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A full-scale method to classify flammability of wildland-urban interface vegetation

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Abstract

Flammability is commonly defined in the context of forest fires as the ability of vegetation to ignite and burn, and depends on the interaction between several factors such as the vegetation structure, the presence of fine dead fuels or its fuel moisture content, among others. We can study the role of some of these factors—such as chemical composition or moisture content—at bench scale (e.g. by using devices such as calorimeters and epirradiators), but the effects of other factors—such as the proportion of living and dead fuels or its spatial distribution—can only be observed at larger scales. To account for all of them, we must study flammability at full scale, i.e. testing full individuals instead of small samples of selected particles (e.g. leaves, fine dead branches, etc.). In this communication, we present a method developed to compare and classify the flammability of ornamental vegetation at large scale so that to detect significant differences in burning ability and behaviour at the wildland-urban interface. To develop our method accounting for flammability variability, we burned isolated trees and groups of trees of different species and under different levels of water stress. We selected four species frequently used in the Mediterranean wildland-urban interface as hedgerows (Leyland cypress, Arizona cypress, Northern-white cedar and Cherry laurel) and subjected them to three different levels of water stress: some of the trees were watered while we kept the others unwatered for one and three months. We monitored different fire behaviour indicators (qualitative and quantitative) and selected mass loss depletion as key variable in our analysis. We built normalized Mass Loss Rate curves dividing the Mass Loss Rate values by the initial weight of the trees and modelled these as Gaussian bell curves (here named flammability bell curves). By comparing characteristic parameters of bell curves with qualitative burning behaviour (i.e. sustained ignition and flame coverage), we could clearly classify three flammability levels (low, medium and high flammability) in our tests. Although the method developed has to be implemented in fire labs equipped with particular weighting devices (e.g. load cells) it is rather simple and affordable and provides realistic results as it directly relates flammability with observable fire behaviour.

Keywords: mass loss rate, burning behaviour, hedgerows, residential fuels