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BOOK OF ABSTRACTS

Block C

Session C4

Scientific research outcomes towards the production and sharing of standardised and harmonised EU soil data

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Abstracts of Oral Presentations

Comparison of LUCAS and national Soil Information Monitoring System (SIMS) datasets – Exploring the technical possibilities to support the development of an EU harmonized monitoring system

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Soil is crucial for life as it provides us food and fibre, regulates water and climate, and hosts thousands of organisms. A recent assessment states that 60-70% of soils in Europe can be considered as unhealthy due to different soil degradation processes. Soil monitoring is needed to determine the current soil properties, assess the soil status and detect soil changes over time.

Many EU member states implemented Soil Information Monitoring Systems (SIMS) that are quite heterogeneous (sampling scheme, resolution, measurement methods, …). In 2009, to develop a homogeneous dataset for EU, the European Commission extended the periodic Land Use/Land Cover Area Frame Survey (LUCAS) to sample and analyse the main properties of topsoil in EU. This survey was repeated several times since 2009 and offers a consistent spatial database.

Recently the EU Soil strategy for 2030 called for the implementation of an EU Soil Observatory (EUSO) that should become a dynamic and inclusive platform aiming to support policymaking by providing the Commission Services and the broader soil user community with the soil knowledge and data flows needed to safeguard soils. An attractive solution would be to pool all available data at all scales (local, national, European), including monitoring (SIMS, LUCAS) and other data in EUSO to provide a clear and up to date picture of soil status in Europe. This induces the question how to assemble these data from different monitoring systems, developed with different purposes? The first step is a compatibility study to determine whether or not different SIMS could be used together to provide meaningful national statistics and maps.

Within EJP SOIL WP 6, we developed a comparison protocol between LUCAS and SIMS, where we propose a framework to localize the differences between the two datasets. A next step is to produce transfer functions to commonly used LUCAS and SIMS datasets regarding different sampling strategies and measurement methods.

Keywords: soil monitoring, dataset, LUCAS Soil, EUSO

A review of existing soil monitoring systems to pave the way for the EU Soil Observatory

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Soils are constantly evolving due to natural factors as climate and living organisms (pedogenesis), but also due to external pressures linked mainly to human activities (e.g. urbanization, management practices, diffuse inputs of nutrients or contaminants through atmospheric deposits or waste spreading). The evolution of soils makes it necessary to set up monitoring programmes.

Designing and implementing a Soil Monitoring System (SMS) requires at least to choose: the statistical sampling design, the field sampling strategy in time and space, the entity that is sampled (i.e. pedogenic horizons or fixed depths) and how (e.g pits, augering, spade), the total thickness over which soil is sampled, the way the samples are managed (e.g. composite sample), prepared and analysed and the metadata is to be collected and stored (data about the sampling itself, its location and surroundings) to interpret the results. All those choices represent possible variations that enable the results to be compared.

Since 20 years, several projects and initiatives underlined the existing difficulties to compare and share data from national SMS, either due to technical issues (e.g. sampling designs and protocols, analytical methods, data format) but also on motivations (e.g. why to share the data, for what purpose) and legal requirements (e.g. are we allowed to share the data). With the objective of overcoming this blockage a questionnaire was designed and circulated within EJP SOIL. Its analysis allows to identify the main technical issues (e.g. major differences between SMS) and possible ways of harmonization/collaboration in the frame of the EU Soil Observatory.

Keywords: soil monitoring, LUCAS Soil, EUSO

Collecting, harmonizing and compiling data on soil biodiversity, from European agricultural plots

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We all depend for our food and our health, for climate mitigation and water resource, of soil functions provided by soil biodiversity. The objective of the program MINOTAUR (Modelling and mapping soil biodiversity patterns and functions across Europe), is to increase the knowledge about soil biodiversity status and trends, with agricultural practices and climate change, at different scales in Europe. Within this program, the task of the Work Package 2 are 1) to inventory existing datasets, 2) to harmonize them and 3) to compile them into a database. We identified 52 datasets across Europe, using questionnaire and bibliographic search. After several meetings, the WP2 members defined the database template. It gathers biological data about micro, meso and macrofauna and metadata about sampling methodology, agricultural practices, soil properties and project information. Regarding the database, we chose to use OpenADOM solutions (Open source Application for Data Organization & Management) with a file configuration in YAML (Yet Another Markup Language). With this tool, the database is flexible and easy to use for scientists. Indeed, the database is accessible by a web interface and the data user can require a first data visualization and filter the data. This work is still on going and the next steps are to finish establishing the database structure and to collect the inventoried data.

Keywords: Fungi, Bacteria, Nematods, Mesofauna, Macrofauna, Relational database

Enabling Soil data exchange and INSPIRE data sharing in Flanders: Database underground Flanders (Regional Soil Information System)

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Database Underground Flanders or DOV is an example of how a regional soil information system (SIS) can support the goals of WP6 concerning data exchange, data publication, soil monitoring and soil mapping making data accessible to a wide range of end users like scientists, citizens, companies and policy makers. As part of our participation in EJP SOIL WP6, we have been improving and strengthening the capabilities of DOV to enable the exchange of soil data within Flanders, and with other countries and Europe. DOV's data model is derived from the INSPIRE data model. The database includes the Belgian Soil Map, profile pits, boreholes, profile descriptions, physical, chemical, and biological soil properties, data on soil erosion, soil monitoring data, data from archaeological surveys and sensor data.

DOV offers several pathways for data exchange, from manual to fully automated. The last two years, a lot of effort was put into fully automating the exchange of data originating from the new Flemish Soil Carbon Monitoring network (Cmon). This required a process of data harmonisation, data centralisation and optimalisation of the infrastructure of each Cmon-partner. The result of this process enables

integrated data-analysis and INSPIRE conform open data publication of the Cmon data. DOV also enabled the exchange of sensor data from a citizen science project using IOT-devices and soil data from archaeological surveys. All this was made possible using a data model and exchange format derived from the INSPIRE data model.

The data in DOV is published as open data, complying with internationalstandards and guidelines such as the PSI- and INSPIRE-directives. This facilitates European and international data exchange, easy understanding of the data structure and integration of the data in other projects. Besides WMS and WFS services, DOV also provides data through WCS, other API's and a python library facilitating data science.

The user interfaces are an important part of DOV, making data available through a geoportal, specific applications, and informative webpages. Examples of specific applications are an informative pop-up illustrating the digital soil map and the 'virtual soil analysis' based on Digital Soil Mapping. This DSM was only possible due to the harmonisation and exchange of soil data supported by DOV and will support a wide range of environment modelling exercises and the development of soil health indicators.

Soil erosion is an important theme in DOV. Soil erosion and sediment transport modelling in Flanders result in yearly maps of parcel scale potential soil erosion to support the CAP, an erosion risk indicator and a thematic explorer. This is enabled by bringing together data from several INSPIRE themes.

DOV is the result of a 20-year cooperation between several government institutions working on soil and Subsoil bringing together soil, geological, geotechnical and groundwater data. This enables cross domain collaboration and integration with themes between and beyond soil and subsoil. The aim of DOV is to be a network organisation, not only enabling data exchange in Flanders but also actively fostering cooperation within the soil and underground community in Flanders.

Keywords: WP6; Regional Soil Information System, Data harmonisation, Data exchange and Soil indicators.

The regional soil organic carbon monitoring network in Flanders (Belgium)

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In 2020, a regional soil organic carbon monitoring network has been set up in Flanders. The purpose of this network is to measure, depending on land use, both the size and the evolution of soil organic carbon stocks till a depth of 1m. Although only recently started, the intention is to work with a 10-year return period. During a 10-year cycle, samples will be taken at 2594 sampling plots. These plots, 10 m by 10 m, are located on five different land uses: cropland, grassland, forest, nature and residential area (gardens, parcs, recreational areas and verges).

Both sampling plots and 16 sampling locations within the plots are selected using a generalized random tessellation stratified (GRTS) algorithm. At first, plot features are documented. If present and before sampling the mineral soil layers, the litter or the felt layer are collected. Sampling is done with a gouge auger at 4 fixed depth intervals: 0-10, 10-10, 30-60 and 60-100 cm. For the 0-10 and 10-30 cm layers, all 16 sampling locations are sampled, while for the 30-60 and 60-100 cm layers only 7 sampling locations are sampled within the plot. All subsamples are pooled per layer, resulting in one disturbed composite sample. Finally, to get an idea of the bulk density 4 undisturbed soil samples are taken per depth interval.

In the laboratory, the disturbed composite samples are analysed for total C, inorganic C, total N, pH-KCl and texture (laser diffraction). In addition, each soil sample is scanned to obtain near infrared spectra. For the litter and felt samples, dry mass, total C and total N are determined.

The errors associated with the sampling, sample preparation and lab analyses are quantified by resampling of 5% of the plots by a different sampling team.

The comprehensive sampling scheme and all measurements are related to the aim to significantly detect small soil organic carbon stock changes. From the start of the second 10-year sampling cycle we will already be able to calculate how much carbon is lost from or additionally stored in soils under different land uses. Additional field observations and lab analyses will help to explain the variation in and the evolution of the soil organic carbon stocks in Flanders.

Keywords: Regional Soil Monitoring System, Sampling scheme, Soil organic carbon, EJP SOIL WP6.