



Sediment budget estimation in a small torrential catchment using DEM of difference approach

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The aim of the study was to estimate the sediment budget (net erosion change) in a small torrential catchment using the DEM of difference (DoD) approach.

The Kuzlovec torrent (~ 0.7 km²; in the Gradaščica River catchment) is located approximately 20 km west of the City of Ljubljana and is part of the Sava River basin. The elevation ranges between 394 and 847 m.a.s.l, the mean catchment slope is 27.3° , the mean annual precipitation typically ranges between 1600 to 1800 mm, forest covers more than 85% of the area, and the predominant soil type is Rendzic Leptosol (according to the FAO classification).

Using the Terrestrial Laser Scanning (TLS) a digital terrain model (DTM) with a 5 cm grid cell was obtained. A smaller (about 25 m wide and 160 m long) specific study site with a mean slope of 37° was selected in order to ensure the high quality of data. A high resolution (several million points) surveys were performed in April 2013 and August 2014.

In the night from 4th to 5th of August 2014 an extreme flash flood happened in the investigated area. Three tipping bucket rain gauges and one disdrometer, which are located in the Gradaščica River catchment, measured 110 to 185 mm of rainfall in less than 10 hours. Two rain gauges measured about 110 mm, one rain gauge (the closest to the Kuzlovec torrent) recorded approximately 140 mm of rainfall, while the disdrometer measured 185 mm of rainfall. The estimated return period of this rainfall event (based on the rain gauge data) was between 100 and 250 years, however based on the disdrometer observations the return period was larger than 250 years. The Gumbel distribution was used in order to construct the intensity-duration-frequency (IDF) relationship and the data from 1976 to 2008 was used for this purpose. Furthermore, the maximum one minute rainfall intensity measured by the disdrometer was 288 mm/h. This high rainfall intensities triggered several shallow landslides and caused intense soil erosion processes, especially large bedload and suspended load movement along the stream channel network.

A DoD approach was used to estimate the net erosion change in the selected section of the Kuzlovec torrent. A mean difference in the elevation between the DTM 2014 (after flash flood) and DTM 2013 (before flash flood) was -0.104 m. Based on the grid cell size (0.05 m) and number of cells ($\sim 1.93 \cdot 10^6$) a net erosion of about 500 m³ was calculated. Furthermore, uncertainty estimation is needed to validate the calculated net erosion change between two DTMs.