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Case Studies of Landslide and Debris Flow Disasters during 2009 Typhoon Morakot

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SUMMARY

In August 2009, Typhoon Morakot invaded Taiwan and had caused severe natural disasters such as landslides, debris flows, and floods over southern Taiwan. The overwhelming rainfall amounts and intensities brought by Typhoon Morakot have been recognized as the major triggering factors to those natural disasters. Despite the serious causalities and devastative infrastructure damages, Typhoon Morakot did provide abundant important data for studying possible causes, mechanisms, and consequences of these natural disasters. These data includes extensive field data of landslides and debris flows occurred, detailed precipitation records, as well as performance data of structures that were observed during this event.

In the proposed study, the authors collected the field data of landslides and debris flows along two severely affected river regions Chen-Yo-Lan River and Lao-Non River. Amount of debris was then estimated using semi-empirical equations that calibrated in previous events. Furthermore, detailed information of twenty four highway bridges damaged during Typhoon Morakot were also collected for accessing structural performance related to the landslide and debris flow disasters. Thanks to the spatial analysis tools of Geological Information System, all these field data could be summarized not only qualitatively but also quantitatively.

In addition to field observation data, the authors also collected precipitation data of over fifty rainfall stations in southern Taiwan. Pattern recognition analysis was conducted to identify typical precipitation patterns that would cause slope failures and related debris flows. Threshold rainfall intensities and rainfall amounts that would possibly trigger the failures were chosen as two indices and their applicability based on different theoretical or empirical approaches from the selected precipitation patterns. Combinations of these threshold rainfall indices could then be used to characterize triggering mechanisms of rainfall-induced landslide failures, according to different geomorphology, geological conditions, or scales of failures. Correlation between triggering rainfall indices and occurrences of landslides is to be established through this analysis. For debris flows that occurred after landslides, similar analysis procedure is also adopted to establish the correlation between debris flows and rainfall indices. Correlations obtained through these analyses would be very important for delineating triggering mechanism of such rainfall induced natural disasters.

In this paper, collected field observation data and typical precipitation data will be presented firstly. Procedures of spatial analysis on disaster data and pattern recognition analysis on critical rainfall patterns will then be described in details. Results of conducted analyses on studied river regions will then be presented for illustration. At the end of this paper, applications of the results to disaster simulation would be also discussed. It is hoped that progress of this study would provide a feasible approach to simulation of large scale rainfall-induced disasters such as landslides and debris flows.