The benefits of a massive harvesting of legacy measured profiles for mapping primary and functional soil properties in the Coastal Plain of Occitanie (Southern France)

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The benefits of a massive harvesting of legacy measured profiles for mapping primary and functional soil properties in the Coastal Plain of Occitanie (Southern France)

INRAE LISAH AtoS

Decision makers needs soil information in the Coastal Plain of Occitanie

Water ressource management

⬇

Soil available water capacity

Decision makers needs soil information in the Coastal Plain of Occitanie

Water ressource management

⬇

Soil available water capacity

Land use (urban) planning

⬇

Soil (potential) quality index

Soil Security 6 (2022) 100034

Contents lists available at ScienceDirect

Soil Security

journal homepage: www.sciencedirect.com/journal/soil-security

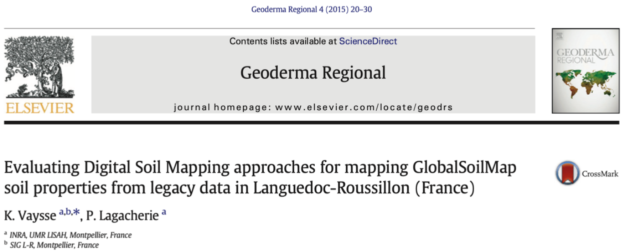
Development and spatialization of a soil potential multifunctionality index for agriculture (Agri-SPMI) at the regional scale. Case study in the Occitanie region (France)

Eva Rabot [a], Maritxu Guiresse [a,*], Yannis Pittatore [a], Marcos Angelini [b], Catherine Keller [c], Philippe Lagacherie [b]

Previous productions of Digital Soil Mapping products in the Coastal plain of Occitanie

Developing GlobalSoilMap products

- 2024 legacy soil profiles in 27,236 km² (1/ 13.5 km2)
- 16 soil covariates
- Quantile Regression Forest



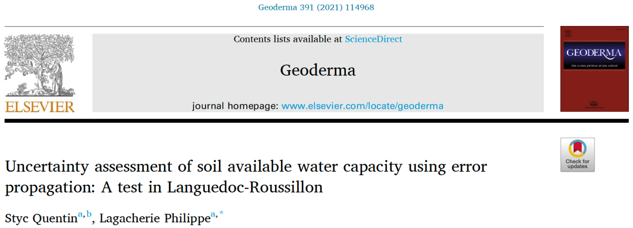
Geoderma Regional 4 (2015) 20–30
Contents lists available at ScienceDirect
Geoderma Regional
journal homepage: www.elsevier.com/locate/geodrs

Evaluating Digital Soil Mapping approaches for mapping GlobalSoilMap soil properties from legacy data in Languedoc-Roussillon (France)

K. Vaysse [a,b,*], P. Lagacherie [a]
[a] INRA, UMR LISAH, Montpellier, France
[b] SIG L-R, Montpellier, France

Mapping Soil Available Water Capacity

- 2024 legacy soil profiles in 27,236 km² (1/ 13.5 km2)
- 16 soil covariates
- Quantile Regression Forest
- Uncertainty propagation using 1rst order Taylor analysis



Geoderma 391 (2021) 114968
Contents lists available at ScienceDirect
Geoderma
journal homepage: www.elsevier.com/locate/geoderma

Uncertainty assessment of soil available water capacity using error propagation: A test in Languedoc-Roussillon

Styc Quentin [a,b], Lagacherie Philippe [a,*]

Mapping a Soil Quality (Multifunctionality) index

- 1229 legacy soil profiles in 12,125 km² (1/ 9.9 km2)
- 161 soil covariates
- Regression Forest and cokriging of residuals
- Uncertainty propagation using stochastics simulations

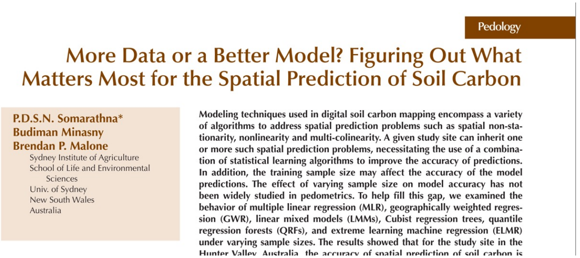
DOI: 10.1111/ejss.13345
ORIGINAL ARTICLE
European Journal of Soil Science WILEY

A multivariate approach for mapping a soil quality index and its uncertainty in southern France

M. E. Angelini [1,2] | G. B. M. Heuvelink [3,4] | P. Lagacherie [2]

→ Lack of precision for effective use in decision making

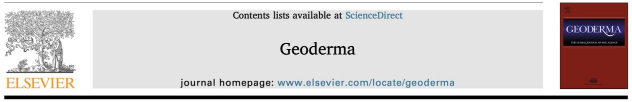
Soil information density: A first order limitation of DSM prediction performances


Pedology

More Data or a Better Model? Figuring Out What Matters Most for the Spatial Prediction of Soil Carbon

P.D.S.N. Somarathna*
Budiman Minasny
Brendan P. Malone
Sydney Institute of Agriculture
School of Life and Environmental Sciences
Univ. of Sydney
New South Wales
Australia

Modeling techniques used in digital soil carbon mapping encompass a variety of algorithms to address spatial prediction problems such as spatial non-stationarity, nonlinearity and multi-colinearity. A given study site can inherit one or more such spatial prediction problems, necessitating the use of a combination of statistical learning algorithms to improve the accuracy of predictions. In addition, the training sample size may affect the accuracy of the model predictions. The effect of varying sample size on model accuracy has not been widely studied in pedometrics. To help fill this gap, we examined the behavior of multiple linear regression (MLR), geographically weighted regression (GWR), linear mixed models (LMMs), Cubist regression trees, quantile regression forests (QRFs), and extreme learning machine regression (ELMR) under varying sample sizes. The results showed that for the study site in the Hunter Valley, Australia, the accuracy of spatial prediction of soil carbon is



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Analysing the impact of soil spatial sampling on the performances of Digital Soil Mapping models and their evaluation: A numerical experiment on Quantile Random Forest using clay contents obtained from Vis-NIR-SWIR hyperspectral imagery

P. Lagacherie[a,*], D. Arrouays[b], H. Bourennane[c], C. Gomez[a,d], L. Nkuba-Kasanda[a]

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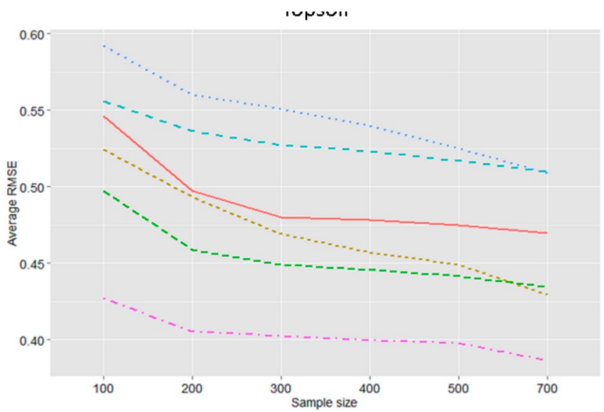
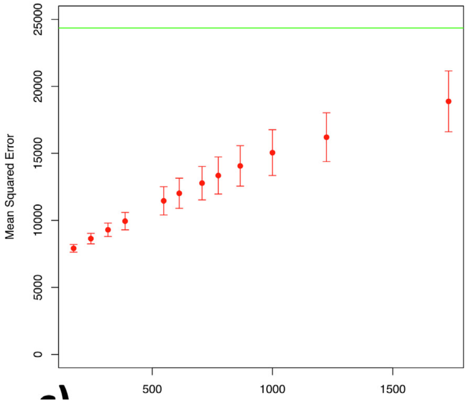
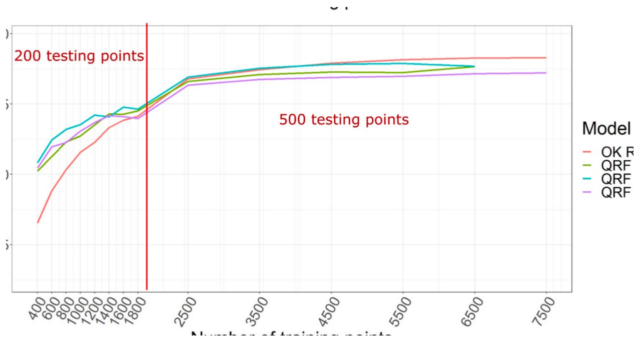
Density of soil observations in digital soil mapping: A study in the Mayenne region, France

Thomas Loiseau[a], Dominique Arrouays[a,*], Anne C. Richer-de-Forges[a], Philippe Lagacherie[b], Christophe Ducommun[c], Budiman Minasny[d]







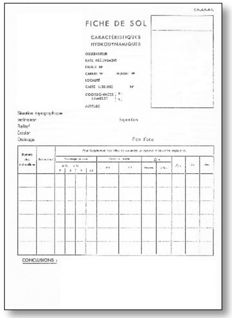
Massive harvesting of legacy measured soil profiles

Soil data rescue projects	Profile numbers	Authors of profiles	profile ages
Projet IGCS 2021	1 192	SIGALES, GeoSOLEAU	1985-2006
Projet TerraOccitania	6 752	CNABRL	1955-92

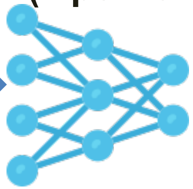
From 1,229 profiles (1/ 9.9. km^2) to 9,135 profiles (1/1.3 km^2)

A semi-automatic procedure for soil profile entries in a soil database

Scanned soil profiles records (4 different formats)

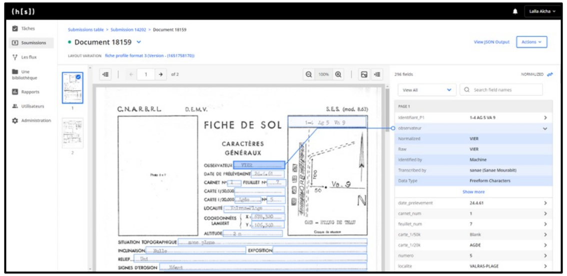


Text recognition model training (1 per format)



87.6% of automatic recognition with 99.5% accuracy

Computer-assisted manual entry of the remaining uncertain fields

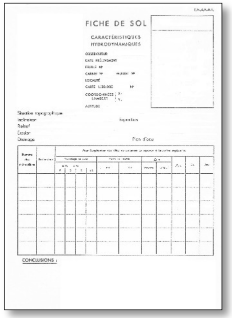


Final checking and field conversions

Chemchem et al, submitted to Soil Use and Management

A semi-automatic procedure for soil profile entries in a soil database

Scanned soil profiles records (4 different formats)



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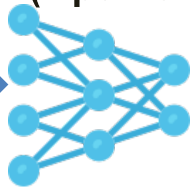

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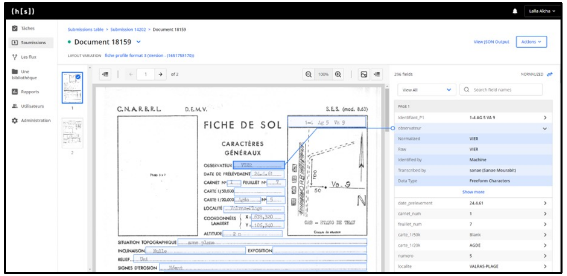


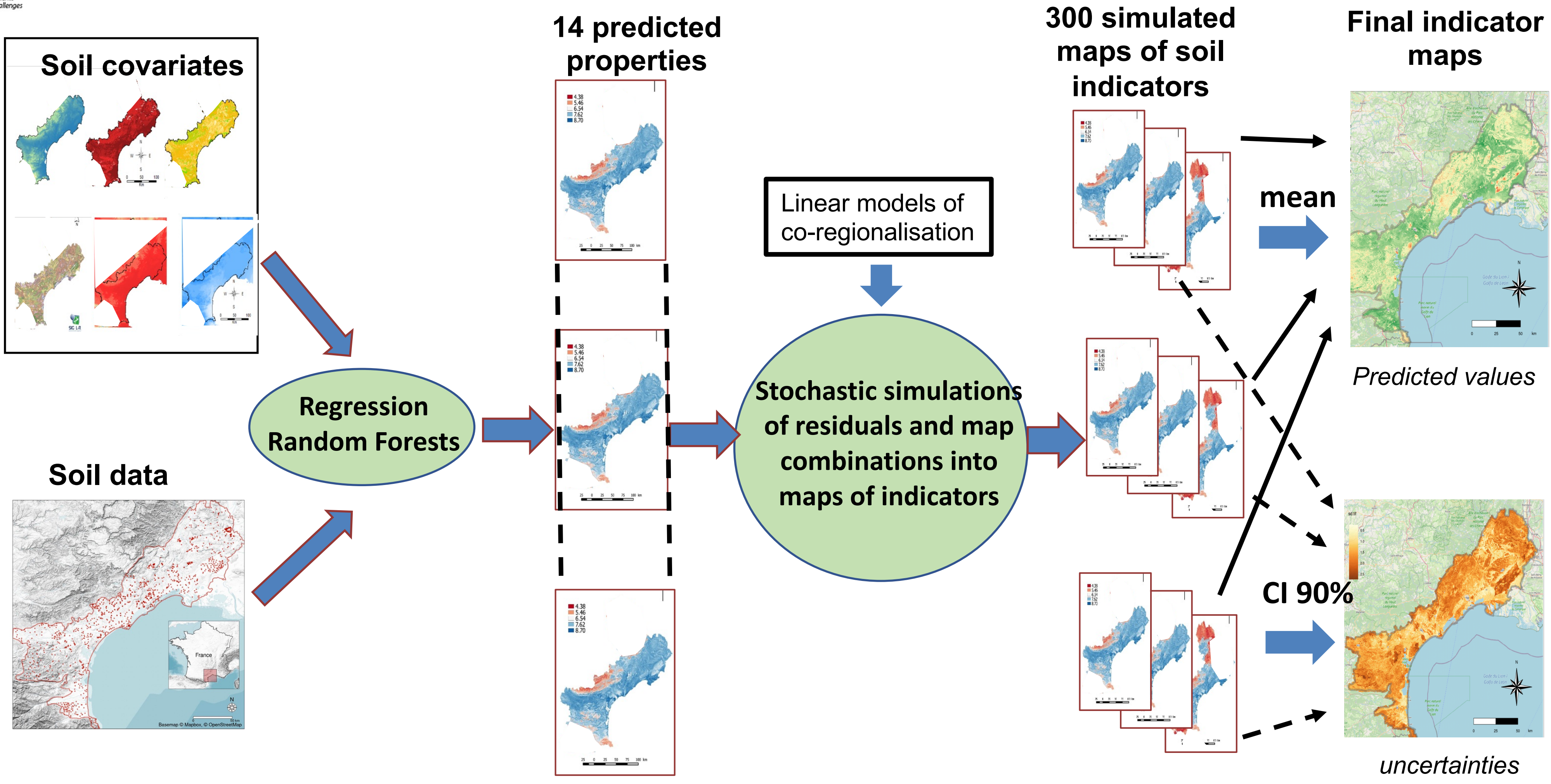
Final checking and field conversions

Procedure evaluation

	Manual entry	Semi-automatic entry	Gain
1 record	13 mn	3 mn	10 mn
6752 records	182 working days	57 working days	125 working days

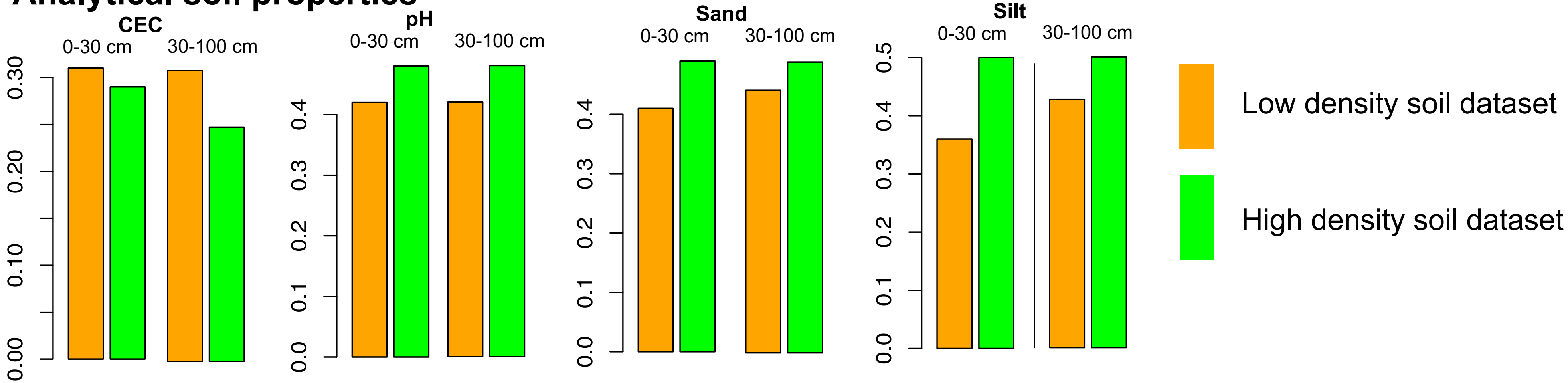
Chemchem et al, submitted to Soil Use and Management

Multivariate DSM approach (Angelini et al, 2023)

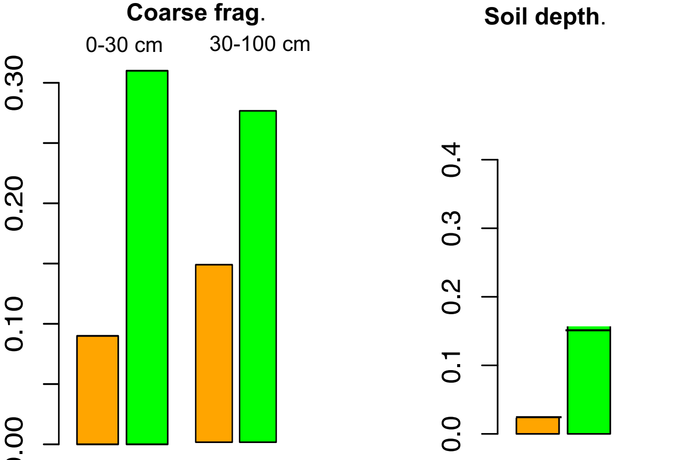


Accuracy (MEC) increases after a massive harvesting of legacy soil data

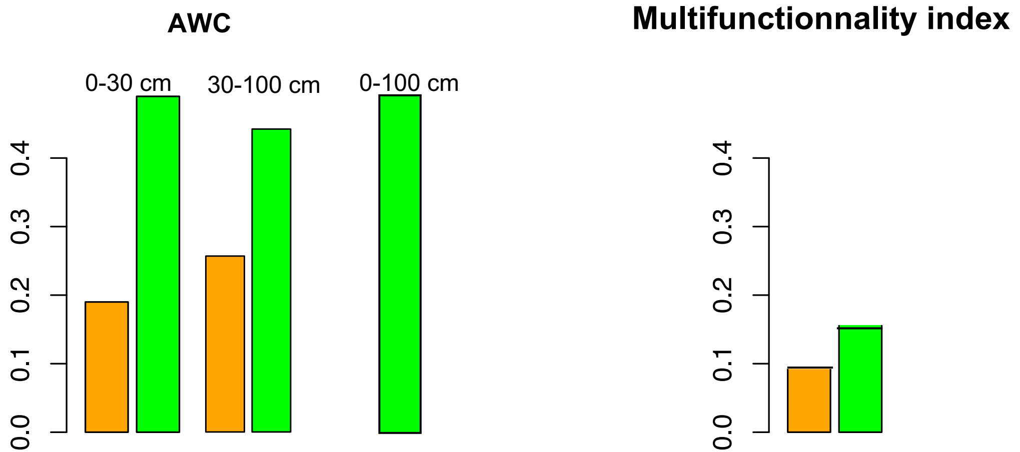
Analytical soil properties



« Observational » soil properties

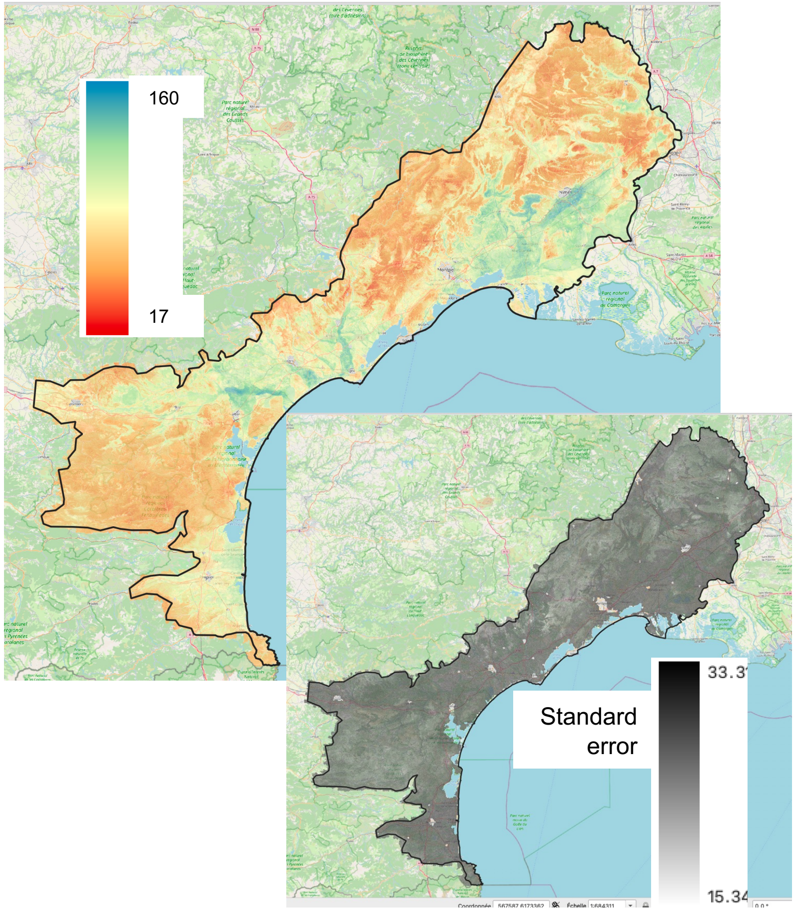


Functional soil properties

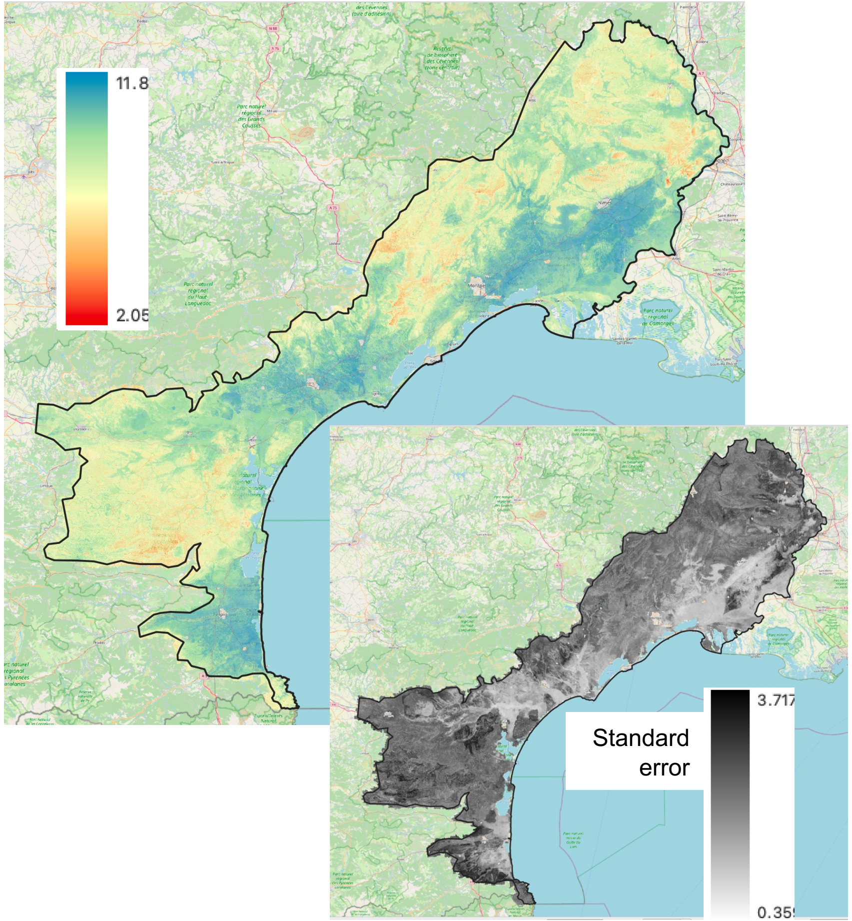


Digital Soil Mapping products for decision makers

Soil Available Water Capacity 0-100 cm (mm)

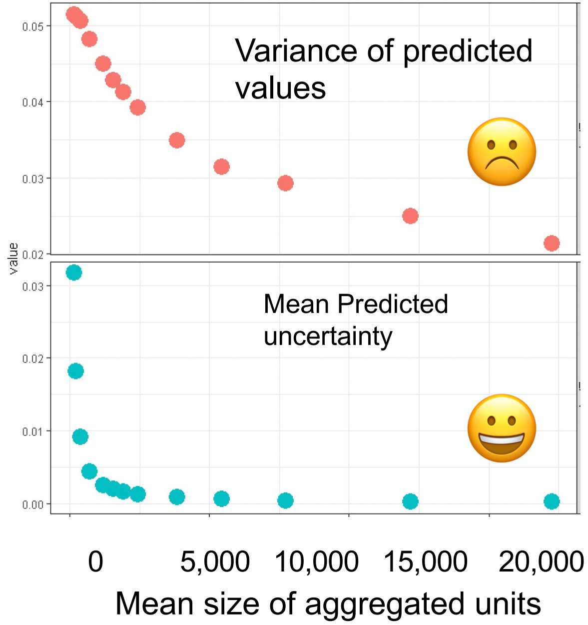


Soil Multifunctionnality Index



Spatial aggregation for uncertainty visualization adapted for decision making
1. approach

- Principle : Reduce the overall map uncertainty by spatial aggregation
- Aggregated units obtained by applying an agglomerative clustering algorithm (Murtagh, 1985) on predicted raster maps
- Areal metric : proportion of area of high quality soil (> 10/12)



Courteille et al, submitted to EJSS

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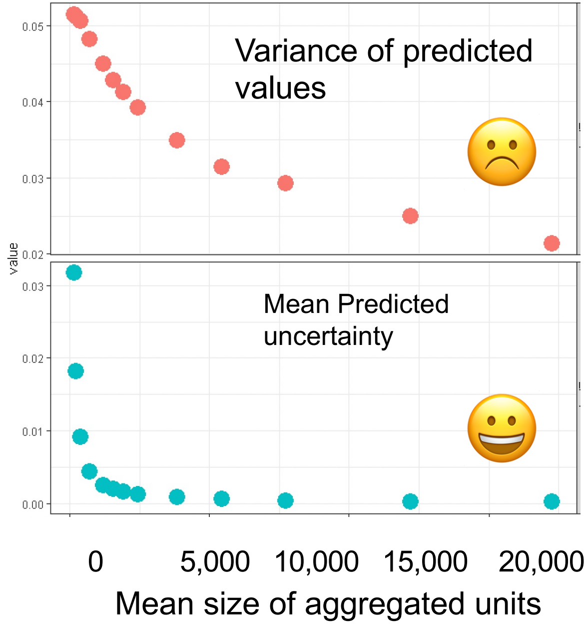
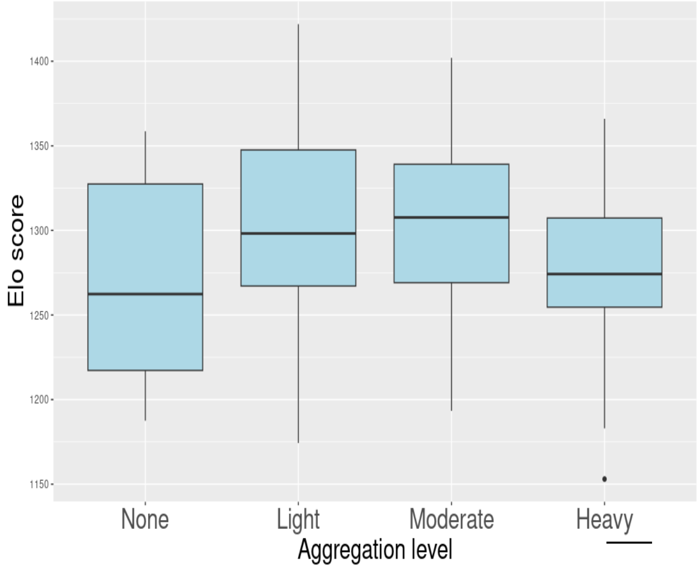


Courteille et al, submitted to EJSS

Which is the best compromise ??

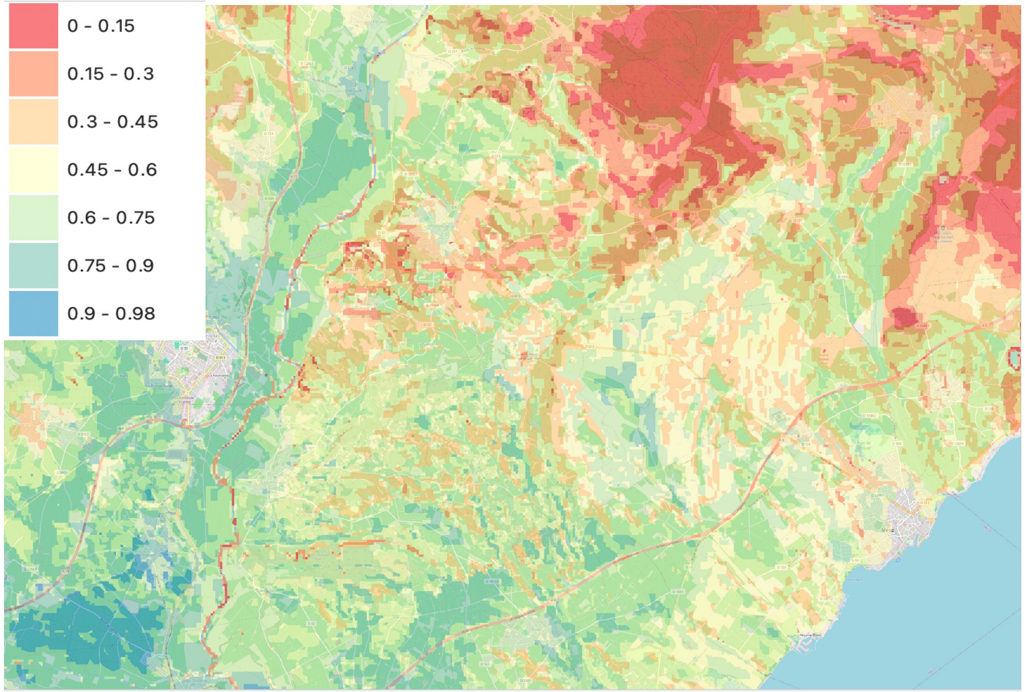
Users' preferences of spatial aggregations
(201 potential users x 10 choices among 2 maps)



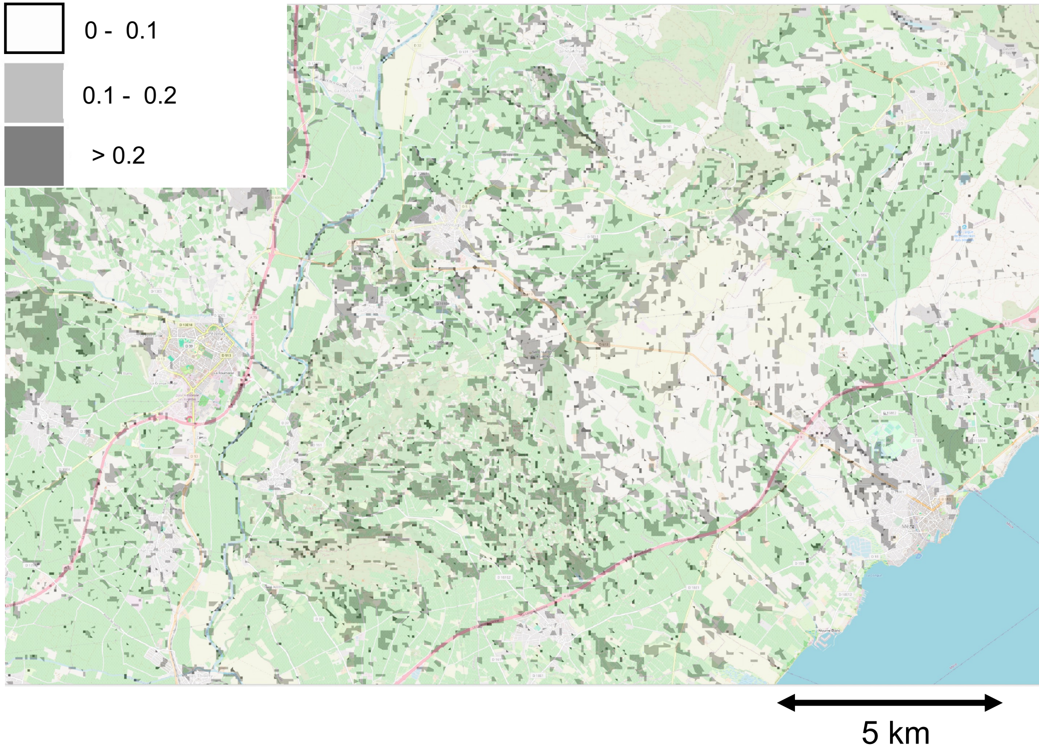
Courteille et al, in prep.

Spatial aggregation for uncertainty visualization adapted for decision making
2. Example of « good » compromise

% of area with high quality soils



Uncertainty (standard error)



Conclusions

- Digital Soil mapping products should be oriented toward the fullfillment of local users needs
- The decrease in mapping uncertainty provided by a massive harvesting of legacy soil profiles is significant but limited for certain soil properties
- Spatial aggregation of DSM outputs is a promising solution for communicating mapping uncertainties to decision makers
- Local Digital Soil mapping should be promoted as an efficient approach for organising and boosting the collection of soil knowledge within the future soil governance entities (soil districts?)

Global SoilMap

Digital Soil Mapping Working Group

Soil Mapping for Sustainable Land Use Planning

3RD JOINT WORKSHOP ON

DIGITAL SOIL MAPPING & GLOBAL SOIL MAP

21st - 24th January 2025

Bengaluru, India

ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur

in association with

Indian Society of Soil Survey and Land Use Planning (ISSLUP), Nagpur

The International Working Group of Digital Soil Mapping &

The International Workshop Group of GlobalSoilMap

International Decade of Soils 2015-2024

SOIL FOR LIFE

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