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Adaptation of Sediment Connectivity Index for Swedish catchments and application for flood prediction of roads

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Climate changes are predicted to increase precipitation intensities and occurrence of extreme rainfall events in the near future. Scandinavia has been identified as one of the most sensitive regions in Europe to such changes; therefore, an increase in the risk for flooding, landslides and soil erosion is to be expected also in Sweden. An increase in the occurrence of extreme weather events will impose greater strain on the built environment and major transport infrastructures such as roads and railways.
This research aimed to identify the risk of flooding at the road-stream intersections, crucial locations where water and debris can accumulate and cause failures of the existing drainage facilities. Two regions in southwest of Sweden affected by an extreme rainfall event in August 2014, were used for calibrating and testing a statistical flood prediction model. A set of Physical Catchment Descriptors (PCDs) including road and catchment characteristics was identified for the modelling. Moreover, a GIS-based topographic Index of Sediment Connectivity (IC) was used as PCD.
The novelty of this study relies on the adaptation of IC for describing sediment connectivity in lowland areas taking into account contribution of soil type, land use and different patterns of precipitation during the event. A weighting factor for IC was calculated by estimating runoff calculated with SCS Curve Number method, assuming a constant value of precipitation for a given time period, corresponding to the critical event. The Digital Elevation Model of the study site was reconditioned at the drainage facilities locations to consider the real flow path in the analysis. These modifications led to highlight the role of rainfall patterns and surface runoff for modelling sediment delivery in lowland areas. Moreover, it was observed that integrating IC into the statistic prediction model increased its accuracy and performance. After the calibration procedure in one of the study areas, the model was validated in the other study area, located in the central part of Sweden, since this experienced flooding in relation to the same triggering event.