



HAL
open science

Digging into the bulk density and coarse fragment data of the French soil quality monitoring network

J. L. Munera-Echeverri, Manuel P Martin, Line Boulonne, Nicolas P. A. Saby,
D. Arrouays

► To cite this version:

J. L. Munera-Echeverri, Manuel P Martin, Line Boulonne, Nicolas P. A. Saby, D. Arrouays. Digging into the bulk density and coarse fragment data of the French soil quality monitoring network. 22. World Congress of Soil Sciences, International Science Council (ISC), Aug 2022, Glasgow, United Kingdom. hal-04181828

HAL Id: hal-04181828

<https://hal.inrae.fr/hal-04181828v1>

Submitted on 16 Aug 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

Digging into the bulk density and coarse fragment data of the French soil quality monitoring network (RMQS)

Munera-Echeverri JL ¹, Martin M ¹, Boulonne L¹, Saby N¹, Arrouays D¹.

¹INRAE, InfoSol, 45075, Orléans, France

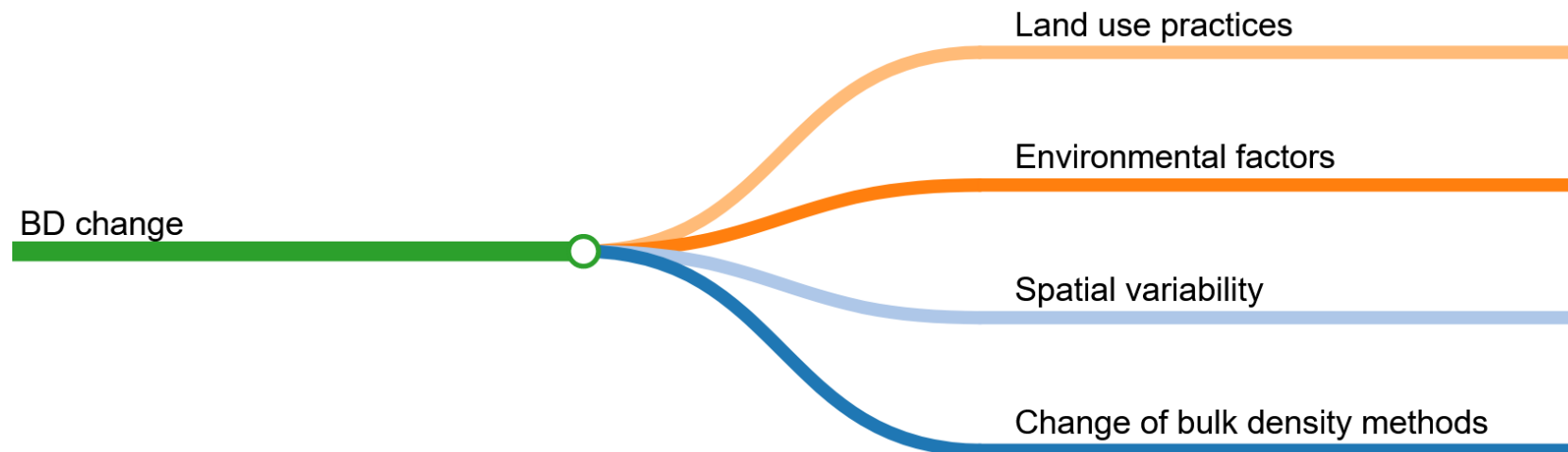


INRAE
science for people, life & earth

Context and problem description

- Bulk density (BD) and coarse fragments (CF) are needed to calculate stocks, e.g. SOC stocks.
- Often missing in soil monitoring networks because of time, labor and budget constraints.
- In RMQS BD and CF have been measured in both campaigns by two methods.
- Calculate stock changes based on equivalent soil mass.
- It is not clear the validity of these measurements and the nature of the BD changes.

What makes BD change?

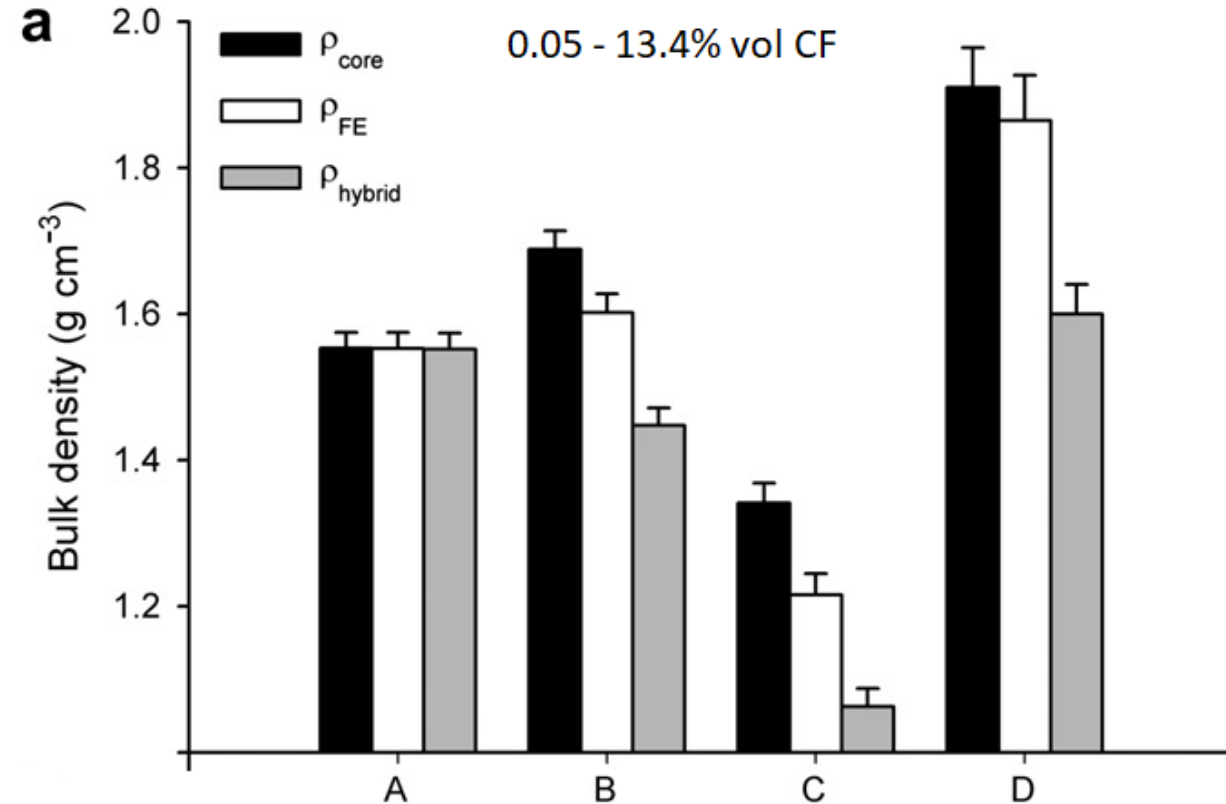


Bulk density and coarse fragments

$$\text{BD (g.cm}^{-3}\text{)} = \frac{\text{Fine soil} + \text{coarse fragments}}{\text{Sample Volume}}$$

$$\text{Fine soil (g.cm}^{-3}\text{)} = \frac{\text{Fine soil}}{\text{Sample Volume}}$$

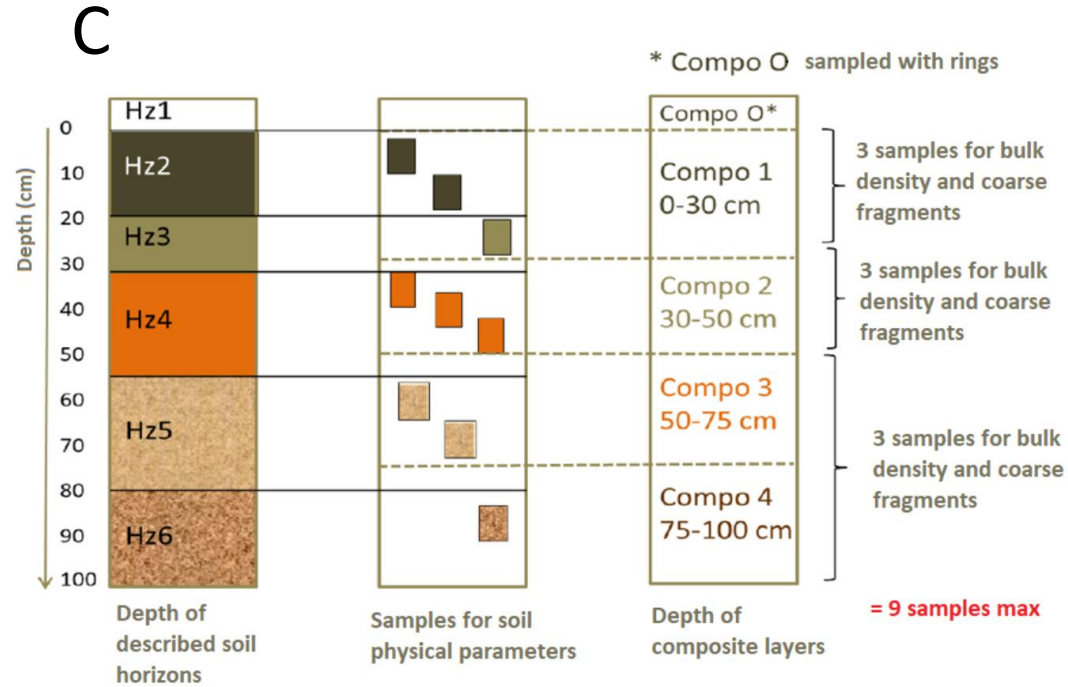
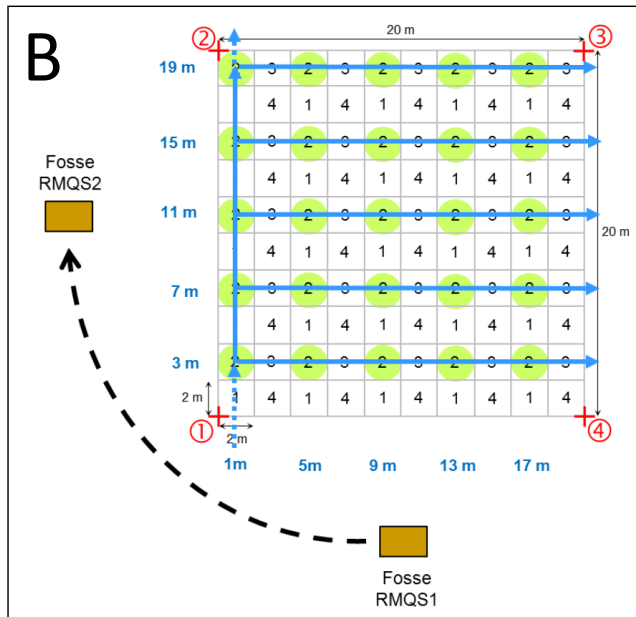
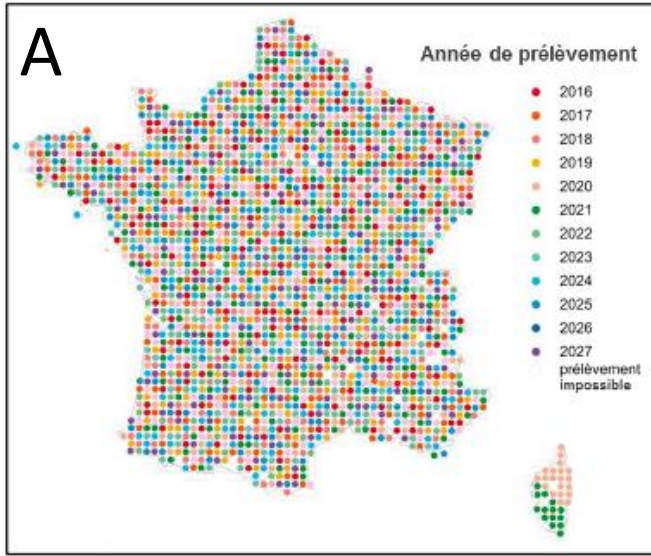
$$\text{Coarse fragments (\%)} = \frac{\text{CF mass}}{\text{Sample mass}} * 100$$



Objectives

- Which soil physical data should be used for estimating changes of SOC stocks in RMQS ?
- How does land use affect the changes of bulk and fine soil density between campaigns?

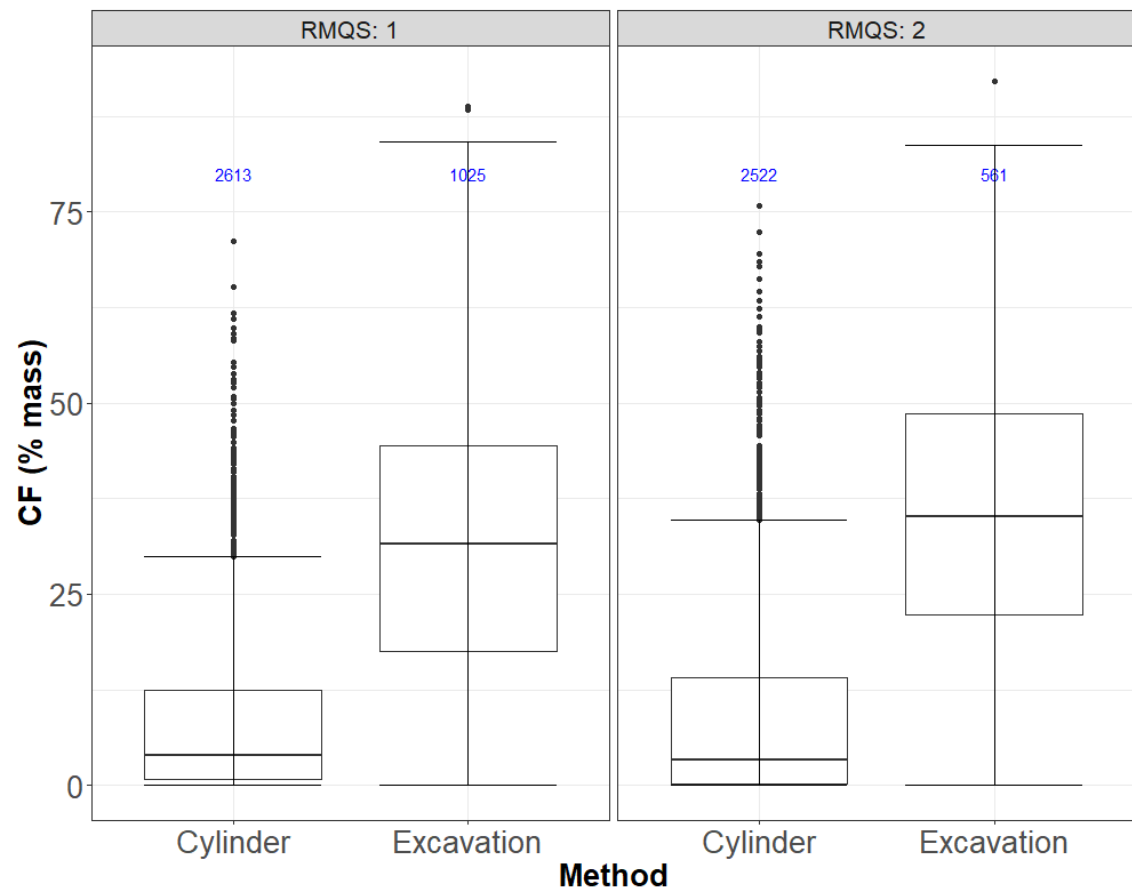
Sampling design



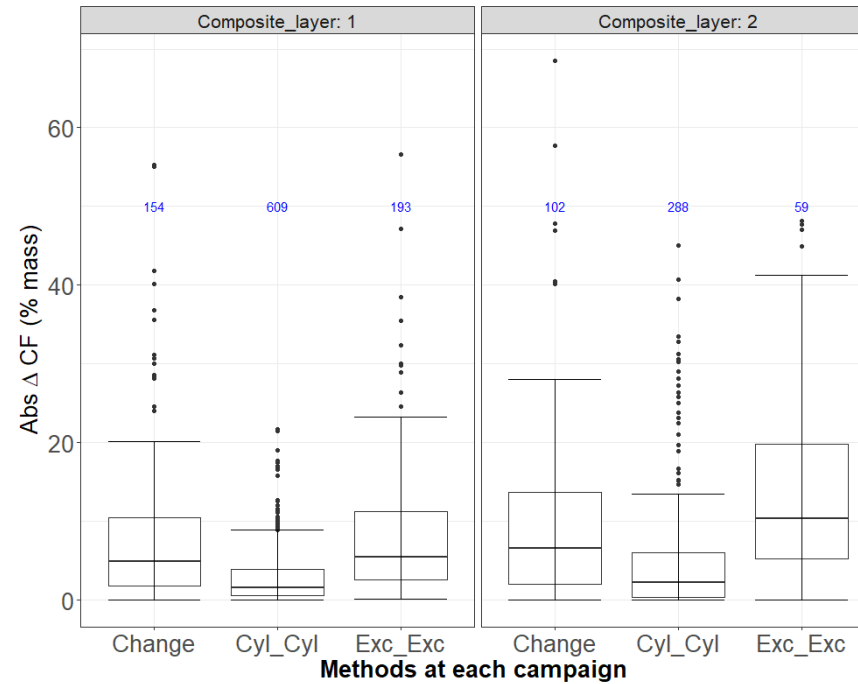
Jolivet et al. 2018

Coarse fragments

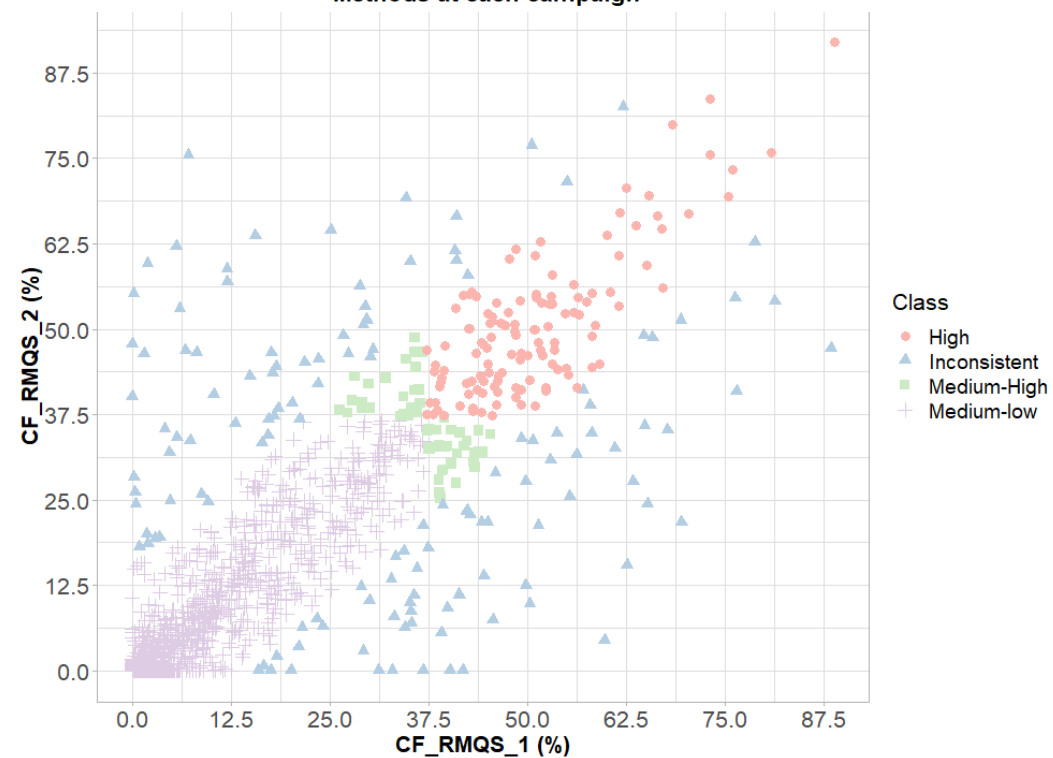
A



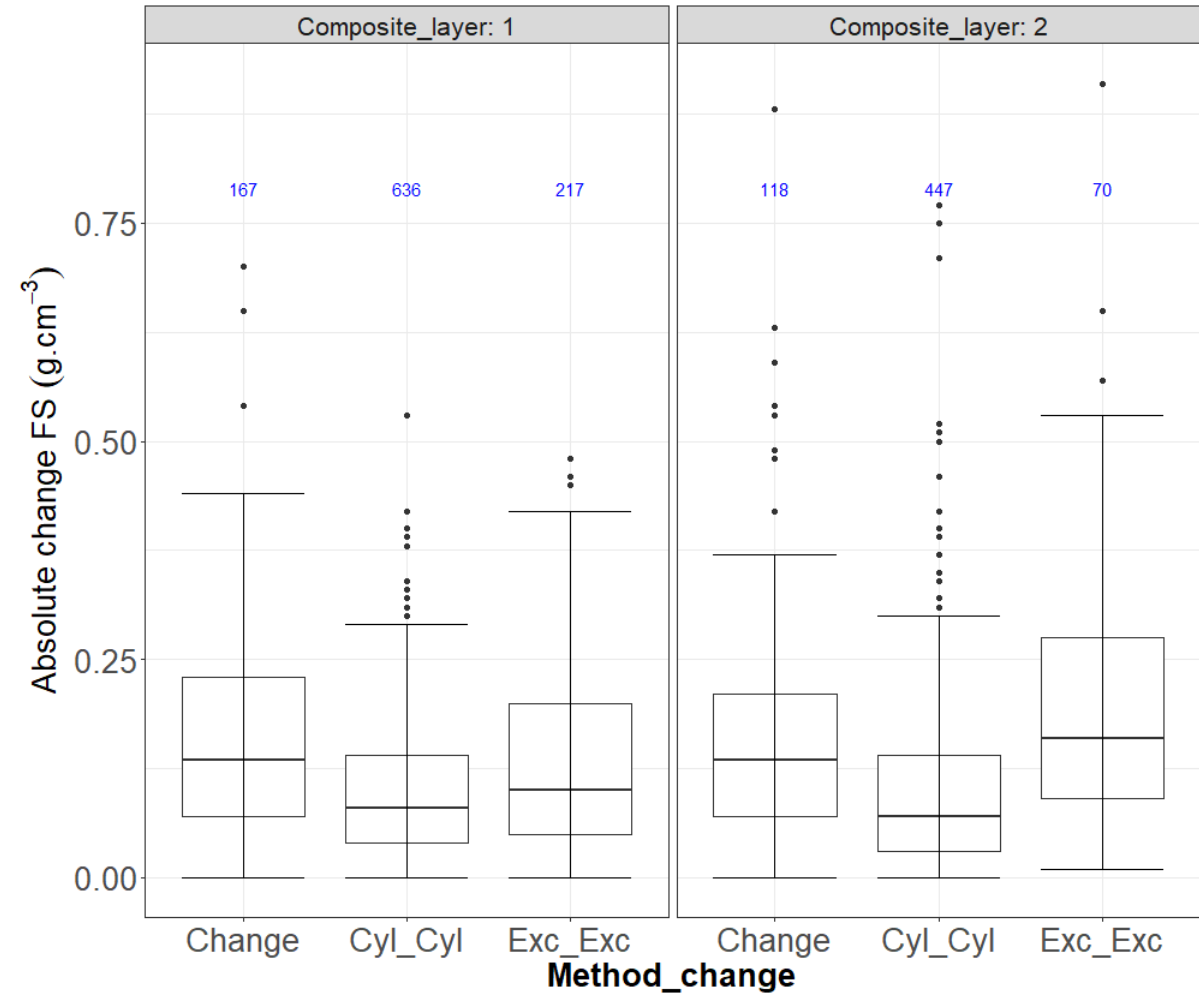
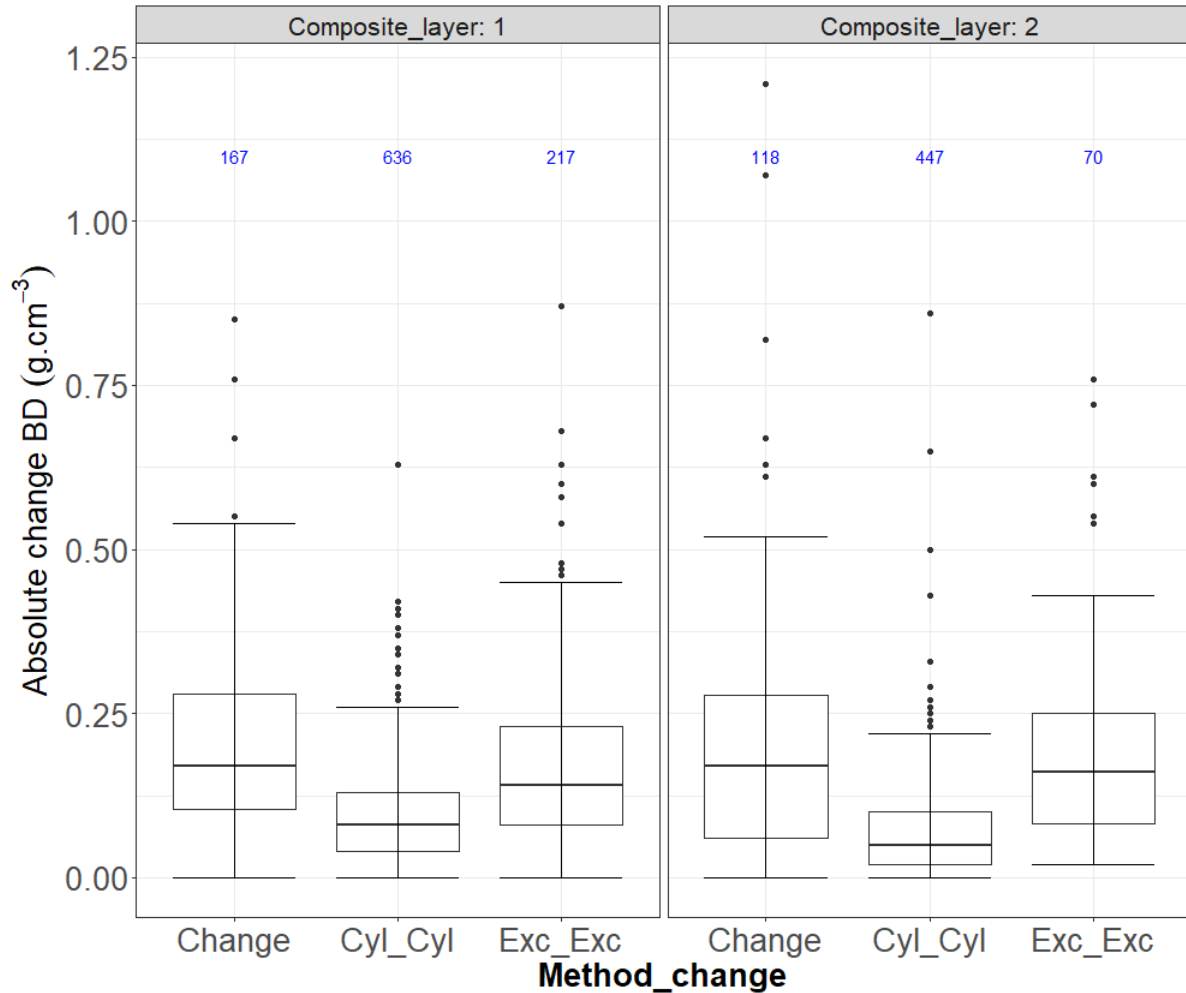
B



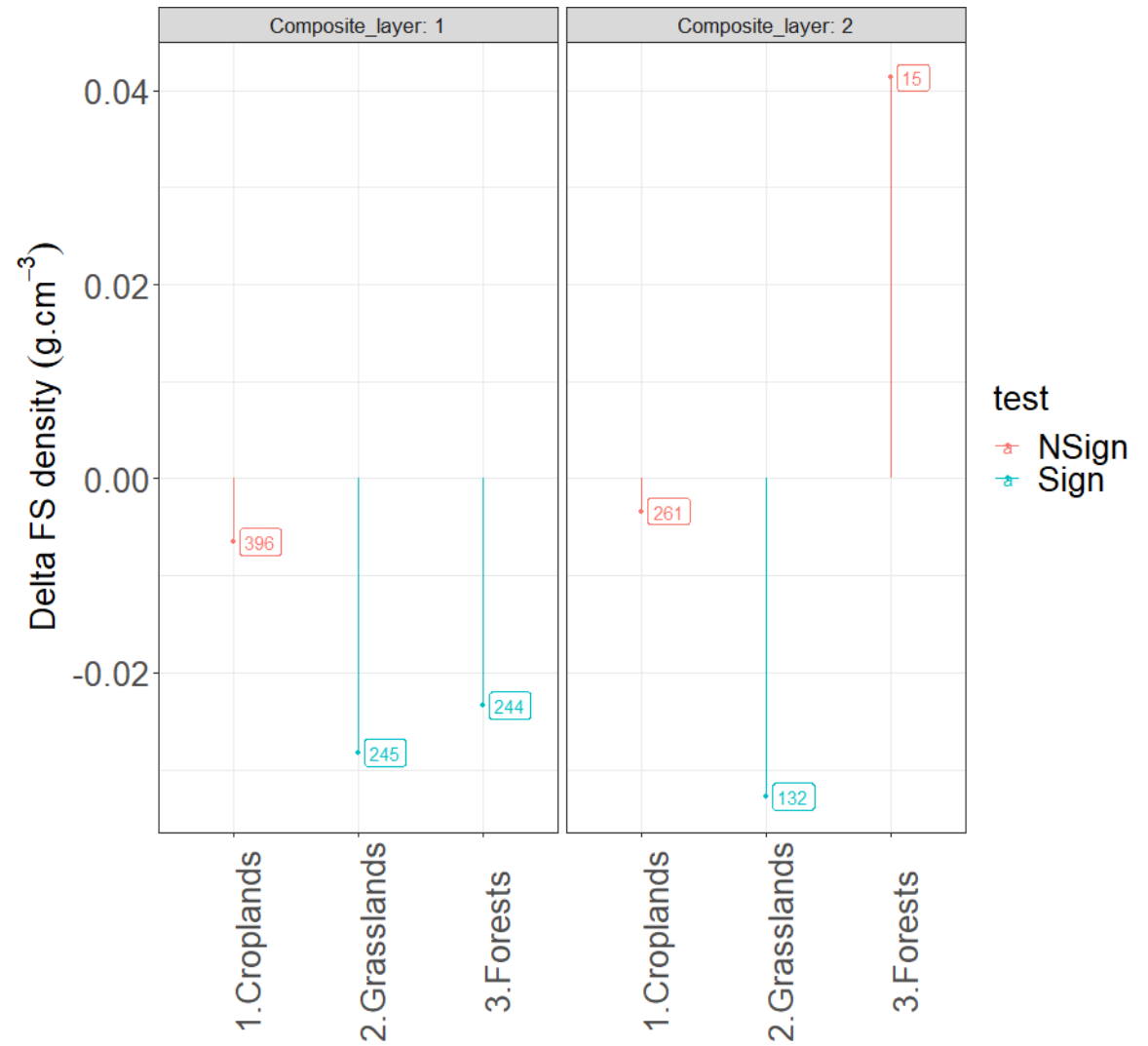
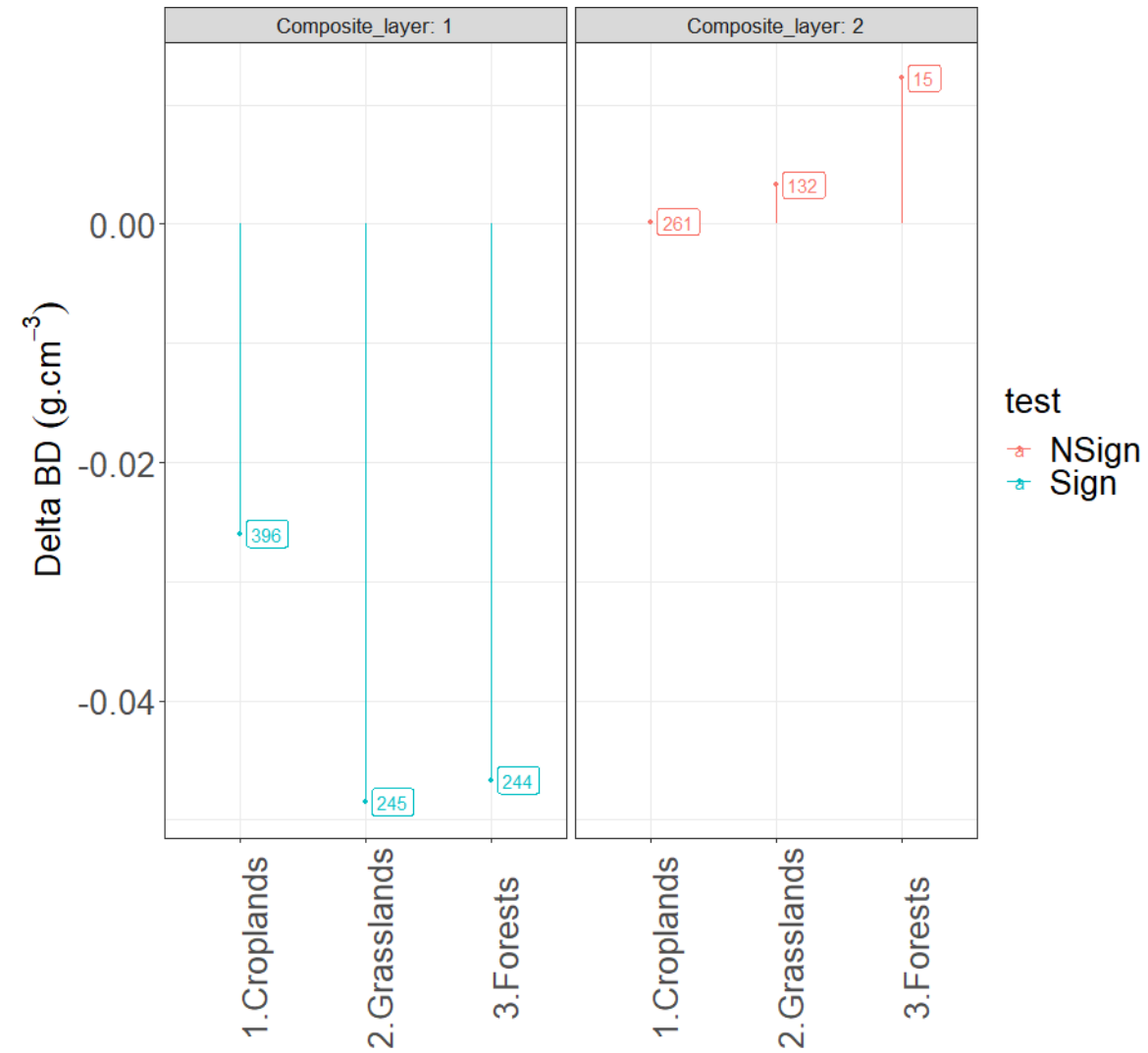
C



Δ Bulk density & Fine soil

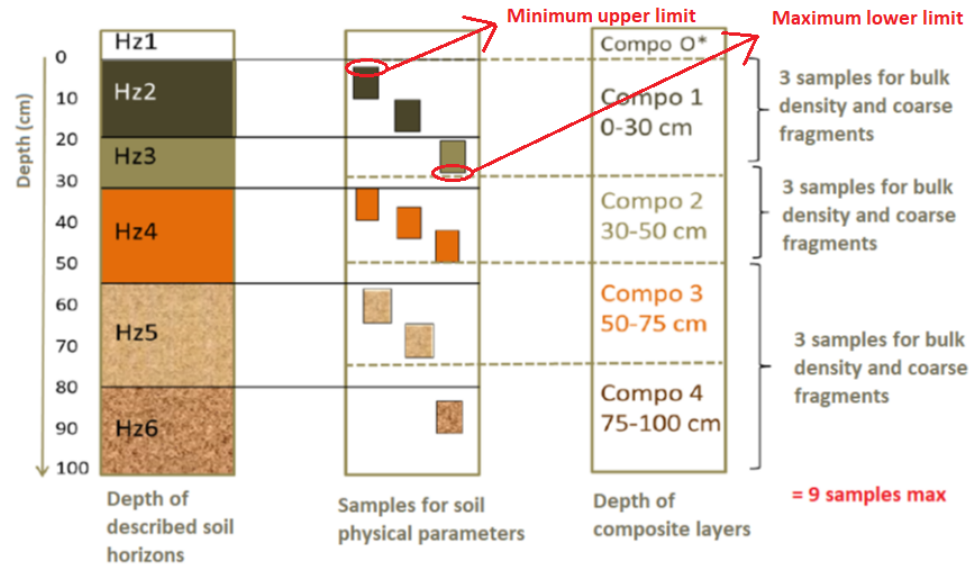


Effect of land use

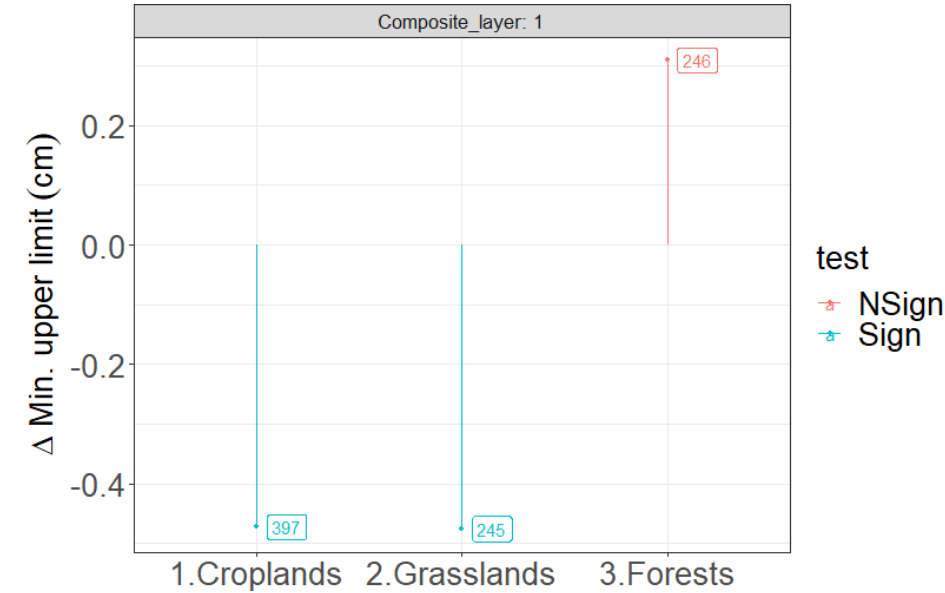


Distribution of samples within the soil pits To be confirmed

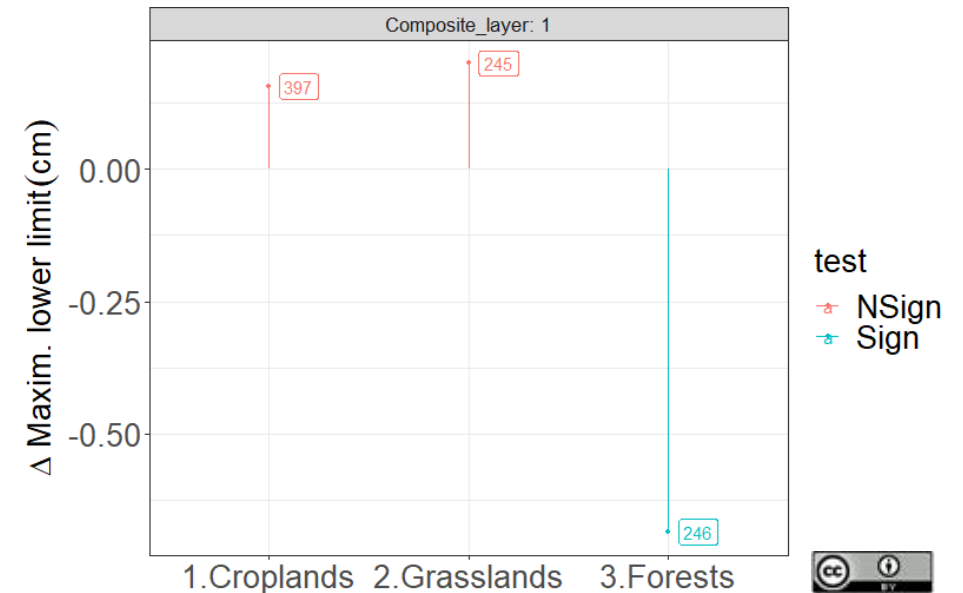
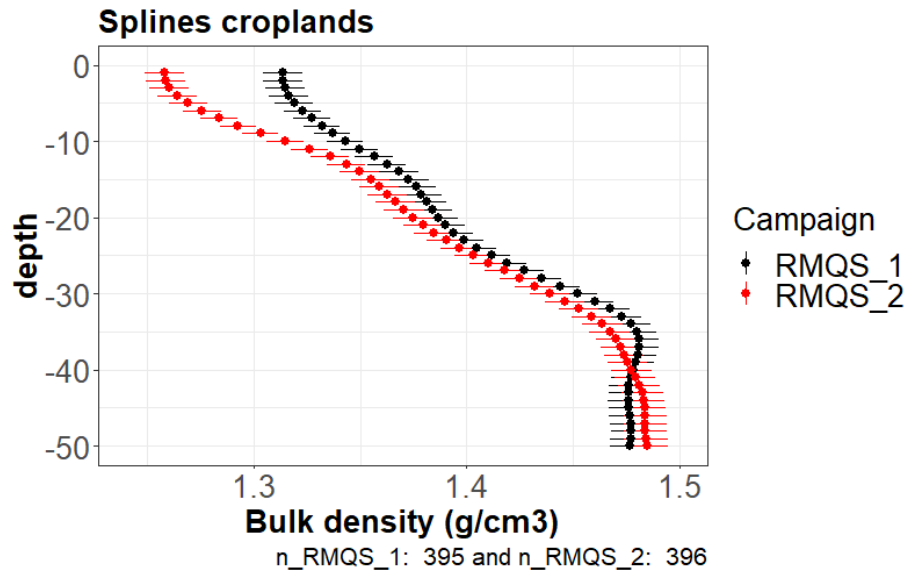
A



B



C



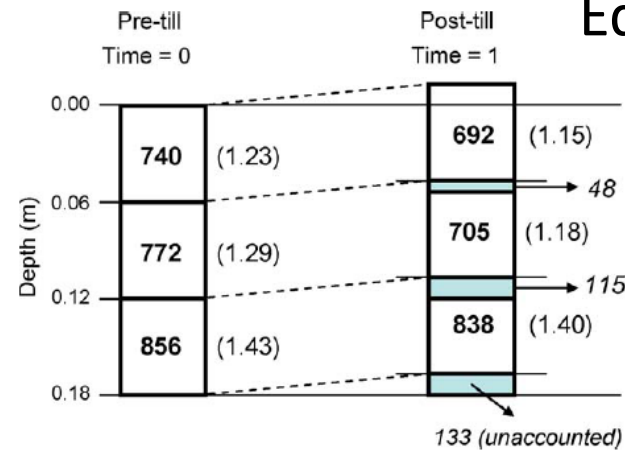
Discussion

- Uncertainty in CF content complicates the assessment of the temporal evolution of BD: decision tree.
- Variability of CF content is not necessarily related to measurement problems.
- Decrease of BD and FS in RMQS 2 in the main land use categories. Not entirely explained so far but there is a chance that this is linked to a change of distribution of samples within the soil profile. Average BD and CF?

Conclusions

- Scenarios for C stock changes:

Fixed depth



Equivalent soil mass

Lee et al., 2009

All data

Decision tree

Average of 2 campaigns:
BD constant

Pedotransfer?

- Significant decrease of BD in croplands, grasslands, and forests in horizon 1 but the reason is not fully understood yet.

The end

Thanks for your attention!



INRAE
science for people, life & earth

References

- Throop, H. L., S. R. Archer, H. C. Monger, and S. Waltman. 2012. “When Bulk Density Methods Matter: Implications for Estimating Soil Organic Carbon Pools in Rocky Soils.” *Journal of Arid Environments* 77 (February): 66–71. <https://doi.org/10.1016/j.jaridenv.2011.08.020>.
- Jolivet, Claudy C., Jose-Luis Almeida Falcon, Philippe Berche, Line Boulonne, Marie Fontaine, Laëtitia Gouny, Sébastien Lehmann, et al. 2018. *Manuel du Réseau de Mesures de la Qualité des Sols (RMQS)*. <https://hal.inrae.fr/hal-02791718>.
- Lee, J., Hopmans, J.W., Rolston, D.E., Baer, S.G., Six, J., 2009. Determining soil carbon stock changes: Simple bulk density corrections fail. *Agriculture, Ecosystems & Environment* 134, 251–256. <https://doi.org/10.1016/j.agee.2009.07.006>