



## **Spatially explicit fuel moisture modelling and critical flammability thresholds provide early warning of potential for catastrophic fire in Southern European forest regions**

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With an abundance of dead and live fuel material, most forests are inherently flammable and can burn whenever the fine dead surface fuels dry out to ignitable levels. At the landscape scale, potential for large fires strongly increases with the spatial connectivity of dry fuel areas. Early warning of where and when forested landscapes are primed for catastrophic fire hence requires (1) reliable, spatially continuous mapping of daily variation in fine dead fuel moisture content, and (2) objectively identification of critical fuel moisture thresholds for major landscape fire events.

Using recent severe fire events in Southern Europe as examples, we demonstrate the potential of this approach. We applied a validated physically-based fuel moisture model to compute a gridded database of fine dead fuel moisture content from readily available weather records of daily air temperature and relative humidity. Critical fuel moisture thresholds for landscape-scale fire activity were then identified by analysing the cumulative distribution of burned area from historical forest fires with 'hindcasted' fuel moisture patterns for the same dates. Fuel moisture thresholds for landscape-scale fire in Southern European forests were similar to those found previously for temperate eucalypt forests in Southeast Australia. Our analyses clearly show that the catastrophic fires of June 2017 in Central Portugal followed shortly after forest fuels in the region reached historically unprecedented dryness levels.

With (gridded) daily air temperature and relative humidity data readily available in many countries, the fuel moisture mapping procedure can be easily automated and applied to detect where and when forested landscapes are approaching critical fuel moisture thresholds. This information would help fire management and emergency agencies to more strategically deploy resources to high risk areas and prepare for potential evacuations or other risk mitigation measures.