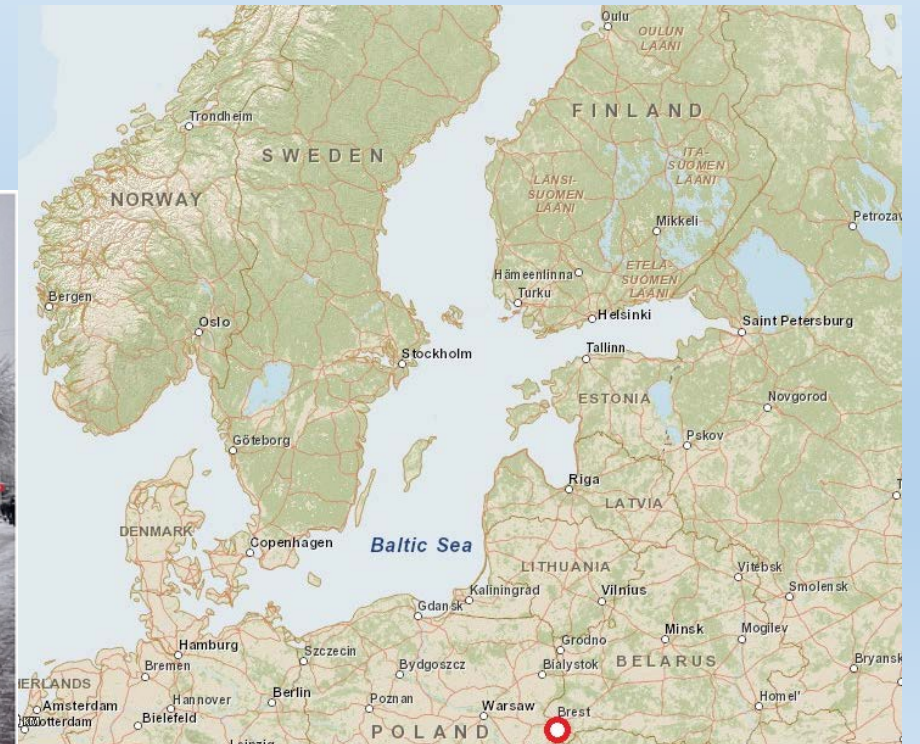
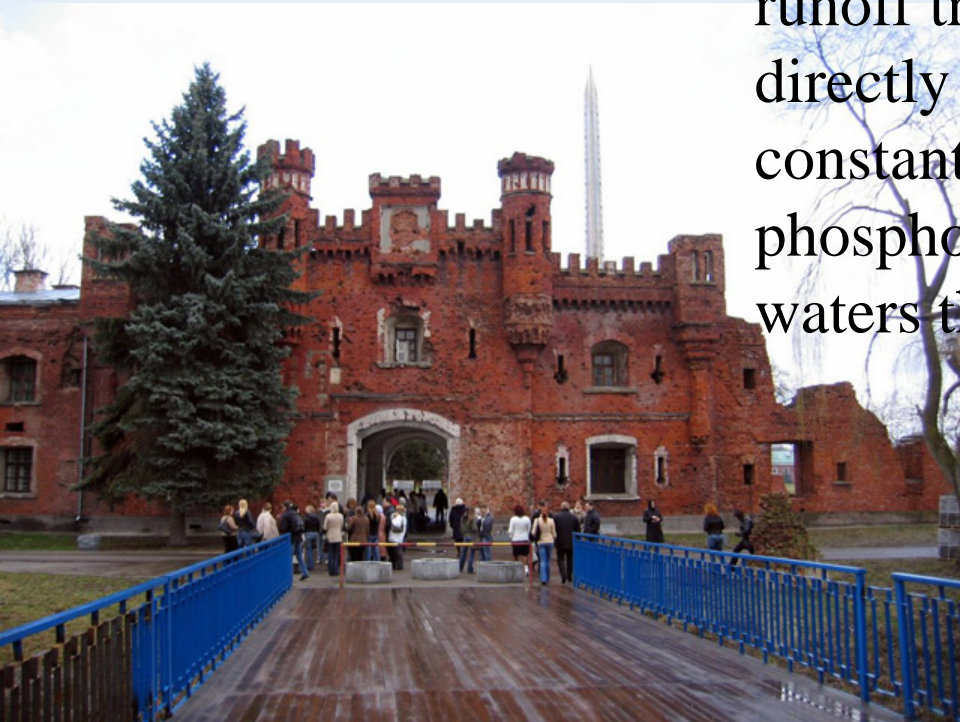


Urban snow and snowmelt runoff inorganic pollution and its impact on the receiving river in the city of Brest, Belarus

Ina Bulskaya
Alexandr A. Volchek

Objective

The drainage system of the city of Brest was designed in the middle of XX century, when little attention was paid to surface runoff treatment, majority of drainage collectors bring their runoff directly to the river Muhavets. Waters of r. Muhavets have constantly elevated levels of such components as inorganic phosphorus and nitrogen despite the fact that amounts of waste waters that are discharged to r. Muhavets are annually reduced.



- The aim is to study snow, snow cover and snowmelt runoff inorganic constituents on the urbanized territories and to point out components that can present a potential environmental threat.
- Concentrations of inorganic ions such as chlorides, phosphates, nitrates and ammonium, heavy metals (HM) as well as suspended solids (SS) and pH were measured in samples of snow, snow cover and snowmelt runoff.
- Results were compared to national regulation – maximum permissible concentrations (MPC) for fish-breeding waters.



Materials and methods

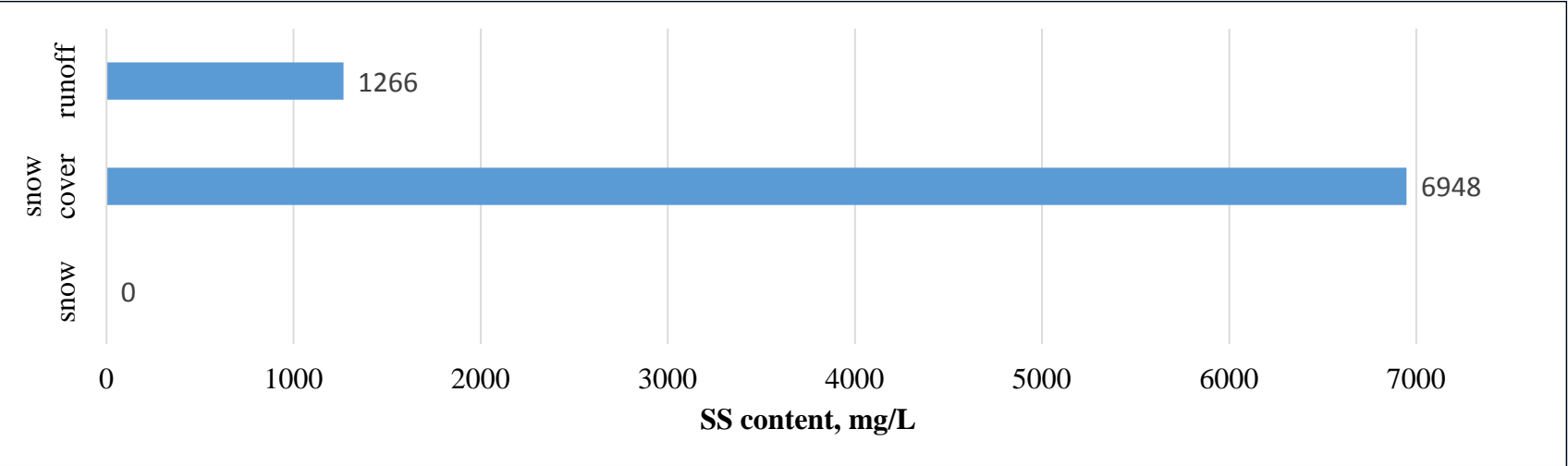
- As sample points territories with different functions typical for urbanized area were chosen in the city of Brest. Samples of snow were taken during the snowfall periods in clean plastic vessels; snow was melted and analyzed during 24 hours. Samples of snow cover were taken at the same points in clean plastic vessels, discarding the very top snow layer, melted and analyzed the same way that the snow samples. Samples of snowmelt effluents were taken in the ends of drainage pipes that carry effluent from target points to the river Muhavets.
- SS were measured by gravimetric method. Chlorides were measured by titrimetric method. Nitrates, phosphates and ammonium were measured by photometric method. HM were measured by AAS.

Results and discussion

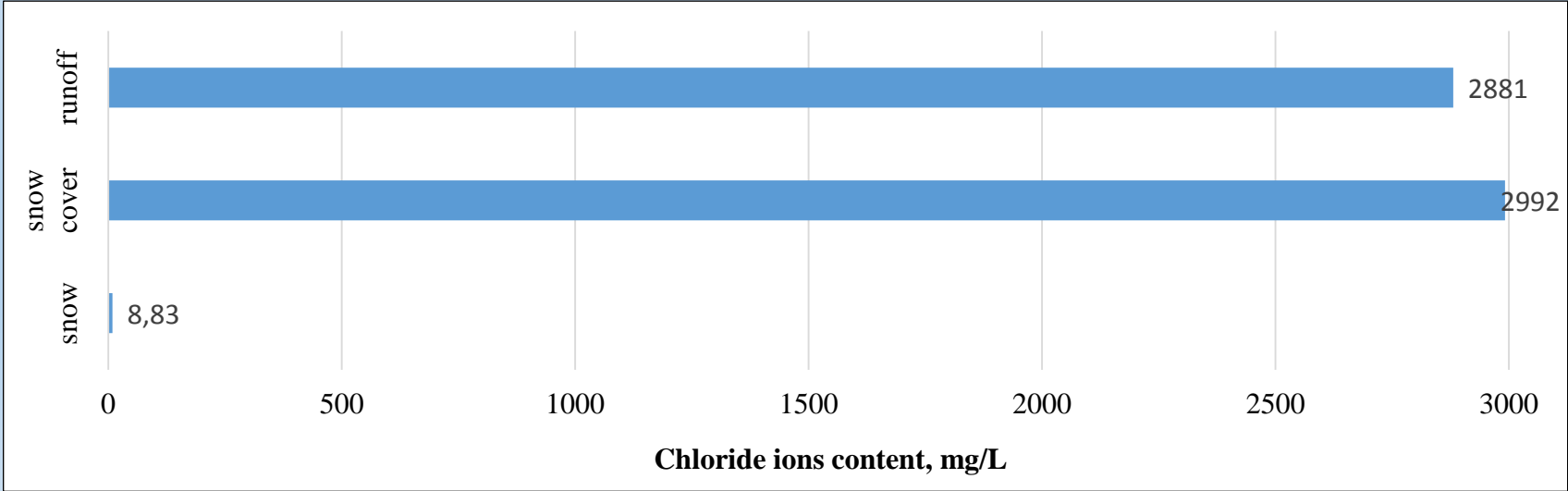
- In snow samples chlorides, nitrates, phosphates, ammonium ions and HM were identified.
- Main source of precipitation pollution on the territory of Belarus is Western atmospheric transport.

Pollutant	pH	Cl ⁻	NO ₃ ⁻	PO ₄ ³⁻	NH ₄ ⁺	Mn	Zn	Fe	Co	Cr
Concentration, mg/L	6,57	8,83	0,37	1,37	0,26	0,005	0,481	0,112	0,051	0,002

SS and chloride ions are the priority pollutants both in snow cover samples and in snow melt runoff



A

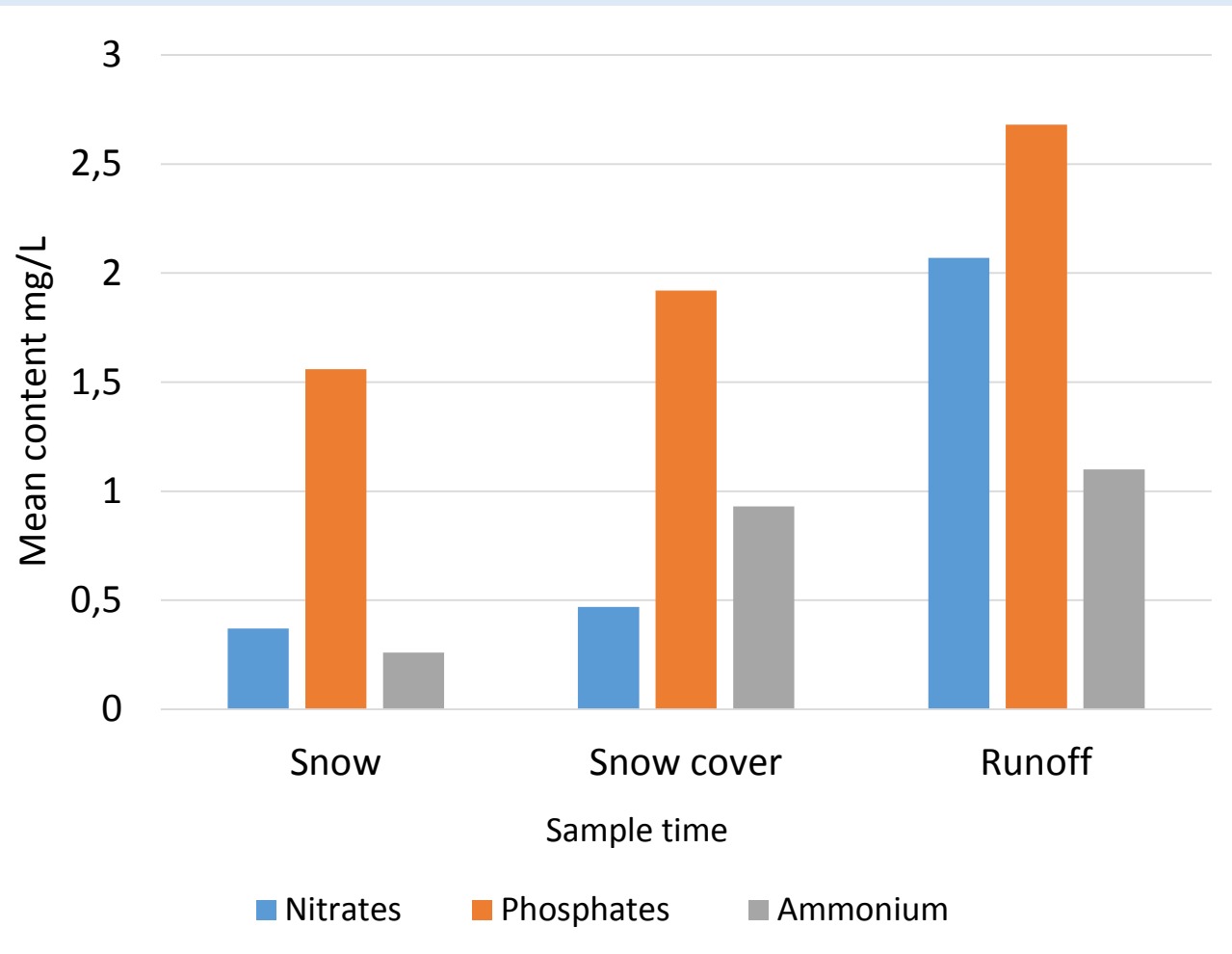


B

Pic. 1. SS (A) and chloride (B) mean concentrations in samples of snow, snow cover and snowmelt runoff



Mean concentrations of phosphates and ammonium overcome maximum permissible concentration (MPC) in samples of snow cover and snowmelt runoff (MPC for phosphates and ammonium ions are accordingly 0,2023 and 0,4736 mg/L)

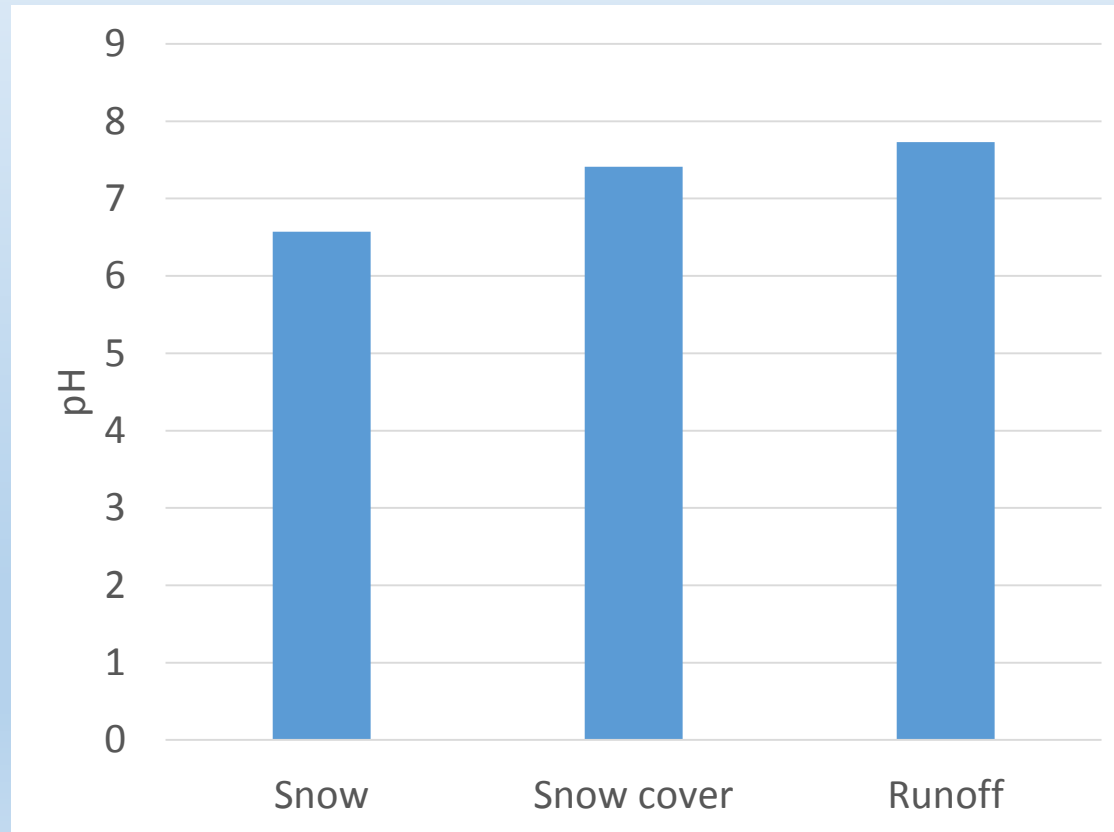


Pic. 2. Mean content of nitrates, phosphates and ammonium in samples of snow, snow cover and snowmelt runoff

- Mean concentration of Mn, Ni overcome the MPC levels in samples of snowmelt runoff; mean concentration of Cu, Zn, Co and Cr overcame MPC both in snow cover and runoff
- The sources of HM on the territory of Brest vehicles and erosion of the constructions

	Pb	Cd	Cu	Mn	Zn	Fe	Ni	Co	Cr
Concentrations in snow cover, mg/L	0,0138	8,33E-05	0,011	0,047	0,391	0,163	0,008	0,036	0,012
Concentrations in runoff, mg/L	0,0160	0,0001	0,016	0,154	0,508	0,295	0,010	0,016	0,008
MPC	0,1	0,005	0,004	0,05	0,016	0,34	0,01	0,01	0,005

- pH mean value slightly increases from samples of snow to snow cover and snowmelt runoff



Pic. 3. pH values in samples of snow, snow cover and snowmelt runoff

Correlation coefficients

- In snow cover samples
 - **0,86 for Cd and Zn**
 - **0,78 for Mn and Cr**
 - 0,77 for Pb and Zn
 - 0,75 for Cd and Cr
 - In runoff samples
 - **0,74 for Mn and Co**
 - 0,66 for Cl^- and Pb
 - 0,64 for NO_3^- and PO_4^{3-}
 - 0,62 for NO_3^- and NH_4^+
- 0,64 for Pb and Cd
 - 0,61 for Pb and Mn
 - 0,60 for Cd and Mn
- 0,51 for Pb and Cr
 - 0,51 for Mn and Zn
 - 0,51 for Mn and Cr

Conclusions

- The priority pollutants of snow layer and snowmelt runoff are SS and chloride ions. Concentrations of phosphates, ammonium and some heavy metals also do not much the regulation levels.
- Taking into account that snowmelt surface runoff contains significant amount of inorganic pollutants and that from majority of drainage collectors it is wasted directly to the river Muhavets, it can be concluded: surface snowmelt runoff poses a threat for the aquatic environment.

Thank you for your attention!