Review response to 17-Feb-2026 (RC4)

Reviewer Comments

Black – reviewer; Blue – response

This manuscript addresses an important and interesting aspect of post-fire debris flow (PFDF) science: the seasonal variability of soil hydraulic properties several years after a wildfire. Your finding that hydraulic conductivity can vary by an order of magnitude between wet and dry seasons in the fourth year. The authors are to be commended for generating a rare multi-year field dataset that provides critical quantitative evidence challenging the traditional assumption of monotonic hydrological recovery in post-fire environments.

The central premise of the paper is to track the evolution of debris flow likelihood from Year 0 to Year 4. However, the manuscript explicitly states that for Year 0 and Year 1, the authors did not measure hydraulic conductivity or grain size in situ. Instead, they assumed a constant of 10 mm/hr based on the nearby Fish Fire.

The "Year 0" condition is the most critical and variable baseline. K values immediately post-fire can vary by orders of magnitude depending on burn severity, soil texture, and ash clogging. By assuming the starting point, the entire "recovery trajectory" (the slope of the curve from Year 0 to Year 4) is synthetic. If the true Year 0 K was 20mm/h or 5mm/hr (instead of 10), the conclusions about the rate of recovery would be different.

Thank you for the comment. We understand the reviewer's comment and point out the long-term trend of the Ks. We also performed a Water Droplet Penetration Time for Year 0, and the droplet did not enter the soil after either 5 and 10 minutes. Thus, leading us to believe a comparable fire with measurement would be a good reference.

The modeling results for the Year 4 Wet Season indicate a high likelihood of debris flow initiation. Specifically, the model predicts that Basins A, B, and E would trigger at I15 = 30mm/hr, and Basin D would trigger at just 20mm/hr. The authors note that actual rainfall events did reach intensities matching these thresholds. Crucially, the authors do not explicitly state whether debris flows actually occurred during these Year 4 events. If the model predicted failure at 20mm/hr (Basin D) and rain hit 20mm/h, but no debris flow occurred, this is a Type I error (False Positive).

Thank you for pointing this out. We will rephrase our wording in the next iteration. We are not able to verify if debris flow did occur immediately after these events given the road closure to the sites for several years. Thus, our objective of the study is to focus on how the different model parameters would influence the PFDF likelihood.

The study uses dNDVI as a direct proxy for vegetation cover in the model. The authors conclude that vegetation has a minimal influence on PFDF likelihood compared to hydraulic conductivity. The authors need to clarify how dNDVI was converted to the hydraulic parameters in the model.

Thank you for the comments. In this case, we only use dNDVI to measure vegetation cover. We could not provide more detailed analysis such as terrain roughness or vegetation density. This vegetation cover parameter is only used as an input parameter for the modeling approach to estimate the PFDF likelihood.

Your discussion currently relies almost exclusively on examples from the Western United States. This may limit the applicability of your findings. You are suggested to compare your results with recent major PFDF events and studies worldwide, particularly in Southwest China, focusing on the Xichang and Yajiang fires. Your study site is Mediterranean. In contrast, Southwest China (e.g., Hengduan Mountains) experiences a monsoon climate where vegetation recovery is often faster, yet PFDF likelihood remains high due to extreme rainfall intensity. How does your seasonal K variation hypothesis change in a region where soil moisture fluctuations are even more extreme?

Thank you for your insight. This would be an interesting test for future studies as it is out of the scope of the study area. Based on our study, we hypothesize that if soil moisture still plays a big role in this climate, we can expect large seasonal variations. We will point this out in our concluding statements and note that future studies could focus on understanding how soil moisture content might influence unsaturated hydraulic conductivity. We will also note that future studies will require a better understanding and discussion of the background/ baseline conditions.