

HYDRO-ECOLOGICAL CHARACTERISTICS OF THE TRANSBOUNDARY RIVERS OF THE BELGOROD REGION IN CONDITIONS OF EXTREME ANTHROPOGENIC LOAD AND CLIMATE CHANGE

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Russia and Ukraine have a lot of shared water currents, using of which involves the search for common solutions for the conservation of natural ecosystems, able to perform their ecological functions in the region and to provide ecological safety. For the rivers of the Belgorod region this is especially actual, because of their low water level. Almost all the water currents of the region can be referred to the small rivers. The only exceptions are the rivers: Tykhaya Sosna, Seversky Donets, Oskol, Vorskla.

Rivers of the Belgorod region are primarily used for agricultural water supply, recreational purposes, as well as the receivers of industrial and municipal sewage. Main rivers of the region are transboundary and are used as water supply sources on the territory of Ukraine. Currently, in the connection with an increasing anthropogenic load on catchments area basins and directly of the rivers themselves, climate change, particularly close attention to the quality of river water is paid.

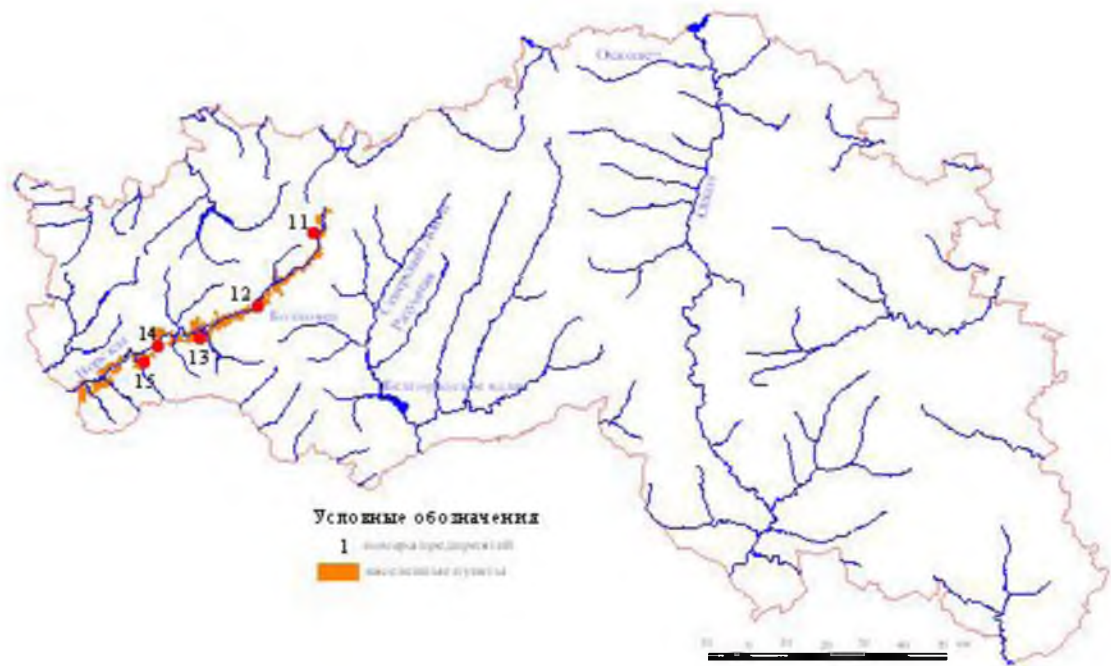
In this article the interannual variability of hydro-ecological mode of transboundary rivers Seversky Donets, Oskol, Vorskla is considered.

The Seversky Donets river – the inflow of the I order of the Don river and has its rises in Podolje village in the Prokhorovskiy district of the Belgorod region. The catchment area within the region - 5540 km², the length - 100,5 km

The Oskol river – the inflow of the II order of the Don river. The source of the river is located in the outskirts of the Pogozhee village in the Tymscy district of the Kursk region. The catchment area within the Belgorod region - 8490 km², the length - 205 km

The Vorskla River – the inflow of the I order of the Dnepr river. The sources of it are located in the South-Eastern part of the Rozhdestvenskoe village in the Ivnya district of the Belgorod region. The catchment area within the Belgorod region - 2001 km², the length is 114 km [1].

To assess the quality of the surface waters of transboundary rivers of the Belgorod region the data of observations over hydrological posts Kiselevo (Seversky Donets river), Razdolye (Oskol river), Kozinka (Vorskla river) and hydrochemical river targets of the Belgorod center for Hydrometeorology and environmental monitoring for the observation period of 2008-2012 were used (Fig. 1).



11 - Yakovlevsky Rudnik branch of LC «Metal groups», 12 - JSC «Tomarovskiy meat-packing plant», 13 - MUE «Borisovodokanal», 14 - OGUZ Sanatorium «Krasivo», 15 - JSC «Sugar factory Bolshhevik»

Fig. 1: Schematic map of distribution of the main sources of anthropogenic load

In the assessment of river water quality it should be noted a general trend of river runoff reduction. Over the past five years, the average water content of the rivers was below the norm: Seversky Donets on 20-44 %, Oskol on 11-22 %. The water content of the river Vorskla for the same period was higher than the norm in 2008 on 12 %, and it was below the norm on 19-32 % in 2009-2012 (table. 1). The reason for the rivers runoff reduction is low, ill-defined floods, as the annual average water content of the rivers of our region depends on the duration of spring floods and values of water consumption during this period. In high-water years the flow of spring floods is 70-80 % of the annual runoff, in average water years - 60-70 %, and in shallow water years - 50-60 %. From table 1 it is seen a steady decline of the average longstanding water discharge for all given hydrological posts.

Table 1: «Sliding» average longstanding water discharge, m³/s

River-post	Period from the beginning of observations to:				
	2008 y.	2009 y.	2010 y.	2011 y.	2012 y.
Seversky Donets river – v. Kiselevo	2,58	2,56	2,54	2,52	2,50
Oskol river - v. Razdolye	28,5	28,4	28,3	28,2	28,2
Vorskla river - v. Kozinka	5,86	5,85	5,83	5,81	5,78

When analyzing changes in precipitation over the last 15 years the change in distribution of precipitation on the territory of the region is traced: in the North, rainfall has not changed and amounts 575 mm, in the South-West it decreased from 553 mm to 517 mm, and in the South-East of the territory it increased from 536 572 mm to mm Clear that water availability reducing in our region is connected with the growing economic activity. Every year the

withdrawal of water from underground sources is increasing (table 2), as the result - the rivers are not adequately supported of soil nutrition [5].

Table 2: Water withdrawal, million. m³

year	2008	2009	2010	2011	2012
The Don Basin:					
underground	256,90	260,29	266,50	266,09	284,98
surface	37,86	30,38	30,24	31,70	33,70
The Dnepr Basin:					
underground	19,11	20,36	20,40	20,22	21,33
surface	9,50	2,26	2,02	2,67	2,95

The main sources of pollutants into water basins of the Seversky Donets, Oskol and Vorskla are enterprises of housing and communal sector, metallurgical, agricultural and other industries (table. 3)[6].

Table 3: Water discharge into surface watercourses, million. m³

year	2008	2009	2010	2011	2012
The Don Basin	126,15	125,78	124,11	119,86	139,05
The Dnepr Basin:	11,62	4,28	5,0	4,24	3,34

The content in the rivers of manganese, copper and iron is the influence of natural origin, phosphate (P), phenols and BOD by presence of bottom sediments and low water levels. For the entire study period studied rivers are characterized by a high content of suspended solids from 4 to 14 MPC.

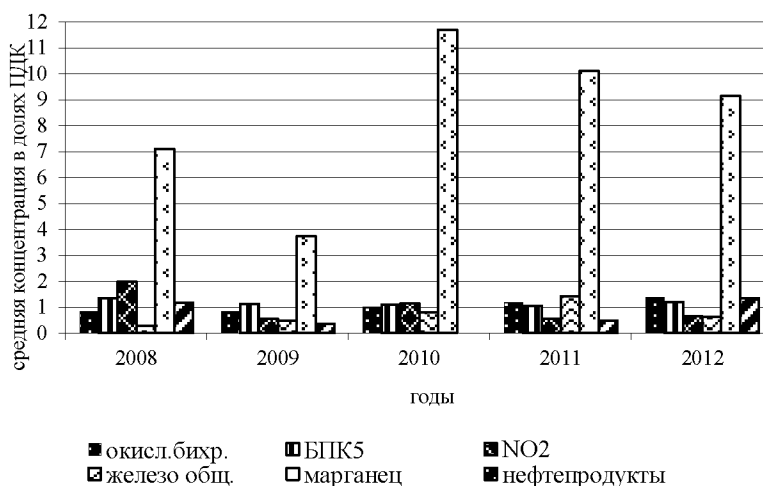


Fig. 2: The change of surface water quality the Seversky Donets river - v. Belomestnoe

Factors affecting the ecological state of Seversky Donets river: natural origin - manganese, iron general, copper and anthropogenic - nitrites, phosphates.

On the target Seversky Donets river - v. Belomestnoe critical pollution index is recognized as manganese, its annual average concentration was observed in the range from 3.7 MPC in 2009 to 11.7 MPC in 2010, for other pollutants do not exceed 2-4 MAC. The offences by easily and hard oxidized organic compounds were fixed. In 2011, the water quality has

deteriorated, the number of polluting indicators increased from 7 to 9 of 13 considered. In 2012 the number of polluting indicators was 9 of 15 considering in integrated assessment [7].

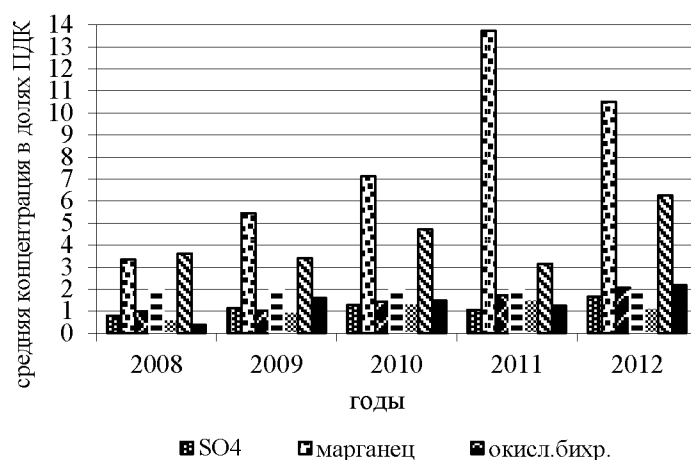


Fig. 3: The change of surface water quality: the Seversky Donets river - 21 km below Belgorod

On the target Seversky Donets river - 21 km below Belgorod steady pollution of manganese and nitrogen nitrite is registered, average annual concentrations of manganese exceeded during the observed period from 3.3 to 13.7 MPC, nitrite nitrogen - from 3.1 to 6.2 MAC. In each water sample the violation of the regulations by easily oxidizable organic substances according to BOD5, reaching 2 MAC was observed. Beginning from 2009 the pollution by phosphates is registered - by 2012, the average annual concentration has increased to 2.2 MAC. In 2011, the water quality has deteriorated, the amount of pollutants increased from 9 to 11 of 16 taken into account in the integrated assessment. The reason for this was the wastewater discharge by the municipal unitary enterprise «Gorvodokanal», Belgorod. In 2012, the quality of water in the reservoir has improved the amount of pollutants - 10 of 16 accounting in the integrated assessment.

Table 4: Change in water quality on the targets of the Seversky Donets river

year	v. Belomestnoe, 1004 km from the mouth		21 km below Belgorod , km from the mouth	
	SCIWP	Quality class	SCIWP	Quality class
2008	3,13	3б	3,88	4a
2009	2,76	3a	3,52	3б
2010	2,62	3a	3,74	4a
2011	3,11	3б	4,89	4б
2012	2,88	3б	4,33	4a

On the target Seversky Donets river – v. Belomestnoe water in most cases is characterized as «very polluted», 3rd class, category «b», SCIWP varies with 3,11 in 2011 to 2.88 in 2012

On the target Seversky Donets river - 21 km below Belgorod quality class basically corresponds to the 4th class, category «a», «dirty». SCIWP is observed in the range from 3,52 (2009) to 4,89 (2011).

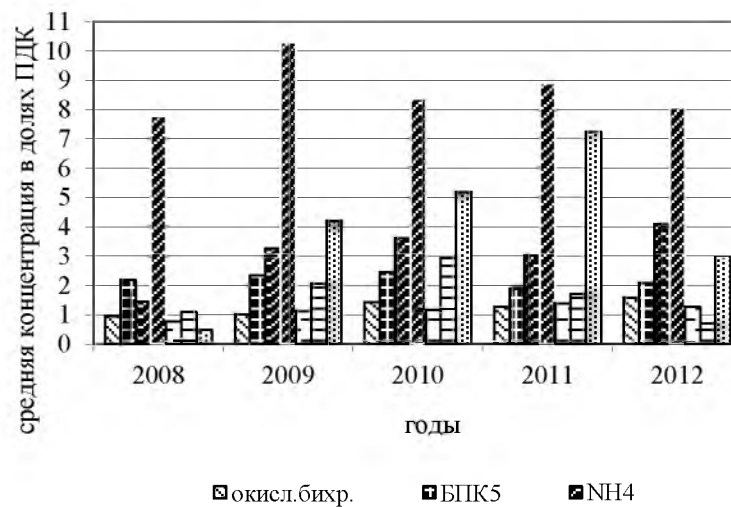


Fig.4: The change of surface water quality on the Oskol river – 25 km below Sary Oskol

On the quality of water of the Oskol river impact as factors of natural descent: copper, total iron and manganese so technogenic: in the river Oskol, crossing the region in 7 districts, iron ore cities - Gubkin and Sary Oskol discharge sewage and further downstream the Valuyki town [8].

Average annual concentrations of major pollutants have reached the compounds of manganese 7,2 MPC, nitrite nitrogen 7,8-10,3 MPC, nitrogen ammonium 1,4-4,1 MAC, BOD5 1.9 to 2.5 MPC, copper compounds 1,1-2,9 MAC. For other pollutants, the annual concentrations reached 1-2 MAC. In 2012 from 16 ingredients, taken into account when calculating complex indices 8 recognized as polluting. 4-5 MAC reached the maximum concentrations of phosphates, copper and iron General, 2 MAC - prone organic substances according to COD and petroleum products.

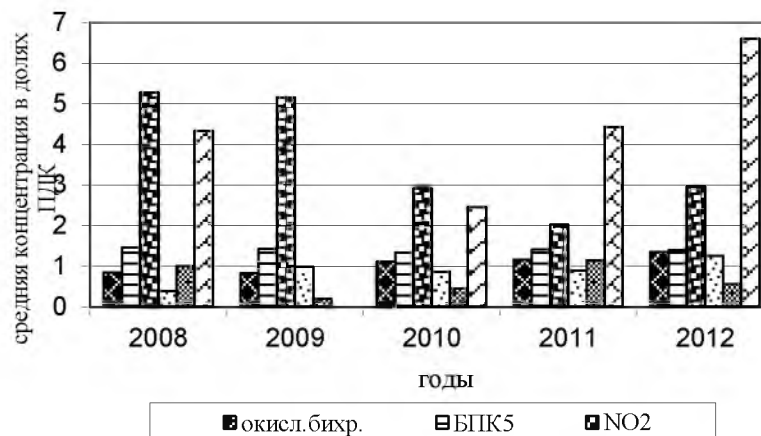


Fig.5: The change of surface water quality on the Oskol river – settlement Volokonovka

In the target Oskol - Volokonovka critical index - nitrogen nitrite, its average annual concentrations reached 2-5,3 MPC, compounds with manganese - 2,4-6,6 MAC. For other pollutants, the annual concentrations reached 2-3 MPC. In 2012, there was a trend for

deterioration of water quality. From 16 accounted ingredients 9 are polluting. Critical values recognized nitrogen nitrite and manganese compounds.

Table 5: Change in water quality on targets of the Oskol river

year	25 km below Stary Oskol city, 372 km from the mouth		s. Volokonovka 262 km from the mouth	
	SCIWP	Quality class	SCIWP	Quality class
2008	3,52	3б	3,27	3б
2009	4,58	4a	2,29	3a
2010	5,08	4б	2,69	3a
2011	4,19	4a	3,48	3б
2012	4,72	4a	3,32	4a

As follows from table 5, water quality on both targets of the Oskol river deteriorated from class 3 category «б», «very polluted» to class 4 category «а», «dirty» from 2008 to 2012. SCIWP increased respectively from 3,52 to 4,72 on target the Oskol river - 25 km below Stary Oskol and from 3.32 to 3.27 on the target Oskol - Volokonovka [7].

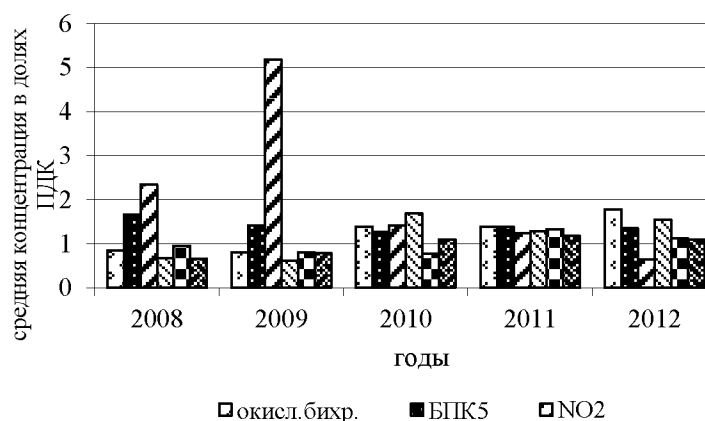


Fig.6: The change of surface water quality on the Vorskla river

The maximum contribution to the pollution of the river has made components of natural origin - manganese, iron. On the target Vorskla - Kozynka to typical and sustainable pollutants can be attributed: organic substances according to COD and BOD5, sulfates and phosphates, nitrogen, ammonia and nitrite, total iron and copper. Average annual concentrations of nitrite nitrogen was reached 1.2-5,2 MPC, nitrogen ammonium - 1-1,4 MAC, phosphates from 1.3 to 1.7 MPC, sulfates MAC 1.1-1.2. In 2012, the river water quality has improved by 1 position.

Table 6: Change in water quality of the Vorskla river

year	v. Kozinka, 348 km from the mouth	
	SCIWP	Quality class
2008	3,75	4a
2009	3,24	3б
2010	2,99	3a
2011	3,15	3б
2012	2,80	3a

Class quality has improved from 4, category «a», «dirty» in 2008 to «polluted», 3rd class, category «a» in 2012, SCIWP has decreased respectively from 3,75 to 2.80.

The above data show that on hydro-ecological regime of transboundary rivers of the Belgorod region not only the natural factors, but in the big degree of anthropogenic factors are influenced. As a result of these components during the period of 2008-2012, the water content of the rivers has decreased and the water quality of the rivers Seversky Donets and Oskol was deteriorated. The water quality of the Vorskla river has changed for the better in comparison with 2008 and is observed within 3 class.

Fur improving the hydro-ecological state of transboundary rivers and their inflows the melioration works, clearing and settlement of springs are carried out. Annually the coastal protective strips and water protection zones are cleaned and contained to the sanitary condition. For the protection of catchment areas in the region the works aimed at reducing water erosion of soils are taken place; the systems of optimal crop rotation, conservation farming across the slope and subsurface tillage are introduced, the land arrangement of water detention and erosion control shafts on the tops and slopes of ravines and beams are organized, the works on planting of soil-protecting forest plantations are taken place. The construction, reconstruction and renovation of wastewater treatment plants and sewerage networks are also very important.

But the main task in the field of water resources protection is a complete rejection from the disposals even treated sewage. International experience shows that this is the only way to avoid the large-scale pollution of the surface waters [9].

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