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Anomalous Manifestation of Erosion and Suspended Sediment Yield on the East of Russian Plain.

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ABSTRACT

On the basis of observation of differences in the amounts of annual sediment yield there are shown its anomalous manifestation. Anomalies are classified as small, large, and extreme. The main factors of anomalous manifestation oferosion and suspended sediment yield in 16 river basins of the east of Russian plain are determined. The expression of positive anomalies of erosion and sediment yield is so much the larger, the lesser the basin, the more southward the zone is situated, and the more intensively the landscape is an-thropogenized. And vice versa, the expression of negative anomalies increases northward with less intensive cultivation and larger catchment basin areas.

Keywords: erosion, suspended sediment yield, temporal changeability, anomaly, extreme, Russian plain.

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INTRODUCTION

The overall intensity of erosion and sediment yield depends to a great extent on their temporal changeability and anomalous manifestation related to changeability [1]. The term "anomaly" is widely used in natural sciences. As a rule, it mean deviation of any values from typical ones.

Data

The initial material for this work were the data from hydrological post on the annual suspended sediment yield in 16 river basins of forest, forest-steppe, steppe and semi-desert zone of the east of Russian plain.

METHOD

In the present paper, the anomalies are distinguished on the basis of the extent of deviation of the value of the suspended sediment yield from the norm. The most acceptable index of deviation is the probability of manifestation of various values of sediment yield. This index is directly related to absolute deviations of values from the norm. There appears an opportunity to estimate series of observations in various points from the common position. The proposed classification of anomalous values of erosion is based on the probability of their manifestation. The annual values of sediment yield with provision of < 3% are referred to position extremes, the ones with provision of 3-6% - to large anomalies, the ones with provision of 6-15% - to small anomalies; negative extremes have provision of > 97%, large anomalies - 97-94%, small anomalies - 94-85%. The values of sediment yield with provision from 15% to 85% are considered to be normal [2].

The role of anomalous manifestation in the overall process of erosion was determined by the abnormality coefficient, which was calculated as the ratio of material, yield during anomalous years to the sum of sediments for the whole period of observation, both for individual types of anomalies, and for all three subdivision taken together.

The expression of anomalous erosion is determined by the influence of natural and anthropogenic factors. Climate and water runoff are referred to natural zonal factor, which determine the expression of anomalous manifestation of erosion and sediment yield. Human economical (and first of all agricultural) activities, and, as a consequence, the degree of anthropogenic impact onto the natural landscape also have a zonal character [3, 4].

RESULTS

The annual amounts of atmospheric precipitation and water runoff regularly decrease from the north to the south, from the taiga to semi-desert and desert. However in the same Direction and with the same regularity the unevenness of atmospheric precipitation increases, the uneven-ness of water runoff increases to a greater extent and the unevenness of erosion increases to an even greater extent, and, consequently the unevenness of suspended sediment yield increases.

The maximum annual suspended sediment yield exceeds the minimum one 10 times in the forest zone and 946 times in the semi-desert, i.e. almost 100 times larger than in the forest zone. As for the normal-ized index (i.e. the ratio of the maximum annual value to the norm), the variation of water runoff in the semi-desert is twice larger than in the forest zone, and the variation of suspended sediment yield in the semi-desert is almost 3 times larger than in the forest zone. Coefficient of variation of water runoff and sediment yield increased almost 3 times from the forest zone to the semi-desert, the variability of sediment yield in each zone being twice as large as the variability of water runoff [5].

In connection with the fast increase of the unevenness of sediment yield southward, the relative role of its positive annual anomalies in the overall suspended sediment yield, estimated by the abnormality coefficient, also increases. If in the forest zone all positive anomalies, which have the summary provision of 15%, from only fifth of the overall sediment yield, in semi-deserts they form about a half . The role of negative anomalies with provision of 85-100% in the same direction regularly decreases from 9.2 in the forest zone to 1.0 in the semi-desert. As the aridity of the climate increases, the role of the "normal" erosion, which is

estimated by the annual values of sediment yield with provision of 15-85%, decreases. The "normal" sediment yield in the south taiga reaches 80-67%, and in the semi-desert it decreases to 44-53%.

These data allow one to draw a general conclusion: the more arid the climate is, the larger role in the erosion development of relief belongs to its positive anomalous manifestations, and the lesser role belongs to negative and normal ones.

The expression of anomalous manifestation of sediment yield also depends on azonal factors. The influence of rock composition and dependent on it mechanical constituents of soil is significant, therewith the degree of water permeability of rocks and soils being of great importance, too. All other conditions being equal, erosion in basins consisting of water-permeable rocks is less significant than in basins consisting of rocks and soils with lower water permeability [6, 7].

The influence of the anthropogenic factor and basin area on the anomalous erosion is significant. This study have shown that the larger cultivation of basins and the lesser their area, the larger the un-evenness of erosion and sediment yield.

On the whole, one can claim that the expression of positive anomalies of erosion and sediment yield is so mush the larger, the more southward the basin is situated, the more intensively the landscape is affected by human activities, and the lesser the basin is. And vice versa, the expression of negative anomalies increased northward with less intensive cultivation and larger catchment basin areas. In the same direction there also changes normal erosion, which provides about 75% of suspended sediments in the forest zone and only a half in the semi-desert.

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