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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Simultaneous state-parameter estimation of rainfall-induced landslide displacement using data assimilation" *by* Jing Wang et al.

Jing Wang et al.

ggnie@whu.edu.cn

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Dear Referee:

Thank you very much for your good evaluation and kind comments concerning our manuscript entitled "Simultaneous state-parameter estimation of rainfall-induced landslide displacement using data assimilation". Those comments are valuable and helpful for revising and improving our paper. We have studied comments carefully and have made extensive modification on the original manuscript. A revised manuscript with the correction portion red marked is attached in the supplement and we hope meet with approval. The main corrections in the paper and the responds to the comments are as

follows:

Answers to comments:

(1) page 1, lines31-32: Please show calculating time needed for existing prediction method. These examples can support superiority of prosed method in this paper.

Response: Thanks for the advice. We have found our deficiencies in the work. We have reviewed many papers on landslide prediction and found that the detailed calculating time is not mentioned. We have tried our best to explain the shortcomings of existing method in page 1, line 31-31 and page 2, line 1-3;

(2) page 3, lines16-25: Geology in study area should be described. This is basic information for the landslide.

Response: Thanks for the kind suggestion. We have added the geology information of study area in page 6, line 24-29. The added section introduces the basic geologic feature and geologic structure of study area;

(3) page 6, line 18: Show "three slopes" in the landslide in Figure 2 or Figure 3 and explain why the slope in Figure 3 was selected for the study.

Response: We are very sorry for our inappropriate writing. It ought to be "three parts". All parts belong to our study area. We have artificially divided the total landslide into three slopes according to the geomophogensis. The necessary change in the paper has been made in page 6, line 24-27 as well as in the referred Figure 3 accordingly;

(4) page 7, lines 7 – 10: Show the location in Figure 2 or 3 and distance from the rain gauge to the monitored site.

Response: The location of rain gauges are illustrated in Figure 3. The distance between rain gauge and monitored site is less than a meter and expounded in page 7, line 19;

(5) page 7, line 13: Explain "model method without SSPE" in chapter 2. I could not

find the model and method for deciding model parameters in chapter 2. If not, readers cannot the content of the paper.

Response: We have revise this negligence in page 7, line 24-26. The “model method” is a method using SSPE strategy without data assimilation. And the calculation of parameters follows the formula Eq.(13) in page 5, line 6;

(6) page 7, lines 15 – 16: Please explain how to decide time step for calculation. It is important information for understanding the calculation process.

Response: The reason why we choose five days as time step is added in page 7, line 28-29. Due to the complex terrain and insufficient power supply of Xishan Village, the monitoring GPS sequence had large error or noise. In order to reduce the influence of these errors and noises, the time step is set to five days;

(7) page 7, lines 27-28: Trend of fluctuation is different between GPS03 and GPS04. For examples, Fluctuation from time step 40 to 50 and that from 70 to 76. More detailed explanation is necessary for them.

Response: The detailed explanation is as shown in page 8, line 12-16. The different fluctuation could be attributed to the impact of geology. The location of GPS 03 and 04 station have different geomophogensis, which will result in different deformation behavior;

(8) page 8, lines 9 to 21: If you can show the comparison of calculating time needed for proposed method to that for the model without SSPE, readers can understand the superiority of the proposed method better. You can show the proposed method can make prediction simultaneously.

Response: We have fixed our program and calculated the needed time of two algorithm. The model method predicts displacement without data assimilation algorithm, so it needs less time than SSPE method. The detailed data is shown in Table 3. The instructions are mentioned in page 9, line 9-11.

We are very grateful to your comments for the manuscript. Should you have any questions, please contact us without hesitate.

Please also note the supplement to this comment:
https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2019-24/nhess-2019-24-AC1-supplement.pdf

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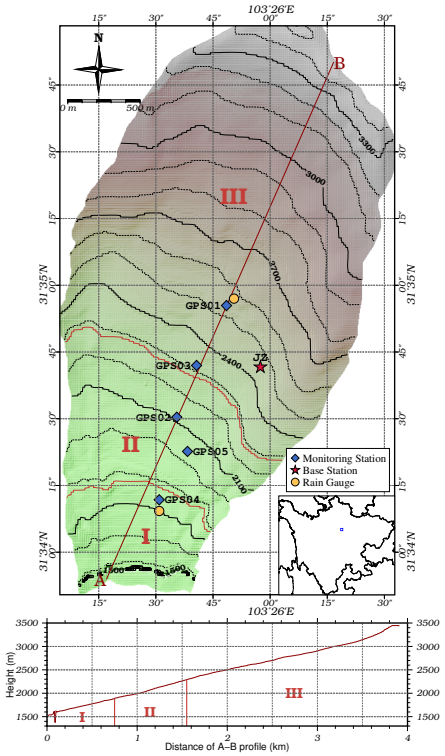

Fig. 1. Figure3:The distribution of three parts, GPS stations and rain gauges at Xishan landslide

Method	MAE(mm)		MSE(mm)		RMSE(mm)		Execution time
	GPS03	GPS04	GPS03	GPS04	GPS03	GPS04	
SSPE assimilation	8.206	10.9272	110.9938	187.99	10.5137	13.7111	0.0889
Model	15.2718	18.0565	382.5577	491.46	19.5591	22.1689	0.0025

Fig. 2. Table3: Comparison of MAE, MSE, RMSE performance and needed time using different methods in two stations