AI-driven spatiotemporal quantification and prediction of soil salinity at European scale using the LUCAS database

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1. Introduction

- Soil Salinity is one of the main drivers of land degradation.
- The presence of excessive salts in soils poses detrimental effects on crop productivity, water resources, and ecosystems.
- Anthropogenic activities, excessive use of fertilizers, soil characteristics and climatic parameters affect soil salinity.

Objective

- To extend the predictive capabilities required to describe soil salinization across Europe under different scenarios.

2. Methodology

- AI-powered tools are employed for the quantification of soil salinity levels throughout Europe, utilizing data of the year 2018.
- The methodology employed is illustrated schematically in Figure 1.
- A classification model is first developed, followed by the d of two regression models, taking into account the 2dS/m threshold of soil salinity.
- The classification model was evaluated based on precision, recall, and F1., while the regression model was assessed using RMSE, MAE, and R^2.
- Soil salinity quantification maps cover the European Union and Great Britain at 1Km spatial resolution.

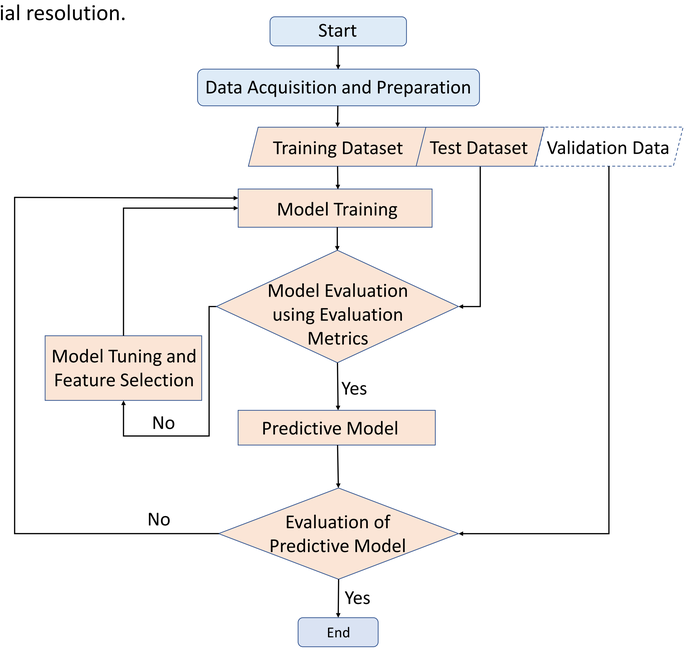

***Figure 1**: Schematic description of the methodology carried out for this study.*

3. Data

- The model considers soil salinity, represented by electrical conductivity (ECe), as the target variable.
- The EC1:5 was obtained from LUCAS survey 2018, and converted to ECe to ensure consistency with other soil salinity maps (Figure 2).

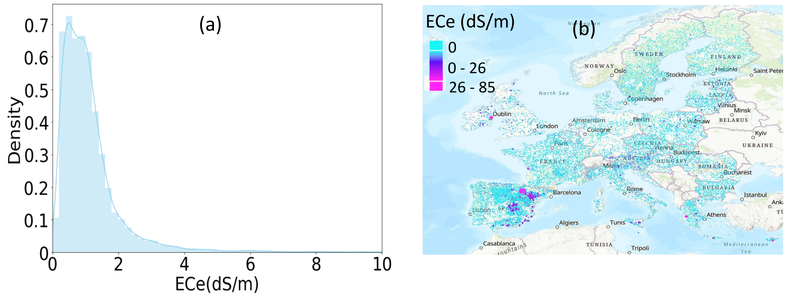

***Figure 2**. a: Distribution curve and the histogram of measured soil salinity across the study area from LUCAS 2018 survey, b: Spatial distribution of measured soil salinity for the year 2018 obtained from LUCAS survey year 2018 .*

- The model utilized 42 environmental covariates as predictors (Figure 3).

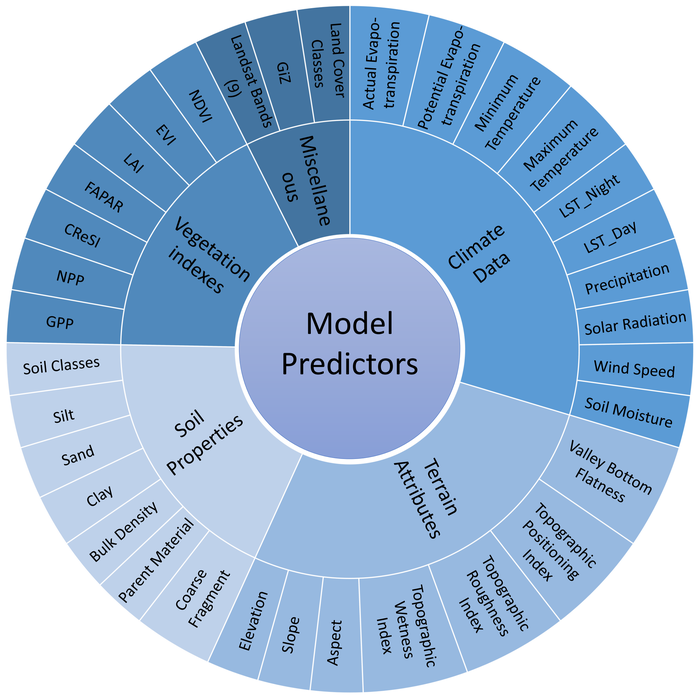

***Figure 3**. Graphical presentation of the model predictors. The dynamic predictors possess yearly temporal resolution. LST= land surface temperature, CReSI= canopy response salinity index, GiZ = Getis-Ord Gi values for ECe.*

4. Preliminary Results

- Seven algorithms were applied to train the binary classification model.

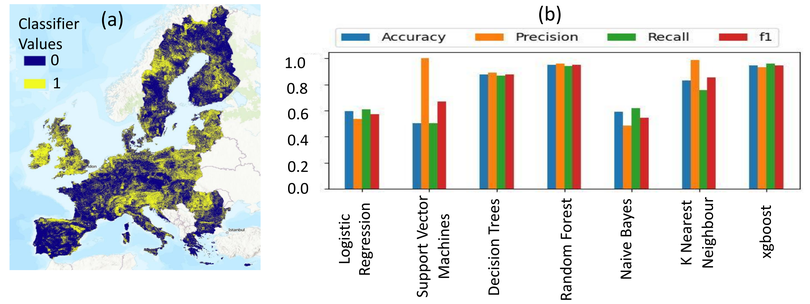

***Figure 4.** a: The per-cell classification map of the study area shows that cells with a value of 0 indicate soil salinity lower than 2 dS/m, while cells with a value of 1 has soil salinity greater than 2 dS/m b: Result of the binary classification models.*

- The predictors matrix was prepared at 1Km spatial resolution and soil salinity was quantified considering the two-phase model for the year 2018.

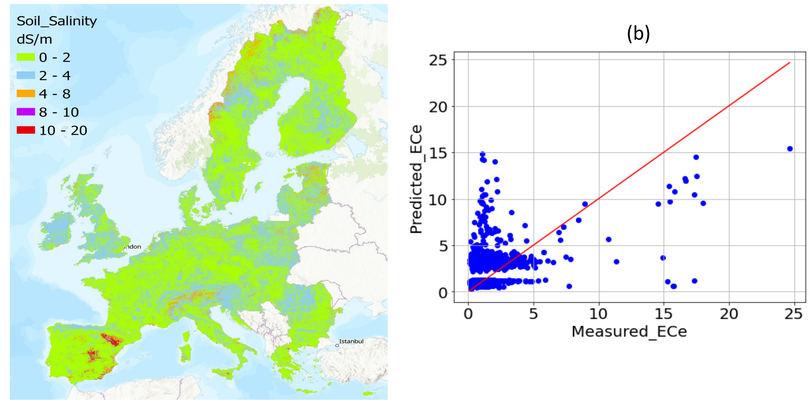

***Figure 5**. a: Spatial distribution of the predicted soil salinity for the year 2018 after development of dual step classification-regression model, b: One-one plot of the map predicted for the year 2018 using the validation data.*

5. Future Works

- To find the proper threshold of soil salinity for development of dual step classification-regression model.
- To develop the classification-regression model for more than 2 classes.
- Quantifying soil salinity under climatic and anthropogenic boundary conditions.

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Abstract :