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Impacts of wildfire and post-fire land management on hydrological and sediment processes in a humid Mediterranean headwater catchment

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The extensive afforestation of the Mediterranean rim of Europe in recent decades has increased the number of wildfire disturbances on hydrological and sediment processes, but the impacts on headwater catchments is still poorly understood, especially when compared with the previous agricultural landscape. This work monitored an agroforestry catchment in the north-western Iberian Peninsula, with plantation forests mixed with traditional agriculture using soil conservation practices, for one year before the fire and for three years afterwards, during which period the burnt area was plowed and reforested. During this period, continuous data was collected for meteorology, streamflow and sediment concentration at the outlet, erosion features were mapped and measured after major rainfall events, and channel sediment dynamics were monitored downstream from the agricultural and the burnt forest area. Data from 202 rainfall events with over 10 mm was analysed in detail.

Results show that the fire led to a notable impact on sediment processes during the first two post-fire years, but not on streamflow processes; this despite the small size of the burnt area (10% of the catchment) and the occurrence of a severe drought in the first year after the fire. During this period, soil loss at the burnt forest slopes was much larger than that at most traditionally managed fields, and, ultimately, led to sediment exhaustion. At the catchment scale, storm characteristics were the dominant factor behind streamflow and sediment yield both before and after the fire. However, the data indicated a shift from detachment-limited sediment yield before the fire, to transport-limited sediment yield afterwards, with important increases in streamflow sediment concentration. This indicates that even small fires can temporarily change sediment processes in agroforestry catchments, with potential negative consequences for downstream water quality.