

# Impacts on sediment yield of post-fire management in a Mediterranean catchment prone to erosion

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## Abstract

The Mediterranean European Region is a high fire-risk area. The last report on forest fires of the European Commission highlighted in the recent years (2019, 2020, 2021) a positive trend of higher levels of fire danger in EU countries. Wildfires can seriously increase soil erosion and impair surface water quality by delivering fire related contaminants to the rivers. Hydrological and soil erosion models can provide valid support for quantifying the catchment hydro-sedimentary response to forest fire events and planning adequate restoration measures. This work aims to predict the effects of forest fires and post-fire mitigation measures on runoff and specific sediment yield (SSY) in the Celone river basin (S-E Italy). The Soil and Water Assessment Tool (SWAT), which was calibrated with field observations, and run to evaluate runoff and SSY for the current land use (baseline) and six post-fire scenarios. The effects of different fire-severity levels were analyzed for one year after the fire, on a limited area (2.3% of the total basin area). For the current land use, the average annual SSY (1990-2011) was  $5.60 \text{ t ha}^{-1}\text{yr}^{-1}$  at basin scale. 20% of the total basin area showed a critical value of SSY ( $> 10 \text{ t ha}^{-1}\text{yr}^{-1}$ ). The post-fire effect on surface runoff was negligible at the basin scale for all scenarios ( $< 0.4\%$ ), while the SSY increased from  $5.86 \text{ t ha}^{-1}\text{yr}^{-1}$  to  $12.05 \text{ t ha}^{-1}\text{yr}^{-1}$ . At the subbasin scale, the post-fire logging scenario showed the highest increase of soil loss (SSY from  $9.48 \text{ t ha}^{-1}\text{yr}^{-1}$  to  $57.40 \text{ t ha}^{-1}\text{yr}^{-1}$ ). Mitigation treatments like straw mulching and erosion barriers reduced soil erosion in high- and moderate-severity fires areas ( $19.12 \text{ t ha}^{-1}\text{yr}^{-1}$  and  $20.93 \text{ t ha}^{-1}\text{yr}^{-1}$ , respectively). At the hydrological response unit level (HRU), the simulated SSY in the baseline ranged from  $1.18 \text{ t ha}^{-1}\text{yr}^{-1}$  to  $2.04 \text{ t ha}^{-1}\text{yr}^{-1}$ . SSY increased more than one order of magnitude for the high-severity fire scenarios and ranged from 4.33 to  $6.74 \text{ t ha}^{-1}\text{yr}^{-1}$  in the very low-severity fire scenario, underlining the scale effect from the HRU to the basin scale.

## Keywords

SWAT, Post-fire erosion, Sediment yield, Fire severity, Model parametrisation