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Application of a two-dimensional numerical model to a real life debris flow event

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Debris flows are common processes and represent a severe natural hazard in mountainous regions. In this study we investigate the evolution and the dynamic of a debris flow event occurred on November 2002 in the Rossiga valley (Lombardia, Italian Central Alps,). This period was characterized by a two week precipitation event that was responsible for triggering four landslides in the Rossiga valley. These landslides carried subsequently in the watercourse a maximum volume up to 150,000 m3 - 200000 m3. The observed debris flow started as a consequence of the last and bigger landslide and was 60000 m3- 80000 m3 in volume. Field evidences revealed a maximum flow height of 7-8 m, the peak discharge was estimated in 400-450 m3/s. We used a two-dimensional routing model (O'Brien, 1993) to replicate the event and to reconstruct the depositional areas. The code describes the flow behavior of a viscous debris flow by using a quadratic rheological model based on the Bingham constitutive equation. The computations was developed on a 10 x 10 m DEM routing downstream different inflow bulked hydrographs resulting from two triggering mechanisms: (1) the occlusion of the channel and the subsequent breaching of the landslide dam, (2) the direct development of the main landslide in debris flow. Model calibration is made with respect to the inflow hydrograph and the coefficients that define the viscosity and the yield stress. The aim of the calibration was to gain the best fit on observed event volume, debris flows runout distance, maximum flow depths and peak discharge. The size of the material covers all the range from clay to boulders and the fraction finer than 0.85 mm represents the 12.5% of the total amount. We carried out the measurements of rheological properties of the deposited debris flow material (yield stress and plastic viscosity) varying the volumetric sediment concentration to define the coefficient of the power law equations required by the model. These coefficients are compared to the ones resulting from the model calibration.