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## A multi-decade assessment of the impact of large fire events on sediment redistribution using LAPSUS - the Águeda catchment, north-central Portugal

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### Abstract

Wildfires have become an increasing threat for Mediterranean ecosystems, due to increasing climate change induced wildfire activity and changing land management practices. Apart from the initial risk, fire can alter the soil in various ways depending on different fire severities and thus post-fire erosion processes are an important component in assessing wildfires' negative effects. Recent post-fire erosion (modelling) studies often focus on a short time window and lack the attention for sediment dynamics at larger spatial scales. Yet, these large spatial and temporal scales are fundamental for a better understanding of catchment sediment dynamics and long-term destructive effects of multiple fires on post-fire erosion processes. In this study the landscape evolution model LAPSUS was used to simulate erosion and deposition in the 404 km<sup>2</sup> Águeda catchment in northern-central Portugal over a 41 year (1979-2020) timespan. To include variation in fire severity and its impact on the soil four burnt severity classes, represented by the difference Normalized Burn Ratio (dNBR), were parameterized. Although model calibration was difficult due to lack of spatial and temporal measured data, the results show that average post-fire net erosion rates were significantly higher in the wildfire scenarios (5.95 ton ha<sup>-1</sup> yr<sup>-1</sup>) compared to those of a non-wildfire scenario (0.58 ton ha<sup>-1</sup> yr<sup>-1</sup>). Furthermore, erosion values increased with a higher level of burnt severity and multiple fires increased the overall sediment build-up in the catchment, fostering an increase in background sediment yield. Simulated erosion patterns showed great spatial variability with large deposition and erosion rates inside streams. Due to this variability, it was difficult to identify land uses that were most sensitive for post-fire erosion, because some land-uses were located in more erosion-sensitive areas (e.g. streams, gullies) or were more affected by high burnt severity levels than others. Despite these limitations, LAPSUS performed well on addressing spatial sediment processes and has the ability to contribute to pre-fire management strategies. For instance, the percentage soil loss map (i.e. comparison of erosion and soil depth maps) could identify locations at risk.

