Geophysical Research Abstracts
Vol. 13, EGU2011-1177, 2011
EGU General Assembly 2011

Reduction of erosion risk by ash and charred litter after burning

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The effects of fire on the soils depend on the temperature reached, duration of burning and post-fire rainfall. The combustion of organic matter, deposition of ashes and alterations in nutrient availability are the main processes of chemical change associated with fire. High intensity and fast moving crown fires can consume a part of litter during the process of combustion because only a small amount of the energy released is transferred to the litter surface. In such cases, litter is charred but not consumed, and a thick ash-bed can be set down on the soil. The effect of charred litter and ashes on the mineral soil surface will persist until external agents (strong rainfall, wind, vehicles or animals) remove or redistribute them. Its presence on the soil surface can be critical during the immediate post-fire period in Mediterranean areas and specifically in the area of the Strait of Gibraltar, where intense rainfall events are not unusual during summer.

The changes induced by charred litter and ashes on the soil hydrological and erosional response after a prescribed fire in a Mediterranean heathland in the area of the Strait of Gibraltar (southern Spain)have been studied in this research. Very little research has been carried out about the modifications on the ground surface after fire immediately after burning. A prescribed fire was conducted to study short-term changes of the ground surface immediately and 1 year following burning. After burning, the soil surface was covered by charred plant skeletons, charred litter, and a thick ash-bed.

After burning, water repellency was significantly reduced at the exposed surface of ash-covered soil plots; in addition, the bare soil plots generated significantly more erosion than did ash and/or chatter litter covered surfaces. Consequently, post-fire changes may decrease the hydrological response while charred organic residues and ashes stay on the soil surface. When this protective cover is removed, the mineral soil surface is exposed; in this case, the water repellency of the mineral soil can accelerate the erosive response.

Therefore, the ash and charred litter layers offered some protection against soil loss that would have occurred in their absence even with significant reductions in water repellency. Results from rainfall simulations at the small scale in this study suggest that interrill soil erosion risk by rainfall in dense heathland can remain stable during the immediate post-fire period when a fire results in a thick deposition of ashes. In contrast, when the bare soil surface is exposed, the erodibility may increase. Although wildfires use to increase soil erodibility, the trends observed in this study suggest that, at the scale of work this increased susceptibility to erosion is limited to some degree while an intact ash and charred litter layer is still present. When burning results in a substantial deposition of ashes, the ash-bed can prevent soil from fast runoff generation and reduce the erosion risk while it is present. After the ash-bed is removed by natural agents (as strong rainfall or wind), runoff coefficients and soil loss can increase considerably at plot scale. The recovery of natural vegetation one year after the prescribed fire practically re-established the initial conditions before fire. Water repellency, hydrological response and erosional response after 1-year period were comparable to pre-fire conditions at a plot scale.