Author Response to Referee #1 (RC1) and Community Comment (CC1)

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Assessing Buried Landslide Rupture Surfaces Using Genetic Algorithms and Dynamic Flow Modeling

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We thank referees for their constructive and encouraging comments. We thank referees for their constructive and encouraging comments, which improved the terminological consistency, physical grounding, and demonstrated robustness of the manuscript.

Referee comments are shown in italics, followed by our response and the corresponding manuscript changes. Bracketed items ([ ]) mark values or locations to be finalized in the revised manuscript.

Part A: Response to Referee #1

RC1.1: Consistency in terminology (landslide vs. flow)

> *[...] the manuscript intermittently uses terms such as flow and debris flow (e.g., in the name MoSES_2PDF). [...] Please ensure consistent terminology [...] that the motion is defined based on the proportions of the solid (soil/grain) and liquid (interstitial fluid) phases, and that the model treats the relatively smooth movement of the collapsed mass through a physics-based dynamic approach.*

Thank you very much for pointing out this issue. MoSES_2PDF was originally developed for debris-flow applications, in which the moving mass is modeled as a solid-fluid mixture. In the present study, however, we focus on the rainfall-induced landslides, and the displaced landslide mass is likewise modeled as a continuum mixture of solid (soil/grain) and interstitial fluid phases. In the revised MS after the discussion stage, we shall clarify this ambiguity and (i) replace “debris flow” with “landslide mass” or “displaced mass” throughout the MS wherever it referred to the moving material, and (ii) added an explicit statement to define the scope of the proposed framework. The acronym MoSES_2PDF will be retained as it is the established name of the published tool (Ko et al., 2021).

RC1.2: Rationale for the basal friction angle δ_b = 16° (Hsiaolin)

> *In Table 2, the basal friction angle delta_b for the Hsiaolin event is set to 16 degrees. [...] it is exceptionally small. Please provide a more detailed explanation and justification [...] Including information on the local geology, such as the degree of weathering and lithological characteristics (e.g., weathered sedimentary rock), would be highly beneficial.*

As already discussed in our previous paper on the two-phase model (Tai et al. 2019), the adopted basal friction angle is an effective lumped parameter rather than the intrinsic Coulomb friction angle of the geomaterial. The magnitude 16 degrees can be obtained through the empirical scaling law suggested in Scheidegger (1973). For the Hsiaolin event (with a volume about 2.2×10^7 m³), the scaling law predicts an equivalent friction coefficient of 0.29 ± 0.14, where the adopted value (tan(16°) = 0.287) lies approximately at the center. Applying the same procedure to the much smaller (6.83×10^5 m³) Provincial Highway No. 7 event yields a basal friction angle δ_b = 35°. It is noted that the present framework is intended as a rapid assessment tool for the preliminary evaluation of landslide hazards using only surface observables (i.e., pre- and post-event DEMs, orthophoto and an estimated volume). In the revised MS after the discussion stage, we shall add a brief note below Table 2 to clarify that the value of δ_b can be estimated from Scheidegger's (1973) volume-mobility relation for each event.

- Scheidegger, A. E. (1973). On the prediction of the reach and velocity of catastrophic landslides. *Rock Mechanics and Rock Engineering*, *5*(4), 231–236.

RC1.3: Integration of subsurface monitoring data (future outlook)

> *[...] In regions where borehole observations (e.g., groundwater level monitoring or changes in water paths) are available, such data could potentially enhance the estimation of pore-pressure-driven stability changes. I would be interested to hear the authors' perspectives [...]*

We thank the referee for this thoughtful and forward-looking question. In regions where borehole observations are available, the monitored groundwater level can provide valuable information for slope stability analysis, allowing the Idealized Curved Surface with the minimum factor of safety to be identified as a candidate rupture surface.