ICG2022-175, updated on 29 May 2023
https://doi.org/10.5194/icg2022-175
10th International Conference on Geomorphology

River adjustment to low-medium rainfall events because of wildfires in highly weathered landscapes

Miguel Gomez-Heras[1], **José Antonio Ortega-Becerril**[1], Julio Garrote[2], and Daniel Vázquez-Tarrío[3]
[1]Universidad Autonoma de Madrid, Madrid, Spain
[2]Universidad Complutense de Madrid, Madrid, Spain
[3]Universidad Politécnica de Madrid, Madrid, Spain

Wildfires are increasingly frequent events which lead to rock weathering, soil erosion and post-fire colluvial-fluvial sediment dispersal in Mediterranean environments. Weathering-erosion balances are typically disturbed at the catchment scale, as well as source-to-sink sediment routing after a wildfire. This is a particularly relevant effect in areas highly weathered prior to wildfires.

A wildfire occurred in August 2021 affected an area of 220 km^2 of eastern Gredos mountain range (Avila, Spain). A systematic series of diachronic pictures in approx. 30 sites were taken after every post-fire storm event. Major changes were observed following a sequence of small to moderate rainfall events occurring immediately after the wildfire. First, ashes filled completely small dams. After, sand bars formed, and several debris flow events occurred at the center of the storms. Most of the tributaries were affected by waves of sediment/erosion showing various levels of damage depending on the distance to the storm center, the slope and degree of coverage. However, certain parts of the area remain in a metastable condition and will probably experience new adjustments after the next major rain events. Sediment production and dispersal has been higher than expected for small to medium rainfall events. This suggests a high sediment supply to channels from mass wasting processes, probably due to the wildfire leaving slopes prone to erosion. The area affected by the fire includes 35 regionally and nationally listed Cultural Heritage sites that were affected both by the wildfire, extinguishing actions and posterior river response. Particularly, a series of pre-Roman sites were affected and there is a still-unknown number of cultural heritage sites that may be affected by post-fire sedimentation. Noteworthy, a 200-year-old bridge was destroyed by floods, which may suggest either an increase of the return period of floods or an anomalous behaviour of the basin.

Theoretical hyetographs and peak flows for a situation pre- and post-fire were obtained by means of sediment sampling, soil infiltration analysis and hydrological models of a series of real rainfall events we obtained. These results can then be fed into hydraulic models to analyze variations in the energetic flow conditions and its erosive capacity. Hydrodynamic results were calibrated by analyzing sediment size deposits (fluvial palaeocompetence analysis). This is especially relevant for land use management due to the increased probability of co-occurrence of high intensity fire and post-fire rainfall episodes.

This research was funded by Top Heritage (P2018/NMT-4372) programme from the Regional Government of Madrid (Spain) and Grants PIC2020-116896RB-C21", "PIC2020-116896RB-C22" funded by MCIN/AEI/ 10.13039/501100011033.