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Editorial: Wildfire severity and forest soils: impacts and post-fire restoration strategies to mitigate climate change

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Editorial on the Research Topic
Wildfire severity and forest soils: impacts and post-fire restoration strategies to mitigate climate change

Impacts of fire on forest soils have been widely studied in the last decades. Early studies compared burned and unburned areas, revealing that soil properties and dynamics are significantly affected by fire. Moreover, the advancements in soil and fire sciences revealed the importance of considering the variety of fire characteristics, ecosystem types and environmental pre- and post-fire conditions when studying fire effects on soils (Certini, 2005; Pereira et al., 2018; Fernández-García et al., 2020). Previous research has shown that the temperature reached in the soil and the residence time are critical factors that determine the effects of fire on soil properties. Biological and biochemical properties are generally altered at low temperatures (Fernández-García et al., 2020), while moderate temperatures cause shifts in soil organic matter and several nutrients (Marcos et al., 2007). High temperatures, on the other hand, can impact other chemical properties as well as ecologically relevant physical properties, such as soil structure and mineralogy (Santín and Doerr, 2016; Alcañiz et al., 2018; Fernández-García et al., 2019).

Despite the objectivity of temperature, residence time or fire intensity (rate of energy released) to investigate the effects on the soil, the unfeasibility of quantifying these variables after wildfires has led the scientific community to focus on the analysis of a variable directly related to them, the wildfire severity (Keeley, 2009; Francos et al., 2018; Fernández-García et al., 2019). Wildfire severity is defined as the degree of environmental change caused by fire, operationally estimated through remote sensing methods or in the field, through measurements of the loss of or change in biomass (Keeley, 2009). The practical value of wildfire severity relies not only on its value on informing about the degree of environmental change, but also as a potential predictor of ecosystem responses, thus being essential to anticipate critical areas to focus post-fire restoration actions (Pereira et al., 2018; Jiménez-Morillo et al., 2020). Additionally, the strong correlation between wildfire severity and biomass loss (Keeley, 2009) makes wildfire severity a suitable indicator to identify target areas where climate change mitigation actions could be implemented. Despite the effects of burn severity on soils have been analyzed in multiple regions, the uniqueness of each ecosystem and environmental conditions across the globe makes necessary further advances and new approaches in the field of burn severity and monitoring of wildfire impacts for increasing generalization. This is crucial to address current global challenges such as climate change.

The approaches compiled in the Research Topic "*Wildfire severity and forest soils: impacts and post-fire restoration strategies to mitigate climate change*" contribute to the advancement of forest soil science and fire ecology across different stages on wildfire severity research: (I) development of effective assessment and monitoring, (II) analysis of burn severity impacts, and (III) study of ecosystem responses in relation to burn severity, all research stages being essential for the design of sound post-fire management strategies. Correspondingly, an alternative for the assessment of burn severity monitoring was presented in a study case that demonstrates the potential of edaphic microarthropods to indicate fire impacts in Mediterranean pine forests (Lisa et al.). The proposed metric, named QBS-ar index is also useful to monitor post-fire recovery until 11 years after fire, and the effectiveness of post-fire rehabilitation actions. In addition, studies that focused on the impacts of burn severity provided a comprehensive understanding by examining various components of the ecosystem. Thus, one of the studies in the topic (Eckdahl et al.) based on an extensive survey across boreal forests with different fire and environmental conditions showed the impacts of burn severity on microbial communities and nutrient mobilization in a comprehensive way. In addition, another study (Przybylski et al.) has provided further insights into the importance of mixing soil organic and mineral layers for *Pinus sylvestris* seed survival and seedling establishment. Finally, the topic addresses ecosystem responses in relation to burn severity with pioneer research (Adkins et al.) on how burn severity drives oligotrophic and copiotrophic bacterial traits 1 year after a wildfire in a mixed-conifer forest in northern California, which might have large implications on C persistence in post-fire environments, and thus in CO_2 fluxes.

Based on the compiled studies, we postulate that metrics aimed at reflecting a comprehensive impact of fire on soil quality and function as well as on post-fire trajectories, could include indices or variables of the microbial (Adkins et al.) and microarthropod community (Lisa et al.) composition because of the differential responses of functional groups to fire. Similarly, we suggest further studies to address the potential interactions between fire impacts and climate change, to disentangle complex interactions such as the one suggested by Eckdahl et al. on soil microbial and nutrient function, which anticipate shifts toward more rapid nutrient cycling rates in post-fire environments under a warmer climate.

Author contributions

VF-G proposed the Research Topic and wrote the draft of the editorial. NJ-M and LC reviewed the articles in the Research Topic. NJ-M, LC, MF, EM, and VF-G co-edited the Research Topic, provided an assessment of how the articles fit within and help advance the fields of fire ecology and soil science. All authors contributed to the editorial and approved the submitted version.

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