ORGANIC CARBON STOCK MODELLING FOR THE QUANTIFICATION OF THE CARBON SINKS IN TERRESTRIAL ECOSYSTEMS

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Given the recent environmental policies derived from the serious threats caused by global change, carbon sequestration is a major measure to reduce atmospheric CO2 concentrations within a short and medium term. Development of tools for quantification, assessment and management of organic carbon in ecosystems at different scales, it is essential to achieve these commitments. The two main carbon sinks in terrestrial ecosystems are soil and aboveground biomass.

Regarding this, FAO and GSP launched a global endeavor to develop national soil organic carbon (SOC) maps to support and contribute the Global Soil Organic Carbon map (GSOC map). In this regard, the state-of-the-art (Figure 1) study evaluates strengths and weaknesses of the different current organic carbon assessment, which allows developing a specific national organic carbon map.

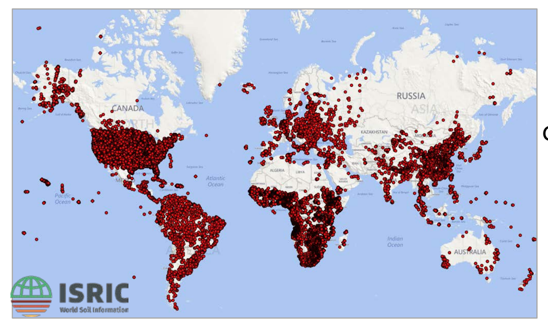
The aim of this study is to establish a methodological framework for the modeling of a tool (soil and biomass carbon), applied to a sustainable land use planning and management at national scale (Figure 2). The study area, Mediterranean ecosystem in Iberian Peninsula, is considered one of the most uncertain areas regarding climate change due to their vulnerability.

Figure 1 A State-of-the-Art

Soil carbon modelling

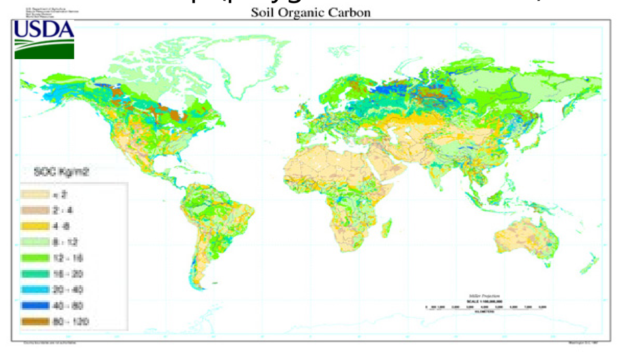
- Baseline data

Soil database (point information)



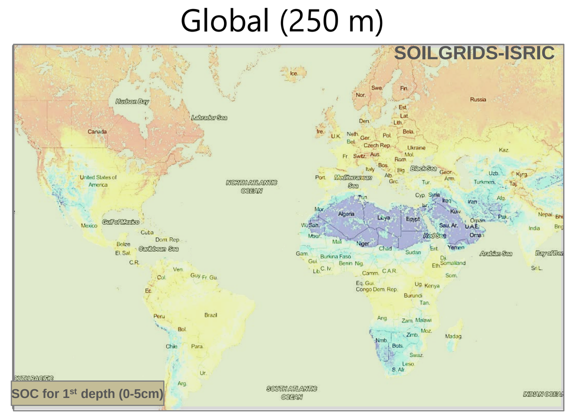
Additional process: from point to continuous data

Soil map (polygonal information)

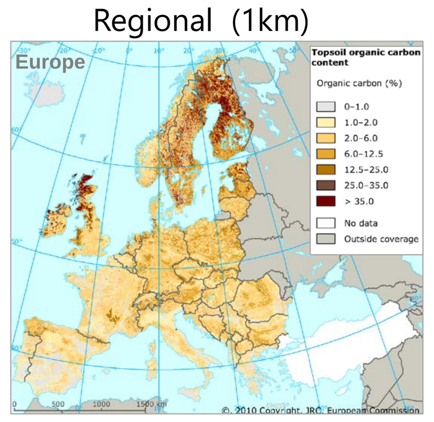


- Spatial representation and pixel resolution (grid)

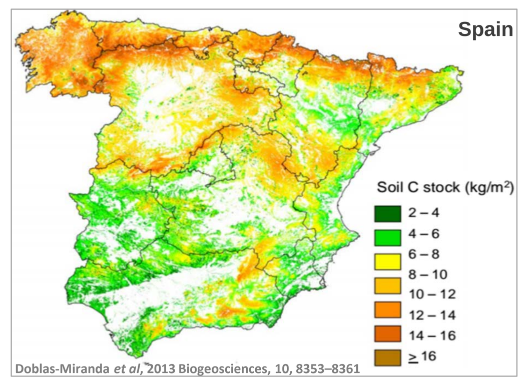
Global (250 m)



Regional (1km)

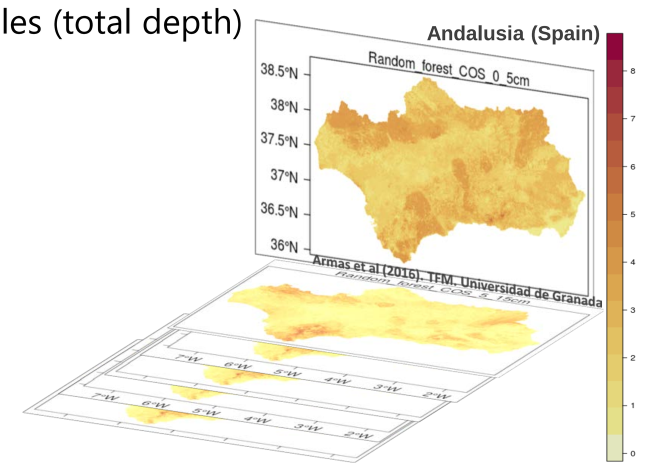


Local (200 m)

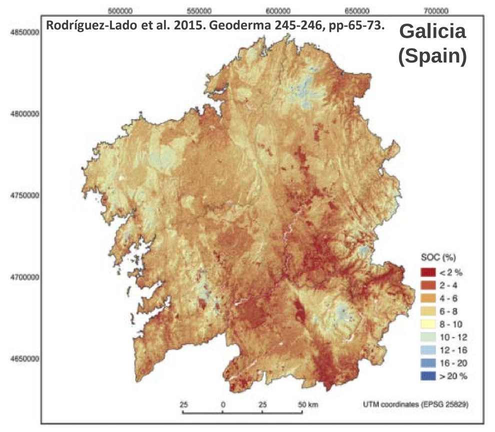


- Depth of sampling

Profiles (total depth)



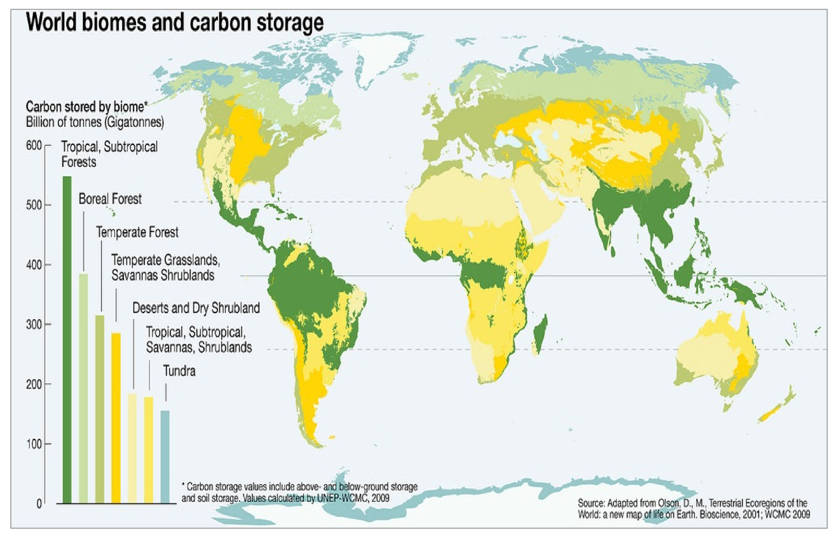
Top soils (0-30cm)



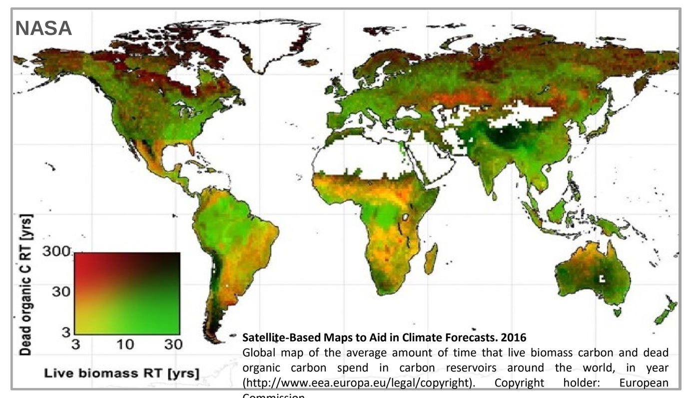
Biomass carbon modelling

- Baseline data

Field data



Remote sensing data
- Net Primary Productivity data
(data from NASA's Terra, Aqua and ICESat spacecraft)



- Structure data (LiDAR information)

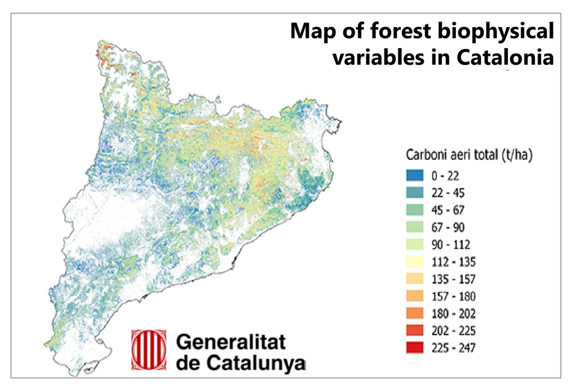
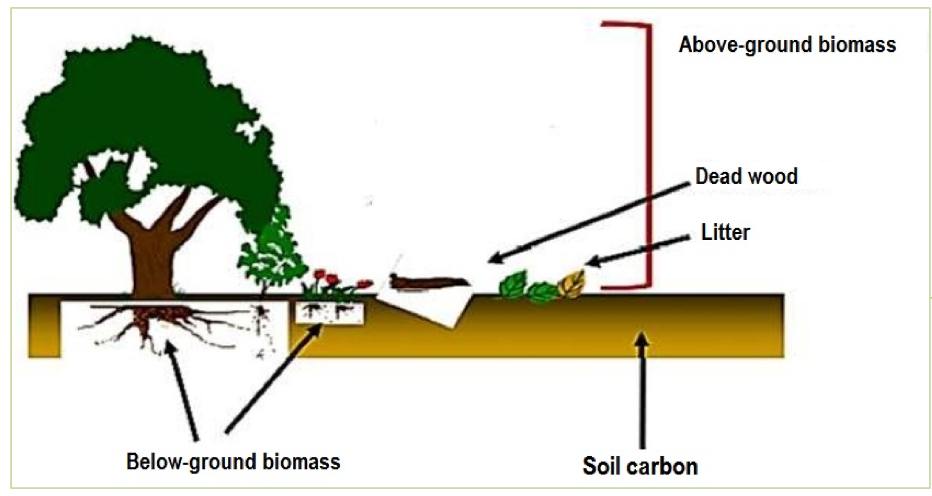


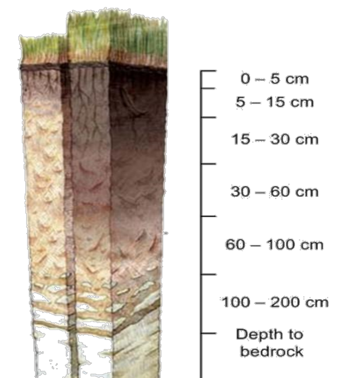
Figure 2 Methodological framework: stock of soil organic carbon (SOC) combined with biomass of forest species



Below-ground carbon sequestration (SOC)

Materials

- **25.000 soil profiles of** database legacy, mainly scattered over Mediterranean Iberian Peninsula.



- **Statistical processing and modelling:**
- SCORPAN method to model SOC.
- GLM: predictor variables selection
- RF (automated random forest regression kriging): spatial inference techniques.
- **R statistical free software**

Soil observations, points (x, y, pH)

Environmental co-variables (raster) (x, y, precipitation, NDVI, topography,…)

Screening and harmonization

SPATAIAL INFERENCE SYSTEM

- Machine learning
- Geo-statistics
- Data mining
- …

20% (approx.) samples out of the model

Validation

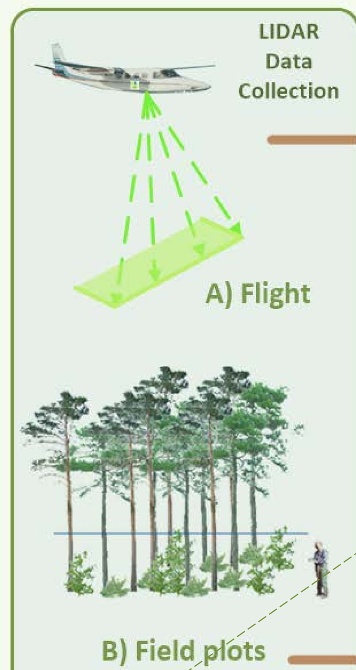
- Estimation of errors
- Statistical quality measures
- Correlations

Carbon soil digital map

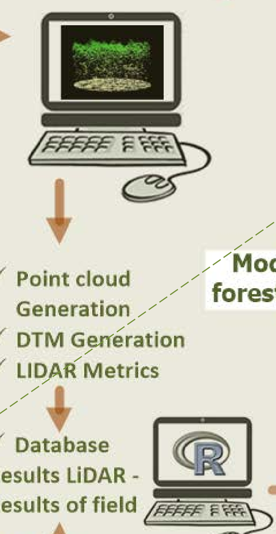
Associated uncertainty (3)

Spatial inference (2)

Above ground carbon sequestration (biomass)



2 Data processing and modeling



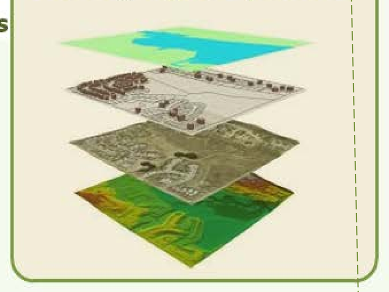
- Point cloud Generation
- DTM Generation
- LIDAR Metrics
- Database Results LiDAR - Results of field
- Processing Field data

Modeling of forest variables

Fitting to allometric equation (4)

Growing stock volume estimation

Cartographic phase



3 RESULTS: Carbon Cartography

Volume – Specific gravity of wood – 0,494 g/cm³ – Biomass (Aerial biomass 76,4 %; Root biomass 23,6 %) – Total Biomass – Conversion to carbon 0,499*44/12 = 1,8296 – CO_2

Materials

- **LiDAR images** (available by PNOA):
- 0,5 pts/m²
- 25x25 m spatial resolution.
- **National forest inventory** (IFN):
- 1:50,000 spatial sale.
- 95,000 study sites.

- **Data processing and modelling:**
- Point cloud processing (Fusion free software & R statistical free software)
- Spatial analysis (QGIS free software)
- Conversion of variable to carbon.

Spatial analysis

CARBON STOCK MAP IN TERRESTRIAL ECOSYSTEMS

Discussion

1. A profile database (vs. topsoil data) to estimation of soil carbon stock.
2. Spatial inference techniques for the carbon assessment at different scale approaches.
3. Uncertainty estimation of the carbon stock variability to assess the modelling quality.
4. Research of allometric equations for calculating of shrubland volume.

Acknowledgement

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