Nat. Hazards Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/nhess-2017-439-AC2, 2018

Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Data Assimilation with An Improved Particle Filter and Its Application in TRIGRS Landslide Model" *by* Changhu Xue et al.

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Received and published: 24 April 2018

Thanks for your comments. The following is my reply.

General comments: The paper presents the results of a study aimed at improving a data assimilation (DA) algorithm based on the residual resampling particle filtering. Two applications are provided in order to respectively test the feasibility of the improved algorithm and show an example concerning slope instabilities. In this latter regard, a 'synthetic' case is presented starting from the expression of the factor of safety implemented in the TRIGRS physically-based model. From this point of view, in the abstract the positive effects of the proposed DA algorithm in the use of TRIGRS should be enhanced and, more in general, the main goal to be pursued with reference to slope

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stability processes should be more clearly stated. Indeed, the submitted version of the paper does not allow understanding the benefits deriving from the adoption of the improved algorithm in addressing practical issues about landslides. In my opinion, for the readers of NHESS International Journal, the paper could be of interest only if the theoretical approach is applied to a real (not to a synthetic) case study. Finally, the paper is poorly written and, in some parts, difficult to understand; in this regard, the manuscript needs some English language editing. Reply: In this paper, a synthetic experiment is presented to verify the feasibility of the algorithm and its application to the TRIGRS landslide model. The main goal of this study is to propose a new method and prove it can be applied to the evaluation of FS in landslide slope. Experiments of real cases is carrying out and it need some more monitoring data. Then the paper is modified in some poorly expressed places to improve the expression of English languages.

Specific comments: Introduction – page 1, line 17. Why the (only) landslide event occurred in China on June 24, 2017 is mentioned? Section 1, Introduction – page 1, lines from 19 to 23. Considering the scope of the paper, why the authors mentioned some numerical methods for landslide modelling? And what type of landslides the authors are taking into account? The description of the TRIGRS model is very poor and should be improved. Section 1, Introduction – page 2, lines from 20 to 22. As mentioned in the general comments, the manuscript includes some sentences that appear meaningless. For example, the authors claim that they choose a 'slope movement model' (?) with a 10*10 size grid (no information about the dimensions are provided), applying the assimilation algorithm and TRIGRS program to 'predict and improve the prediction' (?) of safety factors (more than one?) and deformations (TRIGRS does not allow studying deformations) of the landslide (which?). Section 4, Application to landslide simulation based on TRIGRS model – page 6, lines from 1 to 5. Bearing in mind that TRIGRS allows simulating only the triggering stage of landslides, why the authors considered the post-failure stage? And, once again, what type of rainfall-induced landslide are they referring to? Or, more in general, what kind of physical process are they simulating and how the variation with time of the groundwater pressure head is estimated? Section 4,

Application to landslide simulation based on TRIGRS model – page 6, lines from 11 to 12. Could the authors clarify the meaning of Figure 5? Numbers in Figure are representative of what? And color shadings? Reply: Some extra content has been deleted, such as the landslide event occurred in China on June 24, 2017. In section 1, some methods for landslide modeling are mentioned to introduce the research status of landslide deformation analysis and numerical landslide evaluation. This study is applied to "peristaltic landslides", which is added in the last paragraph of section 1. The description of the TRIGRS model is enriched in the beginning of section 4. In the manuscript, poor expressed contents mentioned in the comment have been modified. In section 4, the useless content of post failure stage has been deleted. To estimate the groundwater pressure head (φ), some content of φ-estimation is added to the manuscript. Formula (21) and its context is the calculation method of φ-estimation, and Figure 6 and Figure 7 are its change of overall distribution and single cell, respectively. The illustration of Figure 5 has been revised to "Model results and assimilation results of FS. The maps in the first row are the model results running for 5, 10, 15, 20 days respectively, and that in the second row are the assimilation results. The horizontal and vertical coordinates in each graph are grid numbers of each cell."

Technical corrections Thanks for your review. The manuscript has been revised. The supplement is the modified manuscript.

Please also note the supplement to this comment:
https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2017-439/nhess-2017-439-AC2-supplement.pdf

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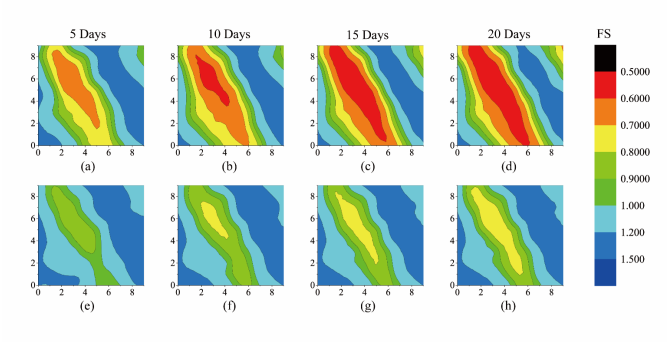

Figure 5. Model results and assimilation results of FS. The maps in the first row are the model results running for 5, 10, 15, 20 days respectively, and that in the second row are the assimilation results. The horizontal and vertical coordinates in each graph are grid numbers of each cell.

Fig. 1.

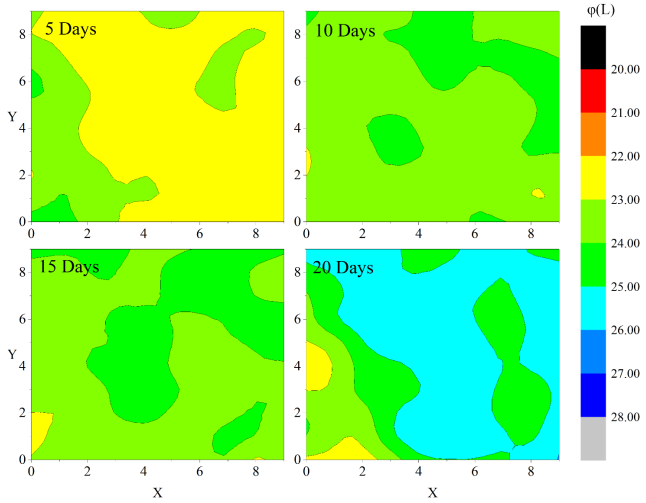

Figure 6. The distribution variation of groundwater pressure head (φ) with assimilated time. The horizontal and vertical coordinates in each graph are grid numbers of each cell.

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Fig. 2.

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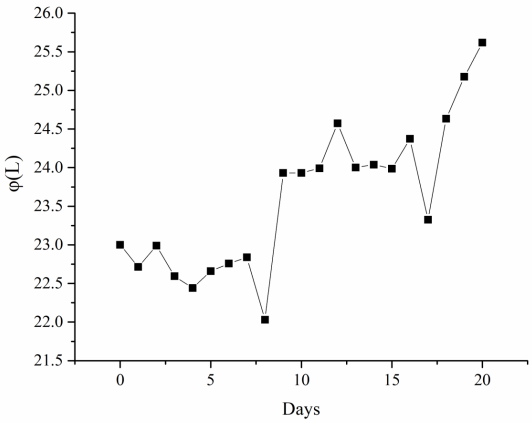

Figure 7. The changing line of the groundwater pressure head (φ) estimation of grid cell (5, 5) with assimilating time. The value is growing with the evolution of the landslide.

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Fig. 3.