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Spatial models to predict ash pH and Electrical Conductivity distribution after a grassland fire in Lithuania

Paulo Pereira (1), Artemi Cerda (2), and Ieva Misiūnė (1)

(1) Mykolas Romeris University, Environmental Management Centre, Vilnius, Lithuania (paulo@mruni.eu), (2) Department of Geography, University of Valencia, Blasco Ibañez 28. 46010 Valencia, Spain (artemio.cerda@uv.es)

Fire mineralizes the organic matter, increasing the pH level and the amount of dissolved ions (Pereira et al., 2014). The degree of mineralization depends among other factors on fire temperature, burned specie, moisture content, and contact time. The impact of wildland fires it is assessed using the fire severity, an index used in the absence of direct measures (e.g temperature), important to estimate the fire effects in the ecosystems. This impact is observed through the loss of soil organic matter, crown volume, twig diameter, ash colour, among others (Keeley et al., 2009). The effects of fire are highly variable, especially at short spatial scales (Pereira et al., in press), due the different fuel conditions (e.g. moisture, specie distribution, flammability, connectivity, arrangement, etc). This variability poses important challenges to identify the best spatial predictor and have the most accurate spatial visualization of the data. Considering this, the test of several interpolation methods it is assumed to be relevant to have the most reliable map. The aims of this work are I) study the ash pH and Electrical Conductivity (EC) after a grassland fire according to ash colour and II) test several interpolation methods in order to identify the best spatial predictor of pH and EC distribution. The study area is located near Vilnius at 54.42° N and 25.26°E and 154 ma.s.l. After the fire it was designed a plot with a 27 x 9 m space grid. Samples were taken every 3 meters for a total of 40 (Pereira et al., 2013). Ash color was classified according to Úbeda et al. (2009). Ash pH and EC laboratory analysis were carried out according to Pereira et al. (2014). Previous to data comparison and modelling, normality and homogeneity were assessed with the Shapiro-wilk and Levene test. pH data respected the normality and homogeneity, while EC only followed the Gaussian distribution and the homogeneity criteria after a logarithmic transformation. Data spatial correlation was calculated with the Global Moran's I Index. In order to identify the best interpolator, we tested several well known techniques as inverse distance to a power (IDP), with the power of 1, 2, 3, 4 and 5, local polynomial (LP) with the power of 1 (LP1), 2 (LP2) and 3 (LP3), spline with tension (SPT), completely regularized spline (CRS), multiquadratic (MTQ), inverse multiquadratic (IMTQ) thin plate spline (TPS) and ordinary kriging. The best interpolator was the one with the lowest Root mean square error (RMSE). The results shown that on average ash pH was 8.01 ($\pm$0.20) and EC (1408$\pm$ 513.51μm cm3). The coefficient of correlation between both variables was 0.34, $p<0.05$. Black ash had a significantly higher pH ($F=6.29$, $p<0.05$) and EC ($F=5.25$, $p<0.05$) than dark grey ash. According to Moran's I index, pH data was significantly ($p<0.05$) dispersed, while EC had a random pattern. The best spatial predictor for pH was IDW1 (RMSE=0.210), and for EC IMTQ (RMSE=0.141). In both cases the least accurate technique was TPS. pH data did not showed a specific spatial pattern and some high values are very close to high values which shows a great local spatial variability, mainly observed in the northern part of the plot. In relation to EC, the high values were identified in the central part of the plot. In conclusion it was observed that ash pH and EC were different according to fire severity (ash color) and data distribution has a different spatial pattern, despite the significant correlation. pH and EC had different spatial impacts on soil properties in the immediate period after the fire.

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