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Mapping fire effects on ash and soil properties. Current knowledge and future perspectives.

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Fire has heterogeneous impacts on ash and soil properties, depending on severity, topography of the burned area, type of soil and vegetation affected, and meteorological conditions during and post-fire. The heterogeneous impacts of fire and the complex topography of wildland environments impose the challenge of understand fire effects at diverse scales in space and time. Mapping is fundamental to identify the impacts of fire on ash and soil properties because allow us to recognize the degree of the fire impact, vulnerable areas, soil protection and distribution of ash and soil nutrients, important to landscape recuperation. Several methodologies have been used to map fire impacts on ash soil properties. Burn severity maps are very useful to understand the immediate and long-term impacts of fire on the ecosystems (Wagtendonk et al., 2004; Kokaly et al., 2007). These studies normally are carried out with remote sensing techniques and study large burned areas. On a large scale it is very important to detect the most vulnerable areas (e.g. with risk of runoff increase, flooding, erosion, sedimentation and debris flow) and propose -if necessary- immediate rehabilitation measures. Post-fire rehabilitation measures can be extremely costly. Thus the identification of the most affected areas will reduce the erosion risks and soil degradation (Miller and Yool, 2002; Robichaud et al., 2007; Robichaud, 2009), as the consequent economical, social and ecological impacts. Recently, the United States Department of Agriculture created a field guide to map post-fire burn severity, based on remote sensing and Geographical Information Systems (GIS) technologies. The map produced should reflect the effects of fire on soil properties, and identify areas where fire was more severe (Parsons et al. 2010). Remote sensing studies have made attempts to estimate soil and ash properties after the fire, as hydrophobicity (Lewis et al., 2008), water infiltration (Finnley and Glenn, 2010), forest floor consumption (Lewis et al., 2011), ash cover (Robichaud et al., 2007) and other aspects related with soil as the vegetation factors that affect post-fire erosion risk (Fox et al., 2008). Field studies had also indented to estimate and map the impacts of fire in soil properties. Contrary to remote sensing studies, the mapping of fire effects on ash and soil properties in the field is specially carried out at small scale (e.g. slope or plot). The small scale resolution studies are important because identify small patterns that are normally ignored by remote sensing studies, but fundamental to understand the post-fire evolution of the burned areas. One of the important aspects of the small scale studies of fire effect on ash and soil properties is the great spatial variability, showing that the impact of fire is extremely heterogeneous in space and time (Outeiro et al., 2008; Pereira et al. in press). The small scale mapping of fire effects on soil properties normally is carried out using Geostatistical methods or using deterministic interpolation methods (Robichaud and Miller, 1999; Pereira et al., 2013). Several reports were published on the spatial distribution and mapping of ash and duff thickness (Robichaud and Miller, 1999; Pereira et al., 2013; Pereira et al. in press), fire severity (Pereira et al., 2014), ash chemical characteristics as total nitrogen (Pereira et al., 2010a), and ash extractable elements (Pereira et al., 2010b).
Also, previous works mapped fire effects on soil temperature (Gimeno-Garcia et al., 2004), soil hydrophobicity (Woods et al., 2007), total nitrogen (Hirobe et al., 2003), phosphorous (Rodriguez et al., 2009) and major cations (Outeiro et al., 2008). It is important to integrate remote sensing and field based works of fire effects on ash and soil properties in order to have a better validation of the models predicted. The aim of this work is present the current knowledge about mapping fire effects in ash and soil properties at diverse scales and the future perspectives.

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