

Assessment of contemporary erosion/sedimentation rates trend within a small well-cultivated catchments using caesium-137 as a chronomarker (on the example of the Republic of Tatarstan, Russia)

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An analysis of sedimentation at a first order valley bottoms allows us to receive a sufficiently reliable quantitative evaluation of soil losses from the catchment area for two time intervals: 1963–1986 and 1987–2015 and its temporal variability. The studied catchment "Temeva River" with total area 1.13 km² is located in the northwestern part of the Republic of Tatarstan (the Myósha river basin). Combination methods and approaches were used for evaluation of sediment redistribution for the both time intervals, including detail geodetic survey of the main morphological units of the valley, large scale geomorphological mapping, cesium-137 technique for the sediment dating in the typical locations of the valley bottom, calculation of soil losses using modified version of USLE and State Hydrological Institute models. In addition available information was collected from the local meteorological stations about some climate characteristics dynamics for the period 1950–2015. Landsat images were applied for evaluation of possible changes of land use. Crop management coefficients were calculated separately for the rainfall season and snow-melt using available data about crop-rotation dynamics for the last 55 years. In the results it was found the significant decrease of average annual soil losses from the cultivated part of the "Temeva River" catchment for the period 1987–2015 if it is compare with period 1963–1986. Such conclusion is mainly based on the different sedimentation rates in the valley bottom: for the period of 1963–1986 the average sedimentation rates were 0.92–1.81 cm per year, while the period of 1987–2015 the rates were 0.17–0.50 cm per year. The main reason for this significant decrease sediment redistribution within the catchment is the reduction of surface runoff caused by climate warming in the region. It is led to the reduction of soils freezing depth and water reserves in a snow cover before the snow-melt, and to the sharp decline in the frequency of extreme (storm) precipitation (>50 mm per a day). The influence of agricultural activity on the erosion and sedimentation changeability was insignificant, although some regional variation of crop rotation including an increase in the proportion of perennial grasses obviously caused the decline in soil losses during warm period of year. The similar trend of erosion/sedimentation rates due to mostly climate changes was identified for south-western sector of the East European Plain, but the more serious reduction of erosion rates is established for the Middle Volga region.

Keywords: erosion, sedimentation, sediment, caesium-137, dry valley, small catchment, cultivated lands, Republic of Tatarstan, East European Plain.