Geophysical Research Abstracts
Vol. 18, EGU2016-853, 2016
EGU General Assembly 2016

Predicting the effectiveness of different mulching techniques to reduce post-fire runoff and erosion in Mediterranean pine stands – does cover matter?

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Wildfires have become a recurrent threat for many forest ecosystems of the Mediterranean. The characteristics of the Mediterranean climate with its warm and dry summers and mild and wet winters make it prone to wildfire occurrence as well as to post-fire soil erosion. Furthermore, climate change and continuation of current land management practices and planning are generally expected to further increase this threat.
The wide recognition of the effects of wildfires to enhance runoff and erosion has created a strong demand for model-based tools for predicting the post-fire hydrological and erosion response and, in particular, for predicting the effectiveness of post-fire forestry operations to mitigate these responses. Such a tool should allow to identify areas with elevated risks of soil erosion and to evaluate which measures should be applied and when to minimize these risks. A key element in evaluating these measures is also their costs, in order to optimize the use of the limited resources that are typically available for post-fire land management.
In this study, two “treatments” are compared with control conditions (i.e. doing nothing) after a wildfire with a moderate soil burn severity: (i) 4 erosion plots were treated with hydro-mulch, (ii) 4 erosion plots were untreated but had a high pine needle cover quickly after the fire, due to needle cast from scorched pine crowns (often referred to as “natural mulching”) (iii) 4 plots were untreated and had a very reduced protective litter cover . The main objective of this study was to asses if the revised MMF model could effectively predict the impacts of hydro-mulching and natural mulching with pine needle on runoff generation and the associated soil losses. If MMF could predict well the impact of natural mulching, it could be very useful in limiting the areas that should be considered for specific soil mitigation measures, especially in the case of wildfires that affect large areas with moderate severity.
The revised MMF model allowed, in fact, accurate predictions of runoff and soil erosion over the first year following hydro-mulch application . The obtained efficiency indices (Nash Sutcliffe Efficiency) of 0.82 and 0.71 for runoff and erosion, respectively, suggested that the revised MMF model could be at the base of a tool to assist decision-making in post-fire forest management. Furthermore, the MMF results obtained for hydro-mulching agreed well with those obtained in a previous study in the region for mulching with forest residues (Vieira et al., 2014). Ongoing work is assessing the possible improvements in model predictions by applying MMF on a seasonal basis and/or taking into account the occurrence of soil water repellency, i.e. using the adjustments of MMF to post-fire conditions as proposed in Vieira et al. (2014) and so far only tested – successfully – for eucalypt plantations in the study region.

Vieira DCS, Prats SA, Nunes JP, Shakesby RA, Coelho COA, Keizer JJ (2014) Modelling runoff and erosion, and their mitigation, in burned Portuguese forest using the revised Morgan-Morgan-Finney model. Forest Ecology and Management 314: 150-165