

PhD thesis in Soil Sciences (M/W):
Study of the links between biodiversity, soil structure and soil functioning.

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Work environment, missions and activities

Scientific context and objectives of the thesis

Environmental forcing from human activities alters the soil's organo-mineral matrix, soil organisms, and the biotic-abiotic interactions that underpin the ecological functions of soils necessary for healthy ecosystems. Preserving soils and the biodiversity they support, and restoring their functions when degraded, are therefore major challenges for all soils worldwide. However, numerous challenges and scientific gaps need to be addressed to tackle this issue.

Soil biodiversity plays a crucial role in maintaining soil structure and associated functions, as soil organisms and biological activity influence porosity and aggregation through the decomposition of organic matter, root activity, exudates, and bioturbation. Recent advances in 3D imaging have improved our understanding of the links between soil structure, organic matter dynamics, and flux transfers. However, the effect of biodiversity and trophic and non-trophic interactions on soil physical structure remains poorly characterized, as the data enabling these characterizations are fragmented, limited to single sites, or focused on isolated soil properties (physical and biological soil properties are still rarely characterized at the same sites). Conversely, bioturbation morphologies depend on pedoclimatic conditions and soil management practices, and we do not know to what extent these different morphologies can impact soil functions such as water infiltration and gas transfer. Furthermore, soil structure is still frequently considered static, without taking into account the lifespan of the biostructures created and the seasonal variations they undergo.

This thesis aims to contribute to answering the following question: what is the impact of biological actors (e.g., roots, soil meso- and macrofauna), as agents of soil stabilization and restructuring, on soil functioning? This thesis project will be carried out within the framework of the PEPR Sols Vivants, whose mission is to produce knowledge on the role of soil organisms and their multiple interaction networks in the multifunctionality of soils, for a diversity of soil types, uses and management methods, in order to meet the challenge of preserving and improving soil health.

Work environment

The successful candidate will be hosted within the Info&Sols Research Unit (INRAE Orléans), under the supervision of Isabelle Cousin (PhD Director) and Marine Lacoste (Co-supervisor). The PhD will also be supervised by Guénola Péres (UMR SAS, Co-director) and Maha Chalhoub (BRGM, Co-supervisor). The Info&Sols unit's scientific project is structured around three main research areas: 1) Soil status, functioning, and monitoring; 2) Soil quality, health, ecosystem services, and impacts; and 3) Environmental data management.

Main missions

The PhD candidate will be tasked with exploring the links between soil biodiversity, soil structure, and soil function, focusing on water and gas transfer properties. Specifically, he/she will be responsible for:

- Designing a conceptual model linking transfer properties and biodiversity characteristics.
- Acquiring data on the physical properties of soils and the characteristics of soil biodiversity across metropolitan France (fieldwork conducted during a campaign in spring 2027, and laboratory experiments).
- Processing the acquired data to extract indicators characterizing the soil.
- Creating and sharing a dataset compliant with FAIR principles.
- Analyzing the dataset to deduce links between biodiversity and soil function.

Application procedures

Funding for the PhD is secured. The PhD supervisors will select candidates after reviewing their applications, and interviews will be offered on November 12 or 13, 2026. Following these interviews, candidates will be ranked, and the PhD topic will be offered to them in order of their ranking until one of the candidates accepts it. The successful candidate will be enrolled at the University of Orléans, within the EMSTU Doctoral School.

Special conditions: travel within metropolitan France is expected in spring 2027. Occasional travel within France and abroad is also planned within the framework of the PEPR Sols Vivants project or for scientific communications.

Required training and skills

Recommended education: Master's degree (Master 2) or engineering degree in soil science, agronomy, or environmental science.

Desired knowledge: Depending on the candidate's specialization, disciplinary knowledge in soil science (pedology, physical and biological properties of soils) and/or agronomy; skills in data analysis (statistics, image processing).

Preferred experience: Prior experience in acquiring soil characterization data in the field and/or laboratory, in data processing, and/or image analysis. Participation in interdisciplinary or collaborative projects in soil science or environmental science.

Desired skills: Strong interest in fieldwork and laboratory work, and data analysis. Excellent writing, communication, and summarization skills. Autonomy, initiative, creativity, scientific rigor, and a collaborative spirit.

Your quality of life at INRAE

By joining INRAE, you will be able to benefit, depending on the type of contract:

- up to 30 days of paid leave + 15 RTT days per year (for full-time employees)
- parental support: childcare vouchers (CESU), leisure activity benefits;
- skills development opportunities: training, career guidance;
- social support: advice and listening services, social assistance and loans;
- holiday and leisure benefits: holiday vouchers, preferential rates for accommodation;
- sports and cultural activities;
- access to a staff restaurant.

Hosting Details

- Host Unit Name: UR Info&Sols
- Postal Code + City of Work Location: 45000 Orléans (France)
- Contract Type: PhD
- Contract Duration: 3 years
- Start Date: January 1^{er} 2027
- Salary: Starting at 2,300€ gross per month

Application Procedures

To apply, please send the following documents to Isabelle Cousin and Marine Lacoste:

- A detailed CV specifying your academic background and internships.
- A cover letter.
- Transcripts from your Master's 1 and 2 programs.
- Copies of diplomas obtained.
- A letter of recommendation or, at a minimum, academic references.

Incomplete applications will not be evaluated.

Contacts : isabelle.cousin@inrae.fr, marine.lacoste@inrae.fr

Application Deadline: **November 2nd 2026**

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