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Event-based modeling and characterization of non-volcanic debris flows, November 2004, Dingalan, Aurora, Philippines

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From 19 November to 03 December 2004, four consecutive typhoons devastated coastal towns and caused hundreds of casualties across the islands of Luzon and Visayas. Located in the eastern coast of Luzon Island, the Subsob and Paltic Rivers in the municipality of Dingalan were swept by debris flows triggered consecutively by continuous heavy rains from Tropical Depression Merbok on 22-23 November and Tropical Depression Winnie on 29-30 November. The village of Paltic downstream of the two rivers was buried in huge boulders and thick mud deposits, causing at least 135 fatalities.

In this study, ground mapping and interviews with local residents were conducted to reconstruct the debris flow extent from the two rivers. A debris flow hazard map was produced based from the ground validation to compare the results of two numerical modelling software. Rainfall intensity-duration-frequency (RIDF) values and 5-meter resolution IfSAR images acquired in 2013 were utilized to run debris flows using FLO-2D, a flood-routing software that has been extensively used for mudflow simulations. The same high resolution images were used to run Flow-R, a Matlab-compiled numerical model for regional scale debris flow assessments. Simulation results show that Flow-R is better suited to assess the probability of debris flows occurring on a larger area prior to an event, while FLO-2D is better suited for detailed hazard maps after an event has taken place. Both hazard maps from the two models show the possible extent and pathways of debris flows in succeeding events, based on the 2013 topography.

On a larger scale, Flow-R can be applied to watersheds around the Philippines and tropical watersheds around the world as a preliminary tool to assess its debris flow susceptibility, while FLO-2D can be applied to watersheds where known previous debris flow events have occurred and where data such as accumulated rainfall values has been recorded.