Digital modeling of erosion soil cover patterns development over the last 300 years (Moscow region, Russia)

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Digital modeling of soil erosion has been actively developed in recent decades, including for solving practical problems of agriculture. This paper presents a new approach to mapping the degree of erosion of the soil cover based on a detailed retrospective analysis of the history of land use over the last 300 years.

The study site is located in the Moscow region, characterized by a stage history of plowing. The analysis of the boundaries of arable land was carried out using the digitization of maps for 1797, 1860, 1871, 1931, 1954, 1985, 2000 and 2018 years.

Erosion processes were simulated using the WATEM / SEDEM. LS factor was calculated based on a digital elevation model based on the digitized detail topographic map. Soil erodibility factor was calculated according to the formula [1] based on our own analytical data on soil properties ($K=0.065–0.090 \text{ kg*hmJ^{-1}m^{-1}}$). The rain erosivity factor was taken from the [2]. The crop erosivity factor was taken from regional data, taking into account a detailed analysis of the history of crop rotation.

Soil erosion was calculated for each of 8 periods. Estimated rates were multiplied by the duration of the periods. The soil loss volumes were summarized using the raster calculator. The authors have database of soil surveys at 1567 points. The obtained estimated long-term volumes of soil loss were correlated with the data of a field survey of soils. Based on the obtained dependencies between the calculated soil loss volumes and the field survey data, a map of the erosion soil cover structures was constructed.

In the territory, the volume of soil loss varied from 0.02 tons to 1170 tons. The average volume of soil loss over 300 years was about 63.33 tons. It was revealed that the volume of soil loss is determined not only by the area of arable land, but also by the location and topography of the plowed plots and the composition of crop rotation. The most intense erosion was observed in the first decades after the abolition of serfdom law (after 1860).

Despite the long period of land use, the soil cover of the study area is not very eroded, primarily due to the low erosion potential of the relief. However, the territory is divided into sections, to a different degree, transformed by soil erosion due to plowing of different duration and the
composition of crop rotation.

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