Soil quality monitoring network (RMQS) : a dedicated tool to evaluate and monitor long-term French soil quality

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Soil monitoring network developed within GIS SOL (Scientific Interest Group on soils)

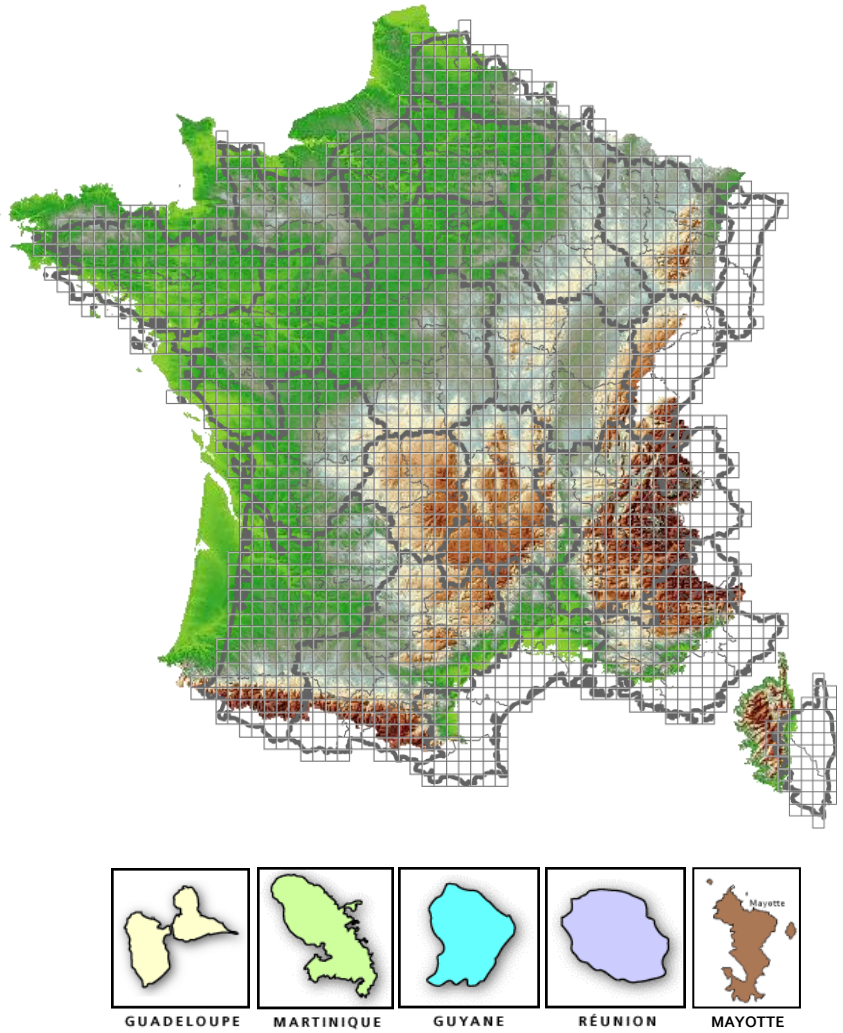
www.gissol.fr

- **GIS Sol created in 2001**
  - **2 Ministries (Agriculture and Environment),**
  - **2 National agencies (Environment and Biodiversity)**
  - **4 research institutes (INRA, IRD, BRGM and IGN) and**

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

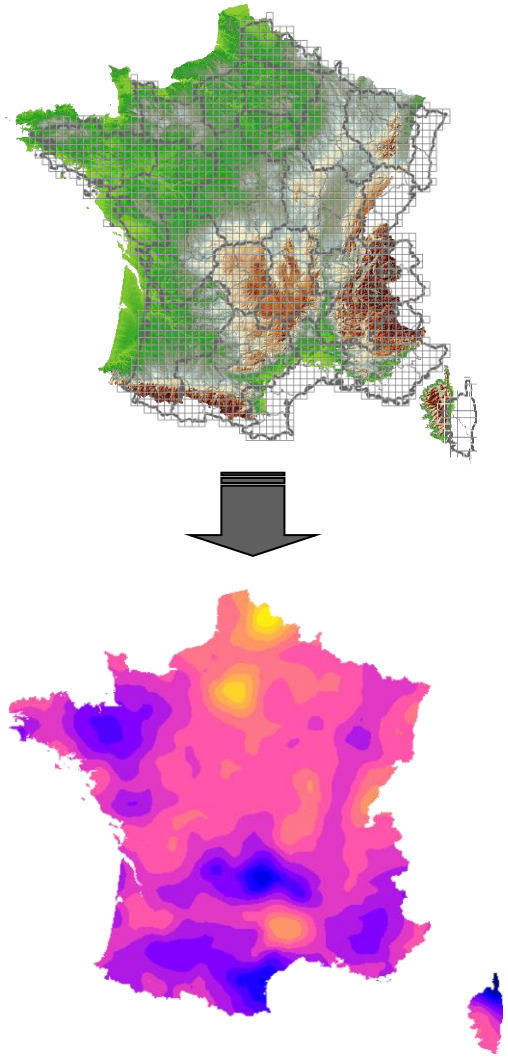
- **InfoSol acts as the national coordinator for the survey and monitoring programmes with the financial support of the funders**

RMQS: a systematic network



- 2240 sites
- Located along a 16 km x 16 km grid *(unbiaised sampling scheme)*
- Representative for French soils diversity and land-uses
- Resampled with 12 to 15 years interval

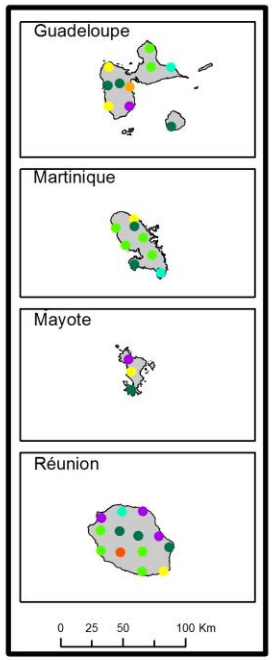
Main goals of RMQS

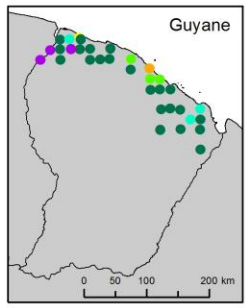


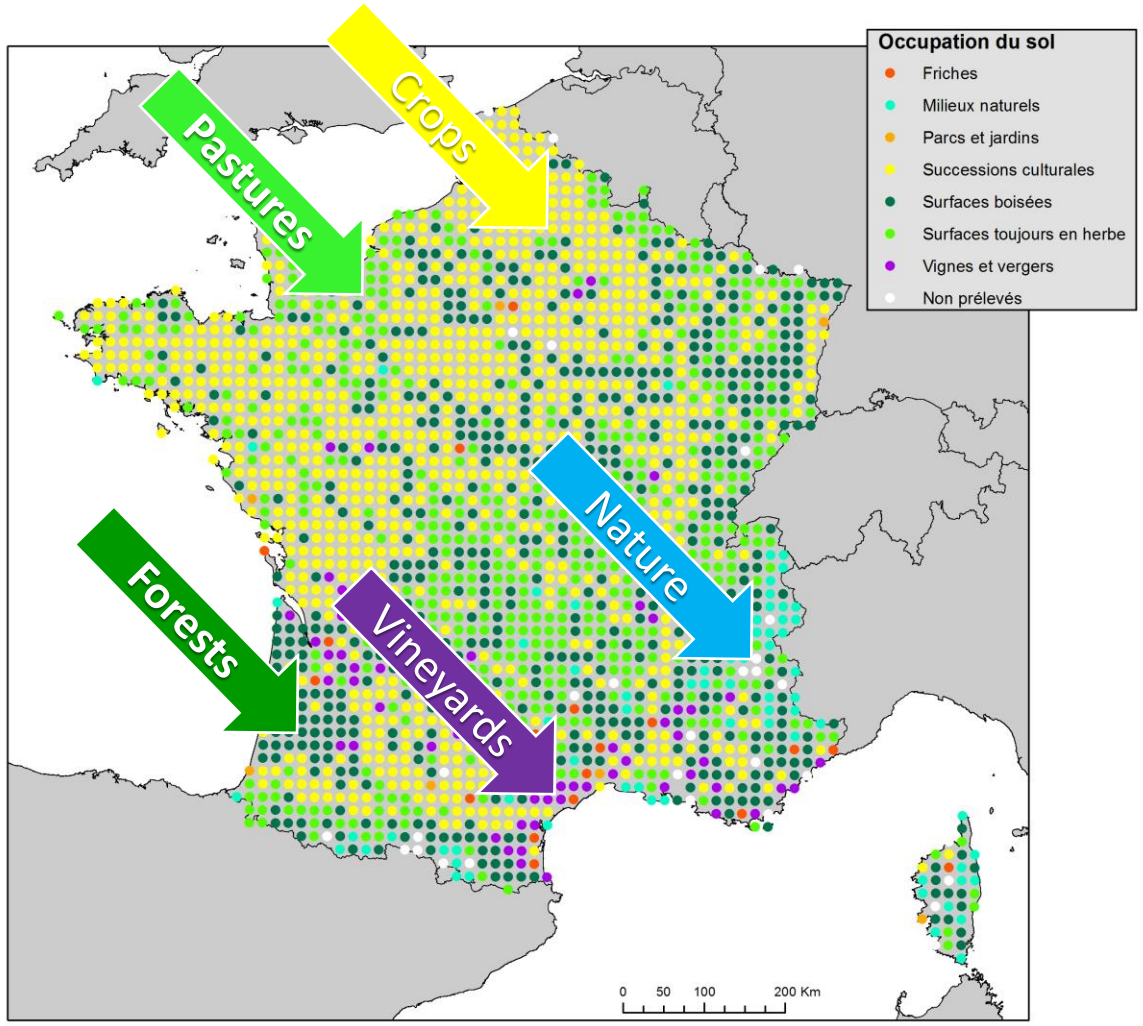
- **National statistics** (global statistic report on soil parameters)
- **Maps** (get an instant picture of soil quality and detect gradients)
- **Warning** (detection of evolutions)
- **Research** (e.g. explore the relationships between soil quality and possible controlling factors, validate spatial predictions, model evolutions)
- **Archiving** (bank of soil samples)

RMQS: representative for French soils and land-uses

© Claudy Jolivet (INRA Orléans)







RMQS : 2 campaigns

Mainland France

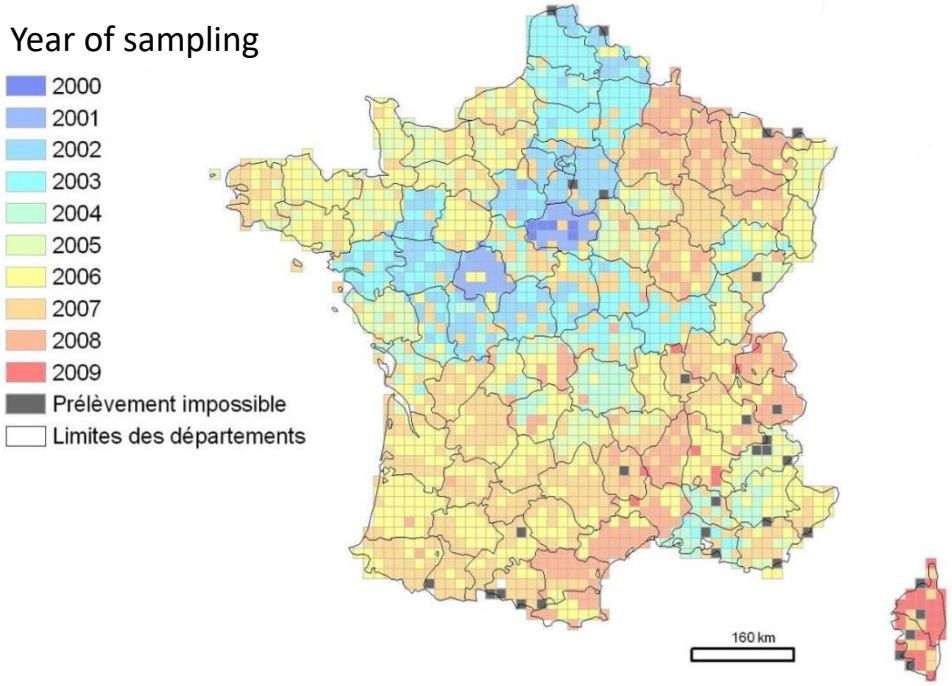
- 2000-2009 : RMQS1
- 2016-2027 : RMQS2
- Etc…

Overseas territories

- 2006 Guadeloupe
- 2007 Martinique
- 2012 Réunion
- 2012 Mayotte
- 2014-15 French Guyana

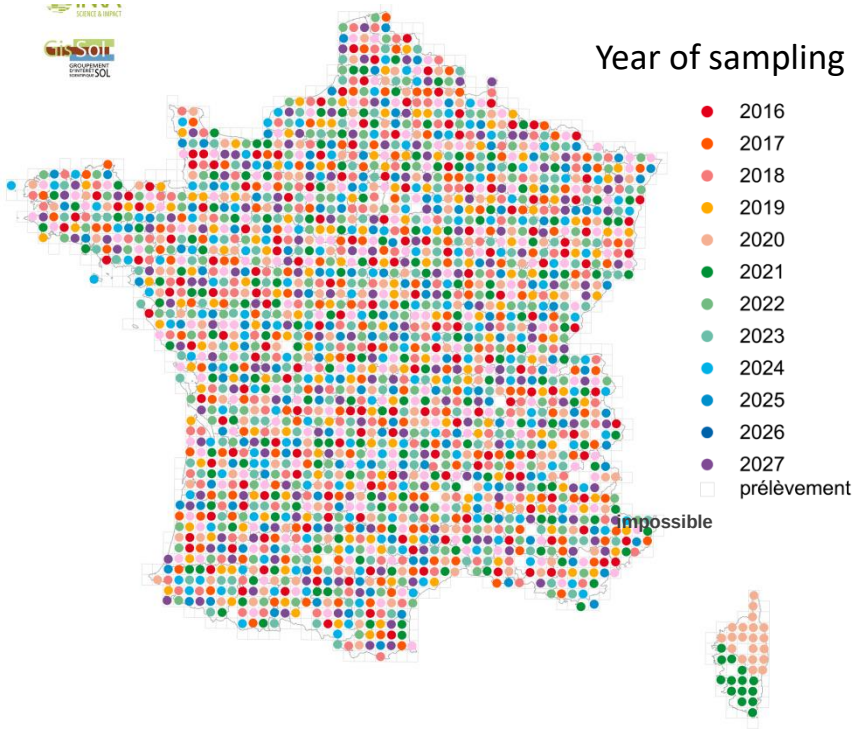
RMQS2: a new sampling strategy

RMQS1



up to 180 sites/year

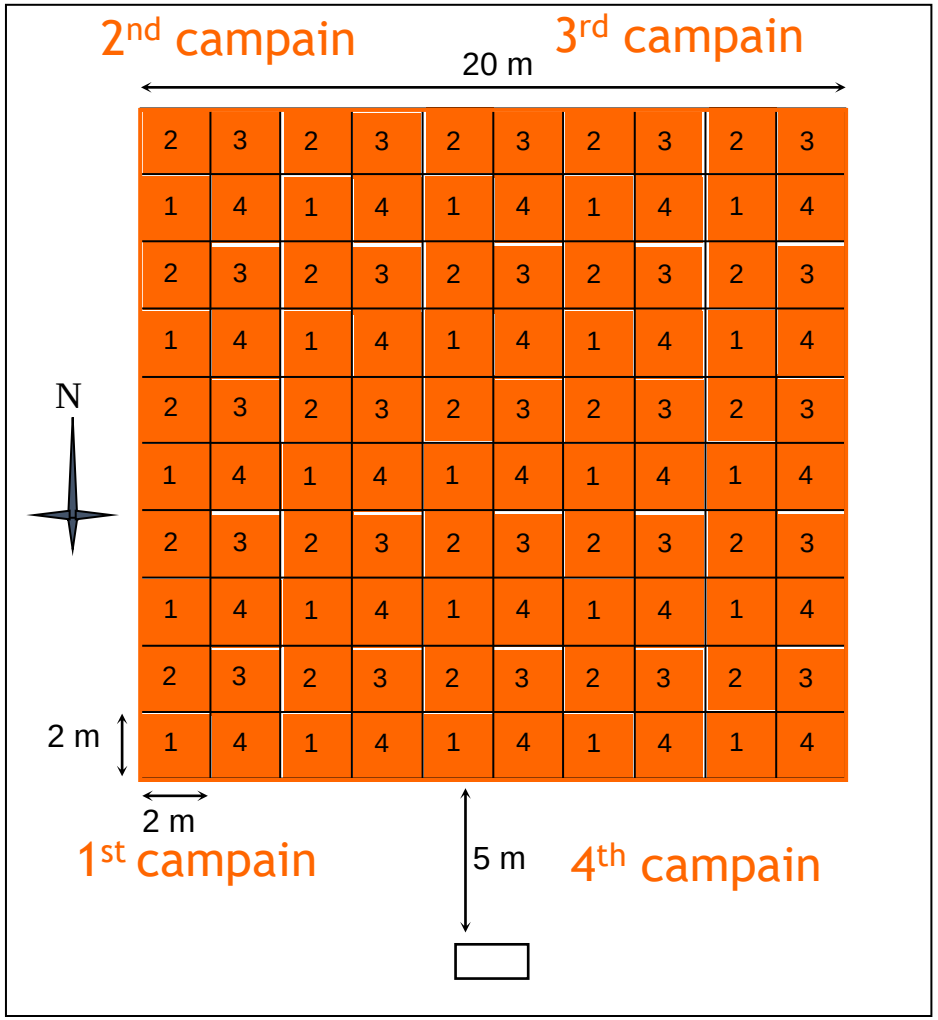
RMQS2

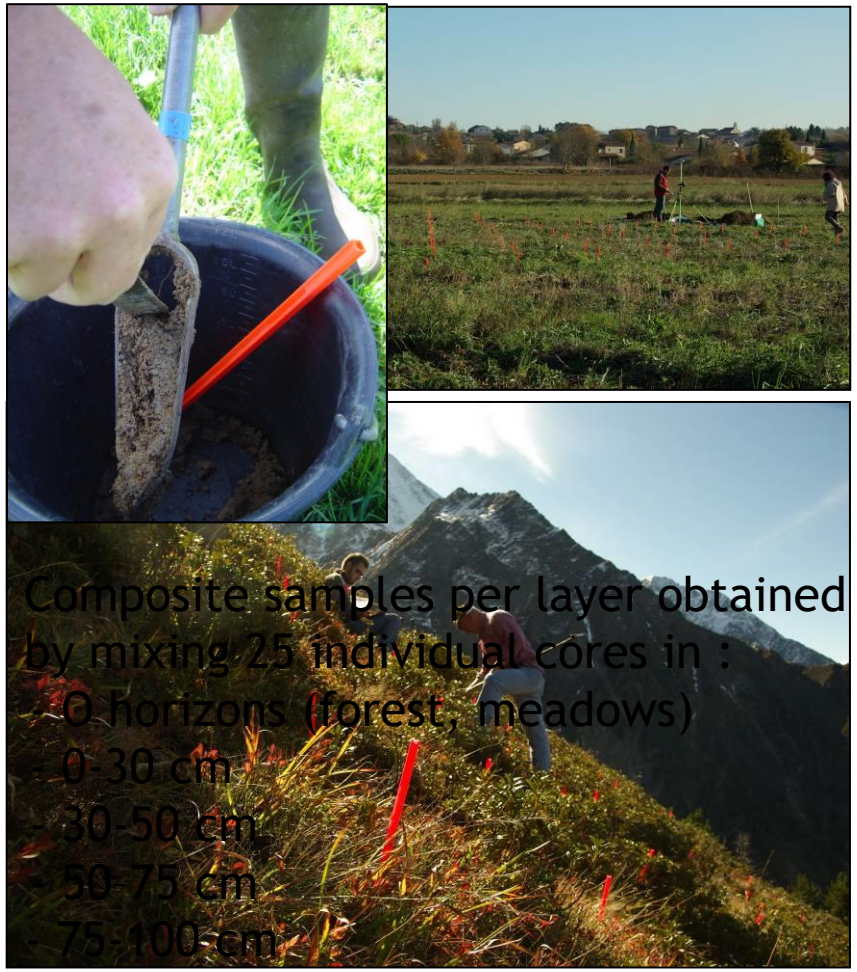


An annualised sampling strategy to improve the capacity of the network to detect soil evolution and to be able to map more quickly variables at national scale

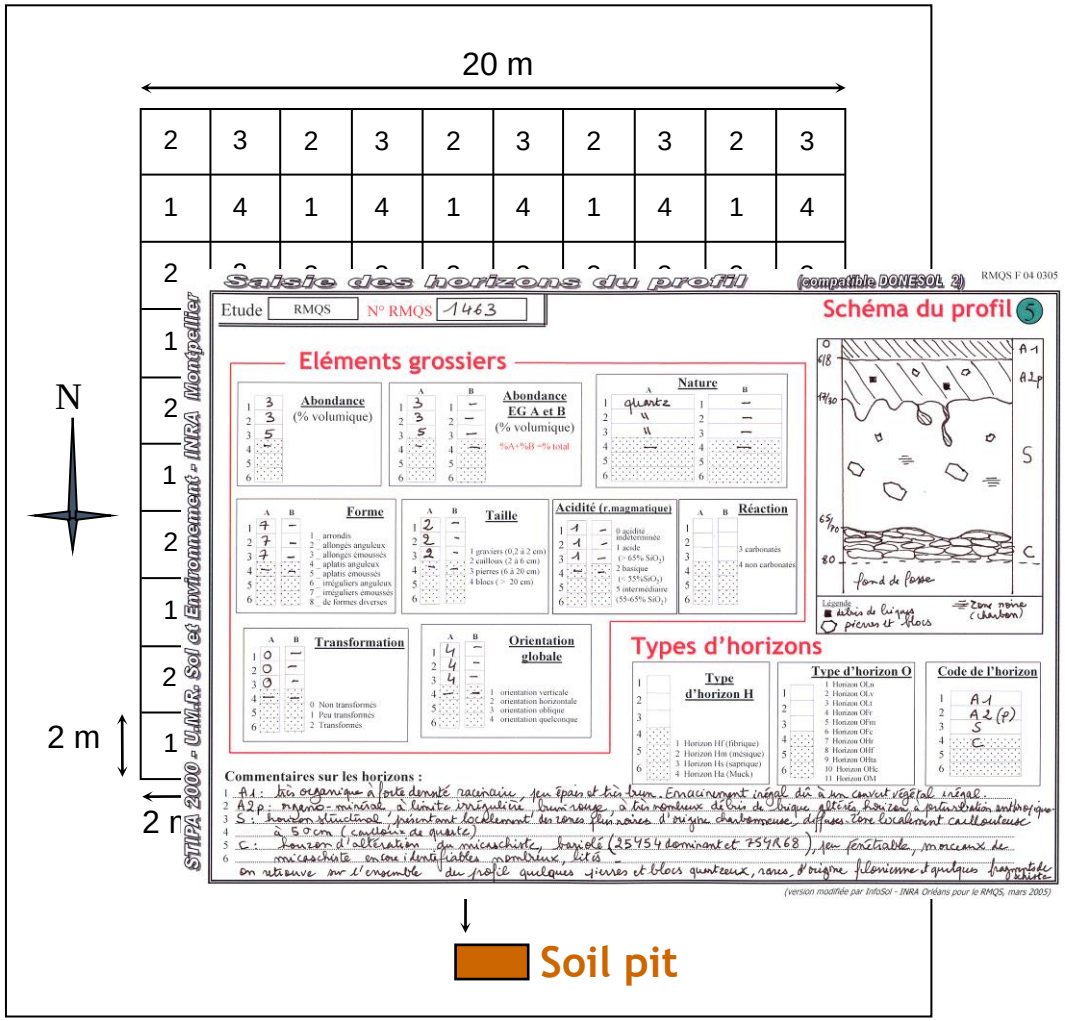
Sampling strategy

Sampling area





Sampling strategy



Soil management and environnemental data

Soil management practicies

Environnemental description and possible sources of contamination

A national handbook to standardize sampling operations

Will be available in english !

https://www.gissol.fr/publications/manuel-du-reseau-de-mesures-de-la-qualite-des-sols-rmqs2-edition-2018-4352

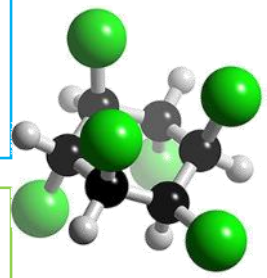
The RMQS is leaned to the European soil samples archive

Analytical paramaters

RMQS1

- Pedological parameters: pH, organic carbon, nitrogen, phosphorus, particle size distribution, CEC and exchangeable cations, major elements, boron, CaCO3…
- Contaminants :
  - Traces elements : As, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Tl, Zn
  - POPs (e.g. PAH, PCB, dioxins)

- Biodiversity :
  - microorganisms : DNA bacterial and fungi
  - fauna : earthworms, nematods, collembola (sites in Brittany)
- Organic matter quality:
  - NIRS, MIRS
  - Black carbon
  - Glomalin



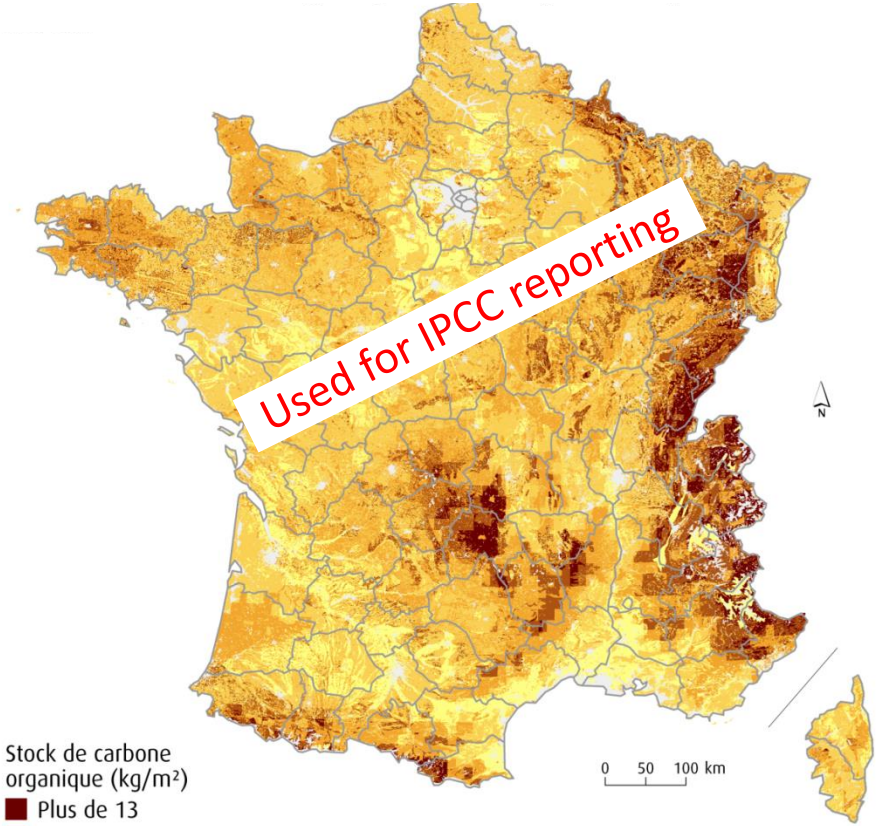
RMQS2

- New campaign:
  - Pedological parameters
  - Particulate organic matter
  - Carbon forms and deep carbon
  - Soil water retention

- Possible new parameters:
  - Pesticides
  - Soil biodiversity
  - Antibiotics ?
  - Microplastics

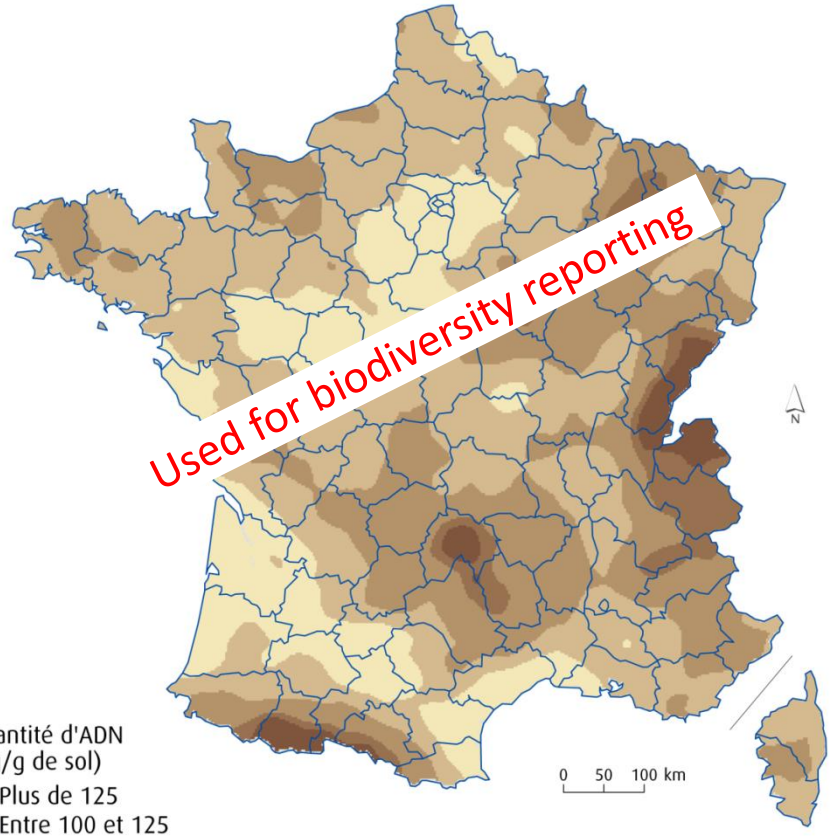
Few results from the RMQS

Organic carbon stocks in surface soil



Source : Gis Sol, d'après Meersmans et al., 2012. Traitements : SOeS, 2013.

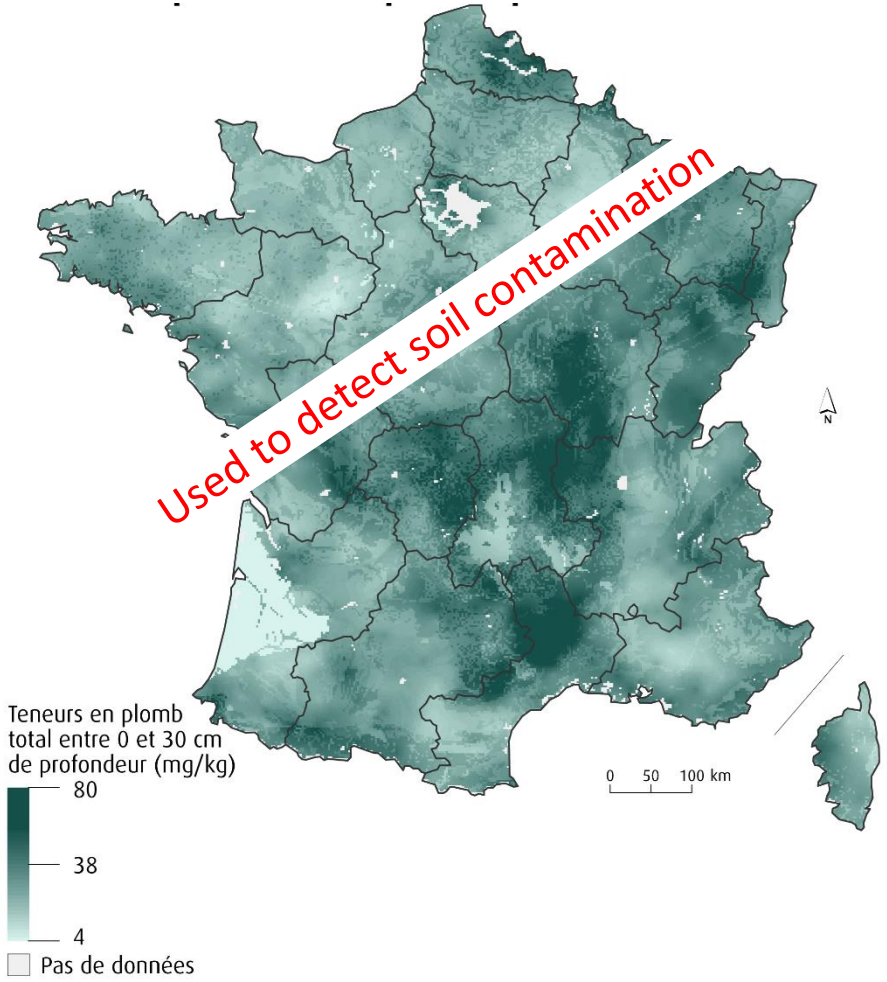
Microbial biomass in surface soil



Source : © Inra Dijon / plateforme GenoSol – Gis Sol, 2015.
Traitements : Gis Sol - SOeS, 2015

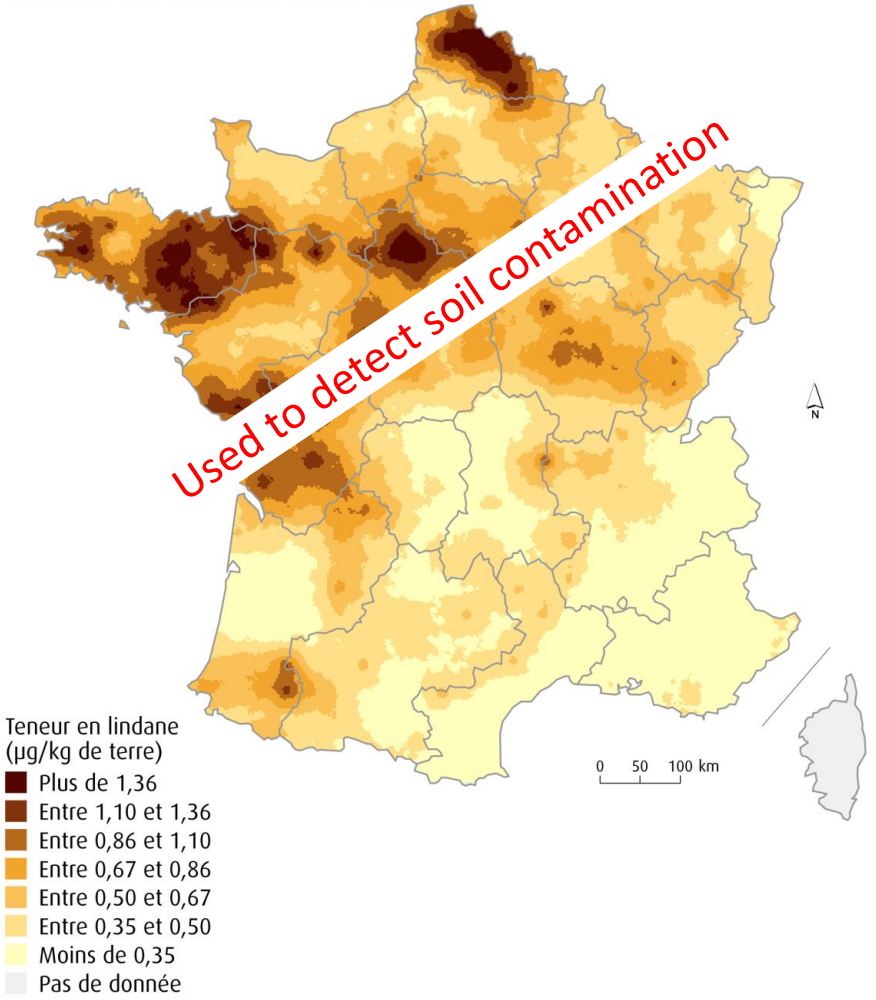
Few results from the RMQS

Lead content in surface soil



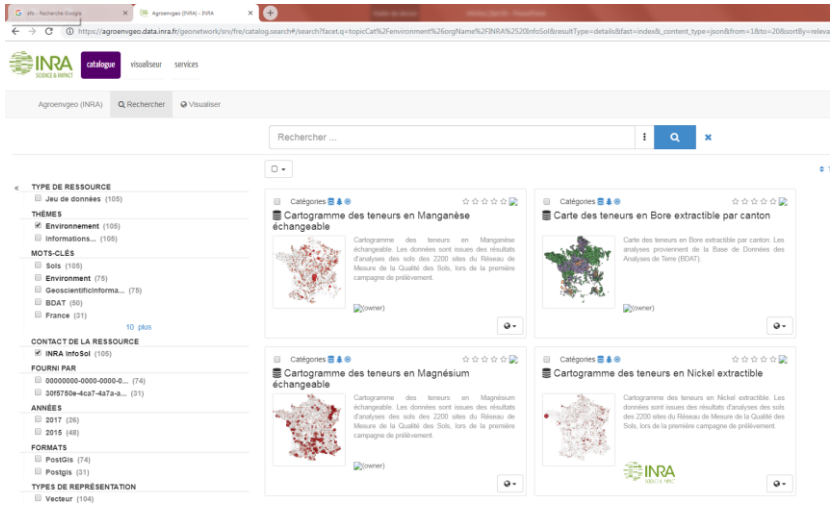
Source : Gis Sol, RMQS, 2015. Traitements : SOeS, 2015.

Lindane content in surface soil

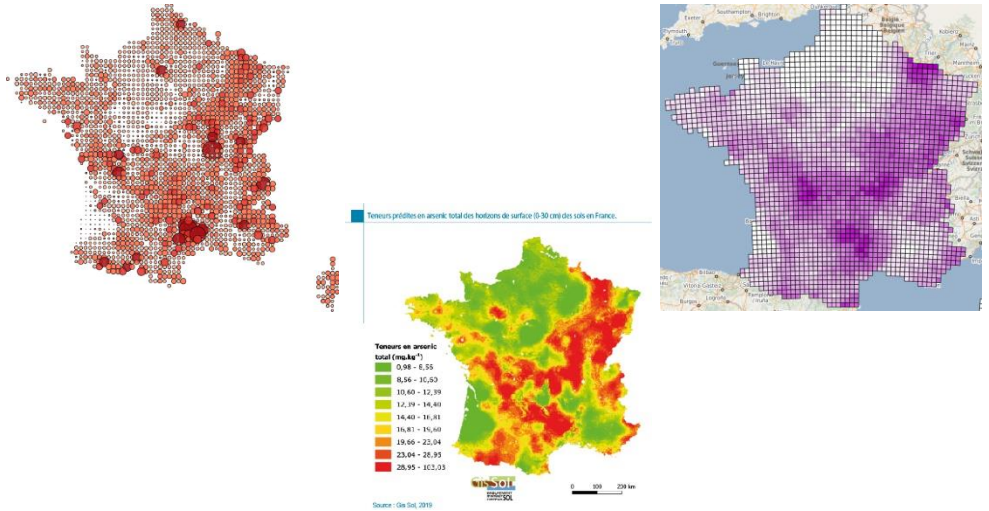


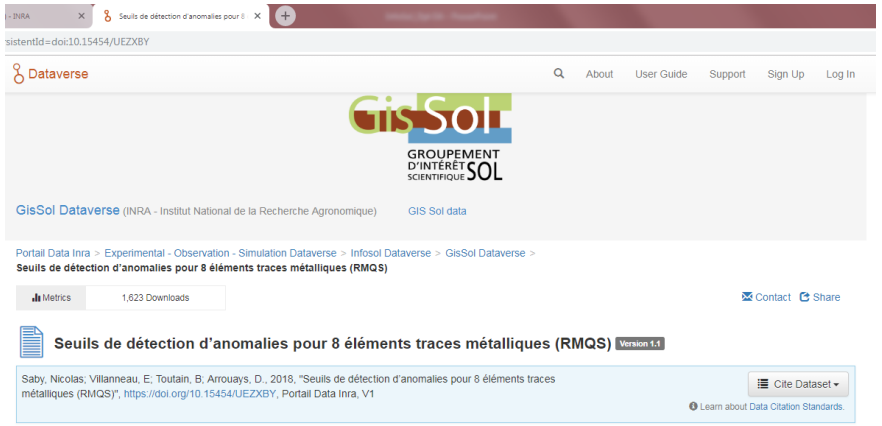
Source : Gis Sol, RMQS, 2013. Traitements : SOeS, 2013.

Availability of data, of results



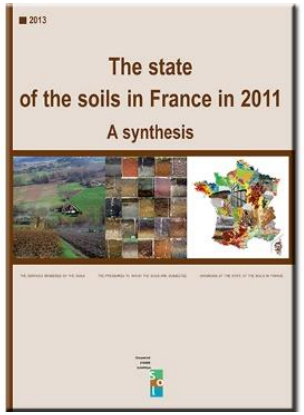
https://agroenvgeo.data.inra.fr/





https://data.inrae.fr

https://traitementinfosol.pages.mia.inra.fr/statistiquesrmqs/#les-tableaux-statistiques

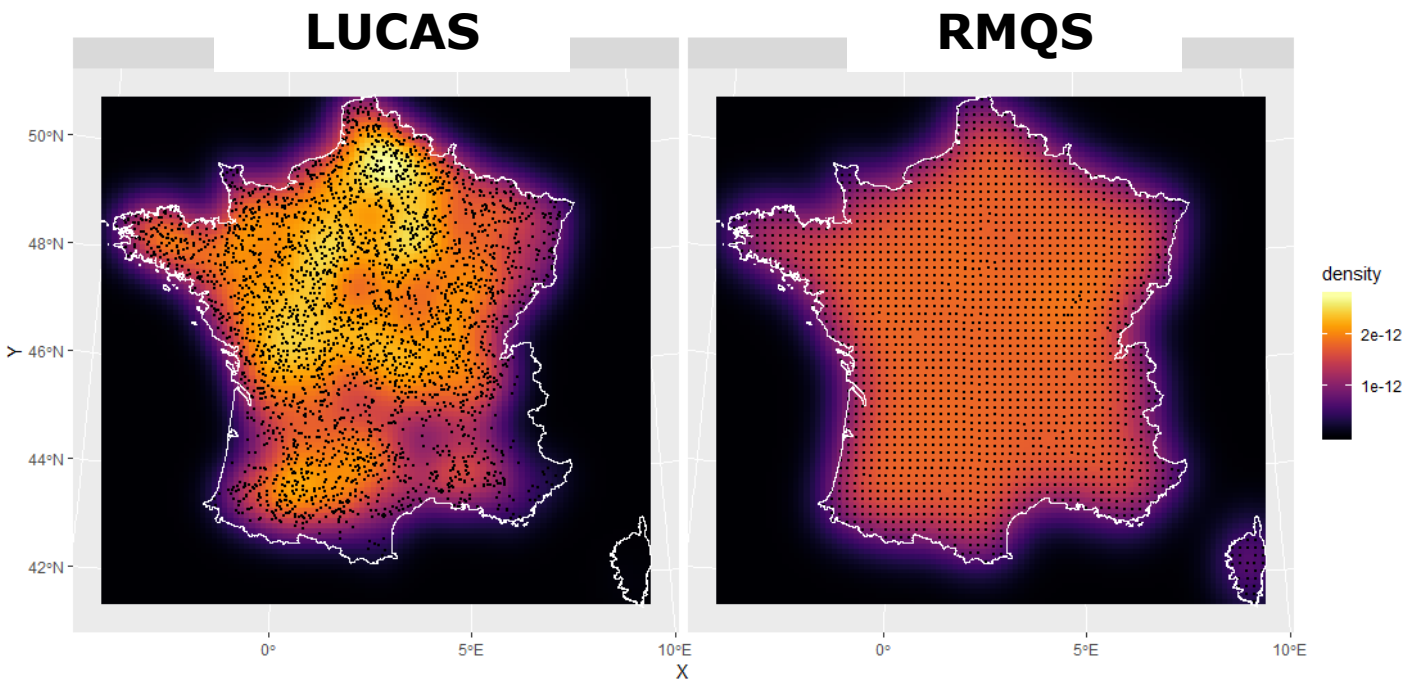


Variable	Effectif	Minimum	1er Quartile	Médiane	Moyenne	3ème Quartile	Maximum	1er Décile	9ème Décile	Variance	Erreur standard
Aluminium total	2144	0,12	3,38	4,71	4,86	6,4	11,59	2,25	7,66	4,37	0,03
Arsenic total	2130	0,39	8,05	12	17,74	19,5	412	5,2	33	454,41	0,42
Cadmium total	2144	0,01	0,12	0,2	0,3	0,33	5,53	0,07	0,61	0,13	0,01
Cobalt total	2144	0,5	5,47	9,01	10,59	13,5	112	2,86	18,57	76,15	0,17
Chrome total	2144	2	33,79	50,4	58,22	67,7	3030	18,93	88,3	10580,39	2,15
Césium total	170	1,08	4,44	6,52	8,2	8,67	55,7	3,06	13,04	53,08	0,5
Cuivre total	2144	0,5	8,67	13,9	20,15	22,3	508	5,02	35,07	779,15	0,53
Fer total	2144	0,03	1,56	2,28	2,55	3,3	13,4	0,94	4,41	2,34	0,03
Mercure total	2130	0	0,03	0,04	0,05	0,06	1,6	0,02	0,09	0,01	0
Magnésium total	2144	0,01	0,21	0,36	0,54	0,57	16,7	0,12	0,97	0,7	0,02
Manganèse total	2144	5	343,75	566,9	664,05	827	4930	170,6	1260	260338,07	9,52
Molybdène total	2144	0,02	0,41	0,57	0,81	0,88	19,8	0,27	1,5	1,05	0,02
Nickel total	2144	0,5	11,2	19,3	26,22	31,3	1530	5,91	46,1	2974,77	1,16
Plomb total	2144	3,06	21,21	27,8	32,63	37,53	624	16,6	49,27	673,99	0,52
Etain	170	0,59	2,57	3,27	3,55	3,97	26,2	2,05	4,89	4,82	0,17
Titane	176	0,09	0,33	0,42	0,44	0,51	1,69	0,24	0,59	0,04	0,01
Thallium total	2144	0,01	0,4	0,54	0,68	0,79	16,8	0,27	1,2	0,38	0,01
Zinc total	2144	2,5	43,1	63,55	74,63	90,13	1231	27,4	127	3910,12	1,23

Collaboration with LUCAS Soil

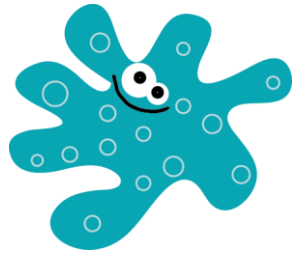
- Sampling protocols and densities are different…

- Within EJP SOIL
  - Compare analytical methods
  - Compare sampling protocols
  - Compare datasets…
  - Try to merge datasets



Main lessons learned

- Huge success! Data and samples are now used for all kind of projects and policies !
- Sampling protocols must be robust and documented (to detect soil evolutions)
- Soil use and soil management activities need to be recorded … (to explain/interpret/model soil evolutions)
- Archive the soil samples (to perform new analysis)



I ❤ soils and RMQS !