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Close-range photogrammetric measurement of the splash and rill soil erosion

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Soil erosion is a complex degradation process that produces significant geomorphological changes on the Earth's surface. One of the most significant erosion factors is water that impacts on the soil surface in two different but intertwined ways. Firstly, the falling raindrops affect the soil particles with their kinetic energy, which causes the disintegration of soil aggregates or the transfer of soil particles. The second phenomenon occurs after saturation of the soil sample and the formation of a surface runoff. Gravity and running water produces much greater force, leaving behind much more pronounced changes in the soil surface like rills or gully in a bigger scale. These phenomena have been researched and analysed at various scales using close range photogrammetry under natural and artificial rainfall.

Our projects are focused on two different experimental plot areas which vary in scale and associated erosion processes. The small scale experiments are performed on a horizontal circular area of 10 cm in diameter. Only splash erosion – soil particles detached by falling raindrops – is observed and measured with modified Morgan splash cup. Ground sampling distance (GSD) of the DEMs is 0,05 mm. In this resolution can be observed degradation of individual soil aggregates. The larger plots, with a size of 4x1 meters, was positioned in various inclination from 10° to 35° which represent artificial steep slopes occurring during construction works of roads, riversides and other linear structures. In this case, surface runoff and accompanying soil erosion results in apparent changes of the soil surface e.g. rills formation. In addition, some of these plots were covered with protection technologies, e.g., geotextiles, geogrids, geocells and others. One of our goals is also to measure the effectiveness against soil erosion and compare these technologies with each other. GSD in this case is slightly lower, it is 1 mm.

The photogrammetric monitoring (Agisoft PhotoScan was used for the processing) results in sets of digital elevation models (DEMs) before and after experiments. Consequently, digital elevation models of difference (DoDs) were calculated and analysed in ArcGIS to obtain following parameters: mean value, standard deviation, slope and aspect. All these parameters are compared with rainfall parameters and manually measured soil loss and also inclination and soil protection technology in case of the larger scale experiments.

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