Risk calculation for human health in Belarus based on the results of moss biomonitoring technique

Yulia Aleksiayenak

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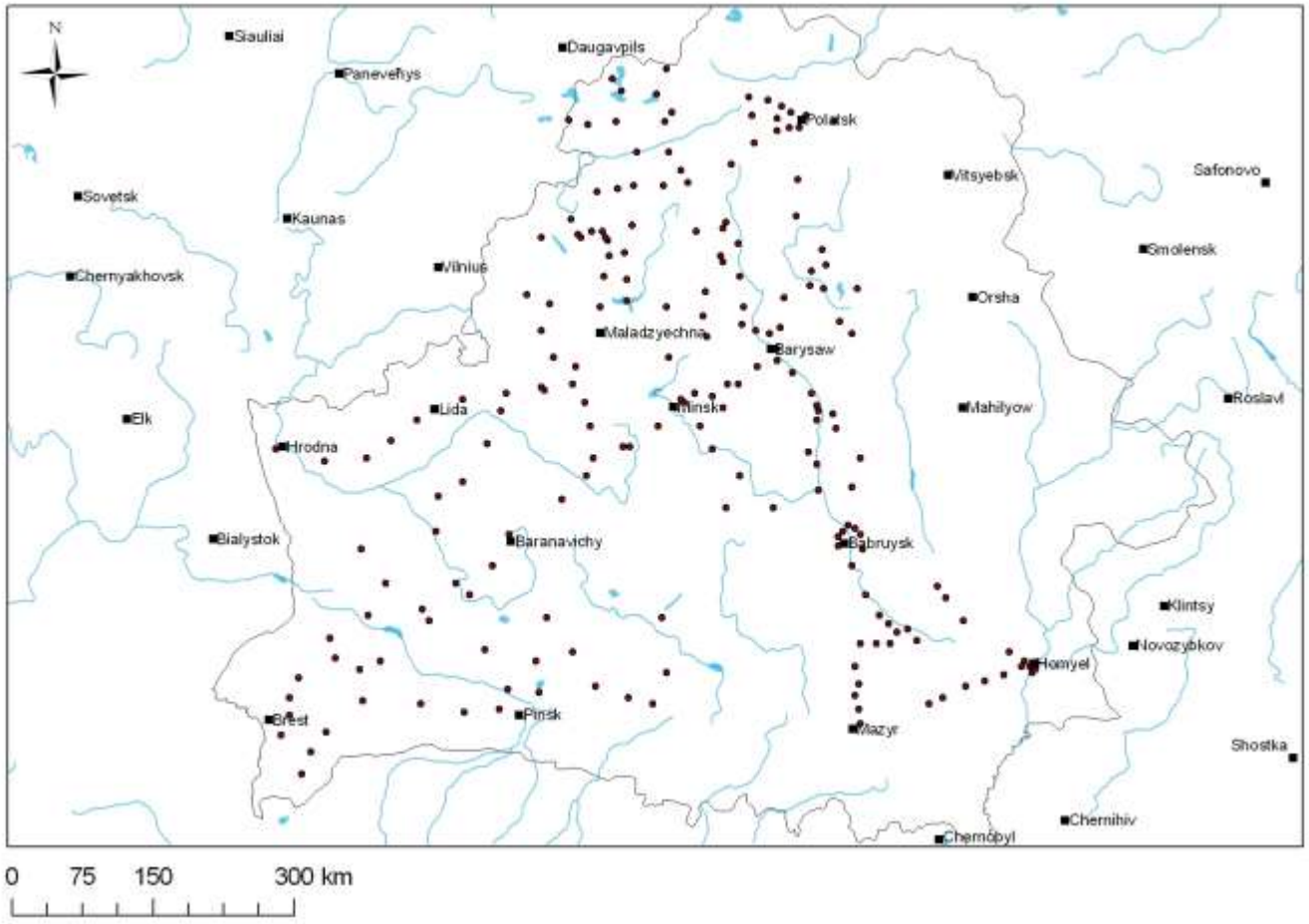
Sampling map



Baseline data

- Our data in 156 sampling sites

for 36 elements - C_{moss} mg/kg

- Official data:

- Annual emission of As, Cd, Cr, Cu, Hg, Ni, Pb, Zn in tons;
- Concentration in precipitation for Na, K, Ca, Mg - C_{atm} mg/l

Estimation of elements deposition concentration, kg/km^2

	As	Cd	Cr	Cu	Ni	Pb	Zn
Official data	0,006	0,012	0,041	0,050	0,283	0,275	1,428
Our results	0,016	0,022	0,218	0,478	0,080	0,238	3,882

$$C_{dep} = C_{moss} * g/1000 * Ks$$

g = 50 g/m^2– density of **moss coverage**
Ks – amount of **forests in region**

Estimation of elements precipitation concentration, mg/l

	Na	K	Ca	Mg
Official data	0,90	0,70	2,04	0,30
Our results	27	1189	492	83

Also Na, K, Mg, Ca belongs to *s-elements,* which are of global significance and biologically essential, so they have different accumulation capacity in comparison with other elements.

Estimation of the risk parameters

Human health risk

We use human health risk models ones presented by USEPA:

- Probability of unfavorable events occurrence (HQ, CR)
- Economic Damage to Health (risks and average cost of living)
- Loss in Life Expectancy (LLE)

The calculation was made for all adult population

Human health risk

Calculation of individual carcinogenic risk (**CR**) is carried out using data on the magnitude of exposure and the values of the **factors of the carcinogenic potential (SF_a)** :

$$CR = LADD * SF;$$

***LADD* – *average daily lifetime dose*.**

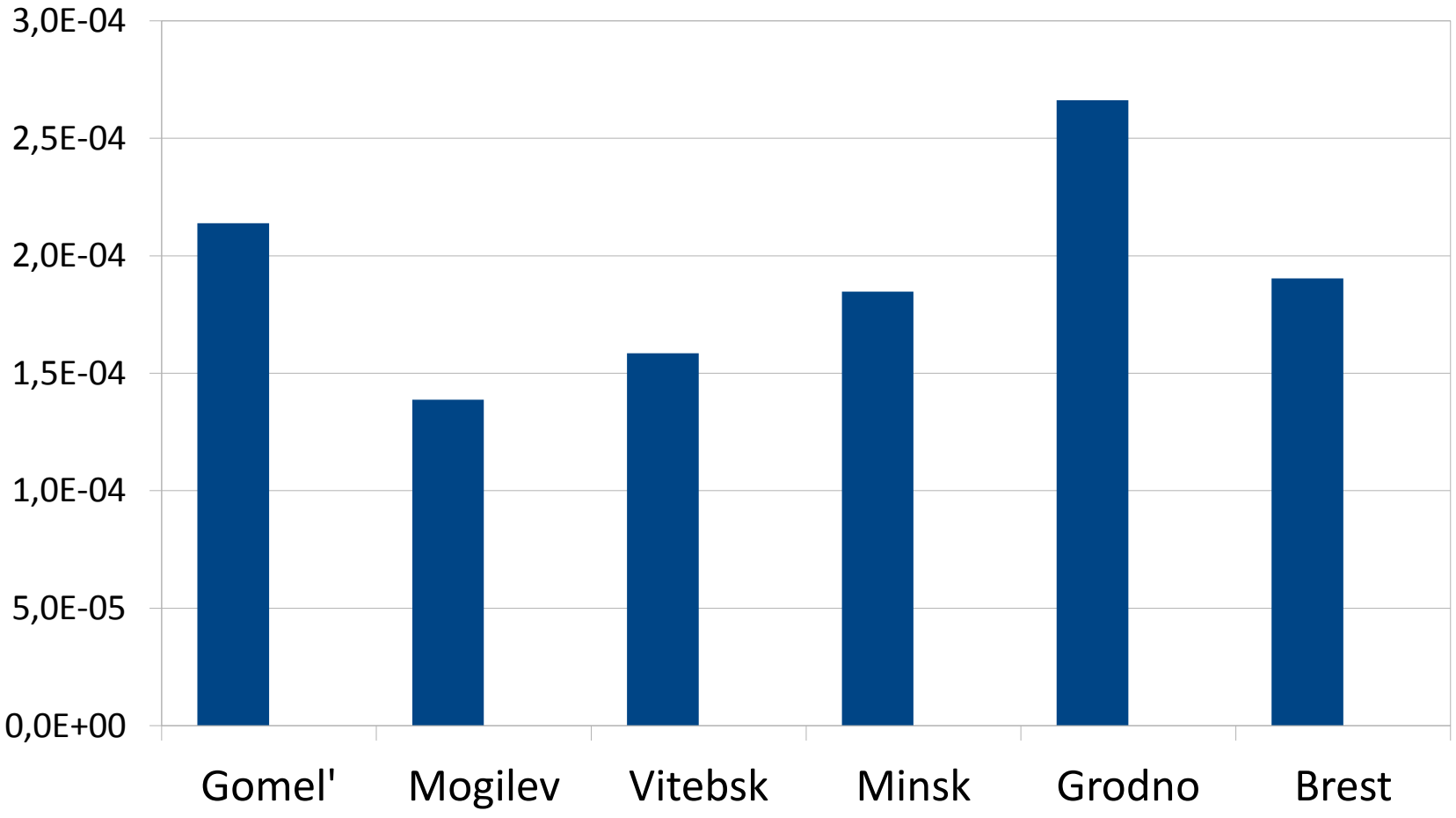
The risk of non-carcinogenic effects (**HQ**)

$$HQ = AD / RfD;$$

***AD* - *average daily lifetime dose*, *RfD* – *reference dose*.**

SF and RfD values are advisory and depend only on the nature of the toxicant and the method of its receipt.

Individual carcinogenic risk, **CR**



Carcinogenic risk of heavy metals for adults (inhalation)

	Pb	Cr	Co	Ni	As	Cd
CR_{BY}	1,89E-07	1,73E-04	4,55E-06	1,27E-06	4,65E-06	2,62E-06
CR_{PRC}	-	5.6E−05	-	-	1.2E−05	1.5E−06
CR_{IN}	-	5.4E−05	-	1.9E−04	-	0.6E−06
SF	0,042	42	9,8	0,84	15	6,3

∑CR = 0,0012

***De minimis* human health risk** - excess cancer risk less than or equal to 10^{-6}

Intermediate human health risk - excess cancer risk between 10^{-4} and 10^{-6}

***De manifestis* human health risk** - excess cancer risk greater than or equal to 10^{-4}

Public health risk

Loss in Life Expectancy (LLE)

$$LLE = (T_{mean} - A_{mean}) * (HQ + CR)$$

T_{mean} – *average life expectancy of the target population, years;*
A_{mean} – *the average age of the target group, years;*

Economic Damage to Health (risks and average cost of living)

$$R = LLE * N * ALC$$

N – the number of people in the group;
ALC – the average living costs, $.

$$ALC = GDP_{BY} / N_{BY} \cdot T_{Mean}$$

Risks calculation in Belarus

Conclusions:

1. **LLE** **=** 14 days

2. **R** **=** 19 $ per person (economic damage to health)

3. Estimation of elements concentration is different by order of magnitude in comparison with official data

4. Values of **CR** obtained for Belarus are comparable with data received by usual methods in other countries.