



## Welcome to the Soil News

August 2019

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### In this issue...

[President's Message](#)

[Society News](#)

[News from the regions](#)

[Related Society Notices](#)

[Abstracts](#)

[Conferences and training](#)

[Opportunities](#)



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

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## Officers of the NZSSS 2019-2020

President: Megan Balks, University of Waikato  
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Secretary: Diana Selbie, AgResearch  
Treasurer: Haydon Jones, Waikato Regional Council

Council: Brendan Malcolm, Plant & Food; Chris Anderson, Massey University; Tanya O'Neill, University of Waikato; Pierre Roudier, Landcare Research; Paul Johnstone, Plant & Food; Sam Carrick, Landcare Research

## President's message - Megan Balks

Nga mihi

One of the great things about soil science is to get down and dirty with the object of study out in the landscape. Now spring is in the air, daffodils have arrived, along with the first cherry blossoms. So for all those with field programmes, longer days and warmer weather will be making an escape from the office an attractive option - enjoy!

On 15<sup>th</sup> August the government released a discussion document with a **Proposed National Policy Statement (NPS) on Highly Productive Land**. A copy of the document is at the link below:

<https://www.mpi.govt.nz/dmsdocument/36624-discussion-document-on-a-proposed-national-policy-statement-for-highly-productive-land>

More general and background information can be found here:

<https://www.mpi.govt.nz/news-and-resources/consultations/proposed-national-policy-statement-for-highly-productive-land/>

Concern related to protection of our most versatile soils for productive land-use was the number one issue raised by members in response to our request for suggestions of areas for Parliamentary Commissioner for the Environment (PCE) investigation last December. Submissions on the Proposed NPS are **due 10 October** and the NZSSS council intends to prepare a submission. However, we are aware that there will be a diversity of views within the organisation so we **strongly encourage you to put in your own submissions as well**. If you want to contribute to the NZSSS submission please contact me, Haydon Jones at Waikato Regional Council, or Paul Johnstone at Plant and Food.

I met with the PCE, Simon Upton, to discuss our response to his request for suggested soil-related questions that he could usefully contribute to. He declined to look into the highly productive land issue as the NPS is underway. He expressed an interest in soil biodiversity and requested further guidance from the New Zealand Soil Science community related to specific questions related to soil biodiversity that would benefit from a PCE investigation. We are currently preparing a response to this amended request and if you have any specific suggestions please let me know ASAP. Email [megan.balks@earthbrooke.co.nz](mailto:megan.balks@earthbrooke.co.nz)

The news from correspondents is one of the most read features of Soil News. We have a great team of correspondents for Soil News; however, we are always looking for more volunteers. If your organisation is not well represented, or you are the only member from your organisation, you are most welcome to become a regular correspondent to share information about what you and your colleagues are doing in the soil science space. Of course, you are always welcome to make a one-off contribution to Soil News as well. Contact our soil news editor [Gina.Lucci@AgResearch.co.nz](mailto:Gina.Lucci@AgResearch.co.nz)

I look forward to seeing many of you at WaiBOP on 29<sup>th</sup> November and hope you are planning towards our joint conference with Australia in December 2020 in Cairns.

Dr Megan Balks  
NZSSS President.

## Society News

# 2019 Norman Taylor Memorial Lecturer

**Professor Marta Camps**  
Massey University

## A Biogeochemical View of Major Soil Orders/Groups

Soils are extraordinarily heterogeneous natural bodies, with an internal organization, components, and properties that vary in time and space in response to complex interactions with the environment. The revised World Soil Charter endorsed by FAO (FAO, 2015) recognizes that “soils are fundamental to life on Earth but human pressures on soil resources are reaching critical limits. Careful soil management is one essential element of sustainable agriculture and also provides a valuable lever for climate regulation and a pathway for safeguarding ecosystem services and biodiversity”. A framework based on the Eh-pH diagram with the three soil evolutionary trends (acid, alkaline, reduced), represents a valuable tool to understand the genesis and biogeochemical conditions of the different soil groups/orders of soil classification systems, as needed to achieve a holistic understanding of soils so that we can optimize sustainable soil management.



Marta Camps is Professor of Environmental Biogeochemistry at Massey University. Marta is originally from Catalonia, where she studied Agricultural Engineering. Her honours project involved the restoration of saline and alkaline soils. She did her MSc and PhD in Soil Science at the University of California, Davis, with her research being focused on the remediation of soils contaminated with selenium. There she met her husband, Adolfo, who is originally from Argentina, and both moved to Santiago de Compostela, Spain, where their two kids (Martina and Inaki) were born. There, she worked at the

University, first as a postdoctoral scientist and then as a junior lecturer. During that time, Marta focused her research on the biogeochemistry of acid soils as well as on local environmental problems such as the remediation of soils contaminated with lindane or the assessment of the critical loads of acidity of the soils in the region. In 2003, she got a position as Senior Researcher “Ramon y Cajal” at the Basque Institute for Agricultural Research and Development (NEIKER-TECNALIA) and worked on soil carbon sequestration and other local environmental issues such as mine restoration. In 2009, she took up an associate professorship at Massey University and co-director of the New Zealand Biochar Research Centre. In Palmerston North, Marta has focused her research on soil carbon sequestration, with special attention on soil organic matter chemistry and soil organo-mineral interactions. She has been a member of the Intergovernmental Technical Panel on Soils (2013-2015).

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## Consultation on National Policy Statement for Highly Productive Land

The Ministry for Primary Industries and Ministry for Environment have released a proposed National Policy Statement for Highly productive Land. <https://www.mpi.govt.nz/news-and-resources/consultations/proposed-national-policy-statement-for-highly-productive-land/>. The closing date for providing feedback is October 10<sup>th</sup> via an online submission process. As a public advocate on the need for an NPS to consider and protect versatile soils, the NZSSS intends to prepare a submission that is generally supportive of the proposal. However there is a great deal of detail to consider and MPI and MFE have raised a number of specific questions that they would like to receive feedback on (Page 58 of the document). We would therefore request that individual members (or their respective organisations) consider putting in submissions addressing specific areas of concern or interest. This will help ensure that the soil science community has a strong voice in the development of a document which will have large implications for soil science/land use policy development for future generations.

Dave Houlbrooke on behalf of the NZSSS Council.

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## New Zealand Soil Mapping Protocols and Guidelines - A Land Monitoring Forum Perspective

Haydon Jones  
Convenor - Land Monitoring Forum  
July 2019

In the February 2019 issue of Soil News (Vol. 67, Issue 1), an article entitled ‘Implications of the recent New Zealand Soil Mapping Protocols and Guidelines’ by Peter Singleton was published. I would like to thank Peter for taking the time to provide this feedback on the recent Envirolink-funded report on ‘New Zealand Soil Mapping Protocols and Guidelines’ that was commissioned by the Land Monitoring Forum (a regional sector-wide Special Interest Group) and prepared by Manaaki Whenua - Landcare Research. The Land Monitoring Forum commissioned the project and resulting report because it could see a

growing need for a nationally consistent framework to guide the collection and presentation of soil map information, particularly at the farm scale, and provide greater certainty around the quality and consistency of that information in the context of regional sector applications (e.g. helping inform resource consent decision-making). The soil mapping protocols and guidelines set-out in the report are intended to be *proposed* protocols and guidelines, which have been presented to stimulate feedback and discussion among the wider soil science community, rather than to be the final word on the matter. The report available on the Envirolink website has been amended to reflect the 'proposed' status of the protocols and guidelines. Following the release of the report, the intention was to 'road-test' the proposed protocols and guidelines for one to two years, then review and update them based on the learnings gained from this practical testing and feedback. And indeed, work is underway on a case study to test the application of the proposed protocols and guidelines within a region and further case studies are planned. The Land Monitoring Forum and Manaaki Whenua - Landcare Research certainly welcome any suggestions or recommendations for improvements to the proposed protocols and guidelines, the amended version can be found on the Envirolink website [HERE](#). Further feedback can be directed to either myself as Land Monitoring Forum Convenor ([haydon.jones@waikatoregion.govt.nz](mailto:haydon.jones@waikatoregion.govt.nz)), or Gerard Grealish at Manaaki Whenua - Landcare Research ([grealishg@landcareresearch.co.nz](mailto:grealishg@landcareresearch.co.nz)). Following the completion of the test case studies and the receipt of feedback, the proposed protocols and guidelines will be updated to incorporate any changes.

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## Wai-BoP Soils 2019

One-day conference for NZSSS: Friday, 29<sup>th</sup> November, 2019  
Room SG.01, University of Waikato, Hillcrest, Hamilton

*Commemorating Mendeleev and his pioneering roles in  
pedology (143 yr ago) and periodicity (150 yr ago)*

### Call for papers and notification of attendance

The fifth one-day regional conference for Waikato-Bay of Plenty-based soil scientists and guests is to be held on Friday, 29<sup>th</sup> November, 2019, University of Waikato, Hamilton. Being convened by David Lowe and Anne Wecking (Earth sciences group, School of Science, University of Waikato) on behalf of NZSSS, the conference provides a great opportunity for the many soil scientists and others in the region with interests in land and soil to assemble for a stimulating day of talks and networking.



Dimitri Mendeleev (1834-1907)

Although the meeting targets Waikato-BOP soil scientists, we welcome attendance from those in other regions who have a professional interest in soils and land (e.g., from Northland, Auckland, Hawke's Bay, Taranaki), our only stipulation being that all participants must be paid-up members of the New Zealand Society of Soil Science (NZSSS). Society membership application forms are available on the website: <http://nzsss.science.org.nz/join-us/> (annual membership, if paid **before 31 August**, is only \$80 for full membership, \$35 for students). Registration for the conference is free, and refreshments will be provided, thanks to generous sponsorship for the event by the Waikato Regional Council, Landcare Research, AgResearch, University of Waikato, and NZSSS. This year's venue is room SG.01 in S-block lecture theatre building, Hillcrest Road (see <http://www.waikato.ac.nz/contacts/map/>). The time of conference opening will be confirmed later but is likely to be early, around 8:00 am or soon after to allow a full day to be planned.

Keynote speaker is Dr Peter Hodder (Victoria University of Wellington and freelance researcher/analyst), by training a geochemist and a former lecturer at the University of Waikato. He will open the conference with a talk entitled "Developing a Periodic Table for Earth scientists".



Dr Peter Hodder

### **N.H. Taylor Memorial Lecture 2019**

The conference is to be concluded with the N.H. Taylor Memorial Lecture for 2019 by Professor Marta Camps (Massey University). She will speak on the topic “A biogeochemical view of major soil orders/groups”. Please see the announcement in *NZ Soil News* for further information about Marta and this year’s N.H. Taylor Memorial Lecture. It will tie in nicely to Peter’s earlier talk.

Note that if you just want to attend the Taylor Lecture, but not the conference, then you are most welcome to come along to **Room SG.01, S block, University of Waikato**, from **~3.30 pm** for afternoon tea before the lecture starts (provisionally) at 4.00 pm on Friday 29<sup>th</sup> November.

**Please email David Lowe before Friday 1<sup>st</sup> November to present a paper at the conference**

If you want to present an oral paper, you must email David Lowe ([david.lowe@waikato.ac.nz](mailto:david.lowe@waikato.ac.nz)) by **Friday 1<sup>st</sup> November 2019** at the latest with the **title** of your paper, **the authorship**, and the **name of the person who will present it**. The title must reflect the content. No abstracts are required. All papers will be oral presentations, probably 12 minutes in total, comprising 10 minutes for presentation followed by 2 minutes for questions or comments, strictly enforced. Presenters of papers will be notified of acceptance or otherwise a week or two after the deadline.

Please email Anne before Friday 15<sup>th</sup> November if you wish to attend the conference

For catering purposes, we also need to know likely attendance by those not giving papers. Consequently, **all those who are planning to attend must advise Anne Wecking via email by Friday 15<sup>th</sup> November, 2019 ([a@wecking-do.de](mailto:a@wecking-do.de))**. Please feel free to pass this notice on to people or organisations who may be interested in attending. We hope to see many of our society members, students, and others interested in the wonderful world of soils at the Wai-BoP Soils 2019 conference on the 29<sup>th</sup> of November. Remember: "Wai-BoP Soils? Why not!"

David Lowe and Anne Wecking  
19 August 2019

## News from the Regions

### Waikato/Bay of Plenty

#### Waikato Regional Council

Congratulations to **Haydon Jones** who has been appointed as the team leader for the Soil and Land Team. The team will soon be getting a new member to replace **Reece Hill** who is now full time with his own consultancy. Haydon is involved with several higher-level activities including Our Land and Water, National Environmental Monitoring Standards for soil quality, coordinating the response to the Proposed National Policy Statement for Highly Productive Land, being Treasurer of the NZSSS and coordinator of the Land Monitoring Forum.

**Justin Wyatt** is working with Manaaki Whenua LCR to develop a peat subsidence monitoring method and network, as well as the soil moisture monitoring network. Justin is also working on suspended sediment monitoring and an update of WRC soil stability monitoring. **Matthew Taylor** is working on contracts for the next stage of SMAP for the region, soil quality monitoring, fertiliser use on farms, several waste water treatment plant consent renewals, and is involved in research projects looking at the effects of riparian planting, cadmium, microbial diversity, emerging contaminants and nutrient leaching. This year the soil quality monitoring trends report will be updated. The previous report, Trends in soil quality monitoring data in the Waikato region 1995 - 2015, is available at: <http://www.waikatoregion.govt.nz/services/publications/technical-reports/2017-technical-reports/tr201726/>.

### AgResearch

Two international visiting researchers are at Ruakura working with **Stewart Ledgard**. **Karla Mena Soto** is from Costa Rica and is working on carbon footprinting of dairying systems for Costa Rica. **Nannan Zhang** has rejoined us, this time to work on a United Nations Sustainability Development Network project related to export of agricultural products to China, including projections through to 2050 and the implications for local GHG emissions versus the increased demand for products from China.

Also recently joining the team is **Andre Mazzetto** who is based in Lincoln as part of the Environmental Research Team, working with Life Cycle Assessment (LCA). He likes to look at research topics using a "birds-eye view" with an interdisciplinary point of view,



understanding not only in the environmental aspect but also thinking about the economic and social impacts. Before arriving in NZ, he was working at Bangor University in the UK.

The four year Peat SFF programme looking at nutrient management on Waikato Peat Soils was completed in June 2019. The programme was a farmer led initiative and a collaboration between AgResearch (**Dave Houlbrooke, Bill Carlson, Gina Lucci**) and Manaaki Whenua Landcare Research (**Scott Fraser**), DairyNZ, Ballance Agri nutrients and Waikato Regional Council (**Justin Wyatt**). Some interesting results were observed regarding the difference between well and poorly developed peat soils. In summary, poorly developed peat soils had very high losses of P in both lysimeter leachate and paddock drainage suggesting the need for fertiliser management practices that decrease the loss of P. This loss is caused by the very low ASC (P retention) available in the soil. In comparison, well developed peat soils with their high ASC had very low P losses. N loss on these soils was much higher than for poorly developed peat soils but comparable or relatively lower than traditional mineral soil types. A key outcome of the research is the recommendation for the addition of a new low risk category in the farm dairy effluent (FDE) soil and landscape risk framework for well-structured, low water table peat soils. Many peat soils will continue to be classed as high risk owing to their poor structure and/or their seasonally high water table, however those that meet the criteria for low risk will benefit from lower FDE storage requirements as calculated by the Dairy Effluent Storage Calculator.



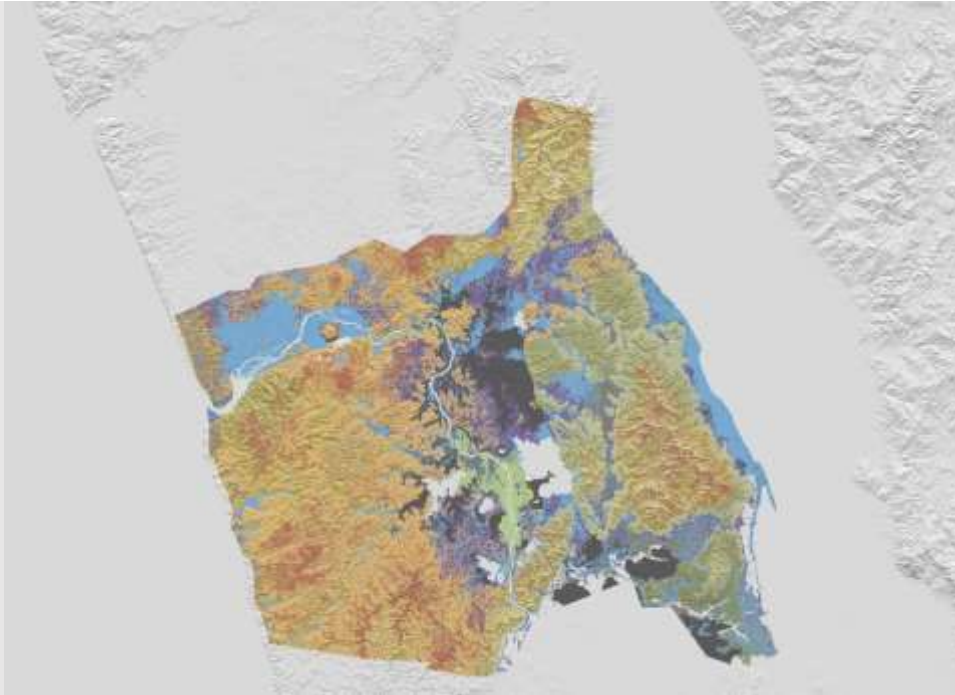
Photo 1. Peat lysimeters at Ruakura



Photo 2. A destructed lysimeter containing a high risk peat soil for FDE management (Rukuhia peat)

## Manaaki Whenua - Landcare Research

**Scott Fraser, Nadia Laubscher and Jonno Rau** have been extremely busy describing soil profiles from April to June at 300 randomly selected locations in the northern Waikato to inform a digital soil model (. Robbie Price has since run the 3 Random Forests models to compare randomly selected points, purposefully selected points (based on the pedologists understanding of the soil-landscape), and a combination of random and purposeful points. Currently Scott is comparing how each model performed by field validating each model, while Nadia and Jonno are collecting more field observations in the central Waikato (Taupiri to Arapuni) to inform another digital soil model. The northern and central Waikato models will be developed into a new digital soil map (DSM) and complete the coverage of S-map for the Waikato and Waipa River catchments.



Caption: Output from Random Forests model using all observation points covering an area from the Awhitu Peninsula in the north-west to Morrinsville in the south-east.

**Suzanne Lambie** has established integrated constructed wetlands (ICWs) on two dairy farms in Taupiri, Waikato. The construction work for this project is funded by the Ministry for the Environment through the Community Environment Fund and is supported by the local community. The purpose of the project is to determine the effectiveness of ICWs for the removal of contaminants from dairy run-off.

In May 2019, Suzanne held a community workshop day with Taupiri Primary School and Taupiri Marae, where they talked about the importance of wetlands as taonga and their role in water treatment and providing habitat for insects. The weather was great for ducks, and despite the rain, the day was enjoyed by students and adults alike.

The Associate Minister for the Environment Hon. Eugenie Sage also attended the workshop to see the wetland construction in progress and to discuss the relevance of these systems for reducing the environmental footprint of farming systems.

These ICWs are part of a larger multi-disciplinary research programme within MWLR, which includes researchers from NIWA. The programme is assessing the treatment efficiency and biodiversity values of constructed wetland systems. Suzanne will be assessing the structure of microbial communities within these systems to identify the contribution of soil to treatment of contaminants within wetland systems.



Caption: Taupiri Primary School students helping with some planting at the ICW workshop. Workshop participants including MWLR staff Suzanne Lambie, Bev Clarkson, and Yvonne Taura.



The Hon. Eugenie Sage talking with the students of Taupiri Primary School (Photo: Yvonne Taura).



Caption: The Hon. Eugenie Sage discussing the ICW project with Suzanne Lambie (Photo: Bev Clarkson).

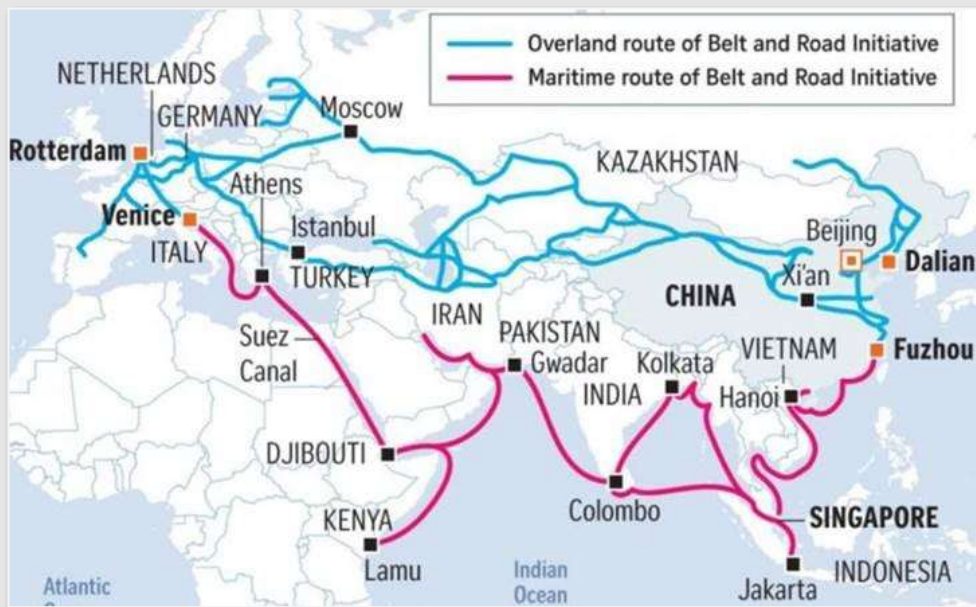
## **Manawatu Plant & Food**

### **A Massive Global Disruptor: The Belt & Road Initiative**

**Brent Clothier** was an invited Plenary Speaker at the **Forum on Irrigation and Drainage Development and Technological Innovation of the Belt and Road** hosted by the China Institute of Water Resources and Hydropower Research (IWHR), and the Chinese National Committee on Irrigation and Drainage (CNCID). This meeting was held from 29 July to 2 August 2019 in Beijing.

The Belt & Road initiative of China is a huge global disruption plan to reconnect Asia, Africa and Europe. Water resources along the Belt & Road will be critical for its economic success and environmental sustainability.

The Belt & Road Initiative (BRI) seeks to re-establish the ancient trade routes of the overland Silk Road (the Belt), and the maritime Silk Route (the Road). There are some 125 countries, including New Zealand, that have signed cooperation agreements with the BRI, along with nearly 30 international organizations.



One of the environmental challenges is that the BRI encompasses the bulk of the world's natural capital assets, and there are concerns that the BRI will put those natural assets and environmental values at risk. Water will be a critical stock of these natural capital assets. Ascensão et al. (2018) recently published a paper in *Nature Sustainability* last year on the environmental options and exigencies of the BRI. They worried that “... *the BRI may clash with environmental sustainability*”. But Ascensão et al. (2018) conclude that “... *these challenges can be turned into opportunities for environmental stewardship*.” Such that “... *the BRI can become a unique opportunity to raise the bar, setting higher standards for best practices that link infrastructure to environmental protection*”

This Beijing Forum sought to seek those higher standards for best practices in relation to water along the BRI.

Brent chose to talk on PFR's water-related work in the Middle East, a nexus on the BRI, and his public-private partnership aid work on water in Kenya, a huge source of natural assets and human resources for the BRI. His talk, a plenary on the first morning, was on “Sustainable irrigation management under challenging conditions along the Belt and Road: The Middle East and Africa”.



Brent notes that water, both in terms of irrigation and drainage, is a critical issue for all countries along the Belt & Road, including within China. And he also notes that China is investing heavily in the Belt & Road, in general, and in relation to water in particular.

Manaaki Whenua - Landcare Research

News from Palmerston North

**Matteo Poggio**, attended the 5th Global Workshop on Proximal Soil Sensing, hosted in Columbia (Missouri, USA), where he presented the project on using a multi-sensing platform to estimate soil organic carbon stock in pastoral soils of New Zealand hill country (see abstract). The project was conducted by the pedometrics team and funded by the New Zealand Government, via the Global Research Alliance. The multi-sensing platform, unique in New Zealand, was the result of a collaboration with CSIRO in Australia and integrates an active gamma-rays densitometer, a Visible Near-Infrared spectrometer and a CCD camera which analyses soil intact cores at field conditions, without the need to pre-process the soil. The focus of the workshop was to go beyond the technological innovation component of the proximal soil sensing movement and actually link the soil sensed data to management decisions. In this context, the project evaluated the innovative platform to estimate carbon stock at national scale, and the suitability of the method. The prospect of the cost-effective method to support future monitoring surveys at different scales could provide valuable information to establish the nexus between distinct management practices and carbon stock changes, and identify the carbon sequestration potential of New Zealand soils.

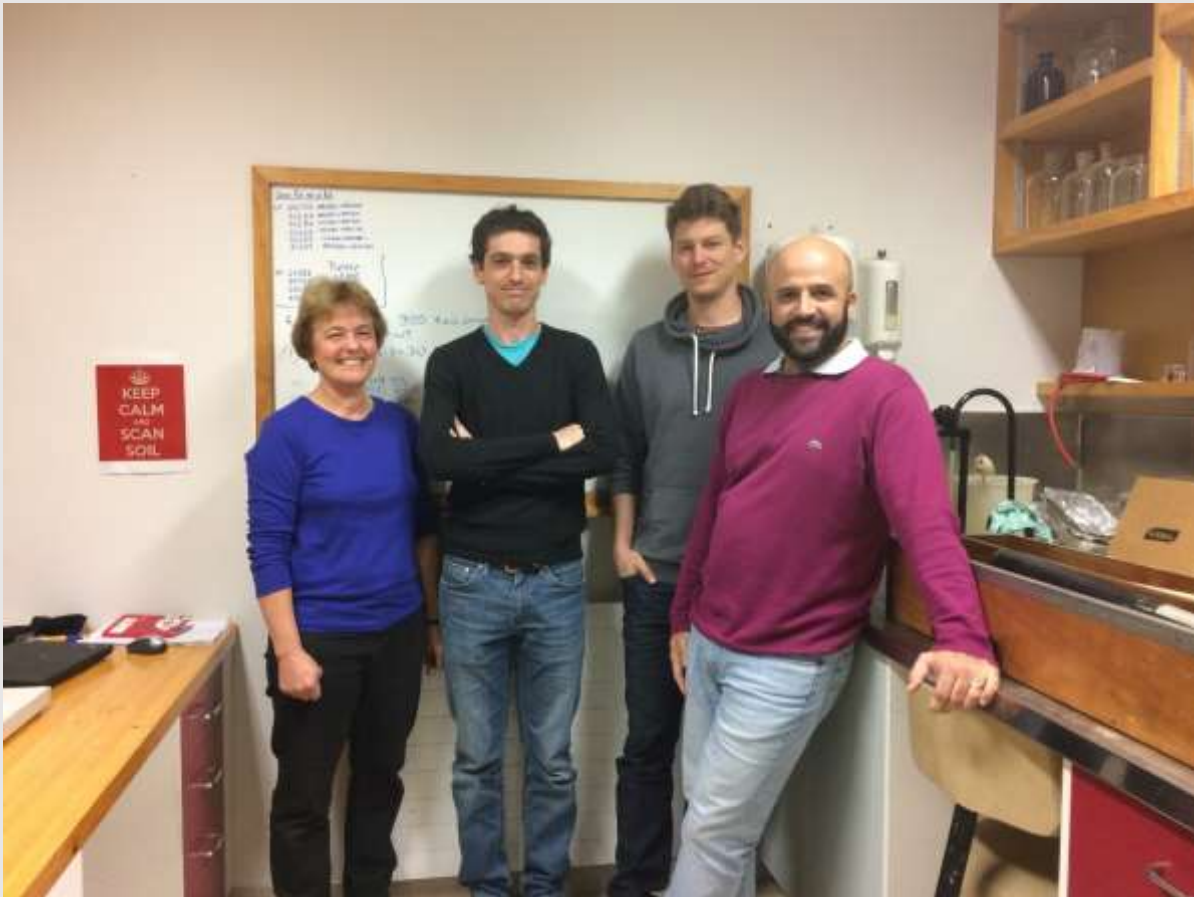
This month we farewelled **Matteo Poggio**, who has been working in our soil spectroscopy team in Palmerston North. During his time with us Matteo has contributed to a number of proximal soil sensing, soil carbon accounting and soil morphometric projects. Matteo scanned hundreds of soil cores on our automated soil core scanner SCANS for a project that has benchmarked soil carbon stocks for pastoral soils in New Zealand hill country. He also helped to commission our FT-IR spectrometer that collects spectral information from a soil sample in the near infrared and mid infrared range for predicting a range of soil properties. We will miss Matteo but wish him all the best for the future.

**Michael Blaschek**, **Matteo Poggio**, and **Pierre Roudier** attended the Pedometrics conference held in Guelph, Canada, early June 2019. Michael presented preliminary results on the creation of a new high-resolution map of soil available water-holding capacity for entire New Zealand using visible near-infrared spectroscopy and environmental covariates derived from satellite imagery and terrain analysis. Matteo presented his work on the contribution of soil spectroscopy to "track" soil organic carbon in full inversion tillage experiments. Finally, Pierre presented two papers, one on the digital soil mapping of soil pH and electrical conductivity for the McMurdo Dry Valleys of Antarctica, the other on the production of a national scale, fine resolution grid of soil pH for New Zealand. He also organised and convened the session "Applications of Pedometrics: Emerging needs and demands". See abstracts.

**Benny Theng** and wife, Judy, returned home in early August 2019 from a working holiday in Europe. Benny convened a workshop in conjunction with Euroclay2019 conference at Sorbonne University, Paris (1-5 July) where he presented eight lectures based on his book "Clay Mineral Catalysis of Organic Reactions, published in August 2018 by CRC Press, Boca Raton, Florida. The workshop was attended by 18 people from both academia and industry (see attached photos). The combined registration fees covered Benny's travel and accommodation expenses. On the way to Paris, Benny and Judy spent three days in Zhaoqing (near Guangzhou) being hosted by Guodong Yuan, a former colleague of Benny at Manaaki Whenua-Landcare Research and now a professor at Zhaoqing University. On the way back to New Zealand, they again transited in Guangzhou for 3 days, meeting up with colleagues and friends of the Guangzhou Institute of Geochemistry, Chinese Academy of Science. After Euroclay2019, Benny and Judy had 4 days in London. Their son, Andrew, from Colorado (USA) joined them there, and became the sole driver (of a rental car) in the Dolomites (Italy), Slovenia, Croatia, and France for 5 memorable weeks.



**Carolyn Hedley** has been the Soil News correspondent for Manaaki Whenua in Palmerston North for many years - too many to remember! Carolyn has handed over the correspondent role to **John Drewry**. We thank Carolyn for her many contributions to Soil News.



Caption: Manaaki Whenua soil spectroscopy team in Palmerston North. Left to right: Carolyn Hedley, Pierre Roudier, Michael Blaschek, Matteo Poggio.



Caption: Benny Theng and colleagues at a workshop at the Euroclay2019 conference at Sorbonne University, Paris.

## Massey University

### Celebration time

Mid-year has passed, Semester Two is running well, and at Massey we celebrate new Doctorates. Congratulations to all of them. Recently, **Kamal Adhikari's** PhD thesis titled **"Mitigation potential of urease inhibitory compounds in reducing ammonia emissions from cattle urine in dairy-grazed pasture soils"** was successfully defended. Kamal's PhD programme was supervised by Prof. Surinder Saggar (Manaaki Whenua - Landcare Research), Dr James Hanly (Massey University) and Danilo Guinto (Ballance Agri-Nutrients Limited). Kamal is now pursuing a research career at Manaaki Whenua - Landcare Research.

**Hisham Zarour** (see photo) was conferred the degree of Doctor in Philosophy in Earth Sciences after presenting his thesis entitled **"Characterisation and numerical simulation of the Lower Manawatu Catchment hydrogeological system"**. A brief hint on Hisham's work follows:



Groundwater is an important resource in the Lower Manawatu Catchment. Geological and groundwater studies commenced in the 20th century but there has been a need for an integrated analytical framework to understand the system and manage it sustainably. Mr Zarour adopted computer modelling as a tool for integrating knowledge about the resource. He developed models to explain the apportionment of rain into surface runoff and groundwater recharge, clarify geomorphological and geological controls on the system, and simulate groundwater flow. In addition, he studied groundwater chemistry to supplement and validate his hydrogeological understanding of the groundwater system. The developed models enhance knowledge of groundwater in the catchment and provide useful management tools for natural resource and environmental managers. The techniques Mr Zarour developed and used in his research can be beneficially utilised worldwide in geological and hydrological work. Hisham Zarour was supervised by Dr Alan Palmer (Massey University) and Dr John Begg (GNS).



More congratulations following. **May (Sasikunya) Cheuyglintase's** PhD thesis, titled **"Removal of dissolved reactive phosphorus from municipal and dairy factory wastewater using Allophanic soil"** was defended successfully recently. May's PhD programme was supervised by Dr James Hanly and Associate Professor David Horne, both from Massey University. May wants to share some details on her research, focusing on phosphorus and wastewater. She comments that phosphorus (P) is one of the key nutrients responsible for eutrophication—once this has occurred, the pristine condition of the affected surface water is lost. There is an abundance of Allophanic soils with high P sorption capacities located in the central North Island of New Zealand. From this aspect, May evaluated this

Allophanic soil in laboratory and pilot-scale soil filtration experiments at removing P from municipal and dairy factory wastewaters. To enhance the soil's P removal capacity, other operational conditions were also investigated which were acidification of wastewater pH and sieving of soil particles. The exhausted phosphorus-saturated Allophanic soils were further applied as fertiliser to perennial ryegrass under glasshouse conditions to investigate its agronomic value. By quantifying the Allophanic soil's P sorption capacities under laboratory and field conditions, her research contributed to a better understanding of important design parameters of full-scale soil-based treatment systems and had substantially recycled the recovered P for plant growth. The photo shows a front view of the fancy filters used at Dannevirke STP as part of this study.

## Save the dates

Researchers at Massey are also planning, behind the scenes, a couple of events that will interest the wider Soils Science community, both in New Zealand and overseas.

On the one hand, Dr **Gabor Keretszturi** (Massey University) is planning a **Workshop on Hyperspectral and thermal remote sensing - From Data to Applications** to be held at Massey University - Manawatu Campus, Palmerston North. Remote sensing is a powerful and versatile technology to assess the surface of the land and natural resources. Imaging technologies and sensor design have developed extensively over the last few decades and now they are becoming more widely available for research and industrial applications. This free workshop will bring New Zealand and International remote sensing experts together to demonstrate Earth and Soil Science applications for the science community, and for industry. Reserve data and time: 1 October 2019, 10:00-16:00. Note that the Registration is free (no fee). Gabor ([G.Keretszturi@massey.ac.nz](mailto:G.Keretszturi@massey.ac.nz)) is happy to give you further information and register those interested. Scientists, students, staff from regional and local councils, representatives from industry are all welcome to attend however, registration is on a first-come-first-served basis. Speakers from research and education sectors of New Zealand, and selected international experts are confirmed, so hurry and do not miss your spot!

On the other hand, we have an early bird note for those awaiting with excitement the classic meeting point at **FLRC**. Date for diaries - the **33rd Annual FLRC Workshop** will be held at Massey University on 11<sup>th</sup>-13<sup>th</sup> February 2020 and details will emerge from the Organising Committee early in October. Watch this space. More news will be shared as received!

## Canterbury

### Scion (Rotorua/Christchurch)

The Scion soil team has recently been examining the impact of various disturbances and disruptions on soil properties, and we have also been exploring the applications of new technologies that promise to alter our approach to soil sampling and analysis. Most of this work relates to our core areas of responsibility, but some of our research in disrupted soils is best described as a flight of fancy...

### Long-lasting effects of forest harvest and fertiliser amendment on soil biodiversity and function

Soil samples collected from two long term plantation trials have been used to assess the impact of different levels of harvest disturbance on soil microbial properties at the end of the next rotation. This research, led by **Sarah Addison**, determined that bacterial

communities were relatively impervious to forest management practices over a long time frame, whereas fungal communities were responsive to this disruption and the effects on community assemblage endured for decades. This work is now published in *Soil Biology and Biochemistry*.

### **Using electromagnetic induction to sense soil properties**

For several years Scion has been employing a DUALEM-1 device to explore variations in soil electrical conductivity to 1.6 m depth, and then relate this data to both sampled soil properties and the performance of the plantation. This analytical process has been implemented successfully across several trials, and has provided a new pathway to understand variations in the performance of different radiata pine genotypes and their response to treatments. A field study led by Marta Gallart, which incorporated this technology, has recently been published in *Plant and Soil*, and several more papers are in preparation.



Using the DUALEM to characterise soil properties under a native forest planting

### **Soil science in disrupted Tibetan alpine meadows**

Through a collaboration with staff and students at East China Normal University, Simeon Smaill has been supporting research conducted to assess the effects of warming and degradation on soil properties and functions in Tibetan alpine meadow ecosystems. This research showed that both degradation and warming were affecting soil chemical properties, whereas degradation was significantly reducing methanotrophic activity. This research has been published in *Agriculture, Ecosystems and Environment*.

### **Soil factors and forest productivity**

As part of the GCOFF programme, Scion held a Forest Productivity Workshop in Taupo that included a visit to a large afforestation trial near Turangi. This trial contains several

elements, including an examination of the effects of a conventional soil cultivation treatment. This disruption to the soil facilitated significant changes, including increased weed biomass, changes to soil chemical and microbial properties, and (by age three) a significant decrease in tree productivity compared to the uncultivated treatment. Workshop attendees saw this growth effect first-hand, and were also able to observe soil pits indicating the impact of the cultivation treatment.



Amanda Matson (left panel) indicating the effect of the cultivation treatment on the variability of horizon depth (right panel)

### **Portable PCR, productivity and forest practice**

The Taupo Forest Productivity Workshop also provided an opportunity for Scion to demonstrate a new portable PCR device. Soil samples collected at the Turangi site were able to be rapidly extracted and run with a primer for a specific gene of interest, and workshop attendees were able to see how different radiate pine genotypes affected the abundance of this gene in the soil bacterial community associated with each tree. The abundance of this gene was strongly related to the productivity of those genotypes at the site, matching more detailed laboratory-based analysis. Several attendees also brought along soil samples from their own forests and were able to clearly see how sampling location affected soil bacterial properties. These demonstrations drove home the importance of soil biology to forest productivity, and how, with new technologies, this aspect of soil science can be meaningfully integrated into forest management.



The portable PCR device

### **And lastly, one for the birds...**

During a walk in the Port Hills south of Christchurch, David Flaspohler, an avian ecologist from Michigan Tech, observed a population of Redpolls eating soil from a cliff face. Although several bird species are known to eat soil, this was the first time geophagy had been observed in this particular species. David contacted Simeon Smail to help ascertain what had caused the change in behaviour, and after deploying some inventive sampling procedures it was determined that disruption from the earthquake had caused a rock fall, exposing a soil face rich in sodium. At some point the bird population detected the greater abundance of sodium in the soil, and now, some eight years later, it had become a part of their diet. The details of this research are published in *Notornis*.

## **Lincoln University**

### **Mitigation of Climate Change in Agriculture (MICCA) Programme**

The Food and Agricultural Organization (FAO) and the International Atomic Energy Agency (IAEA) held a consultancy meeting for designing a coordinated research project (CRP) proposal on “Developing Climate Smart Agricultural practices for mitigation of greenhouse gases” at the IAEA headquarters in Vienna, 22 to 25 July 2019, Vienna International Centre. **Professor Tim Clough** attended as one of five consultants who came from several countries: NZ, Canada, Germany, China and the Czech Republic. The consultants met with two staff of the IAEA to develop the CRP. Of special note were the various linkages to Lincoln University: both IAEA staff (Soil, PhD x1; Soil, postdoc x1) and

three of the five consultants (Plant Science, ex staff x1; Soil, PhD x2) had worked or studied at Lincoln.

### **PhD Success**

Congratulations to **Salome Seyed Alikhani** who successfully defended her thesis entitled “Biowastes to Establish Plants for Essential Oil production on Low Fertility Soils” this afternoon. The examining committee has recommended the award of PhD subject to minor amendments being made to the thesis. Salome’s supervisors were Brett Robinson, Nick Dickinson, Rainer Hofmann, Juergen Esperschuetz and Jason Breitmeyer.

Congratulations to **Zicheng Yi (Michael)**. Michael successfully defended his PhD thesis titled “The role of environmental and management factors in the accumulation and plant bioavailability of cadmium in New Zealand agricultural soils” this morning. The examining committee has recommended the award of PhD subject to minor amendments being made to the thesis. Michael was supervised by Dr Niklas Lehto, Prof Brett Robinson and Dr Jo Cavanagh (Manaaki-Whenua Landcare Research).

### **Lincoln University visit to Northwest Agriculture and Forestry University**

From 23-30 June, a visiting delegation from Lincoln University including Dr. Henry Wai Chau (LU) Dr. Niklas Lehto (LU), Mohamed Bayad (LU) and Professor Brett Robinson (UC), visited the College of Water Resources and Architectural Engineering, the College of Natural Resources and Environment and the College of Enology at Northwest to discuss joint research and teaching collaboration opportunities with Northwest Agriculture and Forestry University (Yangling, China).

The visiting delegation was hosted by Professor Feng Hao from the Institute of Water Saving Agriculture in Arid Areas of China, Professor Li Yi from the College of Water Resources and Architectural Engineering and Yufeng Zou, Coordinator for International Exchange. Studies tours, joint degrees, joint research funding, and New Zealand - China Water Research Centre (NZCWRC) doctoral research scholarships were discussed in the meetings.

A series of seminar presentations entitled: “*Trace element fluxes in the soil - plant system*”, “*Nutrient and trace element biogeochemistry at the plant root-soil interface*”, “*Research highlights on soil water management*” and “*Remote and proximal sensing to map soil water repellency and predict its effect on soil phosphorus mobility*” were presented to a captivated audience. During the tour, the academics visited research sites, laboratories, and cultural heritage sites along with participation in group meetings with post graduate students, supported joint publications and attended seminars.

From 1-10 July, Dr. Henry Wai Chau (LU) was hosted by Professor Li Yi, Professor Hu Xiaotao and Associate Professor Li Min from the School of Water Conservancy and Architectural Engineering to deliver short course entitled “*Hydrology theory*” in English to interested undergraduate and postgraduate students. The course was well received from the students and serves as a precursor for potential undergraduate students and postgraduates to join a NWAUFU study tour in January, 2020. Overall the trip was a success, with invitations extended to visit again to continue the collaboration.





### Northern Exposure

July 2019 - Peter Almond has returned from Columbia Bay in Alaska. He is working with Australian and American colleagues investigating the behaviour of the Columbia glacier. The glacier is known as a tide-water glacier, which has undergone 24 km of retreat since the 1980's leaving behind a deep fiord. The team has been using cosmogenic nuclide exposure dating, tree rings and dendrochronology, and soils to date previous advances and retreats of the glacier to try and establish the climate and glacier dynamical controls on its behaviour. The team spent 10 days camped near Lake Terentiev amongst the local wildlife including a healthy bug population (no-see'ums, sandflies and mosquitoes).



**Congratulations**



Amongst family and close friends, Judith Van Dijk (Senior Tutor, Department of Soil & Physical Sciences) married Steve Butel last Monday 19th August in the Netherlands. They are currently spending their honeymoon travelling and tramping in Europe - congratulations from all of us Mr and Mrs Butel!

## Related Society Notices

### Report on 10<sup>th</sup> ITPS meeting and Global Soil Erosion Symposium, May 2019.

By Megan R Balks. Contact: [megan.balks@earthbrooke.co.nz](mailto:megan.balks@earthbrooke.co.nz)

#### **ITPS (Intergovernmental technical panel on soils) meeting 13-14 May 2019.**

The meeting updated all members on the work on many fronts that is being led by the GSP (Global Soil Partnership) secretariat.

1. *GSP Plenary*: The Global Soil Partnership Plenary Assembly (PA) constitutes the main venue where all GSP partners come together to make important decisions about the global soil agenda. The 7<sup>th</sup> PA of the Global Soil Partnership will take place at FAO headquarters in Rome from 5 to 7 June 2019.

2. *Soil carbon*: ongoing work following up on Soil Carbon Symposium in 2017. An expert group is working on a technical manual for assessment and management of soil organic carbon. Draft has 100 authors, 500 pages, 18 chapters. Final version to be launched on World Soils Day 2019.

Building links with IPCC and climate change activities.

Black soil network has symposium in Moldova in October 2019. Last meeting was in Sept 2018. "Black Soil" defined as Organic (peat) soils or soils with dark coloured surface horizon >25 cm thick with >1.2% SOC in temperate/cold regions and >0.6% C in tropics, high base saturation. Doing a global black soil map.

3. *Soil Pollution*: following on from the Soil Pollution Symposium in 2018. Global assessment and monitoring guidelines are under development with expert group, to be submitted at next GSP Plenary. Global survey, via national focal points, is being undertaken, 72 responses so far.
4. *Soil Erosion*: Global Symposium held 15, 16, 17 May 2019 at FAO headquarters in Rome. 560 people from 104 countries. 95 oral papers and 31 posters. One day of workshops/discussion related to the working documents. 46% of participants women, but under-represented as presenters. 44% from EU., 2 % from SW Pacific. Much ITPS and working group work will be undertaken to follow up on this conference.
5. *Soil Biodiversity*: Global Soil Biodiversity Symposium to be held in early 2020 - about March - date to be confirmed. This will lead into Global biodiversity meeting in China in Oct 2020 which marks the end of International decade on biodiversity. ITPS members are leading preparation of report on status of soil biodiversity for presentation at the March 2020 global symposium on soil biodiversity. It will be presented in March as a working document, updated afterwards to be finalised by the October meeting.

Links with Global Convention on Biodiversity. Opportunity to focus not only on what has been lost but also on potential benefits from better understanding of soil biodiversity.

6. *Code of conduct for sustainable use and management of fertilisers*. Has undergone a number of reviews. Pressure from interest groups. Is to be presented for final approval at the 7<sup>th</sup> GSP Plenary in June 2019. GSP Secretariat are seeking suggestions on how to best distribute and implement it. The final version will be available on-line shortly. Planned to be updated every 5-10 years.
7. *Relationship of work to the GSP (Global Soil Partnership) Pillars*  
Lots of the work described above is related to several pillars. Here I briefly mention other activities that were not included above, in relation to the Pillars under which they fall.

**Pillar 1: Sustainable soil management.** A guideline for assessment of sustainable soil management, based around the "11 Characteristics of a sustainable managed soil" identified in the Voluntary Guidelines on Sustainable Soil Management (FAO, 2017), has had a major review and re-write and will be presented to the GSP Plenary in June. Gary Pierzynski has taken on the role of ITPS chair of Pillar 1.

**Pillar 2: Education and public awareness raising.** World Soil Day on 5<sup>th</sup> December continues to be promoted - over 300 events registered with FAO in 2018. Theme for World Soils day 2019 will be that of the Global Symposium on Soil Erosion: ie Stop soil erosion and save our future.

Soil Doctors programme - a bottom-up initiative to train locals to undertake simple soil measurements and introduce practices to improve sustainable soil management, and then incentivise the trainers to train others, and so gain exponential growth, is being developed.

SoiLEX, a database of global soil-related policy and legislation is under development - FAOLEX, a side ranging data-base of legislation that is of interest to FAO food and agriculture work already exists. The SoiLEX initiative will further develop the soil related information available, particularly as a result of follow-up work after the Global Symposium on Soil Erosion.

Some on-line education resources/Mooches are planned. The online educational platform that the GSP is developing is called EduSoil. For this, we need of lecturers. If you are interested in contributing with one or more MOOCs to EduSoil please contact [megan.balks@earthbrooke.co.nz](mailto:megan.balks@earthbrooke.co.nz) in the first instance.

**Pillar 3: Research:** Looking for funding - suggestions welcome. Main activity = ResSoil platform - which is a place to register current soil research projects so that you and others can see who is working on what to better enable communication and data sharing and avoid replication of effort. ITPS chair = Nsalambi Nkongolo.

**Pillar 4: Data and Information - incl mapping.** Currently a lot of work on Soil organic C and salinity. Work underway on soil sampling and sample treatment manual. GLOSIS = global soil info system. Includes GSP, ITPS, INSII (international network of soil information institutions), SDF = soil data facility of ISRIC ends in 2020.

Global Soil Carbon map was developed with “bottom-up” approach by co-ordinating inputs from each country. Constraints with countries with no data or that are unco-operative. Still being regularly updated. > 70 countries have own SOC maps.

Want to follow this model for further planned maps including: Soil carbon sequestration potential (by Dec 5 2020) - initially top-down model based - not asking countries for new info. , soil erosion, soil salinity (by end of 2019). Soil biodiversity map to be built off soil C map.

Soilstat = statistics component of GLOSIS. Will connect with FAOstat - concept note being prepared. Tool for global soil monitoring. Want harmonised indicators. 2019/20 = Changes in Soil OM, Soil erosion  $\text{Tha}^{-1}$  , soil salinization. 2020 - soil carbon sequestration, soil sealing, soil pollution. 2022-4 - soil compaction, change in soil biodiversity, soil pH (acidification).

Want a validation campaign for Global SOC map. Planning paper submission to Nature communications. ITPS chair is Constanza Cazolari.

**Pillar 5: Harmonisation** - ie trying to get global agreement on common methods etc so that data can be readily swapped between different areas/organisations...

Glosolan = Global network of soil laboratories is progressing well. Resolan (Regional networks for soil laboratories) are established for Asia and South America. Resolan Africa to be launched in May 2019. Pacific launch planned for 2019. Standard operating procedures are planned - limits to resources available so planning to do about 1 method or group of methods/yr. Want to also build strength in labs for fertiliser quality assessments and plant analysis as well as soil. Progress is slow due to limited resources. Should you be able to help by contributing to writing technical documents or training contact [Lucrezia.caon@fao.org](mailto:Lucrezia.caon@fao.org).

8. *Further comments related to ITPS*

ITPS has role to help ensure direction and defensible science in face of pressures from “interest” groups.

FAO is keen that ITPS undertake more publication in peer-reviewed science literature, to complement FAO publications.

There is agreement for co-operation between ITPS and SPI-UNCCD (Science policy interface of the UN convention to combat desertification. UNCCD next meet in India in Sept 2019. Want to improve co-operation between working groups in SPI-UNCCD and ITPS.

Regional soil partnerships are essential for getting information implemented at “ground level”.

## Global Symposium on Soil Erosion 15-17 May 2019 at FAO headquarters in Rome: some personal observations.

Report by Megan Balks contact: [megan.balks@earthbrooke.co.nz](mailto:megan.balks@earthbrooke.co.nz)

This is a report based on my experience at the conference- note there were 5 parallel sessions for much of the conference and I could attend only Theme 2: Policy and practices plus plenary sessions. Thus it is limited in scope. Details are available in the working document at <http://www.fao.org/3/ca4394en/ca4394en.pdf>

Attended by 560 people from 104 countries. 95 oral papers and 31 posters. One day of workshops/discussion related to the working documents. 46% of participants women but under-represented as presenters. 44% of participants from EU., 2 % from SW Pacific. Africa, Asia and Americas all represented. Much ITPS and working group work will be undertaken to follow up on this conference.

Key points of the conference included:

- **Global problem - local solutions - no one size fits all** - has to be local input into choice of suitable practices and implementation.
- **“If you want to stop soil erosion and save our future talk to farmers”** (Alfred Grand). Actions have to be taken by people on the ground at local levels.... It is critical that scientists and policy makers understand the realities for farmers, appreciate their concerns, and utilise the local knowledge of farmers.
- **Many well established, effective methods** to prevent, remediate, or mitigate soil erosion - **implementation is the issue**
- **Few big runoff events produce >50% of soil loss.** Need to design practices for these intense events

- **Low cost changes that give quick returns for farmers will be the most effective** in terms of uptake - Policy makers need to be aware of this.
- **Good News** - lots of examples of policies and laws that are in place and are making a difference
- **Top down or bottom up?** Need both

Catchment or farm scale? Need both

Theme 1. Soil erosion assessment tools and data; creation, consolidation, and harmonisation.

Much work is being undertaken to define parameters for, and produce an improved global soil erosion map. Work remains to further refine methods and specifications and to encourage national scale mapping.

Theme 2. Soil policy and practices.

There are a wide range of well understood practices to avoid, remedy or mitigate soil erosion. Practices need to be tailored to local conditions. There are good examples of policies, both using incentives such as subsidies, and using regulation with enforcement backed by fines, that are giving reduced soil erosion. The challenge is to get policies implemented in regions and countries that currently lack appropriate measures to prevent, remediate, or mitigate effects of, soil erosion. Going forward the plan is to collate information on erosion prevention practices, and to Investigate working with WOCAT <https://www.wocat.net/en/> to use existing information and build on/contribute to existing database. Improved data on policy and legislation that supports erosion prevention is to be collated in a data base that builds on the system developed in FAOLEX <http://www.fao.org/faolex/en/> database. Data gathered will be analysed and interpreted to identify gaps and translated into action through publications and promotion of access to information and via both top-down and bottom-up approaches. Top down to include policy briefs, policy development guidance/information papers for government officials. Bottom up approaches to include participatory programmes to assist local action.

Theme 3. Economics of soil erosion prevention, management, and remediation.

Key points to emerge from theme three included: economic costs are difficult to simulate with precision due to complexity and number of variables. Effects of erosion may be masked by fertiliser use. A certification or eco-label approach needs to be scientifically robust, comprehensive, and assessed by a 3rd party.

Most effective systems will have a combination of incentives and penalties. Some tools already exist.

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## Soil biodiversity - opportunity to be involved in a global initiative

The Global Soil Biodiversity Initiative is an organization that seeks to promote policy and research to support soil biodiversity globally. We are currently updating our contact list. We are in the process of trying to make it more representative of soil biodiversity scientists across the globe. As such, we would appreciate it if you would share this invitation with the members of the New Zealand Society of Soil Science.



GLOBAL  
SOIL BIODIVERSITY  
INITIATIVE

Global Soil Biodiversity Initiative - Secretariat Office  
School of Global Environmental Sustainability  
108 Johnson Hall  
Colorado State University  
Fort Collins, CO 80523-1036  
USA

August 20, 2019

Dear Member of the New Zealand Society of Soil Science,

The Global Soil Biodiversity Initiative is an organization that seeks to promote policy and research to support soil biodiversity globally. We are currently updating our contact list. We are in the process of trying to make it more representative of soil biodiversity scientists across the globe. As such, we are interested in connecting with you.

If you are interested in connecting with the Global Soil Biodiversity Initiative, please visit our website to register (<https://www.globalsoilbiodiversity.org/join>).

We look forward to connecting with you!

Regards,  
Diana and Carl

Thank you and best wishes,

*Diana H Wall*

Diana H. Wall  
Professor and Science Chair  
Global Soil Biodiversity Initiative

University Distinguished Professor  
Director, School of Global Environmental Sustainability  
Colorado State University

*Carl Wepking*

Carl Wepking  
Executive Director  
Global Soil Biodiversity Initiative

[www.globalsoilbiodiversity.org](https://www.globalsoilbiodiversity.org)



For more information on the Global Soil Biodiversity Initiative, please visit our website (<https://www.globalsoilbiodiversity.org/>).

## Abstracts

Automated soil core scanner for soil organic carbon stock estimations in New Zealand hill country

Matteo Poggio, Michael Blaschek, Pierre Roudier and Carolyn Hedley  
Manaaki Whenua - Landcare Research, Palmerston North, New Zealand

Estimation of soil organic carbon (SOC) stocks is fundamental to monitoring the processes of carbon sequestration or loss. Conventional methods are very time consuming and costly. Therefore, we contributed to the development of an automated soil core scanning platform (SCANS) to improve the rate of acquisition of soil data. This multi-sensing platform combines a visible near-infrared (VisNIR) spectrometer, a  $\gamma$ -ray densitometer and a charged coupled device (CCD) camera and allows high resolution scanning of an intact core at field condition without preprocessing.

141 soil cores, from 48 locations across New Zealand, were collected to test the SCANS platform. Entire soil cores were extracted to 60 cm depth and scanned at 2.5 cm increment from 0 to 30 cm depth and 5 cm increment from 30 to 60 cm depth. The cores were analyzed for bulk density and SOC to develop calibration models for SOC stocks. Partial Least Square (PLS) regression was used to predict volumetric water content and SOC percentage from the spectra. The  $\gamma$ -ray attenuation data and volumetric water content estimations were implemented into Beer's law equation for bulk density predictions. Finally, SOC stocks were computed from the bulk density and organic carbon estimations. The results indicate accurate prediction models for bulk density with root mean squared error (RMSE) of 0.13 g/cm<sup>3</sup> and R<sup>2</sup> of 0.8, a satisfactory level of accuracy for volumetric water content and SOC with RMSE of 0.06 cm<sup>3</sup>/cm<sup>3</sup> and 1.29%, and R<sup>2</sup> of 0.72 and 0.7, respectively. Accurate estimations of SOC stocks computed from the bulk density and SOC predictions from SCANS fused data were achieved with RMSE equal to 0.09 t C/Mm<sup>3</sup> and R<sup>2</sup> equal to 0.76.

Our results are important for improving New Zealand's understanding and verification of total SOC stocks and sequestration rates and for encouraging the adoption of these rapid and cost-effective techniques as an enhancement of standard laboratory analysis.

*Proceedings of the 5th Global Workshop on Proximal Soil Sensing. Columbia, Missouri, USA.*

### **Automated soil core scanning for high resolution carbon analysis down a soil profile: full inversion tillage case study**

Matteo Poggio, Roberto Calvelo Pereira, Michael Blaschek, Carolyn Hedley, Mike Hedley, Mike Beare, Sam McNally  
Manaaki Whenua - Landcare Research, Palmerston North, New Zealand

Continuous pasture soils develop a high degree of soil organic carbon (SOC) stratification, which concentrates SOC sequestration near the soil surface. Where strong vertical stratification of SOC can be identified, pasture renewal with full inversion tillage (FIT) through deep ploughing has the potential to accelerate C sequestration by creating a deeper topsoil. For example, recent studies suggest that transferring C-rich topsoil to the subsoil and unsaturated subsoil to the new pasture root zone increases the SOC pool. An increased number of soil profile samples are required to identify the degree of SOC stratification and the feasibility of pasture renewal with FIT. For agricultural contractors to act in a timely manner, soil sampling and C analysis needs to be rapid. For this purpose, we have investigated the use of an automated multi-sensing platform to scan intact cores at field conditions at high depth interval resolution. The sensing platform combines a visible near-infrared (VisNIR) spectrophotometer, a  $\gamma$ -ray densitometer and a charged coupled device (CCD) camera using a method designed and developed by researchers from CSIRO, Australia with our contribution. The sensor platform allows simultaneous determination of several soil properties: the  $\gamma$ -ray densitometer provides estimations of



bulk density and the VisNIR spectrophotometer can predict soil properties such as organic carbon, clay content and pH.

To evaluate the platforms efficiency in estimating SOC stratification, we scanned 81 soil cores, collected from 2 trial sites, where the effects of different tillage practices were being evaluated. Entire soil cores were extracted to 40 or 60 cm depth and analysed at 1.6 cm increment from 0 to 30 cm depth, 2.5 cm increment from 30 to 40 cm and 5 cm increment from 40 to 60 cm. Spectral and  $\gamma$ -ray attenuation data were simultaneously recorded for each scan depth. Following spectral data collection, the cores were cut into 5 cm increments between 0-30 cm, 10 cm increments for 30-40 cm depth and 20 cm increment for 40-60 cm depth and analysed for bulk density and SOC to develop calibration models for SOC stocks. Spectra were transformed into absorbance values. First order derivative of the spectra was calculated from Savitzky-Golay algorithms. Approximately half of the dataset generated was randomly selected and used as a model calibration. We used Partial Least Square (PLS) regression to predict volumetric water content and percentage of organic carbon from the spectra,  $\gamma$ -rays attenuation data and volumetric water content estimation were implemented into Beer's law equation for bulk density prediction. Finally soil carbon stocks were computed from the bulk density and organic carbon estimations. Preliminary results on a dataset portion indicate accurate prediction models for bulk density with root mean squared error (RMSE) of 0.12 g/cm<sup>3</sup> and R<sup>2</sup> = 0.74, satisfactory level of accuracy for volumetric water content and SOC with RMSE equal to 0.05 cm<sup>3</sup>/cm<sup>3</sup> and 1.58%, and R<sup>2</sup> equal to 0.46 and 0.71, respectively. Some degradation in the estimation accuracy, indication of error propagation, is reported for SOC stocks, with RMSE equal to 1.56 Mg/m<sup>3</sup> and R<sup>2</sup> equal to 0.49.

Our results advance the development of proximal sensing techniques to rapidly estimate soil carbon content and stratification with the depth resolution required to identify the feasibility of pasture renewal with FIT to enhance soil carbon storage.

*Proceedings of the 13th Pedometrics conference, June 2-6, 2019, University of Guelph, Guelph, Ontario. <https://www.cvent.com/events/pedometrics-2019/event-summary-81b34052775a43fcb6616a3f6740accd.aspx>*

### **Mapping of soil available water-holding capacity in New Zealand using visible near-infrared reflectance spectra and environmental covariates**

Michael Blaschek, Pierre Roudier, Matteo Poggio, Carolyn Hedley  
Manaaki Whenua - Landcare Research, Palmerston North, New Zealand

The sustainable management of agricultural land requires reliable information about soil physical properties. Among these properties, available water-holding capacity (AWC) is a key attribute, as it quantifies the amount of water available for plants that the soil can hold. Since direct measurements are costly, pedotransfer functions (PTF) are often used to estimate AWC, leveraging statistical relationships with properties that are easier to measure, such as texture, bulk density, and organic carbon content. This study evaluates visible near-infrared spectroscopy (Vis-NIR) as an alternative to PTF to predict volumetric water content at field capacity (FC) and permanent wilting point (PWP) AWC being the difference between PWP and FC. It also examines whether AWC estimates can be used as input data for national scale digital soil mapping projects.

A suite of 970 Vis-NIR soil spectra, recorded from air-dried, 2-mm, sieved soil samples, were associated with FC and PWP analytical data obtained from New Zealand's National Soils Database. Partial least squares (PLS) regression and support vector

machines on PLS latent variables (PLS-SVM) were used for spectroscopic modelling. Final estimates showed promising results with regards to FC with a root mean squared error (RMSE) below 6%, while slightly more accurate predictions were found for PWP with an RMSE below 4%.

The successful direct spectral prediction model for AWC was subsequently used to generate an interpolation set for producing a new generation of high-resolution maps of AWC for entire New Zealand. Preliminary results indicate that a random forest model built from a comprehensive set of environmental covariates derived from satellite imagery and terrain analysis provides a more accurate estimate of the spatial distribution of AWC at pre-defined depth intervals than the official products currently available for New Zealand.

*Proceedings of the 13th Pedometrics conference, June 2-6, 2019, University of Guelph, Guelph, Ontario. <https://www.cvent.com/events/pedometrics-2019/event-summary-81b34052775a43fcb6616a3f6740accd.aspx>*

### **Efforts towards a national scale, fine resolution grid of soil pH for New Zealand**

Pierre Roudier, Anne-Gaelle Ausseil, James McCarthy, Nathan Odgers, Sarah Richardson  
Manaaki Whenua - Landcare Research, Palmerston North, New Zealand

Soil pH has always been an attribute of interest for soil scientists --- but this is also the case outside soil science. pH is a major input variable for crop suitability rules, for soil ecosystem services modelling exercises, and it has been widely used as an explanatory variable for species distribution models in ecology.

Despite the importance of this attribute across scientific disciplines, soil pH information (as a map) is not easy to source in New Zealand, particularly at the national scale. The main nation-wide map of soil pH for New Zealand is one of the New Zealand Fundamental Soil (FSL) layers, generated by pedologists more than 30 years ago, and based on their best guess of the most likely pH value for the whole profile, for every polygon of the New Zealand Land Resource Inventory (NZLRI) polygon. It is widely regarded by NZ soil scientists as a qualitative, outdated resource.

The digital soil mapping (DSM) framework offers an opportunity to update and improve this map. DSM is building quantitative, statistical relationships between points observations of soil attributes, and a suite of environmental covariates (often derived from remote sensing). As a result, continuous grids of soil attributes can be generated. A nice addition is that uncertainty of the estimates can also be mapped.

This paper reports on the efforts towards the creation of a soil pH grid at the national scale and at a fine spatial resolution (100 m). Several thousands of soil pH observations were collated, along with a suite of climatic, topographic, geologic environmental layers. As a result, several spatial layers were created for different depth intervals (0-5 cm, 5-10 cm, 10-30 cm, 30-60 cm, 60-100 cm), according to the GlobalSoilMap specifications. The accuracy of the resulting maps was assessed against both the reference soil profile measurements, the FSL map, and ISRIC's SoilGrids.

*Proceedings of the 13th Pedometrics conference, June 2-6, 2019, University of Guelph, Guelph, Ontario. <https://www.cvent.com/events/pedometrics-2019/event-summary-81b34052775a43fcb6616a3f6740accd.aspx>*

## Mapping functional soil properties of the McMurdo dry valleys, Antarctica

Pierre Roudier, Fraser Morgan

Manaaki Whenua - Landcare Research, Palmerston North, New Zealand

Antarctica is the most arid continent in the world. A range of extreme environmental conditions combine to create a harsh, cold desert environment: extremely low and fluctuating temperatures, very little water in an accessible form, and high salinity. While most of the continent is covered in snow and ice year round, a small proportion of Antarctica (representing about 50,000 km<sup>2</sup>) is permanently ice-free.

Despite the extreme environmental conditions encountered in these ice-free areas, soils have developed there, and do harbour life. A range of organisms (viruses, bacteria, but also larger animals like nematodes or collembollas) are distributed throughout soils of the region. Long thought sterile, the application of new molecular techniques showed that these soils present a surprisingly high and unique biodiversity. The trophic simplicity of these ecosystems also provides scientists with an excellent opportunity to track climate change, as microorganisms living in these environments present a consistent and rapid response to increasing temperatures.

The McMurdo Dry Valleys system is the largest ice-free region in Antarctica, covering about 6900 km<sup>2</sup>. It is a designated Antarctic Specially Managed Area (ASMA), and home to the Onyx River, the largest and longest river in Antarctica. Soils in the McMurdo Dry Valleys are predominantly developed in glacial drift, colluvium, alluvium, or re-worked aeolian deposits.

While microbiologists face a wide range of questions concerning the biodiversity of the terrestrial systems in these valleys, a major hurdle is the sparse coverage of soil information. The spatial distribution of these microbiological communities has been shown to be strongly influenced by soil attributes such as water content, salinity, organic carbon, and pH. But while pedological maps have been published for various ice-free regions across the continent, the spatial distribution of those soil attributes themselves is largely unknown.

Antarctic research is very costly: considering the operational costs, it is important not only to make the most of the existing legacy data, but also to maximise the amount of data collected in the Dry Valleys each season. The use of digital soil mapping (DSM) has been tested to address this lack of soil attributes information: local soil observations can be combined with a range of spatial layers reflecting different factors of soil formation using a machine learning model, in order to predict the spatial distribution of soil attributes measured at those locations.

In this project, we are collating and harmonising data from different soil surveys in order to investigate the spatial distribution of pH, one of the soil properties that are critical for understanding the distribution of life in Antarctic soils. Since other parameters of interest are also measured, this opens an opportunity to extend this soil information system to other important soil properties for the region, such as electrical conductivity, or organic carbon content.

The application of those digital soil mapping techniques can (i) be a tool to understand and predict where microbial habitats occur, and (ii) has the potential to generate base layers for researchers outside the soil science community (in particular the fields of microbiology and climate change).

## A biogeochemical view of the World Reference Base Soil Classification System

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The most fundamental processes determining the properties of a soil involve the exchange of protons and electrons at a specific time over its evolutionary trend. This justifies the use of the Eh-pH diagram (known as Pourbaix diagram) as a framework for defining soil biogeochemical trends, as proposed by Chesworth. Both geogenic and biogenic material undergo modifications (i.e., mineral weathering and breakdown of organic molecules, respectively) with (i) predominance of hydrolytic and/or redox reactions, and (ii) decrease in size and reactivity. Oxidation of organic matter generates a flux of electrons that tend to be neutralised by the oxidants present in the system, and a flux of protons that contribute to the acidification of the weathering system and associated pedogenesis. In turn, through mineral weathering, alkalinity is released and soil pH is buffered. Based on the amount of rainfall and drainage conditions under which a soil evolves, the weathering of most parent materials can follow different evolutionary pathways: (i) the acid trend, (ii) the alkaline trend, and (iii) the reduced trend, with (iv) circum-neutral soils being those that are either at incipient stages of development under an acidifying trend or in poorly leaching environments. Mineral transformation (i.e., formation of vermiculite from mica) and neoformation (i.e., through allitization, mono-siallitization or bi-siallitization) are common in most soils, with trends in mineral neoformation being influenced by solution Si/Al ratio, pH, activity of alkaline earth and alkali metal ions, and residence time of the soil solution. The balance between cations released and protons produced controls the CEC and soil reaction, which in turn, (i) establishes the biogeochemical trend that the soil evolves to, and (ii) controls the thermodynamic stability of primary minerals and the composition of neoformed minerals. Under very specific conditions in the acid, reduced, and alkaline evolutionary pathways, there is no mineral neoformation (the E horizons of Podzols, Planosols, and solodized Solods, respectively) because all minerals are unstable, favoring the dissolution of Al and Si, and hindering the neoformation of silicates. In this paper, based on the framework provided by Chesworth, we use the Pourbaix diagram to describe the genesis and biogeochemical conditions of the different Reference Soil Groups of the World Reference Base for Soil Resources.

*Macias, F., and M. Camps-Arbestain. Advances in Agronomy. In press.*

## Experimental and theoretical aspects of biochar-supported nanoscale zero-valent iron activating H<sub>2</sub>O<sub>2</sub> for ciprofloxacin removal from aqueous solution

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Ciprofloxacin has been frequently detected in water environment, and its removal has become a significant public concern. Biochar-supported nanoscale zero-valent iron (BC/nZVI) to activate hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) has many advantages on promoting the removal of organic contaminants. In this paper, the BC/nZVI activating H<sub>2</sub>O<sub>2</sub> degradation of ciprofloxacin was systematically investigated by experimental and theoretical approaches. The morphologies and property analysis showed that nZVI particles distributed uniformly on the biochar surface, which mainly include -OH, > C=O and C-O-C and C-O groups. Different reaction conditions were compared to define the optimal conditions for ciprofloxacin removal in BC/nZVI/H<sub>2</sub>O<sub>2</sub> system. More than 70% of ciprofloxacin was removed in the optimal conditions: acidic condition (pH 3~4), low doses of H<sub>2</sub>O<sub>2</sub> (20 mM), and temperature of 298 K. The hydroxyl radical (•OH) oxidation was the primary pathway in BC/nZVI/H<sub>2</sub>O<sub>2</sub> degradation of ciprofloxacin process. The theoretical calculation indicated that hydrogen atom abstraction (HAA) pathways were the dominant oxidation pathways contributing 92.3% in overall second-order rate constants (k) of •OH and ciprofloxacin. The current results are valuable to evaluate the application of BC/nZVI activating H<sub>2</sub>O<sub>2</sub> degradation of ciprofloxacin and other fluoroquinolone antibiotics in water treatment plants.

Mao Q, Zhou Y, Yang Y, Zhang J, Liang L, Wang H, Luo S, Luo L, Jeyakumar P, Ok YS, Rizwan M(2019). Experimental and theoretical aspects of biochar-supported nanoscale zero-valent iron activating H<sub>2</sub>O<sub>2</sub> for ciprofloxacin removal from aqueous solution. *Journal of Hazardous Materials*. 380, <https://doi.org/10.1016/j.jhazmat.2019.120848>.

## Conferences and Training

### New Zealand Trace Element Group (NZTEG)

The conference is scheduled to be held **Monday 10 February - Tuesday 11 February 2020**, with an *optional* workshop to be held on **Wednesday 12 February 2020**. The event will be held at the Avantidrome in Cambridge, NZ.

We have recently updated the group website ([www.tracenz.org.nz](http://www.tracenz.org.nz)) and all documents for registration and abstract submission are now live. Please see the dates below as a reminder:

Abstract submission opens: **June 3rd, 2019**

Early bird registration opens: **June 3rd, 2019**

Abstract submission closes: **November 29th, 2019**

Early bird registration closes: **December 13th, 2019**

Registration fees will be as follows:

Full Registration:	Working:	Before 13 Dec	After 13 Dec
	Student:	\$300	\$350
One Day Registration:	Working:	\$175	\$225
	Student:	\$50	\$75

We have agreed on a panel discussion for the workshop (Feb 12th). It

would be great to hear from those interested in attending the workshop what topics you would like to see covered. This will enable us to find suitable panel members to cross all areas of interest. Suggestions can be sent to Amanda French ([Amanda@trace.org.nz](mailto:Amanda@trace.org.nz)).

Kind regards,  
Amanda French  
*On behalf of the NZTEG 2020 organizing committee*

## Wai-BoP Soils 2019



**Abstracts for invited speakers for NZSSS one-day conference: Friday 29  
November, 2019,  
University of Waikato, Hamilton**

### Developing a periodic table for Earth scientists

Peter Hodder - keynote speaker

The development of Mendeleev's Periodic Table has been likened to that of a 'quest', one of seven types of fictional story proposed by Christopher Booker. Although the stages of these fictional stories have been more recently interpreted by Matthew Jockers as trends in emotions, in true-life stories it is generally necessary to have proxies for the stages of fictional tales and the roles of actors. These may be deduced from analysis of correspondence and historic events or - most recently - through using citation analysis. This paper extends and applies these ideas to the 'story' of the development of Bruce Railsback's Periodic Table for Earth Scientists, suggesting that those whose work Railsback cites should be considered 'companions' in the quest, while those who cite his work can be considered 'helpers'. Railsback has been fortunate in that thus far there has been little opposition to his proposed table, i.e., there are no 'monsters'. However, there may yet be 'final ordeals' to overcome, perhaps because of the encyclopedic nature of the data portrayed. The potential usefulness of Railsback's table is its recognition of the importance of ions rather than elements to geological processes. This has its origins in ionic potential (the ratio of ionic charge to ionic radius) proposed decades ago by Viktor Goldschmidt and Groves Cartledge, and models of how ions are incorporated into the crystal lattices of minerals as initially suggested by Naoki Onuma and subsequently

developed more quantitatively. The paper ends by suggesting an alternative form of the Periodic Table for Earth Scientists that allows an element to be included more than once - as ions - and uses ionic charge and radius as variables, rather than the atomic number of elements as used in traditional forms of the Periodic Table.

## **A biogeochemical view of major soil orders/groups**

Marta Camps - N.H. Taylor Memorial Lecturer

Soils are extraordinarily heterogeneous natural bodies, with an internal organization, components, and properties that vary in time and space in response to complex interactions with the environment. The revised World Soil Charter endorsed by FAO (FAO, 2015) recognizes that “soils are fundamental to life on Earth but human pressures on soil resources are reaching critical limits. Careful soil management is one essential element of sustainable agriculture and also provides a valuable lever for climate regulation and a pathway for safeguarding ecosystem services and biodiversity”. A framework based on the Eh-pH diagram with the three soil evolutionary trends (acid, alkaline, reduced), represents a valuable tool to understand the genesis and biogeochemical conditions of the different soil groups/orders of soil classification systems, as needed to achieve a holistic understanding of soils so that we can optimize sustainable soil management.

## **Eurosoil 2020 - 20th anniversary of the European Confederation of Soil Science Societies**

Eurosoil 2020 will take place in Geneva (Switzerland) in 24-28 August 2020. As the conference of the European Confederation of Soil Science Societies (ECSSS), Eurosoil is the soil voice of Europe. Eurosoil 2020 aims at tackling among others the environmental, social, economic and public policy goals related to / impacting soil use and services. In line with the Eurosoil2020 theme “Connecting People and Soil”, the conference program will be structured around selected Sustainable Development Goals (SDGs) of the United Nations.

<https://eurosoil2020.com/>

## **INI2020: 8<sup>th</sup> Global Nitrogen Conference**

The conference will take place on 3-7 May 2020 in Berlin, Germany. The 8th Global Nitrogen Conference of the International Nitrogen Initiative will follow on from the previous conferences held since 1998. This time, the overall framework will be “Nitrogen and the UN Sustainable Development Goals (SDG)”. Most of the SDGs are closely interlinked with the nitrogen cycle. Sustainable nitrogen management is therefore a key element in tackling environmental and societal issues on a global scale.

<https://ini2020.com/>

## **24th International Clean Air & Environment Conference**

The theme 'Air Quality and the Built Environment', addresses all aspects of air quality, including regulation, emerging technologies, environmental challenges in urban environments, health impacts and the growing social awareness of air quality as an everyday concern.

16-18 September / Queenstown

<https://www.casanz2019.com/>

## **Climate Change Mitigation and Adaptation: Assessing the Impacts**

The two-day conference takes a wide view of the potential impacts of climate change adaptation and mitigation in New Zealand and the Pacific.

27-28 November / Auckland

<https://www.nzaia.org.nz/2019-climate-change.html>



WORKSHOP ON

# Hyperspectral and Thermal Remote Sensing

---FROM DATA TO APPLICATIONS---

Topics: Geothermal, volcanoes, minerals, soils and natural hazards

1 OCTOBER 2019 | 10 AM - 4 PM  
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Free registration by email to Gabor Kereszturi  
(G.Kereszturi@massey.ac.nz)

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## Our land in a changing climate: impacts and implications

**James Renwick introduced by Anita Wreford**

Attend a thought-provoking discussion with New Zealand's leading climate researchers as they explore land-based challenges around climate change.

In a week of action, and following the release of the IPCC report on Climate and Land, there has never been a better time to hear from the experts.

This free event is open to the public and will be followed by refreshments.

**25 September 2019**

**5.30-6.30pm**

**Stewart Building, Lincoln University**

For more information, contact [sue.jarvis@lincoln.ac.nz](mailto:sue.jarvis@lincoln.ac.nz)

Pre-register on Eventbrite



## Opportunities

### Principal Scientist

The Ministry for the Environment has an opening for a Principal Scientist.

Closing date: 3 September

<https://careers.mfe.govt.nz/jobs/Wellington/MFE-1415280>

Deadline..... For the November issue of Soil News is 19/11/2019

### We are the New Zealand Soil News:

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