Do fire severity effects on soil change in space and time in the short term? What ash tells us

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Introduction

Fire severity is an indirect measurement of fire effect on the ecosystem. In absence of real data, difficult to be collected during wildfires, indirect estimations are frequently carried out, as soil organic matter content, soil hydrolability, minimum branch diameter, crown scorch, fire fuel combustion, among others [1]. Ash colour is a current method to estimate fire severity. The degree of combustion change ash physical and chemical properties. These changes are an indirect effect of the temperatures reached, which depends also of the plant species and ecosystem affected [2].

Ash is highly mobile, especially in the immediate period after a fire when can be wind (v)distributed uncontrollable times in a complex manner, especially in severe wildland fires, where ash is easily transportable due to the intense combustion [3]. Only after the first rainfalls ash can bind onto soil surface, infilling or front. This mobility can be a problem to assess the fire severity, since the ash analysed in an area could be not produced in the same place. However, it is also an opportunity to study the impacts of fire severity (different ash characteristics) on soil cover and understand that the same ash particle can have implications in different parts of the soil profile and surface. From this point of view fire severity can change in space and time.

The objective of this work is study the ash colour changes in an experimental plot in the immediate period after a fire.

Methods

Study area and sampling

A wildfire occurred in July 26 of 2010 and affected an area of 100 ha near the urban area of Quinta do Conde, located at 38° 57’ N, 0° 07’ W and 115 m of altitude (Figure 1). The geological substratum was composed by Fine-Plintheceous low cementation dunes, and the soils are classified as Podzols [4]. The mean annual temperature is 14.8 °C and the annual precipitation of 882.2 mm. The burned area was 78.6 ha with a very high ash yield of 70%. One day and fifteen days after the fire, the ash colour was observed annually in four parallel transects with 20 m separated by one meter in a south facing uniform slope with an angle of inclination of 15°. In each transect, ash colour was observed with a resolution of 50 cm. A total of 200 of samples were collected per sampling period. This qualitative assessment, do not allow to quantify the degree of fire severity observed in each point. Thus, fire severity was (re)calculated. A previous study by Pereira [2] showed that ash produced at low severity has a reddish colour (R), at medium severity, black (B) and dark grey (DG) colour, and at high severity light grey (LG) and white color (W). Also, after high severity fires patches of bare soil (BS) were found, due the high combustion temperatures that consume all the litter. In the present case this is true because in the contiguous area not affected by the fire, continuous thick accumulations of litter were identified. The ash identified was 8, BS, DG, LG and W. Some areas were bare. To quantify fire severity effects on soil cover, some indexes were applied, 1 to 8, 3 to BS, 5 to LG, 7 to W and 9 to BS (no protection).

Main results and conclusions

Figure 1. Study area.

Figure 2. Distribution of ash colour a) one day after the fire b) fifteen days after the fire

Table 1. Results of Global Moran’s spatial autocorrelation test.

Table 2. Best fitted semi-variogram models of fire severity and corresponding parameters.

References


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