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Interactive comment on "Landslide displacement prediction using the GA-LSSVM model and time series analysis: a case study of Three Gorges Reservoir, China" *by* Tao Wen et al.

Anonymous Referee #1

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The authors develop a new model based approach to study the landslide displacement patterns of a slow-moving landslide at the Three Gorges Reservoir, China. The landslide movement rates are shown to influenced by a combination of both rainfall conditions and reservoir level fluctuations. The study uses monitoring records from the landslide to train and test the model before assessing its capability to predict future ground movements. The results illustrate that the model predictions and displacement behavior of the landslide are broadly consistent and therefore may provide a useful tool in the forecasting of future movements at the site. The study uses novel approaches and will be of interest to a broad readership of NHESS. It is recommended that the article be accepted for publication following revisions as suggested below. Further minor

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Discussion paper

comments and suggestions are provided in the reviewed manuscript attached.

General: The landslide appears to show continuous ongoing slow-movement with periods of episodic accelerated ground creep associated with rainfall and reservoir level changes. The highest rates of movement observed in the landslide appear to occur following periods of heavy intense rainfall after the lake level has been reduced. This behavior is like to be best explained in terms of stress changes within the landslide in that the rainfall events cause increased pore water pressures in the landslide shear zone which reduces the effective stress and increases instability. Similarly, the lowering of the lake level reduces the confining stress whilst pore water pressures are still high which would promote accelerated movement. I would argue that this behavior is common in a number of slopes and therefore the explanation for the movement observed at this site should be considered in this context. Statements such as the degrading of the sliding mass by excess moisture and increases in sliding forces are therefore not likely to be the key driving mechanism in slope instability.

Introduction: Pg 1_line 28 - Geological conditions here are referred to as an external factor influencing landslides. Geoelogical conditions should be considered as an internal factor as is later suggested in the manuscript. Pg 1_line 31-35 - These final sentences of the first paragraph should really be the start of the introduction as this sets out the general motivation for the study before linking this to the site. Pg 2_lines 31-34 - I am not sure that this is needed I would suggest deleting this.

Methodology: Pg 2_ lines 38-39 – I'm not sure I fully understand this point. Landslide displacement is caused by both internal and external factors but why does the lithology, geological structure and topography cause result in monotonic displacement through time? Also groundwater (pore water pressures) should be considered here. Most likely the ground water table remains high enough for ongoing movement to continue. Pg 5_lines 3-16 – This section This section introduces the GA computational model but largely explains this through its previous biological applications. It would be much easier for the reader to explain how this has been adapted for landslide studies.

Case Study Pg 6_ line 29 – Why is landslide monitoring considered a qualitative approach to analyse landslide development. This is quantitative data. Pg 8_lines 17 – 18 – This should be the other way around- the landslide stability decreased and the deformation increased. Pg 9_line 24 - Statement 'materials in the sliding mass are degraded by excess moisture and additional hydrodynamic pressure' is not correct. The excess pore water pressure reduces the mean effective stress at the landslide shear surface making it more susceptible to movement. Pg 12_ lines9-10 – How has the sliding force increased? Is it not the case that the confining pressure reduces with the lowering of the lake but the pore water pressure remains high so this change in stress state makes the slope more unstable? Pg 12_line 12 - Is this an actual piezometer or standpipe installation or is this water observed within the inclinometer tube itself? If the latter is there any certainty as to where this has come from? If not an installed piezometer it could have come from the top cap of the installation and therefore may not be a reliable groundwater measurement.

Figures Fig 4. The key is not explained. A clear key showing instrument type and borehole locations is needed Fig 5. As with figure 4 the key is not clear. Also the borehole and inclinometers should be drawn on to show their depth. Fig 8. Diagrams are hard to read. It would be better to display these as conventional inclinometer plots with depth on the y axis and displacement on the x axis.

Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2017-87/nhess-2017-87-RC1-supplement.pdf

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