Horizon Europe

Deliverable 1.2

Maps of soil districts for Euskadi (Spain)

An application of pedogenon mapping for policy implementation

Version 1.0
16 May 2024

HISTORY OF CHANGES		
Version	**Publication date**	**Changes**
1.0	16.05.2024	▪ Initial version

Action Number: 101063363

Action Acronym: SELVANS
Action title: Soil condition and capability mapping for sustainable forest management

Date: 16/05/2024

Deliverable 1.2 version: 1.0

Introduction and objectives

This document reports the metadata and a figure of the pedogenon map for the Autonomous Community of the Basque Country, which was developed with the aim of delineating soil districts according to the proposal for the Soil Monitoring and Resilience (Soil Monitoring Directive). The resolution from 10 April 2024 by the European Parliament on the **the proposal for a directive of the European Parliament and of the Council on Soil Monitoring and Resilience (Soil Monitoring Law)** (COM(2023)0416 – C9-0234/2023 – 2023/0232(COD)) proposes that "Member States establish soil districts that are capable of adequately reflecting pedoclimatic conditions and soil variety on their whole territory. Soil districts should constitute the basic governance units to manage soils and to take measures to comply with the requirements laid down in this Directive, in particular with regard to the monitoring and assessment of soil health." The proposed Soil Monitoring Law suggests that these soils districts should be homogeneous in terms of: a) soil type as defined in the World Reference Base for Soil Resources (FAO, 2024), b) climatic conditions, c) environmental zone (Metzger at al. 2012), and d) land use or land cover.

The main objective of SELVANS WP1 *Pedogenon mapping in the context of long-term intensive land use* was to adapt and improve the digital soil mapping (DSM) framework for pedogenon mapping of forest soils at regional and local scales, and specifically, **to apply pedogenon mapping for delineating soil districts for Euskadi**. Pedogenon classes are a conceptual taxa that aim to define groups of homogeneous environmental variables. These groups are created applying unsupervised classification to a set of state variables, proxies of the soil-forming factors for a given reference time. The assumption is that the soil-forming processes within these classes (i.e., pedogenons) have been relatively similar over pedogenetic time and thus have developed soils with similar properties. Pedogenon classes can afterwards be divided into subclasses along a gradient from less (i.e., genosoils) to more anthropogenic pressure on soils (i.e., phenosoils), in an analogous way to the concept of genoform and phenoform (Rossiter and Bouma, 2018). The conceptualization and methodology for pedogenon mapping is explained with more detail in Román Dobarco et al. (2021).

The goals of pedogenon mapping are:

- <u>Stratify the landscape</u> into classes of homogeneous soil-forming factors (pedogenons) under the assumption that they delineate areas of similar pedogenesis up to a given reference time, that can be
- Overlayed with information of <u>forest management and land use change</u> to define subclasses across a gradient of contemporary anthropogenic pressure, ranging from least affected and representative of natural and historic anthropedogenesis (i.e., genosoils) to variants by soil management that have seen modified their functions (i.e., phenosoils). In the context of the Basque Country, and example of genosoil would be a mixed broadleaved forest or a pasture that has resulted from the coevolution with human management. Examples of phenosoils could be oak or beech managed forests (relatively low pressure) or pine and eucalyptus commercial plantations (more intensive soil pressure).
- The genosoils and phenosoils can be used to <u>assess changes in soil condition in forest ecosystems.</u>
- The reference soils can be used to set <u>targets for management</u>.
- The pedogenon classes are equivalent to soil districts and used as <u>strata for monitoring soil health in the context of the Soil Monitoring Law.</u>

Overview of the product and metadata

The optimal number of soil districts for Euskadi was nine, and the resulting pedogenon classes reflected the influence of climate, potential vegetation, relief and parent material. The choice of the optimal number of soil districts was based on several criteria: minimum of three observations of the Basque forest soil monitoring network (BASONET) per soil district, maximising the compactness of the soil districts in terms of the environmental variables used for k-means clustering (Calisnki-Harbastz index), and minimising the ratio of within-district to between-district soil profile distances, using the BASONET data on clay, silt, and effective cation exchange capacity from 0-20 cm and 20-40 cm depth as soil variables. The resulting map of soil districts is shown in Figure 1, where each number designates a soil district.

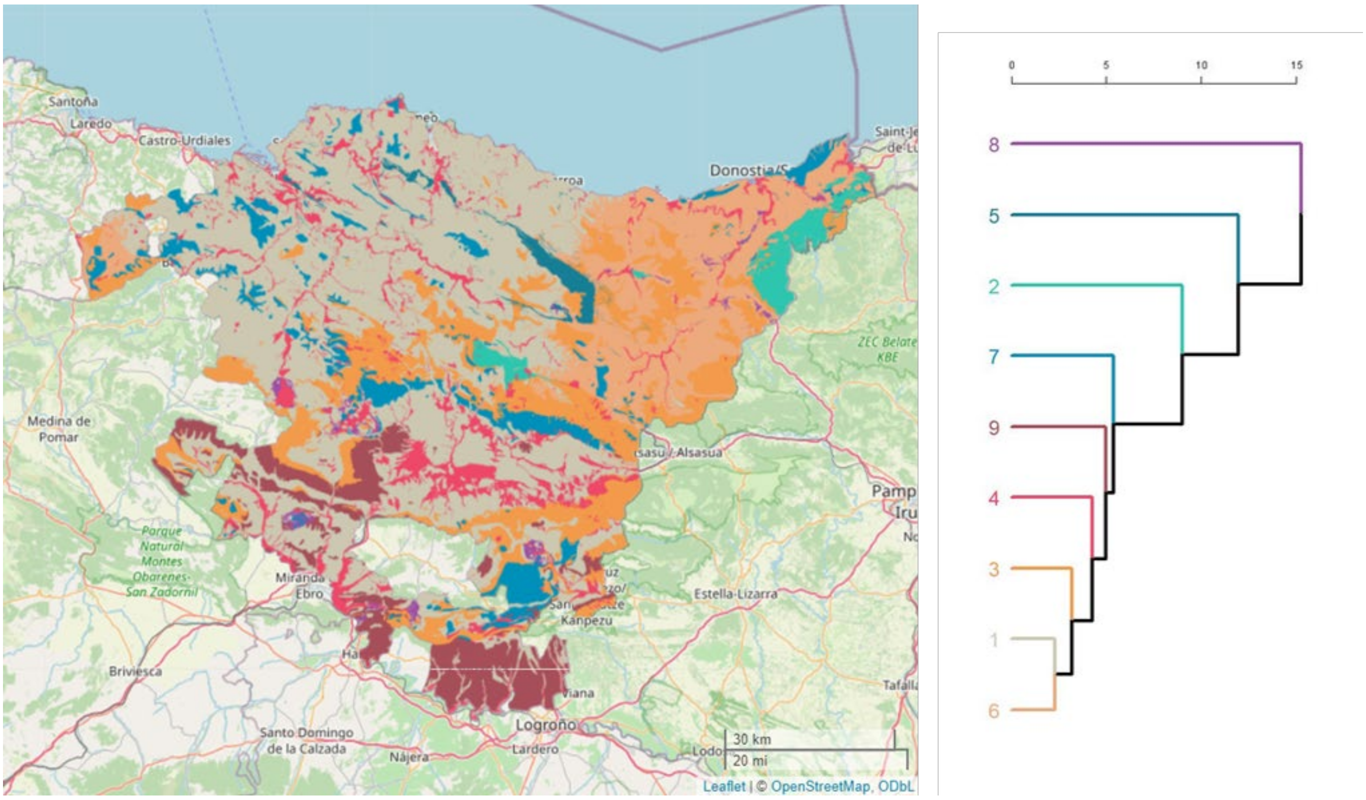

Figure 1: Map of soil districts for Euskadi.

- **File name**: PdGnCmb16K9.tif
- **Version**: 1.0
- **Description**: Map of soil districts for the Autonomous Community of the Basque Country
- **Process used to create the data**: Digital Soil Mapping approach explained in detaile in Román Dobarco et al. (2021) and a publication in preparation. Briefly, quantitative and spatially exhaustive variables representative of the soil-forming factors were sampled over a regular grid. The 90,000 pixels were used for unsupervised classification, applying k-means clustering (k = 9) to the decorrelated variables. The best of ten initializations (k-means ++ algorithm) was selected and used to map 9 soil districts. (see figure 2)
- **Date of publication**: 16/05/2024 but it has not been peer reviewed yet.
- **Reference period**: 2024.
- **Date of creation**: Thursday, March 21, 2024.
- **Last modification**: Thursday, March 21, 2024.
- **Type of data**: GeoTIFF file.
- **Pixel type**: floating point (32 bit).
- **No data value:** nan.
- **Purpose of the data**: Stratification into soil districts for the Soil Monitoring and Resilience.
- **Lineage**: First version. The sources of the input data will be described in the accompanied peer review publication and Deliverable 1.1.
- **Resolution**: 25 m

- **Location details** (geographic extent):
    - North: 4,811,750 m
    - South: 4,700,850 m
    - West: 461,050 m
    - East: 606,500 m
- **Projected Coordinate system**: ETRS 1989 UTM Zone 30N (EPSG: 25830)
- **Geographic Coordinate system**: ETRS 1989 (EPSG: 4258)
- **Creator or author of the data**: Mercedes Román Dobarco, Alex McBratney, Sophie Cornu, Jorge Curiel Yuste.
- **Contact**: Mercedes Román Dobarco (mercedes.roman@bc3research.org and mercetadzio@gmail.com)
- **Access and licensing information**: these maps are avaialble under the CC-BY 4.0 License.
- **Permalink**: Not yet available. After peer-review of the accompanying publication the maps will be uploaded to an open and public repository (e.g., OpenAire, GitHub)
- **Suggested citation**: Román Dobarco, M., McBratney, A., Cornu, S., Curiel Yuste, J. Soil. Monitoring the condition of forest soils in the Basque Country (Spain). An application of pedogenon mapping for policy implementation. Presented at the Centennial of the IUSS (May 19-21, 2024), Florence, Italy.
- **File size**: 4.8 MB.
- **Keywords**: Pedogenon, digital soil mapping, soil districts, Soil Monitoring Law, soil security.

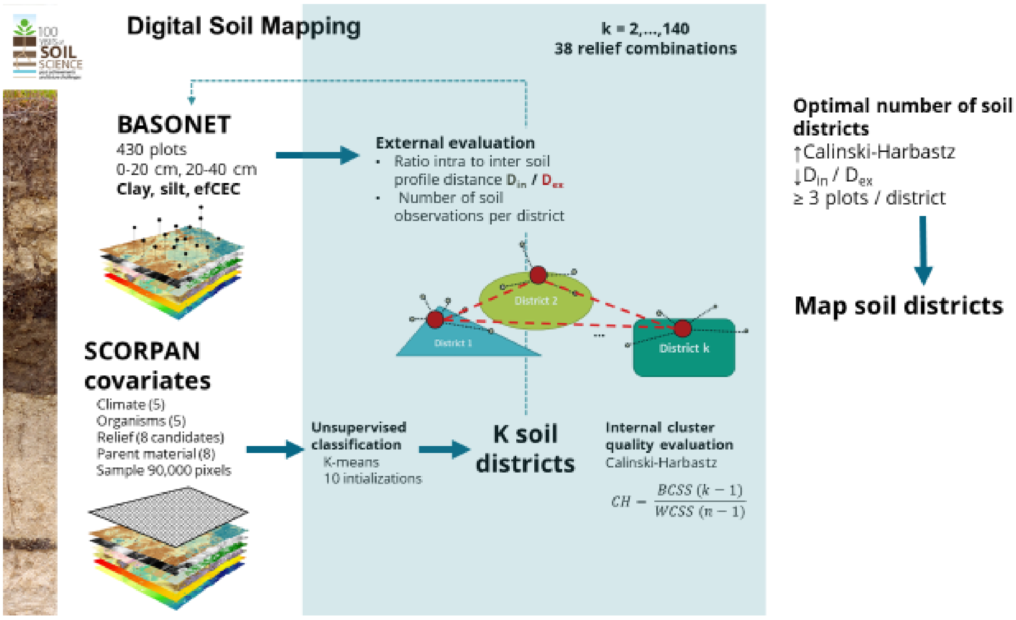

Figure 2: Overview of the methodology followed for mapping soil districts for Euskadi.

References

FAO, 2024 (https://www.fao.org/soils-portal/data-hub/soil-classification/world-reference-base/en/)

Metzger, M.J., Shkaruba, A.D., Jongman, R.H.G., Bunce, R.G.H., 2012. Descriptions of the European Environmental Zones and Strata, Alterra Report 2281 ISSN 1566-7197.

Román Dobarco, M., McBratney, A., Minasny, B., Malone, B., 2021. A modelling framework for pedogenon mapping. *Geoderma*, *393*, p.115012. https://doi.org/10.1016/j.geoderma.2021.115012

Rossiter, D.G., Bouma, J. (2018). A new look at soil phenoforms–Definition, identification, mapping. *Geoderma*, *314*, 113-121. https://doi.org/10.1016/j.geoderma.2017.11.002