

Rainfall-runoff and erosion processes triggered by extreme rainfall event in a forested headwater catchment

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The interconnections between the processes of rainfall-runoff formation and erosion-sedimentation cycle can be characterized by significant spatial and temporal variability. In order to be able to trace such variability, intense hydrological monitoring (6 rain gauges, disdrometer, 3 water stations) was installed at 2 small torrential catchments (Kuzlovec and Mačkov graben torrent) inside the Gradaščica river experimental catchment in central Slovenia. Erosion processes were monitored by continuous turbidity measurements and several sequences of terrestrial lidar scanning. Measurements and observations of erosion processes that are a consequence of rainfall-runoff formation in the Gradaščica river catchment confirm this notable variability in processes. Extreme meteorological events, which occurred in year 2014, caused fast hydrograph formation and consequent erosion, transport and deposition of fine soil particles and also coarse sediment and woody debris along the channel of the Kuzlovec torrent and Gradaščica river. During one particular event in August 2014, highly variable rainfall amounts during short term and localized extreme rainfall event were detected by different rainfall gauging instruments. The total rainfall amount measured by the disdrometer was 185 mm in 9 hours and 40 minutes (1-minute rainfall intensities were up to 288 mm/h and up to 20,000 rainfall particles were detected). On the other hand, one of the tipping bucket rain gauges measured 140 mm in 9 hours. The estimation of the return period of the rainfall event exceeded 250 year return period for the disdrometer and tipping bucket rainfall amounts. During the August 2014 event more than 50 shallow landslides were triggered, about 50 km of roads were damaged, and three road bridges were severely damaged in the larger affected area. The impact of the event was even worse due to the large amounts of damaged and fallen trees in the Gradaščica catchment. The large woody debris was a consequence of an extreme sleet that happened in February 2014 in Slovenia and damaged about 40% of Slovenian forests. Deposited sediments and woody debris can strongly influence the flood safety of some stream reaches and cause damage on road infrastructure, which became apparent during the observed flood events. Further, sediment depositions inside the river channel worsen the flood safety of the urbanized areas of the city of Ljubljana.