

Article

Mapping of Forest Species Using Sentinel-2A Images in the Alentejo and Algarve Regions, Portugal

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Abstract: Land use and land cover (LULC) studies, particularly those focused on mapping forest species using Sentinel-2 (S2A) data, face challenges in delineating and identifying areas of heterogeneous forest components with spectral similarity at the canopy level. In this context, the main objective of this study was to compare and analyze the feasibility of two classification algorithms, K-Nearest Neighbor (KNN) and Random Forest (RF), with S2A data for mapping forest cover in the southern regions of Portugal, using tools with a free, open-source, accessible, and easy-to-use interface. Sentinel-2A data from summer 2019 provided 26 independent variables at 10 m spatial resolution for the analysis. Nine object-based LULC categories were distinguished, including five forest species (*Quercus suber*, *Quercus rotundifolia*, *Eucalyptus* spp., *Pinus pinaster*, and *Pinus pinea*), and four non-forest classes. Orfeo ToolBox (OTB) proved to be a reliable and powerful tool for the classification process. The best results were achieved using the RF algorithm in all regions, where it reached the highest accuracy values in Alentejo Central region (OA = 92.16% and K = 0.91). The use of open-source tools has enabled high-resolution mapping of forest species in the Mediterranean, democratizing access to research and monitoring.

Keywords: machine learning; supervised classification; mediterranean; random forest; k-nearest neighbor



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1. Introduction

Mapping changes in land use and land cover (LULC) is essential for understanding ecosystem dynamics and ensuring sustainable natural resource management. Several methods and techniques have been used, among which are those linked to remote sensing, especially with Sentinel-2 data. Mapping LULC is a challenge when landscape has large variability and fragmentation, such as in the Mediterranean region [1]. The main land use classes in continental Portugal are forest (36%), woods and pastures (31%), agricultural areas (24%), urban use (5%), unproductive (2%), and inland waters (2%) [2]. Considering the aforementioned, it is pivotal to study the potentiality of remote sensing data to map Mediterranean ecosystem. This will enable us to map forest species distribution. For these reasons, maps serve as an intermediate step in more complex analyses such as landscape modeling, estimating forest biomass, and environmental monitoring [3,4]. In addition to being a region prone to forest degradation and wildfire, as is the case for many