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Earth Surface Dynamics Discussions

Interactive comment on "Spatial distributions of earthquake-induced landslides and hillslope preconditioning in northwest South Island, New Zealand" *by* R. N. Parker et al.

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This paper investigates the influence of the damages accumulated during an earthquake on the rate and the pattern of mass wasting caused by the following earthquake through a process of long term weakening. This concept is illustrated by the analysis of the landslide patterns associated to two earthquakes with overlapping epicentral area and separated by a period of 39 years. Using a logistic regression technique to forecast the probability of hillslope failure associated to each of these earthquakes, the authors assess that the landslides caused by the 1968 earthquakes are promoted in the area of strong shaking of the 1929 earthquake. They deduce from this result that

deep, long term weakening effects take place during the shaking, perturbing the erosion rate in the epicentral area during at least half a century. This is a very interesting and innovative result, which surely deserves a run in Esurf. The paper is clearly written and well presented and the figures are useful and well detailed. However, I'm not fully convinced by the strength of the result advanced in the study in its present state. I will present several remarks the author should address before considering this study for publication. I therefore ask for a publication via major revisions.

- First, the authors should clarify what they call the observed probability of landsliding : "observed Pls". By definition, this probability, being based on the observations a posteriori, should only be 0 (no landslide) or 1 (landslide). From the last sentence of the Fig.11 caption, it seems that they have extracted the cumulated landslide coverage in the area defined by the value n of the Predicted probability "Predicted Pls" and then plotted the ratio of the landslide cover of this surface with n. If it is the case, they should explain it more clearly in the manuscript for it is fundamental to know which data is plotted against which model. They should also explain why their 2 Pls never reach the value of 1 on Fig.11. Similarly, are there any landslides reported in the area of predicted Pls=0 ?

- I don't understand why equ.(4) and equ.(5) still include NDS and CA. Fig 12 seems to demonstrate that pseudo-R2 shows no significant increase of the model predictability when they are included.

- Fig. 13G shows that the 1968 model residual shows "partial correlation" with the 1929 Pls, not a strong one. The problem is that, from what I understand, the authors have use models using 2 different parameters (PGA in the 1968 model and FPD in the 1929) to construct it. The correlation should be done with models using the very same parameters (in this case FPD for the 1968 model). Otherwise, we don't really know what we are looking at.

- I somewhat fail to see any correlation on Fig. 13H.

- Looking at Fig. 1, the landslide pattern of the 1968 EQ seems to be strongly influenced by the radiation pattern as the source initiated at the very northern part of the fault and propagated southward, increasing the shaking in the southwest quadrant. I'd suggest the authors to add a parameter for this effect in their 2 models. This could be done by subdividing the epicentral area into two subspaces (or four) with different weights (higher in southwest for the 1968 EQ). The limit of these two subspaces should be centered on the epicenter and should be oriented normaly to the direction of the rupture propagation. If this parameter is found to be controlling (through the pseudo R2), this might significantly change their final correlation between the the 1968 model residuals and the 1929 Pls. In fact, it may strengthen it.

- If maintained after the above modifications, the result of this study is somewhat in contradiction with what has been observed in Taiwan where the prolonged mass wasting, measured as an exess flux of river sediments, seems to vanish after a few years [1]. O.Marc is also preparing a manuscript on the prolonged rate of landsliding in epicentral area of several strong earthquakes (see [2,3] for personal communications) and he's found similar time frames. These contrasting results need to be discussed briefly.

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[1] Hovius, N., Meunier, P., Lin, C.-W., Chen, H., Chen, Y.-G., Dadson, S., Horng, M.-J., and Lines, M.: Prolonged seismically induced erosion and the mass balance of a large earthquake, Earth Planet. Sc. Lett., 304, 347–355, doi:10.1016/j.epsl.2011.02.005, 2011.

[2] Constraints on post-earthquake elevated landslide rate: towards forecasting of a general mechanism? T Uchida, O Marc, C Sens-Schönfelder, K Sawazaki, P Meunier, N Hovius. EGU General Assembly Conference Abstracts 16, 7392.

[3] Geomorphic and seismic coupled monitoring of post-earthquake subsurface weakening. O Marc, K Sawazaki, C Sens-Schönfelder, N Hovius, P Meunier, T Uchida. EGU General Assembly Conference Abstracts 16, 7212.

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