



## The integration of Earth Observation data and other innovative technologies leverages the implementation of Monitoring, Reporting and Verification frameworks of Soil Organic Carbon and Greenhouse Gas Balance

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### Introduction

The European Union has issued a regulation aiming at high quality estimations of carbon removals and certification frameworks that avoid greenwashing. The criteria to receive the certification includes a correct quantification of carbon removals through carbon farming practices that deliver additional climate benefits, a long-term carbon storage, a minimisation of carbon leaks, and sustainable management practices.

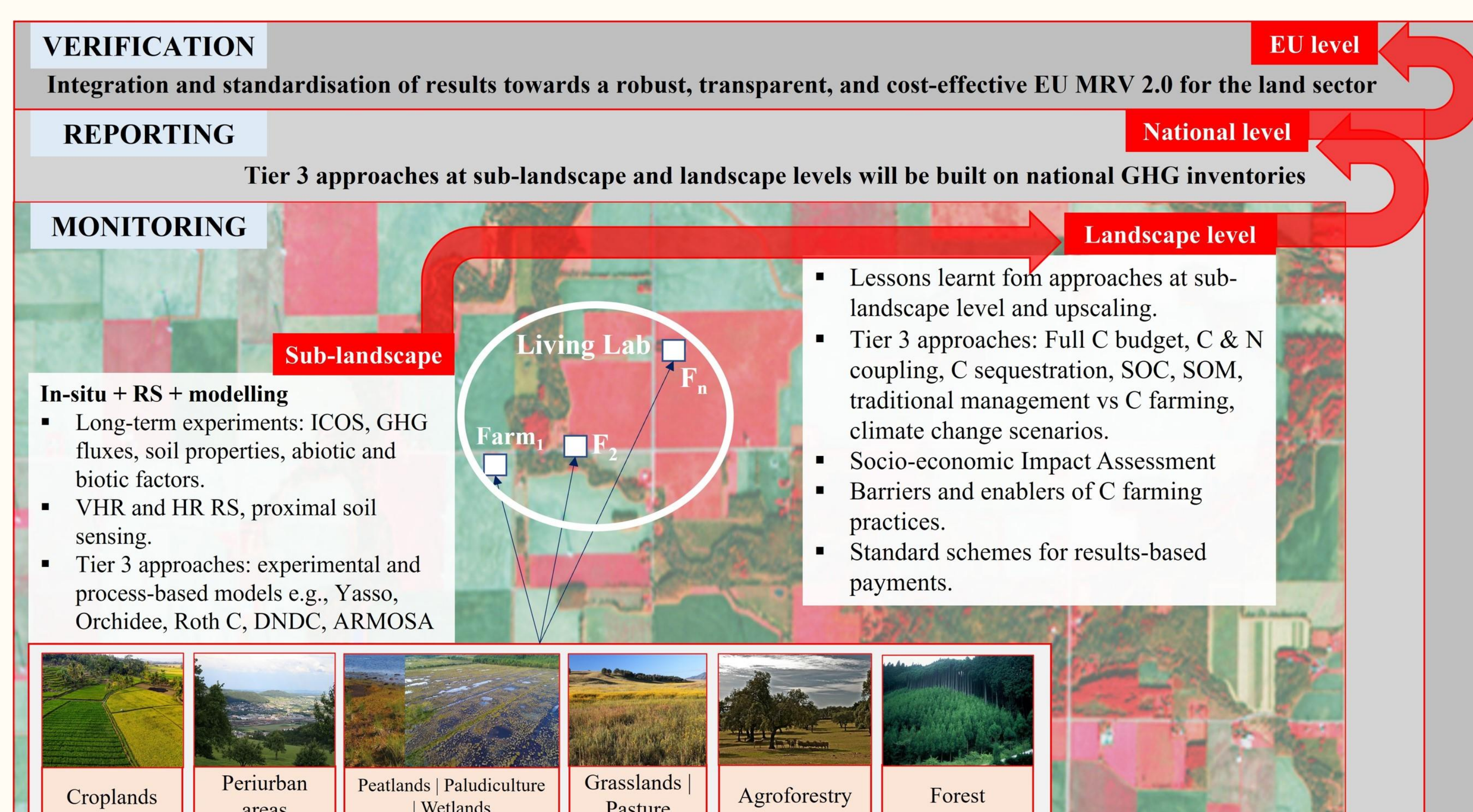
The achievement of these objectives requires comprehensive approaches that integrate positive and valuable features of innovative technologies. MRV4SOC proposes a Tier 3 methodology applied to different spatial and temporal scales to assess robustness, transparency, scalability, standardisation, and cost-effectiveness towards a EU Monitoring, Reporting, and Verification (MRV) framework for the Land Use, Land Use Change, and Forestry (LULUCF) sector.

This approach will be implemented in 14 Demo Sites (DS) and nine land use, land cover (LULC) classes i.e., croplands, grasslands, pasture, agroforestry, forests, peatlands, wetlands, paludiculture, and peri-urban areas subject to conversion. DS are located in five European countries (Spain, Belgium, Italy, Czech Republic, and Germany) and one Associated Country (Norway) with heterogeneous pedoclimatic conditions.

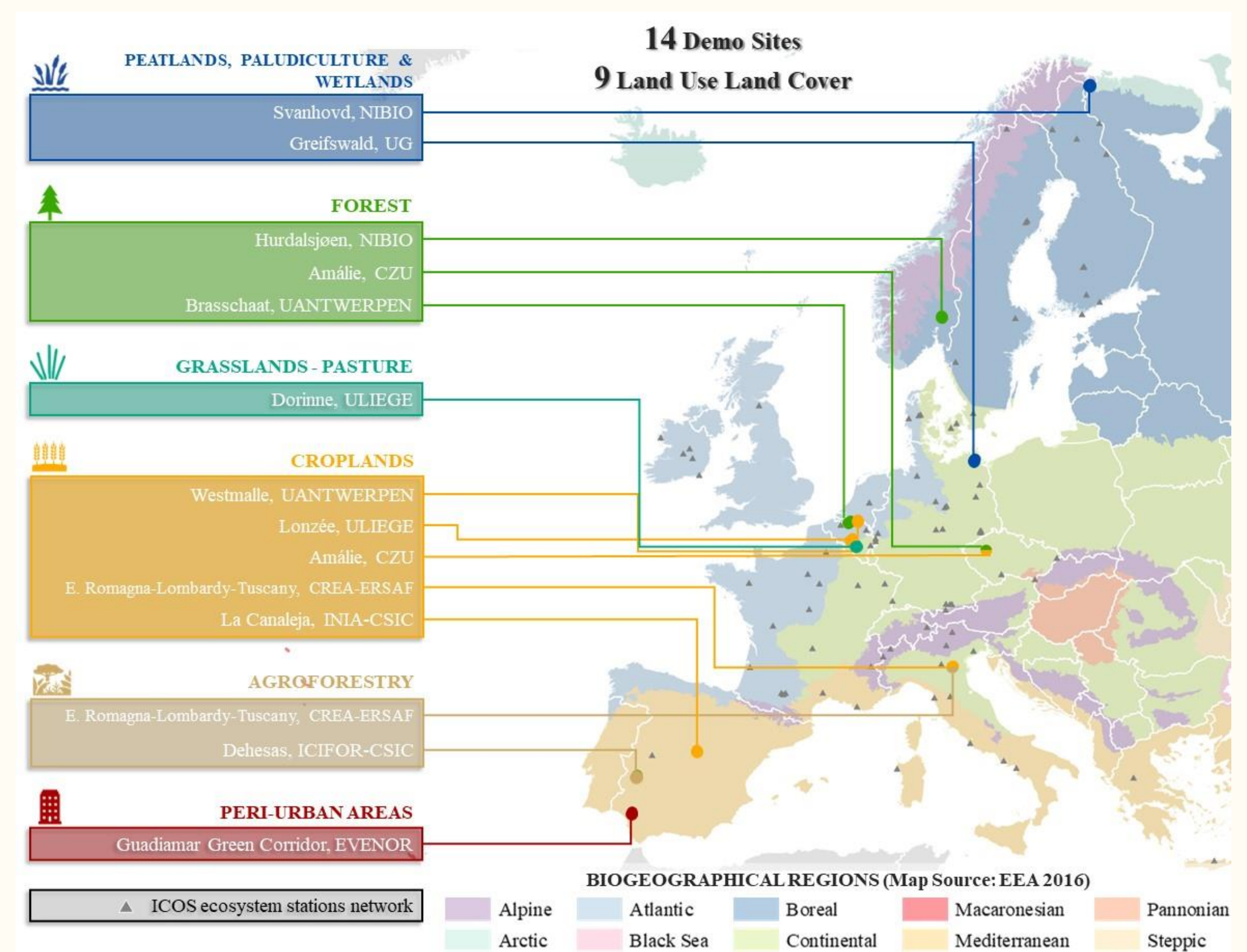
### Objectives

MRV4SOC will target six specific objectives:

- i) to measure long-term Soil Organic Carbon (SOC) accumulation in nine EU representative LULC classes, ii) to assess how carbon farming practices drive carbon flux dynamics in the nine LULC classes, iii) to assess the impact of climate change on SOC accumulation, iv) to develop a robust, transparent, standard, and cost-effective MRV to facilitate results-based payments associated with carbon farming practices, v) to seek out revenue opportunities to unlock results-based payments, and vi) to increase stakeholders' faith in Voluntary Carbon Markets (VCM).



### Demo Sites



### Challenges and Alternatives

Heterogeneous environmental and regulatory contexts have hindered the implementation of such frameworks for the EU LULUCF sector.

MRV4SOC will account for changes in as many carbon pools as possible to estimate greenhouse gas (GHG) and full carbon budgets, couple carbon and nitrogen cycles, quantify SOC accumulation, and assess the results of traditional management practices and carbon farming.

MRV4SOC will identify barriers and enablers to adopt carbon farming practices in each region and integrate outcomes towards policy recommendations. The results of this 3-year project will be shared with local stakeholders and key actors to increase their faith in VCM and leverage result-based payments.

### Lessons learnt from Worldsoils

To overcome challenges, MRV4SOC will assimilate high quality *in-situ* and remote sensing data into statistical and process-based models taking into account the lessons learnt from the ESA Worldsoils project coordinated by Julia Yagüe (GMV). In that project, bare soil reflectance composites were developed. These composites provided a full coverage of croplands without vegetation or residues over Europe. The reflectance of these pixels was used to calibrate a spectroscopic model to predict SOC content. The SOC content in permanently vegetated areas was predicted using a digital soil mapping approach. The validation in three European regions and a province in Brazil demonstrated the performance of the SOC prediction with  $R^2 = 0,52$  and  $RMSE=0,8 \text{ g C kg}^{-1}$  in southern Belgium. The Worldsoils product allows up-to-date SOC predictions over a three-year interval. These results will be considered in the MRV4SOC methodological approach.

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