Abstract
Combining Wildfire Behaviour Simulations and Connectivity Metrics to Support Wildfire Management ‡

Bruno A. Aparicio 1,*, José M. C. Pereira 1,*, Francisco C. Santos 2, Chiara Bruni 1 and Ana C. L. Sá 1

1 Forest Research Centre, School of Agriculture, University of Lisbon, 1649-004 Lisboa, Portugal
2 INESC-ID and Instituto Superior Técnico, Universidade de Lisboa, IST-Taguspark, 1000-029 Lisboa, Portugal
* Correspondence: bruno.a.aparicio@gmail.com
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Abstract: The recent extreme wildfire seasons have overwhelmed the fire-suppression capabilities of national authorities, evidencing the need for a paradigm shift in wildfire management. Wildfire spread and behaviour simulations provide relevant information for the assessment of fire hazards and for guiding decision makers in implementing preventive fuel-reduction strategies. In this study, we introduce and combined a new graph-based connectivity index with fire-line intensity to quantify the influence of spatial arrangement of fuels on wildfire hazards. The analysis uses a new connectivity index complemented by well-established graph-based metrics, namely the centrality and size of the largest component. The developed approach was applied to Serra de Monchique, in Southwestern Portugal. Specifically, we used the connectivity metrics to: (i) quantify the effect of fire weather scenarios on fire hazard; and (ii) evaluate the potential effectiveness of local fuel-break networks in decreasing fuel connectivity. Our results show that the combination of new connectivity index and graph-based metrics allow the location of high wildfire and fuel connectivity areas (i.e., fire hubs); and anticipate the locations where wildfire suppression may be compromised under specific fire–weather conditions. We identified the most important fuel-break segments in the north and west of Serra Monchique, particularly in areas covered by eucalyptus plantations and oak woodlands. These highlighted fuel-break segments are the same regardless of the wind directions and fire–weather scenarios considered. We further show that fuel connectivity is sensitive to the planned fuel-reduction strategy and that active fuel management may decrease landscape connectivity during extreme weather conditions to levels of fire intensity similar to those of non-extreme fire–weather scenarios without management. We anticipate that these network metrics will be helpful to both land planners and wildfire researchers seeking to assess different fuel-reduction strategies in fire-prone regions.

Keywords: wildfire connectivity; spatial indices; decision making


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