Project Database of ICP Forests

PROJECT DESCRIPTION

PROJECT INFORMATION

Project title:	**Holistic management practices, modelling & monitoring for European forest Soils (HoliSoils)**
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PROJECT DESCRIPTION

Knowledge gaps on forest soil processes and lack of integration and harmonisation of soil monitoring data limit the EU's ability to maintain soil related ecosystem services and to reach climate policy targets. A better understanding of the soil processes and a harmonised approach to manage and integrate data to computational models that are used for decision making is urgently required in order to meet climate and sustainability goals, including the UN's Agenda 2030 SDGs, the Paris Agreement of Climate Convention, the EU Bioeconomy Strategy, the EU's LULUCF Regulation, the EU Forest Strategy (2018), and the European Green Deal. HoliSoils will develop a harmonised soil monitoring framework and identify and test soil management practices aiming to mitigate CC and sustain provision of various ecosystem services essential for human livelihoods and wellbeing.

HoliSoils incorporates novel methodologies and expert knowledge on analytical techniques, data sharing, soil properties and biodiversity, and processes with model development, in order to develop tools for soil monitoring, refine GHG assessment of the LULUCF sector, enhance efficiency of GHG mitigation actions, and improve numerical forecasting of soil-based mitigation, adaptation, and ecosystem services. HoliSoils applies a collaborative multi-actor approach, in order to maximise its applicability and impact beyond its duration. The multidisciplinary consortium consists of universities and research institutes from across Europe, with leading expertise on soil analysis and databases, development of advanced analytical techniques, complex system modelling, digital soil mapping, soil ecology, disturbance ecology, forest and GHG inventories, social sciences, and communications. It also involves active engagement with diverse stakeholders, including forest owners and managers, industry actors, forest extension services, a standard setting body for forest certification, forest and soils researchers, climate policy support and GHG inventory experts, and policymakers.

HoliSoils' specific objectives are to

- Advance knowledge of soil properties, processes, biodiversity, and activity of soil microbiota, all of which influence soil-based ecosystem services (wood production, reduction of GHG emissions, water supply, soil nutrient retention, avoidance of land degradation) in organic and mineral soils [WP1, WP2, WP4, WP5];
- Develop and improve state-of-the-art soil models, harmonise them into a monitoring framework for estimation of C and GHG fluxes, nitrogen (N), and base cation stocks in forest soils, and integrate them into forest ecosystem models [WP2, WP3, WP6];
- Develop standardised sampling and monitoring protocols for GHG reporting, harmonise legacy soil data from multiple sources and make them available to end-users through a web portal, and develop and apply digital soil mapping methods to facilitate model upscaling to the European scale [WP3];

- Determine effects of management on soil functionality, biodiversity, nutrient stocks, (i.e. C, N, phosphorus (P), potassium (K), magnesium (Mg), calcium (Ca), and manganese (Mn)), organic matter quality, and stabilisation processes, and integrate C and N into numerical models, and to develop holistic CSF management, taking into account soil productivity, GHG exchange, water availability, erosion, and soil resilience (avoidance of degradation), and study their soil-related CC mitigation and adaptation potential on mineral and organic (forested peatland) soils [WP2, WP4, WP5];
- Determine effects of natural disturbances on soil functioning and resilience, identify good management practices for preventing soil degradation, and map soil vulnerability [WP3, WP5];
- Study the impacts, trade-offs, and synergies of CSF management scenarios for soils and forests on the Europe-wide GHG balance and water budget under future climate conditions and disturbance regimes [WP4, WP6];
- Boost collaboration between universities, research institutes, and intergovernmental bodies such as the EU, UNFCCC, UN Intergovernmental Panel on Climate Change (IPCC), and Food & Agriculture Organization of the UN (FAO), and facilitate the transfer of developed approaches, knowledge, and tools globally to operators within the forest sector via a multi-actor approach [WP7]

HoliSoils WP3 will harmonise and map soil data from multiple streams, such as the soil sampling points of LUCAS (Land Use and Coverage Area frame Survey) located on forest lands, as well as the ICP Forests Level_I soil database and Level_II soil and soil solution databases. These harmonised products are indispensable for Europe-wide GHG inventories and the project's experimental work and modelling. A multiple information stream concept will be applied to mapping tasks by harmonising different datasets of the same domain and period, resulting maps will come with uncertainty estimates, as they are based on more than a single data stream.

Digital soil mapping technologies will be used to upscale soil profile information to high-resolution soil property maps, by accounting for information contained within the soil database, as well as remote sensing-based covariate information on terrain, climate, land use, and parent material. In particular, we will use regression kriging and machine learning to produce soil property maps at seven standard depths, with quantified uncertainty.

Prerequisite for developing digital soil maps are precise coordinates of soil property measurements. LUKE, on behalf of the consortium, will make separate Letters of Agreement with the ICP Forests PCC or each soil property data provider in which they can indicate whether a) standardised location specific soil data may be shared with the user-community or b) the locations themselves may solely be used for map creation and not for any other purposes.

Uncertainty will be communicated by mapping the upper and lower limits of 90% prediction intervals. Mapped soil properties will include crucial inputs for soil models, such as C, N, pH, bulk density, and texture. These maps will be stored in HoliSoils' database and made accessible through an OA web-based platform (Open Geospatial Consortium standards). Web-based platform development will follow a cloud native container design and 12-factor app implementation, to ensure its robust and scalable functioning. The platform will be integrated into services currently provided by ISRIC, the ICS World Data Centre for Soils, ensuring maintenance and data access beyond the project's duration.

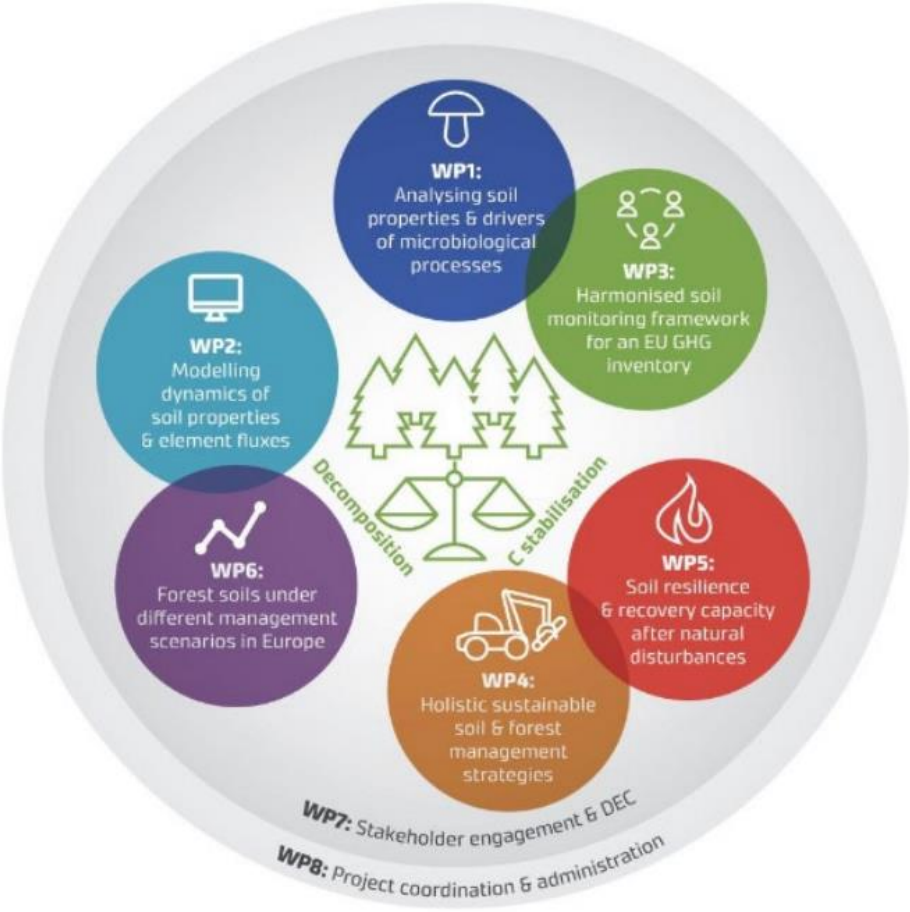

Figure 1. PERT chart showing HoliSoils'WPs & close interactions between WP1⇄WP3, WP2⇄WP6 & WP4⇄WP5. As well as the close interactions (illustrated), flows of data & information exist between all WPs (not illustrated). WP7 & WP8 in particular interact with all WPs.