

Russian participants of AMORE Project in 2009

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Introduction

The research in 2009 was carried out in the frame of the Implementation Agreement on the Joint Research of the Amur River, its Estuary and the Sea of Okhotsk between the Institute of Water and Ecology Problems (IWEP FEB RAS) (Russia) and the Research Institute of Humanity and Nature (RIHN) (Japan), signed on April 19, 2005 and based on the Agreement on Cooperation between the Far Eastern Branch of the Russian Academy of Sciences and the Research Institute of Humanity and Nature, signed on March 4, 2004.

Since its beginning in 2005, the research is based on the contracts, annually developed and signed between IWEP FEB RAS and RIHN and includes detailed field works the Amur River Basin.

The main Project tasks include:

1. Investigation of the main sources of the origin of different iron forms in the Amur River considering the specifics of landscapes most common for the region of interest.
2. Clarification of the role of wetlands and water runoff from the floodplain in the formation of the river water chemical composition.

The research object in 2009 was observation stations in the Kiya River Basin and adjacent areas.

The report presents data of 2009 field research in the Kiya River basin, and analyses of water samples collected at the observation station established in 2008, and at several sites in neighboring areas where samples were collected in April 2009.

The work was started in May and finished in October.

2. Research Objects and Methods

In 2009 water discharge was measured at the Kiya and Birushka Rivers (stations 3, 6 and 7 as indicated in Fig. 1) from the bridge and sometimes on foot with a velocity-meter GR-21M (Russia) calibrated in Hydrometric Lab, Khabarovsk on May 21. In addition, device “KEDR-D” and “KEDR-DM” for automatically measurement of water level, temperature and electric conductivity was installed in observation wells at Marucino, Pereyaslavka and, later, across a hinterland wetland slope in Marucino to observe upper groundwater behavior. “KEDR-DM” was equipped by modem connection to send regularly measured data via GPRS to V. Shamov’s and T. Onishi’s mailboxes.

River water was sampled from middle water horizons. In the Kiya River sampling was done in 5 m from the left bank in Pereyaslavka and from the right bank in Marucino, and in the Birushka River sampling was being performed in the middle of the stream upstream to the road bridge. The groundwater in wetland was sampled along two profiles established in 2008 in the Kiya floodplain in Marucino and across a peaty swamp, with peat layer of more than 1 meter depth, developed in ancient oxbow. Those samples were obtained from the surface directly when soil was sank or, otherwise, from the pit being made in every case of sampling. In some cases when flood river water submerged the wetland (in June and in August) or groundwater lowered beneath mineral layer (in the first half of July), the samplings were missed.

Such physical and chemical characteristics of water mass as turbidity, temperature (t °C) and water pH were measured. Water temperature was measured in situ with a “Toledo” thermo-oxygen-meter and with hydrologic thermometer. Water turbidity was measured with thermostatic-gravimetric technique.

In order to analyze different water compounds the following methods were applied:

- a complex method for water hardness ($\text{Ca}^{2+} + \text{Mg}^{2+}$);
- titration for Ca^{+2} ;
- photometry for Si in the yellow form of molybdic silicic acid;
- titration with mercury salt for chlorides (Cl);
- titration with photometry to follow for sulfates (SO_4^{2-});
- a bio-chromatic method and TOC-analyzer (two final sets of water samples) for dissolved organic carbon (DOC);
- inductively coupled plasma mass spectrometry (ICP-MS) for bulk content of iron, manganese, cadmium, zinc, copper and aluminum;
- photocalorimetry (CPC-3, prod. in Russia) for phosphate ions. During interaction of phosphate-ions and molybdate-ions in acid conditions produce yellow complex compound, which gives deep blue coloration.

As it was planned before water samples were analyzed for such ion forms as Fe(II) and Fe(III).

3. Research Results

3.1. Hydrological conditions within the studied area in Summer-Autumn period of 2009

Background conditions of 2009 warm period in the area of study were totally near average (Tables 1 and 2), but very differ from month to month.

Whereas May was twice drier against average May rate, June precipitation amount was 51 % higher than the norm. It is notable that August 2009 precipitation exceeded the average August one for 51 %, and July was some dryer against average moistening. September and October were as quite dry as in 2008 to maintain a long lower water period in rivers of area of research. Thus, the total precipitation of observation period from May to October at Marucino was 104 % of the norm.

Table 1 and Figure 2 show monthly precipitation for warm period of 2009 at Marucino gauge station, calculated on the base of observation data of Bichevaya meteostation [www.rp5.ru] and using the relation of average monthly sums of the two stations (Fig. 3).

Table 1. Characteristics of atmospheric moistening in the Kiya River basin at Marucino gauge station. Data of summer and autumn periods of 2009 are compared to average ones and according period of 2008.

Months	2009	2008	Average of the whole observation period [data from www.gismeteo.ru]
	Monthly precipitation, mm		
May	29.8	68.3	59
June	137.3	7.9	91
July	106.2	87.7	119
August	189.6	86.2	125
September	57.9	48.6	88
October	32.1	38.4	49
Total	553	337	531

Monthly Precipitation at Bichevaya Meteostation

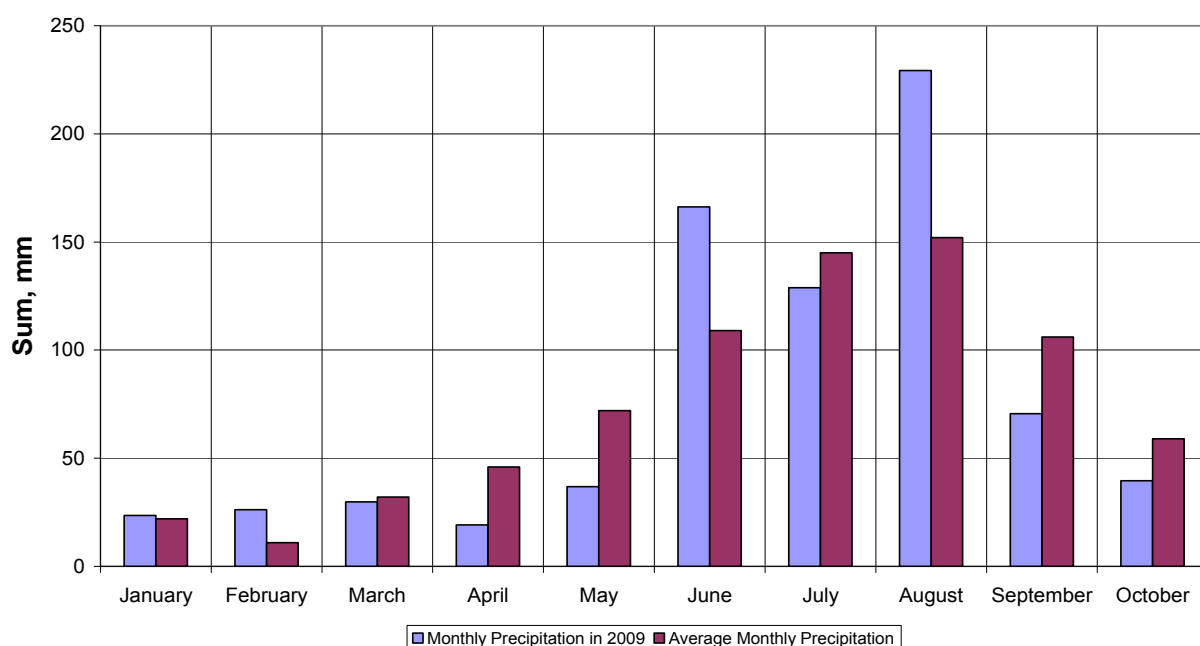


Fig. 2. Monthly precipitation at Bichevaya meteostation for period of January to October 2009 based on data from www.rp5.ru compared to average values.

Daily precipitation rates for the observation period at Bichevaya meteorological station were obtained from www.rp5.ru and placed into Table 2. There, cells with a lot of monthly precipitation compared with average monthly amount are blue, and cells for months with a low precipitation were marked by yellow.

Table 2. Daily precipitation rate at Bichevaya meteostation for period of May to October 2009 based on data from www.rp5.ru.

Date	January	February	March	April	May	June	July	August	September	October
1	4.8					4.0	0.3	8.0		0.1
2	0.0				3.0	24.5	5.0	7.0		18.0
3		0.2			0.6	14.0	3.9	3.0		
4				0.0	0.0	3.8	0.4		9.0	7.0
5		0.6		0.9						0.3
6			3.0	1.0					5.0	
7		1.0	10.0			1.2			13.0	
8		1.0		1.0		1.1	4.4		6.5	
9	0.8	1.4	3.0			0.0	1.0		3.0	
10	3.9		0.0			0.6			0.5	2.0
11	0.0		0.0			2.3	9.0			
12				0.3	7.0	7.0	7.0	46.0		
13		2.5	2.3	3.0	13.9	0.0		10.0		0.5
14	0.2	12.0	0.0	3.0	3.0		37.0	7.0	0.0	
15	0.2	4.0	0.2	2.0			26.0	6.0	0.4	
16		2.4				0.1			3.0	
17		0.0				0.1	12.0		0.7	
18					1.3		0.5	5.0	6.8	9.0
19	0.8		0.3				21.0	15.7		1.4
20	1.2					45.0	0.3	13.0		
21	0.3					5.0	1.0	65.0	2.0	1.0
22	1.0	0.6		5.0			0.0	1.4	13.0	
23	7.0					8.0		8.0		0.3
24	0.7		0.0			25.0	0.0		1.0	
25	0.0		0.0			7.1			1.0	
26	0.2					3.0		6.1		
27	0.0	0.5	9.0			6.0		4.0		
28	0.4		2.0			1.0	0.0	7.0	5.0	
29	2.0					4.0		17.0	0.7	
30				3.0		3.4			0.0	
31					8.0					
Monthly	23.50	26.2	29.8	19.2	36.8	166.2	128.8	229.2	70.6	39.6
Average	22	11	32	46	72	109	145	152	106	59

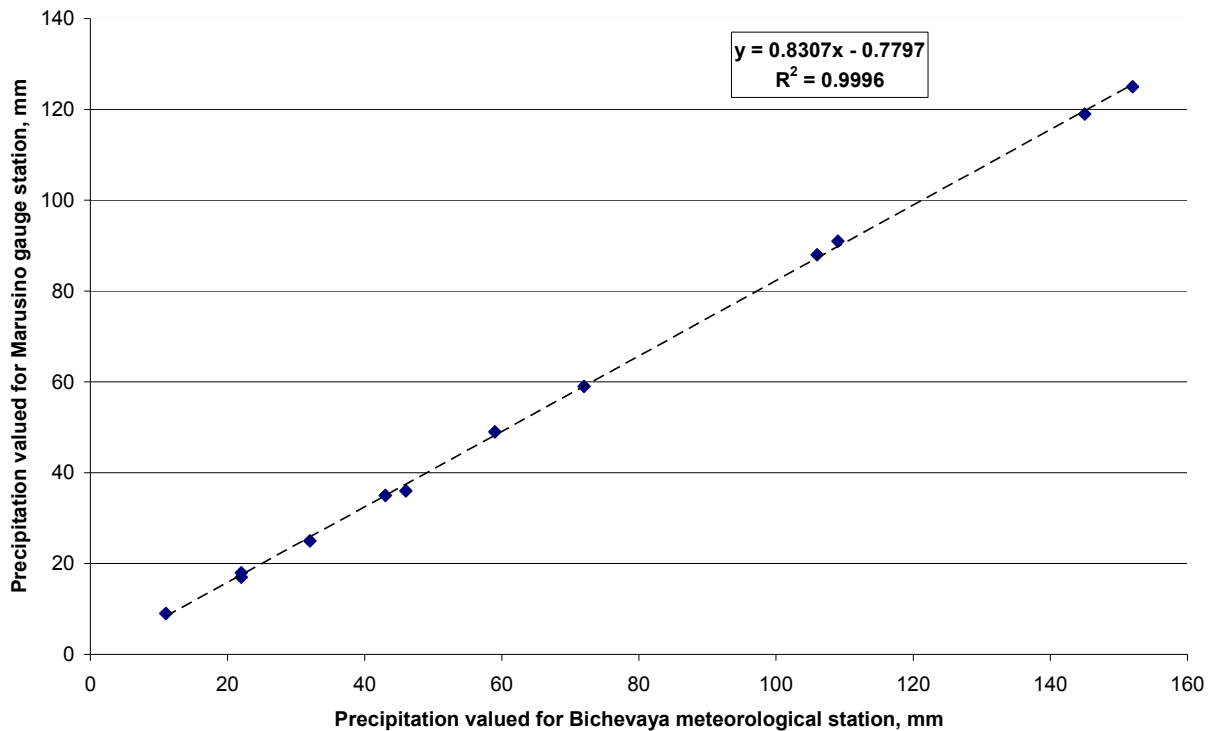


Fig. 3. Correlation between the average monthly precipitation at Bichevaya meteorological and Marucino gauge stations [data from www.gismeteo.ru]. Linear regression equation and correlation measure are shown in a box in upper part of the plot.

Flow rate measurement data are given in Table 3 and Fig. 5, and daily water levels averaged according to hour and half-hour data logging are shown in two tables below (Tables 4, 5). In order to compare, we twice observed and sampled a dyke located 5 km upstream from Marucino village and collected and contributed drainage water from swampy hinterland to the Kiya R. there.

Table 3. Measured Water Flow Rate (m³/sec) in 2009.

NN	Date of observation. Hydrological conditions.	River – observation site			
		Kiya – Marucino	Kiya – Pereyaslavka	Birushka – Georgievka	Dyke in 5 km upstream from Marucino
1	25. V. Low water	3.80	1.76	0.043	No measurement
2	26. VI. Flood	43.2	21.2	0.37	No measurement
3	10. VII. Low water	1.34	4.23	1.60	1.01
4	27. VII. Low water at Marucino. Flood depletion at Pereyaslavka	1.62	10.5	0.74	0.82
5	10. VIII. Low water	2.67	2.02	0.28	No measurement
6	26. VIII. Flood	33.3	12.3	1.16	No measurement
7	14. IX. Low water	3.49	3.51	0.85	No measurement
8	30. IX. Low water	2.75	2.26	0.57	No measurement
9	23. X. Low water	2.20	4.10	0.37	No measurement

Our hydrometric survey in the Kiya R. basin, carried out on May, 25 2009, fixed a deep low water period thanks to a little precipitation during April and May. Hydrological survey on June, 26 coincided with the pick of a high flood, which appeared due to heavy rainfalls during several days before when total precipitation had reached about 90 mm per 6 days (Fig. 4). That is why the Kiya stream-flow at Marucino had sharply increased 11 times compared to the previous

observations, on May 25, and at Pereyaslavka – 4 times accordingly, i.e. occurred more smoothly. The next high flood occurred in the past half of August, and then, through September and October the flow was decreasing.



Fig. 4. High flood in the Kiya River. Marucino village. June 26, 2009.

Table 4. Daily average water level (cm above a top of the lowest measuring pile) in the Kiya R. at Marucino based on logging data and manual measurement in May – October 2009.

Date	V	VI	VII	VIII	IX	X
1			155.3		122.8	
2			141.2		115.4	
3			125.4		99.9	
4			108.8	-11.0	84.6	59.9
5			103	-11.5	73.2	
6			93.8		67.8	
7					63.6	
8					70.2	
9					68.7	
10				38	67.7	44.5
11			3.0		66.7	
12			2.6		61.2	
13			2.9			
14			-2.9		49	
15			-4.8	37.5		
16			14.9	37.9		
17			50.1	37.8		
18			72.0	38.3		
19			74.3	36.3		
20			72.8	38.4		
21			79.3	64.5		
22		58.8	89.7	93.7		
23		75.8	86.0	151.8		28.5

Date	V	VI	VII	VIII	IX	X
24		90.5	72.8	183.3		
25	21.0	107.6	53.3	173.9		
26		151.5	33.4	156.7		
27		181.4	16.3	137.1		
28		178.5	5.0	118.9		
29		172.7	-3.8	106.7		
30		167.3	-9.8	100.3	38.5	
31			-14.1	111.5		

Notes

Yellowed cells – level was out of measurement range

Grey cells – no measurements

August 14 – a jump up in records had been registered

August 21 – a jump down in records had been registered

Aug 15 to 20 – doubtful (noisy) records

Bold data – manual measured with level stuff/scale

Table 5. Daily water levels in the Kiya R. at Pereyaslavka based on logging and the data measured manually in May – October 2009. Data after August 10 were lost due to technical problem.

Date	V	VI	VII	VIII	IX	X
1		-7.2	175.3	9.2		
2		-7.4	138.4	6.6		
3		-7.0	105.9	4.2		
4		-5.1	80.6	3.0		
5		-4.4	61.9	4.1		
6		-4.4	50.8	4.4		
7		-4.4	41.0	1.9		
8		-4.8	35.2	0.7		
9		-5.6	30.9	-0.3		
10		-6.7	29.2	-0.8		
11		-6.9	32.8			
12		-6.6	29.6			
13		-6.6	27.1			
14		-7.1	25.5		12.0	
15		-6.9	24.4			
16		-7.0	29.5			
17		-7.9	41.9			
18		-8.5	65.5			
19		-8.9	88.1			
20		-6.9	100.0			
21		-6.0	104.0			
22		-5.2	106.8			
23		7.1	108.2			0.0
24		16.9	99.1			
25	-4.0	27.2	83.1			
26	-4.0	38.7	65.7	35.0		
27	-4.3	63.1	49.1			
28	-5.1	117.0	30.7			
29	-6.3	159.5	22.9			
30	-7.3	185.5	16.8		4.5	
31	-7.7		12.3			

Notes

Yellowed cells – level was out of measurement range

Grey cells – no measurements

Bold data – manual measured with level stuff/scale

It is remarkable that because of the soil peculiarities a flood in the Birushka R. had occurred later than in the Kiya R., that's why the Birushka water discharge measured on July, 27 was higher than simultaneous (on the same date) discharge in the Kiya at Marucino draining a bigger watershed area (Table 3).

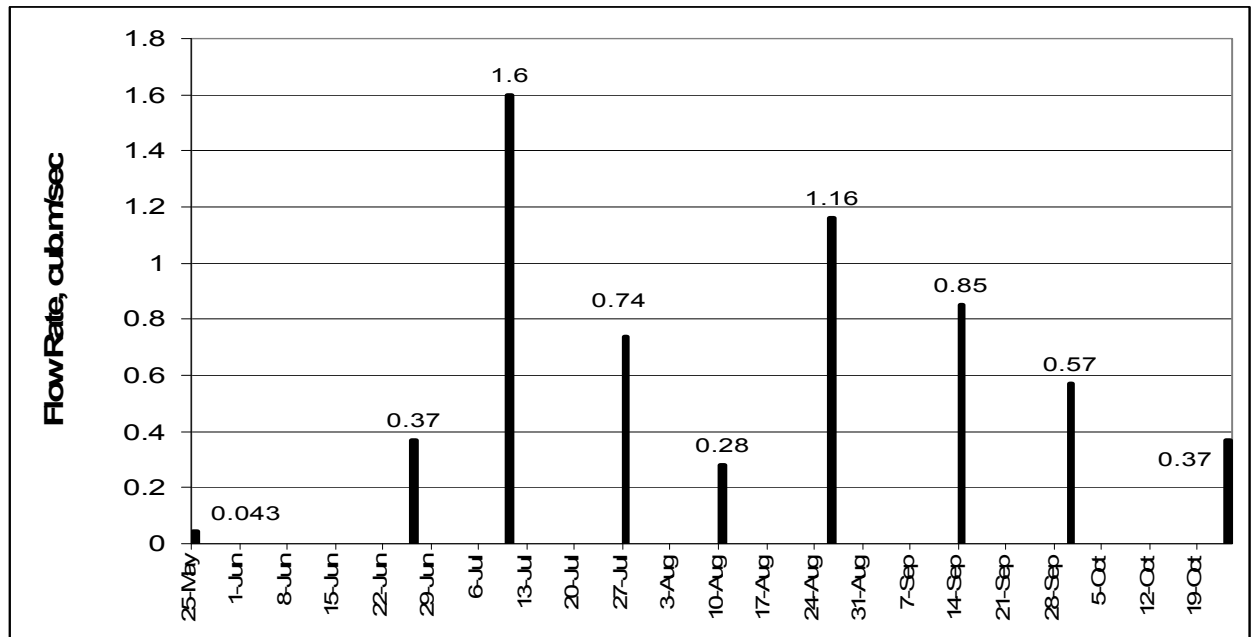


Fig. 5. Temporal distribution of flow rate in the Birushka R. at Georgievka based on measured data (m³/sec) for May – October 2009.

Obviously, atmospheric moistening conditions in the summer-autumn period in 2009 led to recharge of moisture content of alluvial deposits exhausted before, in droughty 2008 as it was found from groundwater level measurements in hinterland nearby Marucino [Report..., 2009], and in predominantly dry spring 2009. This was evident from an occasionally diminished water flow rate at Pereyaslavka in 2009 in comparison with the flow rate at Marucino (Table 3). Such event seems at least to be common within the Kiya R. midstream when floods occur (Fig. 6).

In hinterland of Kiya R., groundwater behavior was attempted to observe along a cross profile established in 2008 in Marucino within a small tussocky wetland area (*Carex* species, mostly) bounded by above-floodplain terraces. The profile was performed by 3 basic observation wells equipped by with digital gauges to register the level as well as temperature and electric conductivity of groundwater (for instance, see Fig. 7). Every measuring gauge was protected and maintained by iron pipes for about 1 m depth.

In the process of observations we found prominent non-compliances in groundwater level inside and aside a pipe for up to several centimeters. It is supposedly sometimes due to withdrawal of water into gravel and sandy alluvium beneath the soil layer, and, in some cases, water level inside a pipe was found to be higher than aside that could be related to hydraulic disconnection through the pipe wall, especially after flooding.

Unfortunately, high floods occurred in the Kiya R. in 2009 led to submerging the observation wells, and the gauges had stopped their work definitely.

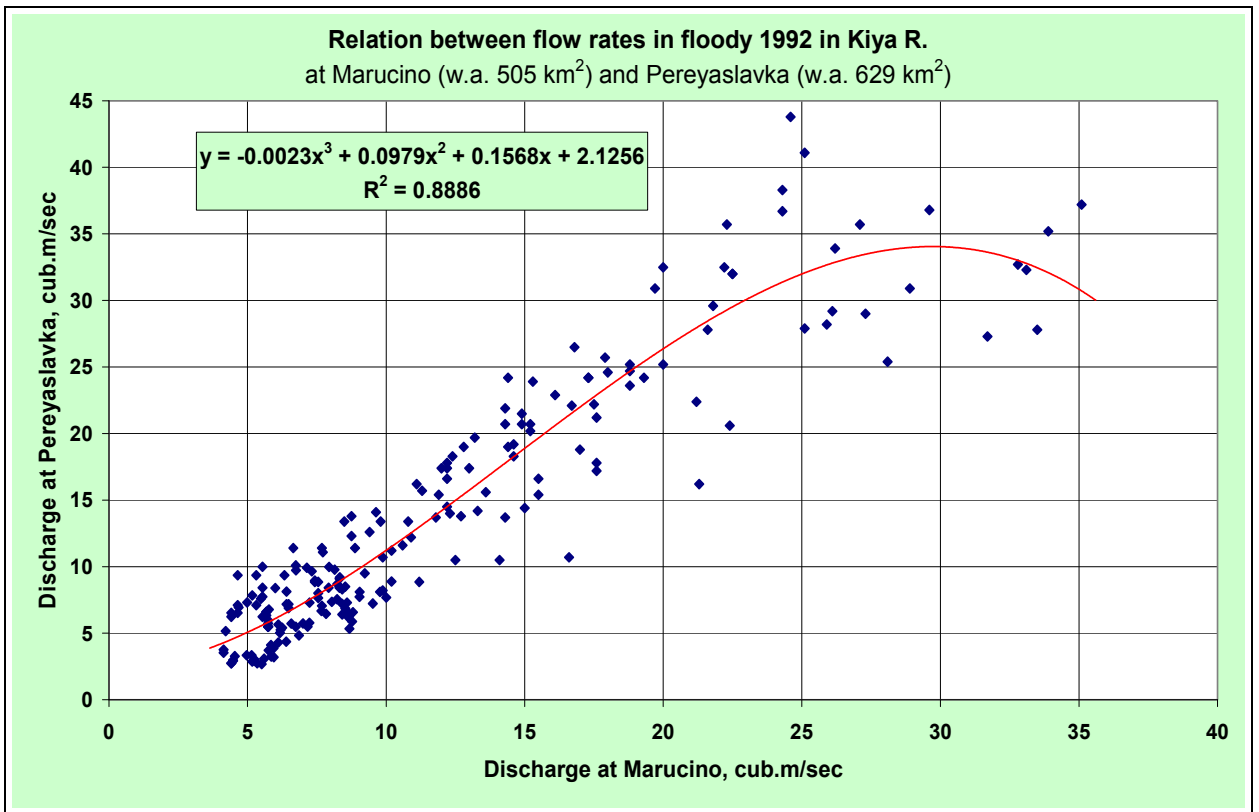


Fig. 6. A relation of daily flow rates in the Kiya R. at Marucino with daily flow rates at Pereyaslavka within waterish ice-free period (April 13 to October 31) of 1992 (data from hydrological statistical book for 1992). Regression equation and correlation measure evaluated with technique of least square are shown in a box enclosed.



Fig. 7. Observation well #2 before the monitoring kick-off in the wetland in Marucino.

In table 6 and figure 8, there are given the results of topographic survey of profile of the experimental wetland plot in Marucino.

Table 6. The results of topographic survey of profile of the experimental wetland plot in Marucino made on September 30, 2009.

NN	Total Distance, m	Elevation, mm
1	0	2082
well 1 pipe top	12.6	981
well 1 soil surface	12.6	633
2	25.8	515
well 2 pipe top	50.0	720
well 2 soil surface	50.0	510
3	63.8	410
well 3 pipe top	77.1	646
well 3 soil surface	77.1	387
4	88.1	357
river water edge	125.0	0

Soil surface profile of wetland in Marucino

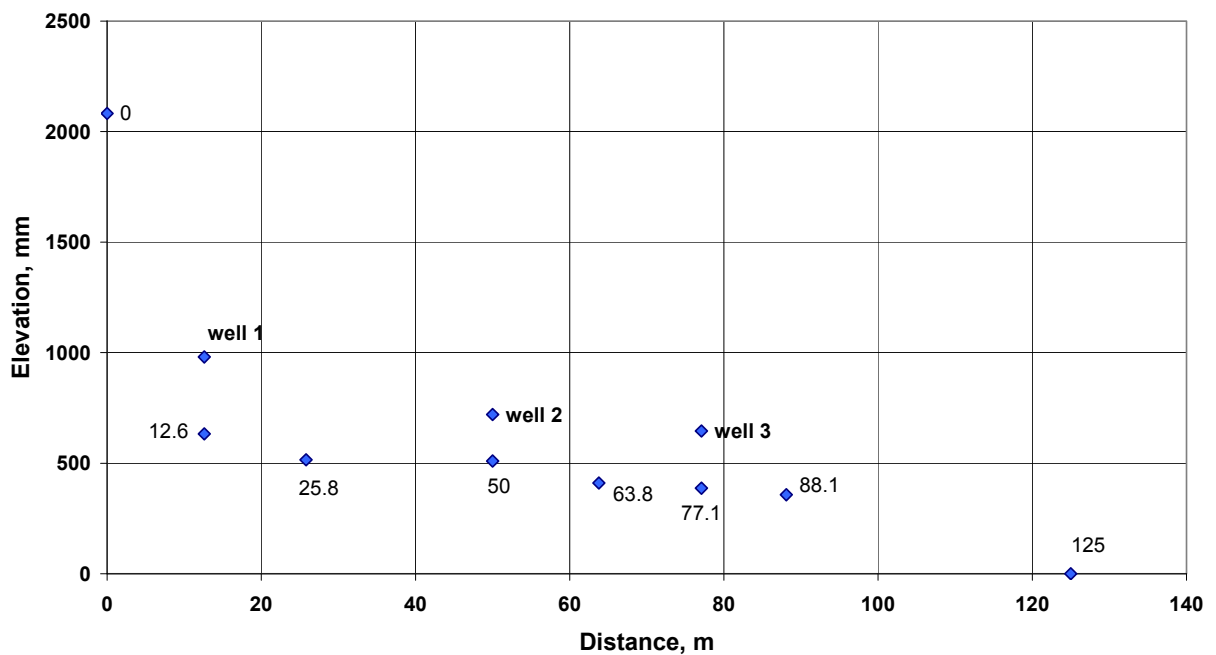


Fig. 8. Elevation profile of experimental wetland in Marucino on the basis on topographic survey on September 30, 2009.

Below, the groundwater level dynamics in experimental wetland plot in Marucino according to manual observations is shown in figures 9, 10 and table 7.

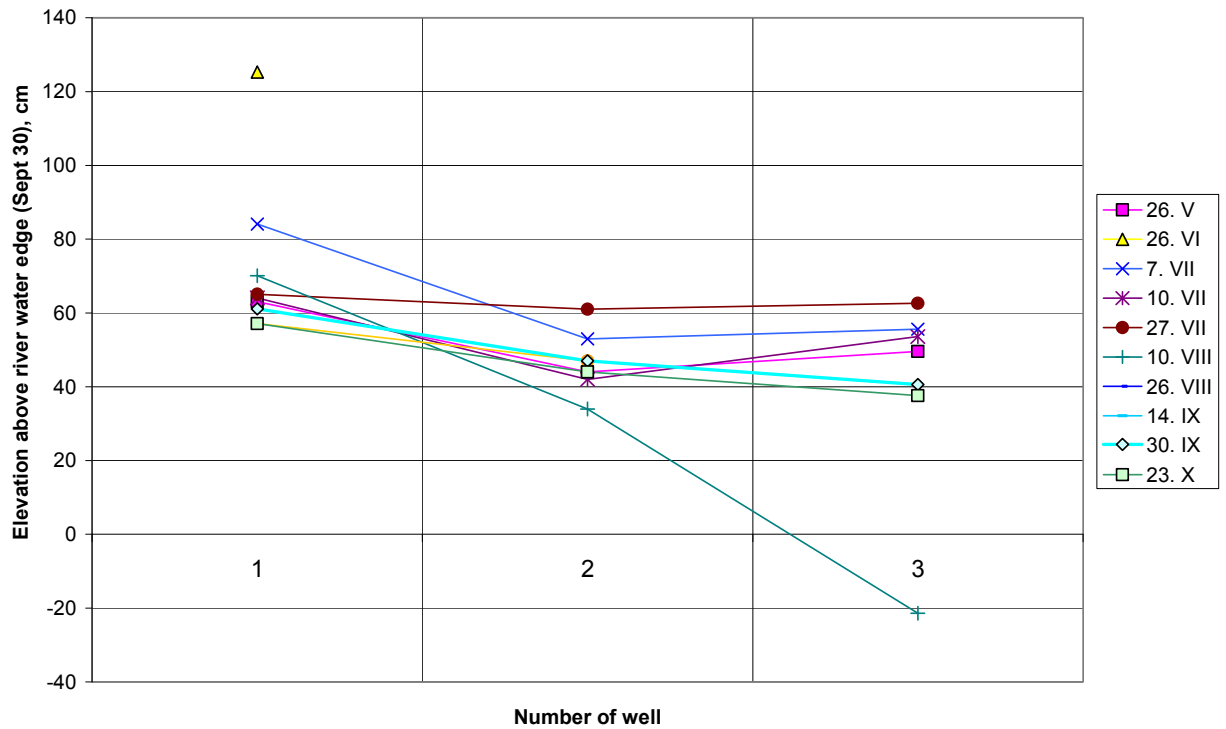


Fig. 9. Dynamics of groundwater level along the profile of the experimental wetland plot in Marucino in 2009.

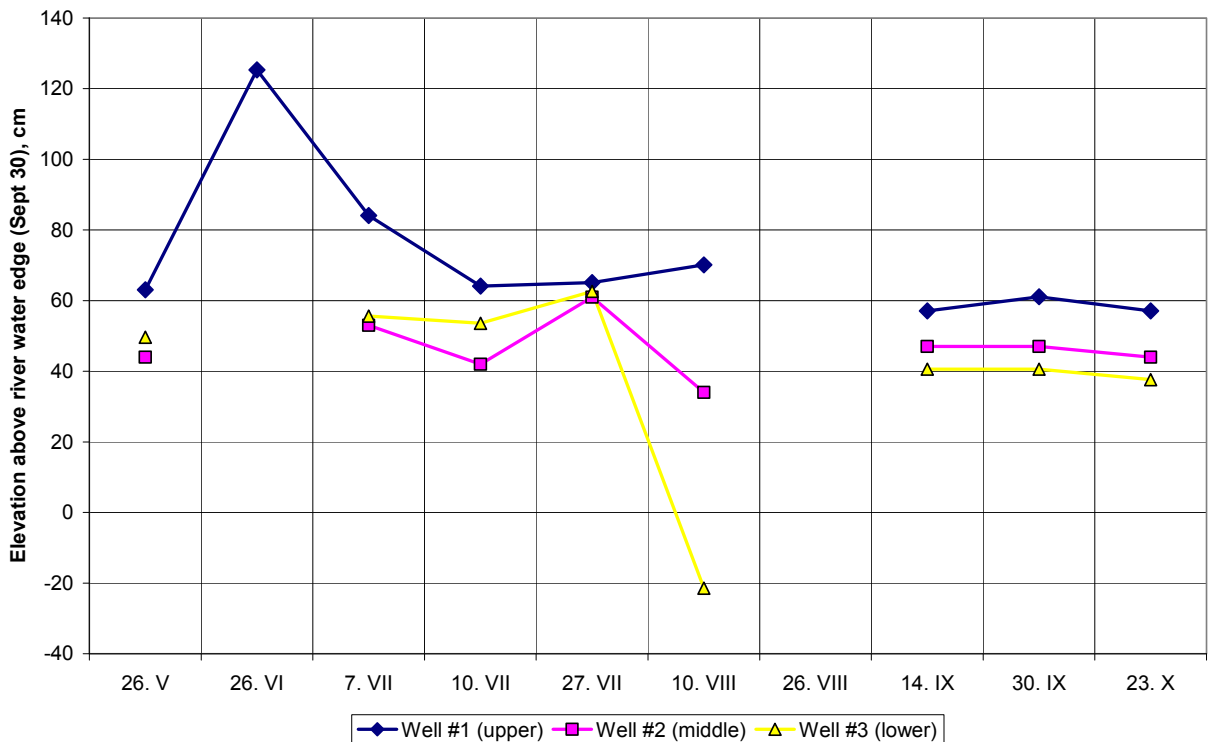


Fig. 10. Dynamics of groundwater level in observation wells on the experimental wetland plot in Marucino in 2009.

Table 7. The results of manual observations of groundwater level in wells on the experimental wetland plot in Marucino in 2009.

Well #	26. V	26. VI	7. VII	10. VII	27. VII	10. VIII	26. VIII	14. IX	30. IX	23. X
1	63.1	125.3	84.1	64.1	65.1	70.1	-	57.1	61.1	57.1
2	44.0	-	53.0	42.0	61.0	34.0	-	47.0	47.0	44.0
3	49.6	-	55.6	53.6	62.6	-21.4	-	40.6	40.6	37.6

3.2. Geochemical features of waters in 2009

Total organic carbon (TOC) in water within the studied area was varying in wide diapason – from 2.3 to 79.0 mgC/L (see Table 6). Herewith, its content was essentially higher than in previous draughty year of 2008 due to its flush out from wetlands on the Kiya watershed. The lowest TOC in river water was detected in April in the Khor R, and the highest TOC was registered in July-August in the Birushka R. and in Kiya R. that could be related to groundwater withdrawal from watered wetlands to adjacent rivers. At the same time, there were observed high TOC content in wetland water (site 7, the Birok R. headwaters) while water of dyke draining swampy hinterlands of the Kiya R. contained not a lot of OC (obviously, not more than 20 mg C/L).

Quite low mobile TOC in the observed rivers owed by relatively not high humus acids and their impaction by calcium and iron oxides within the relevant soils [Ivanov, 1976].

Table 6. Total organic carbon in waters sampled in 2009, mg C/L.
NN are given according to Fig. 1.

NN	Site	Date of water sampling									
		23.04	25.05	26.06	10.07	27.07	10.08	26.08	14.09	30.09	23.10
7	Kiya - Pereyaslavka	10.9	8.5	14	39	19	22	40	11.4	12.8	6.8
6	Birushka - Georgievka	8.3	3.2	5.7	51	21.3	54	48	11.4	9.1	6.5
1	Birushka - Vasilievka	10.5	8.5	10.1	43	16.6	30	38	4.5	9.5	4
4	Wetland nearby Marucino	-	40.1	41	65	21.6	79	51	13.5	17.8	16
5	Transient zone in wetland nearby Marucino	-	10.8	4.5	31	43.2	128	40	55.8	67.2	28
3	Kiya - Marucino	17	8.5	24.2	79	21.3	18	47	9	8.7	5.3
2	Wetland – Birok headwaters	-	27.6	35	137	52.6	130	105	41.5	18.6	25.4
	Wetland in Marucino – observation well 1	-	4	-	102	-	-	-	42.6	36.1	33
	Wetland in Marucino – observation well 2	-	-	-	70	49.6	-	-	54.1	41	35.5
	Wetland in Marucino – observation well 3	-	20	-	50	-	120	-	24.6	36.1	37.6
	Wetland in Marucino – between wells 1 and 2	-	-	-	-	-	-	-	-	41	-
	Wetland in Marucino – between wells 2 and 3	-	-	-	-	-	-	-	-	50	-
	Underground water pumped in household in Marucino	-	-	-	3	-	8	-	1.5	-	-
8	Dyke in 5 km upstream from Marucino	-	-	-	20	5.6	-	-	-	-	-
	Khor - bridge	2.3	-	-	-	-	-	-	-	-	-
	Orochonok - bridge	12.8	-	-	-	-	-	-	-	-	-
	Podkhoryonok - bridge	12.2	-	-	-	-	-	-	-	-	-
	Sita - bridge	14.1	-	-	-	-	-	-	-	-	-
	Julikha-1 - bridge	10.1	-	-	-	-	-	-	-	-	-
	Julikha-2 - bridge	10.9	-	-	-	-	-	-	-	-	-
	Marucino stream - bridge	4.9	-	-	-	-	-	-	-	-	-
	Stream 59 th km - bridge	14.1	-	-	-	-	-	-	-	-	-

Notes

Dash inside a cell hereinafter means an observation was missed.

The samples obtained on September 30 and October 23, were analyzed with TOC-analyzer.

Along the observation period, acidity (pH) in river waters was varying in the range of 6.16 – 7.32 (Table 7) that is to be common for surface waters within the studied area in summer-autumn period [Water resources..., 1990], but the less than in 2008 [Report..., 2009]. Expectably, the swamp waters in were in major characterized by the less pH (5.62 – 6.65), and pH in underground water is found to be quite stable as 6.22 – 6.30. Water in the Birushka R. (average pH at Georgievka was 6.83) was slightly less acid against water in the Kiya R. (average pH at Marucino was 6.65), perhaps, due to the differences of TOC conditions: average TOC in Birushka at Georgievka was 21.9, and the same property of water in Kiya R. was 23.8.

Table 7. Acidity (pH) of waters sampled in 2009. NN are given according to Fig. 1.

NN	Site	Date of water sampling									
		23.04	25.05	26.06	10.07	27.07	10.08	26.08	14.09	30.09	23.10
7	Kiya - Pereyaslavka	6.80	7.04	6.50	7.08	6.93	6.90	7.32	7.12	6.63	6.96
6	Birushka - Georgievka	6.53	6.71	6.62	6.84	7.08	6.74	6.94	7.21	6.59	7.02
1	Birushka - Vasilievka	6.43	6.84	6.44	6.45	6.83	6.60	6.79	6.80	6.27	6.94
4	Wetland nearby Marucino	-	5.78	6.58	6.38	6.5	6.12	6.32	6.65	6.19	6.24
5	Transient zone in wetland nearby Marucino	-	5.87	5.93	6.26	6.49	5.92	6.48	6.49	5.92	6.14
3	Kiya - Marucino	6.56	6.74	6.26	6.56	7.07	6.59	6.61	6.76	6.73	6.60
2	Wetland – Birok headwaters	-	5.75	6.08	5.92	6.15	5.62	6.03	6.00	5.91	6.18
	Wetland in Marucino – observation well 1	-	6.82	-	5.92	-	-	-	5.75	6.05	5.97
	Wetland in Marucino – observation well 2	-	-	-	6.02	-	-	-	5.96	5.94	6.12
	Wetland in Marucino – observation well 3	-	7.07	-	6.06	-	5.76	-	6.07	6.04	6.12
	Wetland in Marucino – between wells 1 and 2	-	-	-	6.10	-	-	-	-	5.74	-
	Wetland in Marucino – between wells 2 and 3	-	-	-	-	-	-	-	-	-	-
	Underground water pumped in household in Marucino	-	-	-	6.30	-	6.22	-	6.29	-	-
8	Dyke in 5 km upstream from Marucino	-	-	-	-	6.38	6.94	-	-	-	-
	Khor – bridge	7.02	-	-	-	-	-	-	-	-	-
	Orochonok – bridge	6.16	-	-	-	-	-	-	-	-	-
	Podkhoryonok – bridge	6.68	-	-	-	-	-	-	-	-	-
	Sita – bridge	6.40	-	-	-	-	-	-	-	-	-
	Julikha-1 – bridge	6.36	-	-	-	-	-	-	-	-	-
	Julikha-2 – bridge	6.64	-	-	-	-	-	-	-	-	-
	Marucino stream – bridge	6.40	-	-	-	-	-	-	-	-	-
	Stream 59 th km – bridge	6.17	-	-	-	-	-	-	-	-	-

Dissolved iron (Fe_{dis}) in river waters were changing within 0.025 – 0.260 mg/L (Table 8). Minimum Fe_{dis} contents were detected in April in Khor R. whereas the highest Fe_{dis} concentrations were found in April in Marucino R. The slumpy Birushka R. contained about twice more iron in comparison with the Kiya R. that is to be related to a lot of mobile iron in peaty soils [Ivanov, 1976] covering predominantly the Birushka watershed area. In river water, iron mainly presented in form of Fe(III), especially when flood occurred.

As a rule, the wetland water was found to contain the higher dissolved iron, but it varied widely – from less than 0.010 to 2.7 mg/L. It is known that if pH lowers Fe(II) increases in water. It should be noted in the beginning of summer season when moistening was low high mobile iron content was recorded in water of wetlands with dense peat layer (as in wetlands nearby Marucino) whereas in grass floodplain wetland (in Marucino) groundwater was found to have a few of mobile iron (Table 6). In some cases, in wetland groundwater Fe(II) prevails in comparison with Fe(III). Underground water sampled through manual pump in household in Marucino is depletion in any forms of iron. According to iron data obtained it is difficult to find prominent relation between iron concentration in wetland water and hydrological conditions.

Table 8. Dissolved iron (Fe_{dis}), ferrous oxide Fe(II) (Fe^{+2}) and iron oxide Fe(III) (Fe^{+3}) (mg/L) in waters sampled in 2009. NN are given according to Fig. 1.

NN	Site	Fe forms	Date of water sampling									
			23.04	25.05	26.06	10.07	27.07	10.08	26.08	14.09	30.09	23.10
7	Kiya - Pereyaslavka	Fe_{dis}	0.061	0.065	0.110	0.064	0.096	0.094	0.065	0.062	0.066	0.046
		Fe^{+2}	0.031	0.031	0.021	0.060	0.060	0.060	0.080	0.050	0.044	0.030
		Fe^{+3}	0.034	0.045	0.055	0.070	0.150	0.090	0.100	0.070	0.046	0.040
6	Birushka - Georgievka	Fe_{dis}	0.072	0.056	0.096	0.107	0.121	0.244	0.075	0.085	0.093	0.045
		Fe^{+2}	0.102	0.063	0.00	0.060	0.100	0.230	0.110	0.040	0.054	0.060
		Fe^{+3}	0.070	0.033	0.033	0.160	0.110	0.310	0.150	0.050	0.056	0.120

NN	Site	Date of water sampling										
		Fe forms	23.04	25.05	26.06	10.07	27.07	10.08	26.08	14.09	30.09	23.10
1	Birushka - Vasilievka	Fe _{dis}	0.125	0.087	0.122	0.124	0.110	0.253	0.093	0.082	0.077	0.075
		Fe ⁺²	0.064	0.059	0.012	0.070	0.190	0.230	0.090	0.040	0.031	0.060
		Fe ⁺³	0.075	0.057	0.087	0.20	0.270	0.310	0.200	0.050	0.064	0.060
4	Wetland nearby Marucino	Fe _{dis}	-	2.733	2.103	1.255	0.975	1.124	0.752	0.654	0.657	0.872
		Fe ⁺²	-	1.759	0.246	0.280	0.10	0.770	0.110	0.100	0.083	0.090
		Fe ⁺³	-	1.612	0.397	0.730	0.21	1.89	0.250	0.090	0.051	0.070
5	Transient zone in wetland nearby Marucino	Fe _{dis}	-	1.841	2.171	2.052	1.983	2.182	0.965	1.545	1.115	1.05
		Fe ⁺²	-	0.495	0.302	1.260	1.020	1.810	0.210	0.870	2.10	1.45
		Fe ⁺³	-	0.646	0.405	0.980	0.400	0.840	0.670	0.870	2.89	0.520
3	Kiya - Marucino	Fe _{dis}	0.11	0.097	0.121	0.087	0.157	0.092	0.052	0.057	0.065	0.052
		Fe ⁺²	0.041	0.042	0.082	0.070	0.080	0.010	0.090	0.060	0.044	0.07
		Fe ⁺³	0.055	0.064	0.240	0.120	0.084	0.120	0.110	0.050	0.064	0.08
	Wetland – Birok headwaters	Fe _{dis}	-	0.349	0.851	0.740	0.892	0.454	0.981	0.742	0.565	0.484
		Fe ⁺²	-	0.163	0.377	2.12	1.04	0.722	0.491	0.391	0.182	0.130
		Fe ⁺³	-	0.377	0.410	0.172	1.042	1.021	0.762	0.366	0.291	0.130
	Wetland in Marucino – observation well 1	Fe _{dis}	-	0.164	-	0.622	-	-	-	0.482	0.528	0.421
		Fe ⁺²	-	0.114	-	0.412	-	-	-	0.340	0.400	0.180
		Fe ⁺³	-	0.019	-	0.701	-	-	-	0.890	0.460	0.340
	Wetland in Marucino – observation well 2	Fe _{dis}	-	not found	-	0.598	1.25	-	-	1.07	0.829	0.652
		Fe ⁺²	-	not found	-	0.260	0.570	-	-	1.69	0.337	0.360
		Fe ⁺³	-	not found	-	0.391	1.12	-	-	2.07	0.341	0.361
	Wetland in Marucino – observation well 3	Fe _{dis}	-	0.102	0.145	0.400	-	0.087	-	0.640	1.02	0.701
		Fe ⁺²	-	0.087	0.019	0.181	-	0.930	-	0.271	0.457	2.234
		Fe ⁺³	-	0.016	0.114	0.432	-	1.771	-	1.07	1.323	not found
	Wetland in Marucino – between wells 1 and 2	Fe _{dis}	-	-	-	-	-	-	-	-	1.05	-
		Fe ⁺²	-	-	-	-	-	-	-	-	0.302	-
		Fe ⁺³	-	-	-	-	-	-	-	-	0.639	-
	Wetland in Marucino – between wells 2 and 3	Fe _{dis}	-	-	-	-	-	-	-	-	0.926	-
		Fe ⁺²	-	-	-	-	-	-	-	-	0.854	-
		Fe ⁺³	-	-	-	-	-	-	-	-	2.162	-
	Underground water pumped in household in Marucino	Fe _{dis}	-	-	-	0.040	-	0.030	-	< 0.001	-	-
		Fe ⁺²	-	-	-	0.040	-	0.030	-	not found	-	-
		Fe ⁺³	-	-	-	not found	-	not found	-	not found	-	-
8	Dyke in 5 km upstream from Marucino	Fe _{dis}	-	-	-	0.102	0.220	-	-	-	-	-
		Fe ⁺²	-	-	-	0.060	0.110	-	-	-	-	-
		Fe ⁺³	-	-	-	not found	0.110	-	-	-	-	-
	Khor – bridge	Fe _{dis}	0.035	-	-	-	-	-	-	-	-	-
		Fe ⁺²	0.048	-	-	-	-	-	-	-	-	-
		Fe ⁺³	0.051	-	-	-	-	-	-	-	-	-
	Orochonok – bridge	Fe _{dis}	0.085	-	-	-	-	-	-	-	-	-
		Fe ⁺²	0.100	-	-	-	-	-	-	-	-	-
		Fe ⁺³	0.105	-	-	-	-	-	-	-	-	-
	Podkhoryonok – bridge	Fe _{dis}	0.105	-	-	-	-	-	-	-	-	-
		Fe ⁺²	0.078	-	-	-	-	-	-	-	-	-
		Fe ⁺³	0.081	-	-	-	-	-	-	-	-	-
	Sita – bridge	Fe _{dis}	0.075	-	-	-	-	-	-	-	-	-
		Fe ⁺²	0.033	-	-	-	-	-	-	-	-	-
		Fe ⁺³	0.020	-	-	-	-	-	-	-	-	-
	Julikha-1 – bridge	Fe _{dis}	0.050	-	-	-	-	-	-	-	-	-
		Fe ⁺²	0.048	-	-	-	-	-	-	-	-	-
		Fe ⁺³	0.059	-	-	-	-	-	-	-	-	-
	Julikha-2 – bridge	Fe _{dis}	0.056	-	-	-	-	-	-	-	-	-
		Fe ⁺²	0.061	-	-	-	-	-	-	-	-	-
		Fe ⁺³	0.065	-	-	-	-	-	-	-	-	-
	Marucino stream – bridge	Fe _{dis}	0.260	-	-	-	-	-	-	-	-	-
		Fe ⁺²	0.062	-	-	-	-	-	-	-	-	-
		Fe ⁺³	0.054	-	-	-	-	-	-	-	-	-
	Stream 59 th km – bridge	Fe _{dis}	0.062	-	-	-	-	-	-	-	-	-
		Fe ⁺²	0.070	-	-	-	-	-	-	-	-	-
		Fe ⁺³	0.078	-	-	-	-	-	-	-	-	-

Prominent correlation between flow rate in the rivers and total dissolved iron concentration in river water was not detected (Fig. 9 and 10).

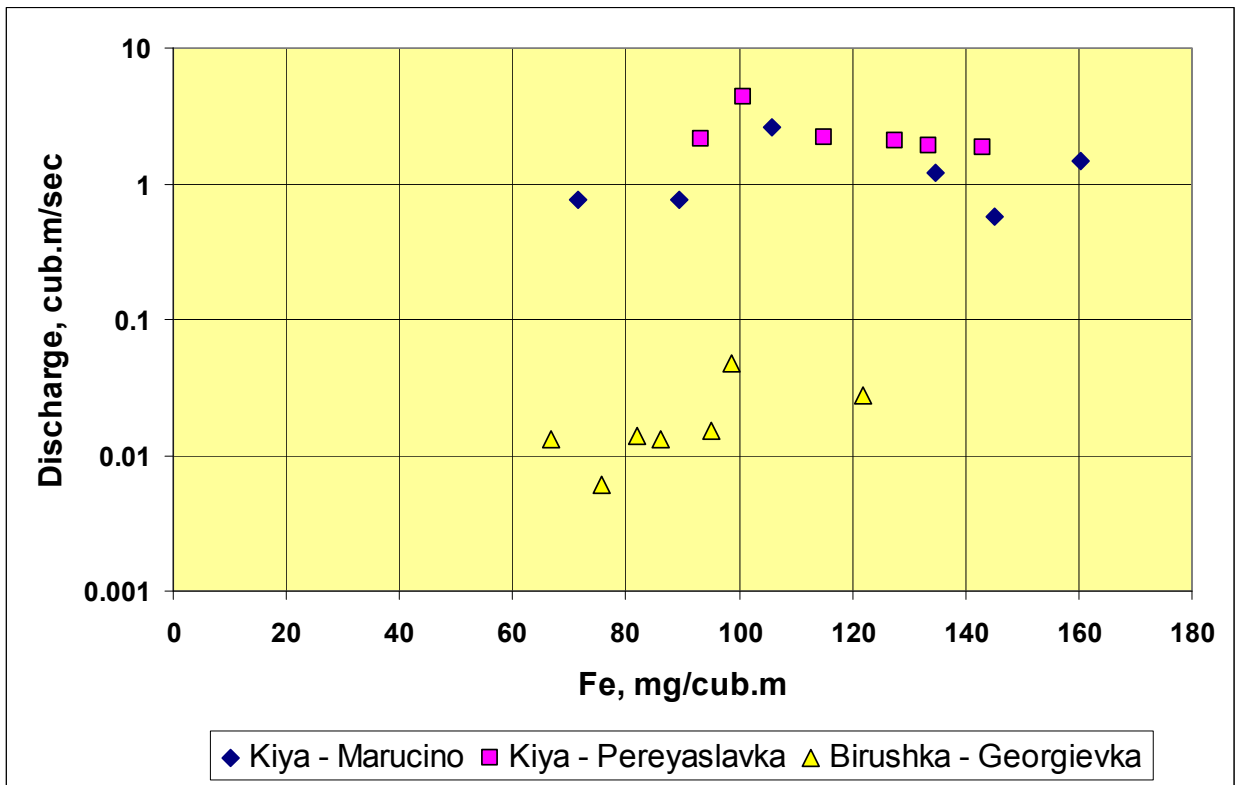


Fig. 9. Relation of total dissolved iron in river water to flow rate in case of low water conditions of 2008.

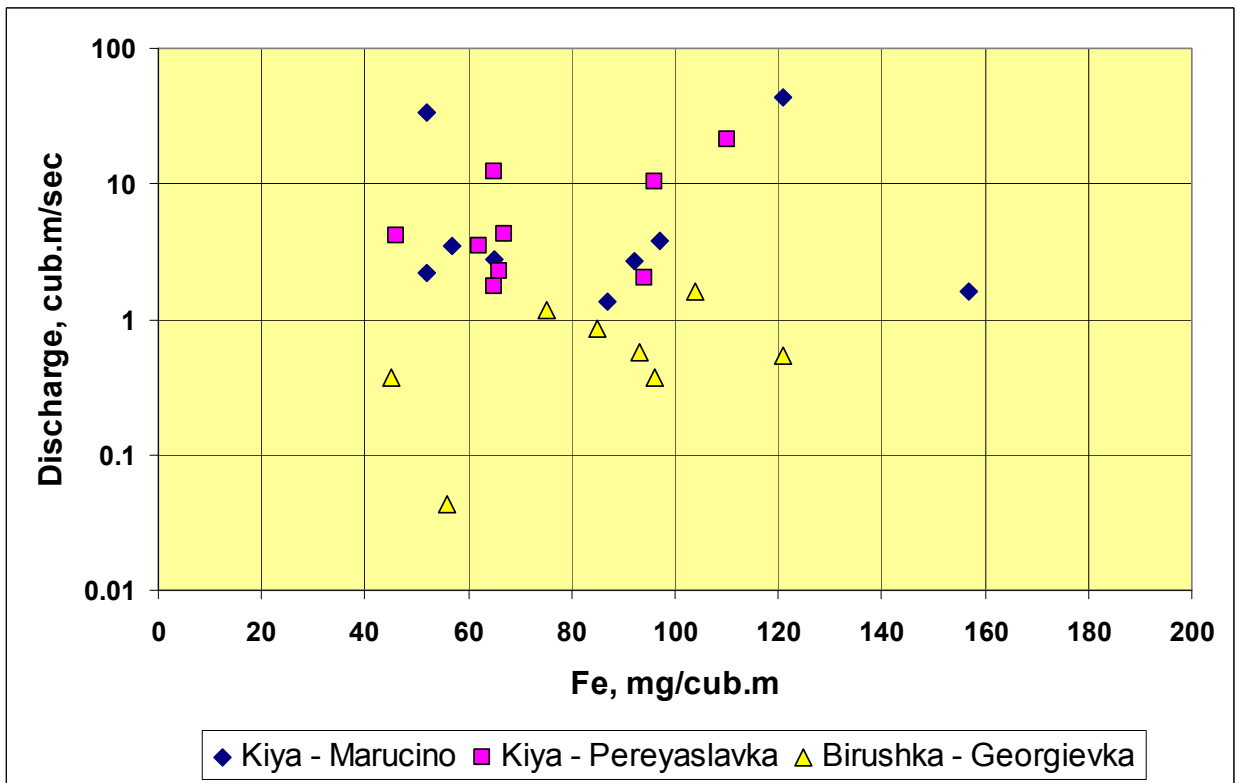


Fig. 10. Relation of total dissolved iron in river water to flow rate in case of flood conditions of 2009.

One can note that in low water conditions (2008) mobile iron seems to be slightly higher in rivers fed by low-mountainous headwaters against rivers with almost totally wetland watershed. In contrary, during a period of high floods in rivers when adjacent wetlands are swamped simultaneously (2009), there are no apparent differences in total dissolved iron between watersheds which differ physically.

Dissolved manganese was found to vary in water samples obtained on April 23 from zero to 47 mcg/L (Table 9). Factually, this metal appeared in water of three rivers with swampy watersheds: the Birushka at Vasilyevka, the Sita and the entirely swampy stream Marucino (where maximum value of Mn was detected). In the rivers observed in 2009 as in the rivers of the Gassi Lake watershed, manganese obviously migrates in major in ion forms, and the role of its organic complexes is considered to be negligible.

Dissolved cobalt was registered only once – in the Sita R. – to be as 0.46 mcg/L. Dissolved nickel was detected in fact in every sample despite of water of the Marucino R. Its content appeared to change through set of samples within diapason 0.06 – 7.11 mcg/L, and to be around background evaluations. Practically, just three water samples were found to contain dissolved copper, and its highest value (3.26 mcg/L) was revealed in the Kiya R. at Pereyaslavka. Low contents of Cu are quite typical for surface water of area considered [Trufanov & Korobiy, 1973].

Table 9. Trace metals (mcg/L) and TOC (mg C/L) in river waters sampled on 23.04.2009. NN are given according to Fig. 1.

NN	Site	TOC	Cu	Al	Mn	Co	Ni
7	Kiya - Pereyaslavka	10.9	3.26	116.55	< 0.001	< 0.001	7.11
6	Birushka - Georgievka	8.3	< 0.001	4.53	< 0.001	< 0.001	0.60
1	Birushka - Vasilyevka	10.5	< 0.001	< 0.001	25.34	< 0.001	0.50
3	Kiya - Marucino	17.0	< 0.001	67.00	< 0.001	< 0.001	0.65
	Khor – bridge	2.3	0.78	32.50	< 0.001	< 0.001	0.73
	Orochonok – bridge	12.8	< 0.001	185.38	< 0.001	< 0.001	1.22
	Podkhoryonok – bridge	12.2	< 0.001	120.42	< 0.001	< 0.001	0.54
	Sita – bridge	14.1	< 0.001	103.01	22.47	0.460	0.06
	Julikha-1 – bridge	10.1	2.47	80.77	< 0.001	< 0.001	0.41
	Julikha-2 – bridge	10.9	< 0.001	39.58	< 0.001	< 0.001	0.09
	Marucino stream – bridge	4.9	< 0.001	< 0.001	47.18	< 0.001	< 0.001
	Stream 59 th km – bridge	14.1	< 0.001	39.50	< 0.001	< 0.001	0.63

Dissolved aluminum was detected factually in every observed site excluding the Birushka R. at Vasilyevka and the Marucino R. This metal experienced rather high variability to vary from almost zero to 185 mcg/L (Table 9). The highest concentrations of Al characterized the Orochonok R. that could be probably related to low pH and higher TOC in water.

Phosphorus is held in water in inorganic form mainly (phosphate-ions) as well as organic and polymer forms. Inorganic phosphorus content is given in Table 10.

Phosphorus in river waters was varying from 0.044 through 0.237 mg/L whereas 0.248 mg/L of P was found in the dyke that was pouring water from drained wetlands into the Kiya R. upstream Marucino. The highest values of phosphorus were timed to the middle of summer supposedly because of the most intensive decay processes. The increased contents of P in rivers (for instance in the Kiya R. at Marucino) were found at the beginning of vegetation when microbial processes in melting soils were to rise up. As usual in inter-rain time the products of decay of organic matter accumulate, and during flood formation these products are brought to stream network. That is why phosphorus increases in river water at the beginning of flood. During long rainfalls the soil is over-wetted to inhibit the processes of decay of humus likewise commonly in soil of wetlands. Up to the end of August, the higher P in the Birushka R. draining

predominantly the wetlands, perhaps, was stipulated by flushing out of the soil P accumulated due to the oxidative conditions maintained somewhere during the previous draughty 2008. After the August flood, there was detected the depletion of phosphorus in rivers that could be determined by P consumption that prevailed P input.

P content in wetlands seemed to depend on moistening conditions – rainfall water diluted groundwater in wetlands, and, otherwise, in dry periods the decomposition of organic matter was to provide the extraction of dissolved phosphorus into ground water. It is notable that the highest P concentration (up to 1.5 mg/L and more) was found in the transient zone connecting a dense peaty wetland nearby Marucino (No 5 in Table 8) and a small forested terrace when rather rainless periods occurred. Obviously, it was due to the intensive decay of defunct matter.

Underground water appeared to contain a few of phosphorus – from almost 0 to 0.040 mg/L.

Table 10. Inorganic phosphor (phosphate-ions) (mg/L) in waters sampled in 2009. NN are given according to Fig. 1.

NN	Site	Date of water sampling									
		23.04	25.05	26.06	10.07	27.07	10.08	26.08	14.09	30.09	23.10
7	Kiya - Pereyaslavka	0.080	0.048	0.068	0.150	0.153	0.156	0.065	0.082	0.052	0.049
6	Birushka - Georgievka	0.046	0.065	0.044	0.099	0.160	0.121	0.078	0.075	0.071	0.078
1	Birushka - Vasilyevka	0.108	0.109	0.085	0.125	0.193	0.237	0.062	0.056	0.042	0.033
4	Wetland nearby Marucino	-	0.130	0.098	0.230	0.124	0.390	0.065	0.033	0.039	0.033
5	Transient zone in wetland nearby Marucino	-	1.430	0.783	0.231	1.510	1.109	0.169	1.521	0.582	0.419
3	Kiya - Marucino	0.056	0.160	0.052	0.091	0.045	0.130	0.095	0.075	0.038	0.048
2	Wetland – Birok headwaters	-	0.044	0.048	0.440	0.032	0.013	0.042	0.023	0.010	not found
	Wetland in Marucino – observation well 1	-	0.013	-	0.563	-	-	-	0.026	0.065	0.085
	Wetland in Marucino – observation well 2	-	-	-	0.270	1.040	-	-	0.130	0.083	0.153
	Wetland in Marucino – observation well 3	-	0.008	-	0.310	-	0.013	-	0.364	0.124	0.174
	Wetland in Marucino – between wells 1 and 2	-	-	-	-	-	-	-	-	0.051	-
	Wetland in Marucino – between wells 2 and 3	-	-	-	-	-	-	-	-	0.053	-
	Underground water pumped in household in Marucino	-	-	-	0.040	-	not found	-	0.026	-	-
8	Dyke in 5 km upstream from Marucino	-	-	-	0.225	0.248	-	-	-	-	-
	Khor – bridge	0.052	-	-	-	-	-	-	-	-	-
	Orochonok – bridge	0.073	-	-	-	-	-	-	-	-	-
	Podkhoryonok – bridge	0.098	-	-	-	-	-	-	-	-	-
	Sita – bridge	0.078	-	-	-	-	-	-	-	-	-
	Julikha-1 – bridge	0.044	-	-	-	-	-	-	-	-	-
	Julikha-2 – bridge	0.101	-	-	-	-	-	-	-	-	-
	Marucino stream – bridge	0.052	-	-	-	-	-	-	-	-	-
	Stream 59 th km – bridge	0.062	-	-	-	-	-	-	-	-	-

Nitrate ions determined in the Kiya R. were found to experience seasonal dynamics (Table 11). According to development of production processes, it demonstrated depletion to the middle of summer and rise whilst autumn cancellation of production. In wetlands this regularity was found to be disturbed in terms of nitrate flashes as in the Birok headwaters on October 14 and in transient zone in wetland nearby Marucino on July 10. The latter probably could be a result of inflow of products of decay of organic matter from the forested terrace within the soil

water.

Extremely high nitrate concentration in underground water in Marucino was registered because of contamination of fertilizer piles left in the open air in 2007-2008 (according to local people's communication). Perhaps, the increased nitrite ions there (Table 12) could occur by the same reason.

Table 11. Nitrate ions (NO_3^-) (mg/L) in waters sampled in 2009. NN are given according to Fig. 1. High concentrations are noted by bold font.

NN	Site	Date of water sampling									
		23.04	25.05	26.06	10.07	27.07	10.08	26.08	14.09	30.09	23.10
7	Kiya - Pereyaslavka	1.23	0.28	0.38	0.63	0.49	0.66	0.76	1.31	1.41	2.01
6	Birushka - Georgievka	0.42	0.29	0.18	0.21	1.43	0.15	0.43	0.30	0.60	1.42
1	Birushka - Vasilyevka	0.10	0.13	0.46	0.14	0.35	0.12	0.30	0.30	0.35	0.80
4	Wetland nearby Marucino	–	0.56	0.42	0.23	0.26	0.35	0.27	0.15	0.18	1.63
5	Transient zone in wetland nearby Marucino	–	0.25	0.19	4.05	0.36	0.47	0.18	0.20	0.46	1.03
3	Kiya - Marucino	1.70	0.84	0.42	0.28	0.60	0.71	0.19	1.30	1.47	1.14
2	Wetland – Birok headwaters	–	0.35	0.42	0.31	0.55	0.15	0.19	1.51	0.21	0.48
	Wetland in Marucino – observation well 1	–	0.53	–	0.25	–	–	–	0.20	0.15	0.43
	Wetland in Marucino – observation well 2	–	–	–	0.21	–	–	–	0.15	0.23	1.22
	Wetland in Marucino – observation well 3	–	0.83	–	0.25	–	0.40	–	0.15	0.42	2.75
	Wetland in Marucino – between wells 1 and 2	–	–	–	–	–	–	–	–	0.26	–
	Wetland in Marucino – between wells 2 and 3	–	–	–	–	–	–	–	–	0.32	–
	Underground water pumped in household in Marucino	–	–	–	19.22	–	10.33	–	16.15	–	12.98
8	Dyke in 5 km upstream from Marucino	–	–	–	1.26	1.23	–	–	–	–	–
	Khor – bridge	2.24	–	–	–	–	–	–	–	–	–
	Orochonok – bridge	3.07	–	–	–	–	–	–	–	–	–
	Podkhoryonok – bridge	1.38	–	–	–	–	–	–	–	–	–
	Sita – bridge	2.92	–	–	–	–	–	–	–	–	–
	Julikha-1 – bridge	1.26	–	–	–	–	–	–	–	–	–
	Julikha-2 – bridge	1.26	–	–	–	–	–	–	–	–	–
	Marucino stream – bridge	0.18	–	–	–	–	–	–	–	–	–
	Stream 59 th km – bridge	1.93	–	–	–	–	–	–	–	–	–

As a whole nitrite behavior in the rivers seemed to depend on moisture conditions to be lowered when flood occurred. Nitrite ions in wetlands experienced not so prominent regularities (Table 12).

Table 12. Nitrite ions (NO_2^-) (mg/L) in waters sampled in 2009. NN are given according to Fig. 1. High concentrations are noted by bold font.

NN	Site	Date of water sampling									
		23.04	25.05	26.06	10.07	27.07	10.08	26.08	14.09	30.09	23.10
7	Kiya - Pereyaslavka	0.014	0.011	0.010	0.019	0.008	0.021	0.013	0.017	0.016	0.020
6	Birushka - Georgievka	0.021	0.011	0.007	0.012	0.008	0.016	0.009	0.014	0.012	0.023
1	Birushka - Vasilyevka	0.021	0.007	0.004	0.013	0.005	0.016	0.018	0.009	0.013	0.018
4	Wetland nearby Marucino	–	0.027	0.005	0.018	0.034	0.036	0.012	0.011	0.011	0.013
5	Transient zone in wetland nearby Marucino	–	0.033	0.004	0.027	0.011	0.094	0.016	0.028	0.021	0.011

NN	Site	Date of water sampling									
		23.04	25.05	26.06	10.07	27.07	10.08	26.08	14.09	30.09	23.10
3	Kiya - Marucino	0.014	0.014	0.007	0.013	0.019	0.022	–	0.011	0.017	0.017
2	Wetland – Birok headwaters	–	0.011	0.007	0.012	0.030	0.025	0.020	0.010	0.010	0.013
	Wetland in Marucino – observation well 1	–	0.007	–	0.028	–	–	–	0.009	0.016	0.042
	Wetland in Marucino – observation well 2	–	–	–	0.014	–	–	–	0.014	0.053	0.032
	Wetland in Marucino – observation well 3	–	0.006	–	0.017	–	0.064	–	0.015	0.028	0.057
	Wetland in Marucino – between wells 1 and 2	–	–	–	–	–	–	–	–	0.005	–
	Wetland in Marucino – between wells 2 and 3	–	–	–	–	–	–	–	–	0.091	–
	Underground water pumped in household in Marucino	–	–	–	0.021	–	0.036	–	0.066	–	0.020
8	Dyke in 5 km upstream from Marucino	–	–	–	0.021	0.036	–	–	–	–	–
	Khor – bridge	0.013	–	–	–	–	–	–	–	–	–
	Orochonok – bridge	0.009	–	–	–	–	–	–	–	–	–
	Podkhoryonok – bridge	0.010	–	–	–	–	–	–	–	–	–
	Sita – bridge	0.016	–	–	–	–	–	–	–	–	–
	Julikha-1 – bridge	0.025	–	–	–	–	–	–	–	–	–
	Julikha-2 – bridge	0.004	–	–	–	–	–	–	–	–	–
	Marucino stream – bridge	0.011	–	–	–	–	–	–	–	–	–
	Stream 59 th km – bridge	0.009	–	–	–	–	–	–	–	–	–

Si in river and in wetland waters was getting higher from the beginning to the middle of summer thanks to intensive decay of organic matter, and then Si was depleting in autumn (Table 13). Besides, in wetlands excluding the wetland in the Birok R. headwaters, silicium was found to be some increased against rivers and to experience prominent dilution by rainfalls at the end of June and after diminishing in September the evident grow up again in October. Si in underground water in Marucino appeared to be rather stable during summer and close to wetlands.

Table 13. Silicium (SiO₂) (mg/L) in waters sampled in 2009. NN are given according to Fig. 1.

NN	Site	Date of water sampling									
		23.04	25.05	26.06	10.07	27.07	10.08	26.08	14.09	30.09	23.10
7	Kiya - Pereyaslavka	5.91	4.63	4.33	6.87	7.40	7.70	6.57	5.43	7.02	7.25
6	Birushka - Georgievka	3.64	2.48	3.73	6.57	6.81	8.15	4.78	4.63	4.93	5.58
1	Birushka - Vasilyevka	3.46	2.60	3.28	3.52	5.82	7.37	6.42	4.03	4.33	5.67
4	Wetland nearby Marucino	–	4.03	1.05	7.02	9.79	8.00	8.36	3.13	2.84	3.28
5	Transient zone in wetland nearby Marucino	–	6.81	1.64	9.94	7.46	7.31	8.81	7.61	7.76	14.90
3	Kiya - Marucino	5.61	5.91	3.00	7.31	7.52	7.61	7.16	6.72	7.31	7.43
2	Wetland – Birok headwaters	–	1.25	0.60	2.69	3.43	3.52	3.19	2.09	1.19	1.94
	Wetland in Marucino – observation well 1	–	0.73	–	10.45	–	–	–	3.28	1.79	8.45
	Wetland in Marucino – observation well 2	–	–	–	8.96	–	–	–	2.69	3.28	5.37
	Wetland in Marucino – observation well 3	–	0.60	–	8.51	–	10.45	–	2.54	3.73	5.67
	Wetland in Marucino – between wells 1 and 2	–	–	–	–	–	–	–	–	3.00	–
	Wetland in Marucino – between wells 2 and 3	–	–	–	–	–	–	–	–	–	–
	Underground water pumped in	–	–	–	8.15	–	7.91	–	6.42	–	8.51

NN	Site	Date of water sampling									
		23.04	25.05	26.06	10.07	27.07	10.08	26.08	14.09	30.09	23.10
	household in Marucino										
8	Dyke in 5 km upstream from Marucino	–	–	–	6.57	6.96	–	–	–	–	–
	Khor – bridge	5.22	–	–	–	–	–	–	–	–	–
	Orochonok – bridge	4.57	–	–	–	–	–	–	–	–	–
	Podkhoryonok – bridge	3.43	–	–	–	–	–	–	–	–	–
	Sita – bridge	4.12	–	–	–	–	–	–	–	–	–
	Julikha-1 – bridge	4.42	–	–	–	–	–	–	–	–	–
	Julikha-2 – bridge	4.63	–	–	–	–	–	–	–	–	–
	Marucino stream – bridge	6.42	–	–	–	–	–	–	–	–	–
	Stream 59 th km – bridge	5.37	–	–	–	–	–	–	–	–	–

The table 14 below contains some main ions as well as electric conductivity of river water obtained in April 2009. The specified electric conductivity is known to correlate with total mineralization. But, it is difficult to explain rather high electric conductivity in such swampy rivers as the Birushka at Vasilyevka and Marucino stream.

Table 14. Some water quality indexes (mg/L) in rivers observed on April 23, 2009. NN are given according to Fig. 1.

NN	River – site	Specified electric conductivity (KCl), $\mu\text{Sm/cm}$	Ca^{2+}	Mg^{2+}	HCO_3^-	NH_4^+	Cl^-
7	Kiya - Pereyaslavka	56.7	4.2	2.0	21.2	0.37	1.4
3	Kiya - Marucino	41.1	3.7	1.6	17.9	0.56	1.1
6	Birushka - Georgievka	45.8	3.0	1.8	19.4	0.41	1.3
1	Birushka - Vasilyevka	64.3	4.9	1.6	32.0	0.94	2.1
	Khor – bridge	42.5	4.0	2.1	17.1	0.28	0.9
	Orochonok – bridge	36.3	3.0	1.8	9.4	0.59	1.2
	Podkhoryonok – bridge	43.9	3.3	1.9	14.0	0.52	1.1
	Sita – bridge	63.3	3.6	1.6	9.6	0.59	2.4
	Julikha-1 – bridge	42.5	3.3	1.2	10.4	0.50	1.6
	Julikha-2 – bridge	50.8	2.4	1.6	17.2	0.39	1.8
	Marucino stream – bridge	75.4	6.5	3.6	47.1	0.30	1.6
	Stream 59 th km – bridge	39.5	3.8	1.5	8.4	0.60	1.4

4. Conclusion

Thus, during hard rainfalls in June, second half of July and second half of August of 2009, the river and wetland water diluting by the atmospheric moisture was registered. During the flood recessions occurred in the beginning of July, in early August and through September and October, terrigenous and autochthonous TOC, mobile forms of iron and some other chemical compounds were detected to be flush out to rivers with gradual depletion of most of them to the end of vegetation period. Distribution of iron and manganese in waters is quite typical for considered area. Manganese is able to be accumulated in soil water mainly due to pH decrease.

Predominantly low iron and trace metal concentrations in river waters were stipulated by soil conditions and appeared to not depend on moisture conditions. Groundwater in wetlands was found to be rich in iron compared to river water and to experience the diluting by atmospheric water when rainfalls occurred.

The underground water located beneath the Kiya River hinterland nearby Marucino was lean in TOC, iron and other chemicals, but evidently is contaminated by nitrogen compounds flushed out from fertilizer piles that were left in the open air in 2007-2008 there.

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Appendixes

1. The Kiya R. water level datasheets from logger. Marucino.
2. The Kiya R. water level datasheets from logger. Pereyaslavka.
3. Groundwater level datasheet from loggers. Wetland in Marucino.
4. Description of soils in the Kiya R. basin with total N included.