

The Theia "Digital Soil Mapping" Scientific Expertise Centre of France

Anne C Richer-De-Forges, Philippe Lagacherie, Dominique Arrouays, Anne Bialkowski, Hocine Bourennane, Xavier Briottet, Youssef Fouad, Cécile Gomez, Stéphane Jacquemoud, Blandine Lemercier, et al.

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ΠΕΔΟΜΕΤΡΟΝ

Newsletter of the Pedometrics Commission of the IUSS Issue 46, October 2022

From the Chair

Dear colleagues,

Welcome to the 46th issue of Pedometron. It as been a while since the 45th issue of Pedometron was released in early 2020. Many of us were impacted by COVID and most conferences and activities were canceled. I am glad to say that this is now over and that the Pedometron is back to report on the many updates on scientific advances and upcoming (pedometrics) events!

This issue is also the first for me as Chair. I thank Titia Mulder and Nicolas Saby for keeping the pedometrics community alive during these past 4 years. It is now my turn to organize the various upcoming events and activities, the Pedometron being only one of them. For these tasks Simone Priori will help me as vice Chair. We also welcome Lei Zhang as our new guest Editor. Lei will gather the contributions for the Pedometron and edit them. You may receive a few emails from him in the coming months.

In this issue we prepared for you the regular items, including a comic, poetry and the Pedomathemagica. An important contribution is from Budiman Minasny, who got awarded the Richard Webster Medal. He relates on his career history and his journey into pedometrics. Another important contribution is from Dick Brus, who is publishing a book on spatial sampling. No doubt that this book is of interest to pedometricians.

Finally, I would like to invite you to attend the next digital soil mapping and Global Soil Map workshop in Orléans, France. In February 2023, we will have many discussions on soil mapping and I hope to connect with you after all this time without conference.

All the best,
Alexandre Wadoux

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Delivered by

Chair
Alexandre Wadoux
Vice-chair
Simone Priori
Editor
Lei Zhang

The Webster Medal

Budiman Minasny was awarded in 2022 with the Richard Webster medal from the Pedometrics Commission of the International Union of Soil Science. He shares with us on his career history.



The Webster Medal

By Budiman Minasny

It is a great honour to receive the Richard Webster medal. And now, our chair Alexandre Wadoux asked me to write about my story. It seems that I had just read previous awardees' stories a few months ago!

The beginning of my pedometrics could be described as a coincidence, but a path that I love and brought me in contact with pedometricians worldwide.

My journey in soil science started around 1992 when I was studying at Universitas Sumatera Utara in Indonesia for my Bachelor in Agriculture degree. We have to choose a specialisation at the end of year 3. Soil Science is always special as the topics and lecturers always interesting. I like quantitative methods, but I cannot say I am a maths or statistics specialist.

Moving forward in 1995, I was doing my Masters degree at the University of Sydney. I remembered vividly Alex McBratney taught the basics of kriging, and I was reading Richard Webster's book and working out the matrix calculation. But my research was about solute transport in soils.

I continued my PhD in 1997 with Alex, and my initial thesis topic was on inverse modelling of soil water flow for estimating soil hydraulic properties. In the research, I was trying to estimate soil hydraulic properties from the measurement of water infiltration from a disc infiltrometer. We have a mechanistic model that describes water flow based on Richardson's equation that takes soil hydraulic properties as inputs. The inverse model is a backward calculation; we can easily measure water flow, we have a process-based model, and we need to figure out the input variables (hydraulic properties). This involves optimisation. At that time, I was programming the algorithms in Fortran, and this skill became useful for practical application. The Australian Centre for Precision Agriculture needed software to process "big data", the yield data that came out of a harvester. Conventional kriging would smooth out much of the local variation. So I programmed the kriging with local variograms in Fortran, using part of Alex's block kriging codes. I made the variogram calculation more efficient and automated the variogram model fitting using Marquardt's nonlinear least squares algorithm. I presented in at the Pedometrics conference in 1999, and it won the best poster presentation. It is still the best local kriging program. And I met Dick Webster for the first time and that was the beginning of my pedometrics journey.

The Webster Medal



In the field in 1999.

During my PhD studies, I studied various numerical methods and found them helpful addressing pedometrics problems. Nowadays it is much easier as many "packages" are available in R, but this also means that we rely on the packages doing the job correctly. I still believe understanding the methods can solve the problem, not the packages. Maybe I am getting too old fashioned.

After finishing my PhD in estimating soil hydraulic properties (and still working on it with my colleagues), my research focuses more on Pedometrics. My first overseas conference was Pedometrics 2001 in Ghent where I presented my work on soil-landscape modelling and Fuzme, the program that does various forms of fuzzy clustering analysis. In 2000, I was awarded the University Sesquicentenary fellow (I was not that old) on soil-landscape modelling.

Subsequently, I joined Alex in the Digital Soil Mapping research. Many of the algorithms I developed are based on what I encountered during my PhD research. For example, the conditioned Latin hypercube sampling (LHS) algorithm came out of my PhD research on analysing the uncertainty of pedotransfer functions and to devise a method for spatial LHS.

I participated in the GlobalSoilMap project with colleagues around the world. With the GlobalSoilMap project as a focus, I was awarded the Queen Elizabeth II fellowship by the Australian Research Council. So I have a connection with the Queen! I can still remember the excitement of the idea of having a "Google Earth" system for soil maps of the world. And now it is common, and any data scientists can do the maps, so the task for pedometrician is to incorporate soil knowledge and understand the soils that were mapped.



With Mike Grundy at the GlobalSoilMap oceania meeting in Bogor, 2011.

As an academic, it brings privilege to work and collaborate with researchers worldwide. Soil mapping from the field to the globe got me in contact with many researchers, PhD students and friends around the world. I learned and worked with them on the application of pedometrics approach. Many of the papers and ideas emerged when working with my colleagues. With colleagues from RDA, Korea, I learned about assessing the temporal change of soil properties. With colleagues from Indonesia, I learned about challenges in mapping peat soils. And of course, I got to travel around the world and we all share a passion for pedometrics. And most colleagues are kind and benevolent and we exchange ideas freely. Our discipline can be competitive but treating others with respect is also part of what makes pedometrics community successful.

After my QEII fellowship, I was awarded another fellowship, the Future Fellowship by the Australian Research Council on mapping soil dynamics. My focus is on quantifying soil carbon sequestration potential and how to map soil carbon change. Here we need a step-change in understanding, modelling and managing soil carbon. Soil carbon sequestration, which I did not realise can be a contentious topic. Some have a strong reservation or maybe a pessimistic view. To tackle this, it is crucial to have a fundamental of understanding of soil science and you can easily dispel the myth (see Geoderma 424, 115975).

Pedometrics is one of the few disciplines in soil science that has diversity not only in soils but also in people. I enjoy working with students and researchers with diverse backgrounds that enrich the scientific skills and knowledge and also the way we work and the community. Diversity can bring new ideas and enhance the way we solve pedometrics problems. I thank my mentor Alex for showing me the wonder of pedometrics, and my collaborators, students and former students for working together to reveal the intricacy of soils.

Finally, I look forward to working with colleagues worldwide to investigate the spatial and temporal heterogeneity of the soil system as a vital parameter driving function. Can we find out the origin and consequences of the variability?

The DSM Théia group

The Theia "Digital Soil Mapping" Scientific Expertise Centre of France

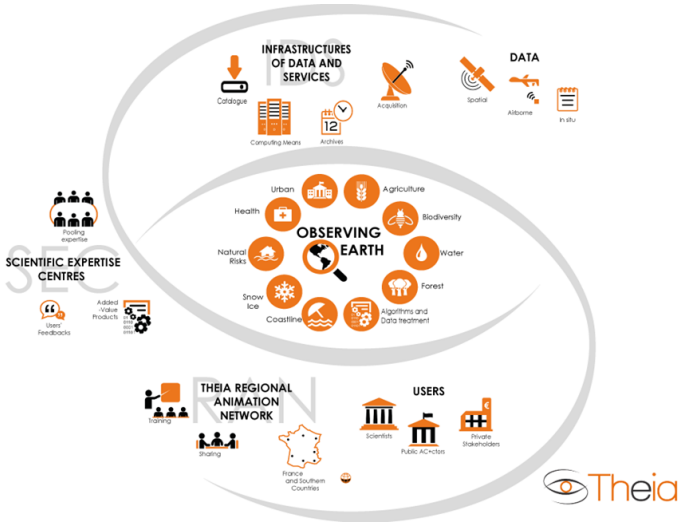
Richer-de-Forges A.C.[1], Lagacherie P.[2], Arrouays D.[1], Bialkowski A.[3], Bourennane H.[4], Briottet X.[5], Fouad Y.[6], Gomez C.[2,7], Jacquemoud S.[8], Lemercier B.[6], Maisongrande P.[9], Martelet G.[3], Martin M.P.[1], Michot D.[6], Pichelin P.[6], Saby N.P.A.[1], Tissoux H.[3], Vaudour E.[10], Wadoux A.M.J.-C.[2*,11], Walter C.[6], Puissant A.[12]

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Theia Land data centre

The THEIA Data and Services Centre (www.theia-land.fr) is a consortium of 10 French public institutions involved in Earth observation and environmental sciences (CEA, CEREMA, CIRAD, CNES, IGN, INRAE, CNRS, IRD, Météo France, and ONERA). THEIA was created in 2012 with the objective of increasing the use of Earth Observation data (spatial, by the scientific community and the public actors.

Theia provides national and international scientific communities, as well as public actors aiming to monitor and manage environmental resources, with a wide range of freely available images at different scales, products, methods and training related to the observation of continental surfaces, especially from space.



Source: https://www.theia-land.fr/en/theia-data-and-services-center/

The DSM Théia group

The consortium is based on three pillars:

1. A Spatial Data Infrastructure distributed among several actors;
2. A network of Scientific Expertise Centres (SECs);
3. Regional Theia Animation Centres in the metropolitan regions and overseas territories of France, as well as in southern countries.

Theia is now one of the active members or so-called “data hubs” of the Earth System Research Infrastructure, an integrated Earth system observation named Data Terra (https://www.data-terra.org/) initiated in 2016.

Theia’s quality-controlled products cover large areas and long periods of time: annual coverage of the national territory by satellite images, times series of surface reflectance, biophysical variables (biomass, leaf and soil water content, etc.), data visualization and preprocessing tools, processing methods and algorithms, and methodological guides for thematic applications.

This infrastructure contributes to improving knowledge and supporting the development of applications resulting from thematic research relevant to public policies, for a better sustainable management of land resources in their anthropogenic, ecological, agricultural, etc. dimensions.

Theia Scientific Expertise Centres

Theia’s Scientific Expertise Centres (SECs) bring together researchers from French laboratories who conduct research and develop innovative methods to analyze satellite, airborne and in situ data acquired on continental surfaces.

These SECs are focused on value-added products, possibly with services associated with these products. They are single or multi-team and spread over one or more regions, pursuing three main objectives:

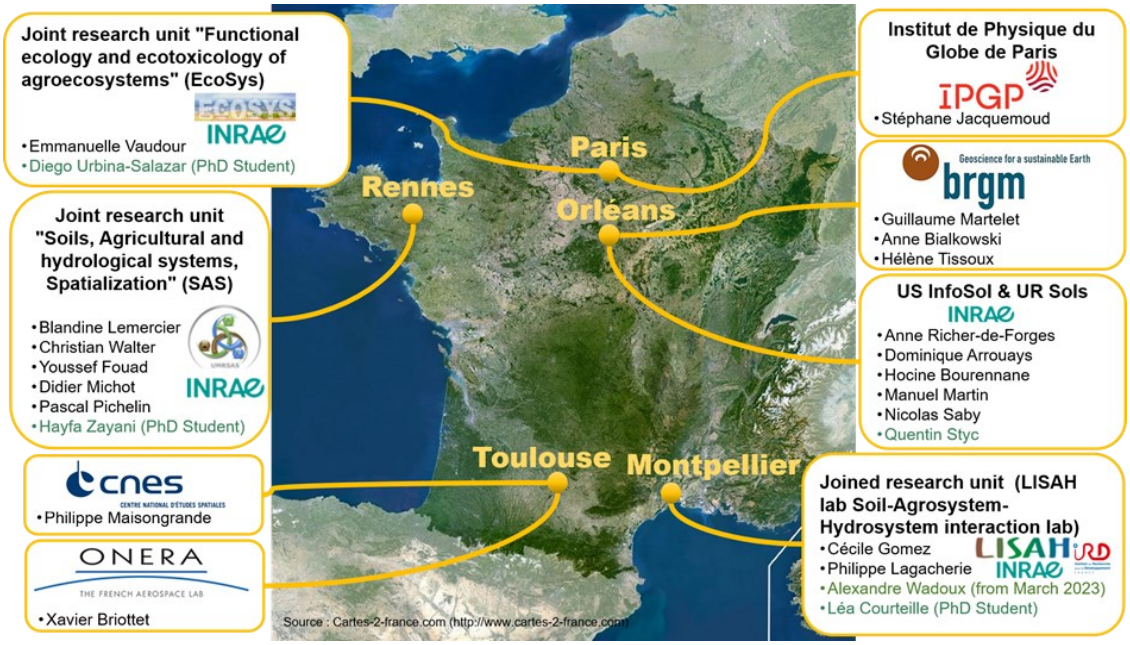
- to network and federate scientific actors at the national or even international level around thematic fields (agriculture, forest, urban areas, coastal, surface/atmosphere exchanges, etc.);
- To collect users’ needs;
- To design and validate innovative methods, develop products and train users.

The "Digital Soil Mapping" Scientific Expertise Centre (SEC

Founded in 2015, the Theia SEC called “Cartographie Numérique des Sols” (DSM for Digital Soil Mapping) was coordinated by Philippe Lagacherie until 2022. It is currently coordinated by Anne Richer-de-Forges. It aims to federate the efforts of French research laboratories developing digital mapping approaches for perennial soil properties.

This SEC is a multidisciplinary team bringing together French digital soil mappers, geologists, and remote sensing specialists from several regions.

The DSM Théia group



- UMR ECOSYS: Joint Research Unit EcoSys (Functional ecology and ecotoxicology of agroecosystems) https://www6.versailles-grignon.inrae.fr/ecosys_eng/
- UMR SAS (Soil, Agro- and hydro-systems, Spatialisation) https://www6.rennes.inrae.fr/umrsas_eng/
- CNES (Centre national d'études spatiales) https://cnes.fr/en
- ONERA (The French aerospace lab) https://www.onera.fr/en
- IPGP (Institut de Physique du Globe de Paris) http://www.ipgp.fr/en
- BRGM (Bureau de Recherches Géologiques et Minières (French geological survey)) https://www.brgm.fr/en
- INRAE US InfoSol & UR Sols https://www.inrae.fr/en/centres/val-de-loire
- UMR LISAH (Laboratoire d'Etude des Interactions entre Sol-Agrosystème-Hydrosystème (Soil-Agrosystem-Hydrosystem interaction lab)) https://www.umr-lisah.fr/?q=en

The SEC "Digital Soil Mapping" develops a mapping of soil properties for scientists and public policy makers. The main data used are multispectral optical images (SPOT6, Pléiades), optical (Sentinel-2, Landsat8) and radar (Sentinel-1) time series, airborne hyperspectral images (Hymap), soil data, digital elevation models (DEM), airborne gamma-spectrometric data and near-surface geological data.

The SEC "Digital Soil Mapping" aims to support the transition to operational digital soil mapping in France as described above. These objectives are:

- To federate and capitalize on the efforts made by the teams involved in terms of methodologies and algorithms applied to digital soil mapping and soil remote sensing;
- To produce the first spatialized estimates of soil properties at the national scale according to *GlobalSoilMap* specifications;
- To transfer and disseminate skills in the field of digital mapping and remote sensing of soils to actors operating at regional or local scales and in the southern countries.

The DSM Théia group

Two plenary meetings are organized each year. The last one took place in Paris in July 2022. It was mainly devoted to the presentation of work in progress carried out by students supervised by at least two laboratories, for which publications are in preparation. The topics discussed were very diverse:

- The use of remote sensing data to optimize the soil sampling design for monitoring soil properties of agricultural plots;
- Surface and subsurface mapping: some examples of achievements and ongoing projects were provided;
- The measurement of metallic trace elements in the framework of the French Soil Quality Measurement Network;
- The investigation of the potential of Sentinel-1 images to estimate soil moisture and surface roughness in a watershed in western France;
- The prediction of soil organic carbon (SOC) content from Sentinel-2 in the Naizin catchment (France);
- The contribution of Sentinel-1 and -2 time series to map the SOC content in agricultural soils from the Beauce region (France);
- The digital mapping of the potential and current status of soil multifunctionality at the European scale;
- Towards interactive and participatory mapping of soil multifunctionality;
- The assessment of the impact of atmospheric corrections and soil surface conditions on soil clay content mapping using Sentinel-2 images;
- The development of a processing chain for legacy soil data for decision support in the Occitanie region in the frame of the Terra OccitanIA project.

The discussions were very rich and the meeting ended with a brainstorming on the continuation of our common work.

Summary of achievements

The CES CNS ("Digital Soil Mapping") has allowed the co-supervision of about twenty master students and ten PhD students. We published more than 30 scientific articles and produced maps of soil properties according to the specifications of the *GlobalSoilMap* project. These maps are available at local, national and regional (Languedoc Roussillon, Brittany) levels . Maps of the available water capacity of soils have been produced at the national and regional levels (Languedoc Roussillon).
Beyond the production of data, the CES CNS has also set as an objective the dissemination of methods and tools used to produce soil maps. This is now materialized by the "Cartograph-e" website, whose ambition is to provide users with basic knowledge about DSM products such as maps of soil properties.

To know more:
https://www.theia-land.fr/en/ceslist/digital-soil-mapping-sec/
Contact: anne.richer-de-forges@inrae.fr

Acknowledgements

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Announcements

Soil Mapping for a Sustainable Future

2nd joint Workshop of the IUSS Working Groups Digital Soil Mapping and Global Soil Map

Orléans, France



Register here https://www.lestudium-ias.com/event/soil-mapping-sustainable-future

TOPICS

GlobalSoilMap: Advances ; Specifications and requirements ; National scale examples ; Integration of local data into global products ; Harmonisation issues

Advances in Digital Soil Mapping: Data collection and processing of soil data, soil and environmental sampling optimization and links to Spectroscopy and spectral library ; Applied statistics for DSM including Upscaling and downscaling ; Uncertainty estimation and propagation

DSM and digital soil assessment: Soil information for environmental modelling and management ; Soil organic carbon mapping; modelling and forecasting ; Soil degradation and links with other issues, human health) ; Soil functions and ecosystem services mapping, soil security mapping(water, air, biosphere

Announcements

Upcoming conferences and call for abstracts

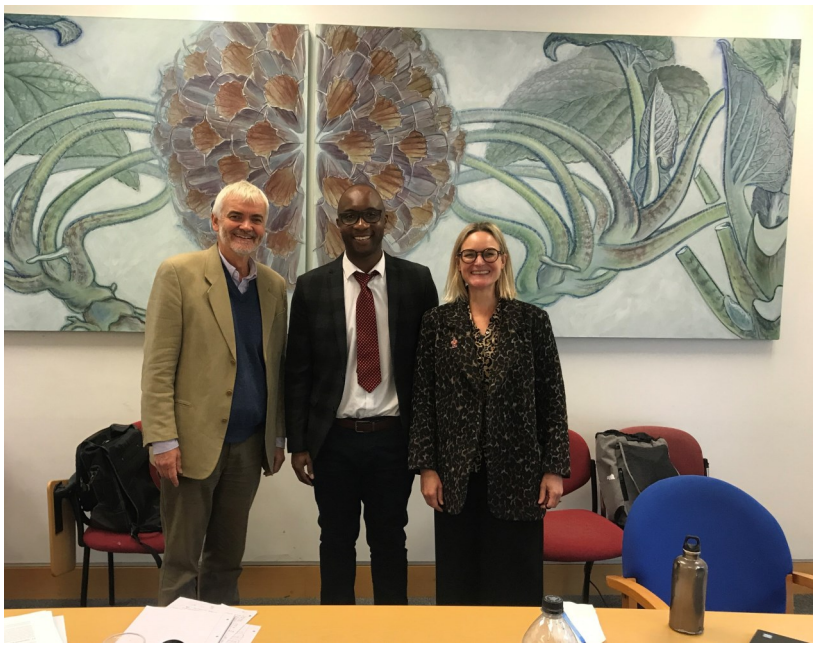
- Wageningen Soil Conference – August 28th to September 2023, Wageningen, the Netherlands.



- EGU 2023 - 23–28 April 2023Vienna, Austria: EGU General Assembly, various interesting sessions – to be announced soon. https://www.egu23.eu/
- The 3rd Global Soil Biodiversity Conference, Dublin, Ireland. 13-15 March 2023. https://gsb2023.org/ Submission deadline 7 October 2022

Announcements

A Pedometrics PhD defence!



In September, Christopher Chagumaira successfully defended his PhD at the University of Nottingham entitled "Geospatial modelling of soil geochemistry at national-scale for improved human nutrition." The thesis was supervised by Murray Lark (University of Nottingham), Alice Milne (Rothamsted Research), Martin Broadley (University of Nottingham/Rothamsted Research), Patson Nalivata (Lilongwe University of Agriculture and Natural Resources) and Joseph Chimungu (Lilongwe University of Agriculture and Natural Resources). Chris worked on understating how uncertainties in the spatial prediction of soil and crop micronutrients can be communicated effectively to diverse stakeholder groups (e.g., agronomists and nutritionists), and how stakeholder groups interpret the information when making decisions to address micronutrient deficiencies in sub-Saharan Africa. Chris' thesis was examined by Dr Jaqueline Hannam (Cranfield University) and Professor Neil Crout (University of Nottingham). Chris' thesis will be uploaded at the University of Nottingham repository soon and some of his papers be accessed through the following links https://gc.copernicus.org/articles/4/245/2021/ and https://www.tandfonline.com/doi/full/10.1080/13658816.2021.2020278

A cartoon

DO YOU KNOW?

That Orléans is the dryest City of France



That Orléans is a city steeped in History



That strikes is the national sport in France



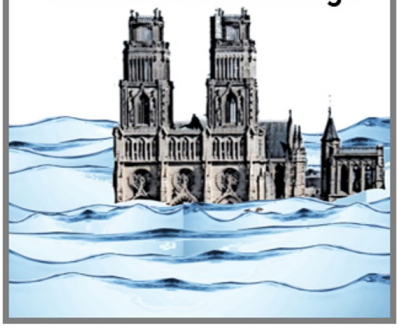
That Orléans is crossed by the longest river in France



That Orléans is at the crossroads of 2 European Cycle Route Networks



That, the probability of a 100 year flood of the Loire river in Feb. 2023 has never been so high



Bring your camera and swimsuit and attend the:
2nd Joint Conference of

Digital Soil Mapping Working Group

GlobalSoilMap

Orléans, France 7th – 9th Feb. 2023



LE STUDIUM CONFERENCE

Soil Mapping for a Sustainable Future

2nd joint Workshop of the IUSS Working Groups Digital Soil Mapping and Global Soil Map

http://www.lestudium-ias.com/event/soil-mapping-sustainable-future

© Richer-de-Forges and Arrouays, 2022

Greek wisdom down under

Let's team up with the Greek polymath Eratosthenes of Cyrene (ca.276 - ca.195 BC). On the southern hemisphere, the longest day is the December solstice around 22nd of December. On this day, you are initially at this touristic point close to the city of Rockhampton (Queensland, Australia), and you observe that, approximately at noon, there is no shadow outside this Spire:



Then, you take a ride with the Queensland Rail Tilttrain from Rockhampton to Brisbane, which is 456 km in south direction (ignore the fact that it heads also a bit to the east, and that we travel time is almost 8 hours: we go infinitly fast and straight south). Please don't forget to have a look at the beautiful Glasshouse Maintains -- vulcanic plug remains -- clearly visible from the track:



In Brisbane, you go quickly to the commercial business district (CBD), where you find this skyscraper, which is 260 meters tall and nicknamed Tower of Power, because it's used by the state government (official name and address: 1 William Street):



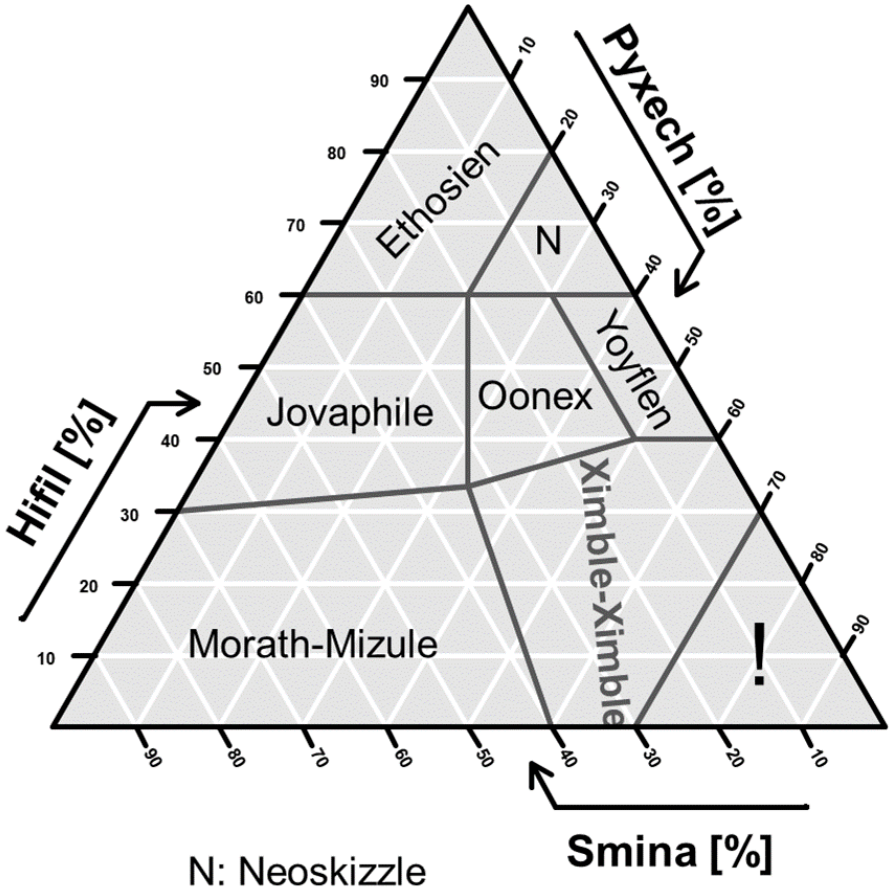
On that same day, actually on that same moment, you measure the smallest possible shadow from this tower over its full height, which appears to be 18.2 meters.
Eratosthenes, in the context of his time, used similar information to estimate the circumference of the Earth with remarkable accuracy – assuming that the earth is a perfect sphere. Can you do the same?
Source:
https://en.wikipedia.org/wiki/Eratosthenes

Sources pictures:
https://www.queensland.com/en-in/attraction/the-tropic-of-capricorn-spire
https://www.queenslandrailtravel.com.au/railexperiences/ourtrains/tilttrain
https://en.wikipedia.org/wiki/List_of_tallest_buildings_in_Brisbane

Pedomathemagica

Answer to the “Alien Soil Triangle” puzzle in Pedometron 45

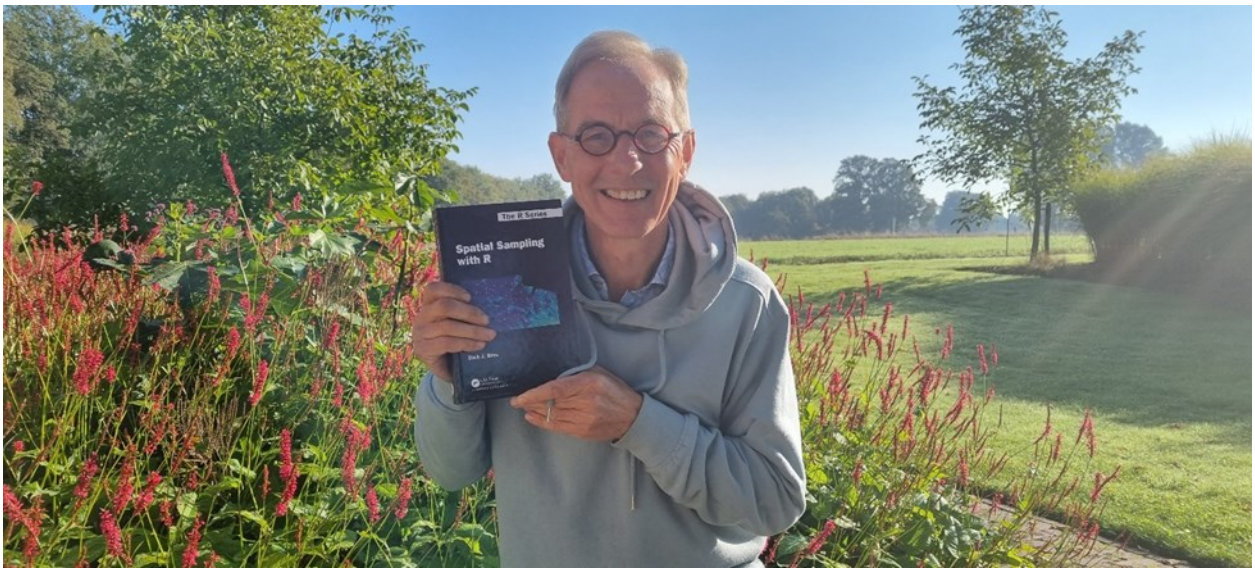
In the two years since publication, light traveled about 18.9E12 km (11.8E12 miles), which is enough quality space-time to solve the problem of our galactic colleagues:



Even more -- at the moment of transmitting, the universe had a special wish for us:
“Enjoy MMXX!”

In conversation with Dick Brus

Dick Brus is publishing a new book on Spatial Sampling with R. We asked him a few questions and questioned his experience on preparing the book.



When did you start working on this book?

I do not precisely know. Since the publication of our handbook Sampling for Natural Resource Monitoring (SNRM) in 2006. I gave sampling courses at many places in the world. For these courses I wrote numerous scripts with computer code, using the programming language R. Since 2015 I worked for 1 month per year in Nanjing, China. Here I got the idea to write a new book on sampling. My naïve idea was that all I had to do was bundle the R scripts into an Rmarkdown document, and add some text explaining the theory and the R code. As usual, it proved to be much more work than expected, but I am very happy that I was able to finish the job just before my retirement.

Why a new book on sampling?

Scientific research often starts with data collection. However, many researchers pay insufficient attention to this first step in their research. I often had to conclude that the data collected by fellow researchers were suboptimal, or in some cases even unsuitable for their aim. One reason is that sampling is frequently overlooked in statistics courses. Another reason is the lack of practical textbooks on sampling.

But we do have Sampling for Natural Resource Monitoring. What is the added value of this new book?

I agree, SNRM is quite a practical textbook on sampling. For a couple of years I had been thinking of a revision of the book, to repair errors and to include new developments in sampling design since 2006. Then I realised that to increase the impact of SNRM, it might be a better idea to write a new book, showing by means of computer code how the sampling designs can be implemented, and how the sample data can be used in statistical inference. This also offered the opportunity to include new sampling designs, such as balanced sampling, developments in model-assisted inference, Bayesian sampling design, and model-based sampling design.

In conversation with Dick Brus

Who is the target audience?

The target group of this book is researchers and practitioners of sample surveys, as well as students in soil, environmental, ecological, agricultural science or any other science in which knowledge about a population of interest is collected through spatial sampling. I have added exercises to most chapters, making this book suitable as a textbook for students.

Which part of the book do you like most? Which one is the most novel?

I especially like Chapter 10 Model-assisted estimation. This chapter presents an overview of how ancillary data can be used in the estimation of population means or totals. It includes sections on the generalised regression estimator, the ratio estimator, and on how machine learning techniques can be used in estimation. Another interesting chapter, I think, is Chapter 14 Sampling for estimating parameters of domains. It includes sections on direct estimators, model-assisted estimators for small domains (small subpopulations), model-based prediction and on supplemental probability sampling of small domains. In Chapter 24 the fundamental differences between the design-based, model-assisted, and model-based approach are explained in detail, and illustrated with simulations. Another novelty is the section on design-based generalised least squares estimation of space-time parameters such as the temporal trend of spatial means.

What is the main message about sampling that pedometricians should take home?

Do not trust your intuition about what is a good sampling design, first read one or more text books on sampling theory, so that you know what sound sampling designs, underpinned by theory, are available.

When the aim is to estimate a parameter of the entire population or several subpopulations, I recommend probability sampling, i.e. random sampling so that the probability that a selected unit is included in the sample is known.

Even when the aim is mapping, probability sampling can be attractive, using a sampling design spreading the sampling locations in geographical and/or feature space. Although probability sampling is not strictly needed for mapping with a statistical model, in some situations, when feasible, it can still be advantageous to select a probability sample. If the aim of the survey is to map the study variable, as well as to estimate the mean or total for the entire study area or for several subareas, probability sampling can be a good option. Think, for instance, of sampling for the dual objectives of mapping and at the same time estimating soil carbon stocks. Although the statistical model used for mapping can also be used for model-based prediction of the total carbon stocks in the study area and subareas, we may prefer to estimate these totals by design-based or model-assisted inference. The advantage of design-based and model-assisted estimation of these totals is their validity. Validity means that an objective assessment of the uncertainty of the estimated mean or total is warranted, and that the coverage of confidence intervals is (almost) correct, provided that the sample is large enough to assume an approximately normal distribution of the estimator and design-unbiasedness of the variance estimator.

R code need to be constantly updated. Do you plan to continue adapting the book as new developments and R updates come available?

Good question. I wrote the book with Rmarkdown and bookdown. The main reason for this is that a GitBook version of the book can be generated. This GitBook can be found at https://dickbrus.github.io/SpatialSamplingwithR/. I can update this GitBook whenever I want. So if anyone discovers an error in the book or has suggestions for improving the text and/or R code, she/he can let me know by cloning the github repository https://github.com/DickBrus/SpatialSamplingwithR and sending me a pull request. I will then have a look at this and update the GitBook when appropriate.

A poem

De quoi s'agit-il?

Why do we do it?
Who is it for?
What is it for?
Ourselves us humanity
The world
Unravelling the unknown
The ratio of what we know
To what we don't
Exasperatingly decreases
The more (we think) we know
Do we feign?
Are we selfless?
Do we fashion?
The fascinated farmer
The considered citizen
The perceptive policymaker
Phantom denizens
Of our rationalised world
Could they even exist?
Did we ever see one?
Talk to one
Over an Aperol spritz?
But not in our dreams
Or in our theories
If indeed they could exist
They pay no mind
To r squared
They want reassurance
And answers
To inconvenient questions
Ones we won't admit
'You're asking the wrong question'

We love the uniform
Of societal duty
But by and buy
We carouse in
Following our noses and tails
In some immense bicycle race
Most feel relaxed
In the thick of the peloton

Even if
It's heading in the wrong direction
Its right it's fun it's noble
And apparently impactful
33 people clicked on my article
One read it
Seven cited it
Possibly no one understood it
But somehow miraculously
Some prescient resident
Will inescapably pick it up
And remodel it into a solution
For a camouflaged problem
Or an unrecognised practice

Que faire?
Tie-dye T shirts?
Learn a TikTok dance?
When it comes
To problems and practices
Policies and poems
Just write your own

By David van der Linden
(cycliste ordinaire)

22nd World Congress of Soil Science 2022, Glasgow, Scotland

By Simone Priori

After four years and a pandemic in between, finally, soil scientists from all over the world had the opportunity to meet again in the 22nd World Congress of Soil Science, organized by the British Society of Soil Science on behalf of the International Union of Soil Sciences. The main theme of the congress: 'Soil Science – crossing boundaries, changing society' focused on the link between soil and society, with sessions covering soil systems, processes, management, and interactions with humans.

The conference has been held from 31st July to 5 August 2022 in the Scottish Event Campus of Glasgow (Scotland), the Scotland's largest exhibition center consisted of a big arena for concert (Ovo), the SEC conference center and the "Armadillo" auditorium, the latter used for plenary sessions.



Day 1 (Monday 1st August):

After the day 0 on Sunday 31st July, day of opening ceremony, the congress started with two plenary sessions with the invited speakers Ismahane Elouafi (FAO) and Peter Gregory (University of Reading), who presented "Soils and Sustainable Food Production" and "Are plant roots only in soil or are they of it? Roots, soil formation and function". Among the scientific sessions, the most related to pedometrics were: "Spatial decision making and mapping for implementing policies for sustainable soil management", chaired by Fabio Terribile, Jack Hannam and Erika Micheli; and the session organized by WG1.04 "Global soil map: main advances and ways forward", chaired by Dominique Arrouays.

Day 2 (Tuesday 2nd August):

During the second day of the congress, there have been no sessions dedicated to pedometrics, although there was the Interdivisional session "Novel methods and techniques", chaired by Alfred Hartemink and Stephen Hiller, which included several presentations on innovative soil monitoring techniques, based on FTIR, MIR and X-ray microdiffraction.

The plenary lectures "How transforming land use change could change our future", by Dr Debra Roberts, Co-Chair of Working Group of the IPCC, concluded the daily activities.

Day 3 (Wednesday 3rd August):

The richest day for pedometricians was probably "too rich", because most of the sessions focused on pedometrics topics have been partly overlying.

The morning started with the session of WG1.2 – "Digital soil mapping: advances towards Digital Soil Assessment", chaired by Laura Poggio and continued with WG1.3 – "Progress in Digital Soil Morphometrics" – chaired by Alfred Hartemink. In the late morning, the Pedometrics Commission meeting has also been held. In the early afternoon, the session of Pedometrics Commission 1.5 "How Pedometrics can cross boundaries and change society", chaired by Titia Mulder and Nicolas Saby, as well as the session of Proximal Soil Sensing WG "Sensing soil chemical, physical and biological properties - advances and emerging techniques", chaired by Asim Biswas was held simultaneously.

The plenary session "Rock dust: a reverse weathering mechanism for tropical soils: environmental and economic aspects" of Prof. Suzi Huff Theodoro (Universidade de Brasília) concluded the daily scientific activities.

Day 4 (Thursday 4th August):

The morning started with the plenary lecture "Empowering Soil Scientists with Data- Driven Techniques" held by Dr. Ranveer Chandra, CTO Agri-Food of Microsoft, a very interesting talk about the innovative Microsoft systems to support digital agriculture.

The sessions probably more interesting for pedometricians were: WG1.6- "Soil information standards and systems -current initiatives and advances", chaired by Fenny van Egmond and WG1.7 "Advances in soil monitoring", chaired by Nicolas Saby. In the morning, business meetings of working groups Digital Soil Mapping, Global Soil Map, and Proximal Soil Sensing have been held.





Report on the DSM COP Workshop 2022

By Ho Jun (Jay) Jang



At the end of August 2022, the DSM workshop was held amongst Australia-New Zealand Community of Practice in Sydney (New South Wales, Australia) from 31st August – 1st September 2022. The workshop is being coordinated and supported by TERN (Terrestrial Ecosystem Research Network) and DSAWG (Digital Soil Assessment Working Group under the National Committee on Soil and Terrain, Australia. The workshop was held as a hybrid of both in-person (within the main campus of the University of Sydney) and virtual session (Zoom). There was a total of 27 presenters focusing on various topics on digital soil mapping.

The workshop was very comfortable and welcoming to everyone. All the people enjoyed the workshop with big smiles and laughed a lot. I was panicking in the beginning because I was the only one who wore a business suit. Gradually, I loved this kind of informal workshop. The topic was very serious, but the atmosphere was very comfortable. Because of this, everyone can keep their motivation to listen to others' presentations, and I was very relaxed during my talk.

At the beginning of the workshop, everyone introduced themselves, their name, position, and their favourite R package. The most popular R package was ggplot2. Unfortunately, no one mentioned the Raster package, which is a key package of digital soil mapping. We should respect our mother package (Raster); even the terra package is better.

Almost half of the presentations were about producing digital soil maps, especially soil organic carbon, with different scales (from national to local scales). My presentation is about using the concept of pedogenon to map soil organic carbon in low Namoi Valley, Australia. There was a big discussion about how to combine all the created maps by researchers.



There are a few presentations about soil data management. Personally, I really think soil data management is very important. The investigation of soil change has become a very important topic these days, but without organised previous data, it is very difficult to compare current data and previous data. Hence, we should consider soil data management have equal importance to finding better covariates or calibration models.

There were also a few presentations that are useful information for improving digital soil mapping techniques, including the better soil sampling design method and very efficient R function based on the terra package.

After the first day of the meeting, the restaurant for dinner was The Rose Hotel which is a classic Aussie pub. This meeting was the first meeting after COVID-19 restrictions, so the warm conversation between Aussies and Kiwis was not stopped, and of course, the discussion of digital soil mapping was continued.

I highly recommend that we should keep teaching students about the importance and knowledge of digital soil mapping to improve the management of agricultural activities for farmers. Moreover, this workshop can be continued with the next generation of digital soil mapping researchers.





Can Homosoil help solve the issue of soil data scarcity?

By Andree Nenkam Mentho

Background

Soil data is critical for a wide range of purposes including environmental risk assessment, policy making, development of strategies to reverse soil degradation, increase crop productivity and improve food security among others. However, despite the increasing need of soil data for the past two decades, there are still many countries experiencing very low soil sampling density and/or very poor soil data spatial coverage (Hartemink et al., 2008). Digital soil mapping (DSM, McBratney et al., 2003) has been widely used for the past 2 decades to increase soil data coverage at unsampled location and to ease access to soil data for different soil related projects (Flynn et al., 2019; Forkuor et al., 2017). Nevertheless, DSM still requires soil data to build robust models for better accurate predictions and this is hard to do in areas with quasi-null soil sample measurements given the enormous existing challenges in collecting new soil data. Thus, the question is "can coupling the concept of homosoil with digital soil mapping be a potential solution in such areas?"

Homosoils are any two soils in the world sharing similar soil-forming factors and consequently similar soils (Mallavan et al., 2010; Nenkam et al., 2022). Homosoils have similar environmental characteristics but may be geographically distant to each other. Finding the homosoil of a data poor area ensures the availability of training data to build soil mapping models which can then be extrapolated to the data poor area to predict required soil properties.

Homosoils are generally found for a specific spatial location and is done in the following three steps:

1. Find a homoclime to the spatial location.
2. Build a covariate database consisting of proxies to soil forming factors.
3. Identify the homosoils by computing the environmental similarity indices and using a defined threshold to determine which areas in the world are homosoils to the spatial location and which ones are not.

After identifying the homosoils to the area of study, the next step is to build soil mapping models and extrapolate them to spatial location of interest for predictions. This is done as follows:

1. First, collect available soil data within the homosoils of the study area,
2. Second, build and validate soil mapping models using the soil data and their corresponding environmental covariates,
3. And finally, apply the soil mapping models on covariate covering the spatial location. And Huzzah!! We have the digital soil map for the limited data coverage area.

Case Study

Mali being one such country with limited soil data coverage. The homosoil concept was thus applied in Mali (Nenkam et al., 2022) followed by a digital soil mapping of 6 soil properties (clay, sand, silt, organic carbon, total nitrogen and pH). **Figure 1** gives a graphical representation of (i) how homosoil were found for Mali, (ii) the homosoil map, (iii) the distribution of the available soil organic carbon (SOC) measurements found within the

homosoil areas of Mali (including Mali), (iii) the building of a numerical model using these soil data and their covariate, and finally (iv) the map generated after applying the model on the covariates covering the study area.

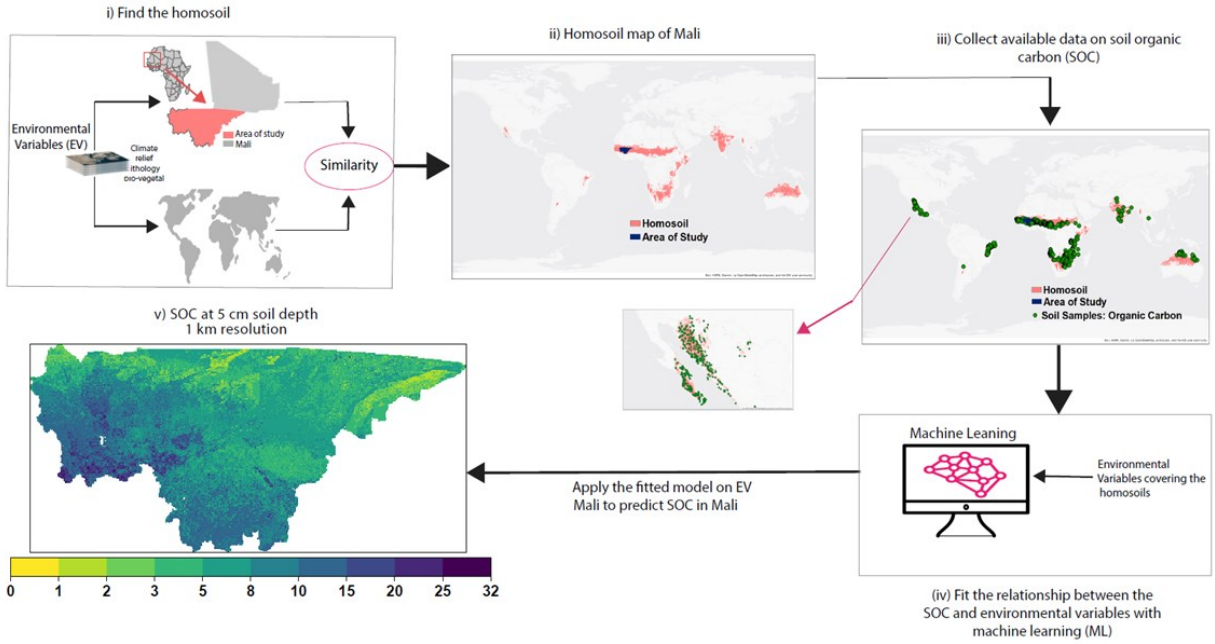


Figure 1: *Example of finding the homosoil for the study area in Mali coupled with DSM on soil organic carbon at 5 cm depth interval.*

The same procedure was applied to predict 5 other soil properties within Mali. The maps were assessed using an independent soil data validation and compared with existing digital soil map generated at continental (IsDA; Hengl et al., 2021) and global (SoilGrids; Hengl et al., 2017) scales.

Results showed that Maps generated by soil models build from homosoils are better than just taking the mean of the soil observation as a predictor. In fact, the maps explained between 15 and 52% of the variability of the independent dataset across all soil properties.

The comparison of the resulting digital soil maps against exiting DSM products at continental and global levels showed that homosoils maps are better in 3 (sand, silt and pH) out of 6 soil properties, whereas predictions from continental maps were better for the dynamic soil properties (OC and Total), while those from global maps were better for clay.

This study also revealed that when extrapolating soil models, it is imperative to have local soil data to build the models. This is because, despite the fact these models are built from areas which have been identified as homosoils to the study area, the soil-covariate structure may, most at times, differ due to local management practices or natural environmental factors which greatly impact the soil variation.

This research suggests that for the meantime – while trying to solve the issue of soil data collection, the homosoil concept can be coupled with DSM activities to generate soil maps for data poor areas or poorly accessible areas. These maps can then serve as basis to improve existing soil databases in areas with low to nil soil data while reducing sampling cost. Such maps may not have the best quality; however, they may drive the integration of systematic soil data collection with the aim of having access to adequate and reliable soil data to mitigate soil degra-

dation, find ways to resist climate change, improve agricultural productivity, improve food security, and soil health. The importance of soil is gradually being recognized to solve numerous global issues and data that were collected half a century or earlier ago are now outdated, it is thus time that more effort be made to give soil its right place when data collection are concerned. Homosoils can serve as basis to achieve that purpose.

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