Geophysical Research Abstracts
Vol. 14, EGU2012-5284, 2012
EGU General Assembly 2012

Rainfall thresholds for soil supply to stream channel in agricultural catchments

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This work presents rainfall threshold values (EI30 and I30), after exceeding of which splash, slope wash and linear erosion processes occur on agricultural slopes and there is a possibility of soil supply to the stream channel. The study was carried out in the Dworski Potok Stream catchment located in the lowest marginal zone of the Carpathian Foothills.
The Dworski Potok Stream catchment is a small agricultural foothill catchment, situated in a moderate climate zone, with slopes covered with loess-like formations. All those features of the catchment contribute to the establishing of threshold conditions for geomorphic processes, determine of the uniqueness of some of its characteristics and the same time make it typical among other catchments sharing similar geographic environment.
Research into splash, interrill and rill erosion was carried out in hydrological years 2007-2009 on experimental plots that were standardized according to the USLE criterion. The plots (2 mx22.1 m) were situated on a convex-concave slope with northern exposure, 50 m away from the local water divide, close to the meteorological station which collects rainfall data. Measurements were taken after each erosive rainfall. Record was also kept of all rainfalls of high energy. The study makes use of the data recorded for the events which happened in hydrological years 1998-2009. Measurements were taken at cross-section profiles of rills, the area of each profile was worked out, and the total volume of rills and the amount of eroded soil were calculated.
Soil erosion by water becomes most dynamic during potentially erosive rains. Rainfall threshold values (EI30 and I30) are different for particular types of processes; the lowest for splash, higher for slopewash, then for rill erosion, and the highest for ephemeral gully erosion.
During many events part of soil material is transported and locally deposited on slopes, and does not transform the slope morphology in any visible way (the 1st threshold). During some events, the material is only transported from the water divide to the foot of the slope and deposited there (the 2nd threshold). Only during several extreme events is the soil supplied directly to the stream channel (the 3rd threshold).
On the basis of empirical data, the following threshold values EI30 or I30 were established for particular soil supply thresholds from slopes to stream channels:
the 1st threshold EI30 = 40.5 MJmmha^{-1}h^{-1} or I30 = 9.8 mmh^{-1},
the 2nd threshold EI30 = 106.0 MJmmha^{-1}h^{-1} or I30 = 30.0 mmh^{-1},
the 3rd threshold EI30 = 226.8 MJmmha^{-1}h^{-1} or I30 = 35.0 mmh^{-1}.
On the basis of the established threshold values, the potential frequency was established of instances of splash, slopewash and linear erosion as well as of exceeding the 1st, 2nd, and 3rd soil supply threshold during potentially erosive rains in the 23 years of taking rainfall measurements in the Dworski Potok Stream catchment. As a result, it was possible to determine the length of periods of stability and transformation of the slope and the probability of occurrence and exceeding threshold values.