FOREST4EU

ITHub 5 - Agroforestry Systems

FOREST4EU partner: ANSUB
OG: OG Fósforo
OG's country: Portugal
Type of Innovation: Technological innovation

Characterization of Portuguese sown rainfed grasslands using remote sensing and machine learning

Introduction

Grasslands are crucial ecosystems that support and provide a diverse number of ecosystem services. Sown biodiverse pastures rich in legumes (SBP) were developed with the main goal of increasing grassland production while minimizing fertilizers inputs. The main properties of SBP in Portugal were estimated using remote sensing and machine learning in six different farms and two production years (spring 2018 and 2019).

Four pasture characteristics were considered: aboveground standing biomass, fraction of legumes, plant nitrogen (N) content and plant phosphorus (P) content.

Remote sensing data were obtained from Sentinel-2. The spectral bands combined with 5 vegetation indices and 9 covariates were used. Multiple linear regression, LASSO, Ridge, random forests, XGBoost and LightGBM regression models were used. Two cross-validation approaches were used: (1) a random approach with random selection of the folds (RN-CV), and (2) a structured approach where each fold is a unique combination of farm and year, which is subsequently used to assess the performance of the model obtained with the 8 other folds (LLYO-CV).

Lessons learned

Results showed that the random forest method had the best estimation accuracy for all pasture characteristics. Regarding cross-validation approaches, the algorithms with RN-CV have higher estimation accuracy for all pasture characteristics (on average about 10% lower RMSE and an R2 85% higher), as compared to the algorithms with LLYO-CV. The RMSE for all variables were significantly low, especially in RN-CV. Plant P is the variable where the choice of CV approach has the least influence (RMSE of test set with RN-CV: 0.71 g P kg− 1; LLYO-CV: 0.72 g P kg− 1). Standing biomass is the variable with the highest difference between CV approaches (RN-CV: 722 kg ha− 1; LLYO-CV: 825 kg ha− 1). The RMSE, of legumes and plant N were moderately affected by the CV approach (legume RN-CV: 0.11; LLYO-CV: 0.12 - plant N RN-CV: 3.96 g N kg− 1; LLYO-CV: 3.99 g N kg− 1). The algorithms developed here were applied for entire parcels in the two farms with the most different climate conditions as demonstration of their potential future use for precision farming.

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Figure 1. Maps of plots obtained by using remote sensing data of different spectral bands.

The information presented in this factsheet was developed by the FOREST4EU partner, drawing on the innovations and knowledge generated by the indicated operational group with their explicit authorization.

Further information

https://eu-cap-network.ec.europa.eu/projects/increasing-viability-sown-biodiverse-pastures-through-optimization-phosphate-fertilization_en

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