A semi-mechanistic model of dead fine fuel moisture for Temperate and Mediterranean ecosystems

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Abstract

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A semi-mechanistic model of fuel moisture for Temperate and Mediterranean ecosystems

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Fire is a major disturbance in terrestrial ecosystems globally. It has an enormous economic and social cost, and leads to fatalities in the worst cases. The moisture content of the vegetation (fuel moisture) is one of the main determinants of fire risk. Predicting the moisture content of dead and fine fuel (< 2.5 cm in diameter) is particularly important, as this is often the most important component of the fuel complex for fire propagation. A variety of drought indices, empirical and mechanistic models have been proposed to model fuel moisture. A commonality across these different approaches is that they have been neither validated across large temporal datasets nor validated across broadly different vegetation types.

Here, we present the results of a study performed at 6 locations in California, USA (5 sites) and New South Wales, Australia (1 site), where 10-hours fuel moisture content was continuously measured every 30 minutes during one full year at each site. We observed that drought indices did not accurately predict fuel moisture, and that empirical and mechanistic models both needed site-specific calibrations, which hinders their global application as indices of fuel moisture. We developed a novel, single equation and semi-mechanistic model, based on atmospheric vapor-pressure deficit. Across sites and years, mean absolute error (MAE) of predicted fuel moisture was 4.7%. MAE dropped <1% in the critical range of fuel moisture <10%. The high simplicity, accuracy and precision of our model makes it suitable for a wide range of applications: from operational purposes, to global vegetation models.