The Comprehensive Slope-land Disaster Magnitude Assessment for Landslide and Debris Flow

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INTRODUCTION

Taiwan is vulnerable to the slope-land disasters due to fragile geology condition and high-frequency earthquake. Numerous rainfall occur during typhoon season caused serious slope-land disasters, especially landslide and debris flow disasters. These disasters occur repeatedly and always cause serious impacts to the community in the mountain. Recently, the extreme rainfall occurs more frequently and brings disasters at the same time with larger magnitude. So, this research intends to establish an analysis process for describing the slope-land disaster occurrence in a catchment by considering the data connection from landslide model to debris flow model. Finally, a case study is utilized to confirm its availability.

DATA CONNECTION FOR LANDSLIDE AND DEBRIS FLOW DISASTERS

This analysis process is represent to describe disaster magnitude with debris flow and landslide. This study assumed that the landslide trigger by an extreme rainfall event and occur firstly and part of area will cause debris flow occurrence. The disaster magnitude will be the total area of landslide area and the debris flow accumulation area (**Table 1**). TRIGRS model (A Fortran Program for Transient Rainfall Infiltration and Grid-Based Regional Slope-Stability Analysis) developed by USGS is utilized for landslide numerical model. It analyzes the safety factor of a catchment. With the interpretation of remote sensing, the range may cause debris flow will be clarified and the amount of sediment volume will be estimated by safety factor variation and landslide area-depth empirical formula.

Flo-2D software is utilized for debris flow simulation. Some database are necessary for the scenario simulation, including parameter dataset, hydrological frequency analysis, and topography data. The parameter dataset gathers parameters from the related papers and research reports with the on-site investigation or experiment results. These numbers are applied by different torrents. The hydrological frequency analysis is carried out by the historical extreme rainfall data and the estimation rainfall data under climate change conditions. A series rainfall amount from 400-year to 2-year return period is generated by statistical analysis. The topography data includes satellite images and digital elevation model (DEM) data. Here DEM data with different resolution are utilized, which are 30-meter and 5-meter. Then determining the extreme rainfall event and the location of the torrent carries out the simulation. The accumulation depth and the velocity are clarified from the simulation. The disaster losses and the amount of the sediment to the main stream can be estimated therefore through this process.

CASE STUDY: DEBRIS FLOW DISASTER IN TYPHOON SAOLA, 2012

Typhoon Saola attacked Taiwan in 2012. This typhoon brought about 130mm hourly rainfall and 900 mm total rainfall in eastern Taiwan. To estimate the disaster magnitude, not only numerical simulation but also field investigation was given. The result shows that this analysis process is available for landslide and debris simulation (**Fig.2**). The result under climate change condition can tell the probable effective area of these two disasters. The results also represents the parameter and the data resolution are two significant factors that influence the result most.

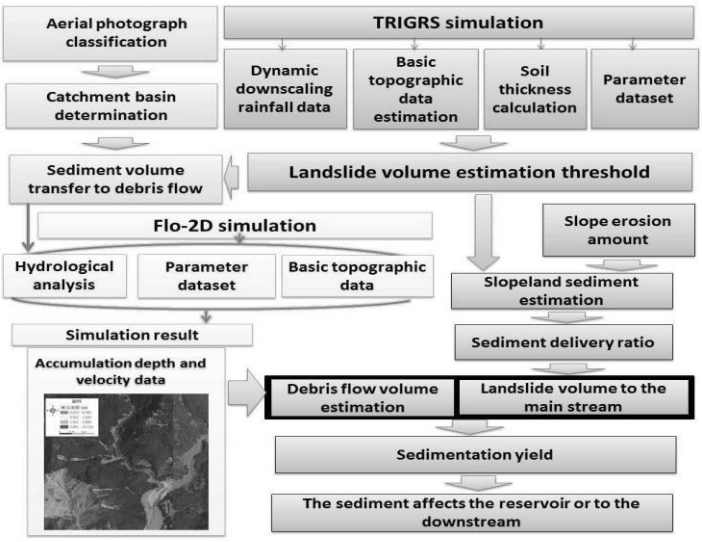

Fig. 1 The scenario simulation process for landslide and debris flow data connection

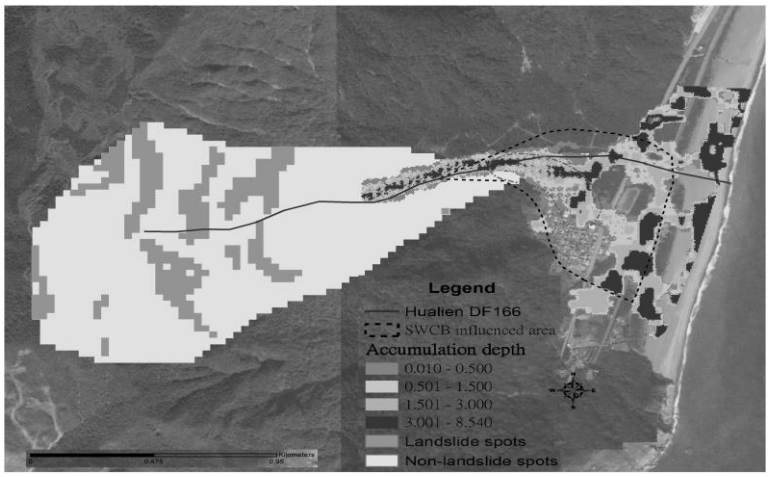

Fig. 2 The landslide and debris flow simulation result in a torrent

CONCLUSION

The authors carried out a methodology for data connection of landslide and debris flow. This method provides a rapid and simple way to estimate the sediment volume induced by a rainfall event. This method is also utilized a debris flow debris flow event during typhoon Saola, 2012. The simulation results represents the DTM data resolution will give a large influence to the simulation precision. The simulation result also reveal that geology and the topographic features are two factors causing the turning curve and debris flow disaster at this area.

Keywords: Flo-2D, TRIGRS, landslide volume, disaster magnitude, extreme event