Geophysical Research Abstracts
Vol. 19, EGU2017-3328, 2017
EGU General Assembly 2017

Mapping ash properties using principal components analysis

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In post-fire environments ash has important benefits for soils, such as protection and source of nutrients, crucial for vegetation recuperation (Jordan et al., 2016; Pereira et al., 2015a; 2016a,b). The thickness and distribution of ash are fundamental aspects for soil protection (Cerdà and Doerr, 2008; Pereira et al., 2015b) and the severity at which was produced is important for the type and amount of elements that is released in soil solution (Bodi et al., 2014). Ash is very mobile material, and it is important were it will be deposited. Until the first rainfalls are is very mobile. After it, bind in the soil surface and is harder to erode. Mapping ash properties in the immediate period after fire is complex, since it is constantly moving (Pereira et al., 2015b). However, is an important task, since according the amount and type of ash produced we can identify the degree of soil protection and the nutrients that will be dissolved. The objective of this work is to apply to map ash properties ($CaCO_3$, pH, and select extractable elements) using a principal component analysis (PCA) in the immediate period after the fire. Four days after the fire we established a grid in a 9x27 m area and took ash samples every 3 meters for a total of 40 sampling points (Pereira et al., 2017). The PCA identified 5 different factors. Factor 1 identified high loadings in electrical conductivity, calcium, and magnesium and negative with aluminum and iron, while Factor 3 had high positive loadings in total phosphorous and silica. Factor 3 showed high positive loadings in sodium and potassium, factor 4 high negative loadings in $CaCO_3$ and pH, and factor 5 high loadings in sodium and potassium. The experimental variograms of the extracted factors showed that the Gaussian model was the most precise to model factor 1, the linear to model factor 2 and the wave hole effect to model factor 3, 4 and 5. The maps produced confirm the patternd observed in the experimental variograms. Factor 1 and 2 maps showed high values in one area of the plot, while factors 3,4 and 5 had a cycled pattern. Using a PCA we resume the information of all dataset and we identify that ash properties have a different distribution in the studied area, that may be attributed to the different fire severities.

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