COMPARATIVE ANALYSIS OF TRACE ELEMENT CONTENT IN IVANOVO REGION MOSSES AND SOILS

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The anthropogenic impact affects the atmosphere and soil in equal measure. However the pollutants can be easily removed from the air with precipitation and contaminate the soil. The reverse direction is insignificant usually. Soil also has a greater ability to collect some toxic elements inside. The pollutants stay for a long time in soil and its quality helps to assess the long-term anthropogenic stress. Otherwise the atmospheric air quality is the key for the short-term monitoring. The difficulties with the sampling of air cause using indirect methods such as briomonitoring instead of the direct ones. This work is concerned with the comparative study of soil and air quality in Ivanovo region.

The moss briomonitoring technique is used for control the quality of atmosphere. All sampling procedures were made according UNECE manual. We used recommended moss species *Hylocomium splendens*, *Pleurozium schreberi*, and *Polytrichum commune*. Soil samples were collected using Russian standards for environmental monitoring.

Ivanovo region situated in the interfluve of the Volga and Klyaz'ma rivers with an area of 22 000 km^2 was the object of the investigation. 48 samples of soil and 25 samples of moss were collected in 2010. Sampling grid on average was about 20 km (Fig. 1).

Fig. 1. Sampling map.

The analysis of element content was carried out with the use of flame atomic absorption spectrometry (AAS) and neutron activation analysis (NAA). Determination uncertainties were about 20-30% for AAS and 5-15% for NAA. The concentrations of gross and movable forms of metals in soil were determined after extraction by HNO_3 and acetate-ammonia buffer with pH=4.8, respectively.

Values of HM content in moss were compared with the results of the research in Yaroslavl, Tver', Tula region and Republic of Udmurtia. In fact, level of heavy metals (HM) content in Ivanovo region was very close to neighbor regions for all observed elements.

The concentrations of some heavy metals gross forms in Ivanovo region soil are depicted on Table 1. The local background concentrations were calculated as average value among ten lowest concentrations. They are compared with literature data. It was established that Ivanovo region background concentrations were sufficiently lower than published ones. However the manganese content in some sampling sites is higher rather than maximum permissible concentrations. It is dealt with the increased natural content of this element in Ivanovo region soils.

Table 1. Comparison of metal content (mg/kg) in soils of Ivanovo region with background concentrations

Element	**Mean**	**Min-Max**	**lbg**	**MPC_s**	**bg[1]**	**bg[2]**
Cr	55	17-95	39	-	140	70
Mn	750	14-1610	343	1500	650	750
Ni	16	3.3-39.0	6.8	80	51	37.3
Co	7	1.5-11.2	4.5	-	7.2	15
Zn	39	10-74	23	220	49	74
Mo	0.6	0.2-1.1	0.4	-	1.5	0.5
V	34	3-62	20	150	72	-
Cu	6	0.2-20	1.6	132	23	24.9
Cd	0.028	0.002-0.167	ND	2	0.3	0.375
Pb	0.23	0.02-3.32	ND	32	19	30

The comparison of our data with the results of soil quality investigations in neighboring regions was also done. It was revealed that elemental content in soils of Ivanovo region is smaller than in other regions, except manganese (Table 2). The Nizniy Novgorod soil is the closest to Ivanovo region soil. This fact successfully supplements previously obtained data on the contaminant concentrations in snow.

The vanadium content in mosses and soil has maximum level in the Northern-West part of region. Unfortunately, we did not collect moss samples in Privolzhsk and Furmanov districts and can't do a direct comparison. However the vanadium concentration in mosses of neighboring Kineshma and Vichuga districts indicates the strong anthropogenic impact. The results of detailed investigation of soil quality in Furmanov and Privolzhsk districts are shown at Fig. 2. The influence of the industrial activity from the town of Furmanov and town of Privolzhsk was studied. It was established that the main source of contamination is situated somewhere outside this districts.

Table 2. Comparison of metal content (mg/kg) in soils of Ivanovo and neighboring regions

Metal Year	**Kostroma, 2010 [3]**	**Vladimir, 2000 [4]**	**Nizniy Novgorod, 2007 [5]**	**Ivanovo, 2010 [6]**	**MPC$_s$ (APC$_s$)**
Cr	73	80	12	55	-
Mn	650	692	-	750	1500
Fe	18000	27700	-	12100	-
Co	16	6	-	7	-
Ni	23	29	21	16	(80)
Cu	23	-	8	6	(132)
Zn	48	47	26	39	(220)
Cd	-	-	0,39	0,03	(2)
Pb	-	16	6,17	0,23	32

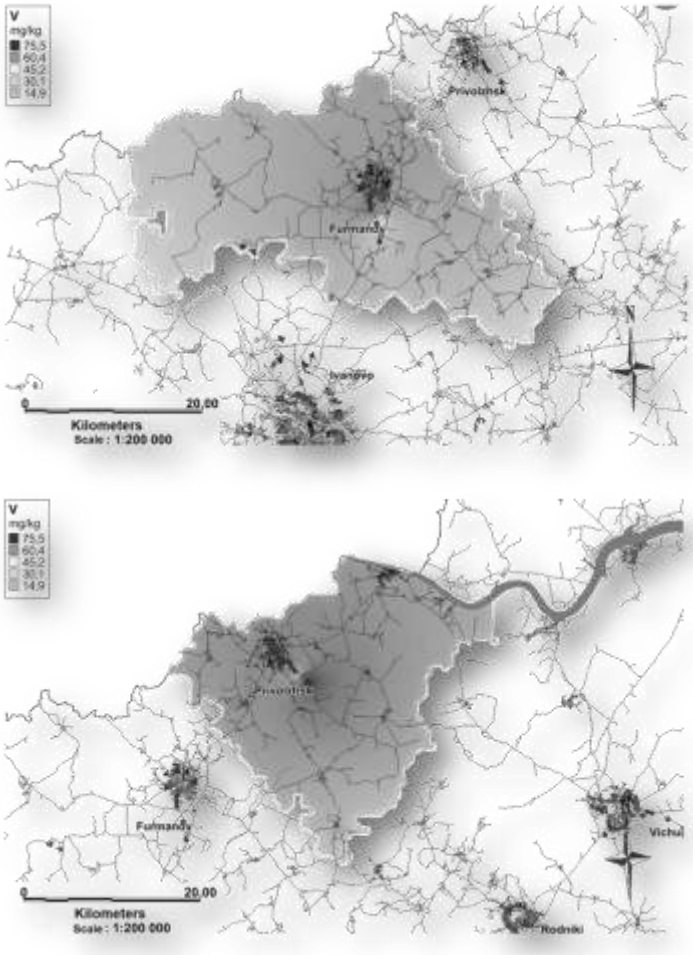

Fig. 2. Vanadium content (mg/kg) in soil of Furmanov and Privolzhsk districts of Ivanovo region.

The explanation of this element arrival may be done in following way. The Volgorechensk power station which is one of the largest at this territory situated near abovementioned districts. The wind transfer promotes scattering of the combustion products at the territory of Ivanovo region. The vanadium and nickel are one of them.

The factor analysis made to detect potential origins of some contaminants also revealed that along with Volgorechensk activity there is another source of toxic element arrival. It was fixed for the samples collected at the territory of natural wildlife preserve "Klyazminskiy". In the beginning it was incomprehensibly what is the reason of this situation.

Nevertheless a hypothesis was postulated that river Klyazma was the source of these metals arrival at flood time. At slide one may see how to change the appearance of this river in spring.

On a basis of this theory the samples of soil and moss from sites, which never being flooded and lowland were taken. Copper, manganese and nickel concentrations into the soil samples from lowlands were higher than permissible levels. It is interesting that this increased element content was fixed for movable forms, which can be formed under water influence. For all samples metal content in the lowlands is higher than in the upland that prove our hypothesis.

Otherwise the concentrations in mosses were very close to each other that exclude the atmospheric way of contamination. Also it was established that concentrations of the elements in moss of preserve were less than those for Ivanovo region as whole confirming good quality of atmospheric air in preserve.

In conclusion analysis of trace element content in soils and mosses of Ivanovo region made by NAA and AAS revealed high level of environmental quality in Ivanovo region in comparison with neighboring regions. The potential sources of air and soil pollution have been suggested by factor analysis and environmental assessment

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