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Flood and Erosion and Sediment Modelling under Land Use Change in a mountainous Catchment

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Land use changes are often considered to be the reason for increased flood frequency and magnitude as well as enhanced erosion and changing erosion patterns. In small mountainous basins where damages due to wind storms occur, the proportion of land exposed to erosion may modify the risk for the downstream areas. A sustainable forest management set to minimize these downstream impacts requires a proper evaluation of the basin response to changes in forest and vegetation cover. Direct observations are limited, so that distributed rainfall-runoff models coupled to erosion models can help in such evaluations. In this study we report the preliminary results of such an analysis on a small mountainous catchment in central Switzerland.

The model we use has a process-oriented fully distributed rainfall-runoff component based on a hydrological routing approximation to the diffusive wave, and an erosion component with a choice of sediment transport formulas and a sediment balance routine. The model predicts the spatial distribution of surface runoff properties, as well as of potential erosion and deposition under transport capacity limited conditions for flood events, and it is applied to study land use change scenarios, e.g. forest windstorm damage scenarios and forest management scenarios. Changes in flood propagation, flood event duration and peak magnitude, and hillslopes and channel sediment yields are investigated through time for the different scenarios, thereby including forest recovery after damaging windstorms.

Preliminary results show that the removal of the forest cover generally intensifies floods and therefore channel sediment transport. With the reestablishment of woody vegetation, the impacts are reduced in time. The simulated spatial patterns of potential erosion on hillslopes shows that steep areas close to the channels supply most of the fine sediment during a flood event. The analysis indicates the potential of distributed

rainfall-runoff-erosion modelling to identify possible space-time impacts of land use changes on flooding and erosion in headwater basins, but also illustrates the calibration and validation problems, and the uncertainties involved in the prediction and scenario interpretation.