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Effects of fires on the soil C and N storage of Mediterranean ecosystems: A meta-analysis

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Wildfires are a major factor controlling ecosystem functioning in Mediterranean-type ecosystems (MTEs). A sizeable number of studies have been published about the effect of fire on soil C and N dynamics in MTEs. However, no attempt has been made to synthesize this literature. Here, we present the results of a meta-analysis aimed at determining the magnitude and duration of the changes induced by fire on soil organic C and total N, and the role of a number of controlling variables. To this end, a systematic search of the literature was conducted in the main scientific databases to select studies that evaluated fire effects on soils in MTEs. Risk ratio was used as a measure of treatment effects, and the combined variance to measure data dispersion. The meta-analysis shows an overall no significant fire effect for soil organic C stock in MTEs. However, although at short term fire did not change soil organic C stock, a significant reduction was detected with time since the last fire. Interestingly, prescribed fires caused a reductions in forest soil C, but no changes were reported for wildfires. Fine textured soil showed lower C stocks than coarse textured ones. In addition, results revealed a higher sensitivity to soil carbon losses in mixed forest. No significant changes due to number of fires, soil depth or annual average precipitation and temperature were observed. On the other hand, the meta-analysis reported an overall significant increase of soil N stock due to fire in MTEs, independently of the soil depth studied. However, soil N stock decreased with time since the last fire, even bellow unburned soil values. Frequently burned soils experienced a decline in surface N stock. The higher increase of total soil N after fire was detected in sites with lower mean annual temperature and higher mean annual precipitation. Wildfires caused the higher increase of soil N in comparison to prescribed or experimental fires. Coarse textured soil showed lower N stocks than coarse textured ones. This work suggest that MTEs are quite resistant to changes in C and N storage due to fire. However, post-fire management criteria should focus at long term were a significant decrease of both elements was observed.