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Transient catchment hydrology after wildfires

Renzo Rosso, Maria Cristina Rulli, Daniele Bocchiola

renzo.rosso@polimi.it

To which extent do wildfires affect runoff production, soil erosion and sediment transport, and the yield of woody biomass in upland catchments? This transient effect is investigated here by combining experimental and modeling techniques to approach a controlled field experiment. The case study deals with the Branega catchment in Tyrrhenian Liguria, Northern Italy, where a severe forest fire occurred in the early August, 2003, so inducing considerable changes in the structure and properties of soil and vegetation cover.

Immediately after the fire, a set of rainfall simulator runs were carried out on two adjacent 30 m^2 plots (burned and unburned, or control plot, respectively) with homogeneous characteristics. We input uniformly distributed 76 mmh^{-1} intensity simulated rainfall events to different soil crust (i.e. burned and unburned, bare and forested soil) under controlled initial soil moisture condition (dry, wet, very wet). The measured runoff from the burned plot was about 60 times larger than that from the unburned one, for the wet run; and about 20 times, for the very wet run. The measure suspended sediment yield from the burned plot was found to dramatically exceed that from the control plot under both dry and wet conditions (i.e., two orders of magnitude). A field survey was further carried out to measure the grounded wood relics produced by the forest fire, and the results compared with that existing in the unburned neighboring area.

A physically based spatially distributed soil erosion and sedimentation model was also calibrated using field measurements from the plot experiments. This model was used to investigate hill slope and channel erosion in a small creek, nested in the upper Branega catchment. The comparison between simulated runs and observed data

showed this model to be capable in providing accurate estimates of sediment yield. A further model development includes the wood delivery process from hill slopes towards the channel. Model results show a satisfactory agreement between the observed and simulated wood biomass amounts.

The approach presented here indicates that accurate field surveys and experiments can enhance our capability of understanding transient hydrology after wildfires. This includes the complex interactions between weather, soil and vegetation. Experimental data also provide a valuable information to model and predict the hydrological response of upland catchments after the occurrence of wildfires, this including those processes, i.e. runoff, erosion and woody debris, that can collectively increase hydrological hazard before landscape restoration is completed.