



A review of existing soil monitoring systems to pave the way for the EU Soil Observatory

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A review of existing soil monitoring systems to pave the way for the EU Soil Observatory

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EJP SOIL
European Joint Programme



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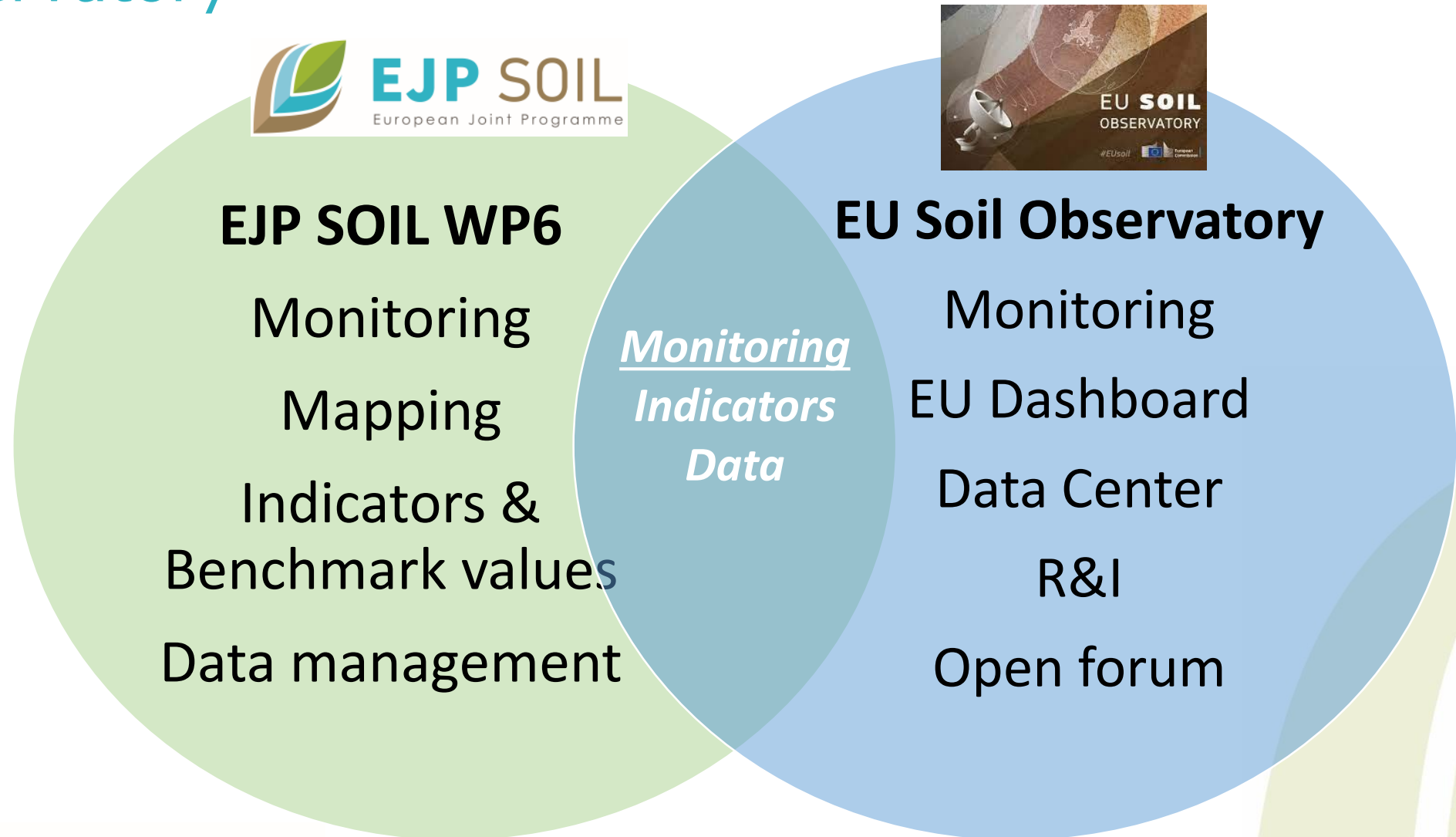
What is EJP SOIL?

- A European Joint Programme Cofund on Agricultural Soil Management contributing to **key societal challenges** including climate change, water and future food security.
- The EJP SOIL consortium consists of **26 partners from 24 countries** ensuring a large representation of European countries.
- The main aim of EJP SOIL is to develop a **sustainable framework for an integrated community of researchers working on related aspects of agricultural soil management.**



www.ejpsoil.eu

EJP SOIL WP6 main objectives and links with EU Soil Observatory

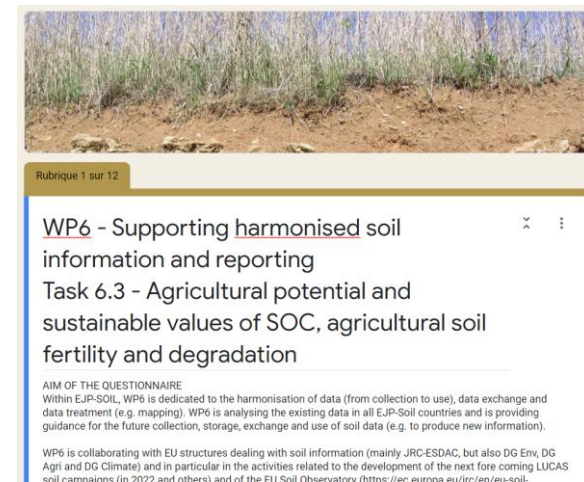


Describe and analyse Soil Monitoring Systems across EJP SOIL partners

- **Stocktake** the description of monitoring networks across EJP SOIL partners through the use of a **questionnaire**
 - Institution identification
 - SMS short description
 - Site information
 - Sampling protocol
 - Sampling for bulk density
 - Soil description
 - Soil sample preparation and conservation
 - Litter sample
 - Analyses and methods
 - Harmonization options
 - Collaborations and/or synergies between Member States and LUCAS
- 20 answers, 41 contributors

Published on the EJP SOIL web portal:

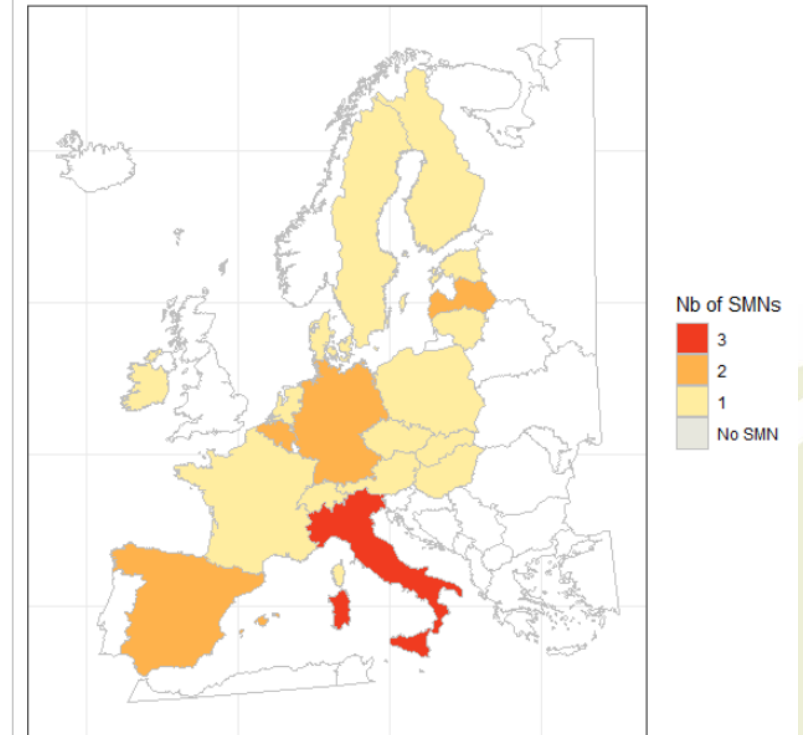
https://ejpsoil.eu/fileadmin/projects/ejpsoil/WP6/EJP_SOIL_Deliverable_6.3_Dec_2021_final.pdf



EJP SOIL Deliverable 6.3

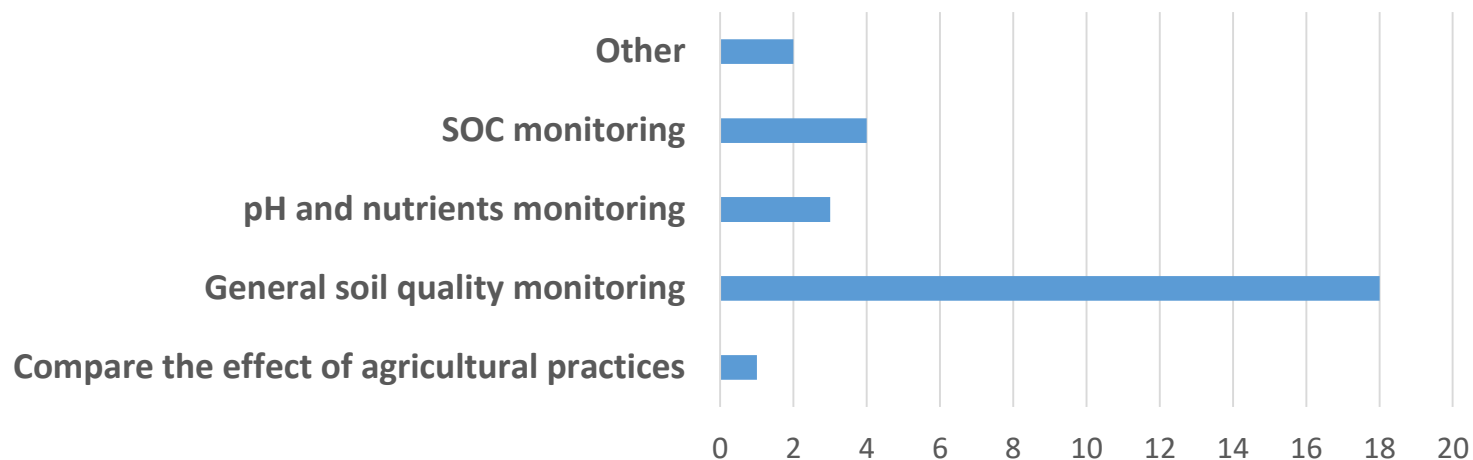
SMS in EJP SOIL countries

- 20 countries answered out of 24 (ending with 27 declared SMS)
- Turkey and Portugal do not have SMS
- Five countries have 2 or 3 monitoring systems
 - SMS managed at regional scale
 - SMS with different purposes (e.g. agricultural vs forest, monitoring trace element vs agricultural parameters, monitoring a network of highly instrumented sites vs network agricultural soils)
- Caution: Not all countries declared their forest SMS

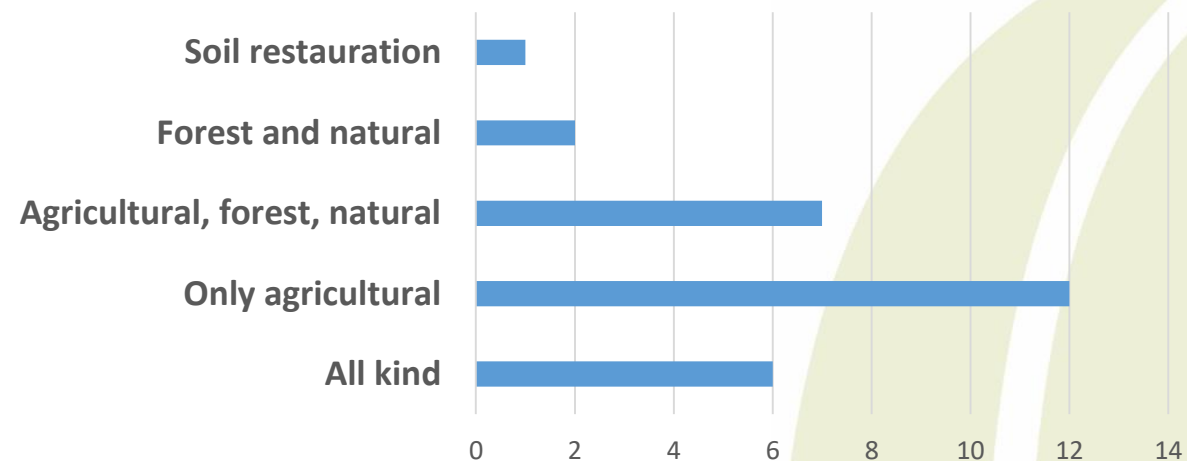


Results at a glance

Main objective of the SMS

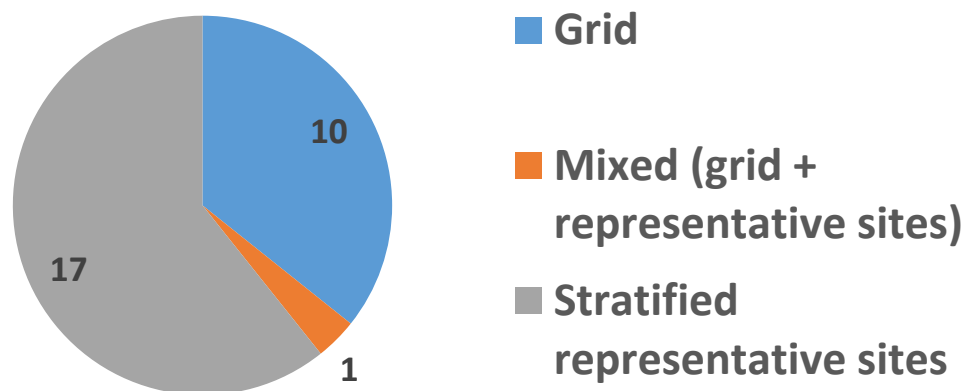


Investigated land uses

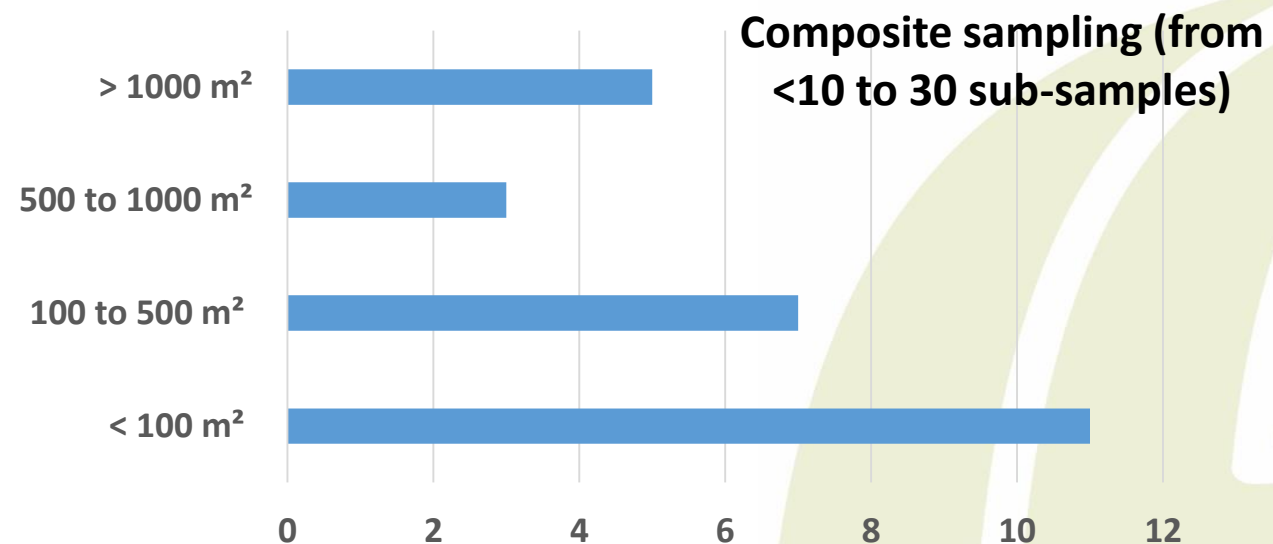


Results at a glance

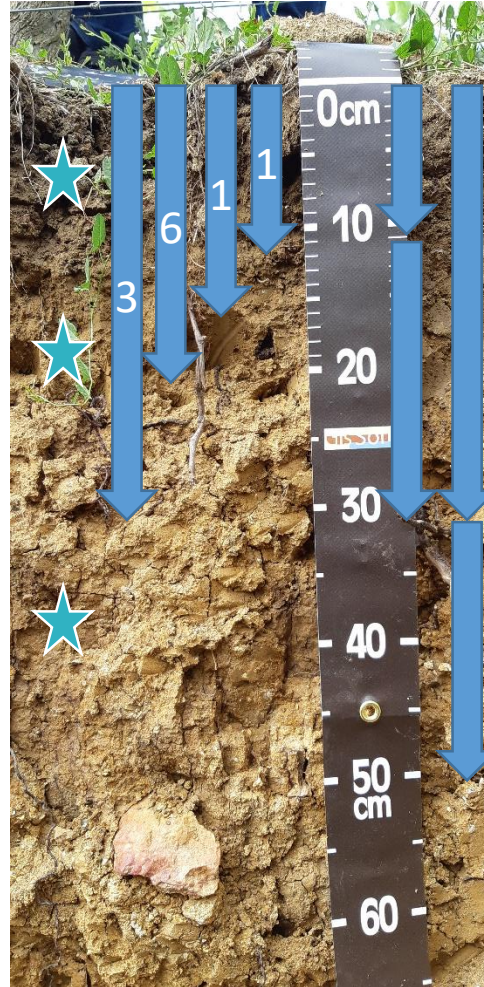
Sampling design



Sampling area



Results at a glance - Sampling depths



11 one fixed depth

14 different fixed depths

to 1 m

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16 MS sample for bulk density

13 MS are sampling deeper than 30 cm

4 according to horizons



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Analytical methods (still to be completed)

	Countries	Sweden	France	EU-JRC	Czech Republic	Latvia	Lithuania	Belgium - Wallonia	Belgium - Flanders	Netherlands	Slovakia	Denmark	Germany	TOTAL	
	Name of the Soil Monitoring System	Soil & Crop Inventory	RMQS	LUCAS _a	Basal soil monitoring	SPPS	SPPS N	Dirv_DR10LT	CARBIOSOL	Koolst of monitoring network	Netherlands Soil Sampling Program (NSSP)	CMS-P	DSMDB	Boden-Dauerbeobachtung _b	
Main soil properties, according to Global Soil Map specifications, 2015	total profile depth		x												6
	plant exploitable (effective) soil depth		x												4
	organic carbon	x	x	x											13
	pH in water	x	x	x											10
	sand	x	x	x											10
	silt	x	x	x											10
	clay	x	x	x											10
	gravel		x	x											6
	ECEC	x	x	x											9
	bulk density of the fine earth (< 2 mm) fraction (excludes gravel)		x												5
	bulk density of the whole soil in situ (includes gravel)		x	x											7
	available water capacity														2
	Electrical Conductivity		x												6
Other soil properties	calcium-carbonate content	x	x	x											10
	Field capacity (mm)														2
	Plant available amounts of macro and micro nutrients	x	x	x											12
	Total amounts of macro and micro nutrients/trace elements	x	x	x											8
	quality of clay minerals (e.g. type or ratio of illite, smectite, montmorillonite in clay fraction...etc)			x											2
	distribution of soil organisms		x	x						x		x		x	5
	properties for NIR and MIR (near and mid infrared)	x	x	x						x					5

Main « common » parameters:

- Organic carbon

- pH (in water)

- Soil texture

- Calcium/carbonate content

- Macro/micronutrients

... but different methods are applied... (see also Deliverable D6.1 from EJP SOIL)

Main « common » parameters:

- Organic carbon
- pH (in water)
- Soil texture
- Calcium/carbonate content
- Macro/micronutrients

... but different methods are applied... (see also Deliverable D6.1 from EJP SOIL)

Harmonization options

Can you modify:

- the sampling design of your SMS => NO but we may add new points (#12)
- the sampling area => NO (#20)
- the sampling depths => NO (#18) but we may sample deeper (#4)
- the soil sample preparation, before analysis => NO (#21)
- the analytical methods => NO (#16)

Any change would make impossible the comparison with previous data...

- Can you consider collecting new information on the monitoring sites?
 - YES: (#24)
- Can you improve soil description on the monitoring sites?
 - YES: (#16)
- Can you add extra analytical parameters?
 - YES: (#21)

But this will require more funds ...

Main recommendations

ONGOING

- Compare national and LUCAS sampling strategies/schemes
- Compare national and LUCAS data, country/country
- Develop transfer functions (from sampling to analytical methods), taking the opportunity of LUCAS 2022
- Identify / test methods to merge national and LUCAS datasets and/or existing maps
- Develop / test benchmark values/scoring approaches

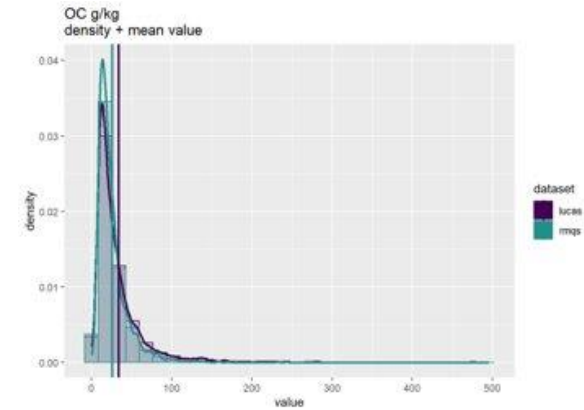
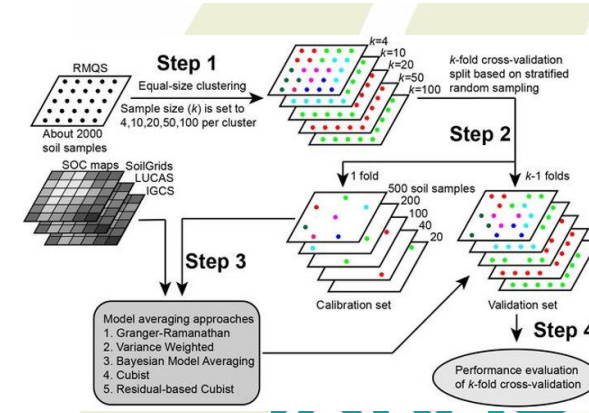


Table 3. Equations of PTFs built by partial least square regression (PLSR) for estimating Olsen P_2O_5 with their mean R^2 and RMSE values based on cross-validation.

R^2	RMSE (mg kg^{-1})	Equations
PTFs built with Joret-Hébert P_2O_5 and other variables		
0.398 a	33.719aa	Olsen $P_2O_5 = 27.215 + 0.244 \cdot \text{Joret-Hébert } P_2O_5$
0.535b	29.627bb	Olsen $P_2O_5 = -19.619 + 0.254 \cdot \text{Joret-Hébert } P_2O_5 + 0.096 \cdot \text{Silt}$
0.535b	29.630bb	Olsen $P_2O_5 = 299.664 + 0.270 \cdot \text{Joret-Hébert } P_2O_5 - 35.208 \cdot \text{pH}_{water}$
0.606c	27.198 cc	Olsen $P_2O_5 = 218.385 + 0.263 \cdot \text{Joret-Hébert } P_2O_5 - 29.419 \cdot \text{pH}_{water} + 0.079 \cdot \text{Silt}$
PTFs built with Dyer P_2O_5 and other variables		
0.638d	27.860dd	Olsen $P_2O_5 = 28.315 + 0.19 \cdot \text{Dyer } P_2O_5$
0.681d	26.167dd	Olsen $P_2O_5 = 21.5 + 0.193 \cdot \text{Dyer } P_2O_5 + 35.49 \cdot \text{exchangeable Al}$
0.699d	27.062dd	Olsen $P_2O_5 = 63.246 + 0.195 \cdot \text{Dyer } P_2O_5 - 6.063 \cdot \text{pH}_{water}$
0.685d	25.985dd	Olsen $P_2O_5 = 57.522 + 0.193 \cdot \text{Dyer } P_2O_5 - 5.987 \cdot \text{pH}_{water} + 35.447 \cdot \text{exchangeable Al}$

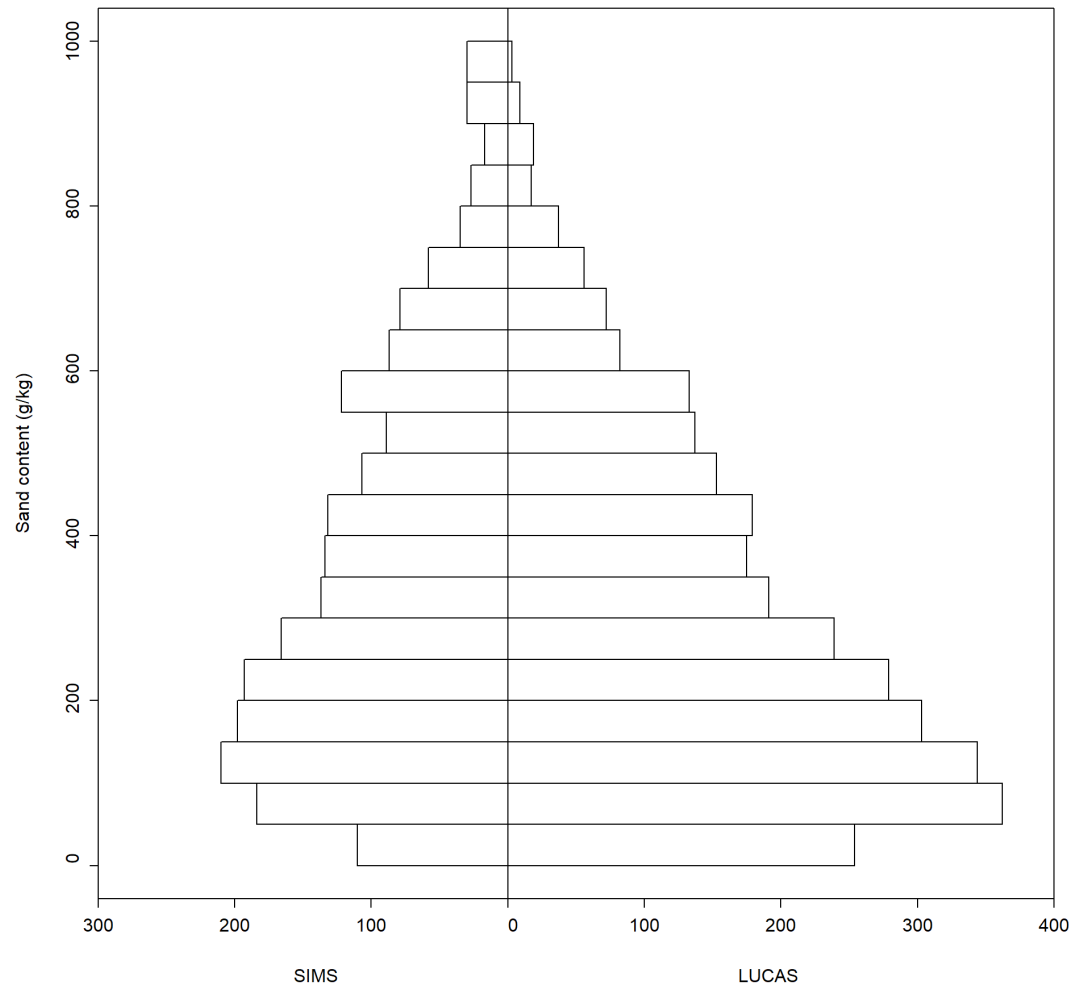
Note: R^2 means coefficient of determination, RMSE means root mean-square error; "a", "b", "c", "d", "aa", "bb", "cc" and "dd": letters indicating significant differences from mean comparison ($\alpha \leq 5\%$) of R^2 and RMSE among PTFs.



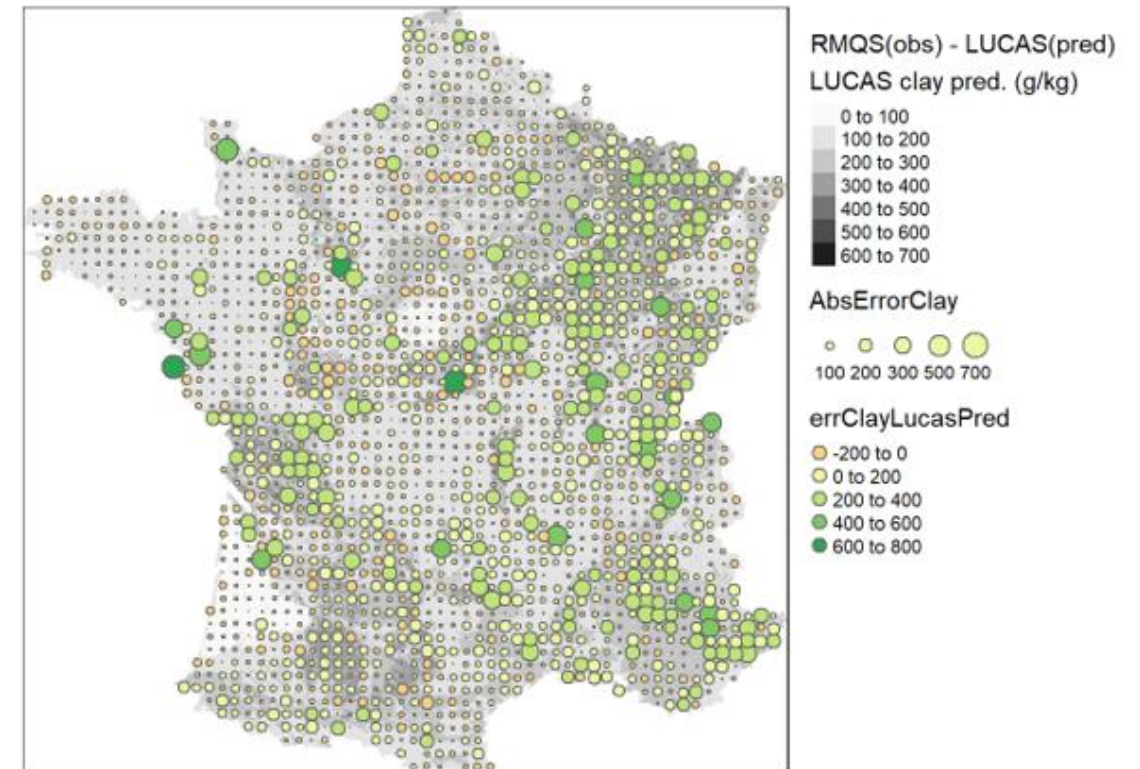
LUCAS / SIMS comparison protocol



Back-to-back histogram of sand content from SIMS and LUCAS datasets



<https://nicolassaby.pages.mia.inra.fr/ejpsoilwp6lucas/>



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EJP SOIL partners investment in the development of transfert functions (in link with LUCAS SOIL 2022)



Analytical procedures

- Double samples obtained from LUCAS 2022 samplers
- Between 100 and 200 sites will be analyzed depending on the countries
- 17 countries involved
- Comparison of EU and national results



Sampling and analytical procedures

- Sampling (on national SMS and/or on LUCAS 2022 points) according to national and LUCAS sampling protocols
- 6 countries involved
- Compare the overall process



Conclusions

- Updated overview of SMS in EJP SOIL countries
- Based on the questionnaire: full harmonization seems impossible
- Next steps:
 - Common sites may be implemented to compare soil monitoring systems
 - Ways to take advantage of national/EU data are currently being tested as
 - Merging datasets / maps knowing and understanding the differences (by the end of this year)
 - Transfer functions to be developed next year using the LUCAS 2022 sampling campaign
 - Scoring functions to transform the data obtained through different ways (next year)
- Results can be later used to implement and populate the EU Soil Observatory!

Thank you for your attention

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Soil Mapping for a Sustainable Future
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Digital Soil Mapping and Global Soil Map

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