

Interactive comment on “State fusion entropy for real-time and site-specific analysis of landslide stability changing regularities” by Yong Liu et al.

Anonymous Referee #1

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The paper presents a new data-driven methodology, based on a multi-attribute entropy analysis of deformation states which are obtained through joint clustering method combining K-means and cloud model. This method aims at identifying, at site-specific scale different state of activity of a landslide, in particular moment of acceleration or reduction of the displacement. The model was applied at different landslide test-case and it obtained consistent results respect to the real deformation patterns of the analyzed phenomena. The paper presents in details all the methodological approach and the achieved results. It represents an interesting model which could allow to improve the comprehension of the state of activity of slope instability, also in relation to an early-warning application. Instead, some aspects of the results presentation are incomplete, requiring clarifications and further explanations. Thus, several revisions are recom-

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mended to improve the overall quality of the work. Suggested revisions follow:

General comments

In Introduction section, it is important to describe better the other methodologies indicated in the text (Saito's method, FEM, LEM), in particular their fundamental principles, the main advantages and limitations and their range of application. This can be reinforced further with references of significant works presented case studies of these applications.

In Introduction section, please indicate some works when displacement thresholds were defined and the values of these thresholds, in relation to the type of phenomenon and the geological context.

The developed methodology is a data-driven model, which is based on displacement data. For a better definition of the k-clusters, it could be necessary developing the method using real data where inactive, active, reactivated, and, also, failure states occurred during the considered measurement periods, as demonstrated in the analyzed case studies. Please, discuss about this aspect, in particular in relation to the potential ability of the methodology to identify the failure times of a landslide even if it has not been occurred yet.

Could this method be applicable also at higher time resolution of displacement data (e.g. daily, hourly)? This could improve the prediction for early warning applications. Please, insert a discussion about the aspect.

Please indicate if there are several references, in previous works, which highlight that the historical maxima identified by the model for each studied landslide are correspondent to acceleration/reactivation periods or failure moments.

Specific comments

pag. 2 line 11: The sentence is unclear. Please, clarify its concept, introducing other references, if it is necessary.

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Please, substitute all the abbreviations in the text (e.g. 's, can't) with the corresponding entire terms. pag. 2 line 19: are there any previous works about entropy concepts application to landslides state of stability analysis? If yes, please refer to them and summarize their main achieved results.

In Methodology section: how many landslide deformation state can be identified by k-means/cloud analysis? This could have effects also on the definition of changing in landslide activity, e.g. a reactivation phase following a stable one.

Please, divide the description of the selected case studies from the results. Thus, it could be added a section ("Study area" or "Materials") before "Results" section.

It could be useful highlighting more geological and geomorphological features of both the study area and the test sites and also the triggering factors of the studied landslides.

"Discussion" and "Conclusion" section present several repetitions of the same concepts. It could be better merged these sections in another one ("Discussion and conclusion"), adding also references supporting the presented concepts.

Technical corrections

pag. 1 line 13: the evolutionary stages of the phenomenon

pag. 1 line 15: for assessing landslide stability

pag. 1 line 18: damages of properties every year

pag. 1 line: at site specific scale

pag. 2 line 5: it becomes of interest to find

pag. 2 line 9: Due to its easy acquisition

pag. 2 line 16: Previous works have introduced

pag. 3 line 8: the individuation of different deformations states

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pag. 3 line 9: to investigate deformation states

pag. 7 line 18: As time goes on

pag. 8 line 4: with a length of 2000 m

pag. 8 line 17: monthly indexes for Xintan landslide

pag. 13 line 8: entering accelerative deformation stage highlighted in previous works
(please insert references about this)

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