CLIMATIC FACTORS AFFECTING THE RECLAMATION OF DISTURBED LANDS IN THE AREA OF THE KMA DEVELOPMENT

PETINA M.A., PETIN A.N., LEBEDEVA M.G., TOLSTOPYATOVA O.S.
Belgorod State National Research University, Russia

Abstract

The water and wind erosion is the most significant factor of land degradation taking into account natural factors, the actual occurrence and natural-economic significance of the effects. The conditions for the deformation of technogenic slopes during spring snowmelt are adverse, and the threat of the erosion process on the overburden dumps at the beginning of the XXI century in the spring is not expressed. The conditions for the development of water erosion in the spring are prolonged. climatic changes occurring during the summer period reduce the risk of water erosion of technogenic landscapes soils, but increase the risk of wind erosion on the loose rocks not occupied by vegetation.

Keywords

Technogenic landforms, water erosion, surface runoff, wind erosion, climate change

1 Introduction

The Belgorod region is the unique Russian district due to its mineral resources. About 400 deposits of mineral resources: iron ore, bauxite, apatite have been identified and explored here. On the basis of these deposits the mining industry is widely developed in the region. Long-term extraction of iron ore in the mining districts of KMA led to the complicated environmental situation caused by the technogenic transformation of natural landscapes with the quarry-dump complex formation, which is characterized by widespread natural and natural-technogenic forms of relief [1,2,3].

The substantiation of the anthropogenic landscapes reclamation necessity of the GOKs, taking into account the climatic factors that affect the deformation of the technogenic slopes is one of the main objectives of this research. Evaluation of erosion hazards of soils and lands is necessary to predict their possible degradation and also for working out the preventing measures of the erosion [4].

2. The explanation

The technogenic landforms as well as natural morphological structures are transformed under the influence of gravitational and climatic factors. The formation of technogenic landforms is connected with erosion, accumulative, suffusion, landslides and other processes. They are especially apparent during the early stages of technogenic relief formation, when the surface of the dump is not fixed by the vegetation cover yet.

The water and wind erosion is the most significant factor of land degradation taking into account natural factors, the actual occurrence and natural-economic significance of the effects. It is possible to distinguish natural (in the framework of the big geological circulation) and anthropogenic erosion. The economic activity often does not prevent, but enhances and exacerbates the negative natural processes.

Erosion is a destruction of soil cover under the influence of surface runoff and wind, with subsequent displacement and redeposition of soil material. In extreme cases the erosion processes lead to the formation of remnant relief of completely destroyed lands [5].

Water erosion is divided into planar, leading to soil washout and linear, which resulted in the formation of various forms of erosion: gullies, ruts, generating deep ravines. Water erosion on reclaimed dumps is the dominant process, and it is presented by planar runoff and linear erosion.

On the slopes of southern expositions vegetation is sparse, the soil structure is worse than in the North. Therefore, soil erosion is more developed on the slopes of the southern exposures than on the northern slopes.

Water erosion is called surface runoff, therefore, the most important climatic factors determining the erosion danger of the lands, are summer rainfall, as well as the regimes of snow deposition and snowmelt in the spring.

Drain of snowmelt and rain water increases with the magnification of steepness and length of slope. The washout of soil increases much faster than magnification of steepness or the length of slope, especially in case of their simultaneous increasing. Therefore, the characteristic of the land along the length of the drain is of great importance. The intensity of soil loss from runoff of melt water depends on the freezing depth of soil. Furthermore, the soil freezing disrupts the infiltration of water in it and increases runoff and with consequently erosion. During thawing of the top soil it fills up with water and slips on the underlying frozen layers.

As a result of climate change [5], in recent years the freezing of the soil during the winter period was reduced by half and becomes more unstable due to the repeated thaws (Fig.1).

The amount of precipitation for the cold period (Fig.2) increases, but during the observed climate warming in winter precipitation falls as in solid so in liquid phase. The snow periodically melts, the moisture goes into the top of soil layer and it reduces. Due to the unstable temperature in winter, maximum reserves of water in snow decreases as well (Fig.3). The conditions for the development of water erosion in the spring are prolonged.

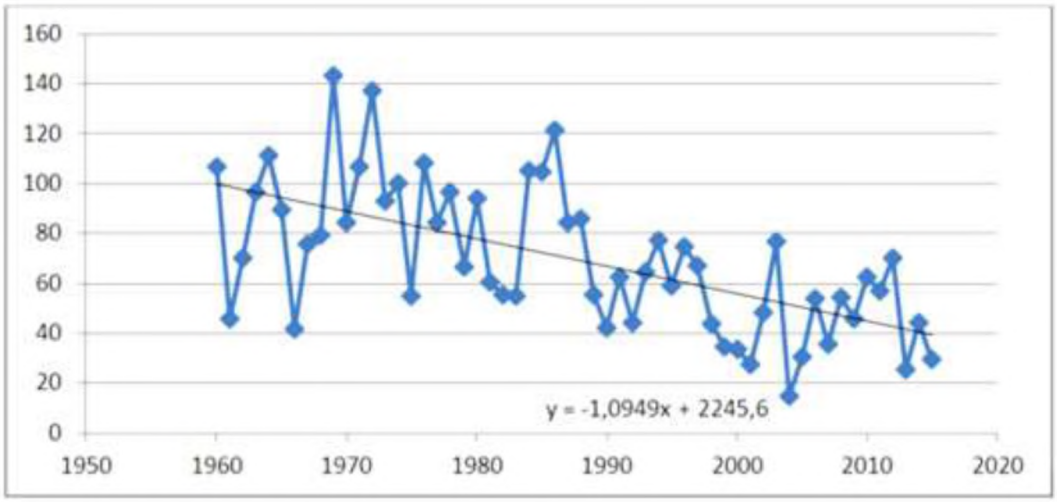

Fig.1: Average regional maximum depth of soil freezing

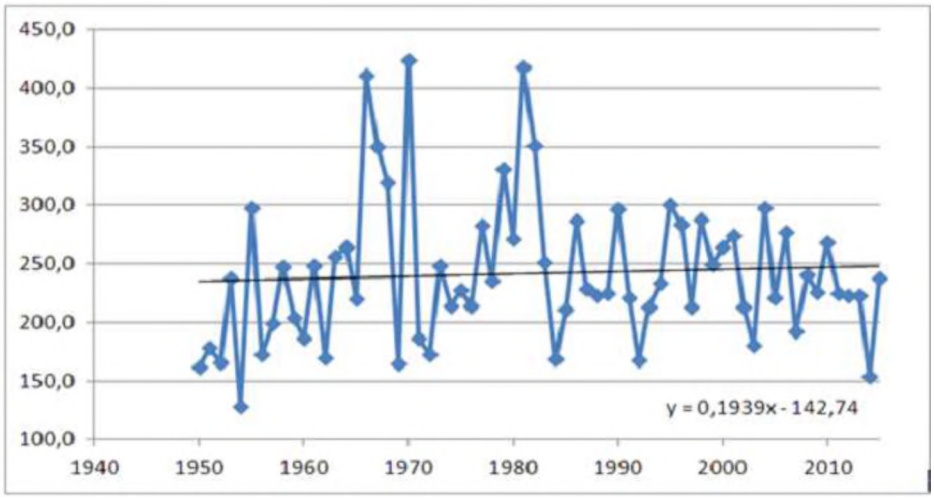

Fig.2: Average regional rainfall during the cold period, mm

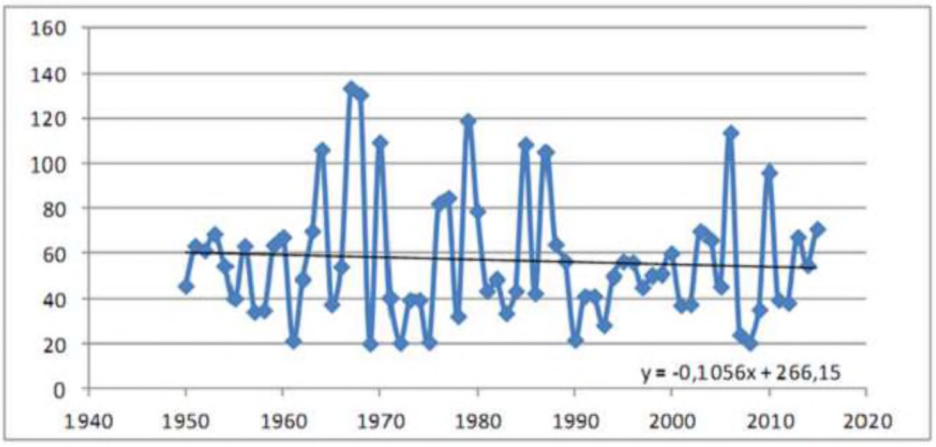

Fig. 3: Average regional maximum amount of moisture in the snow, mm

Thus, the conditions for the deformation of technogenic slopes during spring snowmelt are adverse, and the threat of the erosion process on the overburden dumps at the beginning of the XXI century in the spring is not expressed.

In the warm season storm water runoff just occurs when the soil does not have time to absorb water during prolonged intensive rainfall. The erosion can appear during the rains with the layer of more than 10 mm and high intensity, especially in case of rain over the waterlogged ground. Increased erosion during intensive rainfall is also associated with the increasing the size of rain drops that destroy faster lumps of soil and compact it and reduce the absorption.

In recent years, the climatic characteristics of maximum daily rainfall in areas of the KMA development according to the Roshydromet observation data did not changed and therefore the role of heavy rains in the development of erosion remains constant [7,8].

The conditions for the development of wind erosion gave been changed. Wind erosion is total or partial destruction of topsoil by the wind. Sometimes this process is called deflation of soil - blowing air flow of the soil aggregates and mechanical elements of the soil surface.

The degree of wind erosion rising depends mainly on wind speed and the mechanical composition of the rocks. The processes of deflation on loose rocks – sands and sand-chalk mixture are characterized

by the greatest intensity, and the lowest intensity is characteristic for more dense rocks – chalk and middle and heavy loam [9].

Wind erosion causes: blowing, dispelling of soils, blowing in fine-disperse breeds on soils. Wind erosion of loose soils may occur at any time of the year and if any force of the wind. It is the most dangerous in the spring when the force of the wind is more than 15 m/s when the soil is loosened and there are no grown crops. The soil of arid areas particularly are exposed by wind erosion [10,11].

The peculiarities of atmospheric circulation in the early 21st century in the region [12, 13] have led to increasing aridity of the territory (Tab. 1) and also to the increase of the average maximum air temperatures characteristics for the period of May-September 0.40 C.

Table 1: The frequency of occurrence continuous duration of periods without rain (days) in April – September

The number of days without precipitation	**1901-1930**	**1931 -1960**	**1961-1990**	**1971-2000**	**1981-2010**
5-10	203	192	169	168	171
11-20	98	93	102	100	104
21-30	24	33	35	39	40
31-40	10	5	6	7	7
more 40	3	7	5	2	2
Total	338	330	317	316	324

The increase of the climate aridity in the warm season was observed. Long periods of dry hot weather are replaced by a short storm water precipitation. The conditions of the atmospheric circulation in the early 21st century have led to variability characteristics of the wind regime. The average wind speed in the region has decreased (2.6 m/s) at present in comparison with a hundred years norm (3.1 m/s). But the number of days with strong winds (over 15 m/s) increased 1.5 times. The average number of days with strong winds in the period may-September [7] it has been 3 days currently to 4.5 [8].

3 Conclusions

Thus, the climatic changes occurring during the summer period reduce the risk of water erosion of technogenic landscapes soils, but increase the risk of wind erosion on the loose rocks not occupied by vegetation. The conditions for the deformation of technogenic slopes during spring snowmelt are adverse, and the threat of the erosion process on the overburden dumps at the beginning of the XXI century in the spring is not expressed.

References

[1] Petin A. N., Chandev J. G., Schultz E. Typification of quarry-dump complexes of the Kursk magnetic anomaly in the landscape-geochemical structure // Izvesiya of the Russian Academy of Sciences. Geographical series. 2010. No. 4. Pp. 63-67.

[2] Tokhtar V. K., Martynova N. A., Kornilov A. G., Petin A. N. Experience of the of effective methods of biological reclamation development on the GOKs waste dumps in the South of Central Russian upland // Problems of regional ecology. 2012. No. 2. Pp. 83-86.

[3] Belgorod oblast: Natural resources – 2015 [Electronic resource]. – URL (http://www.ru.all.biz/regions/?fuseaction=adm_oda.showSection&rgn_id=31&sc_id=7)

[4] Rozhkov V. A. Assessment of erosion hazard of soils// Bulletin of the Institute of soil after V. V. Dokuchaev.2007. - Pp. 77-91

[5] Surmach G. P. Relationbetween, the formation of forest-steppe, contemporary erosion and anti-erosion measures. Volgograd, 1992 - 1785 p..

[6] Alexander N. Petin, Maria A. Petina, Maria G. Lebedeva , Yuliya I. Dokalova. Extreme flood situations on the rivers of the Belgorod region. Research Journal of Pharmaceutical, Biological and Chemical Sciences: ISSN: 0975 - 8585, November – December 2015 RJPBCS 6(6) Pages No. 1787-1792 (http://www.rjpbcs.com/2015_6.6.html)

[7] Scientific-applied reference book of the USSR climate. Ser.3. Long-term data. Part 1-6. Vol. 28. Leningrad: Gidrometeoizdat. – 1990. - 366 p.

[8] Applied science reference book "CLIMATE of RUSSIA" [Electronic resource]. – URL (http://meteo.ru/pogoda-i-klimat/197-nauchno-prikladnoj-spravochnik-klimat-rossii)

[9] Malinina Tatiana, Dyukov Anatoly. Erosion control and sanitary-hygienic role of forest plantations with biological reclamation of technogenic landscapes of Kursk magnetic anomaly // Izvestiya of Samara scientific center of RAS . 2012. No. 1-8. URL: (http://cyberleninka.ru/article/n/protivoerozionnaya-i-sanitarno-gigienicheskaya-rol-lesnyh-nasazhdeniy-pri-biologicheskoy-rekultivatsii-tehnogennyh-landshaftov) (reference date: 11.04.2016)

[10] Ecology. Handbook [Electronic resource]. – URL (http://ru-ecology.info/term/1902/)

[11] Kornilov. A. G., Petin A. N., Sergeev S. V., Yu. Pogorelov and others.. Geoecological problems of optimization and bioremediation of overburden iron ore dumps / under the editorship of A. G. Kornilov. – Belgorod: publishing house „Belgorod NIU „Belgu“, 2013. – 124 p.

[12] Petin A.N.,Lebedeva M.G..,Krymskaya O. V.,Chendev Y.G.,Kornilov A.G., Lupo A.R Regional Manifestations of Changes In Atmospheric Circulation in Central Black Earth Region (By the Example of Belgorod Region) Advances in Enviromental Biology, 8(10), June 2014, Pp. 544-547

[13] Kornilov A. G., Kichigin E.V., Kolmykov S. N., Novykh L. L., Drozdova E. A., Petin A. N. and others Environmental situation in the areas of mining enterprises of the region of the Kursk Magnetic Anomaly– Belgorod: publishing house „Belgorod NIU „Belgu“, 2015. – 157 p.

Aknowledgement

The research was supported by the RFBR Grant No. 16-35-00422 “Assessment of technogenic transformation of landscapes in the zone of active development of the KMA mineral deposits influence”