

## **Modelling Forest Fire and Post-Fire Mitigation Measures: Impacts on sediment yield**

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### **Abstract**

A forest fire may change soil properties, alter the hydrological processes, and increase soil erosion. To mitigate the effect of fire on erosion, post-fire rehabilitation measures are used. The aim of this work was to predict the effect of forest fire and post-fire mitigation measures on runoff and specific sediment yield (SSY) in a mountainous river basin (Celone, S-E Italy). The Soil and Water Assessment Tool model, calibrated with field observations, was used to evaluate runoff and SSY for the current land use (baseline) and for six post-fire scenarios. From 1990 to 2011, at the basin scale, the average annual SSY was  $5.60 \text{ t ha}^{-1} \text{ y}^{-1}$  ( $\text{SD} = 3.47 \text{ t ha}^{-1} \text{ y}^{-1}$ ). The 20% of the total drainage area showed a critical value of SSY ( $>10 \text{ t ha}^{-1} \text{ y}^{-1}$ ). Different fire-severity levels were analysed acting on a limited burnt area (2.3% of the basin). At the basin scale, the post-fire effect on surface runoff was negligible for all the scenarios except for the high-severity fire and post-fire logging (Fr1), and the impact on SSY was an increase up to  $12.05 \text{ t ha}^{-1} \text{ y}^{-1}$ . At the subbasin scale, Fr1 scenario showed the highest increase in soil loss ( $57.4 \text{ t ha}^{-1} \text{ y}^{-1}$ ), meanwhile, the post-fire mitigation treatments such as straw mulching and erosion barriers were effective to reduce soil erosion in high- and moderate-severity fires ( $19.1 \text{ t ha}^{-1} \text{ y}^{-1}$  and  $21 \text{ t ha}^{-1} \text{ y}^{-1}$ , respectively). At the hydrologic response unit level, SSY estimated for the forest in the baseline ranged from  $1.18 \text{ t ha}^{-1} \text{ y}^{-1}$  to  $2.04 \text{ t ha}^{-1} \text{ y}^{-1}$ . It increased more than one order of magnitude for the high-severity fire scenarios and ranged from 4.33 to  $6.74 \text{ t ha}^{-1} \text{ y}^{-1}$  in the very low-severity fire scenarios. This work provides a contribution to post-fire risk management.

**Keywords:** forest fire, sediment yield, runoff, SWAT model, post-fire mitigation measures