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The effect of the fires on gypseous soil properties: changes of the hydrology and splash resistance.

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Mediterranean ecosystems have been severely affected by fires in the last decades. Due to social and economical changes, wildfires have caused hydrological and geomorphologic changes to be more pronounced, resulting in enhanced soil erosion. Soil heating caused by fires affects soil aggregates stability, water infiltration and may generate hydrophobicity. In order to understand how wildfire affects soil hydrological behavior in general, and splash and runoff processes in particular, of gypsum soils,it is advantageous to use a rainfall simulator.

In August 2009 a large forest fire affected 6700 ha in Remolinos (NW Zaragoza, Spain). The area is covered by shrubs such as gorse (Genista scorpius L.), broom (Retama sphaerocarpa L.) and rosemary (Rosmarinus officinalis L.), and with small areas occupied by Aleppo pine (Pinus halepensis Mill) and Kermes evergreen-oak (Quercus coccifera L.). This region has a semarid Mediterranean climate, with an average annual rainfall ca 560 mm and a mean annual temperature of 12.5ºC, resulting in an estimated climatic water deficit of ca. 400mm. The relief consists of stepped slopes (200-748 m), on two different types of soil have developed: Renzic Phaeozem, on limestone, and Haplic Gypsisol, on gypsum (IUSS, 2006).
Within this study, we wanted to investigate the differences in affection by fire of the different soil types, as it may be caused by different fire intensities.
Therefore, both soil types were sampled after fire. Also, similar locations were sampled which were not affected by the wildfires. With this, we could differentiate 4 treatments: burnt and unburnt pine forest and burnt and unburnt shrub on gypseous soils. We designed a set of lab experiments to elucidate the effect of heat on soil composition, aggregate stability, and splash susceptibility.
Samples were taken using cylinders of 5 cm depth. Under laboratory conditions were measured pH, CE, organic matter (OM), soil aggregates stability (SAS), bulk density, porosity and mineralogical changes, using 5 subsamples of each treatment. The samples were heated at different temperatures (105 ºC and 205 ºC) in an oven for 30 min to simulated different fire intensities, for comparison. A set was only air dried (35 ºC).
To study the splash effect of the gypsum soils were use small scale rainfall simulator in laboratory, applying a rainfall intensity of 47 mm h-1 during 20 min, resulting in a kinetic energy of 8.94 J m^{-2} mm-1. The gross loss of material of each of the undisturbed samples was measured after 20 minutes of simulation.
The pH is slightly alkaline and oscillates between 7.93-8.32, depending on soil cover type, and is highest under burnt pine forest. The EC (2.08-5.01 mS cm-1) did not change after heating of the unburnt shrub cover, but in the soil under burnt pine forest, the EC was lowered with increasing temperature. The OM content is moderate (3.73-4.85 %), and higher on burnt soils, increasing also with an increase of treatment temperature. The SAS (43.17-75.92 %) is strongly depending on the temperature applied, and was found higher on the burnt surfaces. The gypsum content of the soils is moderate to high (11.30-39.58 %), but decreases with the treatment at 205°C. The soil loss by splash vaied between 0.9 to 2.8 g (per sample) after 20 min of rainfall simulation. Highest losses were found on burnt surfaces.
The results show that fire and temperature affects not all characteristics of soils.
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