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Assessing the social and biophysical conditions that define pyroregions in mainland Portugal

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Abstract

Wildfires occur unevenly in the territory, driven by different biophysical and social factors. Understanding the spatiotemporal distribution of wildfires can help identifying common characteristics and/or dissimilarities between regions. In this research, we use specific fire metrics, from historical fire data from 2000 to 2021, to explore the possibility to identify groups of municipalities based on their pyrosimilarities. We employed four different clustering models to identify and compare groups of municipalities (pyroregions) in mainland Portugal. We calculated different fire metrics, namely cumulative percentage of total burned area (BA), cumulative percentage of BA during summer months, mean annual number of fires, and the GINI index for BA over time. We used GIS and programming with R software to apply the methodological procedure using the several clustering methods. Afterwards, by combining the outcomes of the four methods using majority placement, we established a unified classification for the pyroregions in Portugal. Additionally, a redundancy analysis (RDA) was conducted to identify the biophysical and social factors influencing these fire patterns. The first results categorized the country into four clusters, with 77% of the municipalities being consistently assigned to the same group across different methods. ClusterA (CL-A), located in central Portugal, had the highest percentage of cumulative BA but a low average number of fire occurrences. CL-B, which covers the municipalities in the northwest, had the highest average number of dispersed fires. CL-C, disperse for all Portugal, had the second highest average number of fire occurrences, primarily outside the summer season. CL-D stretches along the west coast, south and centre of the country, had generally lower values for all metrics except the Gini index, indicating concentrated fires in specific years. The RDA preliminary analysis yielded an R2 of 0.14. Significant axes ($p < 0.001$) accounted for 36.2% and 10.0% of variance. CL-A and CL-B displayed clear distinctions, with the proportion of forest and shrublands as primary differentiating factor. CL-C and CL-D lacked clear differentiation, being influenced by anthropogenic and climatic factors like agriculture and temperature. Overall, natural land uses played a crucial role in distinguishing CL-A and CL-B, while CL-C and CL-D were more influenced by anthropogenic and climatic factors. Our findings have the potential to enhance territory management programs aimed at mitigating forest fires in the identified

pyroregions. Additionally, the identification of the social and biophysical conditions describing the pyroregions enables the development of targeted actions, tailored to the specific characteristics of each area.

Keywords: wildfires; clusterin; redundance analysis; pyroregion; Portugal

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