Magnitude of sediment transport due to extreme windthrow event in small catchments in the Tatra Mountains

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In the forested mountain areas tree uprooting plays important role among many other geomorphic processes. In some cases, during extreme wind events, large patches of forest may be destroyed, which causes transport of significant amount of sediment.

The aim of this research was to investigate magnitude of sediment transport during one intense windthrow event, which took place on 25 December 2013 in the Tatra Mountains, southern Poland. The research was conducted in three second- to third-order catchments (16-81 ha), in which 34 to 94 percent of their areas were affected by windthrow. This was achieved by combining field measurements and GIS analyses. During field work root plates located within selected research polygons were measured in order to recognize the amount of sediment transported by a single uprooted tree. Then, each root plate located in the investigated catchments was mapped in GIS software using high-resolution (40 mm) orthophoto. Based on this, total volume of sediment displaced by uprooted trees within each catchment was estimated. Next, taking into account directions of tree fall and slope inclination within each uprooted tree, sediment flux by windthrow event in 2013 was calculated.

In total 211 uprooted trees were measured in the field. Mean volume of measured root plates was 1.84 m$^3$. It was assumed that half of that value is accounted for roots of a tree, thus on average 0.92 m$^3$ of sediment was transported by each root plate. Analysis of the orthophoto allowed for identification of 4650 uprooted trees located in the investigated catchments. Most of the trees have fallen in downslope direction. Sediment flux by windthrow event in 2013 calculated for each catchment was 1.0–4.6 × 10$^{-3}$ m$^3$ m$^{-1}$. 