

Interactive comment on “GIS-based topographic reconstruction and geomechanical modelling of the Köfels Rock Slide” by Christian Zangerl et al.

Anonymous Referee #2

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General Comments

This manuscript deals with the preconditioning, preparatory and triggering factors of the largest catastrophic slope failure in crystalline rocks of the European Alps, called Köfels Rock Slide. The Köfels landslide shows abundant frictionites in the deposits, which makes this landslide a very interesting object for research carried out during the last 150 years. The manuscript focusses on frictional strength properties of the basal shear zone at the stage of complete slope failure. The investigation is based on a back analysis of static landslide stability, using the commercial distinct element code UDEC. The primary inputs to the model are the landslide geometry at the onset of failure, primarily derived from published data, and some assumptions about the elastic and strength properties of the intact rock and discontinuities. New data presented re-

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fer mainly to the orientation of foliation and fractures mapped in the head scarp area. The results are well presented but are of limited significance, they mainly refer to the bulking factor and bulk friction angle along the assumed rupture plane, for dry and wet conditions. The reconstructed pre-failure topography and sliding plane location is similar to previous investigations. The estimation of the bulk friction angle is based on a set of assumptions which are critically reviewed in the next paragraph. The reconstruction of pre- and post-failure surfaces is carefully done with GIS and serves as a reference to future studies (Figures 6 and 7).

Specific Comments

The estimation of the shear strength of the basal sliding zone is based on back-analyses with UDEC for a pre-defined rupture plane geometry and an orthogonal set of fully persistent fractures in the sliding mass with uniform geometric and geomechanical properties. It is known from many previous studies (for example Vajont), that the strength and stability of slides with compound ruptures also depends on the internal strength of the sliding mass. However, the study does not evaluate the effect of sliding mass properties on the back-calculated basal shear zone strength. In addition, the rock-mechanical modeling assumptions are poorly constrained and not related to field and lab data. In fact it seems that some of the field observations (for example the stepped rupture plane) are violated. I suggest to perform a modeling study which is less trivial, which considers the few available field data and known depth trends of fracture properties as good as possible. It might be fruitful, to treat the basal rupture plane not as a pre-defined fully developed shear zone, but to investigate how this surface formed progressively from a previously not fully interconnected fracture network. This would lead to more substantial insights into progressive failure, which is only superficially discussed in the current manuscript. Another comment refers to the discussion and analysis of the rock slide runout. It is known from previous studies (for example Aaron et al 2020, *Frontiers in Earth Sciences* 30), that the dynamic friction angle during rapid runout motion can differ substantially from the static friction angle required

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to initialize the motion. With the new GIS models available in this study, it would be worthwhile, to review some of the dynamic property of the Köfels Rock Slide.

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