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Water Erosion Monitoring On The Territory Of Agrolandscapes Stavropol Territory By Remote Methods.

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ABSTRACT

Article presents the results of monitoring of water erosion, which was conducted in 2015 on the territory of agrolandscapes Stavropol Territory using the methods of remote sensing of the Earth and geo-information technologies.
Keywords: water erosion, agrolandscape, Stavropol Territory, remote sensing methods, geo-information technologies, digital elevation model.

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INTRODUCTION

In the Stavropol Territory, the land area is 6,616 thousand hectares, of which 92.3% is agricultural land, which is represented by a complex and diverse landscape structure. In total, there are 24 landscapes in the province belonging to different provincial groups: forest-steppe, steppe, semi-desert, foothill and mid-mountain landscapes. The soil cover is represented by two zones: chestnut and chernozem. Climatic conditions in the region are not uniform, they vary from extremely dry with an annual rainfall of 387 mm, to unstable wet weather - 665 mm [1, 2, 3].

Currently, the problem of land degradation in the world is one of the most acute and requires close attention. The territory of the Stavropol Territory is characterized by a high degree of agricultural development, which, due to the extremely heterogeneous soil and climatic conditions, causes a change in the state of land resources [4, 5, 6, 7, 8].

The following types of soil cover degradation are most common in the region: salinization, water erosion, alkalinity, deflation, waterlogging, rockiness, waterlogging [9, 10].

Currently there are global climate changes that have their own regional characteristics. So in the Stavropol kraeza for the last 58 years, significant changes in mean annual air temperature (+ 1.1 °C) and annual precipitation (+40 mm) have been revealed. An increase in the frequency of precipitation of rainfall in the period of May-June is observed, which contributes to the development of water erosion processes due to the formation of intensive surface runoff [1].

The regime of runoff depends on the amount of precipitation, the shape of the relief, the structure of the soil and its infiltration abilities, vegetation cover, the nature of land use and other factors. The effects of water erosion may vary. In areas with a small steepness of the slopes, a plane washout of the upper part of the humus horizon occurs, and with an increase in the steepness of the slope, scours, ravines and beams are formed, which with a high degree of accuracy are decoded on satellite images. It is customary to distinguish between two stages in the development of linear forms of erosion in the aspect of remote diagnostics of linear erosion processes: gully or pothole; ravine and ravine [11].

MATERIAL AND METHODS

To analyze the development of water erosion processes on the territory of agricultural landscapes requires the creation of an extensive base of spatial and thematic information. Effectively, this task can be solved by geographic information systems (GIS) and Earth remote sensing data obtained from modern spacecraft [12].

In connection with the active introduction of remote sensing techniques based on recording and analyzing the reflectivity of objects, it is possible to monitor areas of significant size and get an objective view of the current state of soil cover [13, 14, 15, 16, 17].

At present, a large number of satellites are present, which conduct continuous monitoring of the state of land resources. Data from American satellites Digital Globe, such as: QuickBird, WorldView 1-3, GeoEye, Ikonos, were used to effectively identify and analyze water erosion processes. Their total survey performance is 3 million km^2 / day. These satellites belong to the commercial class and allow you to receive images with a resolution of 0.31 - 4 m / pixel, while covering a wide spectral range from visible to infrared radiation. In the work were used archived space images of 2015. on the territory of the Stavropol Territory.

According to the data of space imagery, linear manifestations of water erosion can be detected most effectively when there are no crops in the fields. The decoding of arable land borders and erosion processes was carried out on the basis of direct interpretation signs.

RESULTS AND DISCUSSION

At the initial stage of the research, the area of agrolandscapes in the region was specified according to the 2015 space imagery data. it amounted to 4074.2 thousand hectares, which is 332.2 thousand hectares more than official statistics. The difference in arable land indicates the obsolete statistical data or the facts of illegal plowing of sloping lands that were used as hayfields and pastures.

As a result of the decryption of images, it was found that the total length of erosion processes throughout the study area is 25,209 km, while 94% of erosion processes belong to the class of ravines and burrs, the remaining 6% have already passed into the ravine and gully stage and were removed from agricultural production.

Due to the capabilities of modern GIS technologies, the arable land area was estimated with different stages of linear water erosion processes, it was found that 47% of arable land or 1931 thousand hectares in this region is subject to this type of degradation.

With the help of radar data (SRTM), a digital model of the Stavropol Territory relief was obtained, on the basis of which the morphometric characteristics of agricultural landscapes were analyzed in order to identify factors influencing the development of linear water erosion processes [2, 3, 8]. It is established that a slope of less than 1 ° has 78% of the territory of agrolandscapes, 1-3 ° - 21% and the most erosion-dangerous slope of more than 3 ° is found only in 1% of the territory. An analysis of the exposition of the slopes of agrolandscapes showed that the southern exposure is dominated by the southern exposure - 49%, the western exposure is found on 38% of the territory, the northern - 10% and the eastern - 3%.

Spatial overlay of the identified processes of linear water erosion and morphometric characteristics of the territory did not allow to unequivocally establish their separate influence on the development of erosion processes, which is probably due to the presence of erosion-resistant framework in the form of forest belts in the Stavropol Territory.

The conducted multivariate analysis allowed to establish the cumulative negative impact on the development of linear water erosion processes of such factors as: slope of the area (more than 1 °), southern exposure of the slope and chestnut soils as the most susceptible to this type of degradation.

The existing anti-erosion carcass of forest belts in the Stavropol Territory every year loses its effectiveness due to their natural death or human economic activity.

Based on a digital terrain model using geo-information technologies, watercourses were modeled in the study area. As a result of the imposition, the resulting model and the identified erosion processes, their coincidence was established in individual areas, which indicates their high degree of erosion hazard, a total of 382,326 hectares of such territories were identified. In these territories, the existing anti-erosion carcass is either completely destroyed or ineffective. In this regard, it is necessary to conduct an inventory of forest shelterbelts to assess their effectiveness and develop measures for anti-erosion arrangement of the territory.

Different types of degradation in varying degrees reduce the productivity of crops of agricultural crops. Salinity and alkalinity decrease by 55% to the greatest extent, water erosion - 19%, deflation - 13%, waterlogging - 6%.

It has been established that water erosion as a whole on the edge by 2026 can lead to a loss of 700 thousand tons of grain, the main crop in the region, winter wheat.

CONCLUSION

Modern technologies, such as space imagery and GIS technologies, allow for the efficient and effective detection and analysis of erosion-hazardous ones. The combination of high-resolution remote sensing and medium-resolution data has shown maximum efficiency for analyzing the development of linear water erosion processes. The development of a comprehensive program of erosion control measures will save up to 10% of the future crop in the Stavropol Territory.

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