

Proposal form for a SYNTHESIS project

SECTION A – BASIC INFORMATION

• **Acronym of the project submitted:** LandWorm

• **Title of the project:**

Impact of Land use and management on earthWorm communities

Principal Investigator #1 (PI#1)¹:

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• **Summary** (max 3000 characters):

The biogeography as well as anthropogenic and natural factors driving earthworm communities (composition, structure and functional traits) remain largely unknown. However, earthworms are ecosystem engineers that participate in key soil functions and associated ecosystem services (e.g. water regulation, nutrient dynamics, biomass production). They are also one of the primary foods for many animal species, helping to maintain a complex aerial trophic network. Furthermore, these environment sensitive organisms are recognised as relevant indicators of the biological state of soils. There is therefore a great need for models and scenarios to predict and anticipate the combined effects of climate, soil properties and human activities on the conservation of taxonomic and functional earthworm diversity. LandWorm aims to quantify the current and past effects (< 50 years) of land use and management on earthworm communities considering the heterogeneity of pedo-climatic contexts at national scale, in order to (i) understand and predict the assembly of earthworm communities and (ii) identify favourable land management practices. LandWorm also aims to produce reference and threshold values in order to contribute to the biomonitoring of the French territory currently underway (e.g. RMQS-Biodiv network, SBT-ENI network, #Vers2022 initiative and the Observatoire Participatif sur les Vers de Terre). To meet these objectives, the working group selected for the LandWorm project is composed of experts from 11 institutes (Belgium, Spain, France, Italy, the Netherlands, the United Kingdom and Switzerland) with complementary skills (community and functional ecology, land management practices, data management, statistical and geospatial analysis). The dataset compiled

¹ The project must have two PIs with shared responsibilities. One of the PI (called PI#1) **must be affiliated to a French research institution**. The other PI (called PI#2) can be **from any institution worldwide**.

by the working group currently includes information on 10,000 communities. These data are mostly unpublished in the French metropolitan area, and will be completed by open access or already published data. For the first time, the data collected by this working group covers agricultural, forestry, semi-natural and artificial land uses and the main land management associated with these land uses. This project will (a) valorise these unpublished data in the form of scientific publications and (b) make the data accessible to the international community by depositing them in public databases (SINP-INPN and EDAPHOBASE). This large amount of data on the composition and structure of earthworm communities as well as on certain functional traits, collected for the first time, will provide a strong scientific response to researchers as well as to stakeholders (e.g. farmers, local authorities, urban planners and natural area managers).

• **[FR] Résumé** (max 3000 characters):

La biogéographie ainsi que les facteurs anthropiques et naturels impactant les communautés des lombriciens (composition, structure et traits fonctionnels) restent largement méconnus. Pourtant, les lombriciens sont des ingénieurs de l'écosystème qui participent aux fonctions clés du sol et les services écosystémiques associés (ex : régulation hydrique, dynamique des nutriments, production de biomasse). Ils sont également l'une des principales ressources pour de nombreuses espèces animales, contribuant ainsi au maintien des réseaux trophiques aériens. Par ailleurs, ces organismes sensibles à leur environnement, sont reconnus comme étant des indicateurs pertinents de l'état biologique des sols. Il existe alors un besoin important de modèles et de scénarios pour prévoir et anticiper les effets combinés du climat, des propriétés du sol et des activités humaines sur la conservation de la diversité taxonomique et fonctionnelle des lombriciens. LandWorm vise à quantifier les effets actuels et passés (< 50 ans) de l'utilisation et de la gestion des terres sur les communautés lombriciennes en tenant compte de l'hétérogénéité des contextes pédo climatiques à l'échelle nationale, afin (i) de comprendre et prédire l'assemblage des communautés de vers de terre et (ii) d'identifier des pratiques de gestion favorables des terres. LandWorm vise aussi à produire des valeurs de référence et valeur seuil afin de contribuer à la biosurveillance du territoire français actuellement en cours (ex : réseau RMQS-Biodiv, réseau SBT-ENI, initiative #Vers2022 et l'Observatoire Participatif sur les Vers de Terre). Pour répondre à ces objectifs, le groupe de travail sélectionné pour le projet LandWorm est composé d'experts issus de 11 instituts (Belgique, Espagne, France, Italie, Pays-bas, Royaume-Uni et Suisse) et possédant des compétences complémentaires (écologie des communautés et fonctionnelle, pratiques de gestion des terres, gestion des données et analyses statistiques). Le jeu de données constitué par le groupe de travail rassemble pour l'instant environ les informations sur 10.000 communautés. Ces données sont pour la plupart inédites sur le territoire métropolitain français, et seront complétées par des données en accès libre ou déjà publiées. Pour la première fois, les données collectées par ce groupe de travail couvrent les usages agricoles, forestiers, semi-naturels et artificiels des sols et les principaux modes de gestion des sols associés à ces usages. Ce projet permettra (a) de valoriser ces données inédites sous forme de publications scientifiques et (b) de rendre les données accessibles à la communauté internationale en les déposant dans des bases de données publiques (SINP-MNHN et EDAPHOBASE). Ce grand nombre de données sur la composition et la structure des communautés lombriciennes ainsi que sur certains traits fonctionnels, rassemblées pour la première fois, apportera une réponse scientifique forte aux chercheurs ainsi qu'aux gestionnaires (par exemple, les agriculteurs, les autorités locales, les urbanistes et les gestionnaires d'espaces naturels).

• List **five keywords** that explain your project:

Taxonomic and functional diversity; environmental filters; spatial scale; temporal dynamics; reference values

SECTION B – PROJECT

Note: the projects will be evaluated according the following criteria (i) **Relevance** of the project with the objectives of the call (ii) **Scientific excellence** and innovative nature of the project (iii) Quality of the **working group** (iv) **Feasibility** of the working programme (v) Methods of **disseminating** and making available knowledge and data (vi) Capacity of the project to provide indicators and practices to be avoided or enhanced to preserve biodiversity and (vii) Quality of **deliverables** for stakeholders.

1/ Description of the project: Maximum of 3500 words divided into the 3 items below, which should address the scientific content, the synthesis aspect, the feasibility of your planned project and the dissemination.

Context and objectives - short description of the state of the art, scientific rationale, statement of the objectives, working hypotheses and their relevance to the call.

Biogeographical patterns and anthropic drivers of soil fauna communities remain largely unknown by the scientific community (Eisenhauer and al., 2017; Guerra et al., 2020). Soil organisms are neglected by conservation policies compared to the biodiversity contained in most other aquatic and terrestrial habitats (e.g. IUCN red list, water framework directive, environmental code). Nevertheless, stakeholders (e.g. farmers, local authorities, urban planners and natural area managers) show a growing interest in obtaining simple and reliable indicators to assess soil quality and soil functioning. Within soil organisms, earthworms are largely identified as relevant bioindicators of soil quality (Bispo et al., 2009; Pérès et al., 2011; Cluzeau et al., 2012; Griffiths et al., 2016). They are also considered as soil ecosystem engineer since they modify their habitat and contribute to major soil functions such as organic matter decomposition or water infiltration and retention, and thus participate to the delivery of ecosystem services such as the provision of food, clean air and drinking water for society (Blouin et al., 2013; Bardgett et al., 2014; Delgado-Baquerizo et al., 2020). Their impacts on soil functions vary according to the ecological category to which they belong. Finally, earthworms are part of the main food items for several wildlife species that show (i) high conservation value such as the European hedgehog, the aquatic shrew or endangered birds (Macdonald, 1983; Granval and Aliaga, 1988) and (ii) recreational interest such as woodcock, pheasant or wild boar. Thus, in the current context of decreasing biodiversity, the conservation of high abundance and diversity of earthworms is of major interest, being an important below-ground node involved in maintaining above-ground trophic networks.

Regarding their key role in the functioning of ecosystems and the need for more sustainable ecosystems, it is thus crucial to understand and model earthworm species distribution (Marchan et al., 2015; Si-moussi 2020) and the assembly of earthworm communities (Decaëns et al., 2008; Mathieu and Davies, 2014) according to the main factors that drive the presence of these beneficial organisms (e.g. Rutgers et al. 2016; Philips et al., 2019). Even though valuable attempts exist, there is to date no global framework that incorporates the different natural and anthropogenic pressures, and their interplay, that operate at different spatial and temporal scales. Hence, factor hierarchy depends on the spatial scale studied. At the global scale, Phillips et al. (2019) highlighted the importance of climate on earthworm community (abundance, diversity) while at european scale, Rutgers et al. (2016) demonstrated, in addition to the climate, the effect of soil properties and land use. At finer scales, several studies, review and meta-analyses highlighted the effect of soil management on earthworm communities such as the use of pesticides, tillage and crop rotation (Pelosi et al., 2014; Briones and Schmidt, 2017; Hoeffner et al., 2021). However, most of these previous studies were conducted in very different types of ecosystems and soils, which could have facilitated community discrimination and

exacerbated the relationship with contrasting environmental filters (e.g. land use, land management). In addition, reducing the number of environmental parameters examined and/or their range of variation can lead to contradictory results. In the current context of biodiversity depletion (Orgiazzi et al., 2016; FAO, 2020), agro-ecological transition and climate change, there is a serious need for models and scenarios to predict and anticipate the combined effects of environmental factors on earthworm taxonomic and functional diversity that both determine the ecosystem functioning (Guerra et al., 2020).

The effects of environmental constraints on earthworms are generally described using community indices such as total abundance, biomass or diversity (Cluzeau et al., 2012; Rutgers et al., 2016; Singh et al., 2019; Phillips et al., 2019). In complement to these descriptors, some few studies used functional trait-based approaches to understand the patterns of earthworm community response to both natural and anthropogenic pressures and their potential consequences on ecosystem functioning (Pérès et al., 2011; Pelosi et al., 2014, 2016; da Silva et al., 2020). Functional trait-based approaches complement taxonomic approaches and can help going further by identifying general patterns and their mechanisms. Among earthworm functional traits, adult body mass reflects the performance of individuals in their environment and their contribution to soil ecosystem functioning since this trait is a proxy for several soil functions (e.g. organic matter consumption, creation of macroporosity). The stable species hierarchy (SSH) hypothesis assumes that intraspecific traits variability (ITV) is lower than interspecific variability. It also assumes that for similar species found in different environmental conditions, the species trait ranking is conserved (Garnier et al., 2001). Thus, the body mass SSH would identify consistent patterns of response to natural and anthropogenic pressures across spatial scales and would permit the generalisation of the contribution of species to soil functioning. Despite its important implications, SSH has been tested only on collembola (Bonfanti et al., 2018) among all soil organisms. The role of ITV in structuring communities along ecological gradients, is common when studying plants or fish (Violle et al., 2011) while poorly developed in earthworm ecology (but see Decaëns et al., 2009).

Our goal is to identify the main factors driving earthworm communities (density, taxonomic and functional diversity) changes to promote favourable management of ecosystem functioning and to halt biodiversity loss. By taking advantage of the huge amount of data on earthworm species and communities accumulated over the past several decades (around 10 000 communities covering the whole mainland France under different land use and management) thanks to the scientific community and citizen science initiatives (Surveillance Biologique du Territoire - Effet non intentionnel des pratiques agricoles, Vigie Nature, Observatoire Participatif des Vers de Terre), the main objectives of the LandWorm project are threefold (Fig.1). First, we aim to disentangle the combined effects of natural (climate, pedogenetic features) and anthropogenic factors (soil properties, land use and management) on earthworm species and communities, to identify the main drivers of earthworm community and to identify the underlying mechanisms through the analysis of both taxonomic and functional facets. Second, based on the main drivers previously identified, we will create a typology of responses to environmental factors (alone or combined) and we will attempt to develop a new dashboard of bioindicators based on earthworms. Then, we will generate the value distribution and identify reference values and thresholds for each type of situation described before. Third, according to the hierarchy of factors influencing earthworm diversity, we will define favourable management practices and operational solutions for managers (farmers, urban planners, foresters, managers of natural spaces...). We will model the potential for change in earthworm communities following the adoption of more favourable practices. LandWorm will provide a strong scientific response to researchers and stakeholders (e.g. farmers, local authorities, managers of cities and of natural areas) in defining potential initiatives on soil conservation (Fig.2).

According to two meaningful scales for management/recommendations to stakeholders, LandWorm's main hypotheses are:

First, at the plot scale:

- land use change (LUC, e.g. grassland to cropland) and land use intensification (LUI, e.g. increased frequency of tillage) are harmful to earthworms (density, taxonomic and functional diversity), leading to depauperate communities by selecting a highly restricted number of combination of traits; we hypothesise that this combination of traits depends on regional (biogeographical) constraints;
- the dynamics of earthworm communities after the setup of alternative/less intensive land management will result in increased community abundance, biomass and both taxonomic and functional diversity. However, the expected reinforcement of communities (and the time for this "recovery") will depend on the regional species pool composition both in terms of taxa and traits.

Second, at mainland France scale:

- climate change over the last 50 years induced a turnover in community taxonomic and functional composition, with extirpation of rare species, increase in exotic species distribution area, and homogenization of community composition;
- the interplay of current natural and anthropogenic pressures on earthworm community depends on socio-ecological feedbacks between historical filters (e.g. maximum permafrost extent during the last glaciation leading to patterns of earthworm species; differentiated pedogenesis leading to high pedological variability at national scale) and Anthropocene filters (regionalisation and intensity of French productions, e.g. vineyards, crops, industry, forest).



Figure 1. The three main objectives of the LandWorm project

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LandWorm

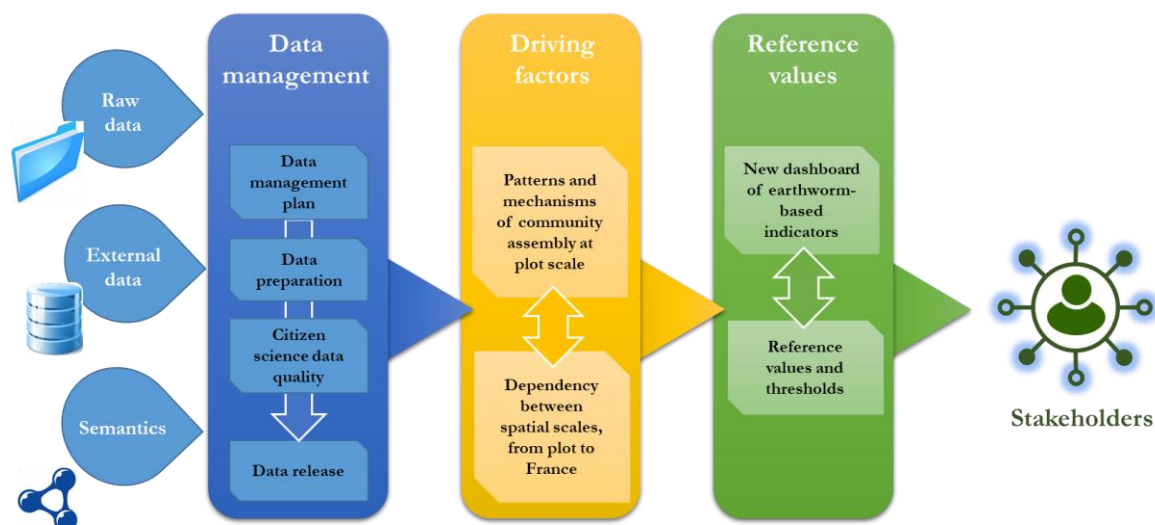


Figure 2. Overview of the LandWorm project

WP2: Data management

This WP will aim to aggregate the data and make it findable, accessible, interoperable and reusable (FAIR, Fig.3). As LandWorm aggregates together a significant amount of data (earthworm data and associated environmental variables) and metadata (descriptive, structural, pre-processing), it is necessary to establish a data management plan (DMP) within the first 5 months of the project. The construction of the DMP will be in accordance with international standards by following the recommendations of the European Commission (H2020) and Inist-CNRS (OPIDoR portal).

WP2. Data management

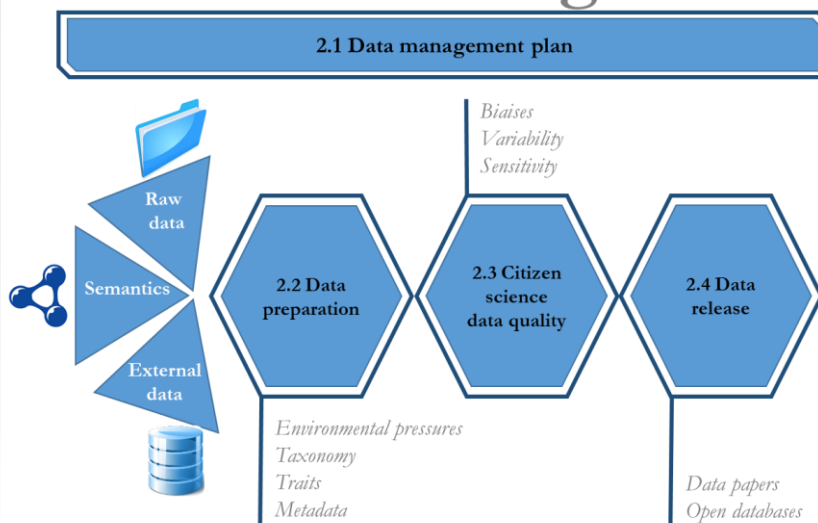


Figure 3. Illustration of the LandWorm WP2

Task 2.1 Provision of a data management plan (Leader: H. Phillips, Partner: G. Pérès)

The DMP will contain (i) the treatment of research data during and after the end of the project, (ii) the type of data that will be collected, processed and/or generated, (iii) the methodology and standards that will be applied, (iv) the status of data sharing and (v) how data will be stored and preserved. A key point is that the DMP will be drawn up with a view to sharing data as well as for data with restricted or closed access, either total or partial. The DMP will be updated during the course of the project at least at the time of progress report and also following certain major changes (e.g. arrival or departure of a member in the consortium).

Task 2.2: Data preparation and characterisation of the environmental constraints (Leader: H. Phillips, Partners: each data contributor)

This task will be first dedicated to the aggregation of the different databases from the consortium. We will also contact colleagues out of the consortium to collect possible other interesting and usable data sets. Literature reviews (peer reviewed and grey literature) could be conducted to extract published data from previous studies (especially in the 70s, 80s, 90s). We will gather data and harmonise the terminology of the data and their metadata. Earthworm functional traits will be extracted from the BETSI database, which has been developed in the eponymous project, funded by the CESAB (2011-2014) and led by Mickael Hedde (partner of the present project). For data and metadata, the consortium will rely on well-established standards (Corine Land Cover classification for land use, TaxRef-INPN classification for earthworm taxonomy) but also on pre-established standards from previous research programs (e.g. Bioindicateurs de Qualité des Sols-ADEME, EcoFinders) and published articles (e.g. Rutgers et al., 2016; Phillips et al., 2019). When necessary, environmental variable dataset will be completed using online databases (e.g. DoneSol for soil properties, CHELSA for climate). Attention will be paid to data traceability and quality that will be checked using a cross validation data process (simple range and constraint check, consistency check, structured check, Roberts et al., 2017; Loo and Jonge, 2020).

Task 2.3 Citizen science data quality (Leader: Post-doc recruited, Partners: G. Pérès and D. Cluzeau)

The data aggregated by the consortium will come from academic scientists and citizen science programs (with varying levels of training in the application of sampling protocols or in data entry). Although citizen science data are useful to increase the number of samples over the territory and thus to collect data in different contexts (Billaud et al., 2020), they may also contain greater levels of variability (e.g. measurement error) or bias (e.g. spatio-temporal clustering, under-detection of species) in comparison to data collected by scientists (Bird et al., 2014; Aceves-Bueno et al., 2017). Based on the law of large numbers (Bird et al. 2014) we expect to sufficiently reduce unsystematic errors in citizen science data. This task will focus on assessing the quality of citizen science data by identifying the range and the source of variation between data from citizen science and academic scientists. We will use generalised linear models and mixed-effect models to analyse datasets produced by citizen-science projects (Kosmala et al., 2016).

Task 2.4: Data release (Leader: Post-doc recruited, Partner: H. Phillips)

We aim to make the data gathered in the LandWorm project findable, accessible, interoperable, reusable and citable. Then, data will be integrated into the [French Natural heritage inventory information system](#) (SINP), the European [EDAPHOBASE](#) database and through it into the [Global Biodiversity Information Facility](#) (GBIF). [EDAPHOBASE](#) is an open, online, reusable information system

(data warehouse) dealing with the distribution and ecological preferences of soil animals currently used in European projects (e.g. COST EUDaphobase, EJP MINOTAUR).

Deliverable:

- a data paper with data upload in EDAPHOBASE database

WP3: Interplay of natural and anthropogenic pressures on earthworm taxonomic and functional diversity

This WP will identify and rank the effects of natural and anthropogenic pressures on earthworm communities and identify whether these effects are spatially and temporally dependent (Fig.4).

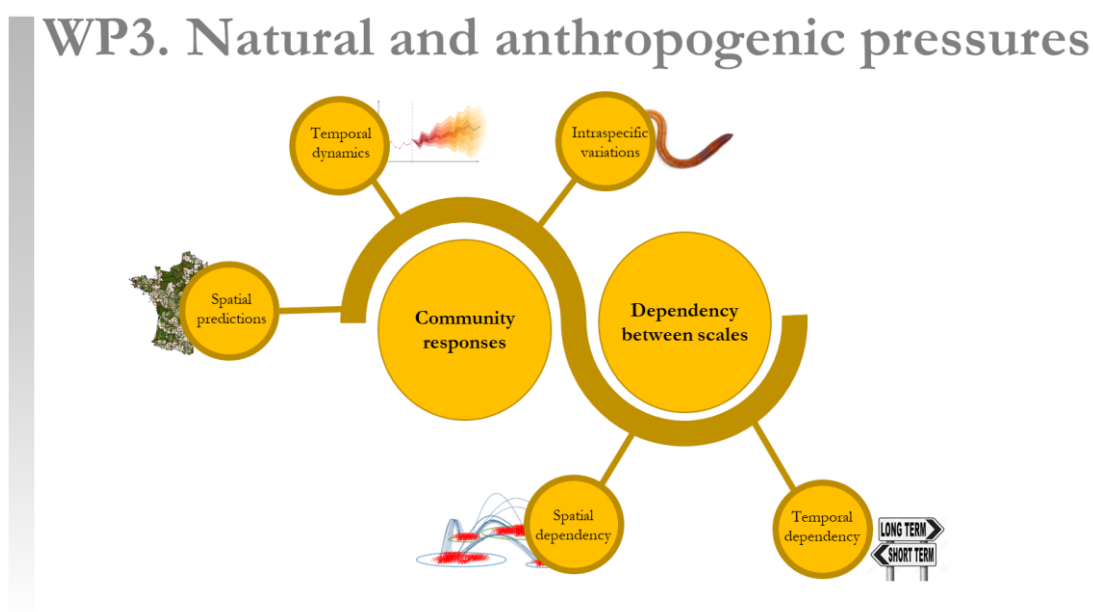


Figure 4. Illustration of the LandWorm WP3

Task 3.1 Patterns and mechanisms of community assembly (Leader: T. Decaëns, Partners: B. Muys, G. Pérès, M. Hedde, K. Butt and R.C. Le Bayon)

Spatial responses. We will identify and rank the effects of environmental pressure gradients (anthropogenic and natural) to extract generic features. Natural factors will encompass climate and pedogenetic gradients. Anthropogenic gradients will concern land use intensity (e.g. annual crops, grasslands, forests), land management intensity (e.g. tillage depth and intensity, fertilisation) and their effects on soil characteristics (e.g. soil organic matter content, pollutants). We will conduct a meta-analysis to compare the effect sizes of climate, soil properties, land use and land management parameters on the taxonomic and functional facets of earthworm communities (Bengtsson et al., 2005; Beninde et al. 2015). We will test how different types of environmental factors may lead to similar depauperate communities with high functional similarity. We will also predict community homogenisation through generalist selection (Denelle et al., 2020). Building on this, we will propose a

predictive model of local earthworm community parameters (density, taxonomic and functional diversity) using generalised linear mixed-effects models (Phillips et al., 2019).

Temporal responses. The multiple factors that drive communities rarely overlap in perfect synchrony in time (Jackson et al., 2021). The different degree of temporal overlap between factors may lead to legacy effects and lag in community temporal dynamics. Using time series (e.g. on LTER), we will investigate more precisely the temporal dynamics of earthworm communities according to changes in land use and land management. We will assess the shape of the response (abrupt, fast, slow) regionally, taking account of the biogeographical constraints (Williams et al., 2021). We will estimate the relative weight of intraspecific variability, species turnover and nestedness to better understand the mechanisms of species assembly during these ecological transitions (Taudière and Violle, 2016; Mori et al. 2018).

Intraspecific variations. The spatial and temporal structure of ITV deserve much interest (Violle et al., 2012; Westerband et al., 2021) and have been little tackled by earthworm ecologists (Mathieu, 2018). We will explore the patterns of inter- and intraspecies trait variation over both natural and anthropic gradients. In addition, we will test how much the trait-based rankings of species are stable enough across datasets and spatial scales to be predictable (Kazakou et al., 2014). We will focus on body mass, considered as a good proxy for individual fitness.

Deliverables (peer-reviewed papers):

- Predicting earthworm communities under natural and anthropogenic pressures in France (targeted journal: Glob Ecol Biogeogr)
- Temporal dynamics, legacy effects and time lags of earthworm community responses to land management changes. (targeted journals: Sc Report)
- Does size matter? Assessment of body mass as proxy for earthworm response to environmental pressures (targeted journal: Funct Ecol)

Task 3.2 Dependency between scales (Leader: M. Hedde, Partners: G. Pérès, T. Decaëns, H. Phillips, K. Butt and R.C. Le Bayon)

Spatial dependencies. Earthworm community assembly is affected by active or passive dispersal of individuals that links the local (community) and regional (metacommunity) species pools. We will test here the hypothesis that the potential for change in the local communities after modifications of management depends on regional species pools. This analysis requires defining the regional species pools for each sampled site. Since we do not know the most relevant size of the regional pool, we will test several buffer sizes around each site. We will then apply a range of null models (Chalmandrier et al., 2013) that already account for spatial or environmental structure.

Temporal dependencies. Community composition may also be affected by global changes, with introduction or extirpation of species or changes in species dominance. Then, we will quantify how global change since the beginning of the Anthropocene has affected the earthworm community by comparing 250 earthworm communities sampled on the same stations in the 1960s and in 2019-2022. Effects will be quantified globally as well as by land use. We will analyse the changes in earthworm rarity both in terms of taxonomic and functional rarity (Violle et al., 2017). Then, we will highlight winner and loser species and the trait combinations they share, with a focus on exotic species. Finally, we will test whether the winner species and traits are more likely to settle after a change in land management.

Deliverables (peer-reviewed papers):

- Effect of the regional species pool on changes in earthworm community diversity during ecological transitions (targeted journal: Ecol Letters)
- Earthworm species winner and loser after 50-yrs environmental changes in France (targeted journal: Ecology)

WP4 - Reference values and guidelines for stakeholders

WP4. Reference values and guidelines for stakeholders

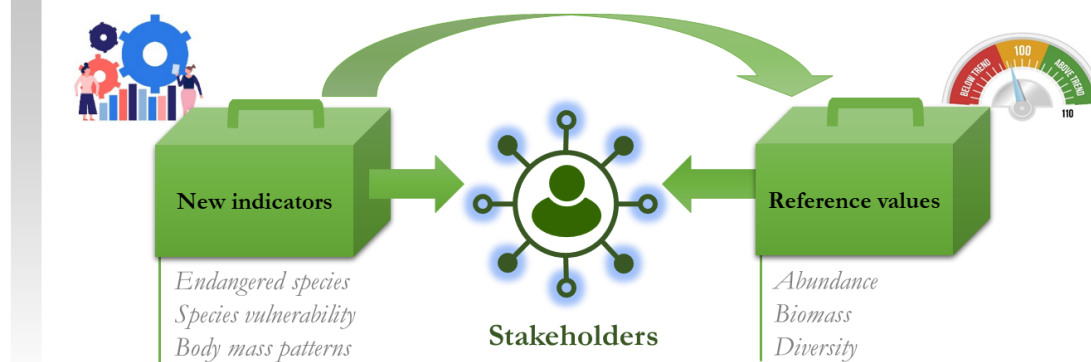


Figure 5. Illustration of the LandWorm WP4

Task 4.1 Development of new earthworm-based indicators as well as reference values and thresholds (Leader: G. Pérès, Partners: C. Pelosi, M. Hedde, B. Muys, M. Briones, A. Orgiazzi, R.C. Le Bayon and D. Cluzeau)

Development of new earthworm-based indicators. To assess the effect of multiple environmental factors on earthworm communities, soil ecologists often seek to acquire more data in different contexts and/or make more complex statistical models to take into account a maximum of explanatory variables. However, the selected response indicators are sometimes restricted to one or two and/or are not always adapted to current ecological issues. This task aims to test/develop new earthworm-based indicators (Fig.5). Based on the results obtained in the WP3, we will assess the potential of new indicators of environmental pressures. For instance, we will produce a list of endangered species based on rarity in terms of density (Leroy et al., 2012; Maciel, 2021) and/or combination of functional traits (Taudière and Violle, 2016) at the regional and French territory scales. We will also establish species vulnerability based on its exposure, its sensitivity and its recovery potential to the constraint(s) (Pérès et al. 2011). The body mass of widespread and easy-to-identify species would be an indicator of earthworm fitness and functional impact. We will also build on the metabolic theory (Ehnes et al. 2011) and the body mass patterns to develop indices that consider the energy demand of the animals (Afzal et al., 2021) and thus can be related to both the response (availability of the trophic resource) and the effect on the soil (consumption of soil organic matter). Finally, we will build a composite indicator,

based on the aggregation of different descriptors (abundance, biomass, diversity, traits) to provide a global and integrative earthworm indicator.

Reference values and thresholds Earthworms are sensitive to their environment by modifying their community composition and structure, moreover, their sampling is simple, fast, reproducible and very cheap. Thus, to improve soil diagnosis using earthworms, this task aims to establish reference values and thresholds for current and newly developed indices (Fig.5). First, we will use the distributions of earthworm community parameters to give initial reference values and thresholds for each land use and management constituting a range of biological status (low/normal/high) within which the measured values in the field will be positioned in order to carry out the desired diagnosis. Second, using the results of T3.1, we will be able to provide reference values for earthworm community parameters under a given soil use and soil-climate conditions as is currently done for soil bacterial biomass and diversity diagnosis (Terrat et al., 2017; Karimi et al., 2018). The measured values in the field will be compared to the predicted values in order to make the desired diagnosis. Predictive models of earthworm community parameters covering the French territory could help policy makers to produce conservation policies based on soil biodiversity.

Deliverables (peer-reviewed paper):

- A new generation of soil quality indicators based on earthworm communities (targeted journal: Ecol Indic)
- Reference values and thresholds for earthworm among the main land uses and management (targeted journal: Science of the Total Env)

Anticipated results and benefits arising from the project within the context of the call.

LandWorm project will allow:

(i) to gather, publish and make available the largest national database on earthworm communities. This dataset will then be available to other CESAB groups or other biodiversity specialists (ecologists, biostatisticians) to explore other facets of this unique dataset (wide spatial and temporal distribution) and thus continue to generate peer-reviewed articles after the end of LandWorm such as:

- Autoecological and synecological investigations of earthworm species
- Conservation management for endangered earthworm species
- Benefits and limits of a French citizen science on earthworms

(ii) to publish high quality peer-reviewed articles (WP 3 and 4) and communicate at forthcoming international conferences (e.g. International Conference on Soil Biodiversity, Amsterdam, 2023; Global Soil Biodiversity Conference, Dublin, 2023; SFE² Sfecology, Lyon, 2024);

(iii) to disseminate the main results obtained through the drafting of communication support (booklet and poster) and the participation in national events such as the Fête de la science, the European Heritage Days, the forum for managers of natural areas by the post doc recruited;

(iv) to promote soil conservation by contributing to the dynamics in soil ecology between the experts present in this consortium and their ongoing projects and also between the experts of this consortium and the decision-makers.

2/ Context of the proposal: Maximum of 500 words. Information on how the proposal emerged, how the consortium was formed, preliminary studies supporting the proposal, links with existing projects, links with national and international policies and initiatives, complementarity between the two PIs.

LandWorm emerges from a severe lack of knowledge on earthworm community assembly rules and an increasing demand from stakeholders (e.g. farmers, local authorities, urban planners and natural area managers) for reference values to implement strategies ensuring the conservation and/or restoration of earthworm communities and consequently of soil functioning. In addition, most of the data collected in this consortium has never been published (separated databases, citizen sciences) and therefore not available to the international community. LandWorm is therefore an opportunity to make them publicly available and to increase the value of these data by concatenating the results of many past projects. Beyond the outputs directly related to the projects, LandWorm will provide baselines and thresholds for earthworm community parameters under different land uses and land managements, which is sorely lacking in monitoring programs to make a real diagnosis. Thus, LandWorm will have a significant impact on many biomonitoring projects in metropolitan France currently underway: [RMQS-Biodiv](#) network (2240 plots sampled over 10 years), [SBT-ENI](#) network (500 plots sampled every year since 2013), the [#Vers2022](#) initiative and the citizen science on earthworms ([OPVT](#)). The selected consortium members have contributed in their respective work to fill the above-mentioned knowledge gap and have therefore been invited to join the LandWorm project. The consortium selected consists of 11 European experts (Belgium, France, Italy, Netherlands, UK, Spain and Switzerland) with different expertise (community and functional ecology, land management practices, data management, statistical analysis). The LandWorm project was prepared by the consortium under the supervision of the two principal investigators and is part of a scientific dynamic through the publications of Rutgers et al. (2016) and Phillips et al. (2019) in which most of the members of this consortium were already present and active. Most of the members of this project know each other well since they have collaborated together on numerous national and international projects over the past 15 years and have already published together; most of them are part of the scientific committee of the 12th edition of the International Symposium on Earthworm Ecology (which takes place every 4 years) and will take place next summer in Rennes (July 2022). Thus, being in frequent interaction with each other on various projects, the members of this consortium were invited to join the LandWorm project.

3/ Data management plan

Description and availability of the datasets to be used/compiled in the project (copy and paste for each dataset to be used) - Please note that the call does not finance collecting new data, only existing data (published or not), are eligible.

The data on earthworm communities (density, taxonomic and functional diversity) gathered in LandWorm only concern the French territory and will come from published (within or outside the consortium) and unpublished data collected during the last decades in several projects. Together, the consortium gathered information about 10 000 earthworm communities. The data gathered through our consortium comes from academic scientists and from citizens. The data covers agricultural, forest and semi-natural and artificial land uses and the main land management associated with these land uses:

Dataset name: SBT-ENI

Description (type of data, format, size): 500 agricultural plots (annual crops, vineyards) spread over the whole of Metropolitan France, monitored every year since 2013, sampling methods: mustard/hand sorting, excel files, 4500 observations, for more details see Andrade et al. (2021).

Current location/owner: personal computer/University of Rennes 1 (D. Cluzeau)

Accessibility (ownership, licence): ownership

Estimated time required to prepare data for analysis: 2 weeks

Dataset name: SOERE-ACBB-Lusignan

Description (type of data, format, size): Agricultural plots (annual crops and grasslands) in an experimental site, monitoring every 3 years, sampling method: formalin watering followed by hand sorting, excel files, 132 observations

Current location/owner: personal computer/University of Rennes 1 (D. Cluzeau)

Accessibility (ownership, licence): ownership

Estimated time required to prepare data for analysis: 1 week

Dataset name: SOERE-ACBB-Mons

Description (type of data, format, size): Agricultural plots (annual crops) in an experimental site, monitoring every 3 years, sampling method: formalin watering followed by hand sorting, excel files, 78 observations

Current location/owner: personal computer/University of Rennes 1 (D. Cluzeau)

Accessibility (ownership, licence): ownership

Estimated time required to prepare data for analysis: 1 week

Dataset name: SOERE-ACBB-Theix

Description (type of data, format, size): Agricultural plots (grasslands) in an experimental site, monitoring every 3 years, sampling method: formalin watering followed by hand sorting, excel files, 60 observations

Current location/owner: personal computer/University of Rennes 1 (D. Cluzeau)

Accessibility (ownership, licence): ownership

Estimated time required to prepare data for analysis: 1 week

Dataset name: SOERE-EFELE-PROs

Description (type of data, format, size): Agricultural plots (annual crops), in an experimental site, monitoring every 3 years, sampling method: formalin watering followed by hand sorting, excel files, 50 observations

Current location/owner: personal computer / Agrocampus Ouest (G. Pérès)

Accessibility (ownership, licence): ownership

Estimated time required to prepare data for analysis: 3 weeks

Dataset name: SoilServ

Description (type of data, format, size): Agricultural plots (annual crops and grasslands), synchronic monitoring, sampling methods: hand sorting followed by AITC watering, excel files, 92 observations

Current location/owner: personal computer/Agrocampus Ouest (G. Pérès)

Accessibility (ownership, licence): ownership

Estimated time required to prepare data for analysis: 1 week

Dataset name: SoilMan

Description (type of data, format, size): Agricultural plots (annual crops), synchronic monitoring, sampling method: hand sorting followed by AITC watering, excel files, 16 observations

Current location/owner: personal computer/ Agrocampus Ouest (G. Pérès)

Accessibility (ownership, licence): ownership

Estimated time required to prepare data for analysis: 1 week

Dataset name: SUSTAIN

Description (type of data, format, size): Agricultural plots (annual crops), synchronic monitoring, sampling method: formalin watering followed by hand sorting, excel files, 25 observations

Current location/owner: personal computer/ Agrocampus Ouest (G. Pérès)

Accessibility (ownership, licence): ownership

Estimated time required to prepare data for analysis: 1 week

Dataset name: Bioindicateur de la qualité des Sol- phase 2

Description (type of data, format, size): Agricultural plots (annual crops), synchronic monitoring, sampling method: formalin watering followed by hand sorting, excel files, 55 observations

Current location/owner: personal computer/ Agrocampus Ouest (D. Cluzeau/G. Pérès)

Accessibility (ownership, licence): ownership

Estimated time required to prepare data for analysis: 1 week

Dataset name: Agrinnov

Description (type of data, format, size): Agricultural plots (annual crops), spread over the whole of Metropolitan France, synchronic monitoring, sampling method: hand sorting, excel files, 200 observations

Current location/owner: personal computer/University of Rennes 1 (D. Cluzeau)

Accessibility (ownership, licence): ownership

Estimated time required to prepare data for analysis: 1 week

Dataset name: RMQS Biodiv

Description (type of data, format, size): Agricultural (annual crops and grasslands) and forest plots in Brittany, synchronic monitoring, sampling method: formalin watering followed by hand sorting, excel files, 109 observations

Current location/owner: personal computer/University of Rennes 1 (D. Cluzeau)

Accessibility (ownership, licence): ownership

Estimated time required to prepare data for analysis: ready for analysis

Dataset name: JASSUR

Description (type of data, format, size): Urban plots (Paris, Nancy, Toulouse, Nantes, Marseille and Rennes), synchronic monitoring, sampling method: hand sorting, excel files, 80 observations
 Current location/owner: personal computer/University of Rennes 1 (D. Cluzeau)
 Accessibility (ownership, licence): ownership
 Estimated time required to prepare data for analysis: ready for analysis

Dataset name: EcobioSoil

Description (type of data, format, size): Agricultural, artificialised and forest and natural plots, sampling method: mustard/formalin watering followed by hand sorting/hand sorting, excel files, 1850 observations
 Current location/owner: personal computer/University of Rennes 1 (D. Cluzeau)
 Accessibility (ownership, licence): ownership
 Estimated time required to prepare data for analysis: 1 month

Dataset name: Decaëns

Description (type of data, format, size): Earthworm communities from different regions in France with special emphasis towards natural habitats and high endemism regions (Mediterranean region, Massif Central, South Western and North-Eastern France), sampling method: hand sorting, excel files, 200 observations
 Current location/owner: personal computer / University of Montpellier (T. Decaëns)
 Accessibility (ownership, licence): ownership
 Estimated time required to prepare data for analysis: 1 week

Dataset names: La Cage, Feucherolles, Rescape, PSDR Dynamiques, PCRD ANSES

Description (type of data, format, size): Agricultural plots (annual crops and grasslands) in experimental sites (La Cage, Feucherolles, PCRD ANSES) and farmer's fields (Rescape) or in urban areas (PSDR Dynamiques); monitoring on several years (La Cage, PCRD ANSES) or once (Feucherolles, Rescape, PSDR Dynamiques); sampling methods: AITC solution followed by hand sorting or electricity (PSDR Dynamiques); excel files, 1000 observations
 Current location/owner: personal computer / INRAE (C. Pelosi)
 Accessibility (ownership, licence): ownership
 Estimated time required to prepare data for analysis: ready for analysis

Dataset names: Bouché 1972

Description (type of data; format; size): Agricultural, artificialised, forest and semi-natural environments; sampling method: hand sorting; structured database; c.a. 1200 observations
 Current location/owner: BETSI database (<https://portail.betsi.cnrs.fr/>)
 Accessibility (ownership, licence): free
 Estimated time required to prepare data for analysis: ready for analysis

Dataset names: #Vers2022

Description (type of data; format; size): Resampling of locations described by Bouché (1972) (Agricultural, forest and semi-natural environments), sampling method: hand sorting; structured database; 250 observations
 Current location/owner: personal computer/INRAE Montpellier (M. Hedde)
 Accessibility (ownership, licence): ownership
 Estimated time required to prepare data for analysis: ready for analysis

Is the metadata available across the data sets you will use? If it is not uniform, how will you deal with this?

Metadata are available for the different datasets that will be used in the project. It mainly gathers information on the sampling method and date. For differences in sampling methods, we will be able to rely on publications that allow us to establish correspondences between protocols (Gutierrez-Lopez et al., 2016; Singh et al., 2016; Andriuzzi et al., 2017) and thus aggregate different databases. Data from too different protocols will be treated separately. This will be the case for data from citizen science where sampling is done with mustard, these data represent about one third of the total dataset (see 3/ data management plan).

Storage and management solutions both during and after the project:

As all the data is currently stored in excel files in personal computers, it seems appropriate to maintain this format to facilitate exchanges with the various data owners during the project. The strength of LandWorm is that most of the data are coming from the University of Rennes 1 who has recorded and managed their data for 30 years in a similar way. Given the size of the final dataset, the management of these excel files will be done through the R software. At the end of the project, the data will be deposited into the French Natural heritage SINP, the European EDAPHOBASE database and through it into the GBIF (see task 2.4).

Policy for further access and use of data after the end of the project:

- What data will be generated through the project?
- What type of data will be created?
- Are there restrictions on data release? If so what are they?

The data concerned by the LandWorm project are variables describing earthworm communities (density, taxonomic and functional diversity), climate (e.g. rainfall, temperature), soil properties (e.g. pH, texture, organic matter content), land use and management (e.g. tillage, fertilization, grazing, mowing) and associated metadata. There are data release restrictions for data that are not yet published and whose intellectual properties have yet to be established. However, when the data will be released in EDAPHOBASE, this data will be findable and may be the subject of a request to obtain a partial or total extract.

Identify at least one member of your proposed group who will be responsible for data management for the project (this will also be noted in the member's contribution to the group in Section C). Explain your plan if that person is incapacitated. Will the data be transparent to all group members? How will you facilitate this?

Helen Phillips will be responsible for data management and will be supported by the post docs recruited. In the event of their incapacity, Guénola Pérès will be in charge of data management. To ensure traceability and data exchange, the data will be available online in a private cloud during the project. This will also ensure the transfer of data in case of change of data manager.

4/ Literature cited

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Terrat, S., Horrigue, W., Dequiedt, S., Saby, N.P.A., Lelièvre, M., Nowak, V., Tripied, J., Régnier, T., Jolivet, C., Arrouays, D., Wincker, P., Cruaud, C., Karimi, B., Bispo, A., Maron, P.A., Prévost-Bouré, N.C., Ranjard, L., 2017. Mapping and predictive variations of soil bacterial richness across France. *PLOS ONE* 12, e0186766. doi:10.1371/journal.pone.0186766

Violle, C., Bonis, A., Plantegenest, M., Cudennec, C., Damgaard, C., Marion, B., Le Cœur, D., Bouzillé, J.-B., 2011. Plant functional traits capture species richness variations along a flooding gradient. *Oikos* 120, 389–398. doi:10.1111/j.1600-0706.2010.18525.x

Violle, C., Enquist, B.J., McGill, B.J., Jiang, L., Albert, C.H., Hulshof, C., Jung, V., Messier, J., 2012. The return of the variance: intraspecific variability in community ecology. *Trends in Ecology & Evolution* 27, 244–252. doi:10.1016/j.tree.2011.11.014

Violle, C., Thuiller, W., Mouquet, N., Munoz, F., Kraft, N.J.B., Cadotte, M.W., Livingstone, S.W., Mouillot, D., 2017. Functional Rarity: The Ecology of Outliers. *Trends in Ecology & Evolution* 32, 356–367. doi:10.1016/j.tree.2017.02.002

Williams, J.W., Ordonez, A., Svenning, J.-C., 2021. A unifying framework for studying and managing climate-driven rates of ecological change. *Nature Ecology & Evolution* 5, 17–26. doi:10.1038/s41559-020-01344-5

Westerband, A.C., Funk, J.L., Barton, K.E., 2021. Intraspecific trait variation in plants: a renewed focus on its role in ecological processes. *Annals of Botany* 127, 397–410. doi:10.1093/aob/mcab011

5/ Comments, if any

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SECTION C – TEAM MEMBERS

Make sure you comply with the call instructions for the composition of your group.

The members you nominate here are an important part of the success of your project. When selecting members² (**max. 12** including the PIs but not the postdoc³ to be recruited under the call), do not just think of the individual's expertise, but also what is required for a highly functioning and innovative team, such as **complementary skills**, international network, **gender balance** and a **range of ages** (and experience) as well as time availability to attend meetings and work on tasks.

You must identify **two co-leaders** of the group, and describe their leadership skills. Information on the intended contribution of each participant to the group, and complementarity among participants, must be clearly mentioned.

You must also identify at least one person responsible for data management, and their expertise for this role should be clear from the information provided.

For each member, please ensure you have 'in principle' agreement for their inclusion (section E)

Member 1

- LAST NAME: PELOSI
- First name: Celine
- E-mail address: celine.pelosi@inrae.fr
- Gender: Female
- Current position: Senior researcher
- Year of completion of PhD: 2008
- Organization: INRAE
- Laboratory: EMMAH
- City: Avignon
- Country: FRANCE
- Function in the group: **Co-leader, expert in agro-ecology and data analysis, expert in project management**
- Brief biography describing expertise relevant to the project (<100 words): CP (39 yr-old, Female, PhD HdR) is a researcher at the EMMAH unit in the INRAE PACA center. CP has been the coordinator of numerous national and international research projects in the past and has supervised or advised numerous postdocs and Ph.D students (see CV). She is familiar with the members of this consortium, which promotes the fluidity of exchanges. Furthermore, CP has a strong experience in earthworm communities in agricultural plots with a past focus on effects of pesticides and other perturbations (different agricultural practices) on these communities. Her research led to 55 scientific papers in

² The group composition can possibly change during the course of the project and additional members can join during meetings on their own funding.

³ The postdoctoral fellow do not need to be mentioned in the working group composition section when the proposal will be submitted.

peer-reviewed journals in total (H-Index 19, Scopus) which will allow her to guide the publication strategies of this project.

- Intended contribution to the group (<50 words): project management, data provider, conceptualization of diversity patterns, expert in agronomy, statistical analyses, contribution to spatial and temporal analyses, and writing of papers

- Top 5 publications in the last 5 years:

- **Pelosi C.**, Thiel P., S. Bart, Amossé J., Jean-Jacques J., Thoisy-Dur J.C., Crouzet O. The contributions of enchytraeids and earthworms to the soil mineralization process in soils with fungicide. *Ecotoxicology*, in press.

- **Pelosi C.**, Bertrand C., Daniele G., Coeurdassier M., Benoit P., Nélieu S., Lafay F., Bretagnolle V., Gaba S., Vulliet E. Fritsch C., 2021. Residues of currently used pesticides in soils and earthworms: a silent threat? *Agriculture, Ecosystems & Environment*, 305, 107167.

- Amossé J., Bart S., Brulle F., Tebby C., Beaudouin R., Nélieu S., Lamy I., Péry A.R.R., **Pelosi C.**, 2020. A two years field experiment to assess the impact of two fungicides on earthworm communities and their recovery. *Ecotoxicology and Environmental Safety*, Volume 203, 110979.

- **Pelosi C.**, Römbke J., 2018. Enchytraeids as bioindicators of land use and management. In *Humusica*, a manual of humus forms. Special issue in *Applied Soil Ecology*, 123, 775-779.

- Bart S., Amossé J., Lowe C., Mougin C., Péry A.R.R., **Pelosi C.**, 2018. *Aporrectodea caliginosa* s.s, a relevant earthworm species for a posteriori pesticide risk assessment: Current knowledge and recommendations for culture and experimental design. *Environmental Science and Pollution Research*.

Member 2

- LAST NAME: CLUZEAU
- First name: Daniel
- E-mail address: daniel.cluzeau@univ-rennes1.fr
- Gender: male
- Current position: lecturer and researcher
- Year of completion of PhD: 1992
- Organization: University of Rennes 1
- Laboratory: UMR Ecobio
- City: Rennes
- Country: FRANCE
- Function in the group: **Co-leader, expert in agro-ecology and data analysis, expert in project management**
- Brief biography describing expertise relevant to the project (<100 words): DC (63 yr-old, Male, PhD HdR) has been the coordinator of numerous national and international research projects in the past and has supervised or advised numerous postdocs and Ph.D. students (see CV). He is familiar with the members of this consortium, which also promotes the fluidity of exchanges. Furthermore, Daniel is involved in research on earthworm ecology, in connection with agricultural, natural and urban land uses. As a synthesis of this research activity, Daniel has published numerous peer-reviewed scientific articles which will allow her to guide the publication strategies of this project.
- Intended contribution to the group (<50 words): project management, data provider, data management, conceptualization of diversity patterns, expertise in agricultural and artificialized land uses and in citizen science.
- Top 5 publications in the last 5 years:
 - Maréchal, J., Hoeffner, K., Marié, X., & **Cluzeau, D.** (2021). Response of earthworm communities to soil engineering and soil isolation in urban landscapes. *Ecological Engineering*, 169, 106307.
 - Hoeffner, K., Beylich, A., Chabbi, A., **Cluzeau, D.**, Dascalu, D., Graefe, U., Guzmán, G., Hallaire, V., Hanisch, J., Landa, B.B., Linsler, D., Menasseri, S., Öpik, M., Potthoff, M., Sandor, M., Scheu, S., Schmelz, R.M., Engell, I., Schrader, S., Vahter, T., Banse, M., Nicolaï, A., Plaas, E., Runge, T., Roslin, T., Decau, M.-L., Sepp, S.-K., Arias-Giraldo, L.F., Busnot, S., Roucaute, M., Pérès, G., 2021. Legacy effects of temporary grassland in annual crop rotation on soil ecosystem services. *Science of The Total Environment* 780, 146140.
 - Hoeffner, K., Hotte, H., **Cluzeau, D.**, Charrier, X., Gastal, F., & Pérès, G. (2021). Effects of temporary grassland introduction into annual crop rotations and nitrogen fertilisation on earthworm communities and forage production. *Applied Soil Ecology*, 162, 103893.
 - Phillips, H.R.P., Bach, E.M., Bartz, M.L.C., Bennett, J.M., Beugnon, R., Briones, M.J.I., Brown, G.G., Ferlian, O., Gongalsky, K.B., Guerra, C.A., König-Ries, B., Krebs, J.J., Orgiazzi, A., Ramirez, K.S., Russell, D.J., Schwarz, B., Wall, D.H., Brose, U., Decaëns, T., Lavelle, P., Loreau, M., Mathieu, J., Mulder, C., van der Putten, W.H., Rillig, M.C., Thakur, M.P., de Vries, F.T., Wardle, D.A., Ammer, C., Ammer, S., Arai, M., Ayuke, F.O., Baker, G.H., Baretta, D., Barkusky, D., Beauséjour, R., Bedano, J.C., Birkhofer, K.,

Blanchart, E., Blossey, B., Bolger, T., Bradley, R.L., Brossard, M., Burtis, J.C., Capowiez, Y., Cavagnaro, T.R., Choi, A., Clause, J., **Cluzeau, D.**, Coors, A., Crotty, F.V., Crumsey, J.M., Dávalos, A., Cosín, D.J.D., Dobson, A.M., Domínguez, A., Duhour, A.E., van Eekeren, N., Emmerling, C., Falco, L.B., Fernández, R., Fonte, S.J., Fragoso, C., Franco, A.L.C., Fusilero, A., Geraskina, A.P., Gholami, S., González, G., Gundale, M.J., López, M.G., Hackenberger, B.K., Hackenberger, D.K., Hernández, L.M., Hirth, J.R., Hishi, T., Holdsworth, A.R., Holmstrup, M., Hopfensperger, K.N., Lwanga, E.H., Huhta, V., Hurisso, T.T., Iannone, B.V., Iordache, M., Irmiler, U., Ivask, M., Jesús, J.B., Johnson-Maynard, J.L., Joschko, M., Kaneko, N., Kanianska, R., Keith, A.M., Kernecker, M.L., Koné, A.W., Kooch, Y., Kukkonen, S.T., Lalthanzara, H., Lammel, D.R., Lebedev, I.M., Le Cadre, E., Lincoln, N.K., López-Hernández, D., Loss, S.R., Marichal, R., Matula, R., Minamiya, Y., Moos, J.H., Moreno, G., Morón-Ríos, A., Motohiro, H., Muys, B., Neirynck, J., Norgrove, L., Novo, M., Nuutinen, V., Nuzzo, V., Mujeeb Rahman, P., Pansu, J., Paudel, S., Pérès, G., Pérez-Camacho, L., Ponge, J.-F., Prietzel, J., Rapoport, I.B., Rashid, M.I., Rebollo, S., Rodríguez, M.Á., Roth, A.M., Rousseau, G.X., Rozen, A., Sayad, E., van Schaik, L., Scharenbroch, B., Schirrmann, M., Schmidt, O., Schröder, B., Seeber, J., Shashkov, M.P., Singh, J., Smith, S.M., Steinwandter, M., Szlavecz, K., Talavera, J.A., Trigo, D., Tsukamoto, J., Uribe-López, S., de Valença, A.W., Virto, I., Wackett, A.A., Warren, M.W., Webster, E.R., Wehr, N.H., Whalen, J.K., Wironen, M.B., Wolters, V., Wu, P., Zenkova, I.V., Zhang, W., Cameron, E.K., Eisenhauer, N., 2021. Global data on earthworm abundance, biomass, diversity and corresponding environmental properties. *Scientific Data* 8, 136.

- van Leeuwen, J.P., Creamer, R.E., **Cluzeau, D.**, Debeljak, M., Gatti, F., Henriksen, C.B., Kuzmanovski, V., Menta, C., Pérès, G., Picaud, C., Saby, N.P.A., Trajanov, A., Trinsoutrot-Gattin, I., Visioli, G., Rutgers, M., 2019. Modeling of Soil Functions for Assessing Soil Quality: Soil Biodiversity and Habitat Provisioning. *Frontiers in Environmental Science* 7, 113.

Member 3

- LAST NAME: PERES
- First name: Guénola
- E-mail address: guenola.peres@agrocampus-ouest.fr
- Gender: Female
- Current position: Dr. Assistant professor
- Year of completion of PhD: 2003
- Organization: Institut Agro - Agrocampus Ouest
- Laboratory: UMR SAS
- City: Rennes
- Country: FRANCE
- Function in the group: **Member, expert in agroecology and soil functions, expert in project management**
- Brief biography describing expertise relevant to the project (<100 words): After 10 years of research activity at Rennes university as soil ecologist, developing a strong expertise on earthworm ecology, GP is an assistant professor at Agrocampus Ouest since 2014. Twenty years of research activities dealing on earthworm ecology, allowed to collect huge quantities of data in different agro-pedo-and climate contexts at national. GP leaded european projects (e.g. Biodiversa-SoilMan 2017-2020) dealing with soil biodiversity, functions, and ecosystem services, and was part of a national project (ANR-SoilServ 2017-2020) dealing with drivers of soil properties, including earthworm community. Actually, GP is part of European (EJP call-MINOTAUR) and national (PIU-INRAe-GloWorms) projects dealing with earthworm distribution.
- Intended contribution to the group (<50 words): Provisioning of data: dataset in different cultivated agrosystems (vineyards, crop-breeding), under different practices (reduced tillage, diversification of rotations including pasture, organic farming) and under different pedological and climat conditions at national and european scales. Expert in agro-ecology and soil functions.
- Top 5 publications in the last 5 years:
 - Hoeffner, K., Beylich, A., Chabbi, A., Cluzeau, D., Dascalu, D., Graefe, U., Guzmán, G., Hallaire, V., Hanisch, J., Landa, B.B., Linsler, D., Menasseri, S., Öpik, M., Potthoff, M., Sandor, M., Scheu, S., Schmelz, R.M., Engell, I., Schrader, S., Vahter, T., Banse, M., Nicolaï, A., Plaas, E., Runge, T., Roslin, T., Decau, M.-L., Sepp, S.-K., Arias-Giraldo, L.F., Busnot, S., Roucaute, M., **Pérès, G.**, 2021. Legacy effects of temporary grassland in annual crop rotation on soil ecosystem services. *Science of The Total Environment* 780, 146140.
 - Phillips, H.R.P., Guerra, C.A., Bartz, M.L.C., Briones, M.J.I., Brown, G., Crowther, T.W., Ferlian, O., Gongalsky, K.B., van den Hoogen, J., Krebs, J., Orgiazzi, A., Routh, D., Schwarz, B., Bach, E.M., Bennett, J.M., Brose, U., Decaëns, T., König-Ries, B., Loreau, M., Mathieu, J., Mulder, C., van der Putten, W.H., Ramirez, K.S., Rillig, M.C., Russell, D., Rutgers, M., Thakur, M.P., de Vries, F.T., Wall, D.H., Wardle, D.A., Arai, M., Ayuke, F.O., Baker, G.H., Beauséjour, R., Bedano, J.C., Birkhofer, K., Blanchart, E., Blossey, B., Bolger, T., Bradley, R.L., Callaham, M.A., Capowiez, Y., Caulfield, M.E., Choi, A., Crotty, F.V., Crumsey, J.M., Dávalos, A., Diaz Cosin, D.J., Dominguez, A., Duhour, A.E., van Eekeren, N., Emmerling, C., Falco, L.B., Fernández, R., Fonte, S.J., Fragoso, C., Franco, A.L.C., Fugère, M., Fusilero, A.T., Gholami, S.,

Gundale, M.J., López, M.G., Hackenberger, D.K., Hernández, L.M., Hishi, T., Holdsworth, A.R., Holmstrup, M., Hopfensperger, K.N., Lwanga, E.H., Huhta, V., Hurisso, T.T., Iannone, B.V., Iordache, M., Joschko, M., Kaneko, N., Kanianska, R., Keith, A.M., Kelly, C.A., Kernecker, M.L., Klaminder, J., Koné, A.W., Kooch, Y., Kukkonen, S.T., Lalthanzara, H., Lammel, D.R., Lebedev, I.M., Li, Y., Jesus Lidon, J.B., Lincoln, N.K., Loss, S.R., Marichal, R., Matula, R., Moos, J.H., Moreno, G., Morón-Ríos, A., Muys, B., Neiryck, J., Norgrove, L., Novo, M., Nuutinen, V., Nuzzo, V., Mujeeb Rahman P, Pansu, J., Paudel, S., **Pérès, G.**, Pérez-Camacho, L., Piñeiro, R., Ponge, J.-F., Rashid, M.I., Rebollo, S., Rodeiro-Iglesias, J., Rodríguez, M.Á., Roth, A.M., Rousseau, G.X., Rozen, A., Sayad, E., van Schaik, L., Scharenbroch, B.C., Schirrmann, M., Schmidt, O., Schröder, B., Seeber, J., Shashkov, M.P., Singh, J., Smith, S.M., Steinwandter, M., Talavera, J.A., Trigo, D., Tsukamoto, J., de Valença, A.W., Vanek, S.J., Virto, I., Wackett, A.A., Warren, M.W., Wehr, N.H., Whalen, J.K., Wironen, M.B., Wolters, V., Zenkova, I.V., Zhang, W., Cameron, E.K., Eisenhauer, N., 2019. Global distribution of earthworm diversity. *Science* 366, 480–485.

- van Leeuwen, J.P., Creamer, R.E., Cluzeau, D., Debeljak, M., Gatti, F., Henriksen, C.B., Kuzmanovski, V., Menta, C., **Pérès, G.**, Picaud, C., Saby, N.P.A., Trajanov, A., Trinsoutrot-Gattin, I., Visioli, G., Rutgers, M., 2019. Modeling of Soil Functions for Assessing Soil Quality: Soil Biodiversity and Habitat Provisioning. *Frontiers in Environmental Science* 7, 113.

- Rutgers, M., Orgiazzi, A., Gardi, C., Römke, J., Jänsch, S., Keith, A.M., Neilson, R., Boag, B., Schmidt, O., Murchie, A.K., Blackshaw, R.P., **Pérès, G.**, Cluzeau, D., Guernion, M., Briones, M.J.I., Rodeiro, J., Piñeiro, R., Cosín, D.J.D., Sousa, J.P., Suhadolc, M., Kos, I., Krogh, P.-H., Faber, J.H., Mulder, C., Bogte, J.J., Wijnen, H.J. van, Schouten, A.J., Zwart, D. de, 2016. Mapping earthworm communities in Europe. *Applied Soil Ecology* 97, 98–111.

- Griffiths, B.S., Römke, J., Schmelz, R.M., Scheffczyk, A., Faber, J.H., Bloem, J., **Pérès, G.**, Cluzeau, D., Chabbi, A., Suhadolc, M., Sousa, J.P., Martins da Silva, P., Carvalho, F., Mendes, S., Morais, P., Francisco, R., Pereira, C., Bonkowski, M., Geisen, S., Bardgett, R.D., de Vries, F.T., Bolger, T., Dirilgen, T., Schmidt, O., Winding, A., Hendriksen, N.B., Johansen, A., Philippot, L., Plassart, P., Bru, D., Thomson, B., Griffiths, R.I., Bailey, M.J., Keith, A., Rutgers, M., Mulder, C., Hannula, S.E., Creamer, R., Stone, D., 2016. Selecting cost effective and policy-relevant biological indicators for European monitoring of soil biodiversity and ecosystem function. *Ecological Indicators* 69, 213–223.

Member 4

- LAST NAME: HEDDE
- First name: Mickael
- E-mail address: mickael.hedde@inrae.fr
- Gender: Male
- Current position: Senior research scientist
- Year of completion of PhD: 2006
- Organization: INRAe
- Laboratory: UMR Eco&Sols
- City: Montpellier
- Country: FRANCE
- Function in the group: **Member, expert in functional ecology and data management**
- Brief biography describing expertise relevant to the project (<100 words): MH is a soil invertebrate ecologist. MH studies the factors that determine the assembly of invertebrate communities and the effect of these communities on soil functioning. MH is PI or WP leader of numerous projects on trait-based approaches and multi-trophic/network analysis of soil biota. MH was leading the BETSI database on the functional traits of soil fauna (a former CESAB project), a WP of the EUdaphobase COST action that will build the European data warehouse on soil biodiversity and a WP of MINOTAUR project (European Joint Program on Soils) on soil fauna distribution modelling.
- Intended contribution to the group (<50 words): data provider, conceptualization of diversity patterns, statistical analyses, contribution to spatial and temporal analyses, and writing of papers
- Top 5 publications in the last 5 years:
 - Bloor, J.M.G., Si-Moussi, S., Taberlet, P., **Hedde M.** Analysis of complex trophic networks reveals the signature of land-use intensification on soil communities in agroecosystems. *Sci Rep* 11, 18260 (2021).
 - Calderón-Sanou, I., Münkemüller, T., Zinger, L., Schimann, H., Yoccoz, N.G., Gielly, L., Foulquier, A., **Hedde, M.**, Ohlmann, M., Roy, M., Si-Moussi, S., Thuiller, W., 2021. Cascading effects of moth outbreaks on subarctic soil food webs. *Scientific Reports* 11, 15054.
 - Bonfanti, J., **Hedde, M.**, Joimel, S., Krogh, P. H., Violle, C., Nahmani, J., Cortet, J. (2018). Intraspecific body size variability in soil organisms at a European scale: implications for functional biogeography. *Functional Ecology*, 32 (11), 2562-2570.
 - Joimel, S., Schwartz, C., **Hedde, M.**, Kiyota, S., Krogh, P. H., Nahmani, J., Peres, G., Vergnes, A., Cortet, J. (2017). Urban and industrial land uses have a higher soil biological quality than expected from physicochemical quality. *Science of the Total Environment*, 584, 614-621.
 - Moretti, M., Dias, A. T., de Bello, F., Altermatt, F., Chown, S. L., Azcárate, F. M., Bell, J. R., Fournier, B., **Hedde, M.**, Hortal, J., Ibanez, S., Öckinger, E., Sousa, J. P., Eilers, J., Berg, M. P. (2017). Handbook of protocols for standardized measurement of terrestrial invertebrate functional traits. *Functional Ecology*, 31 (3), 558-567.

Member 5

- LAST NAME: DECAENS
- First name: Thibaud
- E-mail address: thibaud.Decaens@cefe.cnrs.fr
- Gender: Male
- Current position: Full professor
- Year of completion of PhD: 1999
- Organization: University of Montpellier
- Laboratory: Centre d'Ecologie Fonctionnelle et Evolutive (CEFE)
- City: Montpellier
- Country: FRANCE
- Function in the group: **Member, expert in community ecology and functional ecology**
- Brief biography describing expertise relevant to the project (<100 words): TD is full professor and head of the Laboratoire ECODIV of the Université de Rouen. His research interests include various aspects of invertebrate ecology, including community and functional ecology, taxonomy, and conservation biology. He is particularly interested in soil fauna and macrolepidoptera and has been involved in biodiversity studies in a range of temperate and tropical ecosystems in Europe, Latin America and Equatorial Africa.
- Intended contribution to the group (<50 words): data provider, data management, conceptualization of diversity patterns, expertise in agricultural and land uses, contribution to spatial and temporal analyses, and writing of papers.
- Top 5 publications in the last 5 years:
 - Ganault P., Nahmani J., David J.-F., Iorio E., Pasquet A., Mazzia C., Hättenschwiler S., Henneron L., Gillespie L., **Decaëns T.** (2021) Relative importance of tree diversity, identity, and microenvironment in shaping soil macroinvertebrates community in European forests. *Oecologia*, 196, 455–468.
 - Demetrio W.C., Conrado A.C., Acioli A., Ferreira A., Bartz M.L.C., James S.W., da Silva E., Maia L.S., Martins G.C., Macedo R., Stanton D.W.G., Lavelle P., Velasquez E., Zangerlé A., Barbosa R., Tapia-Coral S., Muniz A.W., Santos A., Ferreira T., Segalla R.F., **Decaëns T.**, Nadolny H.S., Peña Venegas C., Maia C., Pasini A., Motta A., Taube Júnior P., Silva T., Rebellato L., Oliveira Júnior R., Neves E., Pinto Lima H., Feitosa R., Vidal Torrado P., Mckey D., Clement C., Shock M., Teixeira W., Motta A.C., de Freitas Melo V., Dieckow J., TPI Network, Kille P., Brown G.G., Cunha L. (2021) A “Dirty” Footprint: Macroinvertebrate diversity in Amazonian anthropogenic soils. *Global Change Biology*, 27, 4575–4591.
 - Thakur M.P., Phillips H.R.P., Brose U., De Vries F.T., Lavelle P., Loreau M., Mathieu J., Mulder C., Van der Putten W.H., Rillig M.C., Wardle D.A., Bach E., Bartz M., Bennett J., Briones M.J.I., Brown G., **Decaëns T.**, Eisenhauer N., Ferlian O., Guerra C.A., König-Ries B., Lapied E., Orgiazzi A., Pereira H.M., Ramirez K.S., Russell D., Rutgers M., Wall D.H., Cameron E.K. (2020) Toward an integrative understanding of soil biodiversity. *Biological Reviews*, 95, 350–364.
 - Phillips, H.R.P., Guerra, C.A., Bartz, M.L.C., Briones, M.J.I., Brown, G., Crowther, T.W., Ferlian, O., Gongalsky, K.B., van den Hoogen, J., Krebs, J., Orgiazzi, A., Routh, D., Schwarz, B., Bach, E.M., Bennett, J.M., Brose, U., **Decaëns, T.**, König-Ries, B., Loreau, M., Mathieu, J., Mulder, C., van der Putten, W.H.,

Ramirez, K.S., Rillig, M.C., Russell, D., Rutgers, M., Thakur, M.P., de Vries, F.T., Wall, D.H., Wardle, D.A., Arai, M., Ayuke, F.O., Baker, G.H., Beauséjour, R., Bedano, J.C., Birkhofer, K., Blanchart, E., Blossey, B., Bolger, T., Bradley, R.L., Callahan, M.A., Capowiez, Y., Caulfield, M.E., Choi, A., Crotty, F.V., Crumsey, J.M., Dávalos, A., Diaz Cosin, D.J., Dominguez, A., Duhour, A.E., van Eekeren, N., Emmerling, C., Falco, L.B., Fernández, R., Fonte, S.J., Fragoso, C., Franco, A.L.C., Fugère, M., Fusilero, A.T., Gholami, S., Gundale, M.J., López, M.G., Hackenberger, D.K., Hernández, L.M., Hishi, T., Holdsworth, A.R., Holmstrup, M., Hopfensperger, K.N., Lwanga, E.H., Huhta, V., Hurisso, T.T., Iannone, B.V., Iordache, M., Joschko, M., Kaneko, N., Kanianska, R., Keith, A.M., Kelly, C.A., Kernecker, M.L., Klaminder, J., Koné, A.W., Kooch, Y., Kukkonen, S.T., Lalthanzara, H., Lammel, D.R., Lebedev, I.M., Li, Y., Jesus Lidon, J.B., Lincoln, N.K., Loss, S.R., Marichal, R., Matula, R., Moos, J.H., Moreno, G., Morón-Ríos, A., Muys, B., Neirynck, J., Norgrove, L., Novo, M., Nuutinen, V., Nuzzo, V., Mujeeb Rahman P, Pansu, J., Paudel, S., Pérès, G., Pérez-Camacho, L., Piñeiro, R., Ponge, J.-F., Rashid, M.I., Rebollo, S., Rodeiro-Iglesias, J., Rodríguez, M.Á., Roth, A.M., Rousseau, G.X., Rozen, A., Sayad, E., van Schaik, L., Scharenbroch, B.C., Schirrmann, M., Schmidt, O., Schröder, B., Seeber, J., Shashkov, M.P., Singh, J., Smith, S.M., Steinwandter, M., Talavera, J.A., Trigo, D., Tsukamoto, J., de Valença, A.W., Vanek, S.J., Virto, I., Wackett, A.A., Warren, M.W., Wehr, N.H., Whalen, J.K., Wironen, M.B., Wolters, V., Zenkova, I.V., Zhang, W., Cameron, E.K., Eisenhauer, N., 2019. Global distribution of earthworm diversity. *Science* 366, 480–485.

Member 6

- LAST NAME: BRIONES
- First name: Maria J.L
- E-mail address: Female
- Gender: Full Professor
- Current position: Full Professor
- Year of completion of PhD: 1991
- Organization: Universidade de Vigo
- Laboratory: Global Change and Soil Ecology Lab
- City: Vigo
- Country: Spain
- Function in the group: **Member, expert in agroecology and ecology of natural environments, expert in statistical analyses**
- Brief biography describing expertise relevant to the project (<100 words): MJIB (PhD in Biological Sciences) is currently a Professor of Animal Biology at the University of Vigo (Spain) with expertise in the examination of the effects of global change (e.g. climate and land use) on soil-plant interactions. In particular, she tries to quantify soil biodiversity changes and their potential implications for ecosystem services that they govern (i.e. sustainable plant production, soil carbon sequestration, greenhouse gas mitigation, hydrological regulation). To achieve this, she has developed a robust research profile on taxonomy and ecology of different soil organisms.
- Intended contribution to the group (<50 words): Solid background in taxonomy and ecology of earthworms under natural and agricultural systems. Experience in meta-analyses studies to quantitatively assess the influence of climate change and agricultural management practices on earthworm populations.
- Top 5 publications in the last 5 years:
 - Guerra CA, Bardgett RD, Caon L, Crowther TW, Delgado-Baquerizo M, Montanarella L, Navarro LM, Orgiazzi A, Singh BK, Tedersoo L, Vargas-Rojas R, **Briones MJ**, Buscot F, Cameron EK, Cesarz S, Chatzinotas A, Cowan DA, Djukic I, van den Hoogen J, Lehmann A, Maestre FT, Marín C, Reitz T, Rillig MC, Smith LC, de Vries FT, Weigelt A, Wall DW, Eisenhauer N (2021). Tracking, targeting, and conserving soil biodiversity. *Science* 371, art. eabe4744
 - Phillips, H.R.P., Guerra, C.A., Bartz, M.L.C., **Briones, M.J.I.**, Brown, G., Crowther, T.W., Ferlian, O., Gongalsky, K.B., van den Hoogen, J., Krebs, J., Orgiazzi, A., Routh, D., Schwarz, B., Bach, E.M., Bennett, J.M., Brose, U., Decaëns, T., König-Ries, B., Loreau, M., Mathieu, J., Mulder, C., van der Putten, W.H., Ramirez, K.S., Rillig, M.C., Russell, D., Rutgers, M., Thakur, M.P., de Vries, F.T., Wall, D.H., Wardle, D.A., Arai, M., Ayuke, F.O., Baker, G.H., Beauséjour, R., Bedano, J.C., Birkhofer, K., Blanchart, E., Blossey, B., Bolger, T., Bradley, R.L., Callahan, M.A., Capowiez, Y., Caulfield, M.E., Choi, A., Crotty, F.V., Crumsey, J.M., Dávalos, A., Diaz Cosin, D.J., Dominguez, A., Duhour, A.E., van Eekeren, N., Emmerling, C., Falco, L.B., Fernández, R., Fonte, S.J., Fragoso, C., Franco, A.L.C., Fugère, M., Fusilero, A.T., Gholami, S., Gundale, M.J., López, M.G., Hackenberger, D.K., Hernández, L.M., Hishi, T., Holdsworth, A.R., Holmstrup, M., Hopfensperger, K.N., Lwanga, E.H., Huhta, V., Hurisso, T.T., Iannone, B.V., Iordache, M., Joschko, M., Kaneko, N., Kanianska, R., Keith, A.M., Kelly, C.A., Kernecker, M.L., Klaminder, J., Koné,

A.W., Kooch, Y., Kukkonen, S.T., Lalthanzara, H., Lammel, D.R., Lebedev, I.M., Li, Y., Jesus Lidon, J.B., Lincoln, N.K., Loss, S.R., Marichal, R., Matula, R., Moos, J.H., Moreno, G., Morón-Ríos, A., Muys, B., Neirynck, J., Norgrove, L., Novo, M., Nuutinen, V., Nuzzo, V., Mujeeb Rahman P, Pansu, J., Paudel, S., Pérès, G., Pérez-Camacho, L., Piñeiro, R., Ponge, J.-F., Rashid, M.I., Rebollo, S., Rodeiro-Iglesias, J., Rodríguez, M.Á., Roth, A.M., Rousseau, G.X., Rozen, A., Sayad, E., van Schaik, L., Scharenbroch, B.C., Schirrmann, M., Schmidt, O., Schröder, B., Seeber, J., Shashkov, M.P., Singh, J., Smith, S.M., Steinwandter, M., Talavera, J.A., Trigo, D., Tsukamoto, J., de Valença, A.W., Vanek, S.J., Virto, I., Wackett, A.A., Warren, M.W., Wehr, N.H., Whalen, J.K., Wironen, M.B., Wolters, V., Zenkova, I.V., Zhang, W., Cameron, E.K., Eisenhauer, N., 2019. Global distribution of earthworm diversity. *Science* 366, 480–485.

- da Silva PM, Nascimento E, Reis F, **Briones MJJ**, Brussaard L, Sousa JP (2020). More frequent droughts slow down litter decomposition across European agroecosystems and increase the importance of earthworm functional diversity (2020). *Applied Soil Ecology* 145, art. 103628.

- Thakur MP, Philips HRP, Brose U, De Vries FT, Lavelle P, Loreau M, Mathieu J, Mulder C, Van der Putten W, Rillig MC, Wardle DA, Bach EM, Bartz MLC, Bennett JM, **Briones MJJ**, Brown G., Decaëns T, Eisenhauer N, Ferlian O, Guerra CA, König-Ries B, Orgiazzi O, Ramirez KS, Russell DJ, Rutgers M, Wall DH, Cameron EK (2020) Towards an integrative understanding of soil biodiversity. *Biological Reviews* 95, 350-364

- **Briones MJJ**, Elias DMO, Grant H, McNamara N (2019) Plant identity control on soil food web structure and C transfers under perennial bioenergy plantations. *Soil Biology and Biochemistry* 138, 107603

Member 7

- LAST NAME: LE BAYON
- First name: René-Claire
- E-mail address: claire.lebayon@unine.ch
- Gender: Female
- Current position: Adjunct Professor
- Year of completion of PhD: 1999
- Organization: University of Neuchâtel
- Laboratory: Functional Ecology Laboratory
- City: Neuchâtel
- Country: SWITZERLAND
- Function in the group: **Member, expert in functional ecology and urban ecology**
- Brief biography describing expertise relevant to the project (<100 words): Research of CLB focuses on the role of earthworms as ecosystem engineers on soil structure formation (aggregates, porosity, soil stability) and the involvement of soil fauna in bioturbation processes. CLB is also a specialist in soils and humus forms functioning.
- Intended contribution to the group (<50 words): expertise on urban soils and urban ecology, writing of papers
- Top 5 publications in the last 5 years:
 - **Le Bayon, R. C.**, Bullinger-Weber, G., Schomburg, A. C., Turberg, P., Brunner, P., Schlaepfer, R., & Guenat, C. (2021). Earthworms, Plants, and Soils. In Hydrogeology, Chemical Weathering, and Soil Formation. (pp. 81-103). New-York: John Wiley and Sons, Inc.
 - Schomburg, A. C., Verrecchia, E., Guenat, C., Brunner, P., Sebag, D., & **Le Bayon, R. C.** (2021). Rock-Eval pyrolysis discriminates soil macro-aggregates formed by plants and earthworms. Soil Biology & Biochemistry, 117, 117-124.
 - **Le Bayon, R. C.**, Guenat, C., Schlaepfer, R., Fischer, F., Luiset, A., Schomburg, A. C., & Turberg, P. (2020). Use of X-ray microcomputed tomography for characterizing earthworm-derived belowground soil aggregates. European Journal of Soil Science, Special Issue Article, 1-15.
 - Tresch, S., Frey, D., **Le Bayon, R. C.**, Zanetta, A., Rasche, F., Fliessbach, A., & Moretti, M. (2019). Litter decomposition driven by soil fauna, plant diversity and soil management in urban gardens. Science of the Total Environment, 658, 1614-1629.
 - Schomburg, A. C., Brunner, P., Turberg, P., Guenat, C., Riaz, M., **Le Bayon, R. C.**, & Luster, J. (2019). Pioneer plant Phalaris arundinacea and earthworms promote initial soil structure formation despite strong alluvial dynamics in a semi-controlled field experiment. Catena, 180, 41-54

Member 8

- LAST NAME: MUYS
- First name: Bart
- E-mail address: bart.muys@kuleuven.be
- Gender: Male
- Current position: Full Professor
- Year of completion of PhD: 1993
- Organization: KU Leuven
- Laboratory: Division of Forest, Nature and Landscape
- City: Leuven
- Country: BELGIUM
- Function in the group: **Member, expert in forest ecology and functional ecology**
- Brief biography describing expertise relevant to the project (<100 words): Professor of forest ecology with over 30 years' experience in above-ground below-ground interactions in ecosystems, biodiversity function, land use impacts, sustainable forest management. Continued to work on earthworms in relation to litter decomposition and alternative stable states in soils (non-linearities, threshold behavior and hysteresis).
- Intended contribution to the group (<50 words): Sharing experience on earthworm communities in European forest, in relation to humus typology and soil process domains. Interested in co-evolution between earthworms and tree species litter traits.
- Top 5 publications in the last 5 years:
 - Jing X, **Muys B**, Bruelheide H, Desie E, Hättenschwiler S, Jactel H, Jaroszewicz B, Kardol P, Ratcliffe S, Scherer-Lorenzen M, Selvi F, Vancampenhout K, van der Plas F, Verheyen K, Vesterdal L, Zuo J, Van Meerbeek K, 2021. Above-and belowground complementarity rather than selection drives tree diversity-productivity relationships in European forests. Functional Ecology. DOI: 10.1111/1365-2435.13825
 - Ganault, P., Nahmani, J., Hättenschwiler, S., Gillespie, L. M., David, J. F., Henneron, L., Iorio, E., Mazzia, C., **Muys, B.**, Pasquet, A., Prada-Salcedo L.D., Wambsganss J., Decaëns T., 2021. Relative importance of tree species richness, tree functional type, and microenvironment for soil macrofauna communities in European forests. Oecologia 196, 455–468.
 - Desie, E., Van Meerbeek, K., De Wandeler, H., Bruelheide, H., Domisch, T., Jaroszewicz, B., Joly, F.-X., Vancampenhout, K., Vesterdal, L., **Muys, B.**, 2020. Positive feedback loop between earthworms, humus form and soil pH reinforces earthworm abundance in European forests. Functional Ecology 34, 2598–2610.
 - Desie, E., Vancampenhout, K., Heyens, K., Hlava, J., Verheyen, K., & **Muys, B.** (2019). Forest conversion to conifers induces a regime shift in soil process domain affecting carbon stability. Soil Biology and Biochemistry, 136, 107540.

- Phillips, H.R.P., Guerra, C.A., Bartz, M.L.C., Briones, M.J.I., Brown, G., Crowther, T.W., Ferlian, O., Gongalsky, K.B., van den Hoogen, J., Krebs, J., Orgiazzi, A., Routh, D., Schwarz, B., Bach, E.M., Bennett, J.M., Brose, U., Decaëns, T., König-Ries, B., Loreau, M., Mathieu, J., Mulder, C., van der Putten, W.H., Ramirez, K.S., Rillig, M.C., Russell, D., Rutgers, M., Thakur, M.P., de Vries, F.T., Wall, D.H., Wardle, D.A., Arai, M., Ayuke, F.O., Baker, G.H., Beauséjour, R., Bedano, J.C., Birkhofer, K., Blanchart, E., Blossey, B., Bolger, T., Bradley, R.L., Callahan, M.A., Capowiez, Y., Caulfield, M.E., Choi, A., Crotty, F.V., Crumsey, J.M., Dávalos, A., Diaz Cosin, D.J., Dominguez, A., Duhour, A.E., van Eekeren, N., Emmerling, C., Falco, L.B., Fernández, R., Fonte, S.J., Fragoso, C., Franco, A.L.C., Fugère, M., Fusilero, A.T., Gholami, S., Gundale, M.J., López, M.G., Hackenberger, D.K., Hernández, L.M., Hishi, T., Holdsworth, A.R., Holmstrup, M., Hopfensperger, K.N., Lwanga, E.H., Huhta, V., Hurisso, T.T., Iannone, B.V., Iordache, M., Joschko, M., Kaneko, N., Kanianska, R., Keith, A.M., Kelly, C.A., Kernecker, M.L., Klaminder, J., Koné, A.W., Kooch, Y., Kukkonen, S.T., Lalthanzara, H., Lammel, D.R., Lebedev, I.M., Li, Y., Jesus Lidon, J.B., Lincoln, N.K., Loss, S.R., Marichal, R., Matula, R., Moos, J.H., Moreno, G., Morón-Ríos, A., **Muys, B.**, Neirynck, J., Norgrove, L., Novo, M., Nuutinen, V., Nuzzo, V., Mujeeb Rahman P, Pansu, J., Paudel, S., Pérès, G., Pérez-Camacho, L., Piñeiro, R., Ponge, J.-F., Rashid, M.I., Rebollo, S., Rodeiro-Iglesias, J., Rodríguez, M.Á., Roth, A.M., Rousseau, G.X., Rozen, A., Sayad, E., van Schaik, L., Scharenbroch, B.C., Schirrmann, M., Schmidt, O., Schröder, B., Seeber, J., Shashkov, M.P., Singh, J., Smith, S.M., Steinwandter, M., Talavera, J.A., Trigo, D., Tsukamoto, J., de Valença, A.W., Vanek, S.J., Virto, I., Wackett, A.A., Warren, M.W., Wehr, N.H., Whalen, J.K., Wironen, M.B., Wolters, V., Zenkova, I.V., Zhang, W., Cameron, E.K., Eisenhauer, N., 2019. Global distribution of earthworm diversity. *Science* 366, 480–485.

Member 9

- LAST NAME: ORGIAZZI
- First name: Alberto
- E-mail address: alberto.orgiazzi@ec.europa.eu
- Gender: Male
- Current position: Project officer
- Year of completion of PhD: 2012
- Organization: European Commission's Joint Research Centre
- Laboratory: Land Resources Unit
- City: Ispra (VA)
- Country: ITALY
- Function in the group: **Member, expert in data management and statistical analysis**
- Brief biography describing expertise relevant to the project (<100 words): AO hold a PhD in biology and biotechnology with a focus on soil biodiversity analysis through DNA-based techniques. He was chief editor of the 1st Global Soil Biodiversity Atlas published by the European Commission's Joint Research Centre (JRC). Currently he is responsible for all soil biodiversity research activities at the JRC, in particular he coordinates the largest European assessment of soil biodiversity as part of the LUCAS Soil survey.
- Intended contribution to the group (<50 words): Overall support for large-scale assessment and data management with a special eye on possible policy implications of project findings.
- Top 5 publications in the last 5 years:
 - **Orgiazzi, A.**, Bardgett, R., Barrios, E., Behan-Pelletier, V., Briones, M.J.I., Chotte, J-L., De Deyn, G.B., Eggleton, P., Fierer, N., Fraser, T., Hedlund, K., Jeffery, S., Johnson, N.C., Jones, A., Kandeler, E., Kaneko, N., Lavelle, P., Lemanceau, P., Miko, L., Montanarella, L., Moreira, F.M.S., Ramirez, K.S., Scheu, S., Singh, B.K., Six, J., van der Putten, W.H., Wall, D.H. (Eds.). (2016) Global Soil Biodiversity Atlas. European Commission, Publications Office of the European Union, Luxembourg. 176 pp.
 - **Orgiazzi, A.**, Ballabio, C., Panagos, P., Jones, A., Fernández-Ugalde, O. (2018 – awarded “top 20 most read paper 2017-2018 in EJS”) LUCAS Soil, the largest expandable soil dataset for Europe: a review. European Journal of Soil Science, 69: 140-153
 - **Orgiazzi, A.**, Panagos, P., Yigini, Y., Dunbar, M.B., Gardi, C., Montanarella, L., Ballabio, C. (2016) A knowledge-based approach to estimating the magnitude and spatial patterns of potential threats to soil biodiversity. Science of the Total Environment, 545-546: 11-20
 - Phillips, H.R.P., Guerra, C.A., Bartz, M.L.C., Briones, M.J.I., Brown, G., Crowther, T.W., Ferlian, O., Gongalsky, K.B., van den Hoogen, J., Krebs, J., **Orgiazzi, A.**, Routh, D., Schwarz, B., Bach, E.M., Bennett, J.M., Brose, U., Decaëns, T., König-Ries, B., Loreau, M., Mathieu, J., Mulder, C., van der Putten, W.H., Ramirez, K.S., Rillig, M.C., Russell, D., Rutgers, M., Thakur, M.P., de Vries, F.T., Wall, D.H., Wardle, D.A., Arai, M., Ayuke, F.O., Baker, G.H., Beauséjour, R., Bedano, J.C., Birkhofer, K., Blanchart, E., Blossey, B., Bolger, T., Bradley, R.L., Callahan, M.A., Capowiez, Y., Caulfield, M.E., Choi, A., Crotty, F.V., Crumsey, J.M., Dávalos, A., Diaz Cosin, D.J., Dominguez, A., Duhour, A.E., van Eekeren, N., Emmerling, C., Falco,

L.B., Fernández, R., Fonte, S.J., Fragoso, C., Franco, A.L.C., Fugère, M., Fusilero, A.T., Gholami, S., Gundale, M.J., López, M.G., Hackenberger, D.K., Hernández, L.M., Hishi, T., Holdsworth, A.R., Holmstrup, M., Hopfensperger, K.N., Lwanga, E.H., Huhta, V., Hurisso, T.T., Iannone, B.V., Iordache, M., Joschko, M., Kaneko, N., Kanianska, R., Keith, A.M., Kelly, C.A., Kernecker, M.L., Klaminder, J., Koné, A.W., Kooch, Y., Kukkonen, S.T., Lalthanzara, H., Lammel, D.R., Lebedev, I.M., Li, Y., Jesus Lidon, J.B., Lincoln, N.K., Loss, S.R., Marichal, R., Matula, R., Moos, J.H., Moreno, G., Morón-Ríos, A., Muys, B., Neirynck, J., Norgrove, L., Novo, M., Nuutinen, V., Nuzzo, V., Mujeeb Rahman P, Pansu, J., Paudel, S., Pérès, G., Pérez-Camacho, L., Piñeiro, R., Ponge, J.-F., Rashid, M.I., Rebollo, S., Rodeiro-Iglesias, J., Rodríguez, M.Á., Roth, A.M., Rousseau, G.X., Rozen, A., Sayad, E., van Schaik, L., Scharenbroch, B.C., Schirrmann, M., Schmidt, O., Schröder, B., Seeber, J., Shashkov, M.P., Singh, J., Smith, S.M., Steinwandter, M., Talavera, J.A., Trigo, D., Tsukamoto, J., de Valença, A.W., Vanek, S.J., Virto, I., Wackett, A.A., Warren, M.W., Wehr, N.H., Whalen, J.K., Wironen, M.B., Wolters, V., Zenkova, I.V., Zhang, W., Cameron, E.K., Eisenhauer, N., 2019. Global distribution of earthworm diversity. *Science* 366, 480–485.

- Rutgers, M., **Orgiazzi, A.**, Gardi, C., Römbke, J., Jänsch, S., Keith, A.M., Neilson, R., Boag, B., Schmidt, O., Murchie, A.K., Blackshaw, R.P., Peres, G., Cluzeau, D., Guernion, M., Briones M.J.I., Rodeiro, J., Pineiro, R., Díaz Cosín, D.J., Sousa J.P., Suhadolc, M., Kos, I., Krogh, P.-H., Faber, J.H., Mulder, C., Bogte, J.J., van Wijnen, H.J., Schouten, A.J., de Zwart, D. (2016) Mapping earthworm communities in Europe. *Applied Soil Ecology*, 97: 98-111

Member 10

- LAST NAME: BUTT
- First name: Kevin
- E-mail address: krbutt@uclan.ac.uk
- Gender: Male
- Current position: Reader in Ecology
- Year of completion of PhD: 1990
- Organization: University of Central Lancashire
- Laboratory: Earthworm Research Group
- City: Preston
- Country: UK
- Function in the group: **Member, expert in ecology of artificialized environments**
- Brief biography describing expertise relevant to the project (<100 words): Research of KRB over the past 35 years has focused on many aspects of earthworm ecology, for example looking at earthworms in reclaimed and restored soils, often given over to pasture or forestry. Here, starting from an impoverished or even absent soil fauna, the way that colonization occurs has been enlightening. Monitoring of earthworms in translocated soils has also been undertaken over lengthy time periods alongside deliberate inoculation of species into “sterile” soils. Community development has therefore been an interest throughout.
- Intended contribution to the group (<50 words): Bring expertise in areas as mentioned above and even provision of, as yet, unpublished data sets on community development.
- Top 5 publications in the last 5 years:
 - Nuutinen, V., **Butt, K.R.**, Hyvaluoma, J., Ketoja, E. and Mikola, J. (2017) Soil fauna and structural responses to the settlement of a semi-sedentary earthworm *Lumbricus terrestris* in an arable clay field. *Soil Biology and Biochemistry* 115, 285-296.
 - Brami, C, Glover, A.R., **Butt, K.R.** and Lowe, C.N. (2017) Effects of silver nanoparticle on survival, biomass change and avoidance behaviour of the endogeic earthworm *Allolobophora chlorotica*. *Ecotoxicology and Environmental Safety* 141, 66-69.
 - Nuutinen, V. and **Butt, K. R.** (2019) Earthworm dispersal of plant litter across the surface of agricultural soils. *Ecology* 100(7), 2019, e02669.
 - Euteneuer, P., Wagentristl, H., Steinkellner, S., Fuchs, M., Zaller, J. G., Piepho, H-P. and **Butt, K.R.** (2020) Contrasting effects of cover crops on earthworms: Results from field monitoring and laboratory experiments on growth, reproduction and food choice. *European Journal of Soil Biology* 100, 103225.
 - **Butt, K. R.** and Quigg, S. M. (2021) Earthworm community development in soils of a reclaimed steelworks. *Pedosphere*, 31 (3), 384-390.

Member 11

- LAST NAME: PHILLIPS
- First name: Helen
- E-mail address: helen.phillips@smu.ca
- Gender: Female
- Current position: Post-doctoral researcher
- Year of completion of PhD: 2017
- Organization: Netherlands Institute of Ecology (NIOO-KNAW) and Saint Mary's University, Halifax, Canada
- Laboratory: Department of Terrestrial Ecology (NIOO) (with Wim van der Putten) and Department of Environmental Sciences (Saint Mary's) (with Erin Cameron)
- City: Halifax
- Country: CANADA
- Function in the group: Marie Curie Research Fellow
- Brief biography describing expertise relevant to the project (<100 words): My expertise is handling and analysing large datasets of biodiversity. Typically, my research questions focus on assessing the effect of global change drivers (such as land use or climate change) on biodiversity. In the past, my work has focused on the biodiversity above-ground, however, in the last few years I have shifted my focus to belowground organisms (typically earthworms), due to their lack of representation in macro-ecology. As a firm supporter of open science, I also aim to have all my data and code fully open access, and champion for this in other working groups I am part of.
- Intended contribution to the group (<50 words): Assisting in harmonising datasets that are intended to be used (I have experience in using data layers on climate, soil etc), as well as advise on analysis methods. With my experience in open-access science, I will help with the data management plan, and the execution of it.
- Top 5 publications in the last 5 years:
 - **Phillips, H.R.P.**, Guerra, C.A., Bartz, M.L.C., Briones, M.J.I., Brown, G., Crowther, T.W., Ferlian, O., Gongalsky, K.B., van den Hoogen, J., Krebs, J., Orgiazzi, A., Routh, D., Schwarz, B., Bach, E.M., Bennett, J.M., Brose, U., Decaëns, T., König-Ries, B., Loreau, M., Mathieu, J., Mulder, C., van der Putten, W.H., Ramirez, K.S., Rillig, M.C., Russell, D., Rutgers, M., Thakur, M.P., de Vries, F.T., Wall, D.H., Wardle, D.A., Arai, M., Ayuke, F.O., Baker, G.H., Beauséjour, R., Bedano, J.C., Birkhofer, K., Blanchart, E., Blossey, B., Bolger, T., Bradley, R.L., Callahan, M.A., Capowiez, Y., Caulfield, M.E., Choi, A., Crotty, F.V., Crumsey, J.M., Dávalos, A., Diaz Cosin, D.J., Dominguez, A., Duhour, A.E., van Eekeren, N., Emmerling, C., Falco, L.B., Fernández, R., Fonte, S.J., Fragoso, C., Franco, A.L.C., Fugère, M., Fusilero, A.T., Gholami, S., Gundale, M.J., López, M.G., Hackenberger, D.K., Hernández, L.M., Hishi, T., Holdsworth, A.R., Holmstrup, M., Hopfensperger, K.N., Lwanga, E.H., Huhta, V., Hurisso, T.T., Iannone, B.V., Iordache, M., Joschko, M., Kaneko, N., Kanianska, R., Keith, A.M., Kelly, C.A., Kernecker, M.L., Klaminder, J., Koné, A.W., Kooch, Y., Kukkonen, S.T., Lalthanzara, H., Lammel, D.R., Lebedev, I.M., Li, Y., Jesus Lidon, J.B., Lincoln, N.K., Loss, S.R., Marichal, R., Matula, R., Moos, J.H., Moreno, G., Morón-Ríos, A., Muys, B., Neirynck, J., Norgrove, L., Novo, M., Nuutinen, V., Nuzzo, V., Mujeeb Rahman P, Pansu, J., Paudel, S., Pérès, G., Pérez-Camacho, L., Piñeiro, R., Ponge, J.-F., Rashid, M.I., Rebollo, S., Rodeiro-Iglesias, J., Rodríguez, M.Á., Roth, A.M., Rousseau, G.X., Rozen, A., Sayad, E., van Schaik, L., Scharenbroch, B.C.,

Schirrmann, M., Schmidt, O., Schröder, B., Seeber, J., Shashkov, M.P., Singh, J., Smith, S.M., Steinwandter, M., Talavera, J.A., Trigo, D., Tsukamoto, J., de Valença, A.W., Vanek, S.J., Virto, I., Wackett, A.A., Warren, M.W., Wehr, N.H., Whalen, J.K., Wironen, M.B., Wolters, V., Zenkova, I.V., Zhang, W., Cameron, E.K., Eisenhauer, N., 2019. Global distribution of earthworm diversity. *Science* 366, 480–485.

- **Phillips, H.R.P.**, Bach, E.M., Bartz, M.L.C., Bennett, J.M., Beugnon, R., Briones, M.J.I., Brown, G.G., Ferlian, O., Gongalsky, K.B., Guerra, C.A., König-Ries, B., Krebs, J.J., Orgiazzi, A., Ramirez, K.S., Russell, D.J., Schwarz, B., Wall, D.H., Brose, U., Decaëns, T., Lavelle, P., Loreau, M., Mathieu, J., Mulder, C., van der Putten, W.H., Rillig, M.C., Thakur, M.P., de Vries, F.T., Wardle, D.A., Ammer, C., Ammer, S., Arai, M., Ayuke, F.O., Baker, G.H., Baretta, D., Barkusky, D., Beauséjour, R., Bedano, J.C., Birkhofer, K., Blanchart, E., Blossey, B., Bolger, T., Bradley, R.L., Brossard, M., Burtis, J.C., Capowiez, Y., Cavagnaro, T.R., Choi, A., Clause, J., Cluzeau, D., Coors, A., Crotty, F.V., Crumsey, J.M., Dávalos, A., Cosín, D.J.D., Dobson, A.M., Domínguez, A., Duhour, A.E., van Eekeren, N., Emmerling, C., Falco, L.B., Fernández, R., Fonte, S.J., Fragoso, C., Franco, A.L.C., Fusilero, A., Geraskina, A.P., Gholami, S., González, G., Gundale, M.J., López, M.G., Hackenberger, B.K., Hackenberger, D.K., Hernández, L.M., Hirth, J.R., Hishi, T., Holdsworth, A.R., Holmstrup, M., Hopfensperger, K.N., Lwanga, E.H., Huhta, V., Hurisso, T.T., Iannone, B.V., Iordache, M., Irmeler, U., Ivask, M., Jesús, J.B., Johnson-Maynard, J.L., Joschko, M., Kaneko, N., Kanianska, R., Keith, A.M., Kernecker, M.L., Koné, A.W., Kooch, Y., Kukkonen, S.T., Lalthanzara, H., Lammel, D.R., Lebedev, I.M., Le Cadre, E., Lincoln, N.K., López-Hernández, D., Loss, S.R., Marichal, R., Matula, R., Minamiya, Y., Moos, J.H., Moreno, G., Morón-Ríos, A., Motohiro, H., Muys, B., Neirynck, J., Norgrove, L., Novo, M., Nuutinen, V., Nuzzo, V., Mujeeb Rahman, P., Pansu, J., Paudel, S., Pérès, G., Pérez-Camacho, L., Ponge, J.-F., Prietzel, J., Rapoport, I.B., Rashid, M.I., Rebollo, S., Rodríguez, M.Á., Roth, A.M., Rousseau, G.X., Rozen, A., Sayad, E., van Schaik, L., Scharenbroch, B., Schirrmann, M., Schmidt, O., Schröder, B., Seeber, J., Shashkov, M.P., Singh, J., Smith, S.M., Steinwandter, M., Szlavecz, K., Talavera, J.A., Trigo, D., Tsukamoto, J., Uribe-López, S., de Valença, A.W., Virto, I., Wackett, A.A., Warren, M.W., Webster, E.R., Wehr, N.H., Whalen, J.K., Wironen, M.B., Wolters, V., Wu, P., Zenkova, I.V., Zhang, W., Cameron, E.K., Eisenhauer, N., 2021. Global data on earthworm abundance, biomass, diversity and corresponding environmental properties. *Sci Data* 8, 136.

- Thakur, M.P., **Phillips, H.R.P.**, Brose, U., De Vries, F.T., Lavelle, P., Loreau, M., Mathieu, J., Mulder, C., Van der Putten, W.H., Rillig, M.C., Wardle, D.A., Bach, E.M., Bartz, M.L.C., Bennett, J.M., Briones, M.J.I., Brown, G., Decaëns, T., Eisenhauer, N., Ferlian, O., Guerra, C.A., König-Ries, B., Orgiazzi, A., Ramirez, K.S., Russell, D.J., Rutgers, M., Wall, D.H., Cameron, E.K., 2020. Towards an integrative understanding of soil biodiversity. *Biological Reviews* 95, 350–364.

- White, H.J., León-Sánchez, L., Burton, V.J., Cameron, E.K., Caruso, T., Cunha, L., Dirilgen, T., Jurburg, S.D., Kelly, R., Kumaresan, D., Ochoa-Hueso, R., Ordonez, A., **Phillips, H.R.P.**, Prieto, I., Schmidt, O., Caplat, P., 2020. Methods and approaches to advance soil macroecology. *Global Ecology and Biogeography* 29, 1674–1690.

- **Phillips, H.R.P.**, Newbold, T., Purvis, A., 2017. Land-use effects on local biodiversity in tropical forests vary between continents. *Biodivers Conserv* 26, 2251–2270.

Comment(s) about the working team and its members, if any

SECTION D – CVs

Céline PELOSI (PhD, HDR)

39 years-old (born 17-03-1982), 2 children

<https://orcid.org/0000-0002-7100-5760>

Present position: Researcher in soil ecology at INRAE Avignon

UMR 1114 EMMAH INRAE-Avignon Université, 228 route de l'Aérodrome, CS 40 509, 84914 AVIGNON Cedex 9.

Tel: +33(0)4.32.72.22.28; Email: celine.pelosi@inrae.fr

Education

2005-2008 PhD in Agroecology, National Institute for Agricultural Research (INRA)-AgroParisTech
2003-2005 Master « Ecology, Biodiversity, Evolution » at Pierre and Marie Curie University

Main positions

2021 Senior researcher in soil ecology, UMR EMMAH, INRAE, Avignon, France
2019-2021 Researcher in soil ecology, UMR EMMAH, INRAE, Avignon, France
2018 Habilitation à Diriger des Recherches, Paris-Saclay University, Orsay
2011-2019 Researcher in soil ecotoxicology, ECOSYS research unit, INRA Versailles, France
2008-2010 Postdoctoral Fellowship in landscape ecology, INRA Toulouse, France

Publications

Fundamental research

- 55 articles indexed in the Web of Science: 33 as first or last author, 15 reviews, one data paper in peer-reviewed international journals of agronomy, soil biology, ecology, ecotoxicology, and modelling.
- 6 articles submitted, 7 book chapters and handbooks, 78 participations to international and national conferences, organisation of a research school, one national and one international conferences.
- H-index (October 2021): 19 (Publons, Scopus).
- Prizes and distinctions: 4 nominations for « lauriers INRAE », laureate of Zhang-Heng Program in 2013 and Young Talents France-China in 2017.

Science and society

- Participation in the revision of 5 international ISO norms
- Declaration of invention INRAE (DI-RV-20-0046) and scientific support (max. 20% of time) to a start-up (PRODIGGA)
- 3 'opinion papers'
- 20 participations to productions for the general public (3 movies, 3 radio, 2 invited conferences, 12 newspaper and specialised journals)

Prizes and distinctions: Laureate of the SUEZ Program « Acting for Natural Capital », prize Technical and Digital Innovation.

Supervision

2021 – 2024 Ph.D. thesis supervisor (100%), C. Serbource, INRAE – PACA Region: “Climate and organic matter effects on enchytraeid and earthworm activity, soil Structure and dynamics of wAteR in vineyards.”
2021 – 2024 Ph.D. thesis supervisor (50%) of L. Petit Dit Grazielat, INRAE-Avignon University “Revitalization of vineyard soils by inoculation of earthworms.”
2021 – 2024 Ph.D. thesis supervisor (50%) of M. Avignon, CIFRE INRAE/BIK (National Interprofessional Department of Kiwi): “Understanding of the mechanisms of dieback of kiwi orchards in France and search for remedial solutions.”
2016 – 2019 Ph.D. thesis supervisor (20%) (INRA/CIRAD La Réunion) of C. Laurent: “Biogeochemical determinants of ecotoxicological effects in agricultural soils polluted by trace elements”.
2015 – 2018 Ph.D. thesis supervisor (60%) of Sylvain Bart: “Behavioural, demographic and functional impacts of pesticides on soil annelid Oligochaeta”.
2015 – 2017 Post-doc supervisor (100%), J. Amossé: “Field monitoring of pesticide impacts on soil annelid Oligochaeta”.
2011 – 2016 14 Master Students: University of Paris 6, Paris 7, Paris-Sud 11, Paris Descartes, Rouen, Maine Engineering schools of AgroParisTech Paris, and ISARA Lyon, France; University of Siena, Italy (Erasmus scholarship).
2013-2021 Advisor in seven PhD student committees.

Involvement in research initiatives and networks

Since 2020	Participation in the National collective expertise PestiEcotox, INRAE/Ifremer
Since 2020	Member of scientific committee Metaprogram METABIO
Since 2016	Member of the scientific committee of AgroEcoSystem department, INRAE
June 2018	Organizer of the 13th Symposium International on Enchytraeids, Versailles, France (50 people)
2013-2017	Member of administrative committee 'Groupe français des Pesticides' (GFP). President of the 45th congress of GFP, Versailles, 2015 (150 people)
2013 - 2016	Co-responsible of the Soil Network, Labex BASC (SolFIT). Co-organizer of the research school on soil ecosystem services, Villarsceaux, France 2013.
2011 - 2018	Member of the BASC LabEx (Biodiversity, Agroecosystems, Society, Climate)
2011 - 2018	Member of SETAC (Society of Environmental Toxicology and Chemistry)
Since 2011	Member of INRAE ecotoxicologist network

Project coordination and involvement

2020-2023	Coordinator of REVers, SUEZ « Acting for Natural Capital », 216 k€
2020-2022	Co-coordinator of TRASS, INRAE AgroEcoSystem department, 51k€
2017-2021	Coordinator of PING, INRAE Metaprogram SMaCH, 120k€
2015-2019	Coordinator of RESCAPE, Ecophyto Program 2014, ONEMA/French Ministries, 110 k€
2015-2018	Coordinator of PCRD-ANSES, 120 k€
2015-2018	Coordinator of COLLECHY, France/Hongrie, Ministry of Foreign Affairs, France / National Department for Research, Development and Innovation, Hungary, 15 k€
2014-2016	Coordinator of BIOPRO, LabEx BASC, 20 k€
2012-2014	Coordinator of ADVERPE, INRAE AgroEcoSystem department, 30 k€
2013-2015	Co-coordinator of BIOPURE, French Embassy and INRA/CIRAD in China

Participation in 12 projects funded by:

- European Union H2020 (MAGIC, 2018-2022, 26 partners from 12 countries)
- Institute for Mediterranean Environmental Transition (ITEM) (ALCOVE, 2020-2023)
- Provence-Alpes-Côte d'Azur Region (COSME, 2021-2027)
- French Agency for Biodiversity (Dynabio, 2019-2022)
- EcoServ Metaprogram INRAE (Sys&Div, 2017-2020)
- ADEME (CICESOL, 2014-2016)
- BASC Labex x2 (SOLTER, 2014-2016 et MACMINE, 2014-2016)
- Ile-de-France Region x2 (DYNAMIQUES et PROLEG, 2016-2020)
- French Foundation for Biodiversity Research (FRB) (BETSI, 2011-2014)
- NatureParif (2010-2012)

Temporary breaks in the career

- March - August 2019 Availability to raise a child < 8 years old (6 months)
- June - Sept. 2015 2nd child (4 months)
- April - July 2013 1st child (4 months)

Five more relevant publications (in the past 4 years)

- **Pelosi C.**, Thiel P., S. Bart, Amossé J., Jean-Jacques J., Thoisy-Dur J.C., Crouzet O. The contributions of enchytraeids and earthworms to the soil mineralization process in soils with fungicide. *Ecotoxicology*, in press.
- **Pelosi C.**, Bertrand C., Daniele G., Coeurdassier M., Benoit P., Nélieu S., Lafay F., Bretagnolle V., Gaba S., Vulliet E. Fritsch C., 2021. Residues of currently used pesticides in soils and earthworms: a silent threat? *Agriculture, Ecosystems & Environment*, 305, 107167
- Amossé J., Bart S., Brulle F., Tebby C., Beaudouin R., Nélieu S., Lamy I., Péry A.R.R., **Pelosi C.**, 2020. A two years field experiment to assess the impact of two fungicides on earthworm communities and their recovery. *Ecotoxicology and Environmental Safety*, Volume 203, 110979.
- **Pelosi C.**, Römbke J., 2018. Enchytraeids as bioindicators of land use and management. In *Humusica*, a manual of humus forms. Special issue in *Applied Soil Ecology*, 123, 775-779.
- Bart S., Amossé J., Lowe C., Mougin C., Péry A.R.R., **Pelosi C.**, 2018. *Aporrectodea caliginosa* s.s., a relevant earthworm species for a posteriori pesticide risk assessment: Current knowledge and recommendations for culture and experimental design. *Environmental Science and Pollution Research*.

Dr Daniel Cluzeau (PhD, HDR)

63 years-old (born 03-02-1958), married, 3 children

Present position: Research Director in Soil Ecology & Associate Professor of University of Rennes 1
UMR 6553 Ecobio, Ecosystems - Biodiversity - Evolution, CNRS-University of Rennes1, Campus de Beaulieu,
Bâtiment 14 A – F-35042 Rennes, France.

Tél. +33 (0)6 0714 8555 - E-mail : daniel.cluzeau@univ-rennes1.fr

Academic education and degrees

2005 Habilitation to conduct researches, University Rennes 1

1989-1992 PhD in Biology, University of Rennes 1

Main positions

Since 2008 Director of Biological Research Station of the University Rennes 1

Since 1997 UMR-CNRS 6553 EcoBio, University Rennes 1 (senior lecturer)

1984-1997 Research Center for Biological and Social Studies (CREBS), France (research engineer)

Research & Teaching Specialities

Earthworm ecology & biology: Life cycles; demographic dynamics; community structure; ecological interactions; earthworm bioturbation; organic matters inputs; soil structure; bioporosity and water-transfer; carbon transfer and microbial activities; modelisation of ecological functions.

Land use and Land management interactions with earthworm communities: Arable, grassland and vineyard agrosystems; agricultural practices; urban agriculture; bioindicator; monitoring; long term experiment; database of soil biodiversity; alternative management of agricultural production systems (conservation agriculture, organic agriculture).

Applications to the multicriteria management of suburban and rural areas: Recycling eco-techniques of wastes refuses and animal manures; Soil reclamation; Eco-agriculture managements.

Director of professional licence PARTAGER (Agricultural practices, Rural Development, Alternative Techniques & Ecological Management Environmental Resources).

Founder and director of the ERPUR Master's Degree, from 2004 to 2017 (Rural and Peri-urban development)

Project coordination and involvement

Contribution to more than 30 research programs (including 8 international programs) allowing the creation of a large network of collaborations in disciplines ranging from agronomy to physical chemistry of the environment and often associating human sciences:

- 2018 - 2021 Earthworm biodiversity, an indicator of the state of the soil, the environment, the pressures and the ecological services (Office Français de la Biodiversité - Stratégie nationale de connaissance de la biodiversité)
- 2018 - 2020 Sols de Bretagne III - Contribution of earthworm biodiversity to agro-ecological soil management (Conseil Régional de Bretagne)
- 2017-2020 SOILMAN (ERANET BIODIVERSA) on ecosystem services driven by the diversity of soil biota under agricultural management.
- 2014-2018 VineDivers (ERANET BIODIVERSA) - Biodiversity-based ecosystem services in vineyards: Analysing interlinkages between plants, pollinators, soil biota and soil erosion across Europe
- 2014-2019 LIFE+ PTD European Program - Dynamic rotational grazing: Understanding & improving the sustainability and agro-ecological functioning of soil-grassland systems
- 2012-2016 SOFIA - Agrosystems and Functional Biodiversity of Soils Programme (ANR)
- 2011-2015 SUSTAIN project (ERANET- SNOWMAN) Soil Functional Biodiversity and Ecosystem Services, a Transdisciplinary Approach.

1998 - 2022 Contribution to soil biodiversity assessment programs:

- 2012-2022 Transfer of an operational toolbox to assess soil biodiversity and its functional impacts on and its functional impacts on soils (CASDAR Agrinnov 2012-2016 - REVA 2017-2022)
- 2012-2027 SBT-ENI - Network of 500 plots for Biological Monitoring of the Territory to evaluate the Unintended Effects of agricultural practices (Ministry of Agriculture DGAL - Ecophyto)
- Since 2011 Coordinator of a citizen science program on earthworm (Observatoire Participatif des Vers de Terre)
- 2004-2012 Network of ecological engineering research with the Universities of Shanghai, supported by the CNRS INEE.

- 2003-2007 European Program 6ème PCRD ENVASSO (Environmental assessment of Soil for Monitoring) – “Decline in soil biodiversity”.
- 1990-2016 Long term program of Champagne vineyard practices on soil biota levels : how to integrate the knowledge gained on this soil biodiversity heritage at the base of the sustainability of the vineyards of Champagne? (VitiEcoBioSoil).
- 1988-2000 First french interdisciplinary research program on organic farming system development (GIS GEPAB).

Since 1998 active participation at the french consortium on functional ecology who built experimental approaches in the Ecotron of Montpellier and the French Long Term Experiment, SOERE ACBB and PRO

Supervision

- 2018 – 2022 Ph.D. thesis supervisor (50%) of J. Maréchal: “Contribution of earthworm communities to the functions of reconstructed Anthrosoles”
- 2015 – 2018 Ph.D. thesis supervisor (50%) of K. Hoeffner: “Assessing the functional contribution of anecic earthworm species to grassland litter decomposition: interspecies variability within an ecological category”
- 2009 – 2012 Ph.D. thesis supervisor (50%) of Q. Zhao: “Taxonomy, phylogeny and paleogeography of pheretimoid earthworms (megascolecidae: amynthas, metaphire) in Hainan Island, China”
- 2008 – 2011 Ph.D. thesis supervisor (50%) of L. Luth “Effect of the combination of lombrifiltration and macrophyte lagoon on effluent recycling on the farm”
- 2005 – 2008 Ph.D. thesis supervisor (50%) of D. Piron: “Distribution of the earthworm drilosphere and bio-physical characterization of bioturbation facies under gradient of de-intensification of mechanical soil tillage”.
- 1999 – 2003 Ph.D. thesis supervisor (50%) of G. Pérès: “Identification and in situ quantification of interactions between earthworm diversity and macro-biopores in the Brittany polyculture context. Influence on soil hydric functioning”.
- 1995 – 1998 Ph.D. thesis supervisor (50%) of M. Cannavacciuolo: “Biodiversity and spatial structure of the earthworm fauna in a temporary grassland in western France”.

Relevant publications

- Maréchal, J., Hoeffner, K., Marié, X., & Cluzeau, D. (2021). Response of earthworm communities to soil engineering and soil isolation in urban landscapes. *Ecological Engineering*, 169, 106307.
- Hoeffner, K., Beylich, A., Chabbi, A., Cluzeau, D., Dascalu, D., Graefe, U., Guzmán, G., Hallaire, V., Hanisch, J., Landa, B.B., Linsler, D., Menasseri, S., Öpik, M., Potthoff, M., Sandor, M., Scheu, S., Schmelz, R.M., Engell, I., Schrader, S., Vahter, T., Banse, M., Nicolai, A., Plaas, E., Runge, T., Roslin, T., Decau, M.-L., Sepp, S.-K., Arias-Giraldo, L.F., Busnot, S., Roucaute, M., Pérès, G., 2021. Legacy effects of temporary grassland in annual crop rotation on soil ecosystem services. *Science of The Total Environment* 780, 146140.
- Hoeffner, K., Santonja, M., Monard, C., Barbe, L., Moing, M.L., Cluzeau, D., 2021. Soil properties, grassland management, and landscape diversity drive the assembly of earthworm communities in temperate grasslands. *Pedosphere* 31, 375–383.
- van Leeuwen, J.P., Creamer, R.E., Cluzeau, D., Debeljak, M., Gatti, F., Henriksen, C.B., Kuzmanovski, V., Menta, C., Pérès, G., Picaud, C., Saby, N.P.A., Trajanov, A., Trinsoutrot-Gattin, I., Visoli, G., Rutgers, M., 2019. Modeling of Soil Functions for Assessing Soil Quality: Soil Biodiversity and Habitat Provisioning. *Frontiers in Environmental Science* 7, 113.
- Rutgers, M., Orgiazzi, A., Gardi, C., Römbke, J., Jänsch, S., Keith, A.M., Neilson, R., Boag, B., Schmidt, O., Murchie, A.K., Blackshaw, R.P., Pérès, G., Cluzeau, D., Guernion, M., Briones, M.J.I., Rodeiro, J., Piñeiro, R., Cosín, D.J.D., Sousa, J.P., Suhadolc, M., Kos, I., Krogh, P.-H., Faber, J.H., Mulder, C., Bogte, J.J., Wijnen, H.J. van, Schouten, A.J., Zwart, D. de, 2016. Mapping earthworm communities in Europe. *Applied Soil Ecology* 97, 98–111.
- Griffiths, B.S., Römbke, J., Schmelz, R.M., Scheffczyk, A., Faber, J.H., Bloem, J., Pérès, G., Cluzeau, D., Chabbi, A., Suhadolc, M., Sousa, J.P., Martins da Silva, P., Carvalho, F., Mendes, S., Morais, P., Francisco, R., Pereira, C., Bonkowski, M., Geisen, S., Bardgett, R.D., de Vries, F.T., Bolger, T., Dirilgen, T., Schmidt, O., Winding, A., Hendriksen, N.B., Johansen, A., Philippot, L., Plassart, P., Bru, D., Thomson, B., Griffiths, R.I., Bailey, M.J., Keith, A., Rutgers, M., Mulder, C., Hannula, S.E., Creamer, R., Stone, D., 2016. Selecting cost effective and policy-relevant biological indicators for European monitoring of soil biodiversity and ecosystem function. *Ecological Indicators* 69, 213–223.

SECTION E – Confirmation of participation

Insert (copy and paste) here e-mailed confirmations from each participant.

Bonjour Céline et Daniel,

Merci de m'avoir invitée à ce projet, auquel je participerai volontiers. Je pourrai mettre à disposition un certain nombre de jeux de données.

Bonne fin de journée

Guénola

Guénola PERES
Maître de Conférences en Ecologie des Sols
Assistant Professor in Soil Ecology

Institut Agro (Agrocampus Ouest Rennes)
Département MiPPaT, UP Sciences du Sol
UMR INRA/Agrocampus 1069 SAS
Sol, Agro et hydrosystème Spatialisation
Bâtiment 13
65, rue de St-Brieuc - 35042 Rennes Cedex
Tél : 00 33 (0)2 23 48 70 43

Bonjour Daniel et Céline,

C'est avec enthousiasme que j'accepte votre proposition de collaborer à la réponse à l'AAP Synthèse FRB-MTE-OFB intitulée LandWorm.

Bien amicalement

Mickael

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RÉPUBLIQUE
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Liberté
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Fraternité

INRAE

Dr. HDR Mickaël HEDDE
Directeur de Recherche
INRAE Montpellier – UMR Eco&Sols
<https://www.umar-ecosols.fr>

Bonjour Céline et Daniel,

Merci pour votre proposition qui m'intéresse également. Au plaisir d'en rediscuter avec vous.

Amitiés

Thibaud Decaens
UMR CEFE CNRS
1919 route de Mende
34293 Montpellier cedex 5

Dear Céline and Daniel,

Thank you very much for thinking of me for this interesting proposal!! Attached is my "team member presentation". I have chosen the recent publications on the basis of journal impact but I could choose only those focussing on earthworms. Please let me know if you want me to modify the text in any particular way.

Best regards,

Maria

Prof. Dr. Maria J. I. Briones
Dept. Ecología y Biología Animal
Facultad de Biología
Universidad de Vigo
36310 Vigo
SPAIN

Bonjour Céline et Daniel,

Bien volontiers pour participer à cette petite équipe, ça tombe bien, c'est la journée mondiale des vers de terre aujourd'hui !

Voici en copie ma contribution... 😊

Belle journée !

Claire

Dear Céline and Daniel,

Many thanks for this kind invitation. The project looks exciting, and the team is high level. I am enthusiastic to participate in this community. Please find my form in attach.

Success!

Bart

OK, Daniel and Céline, I'm on board. Will then see in January how things go.

Thank you very much for involving me.

Alberto

Alberto Orgiazzi

European Commission

DG Joint Research Centre

Directorate D – Sustainable Resources

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Dear Céline and Daniel,

Thank you for thinking of me. Please see the attached. Happy to play a part.

[Redacted signature block]

Best wishes

Kevin

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Hi Daniel and Céline,

Sorry, for the slow response – there’s been a few things I needed to think about before getting back to you.

This definitely sounds like a very good working group, and definitely something I would be happy putting my name down for.

[Redacted signature block]

Thank,

Helen