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Modeling the earthquake-induced landslide hazard assessment based on cumulative displacement method by considering topographic amplification and sliding area effect

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During developing the GIS landslide hazard assessment methods, landslide inventory maps are always used to be compared with the result of modeling for assessing the workability of the models. Usually the modeling methods consider the failure criteria of the slope, such as safety factors, cumulative displacements, or the combining effect of the factors triggering the landslides by statistical analysis, in other words, the models only predict the source areas of the landslides. However the landslide areas indicated on the landslide inventory maps usually include the source, sliding, and covered area of the landslides due to the limitation of the image interpretation ability, therefore the discrepancy between the result of models and landslide inventory maps are expected.

In our model, we try to put in the run out behavior of the sliding material, so the model can predict the all the source, sliding, and covered areas, which are more close to the real condition of the landslide inventory maps. Two indexes are used to evaluate the workability of the models, the first one is failure ratio, which is defined as the proportion of real landslide cells among the predicted failure cells, and this index is popularly used for many researches. The second index is named as “correct ratio” in this research, which is defined as the proportion of the predicted failure cells among the real failure cells. A good model shall have a good numbers for both indexes, and it seems to be that the above idea can improve the accuracy of both indexes simultaneously.

Since topographic amplification effect is a generally observed phenomenon during earthquake, this research uses a method to introduce this effect into the model. A vertical propagated Ricker wavelet is used to calculate the amplification factors of each frequency for the each cell (15m by 15m) on the surface of the study mountain site, which is located at the central part of Taiwan and was heavily hit by 1999 Chi-

Chi earthquake. The amplification factors is then applied to the simulated earthquake waves of the horizontal plane surface at the study site to obtain the amplified earthquake wave at each surface cell of the study site, and the cumulative displacement of each cell can be then obtained by the integration method. Fifty simulated earthquake waves are used to obtain the average cumulative displacement of each cell on the study site. These cumulative displacements are then used to predict the source area of landslide of the study mountain site.