Earth Syst. Sci. Data Discuss., author comment AC4
https://doi.org/10.5194/essd-2020-324-AC4, 2021

Reply on RC4

Alessandro Tibaldi et al.

Author comment on "Slope deformation, reservoir variation and meteorological data at the Khoko landslide, Enguri hydroelectric basin (Georgia), during 2016–2019" by Alessandro Tibaldi et al., Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2020-324-AC4, 2021

Dear Reviewer 4,

thank you for your very useful constructive suggestions and for your sketch of the landslide area that has been highly appreciated. We have prepared a new version of the paper where we included all your suggestions. The point-by-point replies to all suggestions are listed below. The Editor advised me that the we will be allowed to upload the new version of the manuscript only in a successive stage when we will have received all the reviews.

GENERAL COMMENTS

The present work represents an interesting case study (first time for the Republic of Georgia) of a monitoring of an important landslide phenomenon facing an artificial water reservoir. Despite its uniqueness, however, the study does not seem to provide methodological or quantitative indications such as those required by such a high IF journal. Even the interpretations proposed remain generic and not adequately justified by the data collected. At present, the manuscript should be implemented and the data more thoroughly discussed and interpreted.

Reply: we have expanded the data section and the discussion, and both have been really implemented: we now present new results on the inner structure of the landslide from logs, piezometers, geological-structural mapping, and numerical modelling. We added a new figure showing a geological-structural section through the landslide body with superimposed the potential multiple slip planes resulting from numerical static slope instability modeling and log/piezometer observations. Thus, the chapter "2 Site description" is now divided into two subsections: "2.1 Quaternary geology and geomorphology" and "2.2 Substrate characterization". We also expanded the Discussion with the subsections: "5.1 Correlation slope deformation - lake level - rainfall" and "5.2 Behavior of the landslide and slip planes". This latter new subsection contains a discussion on the internal behaviour of the landslide respect to the presence of different slip planes, and on the possible differential movements of the various parts of the landslide also based on GPS monitoring stations located in different parts of the unstable slope, which have been now described.

SPECIFIC COMMENTS

1) Figure 3 - Observing the aerial image, the perimeter of the landslide does not seem adequately bordered. At the link below, for greater clarity, I have reported a sketch of my hypothesis based on the morphology and some characteristics of the slope, https://we.tl/t-9TlRiDhnlZ. In particular, I believe that the area is affected both by a deep phenomenon (related to the gravitational trench - DSGSD?) and by more "superficial" ones coinciding with that bordered in blue and that described by the authors.

Reply: thank you for your constructive interpretation. We have taken into account your suggestions, which, anyway, have to match with the field observations. The boundaries of the landslide area, as depicted in Figures 2 and 3a, are based upon our field surveys, and also on surveys made by Soviet researchers before the lake infilling, that show the presence of scarps, sink holes and fissures in the drawn landslide body, as well as on a series of piezometers broken by movements along the landslide slip planes and on logs. These data are now described in the new section "2.2 Substrate description". If on one side these observations allowed us to precisely draw the boundaries of this complex landslide, on the other side we have taken into account your suggestion of possible different landslide bodies. The latter have been assessed also with the aid of GPS monitoring stations located in different parts of the unstable slope.

The latter, however, would seem to be composed of two distinct movements, with different velocity and (perhaps) type (red and orange in the sketch). This fact would also justify the different phases of activation (probably one consequent to the other).

Reply: We have taken into account this suggestion that is now included in the Discussion, and we also added a new figure where we tried to define different landslide units/bodies. In this figure we also placed the arrows representing the GPS vectors measured in different parts of the landslide.

2) Figure 10 - Based on what has been said, I believe a direct correlation between the oscillations of the lake level and the response to the estesimeters is unlikely, although these oscillations certainly represent a strongly destabilizing element. More likely a direct relationship with rainfall events; the different response time would be related to the differential movements inside the landslide body (red + orange). As is well known in geomorphology, more superficial landslides can be activated after a few days of intense rainfalls, while deeper landslides respond with delay to "seasonal" events. In this regard, the use of inclinometers inside the landslide body would have been useful.

Reply: we now made a more in-depth discussion analyzing the deformation at each extensiometer in comparison with lake level variations and rainfall values. We recalculated the rainfall values month by month (instead of daily values) to see if there is some clearer relationship with cumulated rain. We now better clarified the possible influence of rainfall on some periods of enhance extension rates, while we still think that the first strongly increase of extension rate at extensometer 1 has been influenced also by the close-in-time increase of lake level. We put in evidence the presence of different rock volumes in the landslide that can move independently, as also suggested by the presence of different slip planes (described in the new section "2.2 Substrate description") and of GPS vectors. This can explain the different behaviors recorded at the two trenches.