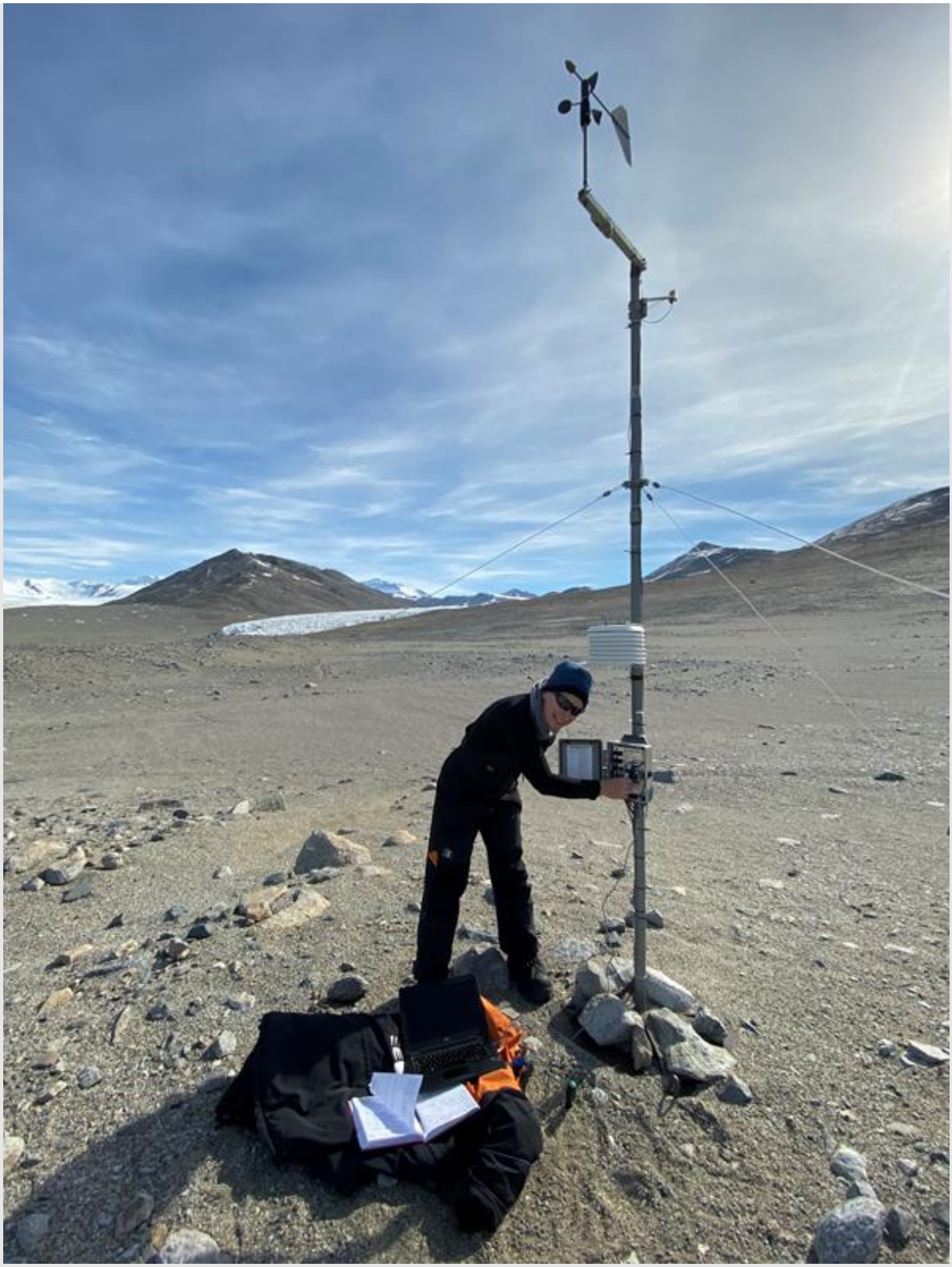
Emily McKay and her hot-off-the-press MSc thesis

Aaron Wall and **Jordan Goodrich** established a new eddy covariance tower at Owl farm near Cambridge at St Peter's school to measure carbon balances over pasture and in the future during growth and grazing of turnips. The team hosted 80 year-9 students at the site to talk about soils and greenhouse gas emissions from agriculture.

Soils meet students at St Peters school, Cambridge

Along with **Vic Arcus**, **Louis Schipper** hosted a virtual meeting of collaborators on their Marsden Council grant that will examine the temperature dependence of the biosphere scaling from enzymes through microbes, soils, plants, and ecosystems. They were joined by collaborators from the US, UK, and Australia. In this research theme, two new masters students have joined the group. **Allycia van de Laar** will examine the temperature dependence of soil respiration along a geothermal gradient. **Alice Wheatley-Wilson** has also started a masterate thesis with **Jordan Goodrich** and **Dave Campbell** looking at the temperature dependence of methane production in Organic Soils on peat.

Tanya O'Neill and Associate Professor **Sally Gaw** of Canterbury University have been awarded a Marsden Fund fast-start grant to study penguin mounds as natural archives of contamination in remote Antarctic environments. They will investigate the role of penguins as vectors for contaminant transfer from the marine to terrestrial environment, whether geochemical markers of specific global-, hemispheric-, and local-scale anthropogenic events are preserved in Adélie penguin colonies, and the potential sources of the contaminants.



Cool photo of Tanya at met station in Miers Valley. Photo: Jamie McGaw

Landscape and penguins at Cape Bird, Antarctica. Photo: Fiona Shanhun

Meanwhile, Dr **Oliver McLeod** has successfully negotiated his PhD orals on the volcanoes of southwest Waikato (Karioi, Pirongia, Kakepuku, and Te Kawa) and is now undertaking a public lecture tour in and around Te Awamutu and Pirongia village to promote and explain his bulletin and map on Mt Pirongia, the first detailed map (scale 1:30,000) of the volcano (which is the North Island's largest basaltic volcano). The peer-reviewed bulletin and map have just been been published by the Geoscience Society of New Zealand in its miscellaneous publication series (Oliver et al. 2020). Oliver's bulletin includes mention of the cover bed stratigraphy and soils. Congratulations on the PhD, the impressive bulletin/map publication, and the public lecture tour, Oliver.

David Lowe, with engineering geologist **Vicki Moon**, is leading a project on the earthquake history of the Hamilton Basin being developed using liquefied lacustrine tephra layers in lakes (called 'tephra seismites') as a novel palaeoseismological tool to investigate hidden faults. The project is funded by MBIE's Endeavour Fund (Smart Idea) and the Marsden Fund. An associated project on the newly discovered Te Puninga Fault near Morrinsville, funded by EQC, is also getting underway. After considerable delays because of covid-19, David and Vicki have been joined by postdoctoral fellow Dr **Max Kluger** (Bremen University) together with research officer Dr **Tehnuka Ilanko** (part time), and PhD student **Jordanka Chaneva.** More graduate students, including masterate student **Sam Brinkworth**, will join the project in 2021. Three lakes were cored in October in Hamilton (Hamilton Lake, Forest Lake, and Horseshoe Lake) with colleagues Dr **Marcus Vandergoes** (GNS), Dr **Andrew Rees** (VUW), and Dr **Susie Wood** (Cawthron Institute) in tandem with the Lakes 380 project. More information on the tephra seismites project will be available shortly via a new project website.

Lakes 380 team coring Forest Lake (Lake Rotokaeo) in Hamilton in October for the Waikato Uni-based Tephra Seismites project.

Retirement

David Lowe is retiring on 18 December 2020 after almost 40 years as a full-time academic at the University of Waikato (around 44 years in a teaching role, and nearly 49 years since he stepped onto the fledgling Waikato campus as an 18-year-old student in late February 1972). David will be returning part time at Waikato for another 3.5 years, funded partly by his MBIE/Marsden project and with some graduate-only teaching and supervision. David has been a correspondent for *Soil News* for more than 40 years (more or less continuously) and has additionally contributed around 50 articles to the newsletter, his first being in 1979. Along with several contemporaries, joined NZSSS as a student in 1975 (at the gentle persuasion of Harry Gibbs). He was awarded the Rigg Award in 1982 for best masterate thesis (the first University of Waikato recipient of the award), and a fellowship of the society in 2002, the same (50th jubilee) year he received the N.H. Taylor Memorial Lecture Award. His role at Waikato is partly summarised in Lowe and Balks (2018).

Undergrad teaching

After several decades of utilising a great plain-hill site at Tamahere for year-2 soil science students undertaking soil profile descriptions and a simple mapping exercise, new owners and a change in land use forced us to find a new location. Two nearly-adjacent paddocks on the Ruakura campus proved to be a great choice. Access was kindly facilitated by Ruakura farm manager, Tim Hale. Staff from AgResearch including Dr **Dave Houlbrooke** and **Stuart Lindsay** and others visited

the opened pits the day before the university field trip, and the students seemed to enjoy the experience as well.

Waikato soil science students describing soils on part of Ruakura campus, 17 September 2020.

Exploring the delights of a Bruntwood soil (phot above) and Kainui soil (photo below).

An aggregate of pedologists

David Lowe was one of 11 pedologists and others who converged on Lincoln Event Centre on 5 November to explore ways of integrating landscapes and landforms into Smap at a workshop convened and run by **Linda Lilburne** and **Melissa Robson-Williams** (Manaaki Whenua Landcare Research, MWLR). Participants included **Peter Almond** (Lincoln University), **Alan Palmer** (Massey University), **Andre Eger**, **Scott Fraser**, **James Barrington**, and **Sharn Hainsworth** (MWLR), **Trevor Webb** (formerly MWLR), and **Peter Singleton** (consultant, formerly Waikato Regional Council and other organisations). Their efforts were scrutinised and developed further by **Phil Tonkin** (formerly Lincoln and Canterbury universities) and **Ian Lynn** (MWLR) a week later.

Alan Palmer (far left) presents the geological and tectonic basis of land systems for southern North Island.

Andre Eger (closest to wall with pink slips) leads discussion about another set of land systems.

Book

We are pleased to advise that the book “Soils of Aotearoa New Zealand” by Drs **Allan Hewitt, Megan Balks, and David Lowe**, is now with the publishers, Springer, and has entered the production phase. It is a contribution to the World Soils Book Series instigated by Prof Alfred Hartemink, who is the series editor. The series comprises peer-reviewed books on the soils of a particular country. The book on New Zealand comprises 18 chapters: an introduction followed by a chapter on each soil order (15 chapters), a chapter on soils of the Ross Sea region, and a concluding overview chapter.

World Soils Day 2020

Megan Balks, Tanya O'Neill, and David Lowe are convening the World Soils Day meeting and webinar on **Friday 4 December, 2020. The in-person meeting is being held on the University of Waikato campus, Hamilton, in room MSB1.05 (Management Studies Building, Hillcrest Rd, Hamilton) from 1.30 pm onwards.**

The afternoon meeting will include this year's N.H. Taylor Memoria Lecture ("Learning is better by doing": pedagogy in a disruptive world") by Dr Carol Smith (Lincoln University), the biennial general meeting of NZSSS, and the annual awards of the society as well as special talks via Zoom by some of our Soil Science Australia counterparts. An afternoon tea is also on offer. For further details, including the Zoom link, see notices elsewhere in this issue.

If you want to attend in person, it is essential that you **email Dr Tehnuka Ilanko** of your intent and advise any special dietary needs **by Friday 27 November:** tehnuka.ilanko@waikato.ac.nz

World Soils Day 2019 – Wai-BOP Soils and the special commemorative mug: what happened next

This time last year we enjoyed the Wai-BOP soils meeting in Hamilton that included a special commemorative mug featuring an image of Mendeleev on one side. Our subsequent write up in *Soil News* caught the attention of Ed Landa and Del Fanning, both geoscientists at the Dept of Environmental Science and Technology at University of Maryland, College Park. Ed was previously at US Geological Survey and has worked on element 43 (technetium) in soils and plants and wide-ranging environmental applications of geochemistry. He co-edited a great book, "Soils and Culture" (Landa and Feller 2020). Del, with a special interest in acid-sulphate soils, wrote a seminal text book in the 1980s which I still refer to: Fanning and Fanning (1989) in which he notably refers to egg-cup podzols (Del visited Northland in 2002).

Both Ed and Del have deep interests in soil science history, and Del has an enthusiasm for soil displays including his university's impressive monolith collection (Fanning 2004), and so I sent them each a mug (the last two I had) via courier on the day before lockdown in March. Ed and Del were not able to get the mugs until quite recently because of restricted access to the campus but Ed sent me the two photos below, one celebrating the US election outcome, and the other is a "selfie" showing the cup with handle in element 43 position and a very nice periodic table shirt.

Photo by Ed Landa showing off the Wai-BOP Soils 2019 commemorative mug with an appropriately uplifting background.

Ed Landa with the Wai-BOP Soils 2019 mug, and some interesting soils books alongside. The handle of the mug is in position 43 for technetium.

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Fanning, D.S. 2004. The University of Maryland soil monoliths collection and some associated history. *Soil Survey Horizons* 45, 7-13.
Fanning, D.S., Fanning, M.C.B. 1989. S*oil: morphology, genesis, and classification*. John Wiley and Sons, New York. 395 pp.
Landa, E.R., Feller, C. (eds) 2010. Soil and culture. Springer, Dordrect. 488 pp.
Lowe, D.J., Balks, M.R. 2018. Pedological and some other soil-related activities within the Earth sciences discipline at the University of Waikato, Hamilton, New Zealand – the first 50 years (1969-2018). *New Zealand Soil News* 66 (2), 27-60.
McLeod, O.E., Pittari, A., Brenna, M., Briggs, R.M. 2020. Geology of the Pirongia volcano, Waikato. 1:30,000 map. *Geoscience Society of New Zealand Miscellaneous Publication* 156. 58 pp. + map.

Lincoln Agritech

Understanding the nutrient and flow contributions of different sub-catchment

The MBIE-funded Critical Pathways Programme (CPP) aims to unravel the different pathways of contaminant transfer at the sub-catchment scale. Our two study catchments are the headwaters of the Piako, and the Waiotapu stream catchment. In order to get a better understanding of the lithology at different depths and how water moves through the different layers, we have undertaken two types of geophysical (electromagnetic) surveys: an aerial survey (SkyTEM), completed in February 2019 (Figure 1), and more recently, ground-based surveys (tTEM) using equipment from our collaborators at Aarhus University (Figure 2), which will give a finer resolution at the all-important shallow depths.

Figure 1: SkyTEM aerial survey carried out in the Upper Piako catchment in February 2019.

Figure 2: tTEM ground-based survey carried out in the Upper Piako catchment in November 2020.

We have recently had four 50m deep boreholes drilled and groundwater monitoring wells installed, two in each of the study catchments (Figure 3). The primary purpose was to gain detailed lithological information at key locations to help interpret both the SkyTEM and tTEM data. Preliminary results indicate that changes in resistivity in the SkyTEM data correlate well with changes in lithology. The wells will also be sampled periodically to inform our understanding of the deeper groundwater conditions in each catchment.

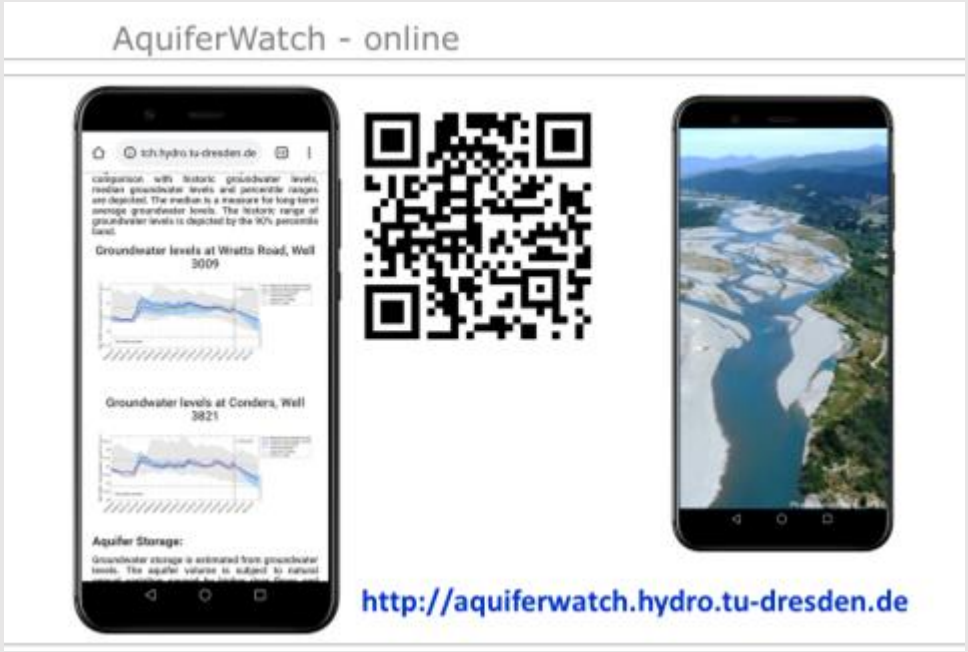
Figure 3: A 50 m deep borehole was drilled to gather detailed lithological information at 2 locations in each study catchment to cross reference with the geophysical data collected.

Make a note in your diaries: LuWQ 2021 has a new date!

While it seems inevitable that participation by New Zealanders will be much lower than in previous years, if feasible at all, here's a note on the new date for LuWQ2021 in Maastricht:

https://www.luwq2021.nl/

AquiferWatch:
Lincoln Agritech and TU Dresden in Germany have developed AquiferWatch, a web-based groundwater forecasting tool which has been trialled in Marlborough. The tool provides daily updates on the state of the unconfined Wairau Aquifer and issues forecasts of groundwater heads and abstractable storage under drought conditions when management of groundwater resources is most challenging. For more information use the QR code or web link below. The maths underlying the tool was developed in collaboration with ESR and is reported in the following publication: Wöhling T & Burbery L (2020). Eigenmodels to forecast groundwater levels in unconfined river-fed aquifers during flow recession. Science of the Total Environment, 747, 141220.



Manawatu
Plant & Food

In June **Steve Green** and **Nathan Arnold** installed a second array of fluxmeters in a field in the Rotorua region to track nutrient losses under hemp. They have also installed equipment to monitor the soil moisture and the microclimate at the site. The work is part of a new project with Bay of Plenty Regional Council and Te Arawa Primary Sector Inc and will run for the next 1.5 years. The fluxmeters allow them to track nitrogen and phosphorus losses in drainage water and explore the impact of land management decisions on environmental outcomes. Along with collecting

drainage samples they will be monitoring the hemp biomass accumulation under two irrigation treatments to see if this has any effect on the nutrient losses. This work is important to the client, as the regional council are looking to implement nutrient management restrictions in the Lake Rotorua catchment, so they need to have data on hand to ensure their farming practices stay within the guidelines that are set.

Photos: installation of fluxmeters in a field to be sown to hemp.

In October **Roberta Gentile**, **Carlo van den Dijssel** and **Nathan Arnold** began soil sampling for a new commercial project for Zespri to measure soil carbon stocks under kiwifruit production. We will validate soil carbon stock quantities in our main New Zealand kiwifruit growing regions to provide a baseline value, against which future measurements can measure the rate of change. Soil carbon stocks will be correlated with selected orchard management variables such as age, management style, cultivar and soil type. They visited orchards in the Bay of Plenty, Northland and Gisborne regions and collected soil samples down to one metre depth to measure stocks of total carbon and nitrogen, labile carbon and soil texture. This work will help generate tools for kiwifruit growers to foster healthy soils and will help mitigate the industry's carbon footprint.

Photo: soil sampling under a kiwifruit canopy in Gisborne.

Manaaki Whenua – Landcare Research

Les Basher's retirement

Les Basher's last day at Manaaki Whenua – Landcare Research (MWLR) was 30 September 2020. Les retired after 43 years with MWLR and its predecessor organisations. Les started with the Soil Conservation Group in the Ministry of Works Water and Soil Division in November 1977 after completing a BSc (geology) at University of Canterbury 1973. He went on to be awarded a PhD (Soil Science) from Lincoln University in 1986.

Les's PhD work in the Cropp Valley in the Southern Alps was unique at the time. The relationship between the dynamics of soil formation, erosion and the environment had not been studied anywhere else in the world before. This study set Les up for the wide and varied interests he studied in future years.

Les' area of expertise was as a scientist in erosion and sediment processes (including assessment of erosion processes, erosion modelling, integrated catchment management), as well as pedology, and geomorphology. Les' career was varied, and he undertook research in many areas of the country and was well known for organising great and memorable field trips.

Les provided leadership in many areas of erosion research particularly modelling erosion and sediment processes. He provided the first quantitative data on rates of surface erosion processes on arable/vegetable production land in New Zealand (Pukekohe, Ohakune, Levin areas). He pioneered the use of radionuclides in New Zealand for studying soil loss. He led a suite of projects investigating and modelling erosion and sediment processes, for example, in the Motueka and Manawatu catchments involving many other researchers and end-users, with emphasis on linking sediment generation with its impacts in freshwater and marine environments. Les led research on critical source areas for sediment generation through a combination of modelling, field data collection and sediment tracing. The core aim was to improve erosion process understanding to allow better targeting of erosion mitigation.

In recent years, Les has been more involved in work related to forestry. He was a key figure in driving the development of the erosion susceptibility classification to underpin the National Environmental Standard for Plantation Forestry and how it could be implemented. He was also involved in work underpinning the recent proposals for sediment attributes in the NPS for Freshwater Management.

Les provided leadership in many areas of applied geomorphology and was President of the NZ Soil Science Society from 1994–1996. During that time, and on behalf of the Society, he was involved in preparing a lengthy submission contributing to the debate on the preservation of high-class land in New Zealand.
Les has published at least 70 peer reviewed journal papers, 15 book chapters, many conference papers and reports.

While now supposedly retired, Les is staying on at MWLR as a Research Associate. We are delighted his experience and advice will still be available to colleagues and stakeholders for several years to come. Thanks Les, for your contribution to our organisation and to soil erosion science.

Acknowledgment: Thanks to Chris Phillips and Jeanette King for providing some of the text in this article.

Photo: Les Basher's farewell on 30 September 2020. From left to right (seated) are: Ian Lynn, John Payne, Les Basher, James Barringer and Robyn Basher. Standing is Chris Phillips.

Photo: There were lots of cakes to mark Les Basher's retirement, 43 of them to be exact. The cupcakes were iced with every calendar year of Les's employment with MWLR.

Photo: Les Basher and Ian Lynn undertaking fieldwork.

Other news

Our new member to NZSSS is **Lauren O'Brien**. Lauren joined Manaaki Whenua – Landcare Research earlier in the year from the Queensland Department of Environment and Science. Lauren works as a pedologist helping to deliver S-Map for areas particularly in the Manawatu-Whanganui and Wairarapa regions. Lauren has an enthusiasm for digital soil mapping. She is a contributor to open source projects, such as various R packages used for soil and geospatial research. Lauren is an author, co-author and maintainer of "slga" and "mpspline2", and contributes to open learning initiatives.

This month, we farewelled **Marmar Sabetizade**, who left MWLR after two years working with **Pierre Roudier** and **John Dymond**. Marmar was hosted at MWLR as a visiting PhD student from the University of Tehran, and worked mainly on the development of mid-infrared (MIR) soil spectroscopy for soil organic carbon assessment. During her stay, she helped MWLR to develop methods and protocol for MIR operations, and successfully published two papers.

Manaaki Whenua – Landcare Research published its 29th issue of **Soil Horizons**. This is a web-based newsletter on our latest soil and environmental research to update and inform end users and stakeholders. There are 8 articles available: https://www.landcareresearch.co.nz/publications/soil-horizons/

- Lilburne L, Carrick S. More S-map support for farm-scale soil information
- Graham S, Hunt J, Laubach J, Rogers G, Whitehead D. Lysimeter research identifying management practices to reduce nitrogen leaching
- Aislabie J. Dung beetles: NZ's missing link to achieve sustainable pastoral agriculture?
- Harmsworth G, Stevenson B. Defining soil health from a Māori world view
- Lilburne L, Carrick S. New water retention model in S-map

- Neverman A, Vale S, Smith H, Betts H. Real-time monitoring to detect erosion sources affecting sediment-related water quality
- Drewry J, Claydon J, Carrick S. 2020. Soil physics and environmental chemistry laboratories – historical lineage and their role in supporting critical national research and soil monitoring.
- Drewry J, Carrick S, McNeil S. 2020. Temporal changes in soil physical properties under winter wheat cropping.

Massey University

February's annual FLRC event

Covid has caught up with the annual Feb FLRC workshop, and the FLRC team has put in place an alternative plan for 2021. FLRC is making arrangements to hold a zoom simulcast one-day webinar/seminar on Wed 10th Feb 2021. This will happen live from AH1 on Massey's campus (our normal venue) and on Zoom. The theme of this webinar/seminar will be 'Getting the most from Farm Environment Plans (FEPs)' and the FLRC team is putting together an informative one-day programme on this topic. Speakers will be brought in both live and on-line. Full catering for the day will be available and an informal social dinner is planned for the evening of 10th Feb for those people staying in Palmy. Information is available on the FLRC website (http://flrc.massey.ac.nz/). We hope to see you here….. but this is not the end of the FLRC event as we know it! We expect to hold the 34th Annual FLRC Workshop (the three-day event) in February 2022.

Professional Development short courses delivered by FLRC, Massey University, during 2020

This year has been particularly busy for staff of the Farmed Landscapes Research Centre (FLRC, Massey University) delivering Professional Development short courses. When lockdown was imposed there were more than 150 people already enrolled on the Sustainable Nutrient Management (SNM) courses, both 'Intermediate' and 'Advanced'. Urgency was given to recording lectures and providing online resources to allow the courses to continue through digital delivery. Throughout lockdown, and probably as a consequence of the Minister of Finance's budget in May, which committed significant funding to environmental initiatives, demand for the SNM courses increased and further courses were organised for the second half of 2020 - and digital delivery has now become the new normal. Whilst this has provided several challenges, the digital delivery mode has been very well received by course participants, as it offers greater flexibility for learning from home and without the need to travel to Palmerston North for contact courses. Components of the courses are delivered through live tutorials using Zoom, which has proven to be an effective means of teaching.

In addition to the SNM courses, in 2020 FLRC also delivered short courses with a focus on 'Agricultural Green House Gas Emissions and Management', 'Advanced Soil Conservation' and 'Farm Dairy Effluent'.

With the Government's requirements under the new 'Action for Healthy Waterways' plan, which will require Fresh Water Farm Plans for most NZ farms, FLRC has also

developed new 'Intermediate' and 'Advanced' courses that focus on 'Farm Environment Planning' (FEP) with support from the Fertiliser Association. These courses have been developed in line with the key competencies required for accredited advisors.

More information about FLRC short courses can be found at http://flrc.massey.ac.nz/courses.html or by contacting Fiona Bardell: F.M.Bardell@massey.ac.nz

Collecting soils for fast and accurate proximal sensing of metals

On 29 October 2020, **Gautam Shrestha** a PhD student in Soil Science from Nepal, enrolled at the School of Agriculture and Environment (Massey University), along with help from **Peter Bishop,** went to the Stratford Demonstration farm, Stratford (Taranaki area) to collect an Allophanic soil under dairy pasture. Gautam's doctoral research aims to utilise proximal sensing techniques as reflectance and fluorescence spectroscopy to quantify soil Cd concentration in pastoral soils. This project is under the supervision of a joint multidisciplinary team from Massey University (**Roberto Calvelo**, **Chris Anderson**, **Jeya Jeyakumar** and **Gabor Kereszturi**) and Manaaki Whenua – Landcare Research (MW-LCR) (**Pierre Roudier**).

The Allophanic soil collected will be used to conduct a glasshouse experiment growing chicory at increased concentration of Cd to find out fate of cadmium added in the soil. This pot experiment complements a previous one, under similar conditions, using a Pallic soil.

Photos: Left to right, (a) a nice dark Allophanic topsoil collected near Stratford, (b) glasshouse experiment showing chicory plants growing in a Pallic soil under increasing concentration of Cd, (c) Gautam Shrestha scanning (vis-NIR) pots to gather data for further spectroscopic modelling. Photos courtesy of Gautam Shrestha.

Periodic soil and chicory leaf surface scanning will be done using visible and near infrared (vis-NIR) spectroscopy. In addition, proximal sensing spectroscopy laboratory facilities at MW-LCR will be used to obtain vis-NIR, mid-infrared (MIR)

and x-ray fluorescence (XRF) spectra from the same samples. With the help of chemometric modelling techniques, Gautam is determined to use all the information to develop reliable Cd assessment in soils based on proximal sensing techniques. In the longer term, the doctoral project can potentially develop fast and accurate methods based on proximal sensing techniques to quantify soil Cd concentration in pastoral soils.

Hawke's Bay

Plant & Food

At the end of September, we celebrated **Jeff Reid**'s retirement. The event marked a hugely successful and productive 40-year career in research – starting in 1981 at Lincoln College, before a move to MAF, then to Crop and Food Research and since 2008 with Plant and Food Research.

Photo: Jeff addressing the crowd at his retirement function. Displayed is a word-cloud of single words that his colleagues felt described their interactions with him, his contributions and his skills.

Photo: Jeff's stunning cake reflecting his contribution to developing new nutrient management guidelines for vegetables.

Canterbury

Lincoln University

Congratulations to **Dharshika Welikala** on the successful defence of her PhD thesis on Tuesday 20th October.

Dharshika's project was entitled "The effects of organic matter, pH and dissolved ligands on the mobility of cadmium in soils". She arrived from University of Peradeniya in Sri Lanka having a pure chemistry background, but quickly acquired an impressive amount of knowledge on soil science and the behaviour of trace element contaminants in the agricultural landscape. She developed innovative new analytical and numerical modelling methods to analyse solution phase speciation and sorption reaction kinetics of cadmium. She has published one and submitted another peer-reviewed paper on her work to date, and is expecting to submit at least one more before the year is out (but only after she's had well-earned, relaxing campervan holiday in Queenstown & Wanaka).

Fig. L-R: Nik Lehto, Nick Kim (NZ external examiner on Zoom) Dharshika Welikala, David Dean

Dharshika was supervised by Dr **Nik Lehto**, Prof. **Brett Robinson** (University of Canterbury) and Dr **Adam Hartland** (University of Waikato) and she was supported by the Lincoln University Doctoral Scholarship. Her external examiners were Dr Nick Kim (Massey University) and Dr Markus Puschenreiter (University of Natural Resources and Life Sciences, Vienna, Austria). The examination Convener was Dr David Dean.

Well done, Dharshika!

Carmen Medina successfully defended her PhD thesis. Her thesis is entitled: *Irrigation effects on soil organic carbon under a ryegrass-white clover pasture in a Lismore stony silt loam soil*. Supervised by **Tim Clough**, **Mike Beare** (Plant & Food) and **Sam McNally** (Plant and Food). Her research was funded under the Global Research Alliance project: Management Options for Increasing Soil Carbon Under Grasslands.

Carmen did a great job and there was unanimous agreement that she should be awarded the PhD. The external examiners and her supervisors have made a recommendation to the Lincoln University post-graduate committee that she be granted the PhD. We will be exploring options for Carmen to present a summary of her work via video link from Scotland at some stage.
Well done Carmen.

Soil Judging Competition
Over the weekend of 6-9 November, 13 students (6 PG, 7 UG) plus **Roger McLenaghen**, **Josh Nelson** and **Carol Smith** travelled to Golden Bay for the formal assessment part of our micro credential SOSC901. Otherwise known as the Lincoln University 2020 soil judging competition, the students convened on Ellis Creek Farm, near Takaka. The soils and landscapes of this unique part of Golden Bay are

dominated by faults, old basement rocks (Arthur Marble, Takaka Terrane, Separation Point granite) plus younger cover strata of mudstones, coal measures and clays. The warmer, wetter climate made for some highly weathered soils. Landslides are frequent, and buried soils are common. These all combined to produce some really unique soils, quite different to those in Canterbury, and a good test of the students soil description and interpretation skills. The teams chose their own soil themed team names…

Roger McLenaghen admiring a buried Ap horizon in an Immature, Orthic Brown

The 2020 SOSC901 class

Team Results:
1st:.... Ragey geophages (Louisa Hall, Kirstin Deuss, Sam Earl-Goulet)
2nd:.... 10YR we so loud (Julie Gillespie, Will Talbot, Balin Robertson)
3rd:.... The knights who say Ni- washi (Shana Dooley, Fin Proebst, Erin Cheng)
4th:.... Roes Hoes (Doug Stalker, Bella Taylor, Henry Bassant, Carole Lim)

Individual results:
1st:.... Louisa Hall
2nd:.... Fin Probst
3rd:.... Shana Dooley
We would like to thank Jono Williams for his help with organising the competition and for being able to use his Family farm. We also thank one of our alumni, Veronica Penny from Maanaki Whenua Landcare Research for acting as chief judge.

Manaaki Whenua – Landcare Research

Bringing landforms into S-map
Some of the kaumatua of geomorphology and pedology in Aotearoa have been kindly contributing to a MWLR initiative to add information on soil - landform relationships into the S-map system. A series of mini workshops have been held this month. The objective is to develop and refine the hierarchical framework that S-map soil surveyors will use to capture this landform knowledge. The group agreed it was critical to capture this matauranga (a taonga in its own right) before it was lost, and that it is an essential component of helping us understand our land and soils.

The MWLR S-map team have been greatly assisted by the expertise of **David Lowe**, **Alan Palmer**, **Peter Almond**, **Peter Singleton** and **Phil Tonkin**. Once the framework has been finalised, soil surveyors will be able to add narratives (written and audio), photos and sketches that link the S-map siblings to landform units. This information will be made available on S-map Online.

Soil legacy maps now available online
Manaaki Whenua – Landcare Research has recently released a web-based viewer for exploring and downloading New Zealand's soil legacy maps. In a first installment it offers low-barrier access to some 200 'reference' Soil Bureau maps from between 1932 and 1989.

These maps make up a significant component of our LRIS Nationally Significant Database and Collection. A collaborative effort across the Informatics, Soils & Landscapes, and IS&KM teams of Manaaki Whenua, this project represents an important milestone in securing a rich collection of knowledge and investment from past generations, to make readily accessible for not just today's issues, but importantly for the generations to come.

The new viewer has been integrated into Manaaki Whenua's Soils Portal website, and can be accessed from here: Legacy Map Viewer.

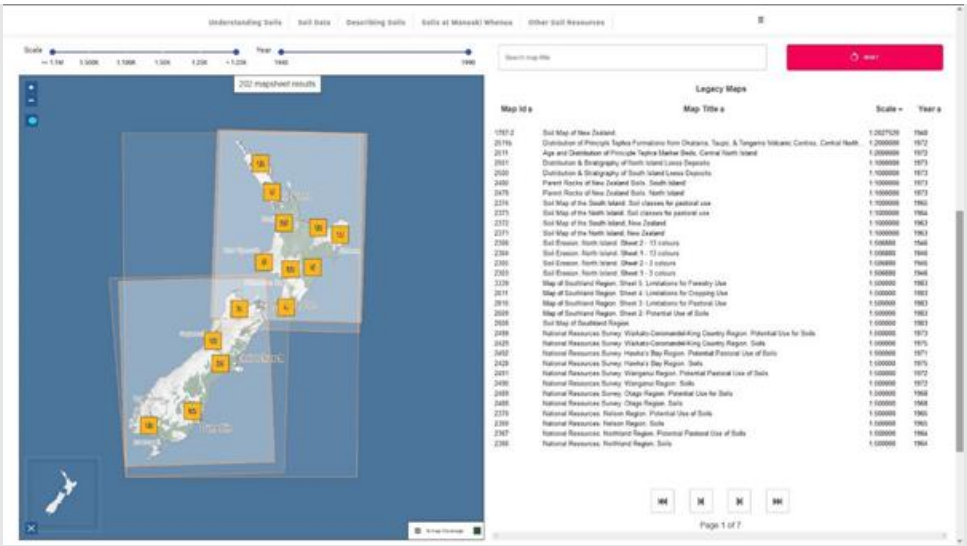


Figure 1: Screenshot of the new Legacy Map Viewer to explore an initial set of 202 soil maps.

You can filter map items by scale and/or year of publication. You can also search for words in the title. Using the zoom and pan capabilities on the map you can explore the maps and their extents. Metadata about a specific map is displayed in a pop-up window. Map download is through a link to the new MWLR Digital Library (DL) soil maps collection of currently 355 map scans. You are welcome to also explore this new DL collection separately.

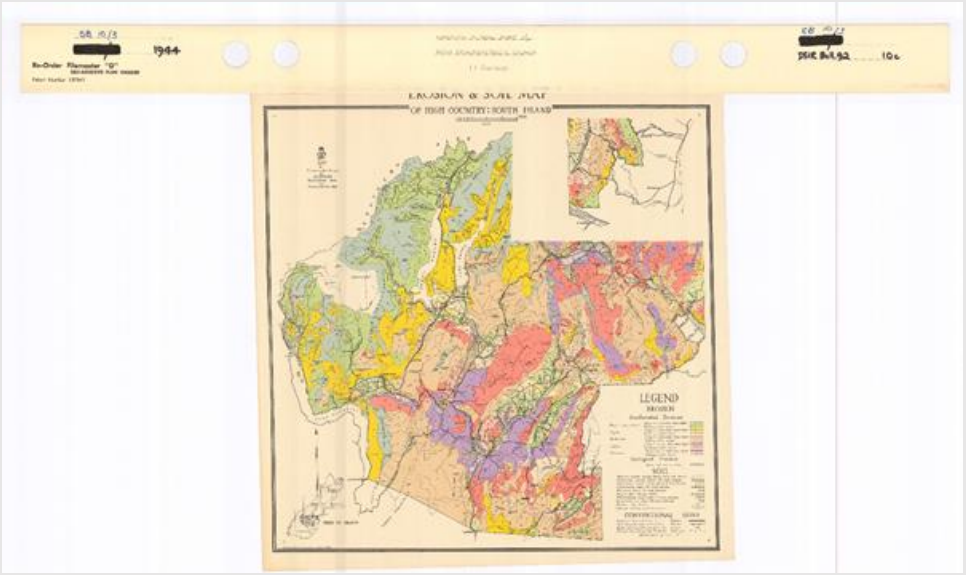


Figure 2: Example of a soil legacy map scan, now just a mouse-click away (Erosion & Soil Map of High Country: South Island. Sheet 3, https://doi.org/10.7931/8vtp-fq65).

Many of these legacy maps and associated data and reports are the basis for S-map. The new tool has an immediate direct benefit of it now being much easier to identify relevant legacy data to underpin extension of S-map into new areas of New Zealand.

While those 200 maps now available are covering a large part of the Soil Bureau ‘reference’ collection already, we are working on extending the viewer’s data base.

Some 100 more maps will be uploaded by June 2021, and we will be endeavouring to upload map scans whenever they are digitised in the future.

Last but not least, if you have soil legacy maps that you believe could be deployed through the new viewer tool please do not hesitate to get in touch!

AgResearch

This year has been busy within increasing interest in soil health. **Alec Mackay**, **Ronaldo Vibart** and **Nicole Schon** have been working within the B+LNZ Hill Country Futures programme to investigate extending current soil health indicators on-farm to include soil organic carbon, biology and physical conditions. Data collected from the long-term fertiliser and sheep grazing experiment at Ballantrae is being used to determine whether medium slopes used for monitoring soil fertility in hill country, are also representative of the other elements of soil health in a hill-country landscape.

Work funded through Our Land and Water and Ravensdown has investigated the changes in soil health across a pine forest to pasture conversion chrono-sequence on Ngai Tahu farms. This includes how to represent results visually to inform a wider audience.
AgResearch (led by **Nicole Schon**) has started a project with Synlait to benchmark soil health across their farmer supply base in both the North and South Island. This has involved thus-far interviews with Synlait's customers and workshops with their farmer suppliers in both Islands to gather perspectives on soil health and potential measures.

Nicole Schon has recently completed a Sustainable Farming Fund project looking at approaches for increasing earthworm functional diversity through introductions across sheep and beef and dairy farms in both the North and South Island where they are currently absent. The project showed that the addition of missing functional groups is likely to be successful, although after four years their abundances were still low.

Nigel Bell and **Shengjing Shi** are leading an AgR SSIF Pasture Microbiome Project exploring the links and interaction between soil-plant-animal-human microbiomes. Of relevance to soils there are currently subprojects (and leaders) exploring: NZ's forage plant and pasture soil microbiome diversity (**Nigel Bell**); field and lab studies investigating spatial and temporal impact of *Epichloe* endophyte-perennial ryegrass associations on plant, soil and animal microbiomes (**Shengjing Shi, Christina Moon** and **Stefan Meutzal**); variation in soil- and water-borne microbiomes influenced by grazing animal dung at catchment scale (**Richard Muirhead** and **Adrian Cookson**); soil-borne forage plant disease (**Sean Marshall**) and investigating soil and plant microbiomes under Free-Air Carbon dioxide Enrichment (**Shengjing Shi**). The project is contributing to the Global Crop Microbiome Survey research programme (https://www.globalsustainableagriculture.org/). That programme intends to establish a global collaborative network to collect soils from cropland worldwide with the aims of identifying a list of microbes and functional attributes characterising the

soil crop microbiome worldwide. If you know of interesting sweetcorn, wheat or potato crops that would have willing landowners for sampling please let Shengjing know (before crop flowering if possible).

Article

One hundred years of Soil Survey in Nelson, New Zealand.
Philip Tonkin

In 2021 the Cawthron Institute in Nelson will celebrate one hundred years since its foundation. The role of this Institute in the early days of soil science should be acknowledged by the New Zealand Society of Soil Science.

In 1920 Theodore Rigg arrived back in New Zealand to be appointed as an agricultural chemist in the foundation years of the Cawthron Institute in Nelson. The life of this Quaker scientist was published by his daughter (Hughes, 2005).

By February 1920 Theodore Rigg assisted by J.A. Bruce undertook the reconnaissance soil survey of Waimea Country, Nelson. This survey was conducted according to the methods developed by Hall and Russell in England and the Bureau of Soils in the United States of America and constituted the first systematic soil survey conducted in New Zealand which gave due recognition to the important part played by both geological origin and texture of soil properties. Following on from this survey, similar surveys were done of Takaka County and less detailed rapid surveys of Collingwood County and parts of Murchison and Buller Counties. A reconnaissance soil map of the Nelson District prepared by the Cawthron Institute is dated 1922 (Rigg, 1945).

Rigg (1945) noted that soil survey was regarded with skepticism by agriculturalists in 1920 and is now held in high esteem and considered fundamental to agriculture. Among the soils in Waimea Country the Moutere and Kaiteriteri loams furnished spectacular nutrient deficiencies and led on to studies of stock ailments and plant food deficiencies for which the Institute developed a notable reputation. During the Waimea County survey Rigg and Bruce recognized about 1000 acres of modified “maori gravel soils“. This is the first scientific description of soil modification by Maori in the Nelson District (Rigg and Bruce 1923). J.A. Bruce who assisted Rigg in the soil surveys was a relative of John G. Bruce pedologist and soil correlation in Soil Bureau DSIR (Tonkin and Crozier, 2006).

In the 1930’s Theodore Rigg together with the analytical services of the Cawthron Institute played a key role in the resolution of problems of ill thrift in sheep and cattle, which at the time were known as Morton Mains disease in Southland, Glenhope disease in Nelson and Bush sickness in the central volcanic regions of the North Island. Dr J.K. Dixon then based in the Cawthron Institute and Dr Les Grange and Norman Taylor of the Geological Survey were also key figures in this research. The resolution of these stock health problems transpired to be a cobalt deficiency.

Other pioneers in the early days of soil survey include Bernard C. Aston agricultural chemist and botanist who began studies of Bush Sickness in 1911 and in 1914, Leonard J. Wild who made a soil survey of part of the Wairau Plains in 1914 and Hartley T. Ferrar who arrived in New Zealand in 1920 and undertook agrogeological surveys in Northland in 1922, irrigation soil surveys in Central Otago in 1926 -28 and soil surveys in the King Country in 1928-32. Norman Taylor began in soil survey as an assistant to Hartley Ferrar. Aston, Wild and Ferrar were all strong advocates for the establishment of a national soil survey program (Tonkin 2007).

References.

Hughes, H.R. 2005: A Quaker Scientist. The life of Theodore Rigg KBE. Quaker Historical Manuscripts No. 10 Beechtree Press Rotorua 100p.
Rigg, T. 1945: Silver Jubilee Commemorative Lecture 43p. Cawthron Institute, Nelson.
Rigg, T.; Bruce, J.A. 1923: The Maori Gravel Soil of Waimea West. Journal of the Polynesian Society 32.
Tonkin, P.; Crozier, M 2006: Obituary J.A. Bruce 1933-2006. New Zealand Soil News vol. 54 pp139-140.
Tonkin, P. 2007: A history of soil survey and selected aspects of soil conservation in New Zealand. Part 1. New Zealand Soil News Vol. 55 pp 59-71.

Related Society Notices

Royal Society Te Aparangi:

The "Research Charter for Aotearoa New Zealand" sets out the principles underpinning sound research practice in Aotearoa New Zealand. The charter exemplifies good research practices in the context of Aotearoa New Zealand, and is intended as a resource that organisations will draw on when they review, refine and implement their own policies and procedures. You can find it here: https://www.royalsociety.org.nz/what-we-do/research-practice/research-charter/research-charter-aotearoa-new-zealand/

From EIP-AGRI

EIP-AGRI online workshop on soil

Over 90 people attended the online EIP-AGRI Workshop: Shaping the EU mission 'Caring for soil is caring for life' which took place on 20-21 October 2020. To restore soil health in the EU and beyond, the European Commission has established this Mission: **Caring for Soil is Caring for Life**. Mission Board members presented the different actions proposed by the mission, innovative farmers presented inspiring examples, and interactive sessions enabled participants to discuss urgent research and innovation needs from practice and practical needs for implementation. You can watch the workshop videos and download documents from the event here: https://ec.europa.eu/eip/agriculture/en/event/eip-agri-workshop-shaping-eu-mission-soil?pk_source=mailing_list&pk_medium=email&pk_campaign=newsletter&pk_content=nl_11_2020

Farm to Fork 2020 - building sustainable food systems together

On 15 and 16 October 2020 the European Commission held the 'Farm to Fork' conference. The event provided an important opportunity to debate the implementation of the recently adopted *Farm to Fork Strategy* and it provided a forum for discussion on the challenges and opportunities linked to the transition to sustainable food systems. You can watch videos from the event here: https://ec.europa.eu/food/farm2fork/farm-fork-conference_en

FAO Webinar: Sustainable Soil and Land Management for Climate Smart Agriculture: Preventing and mitigating land degradation

This international technical webinar, which took place 20 June 2020, is part of the series organized by the FAO eLearning Academy, Agreenium (l'Institut agronomique, vétérinaire et forestier de France) and UN-ESCAP (United Nations Economic and Social Commission for Asia and the Pacific).
Link to the webinar: https://vimeo.com/432460070

From across the ditch:

Parliamentary Friends of Soil group announced | Soil CRC

A Parliamentary Friends of Soil group has been established, chaired by Deputy Prime Minister the Hon Michael McCormack, with the Hon Linda Burney MP acting as co-chair. The group will bring together a bi-partisan forum for parliamentarians to interact with farmers, scientists, industry groups and policy makers on issues relating to health and maintenance of Australia's soils.
https://soilcrc.com.au/parliamentary-friends-of-soil-group-announced/

Abstracts

Comparing deep soil organic carbon stocks under kiwifruit and pasture land uses in New Zealand

Soil organic carbon (SOC) is important natural capital for agricultural production, as it affects soil physical, chemical and biological functions and the provision of ecosystem services. Measures of land-use effects on SOC stocks generally focus on the top 0.3 m of soil, as the topsoil has the highest SOC concentration. However, while subsoil horizons have low SOC concentrations, they contain a greater absolute amount of SOC with longer mean residence times than topsoil layers. Perennial horticultural crops offer potential to store SOC deep in the soil profile because of their long-lived and deep rooting systems. To investigate the hypothesis that kiwifruit (*Actinidia chinensis* Planch.) can increase subsoil SOC stocks, we sampled soils from 19 paired kiwifruit and pasture sites in New Zealand in 2018. Pasture was selected for comparison as it was the antecedent land use before establishment of the kiwifruit orchards. Paired land uses were located within 100 m of each other on the same soil type. Kiwifruit vines were at least 15 years old and the pasture was not cultivated during that time. Total SOC and nitrogen (N), and labile soil SOC stocks

were assessed to a depth of 2 m. Kiwifruit production resulted in a modest increase in SOC and N stocks at a depth of 1.5-2.0 m (1.6 Mg C ha^{-1} and 0.52 Mg N ha^{-1}), averaging to increases of 0.06 Mg C ha^{-1} y^{-1} and 0.02 Mg N ha^{-1} y^{-1}. However, cumulative SOC and N stocks to 2-m depth were not different between land uses. The labile water extractable pools of SOC were lower under kiwifruit in the topsoil (0-0.1 m) and corresponded with lower N stocks and a higher soil C:N ratio at this depth. Further work on the dynamics of subsoil SOC pools is needed to understand the contribution of perennial horticulture crops to subsoil SOC storage.

Gentile RM, Malepfane NM, van den Dijssel C, Arnold N, Liu J, Müller K. 2021. Comparing deep soil organic carbon stocks under kiwifruit and pasture land uses in New Zealand. Agriculture, Ecosystems & Environment 306:107190. https://doi.org/10.1016/j.agee.2020.107190

Winter forage crop grazing in the Gore-Mataura area of Southland: using time series mapping to estimate location and frequency of cropping

Winter grazing of forage crops is a key land-use in southern New Zealand, providing important feed for livestock but has been identified as risky if not managed well, potentially resulting in soil degradation and nutrient losses. We hypothesised that analysing an existing time series of winter-forage maps, derived from satellite imagery could be used to identify how often paddocks are re-used for winter forage. A pilot study was undertaken to explore the practicality and utility of this new method by examining maps derived from satellite images of the Gore-Mataura area, Southland taken in 2013, 2014, 2017, and 2018. Within the study site (67,618 ha), 8925 ha was classed as winter forage in one or more of the source maps. Eighty-five percent of this area was used in only one of the four years, and just 1% in three or four years. High-certainty class pairs for 2013/14 and 2017/18 show two consecutive years of winter forage in the same paddock, 31% or 21% of the time, respectively. These winter-forage crops were generally grown on Brown soils (63%), followed by Pallic and Gley soils. Although, this study was limited by differences in the mapping methodologies of the source maps, it nonetheless demonstrated that potentially valuable data can be derived. It showed a low level of repeat use of paddocks for winter forage grazing over all the years studied, and that Brown soils are more commonly used for winter forage than previous studies suggested.

Drewry JJ, North H, Belliss SE, Amies A. 2020. Winter forage crop grazing in the Gore-Mataura area of Southland: using time series mapping to estimate location and frequency of cropping. Journal of New Zealand Grasslands 82: 129-137. https://doi.org/10.33584/jnzg.2020.82.425

Formation of adenosine from adenine and ribose under conditions of repeated wetting and drying in the presence of clay minerals

Ribonucleic acid (RNA) was possibly the most important biopolymer in Earth's early existence. However, the prebiotic synthesis of the nucleoside component of RNA is problematic. Here we report the formation of adenosine by subjecting a mixture of adenine and ribose to repeated wetting and drying from 40 to 80 ^{o}C in air, with or without the addition of clay minerals. Using liquid chromatography-mass spectrometry (LCMS) and 1H NMR spectroscopy, we were able to detect the formation of adenosine in the presence of kaolinite and Mg2+-exchanged montmorillonite at 70 ^{o}C. At this temperature adenosine was also formed in the absence of these minerals but none was detected in the presence of the raw (sodium-rich) montmorillonite. In all instances, only small amounts of adenosine were formed. On the other hand, a 12–13% yield of adenosine was measured in the presence of kaolinite at 60–80 ^{o}C, using the highly sensitive method of liquid chromatography coupled with tandem mass spectrometry (LCMS/MS). Kaolinite can apparently act as both a concentrating surface and a catalyst in the formation of adenosine from adenine and ribose although the underlying mechanism has yet to be established. The mild experimental conditions used here for nucleoside formation could plausibly obtain in some parts of the prebiotic Earth.

Hideo Hashizume, Benny K.G. Theng, Sjerry van der Gaast, Kazuko Fuji. *Geochimica et Cosmochimica Acta*, 265: 495–504, 2019.

Rapid carbon accumulation in a peatland following Late Holocene tephra deposition, New Zealand

Contemporary measurements of carbon (C) accumulation rates in peatlands around the world often show the C sink to be stronger on average than at times in the past. Alteration of global nutrient cycles could be contributing to elevated carbon accumulation in the present day. Here we examine the effect of volcanic inputs of nutrients on peatland C accumulation in Moanatuatua Bog, New Zealand, by examining a high-resolution Late Holocene C accumulation record during which powerful volcanic eruptions occurred, depositing two visible rhyolitic tephra layers (Taupo, 232 ± 10 CE; Kaharoa, 1314 ± 12 CE). Carbon accumulation rates since c. 50 CE, well before any human presence, increased from a background rate of 23 g C m^{-2} yr^{-1} up to 110 g C m^{-2} yr^{-1} following the deposition of the Taupo Tephra, and 84 g C m^{-2} yr^{-1} following the deposition of the Kaharoa Tephra. Smaller but nevertheless marked increases in C accumulation additionally occurred in association with the deposition of three andesitic-dacitic cryptotephras (each £~1 mm thick) of the Tufa Trig Formation between the Taupo and Kaharoa events. These five periods of elevated C uptake, especially those associated with the relatively thick Taupo and Kaharoa tephras, were accompanied by shifts in nutrient stoichiometry, indicating that there was greater avail-ability of phosphorus (P) relative to nitrogen (N) and C during the period of high C uptake. Such P was almost certainly derived from volcanic sources, with P being present in the volcanic glass at Moana-tuatua, and many of the eruptions described being associated with the local deposition of

the P rich mineral apatite. We found peatland C accumulation to be tightly coupled to N and P accumulation, suggesting nutrient inputs exert a strong control on rates of peat accumulation. Nutrient stoichiometry indicated a strong ability to recover P within the ecosystem, with C: P ratios being higher than most other peatlands in the literature. We conclude that nutrient inputs, deriving from volcanic eruptions, have been very important for C accumulation rates in the past. Therefore, the elevated nutrient inputs occurring in the present day could offer a more plausible explanation, as opposed to a climatic component, for observed high contemporary C accumulation in New Zealand peatlands.

Ratcliffe, J.L., Lowe, D.J., Schipper, L.A., Gehrels, M.J., French, A., Campbell, D.I. 2020. Rapid carbon accumulation in a peatland following Late Holocene tephra deposition, New Zealand. *Quaternary Science Reviews* 246, article 106505 (**open access**: https://doi.org/10.1016/j.quascirev.2020.106505)

A review of the world's soil museums and exhibitions

The soil science community needs to communicate about soils and the use of soil information to various audiences, especially to the general public and public authorities. In this global review article, we synthesis information pertaining to museums solely dedicated to soils or which contain a permanent exhibition on soils. We identified 38 soil museums specifically dedicated to soils, 34 permanent soil exhibitions, and 32 collections about soils that are accessible by appointment. We evaluate the growth of the number of museums since the early 1900s, their geographical distribution, their contents, and their attendance. The number of museums has been continuously growing since the early 1900s. A noticeable increase was observed from 2015 to 2019. Europe (in a geographical sense), Eastern and South-East Asia have the highest concentration of soil museums and permanent exhibitions related to soils. Most of the museums' attendance ranged from 1,000 to 10,000 visitors per year. Russia has the largest number of soil monoliths exhibited across the world's museums, whereas the ISRIC-World Soil Museum has the richest and the most diverse collection of soil monoliths. Museums, collections, and exhibitions of soil play an important role in educating the population about this finite natural resource that maintains life on the planet, and for this reason, they must be increasingly supported, extended, and protected.

Richer-de-Forges, A.C., Adamo P., Amato M., Anjos L., Caubet M., Ceddia M., Chang S., Chen S., Chen Z.-S., de Araújo Pedron F., Feller C., Goulet R.-C., Hseu Z.-Y., Kārkliņs A., Kim H.S., Leenaars J.G.B., Levin M.J., Liu X.-N., Lowe D.J., Machado Pinheiro E.F., Maejima Y., Mantel S., Martín Peinado F.J., Martínez Garzón F.J., Mataix-Solera J., Minasny B., Olgerts N., Ortega C., Reintam E., Roudier P., Rozanov A., Sánchez Espinosa, J.A., Savin, I., Shalaby, M., Sujatha, K., Sulaeman, Y., Taghizadeh-Mehrjardi, R., Tran Minh Tien, Yang J.E., Ytati Valle, M.,

Arrouays, D. 2021. A review of the world's soil museums and exhibitions. *Advances in Agronomy* 166 (in press)

The Taupō eruption sequence of AD 232 ± 10 in Aotearoa New Zealand – a retrospection

The Taupō eruption, also known as eruption Y, occurred in late summer to early autumn (typically late March to early April) in AD 232 ± 10 yr at Taupō volcano, an 'inverse' caldera volcano underlying Lake Taupō in the central Taupō Volcanic Zone, North Island, Aotearoa New Zealand. The complex rhyolitic eruption, the most powerful eruption globally in the last 7000 years, lasted between several days and several weeks and generated five markedly contrasting pyroclastic fall deposits (units Y1 to Y5) followed by the extremely violent emplacement of a low-aspect-ratio ignimbrite (unit Y6). The fall deposits include three phreatomagmatic units, Y1, Y3, and Y4, the latter two being the products of archetypal phreatoplinian events; and two magmatic units, Y2 and Y5, the latter being the product of an exceptionally powerful plinian (previously described as 'ultraplinian') event with an extreme magma discharge rate around 10^8 to 10^{10} kg s^{-1}. The pyroclastic fall-generating eruptions were followed by the climactic emplacement of the entirely non-welded Taupō ignimbrite (Y6). It was generated by the catastrophic collapse of the 35 to 40-km-high plinian eruption column (Y5) that produced a very-fast-moving (600 to 900 km h^{-1}), hot (up to 500° C) pyroclastic flow (density current) that covered about 20,000 km^2 of central North Island over a near-circular area ~160 km in diameter, centred on Lake Taupō, in fewer than about ten to 15 minutes. This violent ground-hugging pyroclastic flow generated its own air lubrication, forming a near-frictionless basal region, and the resultant highly fluidised ignimbrite was spread as a near-continuous but thin sheet over the entire landscape, both infilling valleys and mantling ridges. Caldera collapse formed a new basin in the older Ōruanui caldera in Lake Taupo. The pressure-wave arising from the plinian-column collapse probably generated a global volcano-meteorological tsunami. Studied intensely by extraordinary volcanologists Colin Wilson and George Walker, and others, the exceptionally well-preserved and readily-accessible Taupō eruptives provide a one-in-a-hundred classic sequence that is arguably the most informative in the global world of volcanology with respect to explosive rhyolitic eruptions and their products. The total volume of the Taupō eruptives amounts to ~35 km^3 as magma, equivalent to ~105 km^3 of bulk (loose) pyroclastic material, of which the Taupō ignimbrite comprises ~30 km^3. The impacts and landscape response of the eruption were profound, spatially extensive, and enduring, and the young glassy soils (Vitrands in *Soil Taxonomy*, Pumice Soils in the *New Zealand Soil Classification*) developed in the silica-rich pumiceous deposits, although well suited to plantation forestry (especially exotic *Pinus radiata*), pose unique problems for agriculture and other land uses, including a high susceptibility to gully erosion and an inherent deficiency in cobalt and other trace elements, and require special management.

Lowe, D.J., Pittari, A. 2020. The Taupō eruption sequence of AD 232 ± 10 in Aotearoa New Zealand – a retrospection. *Journal of Geography (Chigaku Zasshi)* 129 (in press) [in special series: "The 100s: Significant Exposures of the World"]

Sub-millennial eruptive recurrence in the silicic Mangaone Subgroup tephra sequence, New Zealand, from Bayesian modelling of zircon double-dating and radiocarbon ages

Accurate dating of young (<1 Ma) volcanic eruptions has long been a challenge for modern geochronology given the scarcity of datable mineral phases and low quantities of radiogenic daughter products. Combined U-Th-Pb and (U-Th)/He dating of zircon (i.e., zircon double-dating, ZDD) is a relatively new dating approach that offers a viable option for dating zircon-bearing volcanic and pyroclastic deposits as young as ca. 3 ka, and has a great potential for application in many fields within the Quaternary sciences, including volcanology, palaeoclimatology, and archaeology. In our study, a stratigraphically and spatially well-defined sequence of 13 rhyodacitic to rhyolitic tephra beds – the Mangaone Subgroup (MSg) – erupted from the Okataina Volcanic Centre (OVC), is used as a natural laboratory to conduct a cross-validation experiment in which the ZDD eruption ages are compared with published and new radiocarbon (^{14}C) eruption ages. These ZDD and ^{14}C ages are then used together to underpin a Bayesian age model developed (using ChronoModel) to provide new ages for the entire MSg sequence. New ZDD eruption ages of 36.1 ± 4.4, 31.5 ± 5.2, 30.9 ± 5.6, 31.2 ± 4.4 ka BP for four MSg tephras (Units D, I, J, and K, respectively) are statistically indistinguishable from ^{14}C-based eruption ages. These results validate the feasibility of ZDD to date late Quaternary eruptions accurately. The Bayesian age sequence model provides provides an eruptive geochronology eruptive geochronology for all 13 MSg tephra beds for the first time (and for the stratigraphically-interbedded Taupo-volcano-derived Tahuna tephra, 38.4−1.4+1.7 ka BP), and constrains the beginning of the MSg eruption period to 42.7−3.5+3.7 ka BP (Unit A) and the end to 30.6−1.5+0.6 ka BP (Unit L). Thus, the entire MSg sequence was emplaced in ~12,100 years, representing an eruption frequency of one event per ~930 years on average. Our study demonstrates the efficacy of ZDD to yield accurate eruption ages on pyroclastic deposits, highlighting its potential for dating young (<1 Ma) magmatic and eruption events that are difficult to date by other geochronological methods, and also shows that ZDD dates can be integrated with ^{14}C ages using Bayesian modelling to develop new age models for long sequences of tephra beds, in this case those of the MSg tephras that were deposited during MIS 3. In addition, the U-Th zircon crystallization data revealed distinct U-Th model age spectra for older and younger MSg tephras, providing geochronological evidence for a decreasing degree of interconnectedness within the OVC magma reservoir during the MSg eruption period that followed caldera collapse associated with the pre-MSg Rotoiti (Rotoehu) eruption at ca. 45 ka BP.

Danišík, M., Lowe, D.J., Schmitt, A.K., Friedrichs, B., Hogg, A.G., Evans, N.J. 2020. Sub-millennial eruptive recurrence in the silicic Mangaone Subgroup tephra sequence, New Zealand, from Bayesian modelling of zircon double-dating and radiocarbon ages. *Quaternary Science Reviews* 246, article 106517 (https://doi.org/10.1016/j.quascirev.2020.106517)

TephraNZ: a major and trace element reference dataset for prominent Quaternary rhyolitic tephras in New Zealand and implications for correlation

Although analyses of tephra-derived glass shards have been undertaken in New Zealand for nearly four decades (pioneered by Paul Froggatt), our study is the first to systematically develop a formal, comprehensive, open access, reference dataset of glass-shard compositions for New Zealand tephras. These data will provide an important reference tool for future studies to identify and correlate tephra deposits and for associated petrological and magma-related studies within New Zealand and beyond. Here we present the foundation dataset for TephraNZ, an open access reference dataset for selected tephra deposits in New Zealand. Prominent, rhyolitic, tephra deposits from the Quaternary were identified, with sample collection targeting original type sites or reference locations where the tephra's identification is unequivocally known based on independent dating or mineralogical techniques. Glass shards were extracted from the tephra deposits and major and trace element geochemical compositions were determined. We discuss in detail the data reduction process used to obtain the results and propose that future studies follow a similar protocol in order to gain comparable data. The dataset contains analyses of twenty-three proximal and twenty-seven distal tephra samples characterising 45 eruptive episodes ranging from Kaharoa (636 ± 12 cal. yrs BP) to the Hikuroa Pumice member (2.0 ± 0.6 Ma) from six or more caldera sources, most from the central Taupō Volcanic Zone. We report 1385 major element analyses obtained by electron microprobe (EMPA), and 590 trace element analyses obtained by laser ablation (LA)-ICP-MS, on individual glass shards. Using PCA, Euclidean similarity coefficients, and geochemical investigation, we show that chemical compositions of glass shards from individual eruptions are commonly distinguished by major elements, especially CaO, TiO_2, K_2O, FeOt (Na_2O+ K_2O and SiO_2/K_2O), but not always. For those tephras with similar glass major-element signatures, some can be distinguished using trace elements (e.g. HFSEs: Zr, Hf, Nb; LILE: Ba, Rb; REE: Eu, Tm, Dy, Y, Tb, Gd, Er, Ho, Yb, Sm), and trace element ratios (e.g. LILE / HFSE: Ba / Th, Ba / Zr, Rb / Zr; HFSE / HREE: Zr / Y, Zr / Yb, Hf / Y; LREE / HREE: La / Yb, Ce / Yb). Geochemistry alone cannot be used to distinguish between glass shards from the following tephra groups: Taupō (Unit Y in the post-Ōruanui eruption sequence of Taupō volcano) and Waimihia (Unit S); Poronui (Unit C) and Karapiti

(Unit B); Rotorua and Rerewhakaaitu; and Kawakawa/Ōruanui, Okaia, and Unit L (of the Mangaone subgroup eruption sequence). Other characteristics can be used to separate and distinguish all of these otherwise-similar eruptives except Poronui and Karapiti. Bimodality caused by K_2O variability is newly identified in Poihipi and Tahuna tephras. Using glass shard compositions, tephra sourced from Taupō Volcanic Centre (TVC) and Mangakino Volcanic Centre (MgVC) can be separated using bivariate plots of SiO_2/K_2O vs. Na_2O+K_2O. Glass shards from tephras derived from Kapenga Volcanic Centre, Rotorua Volcanic Centre, and Whakamaru Volcanic Centre have similar major- and trace-element chemical compositions to those from the MgVC, but can overlap with glass analyses from tephras from Taupō and Okataina volcanic centres. Specific trace elements and trace element ratios have lower variability than the heterogeneous major element and bimodal signatures, making them easier to geochemically fingerprint.

Hopkins, J.L., Bidmead, J.E., Lowe, D.J., Wysoczanski, R.J., Pillans, B.J., Ashworth, L., Rees, A.B.H., Tuckett, F. 2020. TephraNZ: a major and trace element reference dataset for prominent Quaternary rhyolitic tephras in New Zealand and implications for correlation. *Geochronology Discussion* (**open access** - online, open for comments: https://doi.org/10.5194/gchron-2020-34)

A well-being approach to soil health–insights from Aotearoa New Zealand

This paper explores the concept of soil health from a human well-being perspective in Aotearoa New Zealand. Globally, soils play an integral role in wider society and the environment by maintaining a large range of ecosystem services and benefits. As populations and resource constraints increase and food production and food security become growing issues globally, there is a recognition of the importance of defining soil condition or soil health for sustaining all ecosystems, including services and benefits to humans, plants, animals, and micro-organisms. While the ecosystem services approach has helped to illuminate the varied services soils provide, an understanding of the complex human-soil relationships and values has been missing. Those seeking to understand and form concepts about soil health have concentrated on the more inherent biochemical, physical and economic (e.g., productivity) aspects of soils, but not on the human, social or cultural dimensions. It is argued in this paper that soils form an integral part of our social and cultural fabric and are fundamentally important to human and societal well-being. The way humans interact with, value and use soil is a critical part of determining the health and sustainability of soil ecosystems. We discuss how a well-being approach can improve understanding of soil health with respect to societal goals and needs. We believe this type of approach, which includes social and cultural dimensions, provides a more diverse and inclusive knowledge base and perspective to better inform the development of integrative policy. This would lead to improved management and decision-making of land resources and soils in Aotearoa New Zealand and globally.

Stronge DC, Stevenson BA, Harmsworth GR, Kannemeyer RL 2020. A well-being approach to soil health–insights from Aotearoa New Zealand. *Sustainability 12(18)*: 7719. https://doi.org/10.3390/su12187719

Effect of soil cadmium on root organic acid secretion by forage crops

The two forage species used in New Zealand pastoral agricultural systems, chicory (*Cichorium intybus*) and plantain (*Plantago lanceolata*) show differential ability to absorb and translocate cadmium (Cd) from roots to shoots. Chicory can accumulate Cd from even low Cd soils to levels that might exceed regulatory guidelines for Cd in fodder crops and food. Chicory and plantain were grown in soil-filled rhizocolumns under increasing Cd levels (0 (Control), 0.4, 0.8 and 1.6 mg Cd/kg soil) for 60 days and showed variable secretion of oxalic, fumaric, malic and acetic acids as a function of Cd treatment. Plant roots secrete such Low Molecular Weight Organic Acids into the rhizosphere soil, which can influence Cd uptake. Chicory showed significantly ($P < 0.05$) lower secretion of fumaric acid, and higher secretion of acetic acid than plantain at all Cd treatments. We propose that the significant secretion differences between the two species can explain the significantly ($P < 0.05$) higher shoot Cd concentration in chicory for all Cd treatments. Understanding the mechanism for increased uptake in chicory may lead to breeding or genetic modification which yield low Cd uptake cultivars needed to mitigate the risk of Cd accumulation in pastoral agricultural food chains from this increasingly important fodder crop.

N Ubeynarayana, P Jeyakumar, P Bishop, R Calvelo-Pereira, C W N Anderson. 2021. Effect of soil cadmium on root organic acid secretion by forage crops. Environmental Pollution 268, 115839. DOI: 10.1016/j.envpol.2020.115839

Lime and/or Phosphate Application Affects the Stability of Soil Organic Carbon: Evidence from Changes in Quantity and Chemistry of the Soil Water-Extractable Organic Matter

The mechanisms by which lime and/or phosphate addition impacts the preservation of soil organic matter (OM) are poorly understood. We explored the changes in quantity and chemistry of water-extractable organic matter (WEOM) in the bulk soil and its heavy density fraction (>1.6 g/cm^3) of an unmanaged C-rich volcanic soil caused by lime and/or phosphate application. The addition of lime or phosphate caused (i) a significant increase in the WEOM, along with a decrease in its C/N ratio and an increase in its aromaticity, and (ii) changes in the WEOM chemical composition, measured with pyrolysis-gas chromatography/mass spectrometry, this being most impacted by lime application. The combined effect of lime and phosphate addition on the quantity and chemistry of WEOM was larger than the effects of separate lime and phosphate additions. By comparing the response of the bulk soil and the heavy fraction, we infer that phosphate has a greater contribution to the

destabilization of vulnerable particulate OM, while lime causes a comparable disruption in the particulate OM and that in the heavy fraction. These findings provide a mechanistic insight into the decreased OM stability after liming and/or P fertilizing Andosols. They have implications for designing climate-smart management practices for these soils.

Y Li , T Wang, M Camps-Arbestain, M Suárez-Abelenda, C P Whitby. 2020. Lime and/or Phosphate Application Affects the Stability of Soil Organic Carbon: Evidence from Changes in Quantity and Chemistry of the Soil Water-Extractable Organic Matter. Environ Sci Technol 54, 13908-13916. https://dx.doi.org/10.1021/acs.est.0c01341

Soils of the Lower Awatere Valley

Campbell Iain B, Oliver Matt: 2020

The soils that occur on 9500 ha of terrace lands in the Lower Awatere Valley, Marlborough, are described in this report, which is an accompaniment to the soil map for Awatere Valley of the Manaaki Whenua Landcare Research on-line S-Map series and the soil map of the Marlborough District Council web site. This report captures data that was acquired during a field survey undertaken by New Zealand Soil Bureau staff of the Department of Scientific and Industrial Research in the mid 1970's. The soil distribution pattern over the survey area is largely fragmented because the Lower Awatere Valley is within an active tectonic environment and ongoing river downcutting has resulted in numerous discontinuous terrace surfaces. Approximately 75% of the soils in the mapped area are formed from river alluvium of which about 45% are shallow and stony. On the south side of the Awatere River, loess of variable thickness covers the higher elevation river terraces and the soils on this material occupy 25% of the surveyed area. Twenty seven soil families are identified within the surveyed area. They differ widely in respect of their age and development status, their depth and stoniness, soil textures, physical properties, drainage attributes and also the parent materials from which they are formed. Soil chemical, physical and mineralogical properties for a range of the soils are given in the accompanying appendices.
www.marlborough.govt.nz MDC Technical Report No: 20-001 001. ISSN 1179-819X (Online) ISBN 978-1-927159-92-7 (Online)

Eigenmodels to forecast groundwater levels in unconfined river-fed aquifers during flow recession

Low-land alluvial gravel aquifers are formed from, and tend to be recharged, by rivers. These interconnected river - groundwater systems can be highly dynamic with groundwater levels following the seasonality of the hydrological regime of the river. The associated groundwater resources are regularly under stress during summer periods when abstractive demand is high and recharge is low. Predicting lead-times

for critical groundwater levels allows for a more flexible and adaptive groundwater management. An eigenmodel approach is proposed here as a way of making such predictions, fast and efficiently. The eigenmodel is a mathematical concept that represents the hydraulic function of a groundwater aquifer as a set of conceptual linear reservoirs, arranged in-series. River recharge, land surface recharge, and groundwater abstraction for irrigation are considered as model forcings. The eigenmodel approach is demonstrated on three wells of the unconfined Wairau Aquifer in the Marlborough District of New Zealand, which are used for water resources management. Individual eigenmodels were calibrated to historic data and predictive uncertainty bounds were determined by Markov chain Monte Carlo sampling. Hindcasting of past recession periods showed a low predictive error of the models and a good coverage of the predictive uncertainty bounds. The main advantage of the approach is a 4-orders of magnitude higher computational efficiency compared to a numerical benchmark model. This allows for probabilistic simulation in operational forecasting of groundwater levels. The framework is implemented as a web application for 30-day operational forecasts that comprises automatic data downloads and model input generation, stochastic simulation, uncertainty estimation, visualization, and daily updates on a website.

Wöhling T., Burbery L. (2020). Eigenmodels to forecast groundwater levels in unconfined river-fed aquifers during flow recession. *Science of the Total Environment*, 747, 141220, https://doi:10.1016/j.scitotenv.2020.141220.

Detecting the cause of change using uncertain data: Natural and anthropogenic factors contributing to declining groundwater levels and flows of the Wairau Plain Aquifer, New Zealand

1 Study Region: The unconfined Wairau Aquifer in the Marlborough District of New Zealand is almost exclusively recharged by the Wairau River and serves as the major resource for drinking water and irrigation in the region. A declining trend in aquifer levels and low-land spring flows has been observed for the past decades. *2 Study Focus:* The aim of this study is to identify and analyse natural and anthropogenic factors controlling the hydrological regime of the Wairau Aquifer. Concurrent trends in the long-term water balance components for the Wairau catchment and in low-flow statistics as well as the correlation between hydro-meteorological drivers and the Interdecadal Pacific Oscillation (IPO) index were investigated. The impact of river morphology changes on river recharge rates was studied using a previously developed groundwater flow model. *3 New Hydrological Insights for the Region:* Our study found that long-term trends in declining catchment-scale precipitation are superimposed on climate oscillation and a strong annual variability. Jointly, these processes have resulted in lower than average river flows, increased low-flow periods, and consequently in lower rates of aquifer recharge. River engineering caused erosion of the braided river morphology, leading to a possibly permanent loss of aquifer storage. Groundwater abstraction is not accurately known which is a limitation of this study. This additional information

and adaptation strategies are required for sustainable management of the groundwater resources.

Wöhling T., Wilson S.R., Wadsworth V., Davidson P. (2020). Detecting the cause of change using uncertain data: Natural and anthropogenic factors contributing to declining groundwater levels and flows of the Wairau Plain Aquifer, New Zealand. Journal of Hydrology: Regional Studies, 31, 100715, https://doi:10.1016/j.ejrh.2020.100715.

Extension of Bayesian chemistry-assisted hydrograph separation to reveal water quality trends (BACH2)

A Bayesian chemistry-assisted hydrograph separation (BACH) approach was previously demonstrated using 15 years of monthly total phosphorus (TP) and total nitrogen (TN) data from eight mesoscale catchments in New Zealand's North Island. Calibration was done separately for three 5-year data periods, and in each period, concentrations of the two tracers (TP and TN) discharged from each of the three separated flow paths–fast (event-response near-surface flow), medium (seasonal shallow local groundwater flow), and slow (persistent deeper regional groundwater flow)–were assumed to be constant. This approach has now been extended to reveal non-linear trends in the tracer concentrations in each flow path, each represented using a four-parameter curve (initial and final values of a linear trend plus two harmonics). The extended method (called BACH2) identified clear TP and TN concentration trends in the medium and slow flow paths in most of the eight catchments. TP and TN concentration trends in the fast flow path were generally uncertain, however, due to the infrequency and inherent variability of concentrations sampled during high flow conditions. Concentrations closely matched previously published results from the constant-concentration BACH model calibrated to shorter data series. The BACH2 approach is a powerful tool for revealing concentration trends in the different pathways that sustain stream flow using commonly available water quality and flow data. This type of analysis has not previously been available outside of complex distributed simulation models.

Woodward, S. J. R. and Stenger, R. (2020) Extension of Bayesian chemistry-assisted hydrograph separation to reveal water quality trends (BACH2). *Stochastic Environmental Research and Risk Assessment,* https://doi.org/10.1007/s00477-020-01860-7

Soil organic carbon stocks in hill country pastures under contrasting phosphorus fertiliser and sheep stocking regimes, and topographical features

Alec D. Mackay [a], Ronaldo Vibart [a],*, Catherine McKenzie [a], Des Costall [a], Franco Bilotto [a],1, Francis M. Kelliher [b]

Temporal and spatial measurements of soil organic carbon (C) under grazed pastures are needed to quantify the effects of different grazing management regimes on C stocks. We examined soil organic C stocks under permanent pastures at the Ballantrae Hill Country Research Station in southern Hawke's Bay, New Zealand. Soils were sampled to three depths (0-75, 75-150, 150-300 mm) in 2003 and to the two upper depths in 2014, in three farmlets under different annual phosphorus (P) fertiliser inputs and stocked with sheep to maintain similar grazing pressure (i.e., stock units per unit of pasture production) across farmlets since 1975. The farmlets examined were NF = no annual P applied, LF = 125 kg single superphosphate (SSP) ha 1, and HF = 375 kg SSP ha 1, on an annual basis since 1980. The permanent sites included three slope classes [low slope (LS; 1-12○), medium slope (MS; 13-25○), high slope (HS; >25○)], on three different aspect locations grouped relative to the true north [east (E; 35-155○), southwest (SW; 275-35○), northwest (NW: 155-275○)]. A year-by-farmlet interaction trend on soil C stocks in the upper depth (0-75 mm) was associated with linear numerical differences in soil C stocks in 2003 (30.9, 32.5 and 35.1 Mg C ha 1 on the NF, LF, and HF farmlets, respectively) but not in 2014. This trend was not seen in the deeper soil layers (75-150 and 150-300 mm). In contrast, slope and aspect had major effects on soil C stocks. Overall, soil samples collected on the steepest slope class (>25○) resulted in higher soil bulk densities (BD) and carbon-to-nitrogen (C:N) ratios, and lower N and C concentration, and soil C stocks at all soil depths, compared with samples collected at the other two slope classes. Soil samples collected on the NW-facing slopes resulted in higher BD, and lower N and C concentration, and soil C stocks at all soil depths, compared with samples collected at the other two aspect locations. Both of these topographic features need to be considered in soil sampling regimes of hill grazing lands to obtain an accurate estimate of organic C stocks. Data from this long-term study provide science, policy and industry with invaluable insights on soil organic C stocks in grazing hill-country soils and highlight the value of long-term structured experiments for monitoring soil C stocks. *Implications:* Sequestering of organic carbon (C) in soil offers an option for offsetting C in atmospheric emissions. We examined soil C accumulation under a long-term phosphorus (P) application and sheep stocking regime grazing experiment. The hill country experiment has been running since 1975, with three distinct farmlets that received either no P, an intermediate amount or an amount that exceeds annual maintenance. Farmlet per se had a minimal impact on soil C accumulation, but slopes and aspects had a substantial impact and need to be considered in the design of soil sampling regimes that monitor soil organic carbon over space and time.

Conferences and Training

New Zealand Ecological Society

4 December, Lincoln & Online

This year, the New Zealand Ecological Society Annual General Meeting will be followed by presentations from the Society's two major prize winners from 2019: Te Tohu Taiao award for ecological excellence winner Dr Sarah Richardson, and Ecology in Action award winner Laura Young.

https://newzealandecology.org/events/upcoming-meetings

Weathering the Storm Conference

1-4 December, Invercargill
This three-day conference, featuring keynotes speakers Dr Susie Wood, Dr Jenny Webster-Brown and Professor Peter Wilcock, will focus on the ongoing research surrounding New Zealand waterways and aquatic life.
https://www.nzhsrivers2020.co.nz/

1st Special FLRC One-Day Webinar

10 February 2021, Massey University, Palmerston North (or via Zoom)
How can we get the most out of Farm Environment Plans?
Registrations open 3 December 2020
Enquiries to: C.L.Christensen@massey.ac.nz
For all other information and to register, please visit: http://flrc.massey.ac.nz

9th National Symposium on Control of Soil Degradation and Recovery

May 24-26, 2021, "Ciutat d'Elx" Congress Center, Elche, Spain
Soil is a key element for sustainability, mitigation of the effects of climate change and food production. In addition, it is the support of human activities, both cultural and productive. The symposium focuses on aspects associated with soil degradation, with an emphasis on Mediterranean environments, and proposes solutions to reverse these situations.
Read more: https://condegres.es/

Eurosoil 2021: Connecting People and Soil

23-27 August 202, Geneva, Switzerland
The objective of Eurosoil 2021 is to bring together leading research scientists working on soil related topics and stakeholders dealing with issues of public concern, such as soil degradation and consequences of climatic changes. The important bridging role of soil practitioners to translate scientific knowledge into practice will be emphasised during Eurosoil 2021.
https://eurosoil-congress.com/

Deadline..... For the February 2021 issue of Soil News is Wednesday 17 February 2021

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