

## Changes of cropland area in the river basins of the European part of Russia for the period 1985-2015, as a factor of soil erosion dynamics

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### Abstract

The work is devoted to the effect of the change of cropland area on the rate of soil erosion in sites of the European part of Russia located in different climatic, landscape and geomorphological conditions. Using the results of visual interpretation of multi-seasonal Landsat-5 and -8 images, the cultivated cropland areas in 9 river basins for two time slices (mid-1980s and the current period 2013-2015) were calculated, and the changes that occurred over 30 years were estimated. Croplands is the dominant category of land use in almost all regions, and it is in the range of 40-65 % in 2015. The decrease of croplands area was revealed in all studied river basins. An assessment of the effect of cropland reduction on the soil loss rate was carried out. Using the SRMM DEM with a 30 m spatial resolution, the following morphometric characteristics of relief for cultivated and abandoned croplands were calculated: steepness of slopes, flow path length, factor LS. Based on the results of calculations, the average values of the factor LS reduced from 1985 to 2015 on the croplands in all considered basins. The obtained data confirm that the reduction of the croplands area is one of the factors responsible for the decrease of modern soil loss rates observed in field studies.

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### Keywords

Cropland, European part of Russia, Landsat, Relief morphometry, Soil loss, SRTM

### References

- [1] Voskresenskii S. S., Leont'ev O. K., Spiridonov A. I., Luk'yanova S. A., Ul'yanova N. S., Anan'ev G. S., Andreeva T. S., Varushchenko S. I., Spasskaya I. I., Geomorfologicheskoe raionirovanie SSSR i prilgayushchikh morei (Geomorphologic zoning of the USSR and adjacent seas), Moscow: Vysshaya shkola, 1980, 343 p.
- [2] Larionov G. A., Eroziya i deflyatsiya pochv: osnovnye zakonomernosti i kolichestvennye otsenki (Erosion and deflation of soils: basic patterns and quantitative estimates), Moscow: Izd-vo MGU, 1993, 200 p.
- [3] Apitz S. E., White S., A conceptual framework for river-basin-scale sediment management, Journal of Soils and Sediments, 2003. Vol. 3, pp. 132-138.
- [4] Baumann M., Kuemmerle T., Elbakidze M., Ozdogan M., Radeloff V. C., Keuler N. S., Prishchepov A. V., Kruhlov I., Hostert P., Patterns and drivers of post-socialist farmland abandonment in Western Ukraine, Land Use Policy, 2011, Vol. 28 (3), pp. 552-562.

- [5] de Vente J., Poesen J., Predicting soil erosion and sediment yield at the basin scale: scale issues and semiquantitative models, *Earth-Science Reviews*, 2005, Vol. 71, pp. 95-125.
- [6] García-Ruiz J. M., The effects of land uses on soil erosion in Spain: A review, *Catena*, 2010, Vol. 81, No. 1, pp. 1-11.
- [7] Golosov V. N., Gennadiyev A. N., Olson K. R., Markelov M. V., Zhidkin A. P., Chendev Y. G., Kovach R. G., Spatial and temporal features of soil erosion in the forest-steppe zone of the East-European Plain, *Eurasian Soil Science*, 2011, Vol. 44, No. 7, pp. 794-801.
- [8] Golosov V., Ivanova N., Kurbanova G., Influence of agricultural development and climate changes on the drainage valley density of the southern half of the Russian Plain, *International Journal of Sediment Research*, 2017, Vol. 32, No. 1, pp. 60-72.
- [9] Hostert P., Kuemmerle T., Prishchepov A. V., Sieber A., Lambin E. F., Radeloff V. C., Rapid land use change after socio-economic disturbances: The collapse of the Soviet Union versus Chernobyl, *Environmental Research Letters*, 2011, Vol. 6(4), p. 045201.
- [10] Lal R., Soil erosion impact on agronomic productivity and environment quality, *Critical Reviews in Plant Sciences*, 1998, Vol. 17, No. 4, pp. 319-464.
- [11] Lal R., Soil erosion and the global carbon budget, *Environment International*, 2003, Vol. 29, P. 437-450.
- [12] Maetens W., Vanmaercke M., Poesen J., Jankauskas B., Jankauskien G., Ionita I., Effects of land use on annual runoff and soil loss in Europe and the Mediterranean: A meta-analysis of plot data, *Progress in Physical Geography*, 2012, Vol. 36, No. 5, pp. 597-651.
- [13] Mitasova H., Hofierka J., Zlocha M., Iverson R. L., Modeling topographic potential for erosion and deposition using GIS, *International Journal of Geographical Information Science*, 1996, Vol. 10, pp. 629-641.
- [14] Morgan R. P.C., *Soil Erosion and Conservation*, Oxford: Blackwell Publishing, 2005, 304 p.
- [15] Moore I. D., Grayson R. B., Ladson A. R., Digital terrain modelling: a review of hydrological, geomorphological, and biological applications, *Hydrological Processes*, 1991, Vol. 5, No. 1, pp. 3-30.
- [16] Olson K. R., Al-Kaisi M. A., Lal R., Cihacek L. J., Impact of Soil Erosion on Soil Organic Carbon Stocks, *Journal of Soil and Water Conservation*, 2016, Vol. 71, pp. 61-67.
- [17] Prishchepov A. V., Radeloff V. C., Baumann M., Kuemmerle T., Müller D., Effects of institutional changes on land use: agricultural land abandonment during the transition from state-command to market-driven economies in post-Soviet Eastern Europe, *Environmental Research Letters*, 2012, Vol. 7, p. 024021.
- [18] Prishchepov A. V., Müller D., Dubinin M., Baumann M., Radeloff V. C., Determinants of agricultural land abandonment in post-Soviet European Russia, *Land use policy*, 2013, Vol. 30 (1), pp. 873-884.
- [19] Prishchepov A. V., Müller D., Baumann M., Kuemmerle T., Alcantara C., Radeloff V. C., Underlying Drivers and Spatial Determinants of post-Soviet Agricultural Land Abandonment in Temperate Eastern Europe, *Land-Cover and Land-Use Changes in Eastern Europe after the Collapse of the Soviet Union in 1991*, 2016, pp. 91-117.
- [20] Quinton J. N., Govers G., Van Oost K., Bardgett R. D., The impact of agricultural soil erosion on biogeochemical cycling, *Nature Geoscience*, 2010, Vol. 3, pp. 311-314.
- [21] Van Oost K., Govers G., Desmet P. J.J., Evaluating the effects of changes in landscape structure on soil erosion by water and tillage, *Landscape Ecology*, 2000, Vol. 15, pp. 579-591.
- [22] Van Oost K., Quine T. A., Govers G., De Gryze S., Six J., Harden J. W., Ritchie J. C., Carty G. W., Heckrath G., Kosmas G., Giraldez J. V., Marques da Silva J. R., Merckx R., The impact of agricultural soil erosion on the global carbon cycle, *Science*, 2007, Vol. 318, pp. 626-629.
- [23] Walling D. E., Linking land use, erosion and sediment yields in river basins, *Hydrobiologia*, 1999, Vol. 410, pp. 223-240.