

Soil biodiversity monitoring in France

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on the behalf of GIS Sol



GIS Sol a Scientific Interest Group on soils dedicated to collect, use and give access to soil data in France

- **Involvement:**

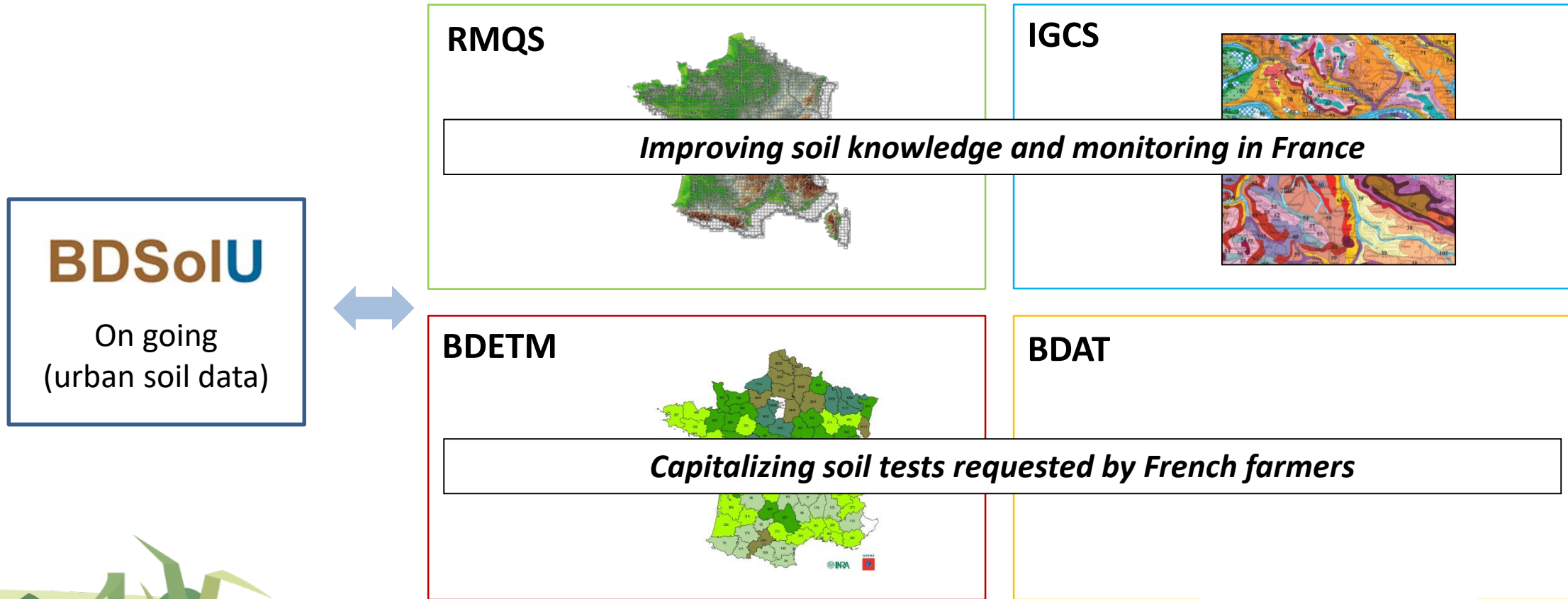
- 2 ministries (Agriculture and Environment),
- 2 national agencies (Environment and Biodiversity)
- 4 research institutes (INRAE, IRD, IGN and BRGM)
- INRAE InfoSol: coordination of programs and databases

- **Main aims:**

- Survey and monitor French soils
- Organize and store soil samples and soil information
- Give access to soil information and samples
- Support public policies

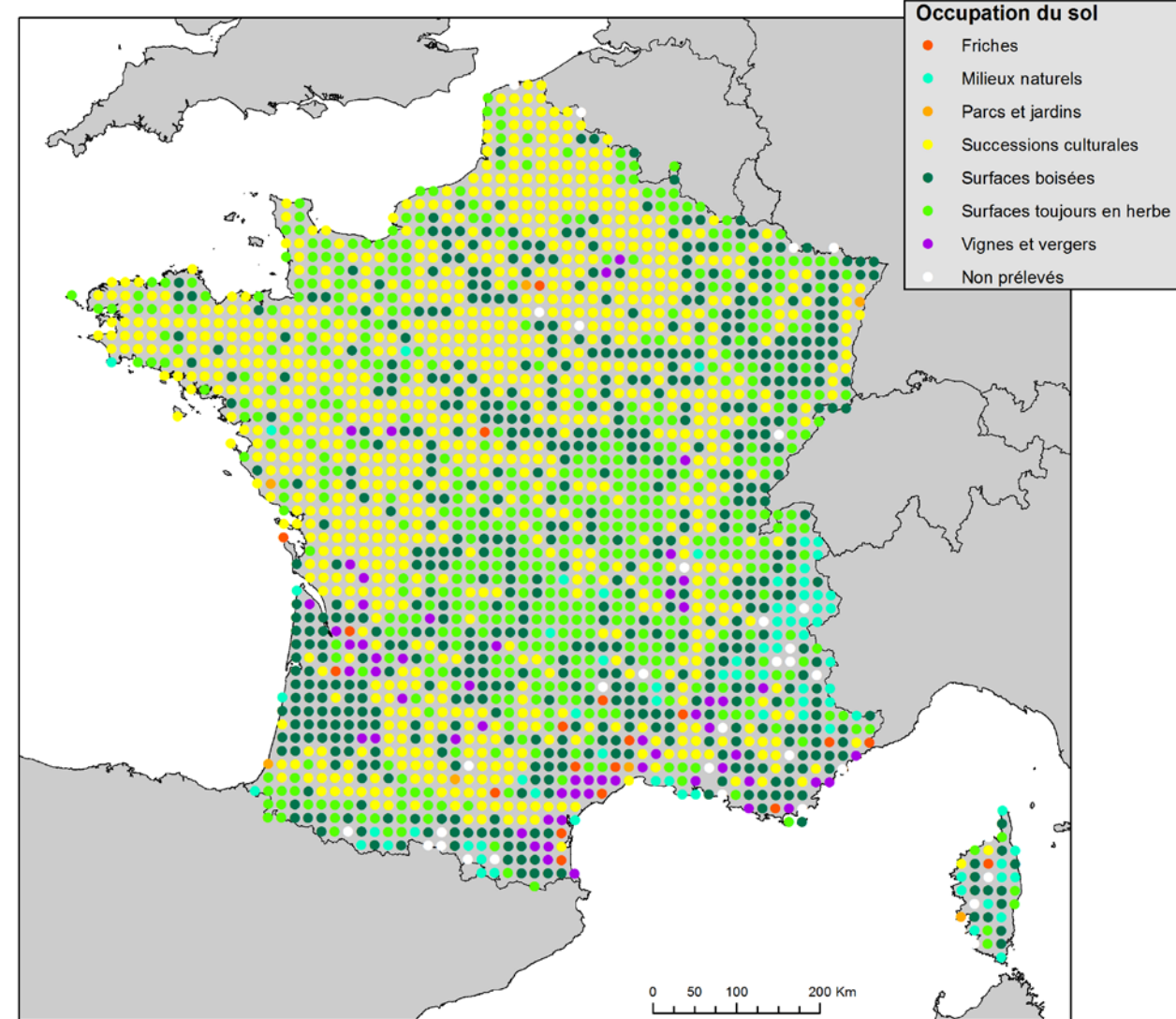


Four main soil survey and monitoring programmes

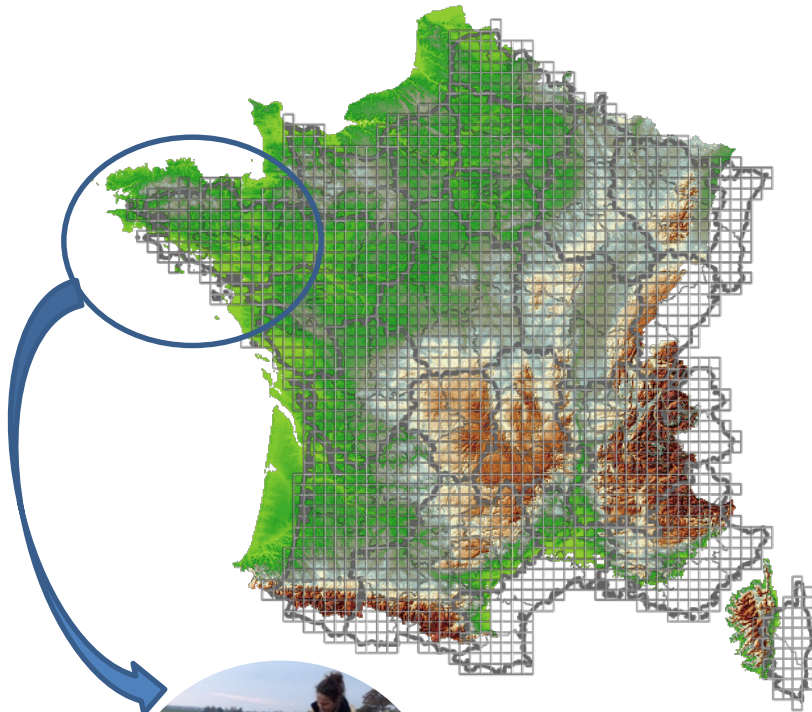


RMQS: French National Soil Quality Network

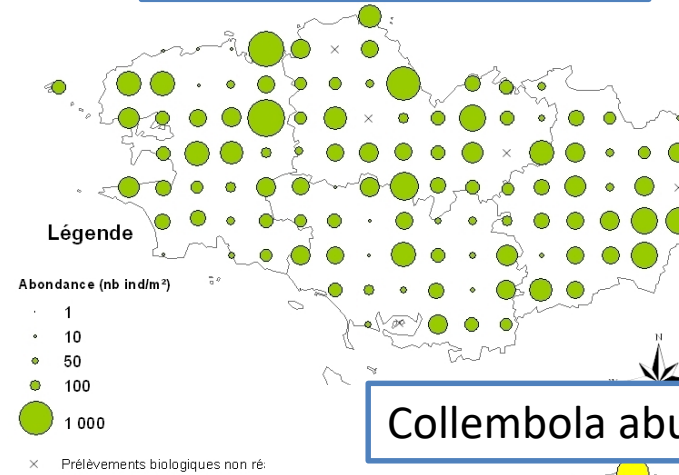
- 2240 sites, 16 km x16 km grid
- On different land uses in continental France and overseas territories
- Each site is sampled every 15 years, since 2000 (2nd campaign started in 2016)
- 12 sub-contracted teams in France doing the fieldwork, based on a common manual
- Data available on soil:
 - Physical and chemical characteristics,
 - Contaminants,
 - Biodiversity,
 - Management practices



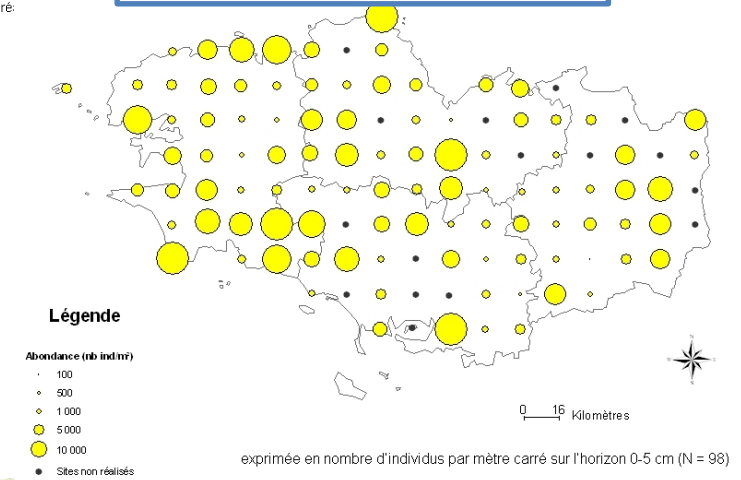
Early experiences – Soil fauna (2005-2010)



Earthworms abundance

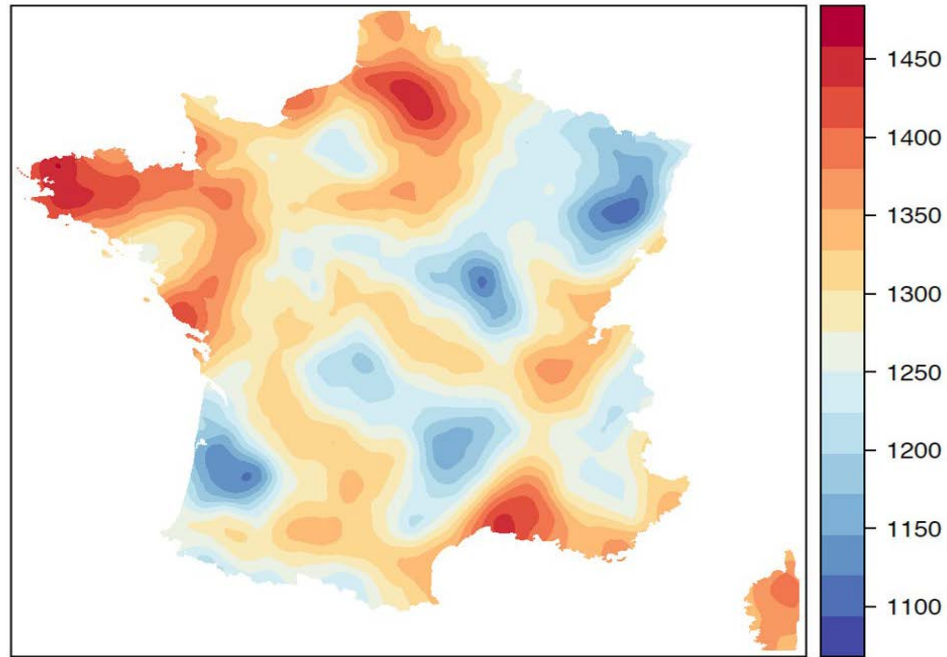


Collembola abundance



Early experiences – Microbial biomass and bacterial communities (based on DNA extracts) (2005-...)

Bacterial diversity of soils – France



Source : © GIS Sol, UMR Agroécologie – équipe BIOCUM, plateforme GenoSol

Environmental Chemistry Letters, 15 (2017), pp. 265-281

19. FIBROBACTERES

Généralités et distribution géographique

Classification: Milieux de vie: tractsus digérés des mammifères, sols, eaux usées, Biofacteurs, eaux douces, sédiments marins.

Morphologie et organisation: Gram négatives, Formes de bâtonnets ou cellule ovoide polymorphe

Classes	Ubiquité (%)	Abondance relative (%)	Métabolisme	Caractéristiques communes
Fibrobacteria (Fibrobacter sp.)	75	< 1	Anaérobies obligatoires, hétérotrophes et chemo-organotrophes.	Mésophiles, parfois thermophiles. Dégradation de matériaux ligno-cellulosiques (composés du glucose, xylose et de la cellulose en acides succiniques et en acide succinique). Développement en présence d'acides gras, de CO ₂ ou de carbonates et de sélénium. Source d'acides aminés et d'antimoine.

Autécologie

La distribution spatiale des Fibrobacteres est principalement expliquée par les paramètres géographiques et le mode de vie (respectivement 2,2% et 2,1%) et le climat explique en partie la distribution des Fibrobacteres (12,1%).

Effet des paramètres physico-chimiques du sol

Paramètre	Abondance relative (%)
pH	1,1 %
Teneur en azote	1,2 %
Phosphore	3,9 %
Teneur en carbone	1,5 %

Les Fibrobacteres sont stimulés dans les sols riches en azote, de grandes concentrations en pH acides et riches en phosphore.

Bactériologie

Nombre de liens: 23 - NIVEAU ÉLEVÉ

Interactions	Nombre	Phylum concerné
COOPÉRATION	18	Gemmatimonadetes, Bifidobacteriota, Nitrospirae, Alphaproteobacteria, Acidobacteria, Planctomycetes.
ANTAGONISME	5	

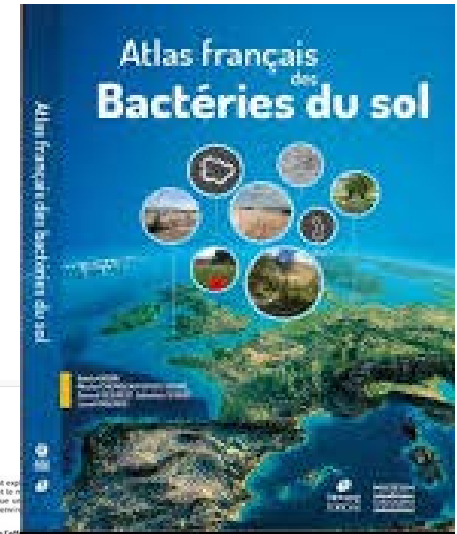
Les Fibrobacteres co-occurrent avec les Gemmatimonadetes, les Bifidobacteriota et les Nitrospirae, ce qui suggère un lien par leur affinité pour des milieux riches en azote. Leur co-occurrence avec les Alphaproteobacteria, les Acidobacteria et les Planctomycetes peut s'expliquer par l'abondance plus forte de ces derniers dans des sols acides.

Distribution spatiale: Hétérogène et structurée.

Taille des profils biogéographiques: Petite taille, 40 km de rayon.

Centres biogéographiques identifiés: Nord - Nord - Pas-de-Calais, Beauce - Ouest - Bretagne.

Régions présentant une abondance faible: Centre - Limousin, Centre, Bourgogne - Sud-Ouest - Grand-Est, Landes - Nord-Est - Alsace, Lorraine.



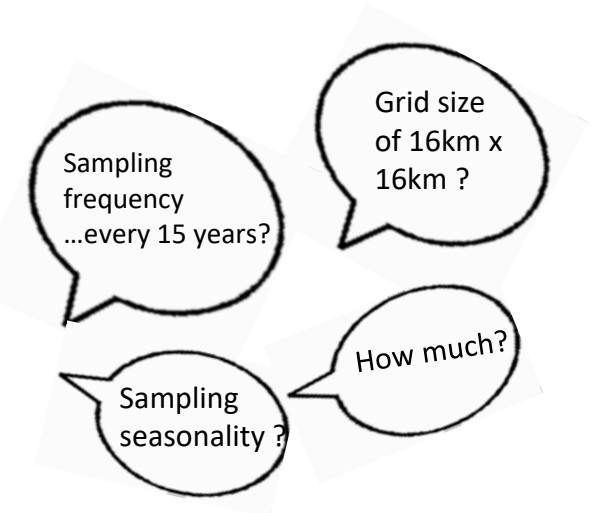
(Karimi et al. 2018)

Currently testing the inclusion of soil biodiversity in the RMQS

- **OFB is in charge of a French long-term biodiversity monitoring network?**
 - Based on these early experiences, in 2018, OFB approached the GIS Sol about the possible inclusion of soil biodiversity in this national network
 - RMQS being the possible device for such measurements (*as already implemented in mainland France and overseas territories*)



- **Our strategy**
 - Ask experts (on the indicators, the sampling strategy, the sampling procedures, the logistical constraints, the costs...)
 - Develop a handbook to be tested, identify relevant labs and estimate costs
 - Test the handbook on field with all partners across France
 - Analyze the results and feedbacks from field operators and labs
 - Conclude...



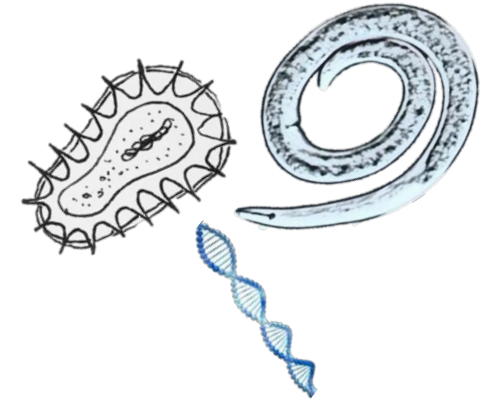
5 protocols selected to monitor both taxa and functions

* Already done in the RMQS

1

Surface soil composite sample*

Bacteria, Fungi and Protists
Nematods
Soil seed bank
Enzymatic activity
Organic matter degradation



2

Cylindrical split corer \varnothing 5 cm

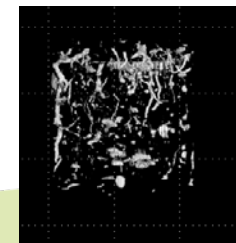
Below-ground mesofauna



3

Cylindrical split corer \varnothing 16 cm

Soil porosity

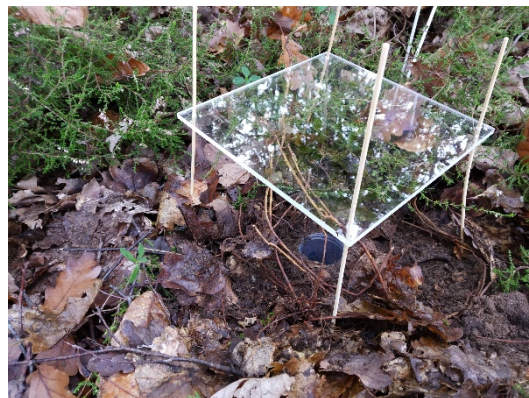


5 protocols selected to monitor both taxa and functions

4

6 Pitfall traps

Surface macro and mesofauna



5

6 Hand sorting of a soil block + mustard

Earthworms and larvae



First lessons from the field

Until now : around 20 sites sampled
(10 to come...)



Mean duration for applying on field the 5 protocols: 8h (min ~6h and max ~11h)
with 2 (or 3) people in addition to the team already involved for classical monitoring



Next steps and conclusion

- **Next steps :**

- Finish the field testing (February 2022)
- Update the manual, manage and analyze the data (spring 2022)
- Conclude and decide with OFB about what to monitor and how

- **1st conclusions**

- Sampling soil biodiversity is feasible on an existing network (as demonstrated by early experiments)
- Requires time (and money)
- Will we need to adapt the overall monitoring process?

