Geophysical Research Abstracts,
Vol. 11, EGU2009-890-1, 2009
EGU General Assembly 2009

Influence of vegetation spatial heterogeneity on soil enzyme activity in burned Mediterranean areas

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Mediterranean ecosystems are commonly considered resilient to wildfires. However, depending on fire severity and recurrence, post-fire climatic conditions and plant community type, the recovery rate of the vegetation can greatly vary. Often, the post-fire vegetation cover remains low and sparsely distributed many years after the wildfire, which could have profound impacts on ecosystem functioning. In this work, we studied the influence of vegetation patchiness on soil enzyme activity (acid phosphatase, β-glucosidase and urease), at the patch and landscape scales, in degraded dry Mediterranean shrublands affected by wildfires. At the patch scale, we assessed the variation in soil enzyme between bare soils and vegetation patches. At the landscape scale, we studied the relationships between soil enzyme activity and various landscape metrics (total patch cover, average interpatch length, average patch width, and patch density). The study was conducted in 19 sites in the Valencia Region (eastern Spain), which had been affected by large wildfires in 1991. Site selection aimed at capturing a wide range of the variability of post-fire plant recovery rates in Mediterranean areas. The activities of the three enzymes were significantly higher in soils under the vegetation canopies than in adjacent bare areas, which we attributed to the effect of plants on the soil amount of both enzyme substrates and enzymes. The differences between bare and plant microsites were larger in the case of the acid phosphatase and less marked for urease. The activity of acid phosphatase was also higher under patches of resprouter species than under patches of seeder species, probably due to the faster post-fire recovery and older age of resprouter patches in fire-prone ecosystems. Soil enzyme activities of β-glucosidase and urease in both bare soils and vegetation patches showed no relationships with any of the landscape metrics analysed. However, the activity of acid phosphatase increased linearly with the total cover of vegetation patches, which is consistent with the strong effect of plant patches on the activity of this enzyme. According to our results, variations in the cover and composition of vegetation patches may have profound impacts on the soil enzyme activity and associated nutrient cycling processes in burned Mediterranean areas, particularly in the case of phosphorus.

Keywords: wildfires, landscape metrics, Mediterranean shrublands, soil enzyme activity, resprouter species.