

Manuscript title: *Explainable Artificial Intelligence for deriving 3D dynamic rainfall thresholds for landslide triggering using Kolmogorov-Arnold Networks*

General comments

The manuscript addresses a relevant and timely topic by combining explainable AI with rainfall-induced landslide prediction. The proposed Dynamic Rainfall Threshold framework appears promising and has the potential to improve model interpretability for operational Landslide Early Warning Systems. However, several methodological aspects require clarification before the scientific contribution can be fully assessed.

The manuscript is generally understandable; however, a careful proofreading is recommended to improve the fluency and readability of the text.

Major comments

In the Methodology section:

- In general, the validation procedure is not clearly explained in the Methodology section. Details that belong to the methodology are found in the Results section (lines 125-132 and 140-150). I suggest adding a short but clear paragraph in the Methodology section where the validation procedure is addressed.
- Only 40 events are reserved for validation, which appears rather limited considering the overall database. Please justify this choice and clarify whether the validation subset adequately represents the temporal and spatial variability of the complete dataset.
- Regarding the comparison among the different models, the methodology does not describe the characteristics chosen for each model:
 - No hyperparameters
 - No details on optimization procedures
 - How thresholds were chosen

Without this information it's difficult to see if the reported superiority of KANs is a consequence of better tuning or not. To ensure a fair comparison, it would be useful to report whether all competing models underwent comparable hyperparameter optimization procedures.

- The paragraph 2.2 *Network Explanations* is well written, however, while the mathematical background of KANs is useful, some of this material is already available in the cited literature. In contrast, additional methodological details on the generation of the proposed Dynamic Rainfall Thresholds (citing the produced figures) would improve reproducibility.

The Discussion section is well structured. I appreciate the interpretation of results and the acknowledging of limitations, as well as the outlining of future improvements. However, there are a few aspects that could be improved or discussed.

- The main scientific issue remains the lack of comparison with conventional rainfall thresholds. Although the authors highlight their potential role in enhancing predictive capabilities; in the end we do not know how they perform. Since the manuscript introduces DRT as an interpretable decision-support tool, it would greatly benefit from a comparison with traditional empirical rainfall thresholds (e.g., intensity-duration or event-duration thresholds). Such a comparison would help readers understand the practical advantages, limitations, and potential complementarity of the proposed framework within existing operational Landslide Early Warning Systems.
- Generalizability: The authors state “The method is widely applicable as long as landslide inventory data is available”. I suggest softening this statement. In fact, the model has only been trained and tested in Northern Italy. Rainfall-landslide relationships vary considerably due to

climatic conditions, geological setting, vegetation, soil properties etc., therefore, I would suggest being a little more cautious.

- The Discussion could further analyse how the proposed interpretability framework would translate into operational Landslide Early Warning Systems. In addition, the manuscript would benefit from a discussion of the uncertainty associated with the predicted dynamic thresholds or model outputs, particularly if the framework is intended for operational applications.

Minor comments

In the Introduction section:

- A deeper discussion on the limitations of current approaches and an explanation on why KANs are supposed to provide a substantial advantage beyond interpretability.
- A clearer introduction should be given to DRTs which seem to represent one of the main scientific contributions of the paper.
- The novelty of the work is currently presented across several parts of the Introduction. I suggest adding a short concluding paragraph summarising the main scientific contributions.

Please, carefully check the Figures and their citation in the text:

- Figure 3 and 4 seem to have been exchanged,
- Is Figure 3b missing?
- Line 154, is citing Figure 3 correct?