UNIVERSITY OF HELSINKI

LOMONOSOV MOSCOW STATE UNIVERSITY

Russian MegaGrant “Megapolis – heat and pollution island”

Hydrogeochemical research within Moscow megacity

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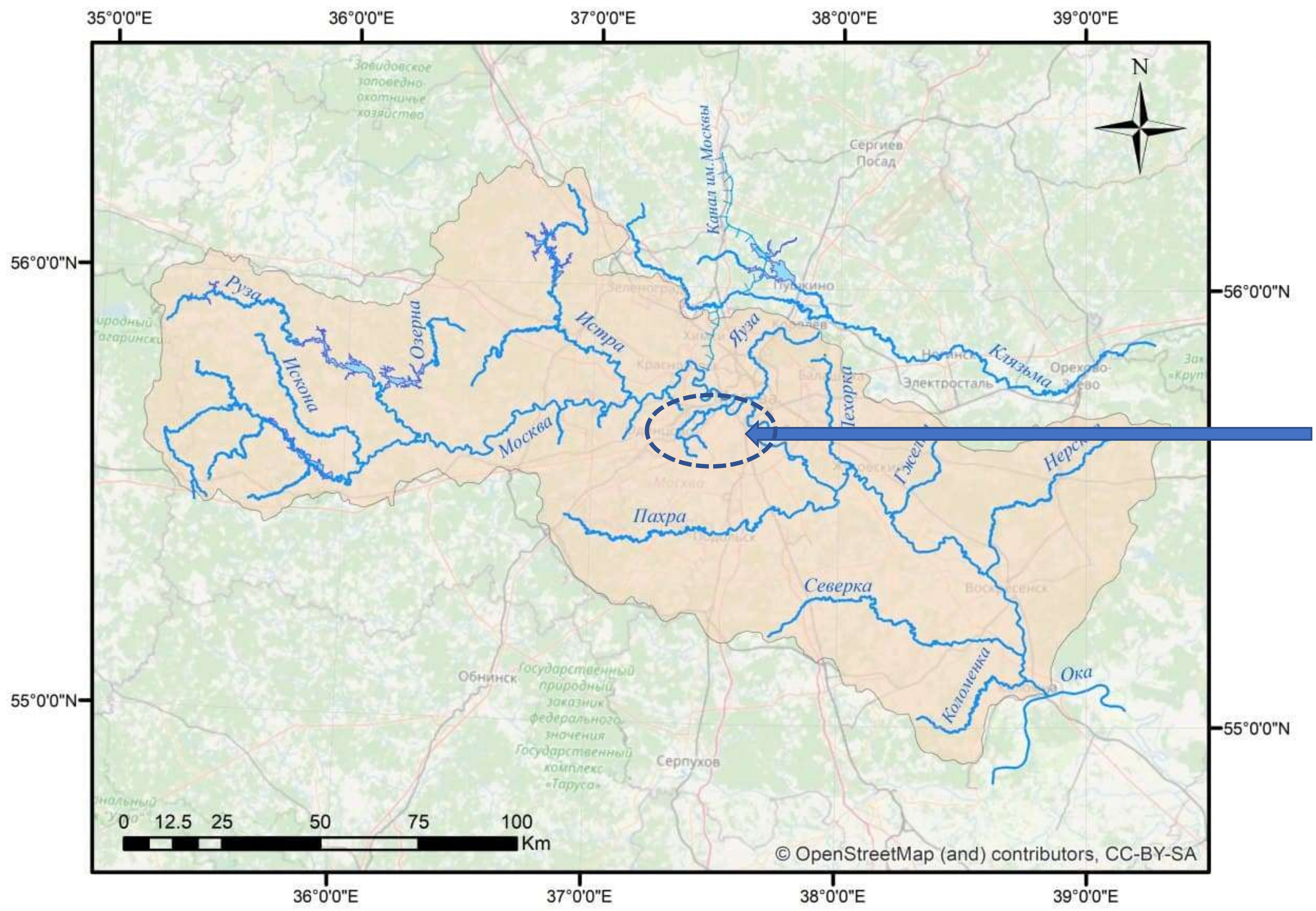
MAIN DIRETIONS OF THE RESEARCH

- Water and sediment quality high resolution monitoring
- Source Apportionment methodology for riverine particulate matter
- Surface-atmosphere interactions at the case study urban and natural lakes

Emissions of road dust as one of the most important sources of microparticles in the atmosphere in the United States (The National Emissions Inventory, 2017)

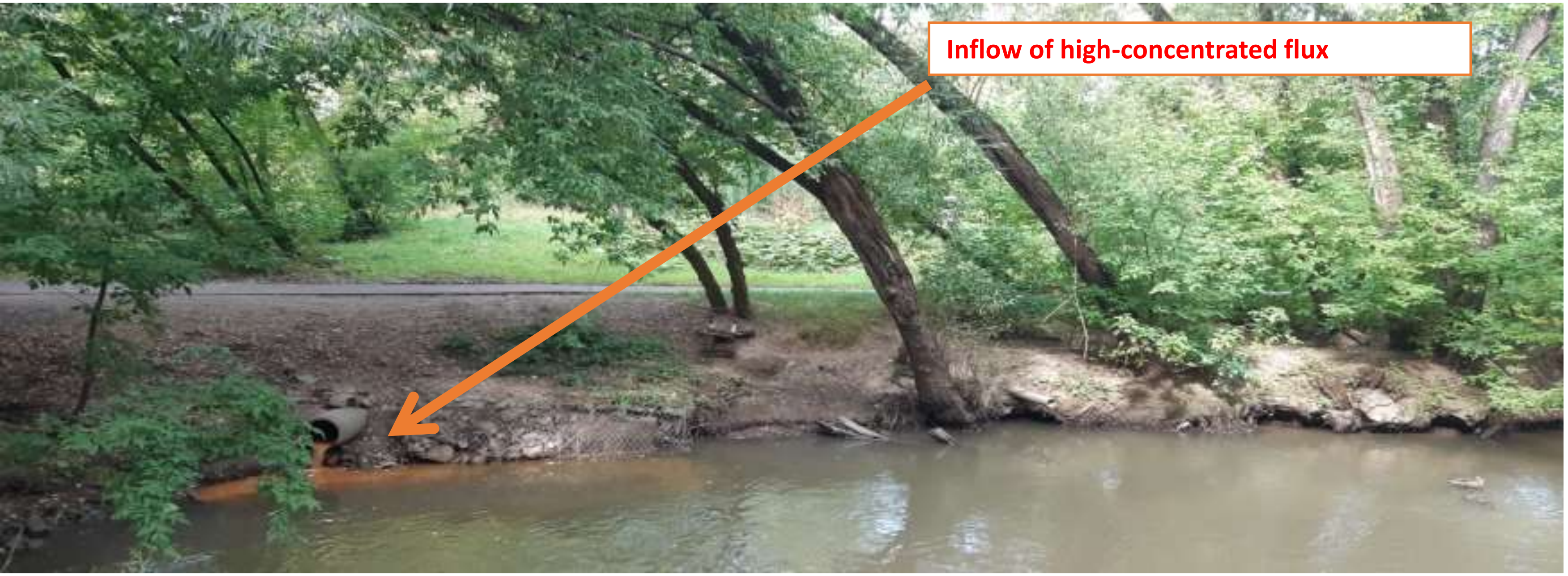
Hydrogeochemical research: Study Sites



The Moskva	
Length	473 km
Basin Area	17600 km^2
Mean Annual Discharge	155 m^3/s
Mean Annual Flow	4,734 km^3

The Setun	
Length	23 km
Basin Area	106 km^2
Mean Annual Discharge	2,8 m^3/s
Mean Annual Flow	0,088 km^3

High temporal variability of effluents which drive pollutants migration along river system

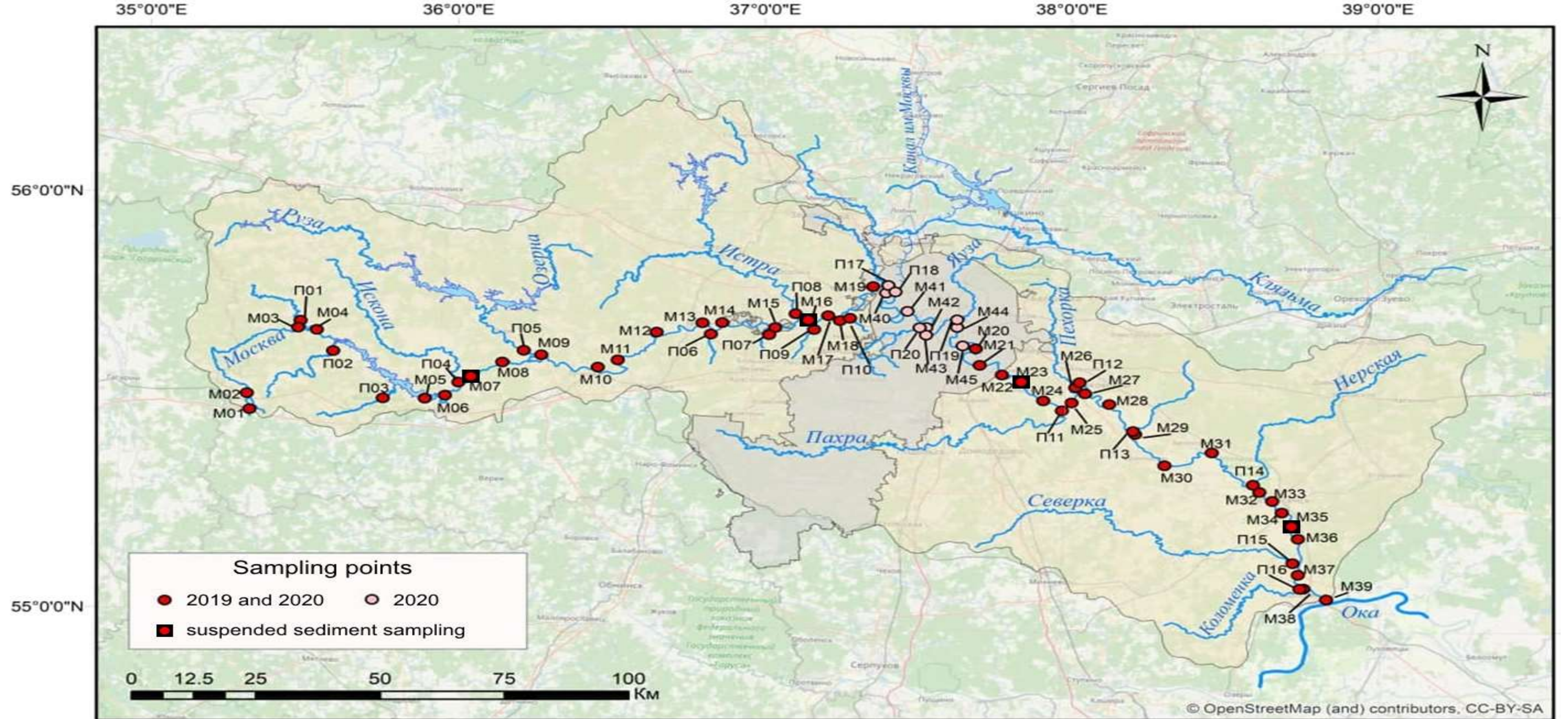


Setun River
September 7,
11-53 am

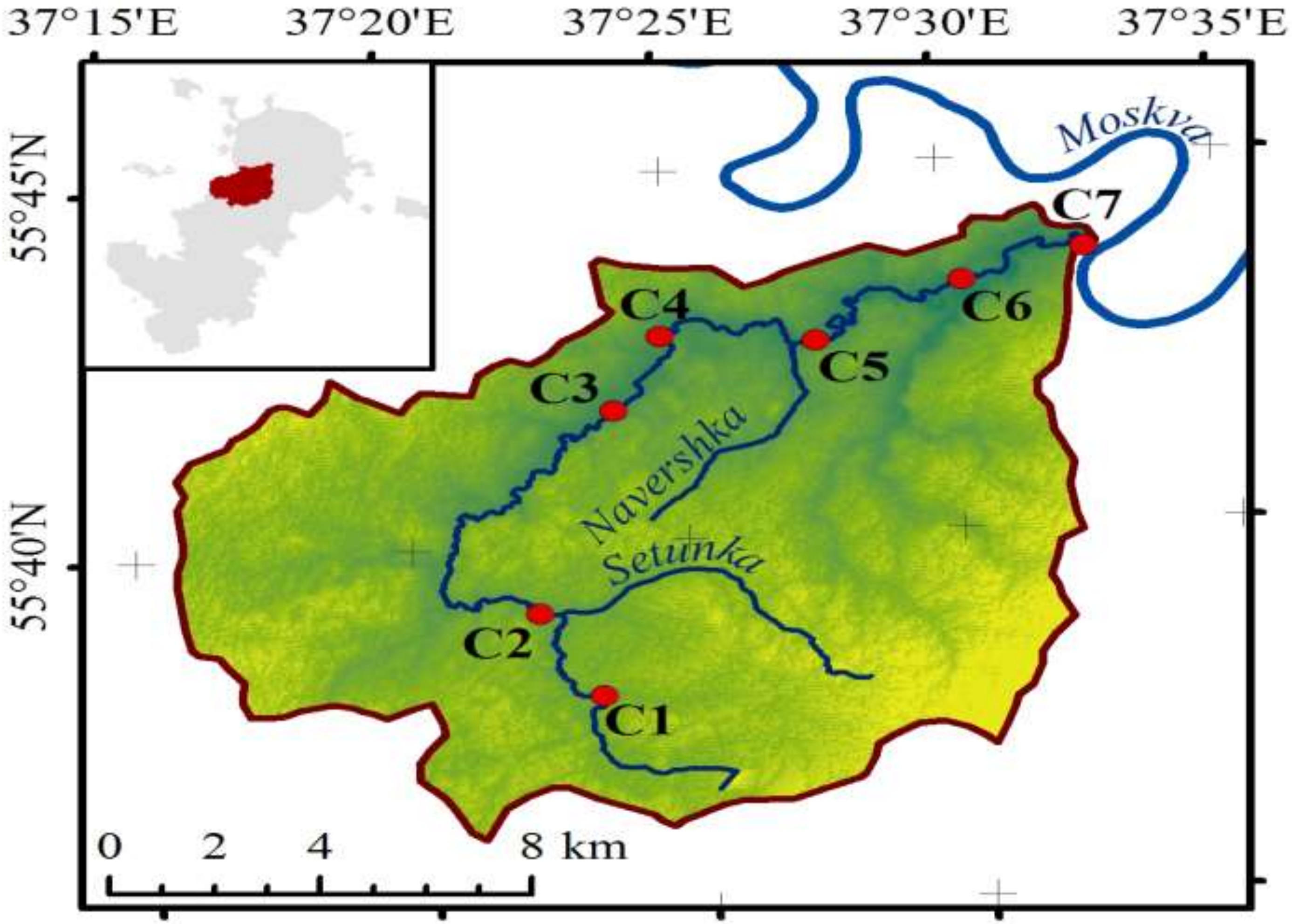
Setun River
September 7,
12-45 pm

Monitoring points for water, suspended sediment and bottom sediment quality in the Moskva River basin

- 2 years of monitoring, 2-3 campaigns per year (low flow and high flow periods)
- 45 stations on the Moskva River, 22 stations on tributaries



Water and sediment sampling in the Setun watershed

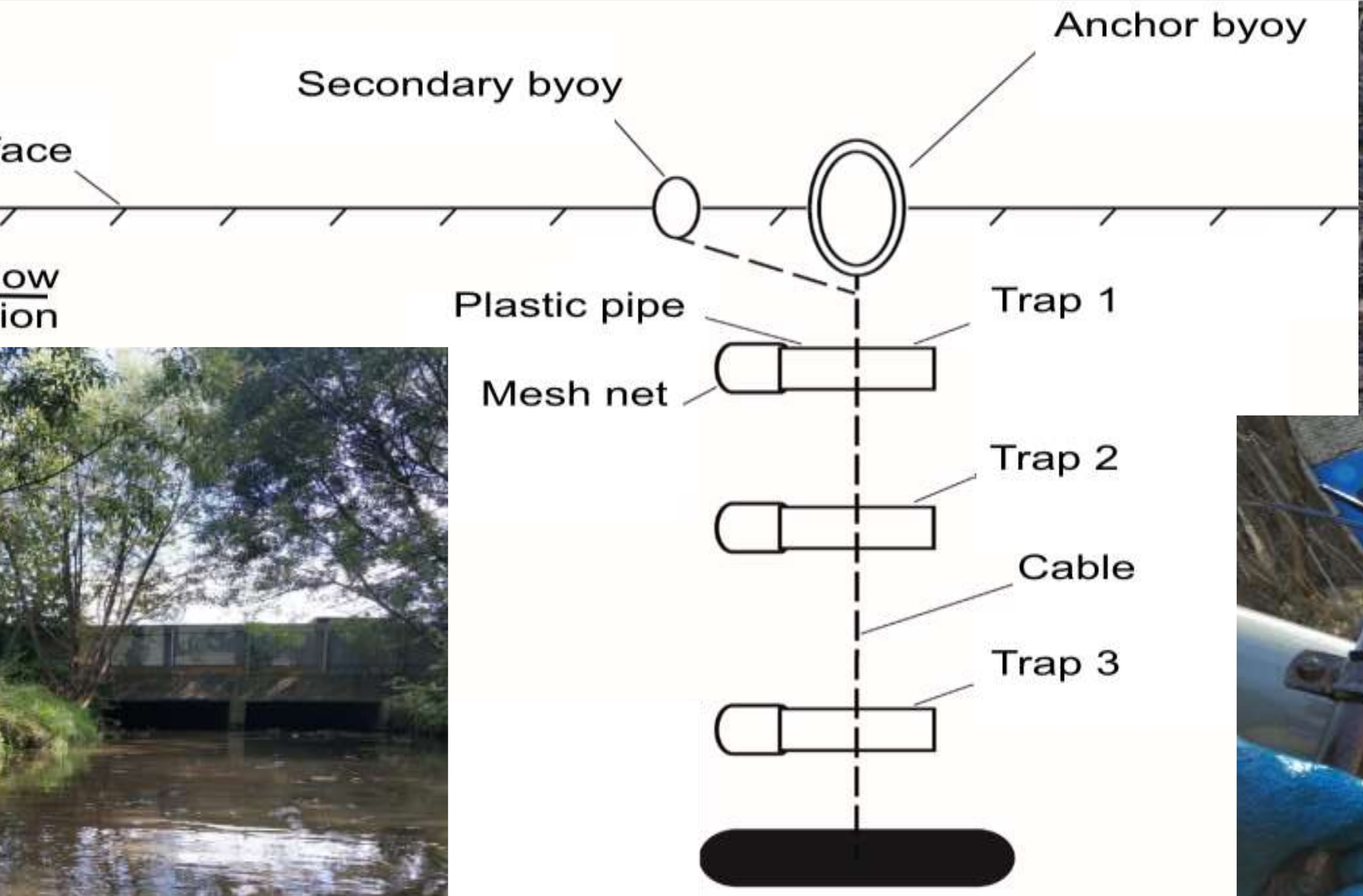


7 stations on the Setun River, 2 tributaries

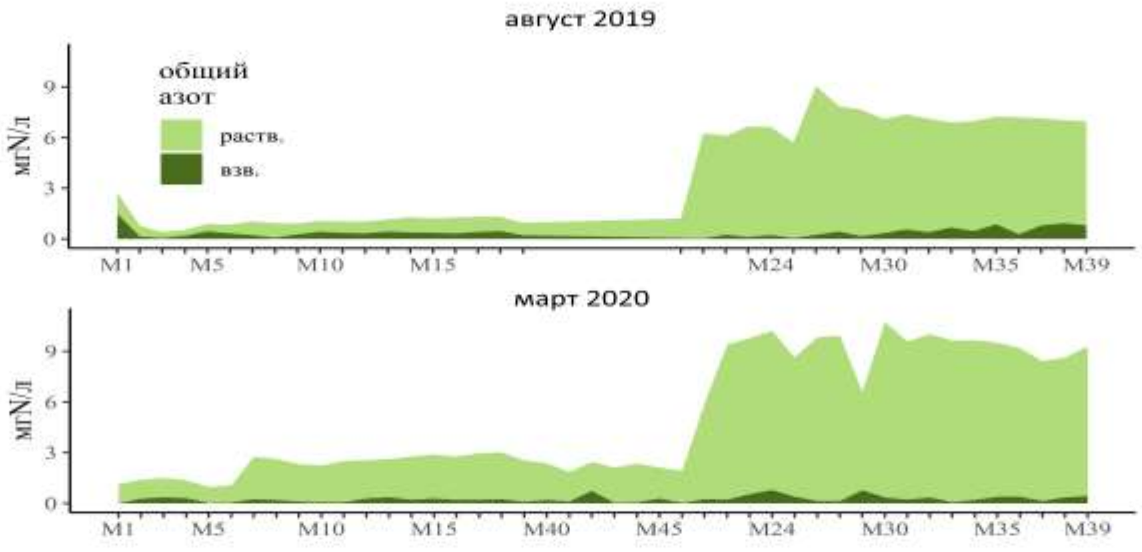
- Monthly sampling at 3 stations (the Setun River mouth and 2 tributaties)
- Seasonal sampling (4 times per year) at all 9 stations
- Bottom sediment sampling – once per year

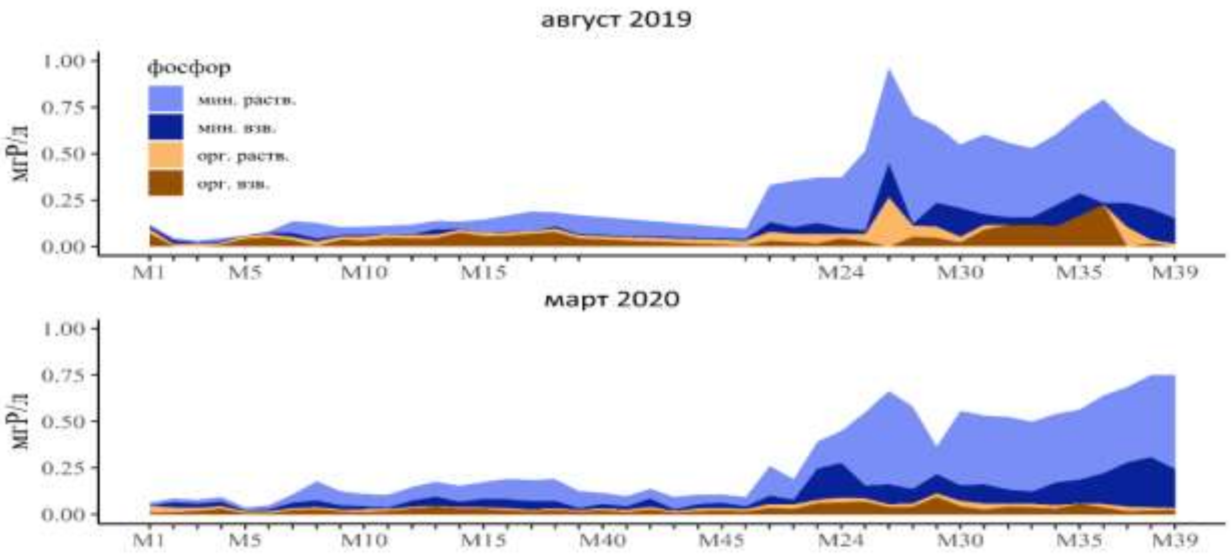
Suspended sediment trap samplers

- Integrated samplers - used to sample sufficient amount of riverine particulate matter the microparticle transport in rivers

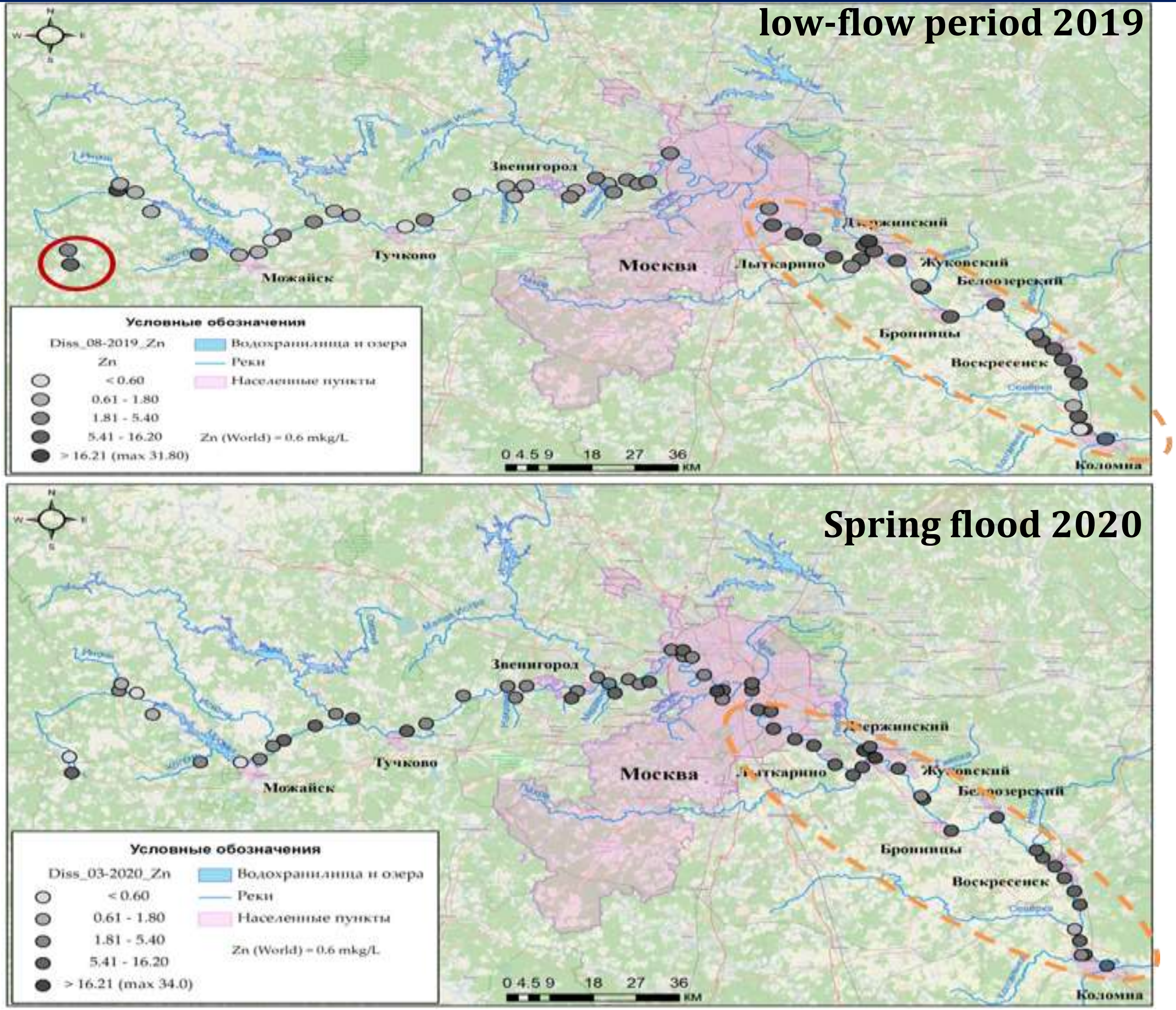


Preliminary results: Megacity impact on nutrient concentrations in the Moskva river basin





Impact of megacity on trace element concentrations in the Moskva river water

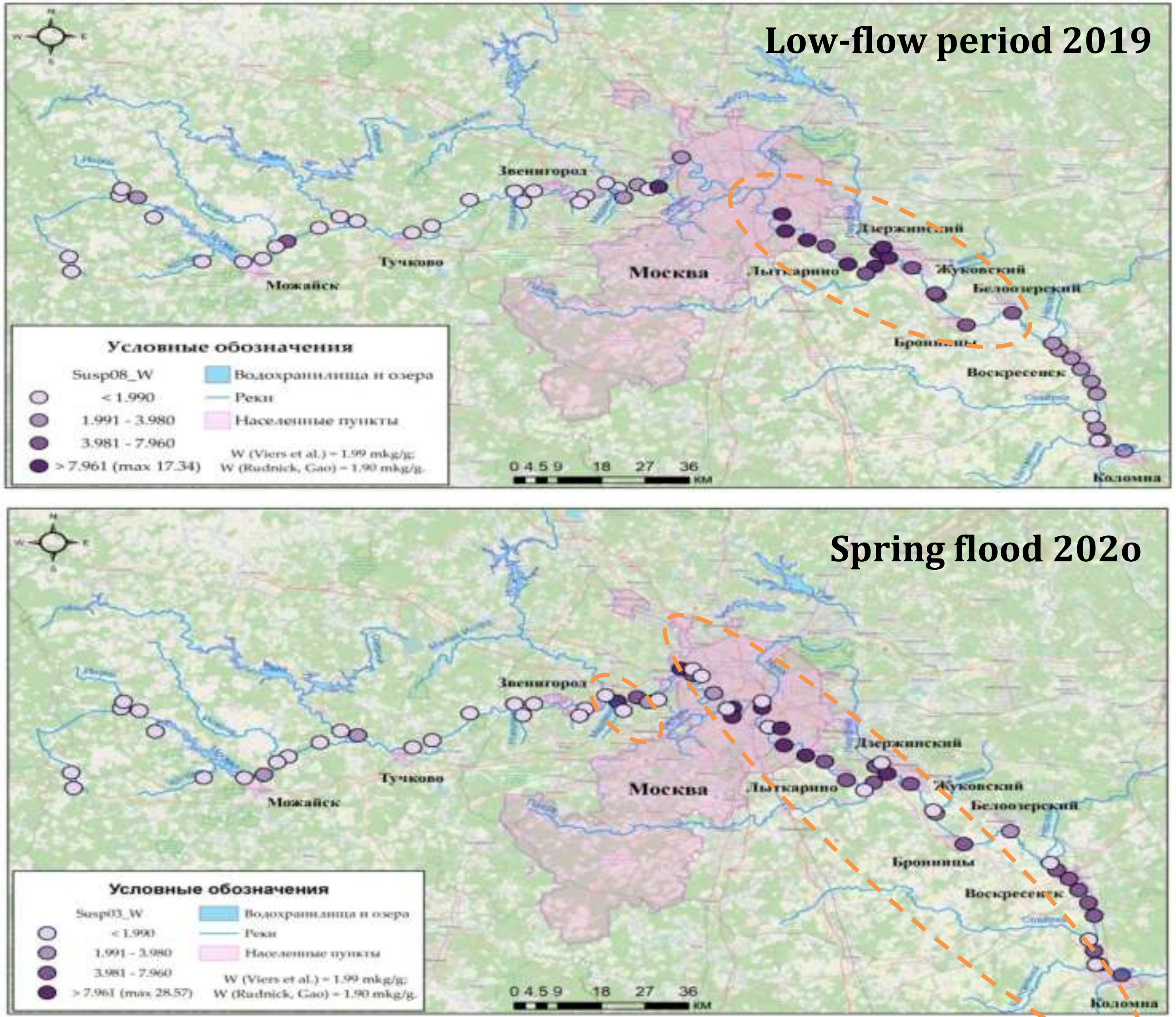


Preliminary results

- At headwaters (baseline section of the river), most trace elements did not exceed average concentrations for world rivers. Exceptions: **B**, **Zn**, **Se**, **Zr** and **Nb** (1,5 – 5,5 times above average in both summer and spring).
- At the rest of monitoring stations, concentrations of **W**, **Cs**, **Ni**, **Cd**, **Rb**, **Al** exceeded headwaters baseline 4-42 times.
- Below the Kurianovo wastewater treatment plant and to the river mouth, elevated concentrations of **Cs**, **Sb**, **Mo** and **Ni** were observed in summer of 2019, and **Cs**, **Mo**, **Co**, **Ni** – in spring flood of 2002
- Below Lytkarino wastewater treatment plant, **Sr** concentrations are elevated.

Figure: Dissolved Zn concentration in the Moskva River

Seasonal impacts of megacity on trace elements concentrations in suspended solids of the Moskva river



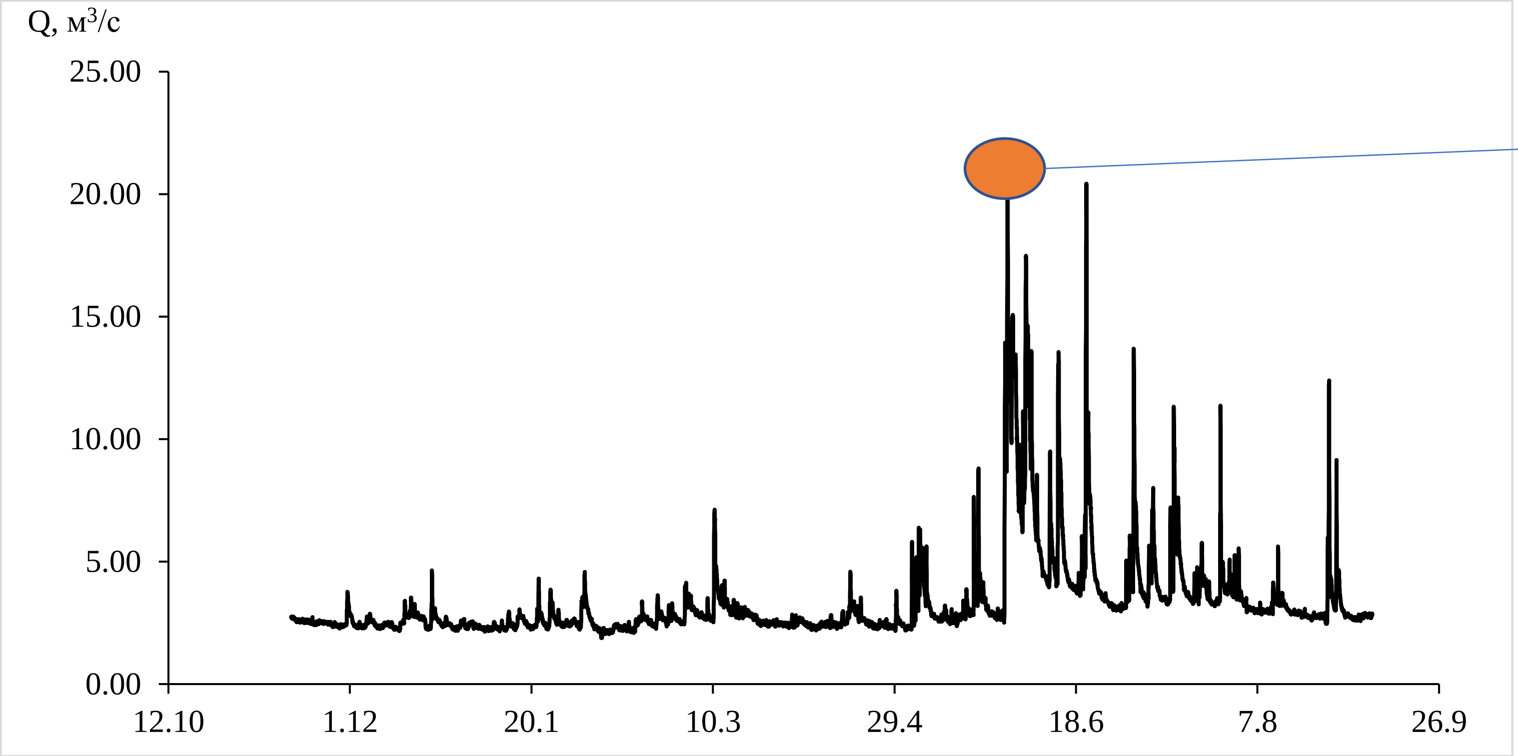
Preliminary results:

- Baseline concentrations of trace metals in suspended sediment of the Moskva River are slightly above world average concentrations, especially **Mn**, **Mo**, **Ni**, **Cr**, **Fe**, **Zn**, **Sr**, **Ba**, **As**, **Li** in summer of 2019.
- Maximum exceedance of baseline concentrations was observed for **Bi** and **W** (*Kc* 2,7–7,7), in spring flood of 2020 – also for **Rb**, **Ni**, **Cr**, **Pd**, **Cu** and **Pb** (*Kc* 1,8–2,9).

Figure: W concentration in the suspended sediment of the Moskva River

High resolution monitoring of water and pollutants transfer along river system

Water discharges and particulate flux



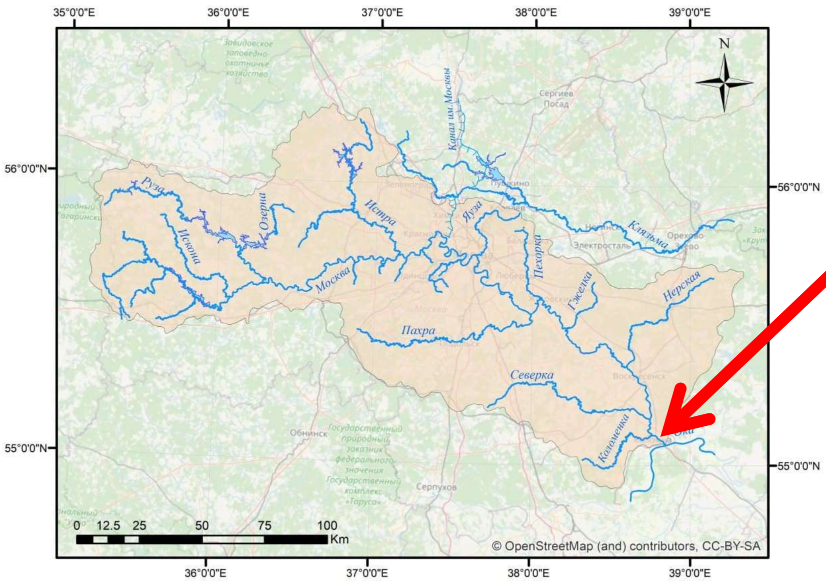
2020

Regular grab sampling for trace elements

Novel monitoring station to establish under MegaGrant at the outlet of the Moscow River

- related to monitoring of the most drastic environmental problem of Moscow megacity

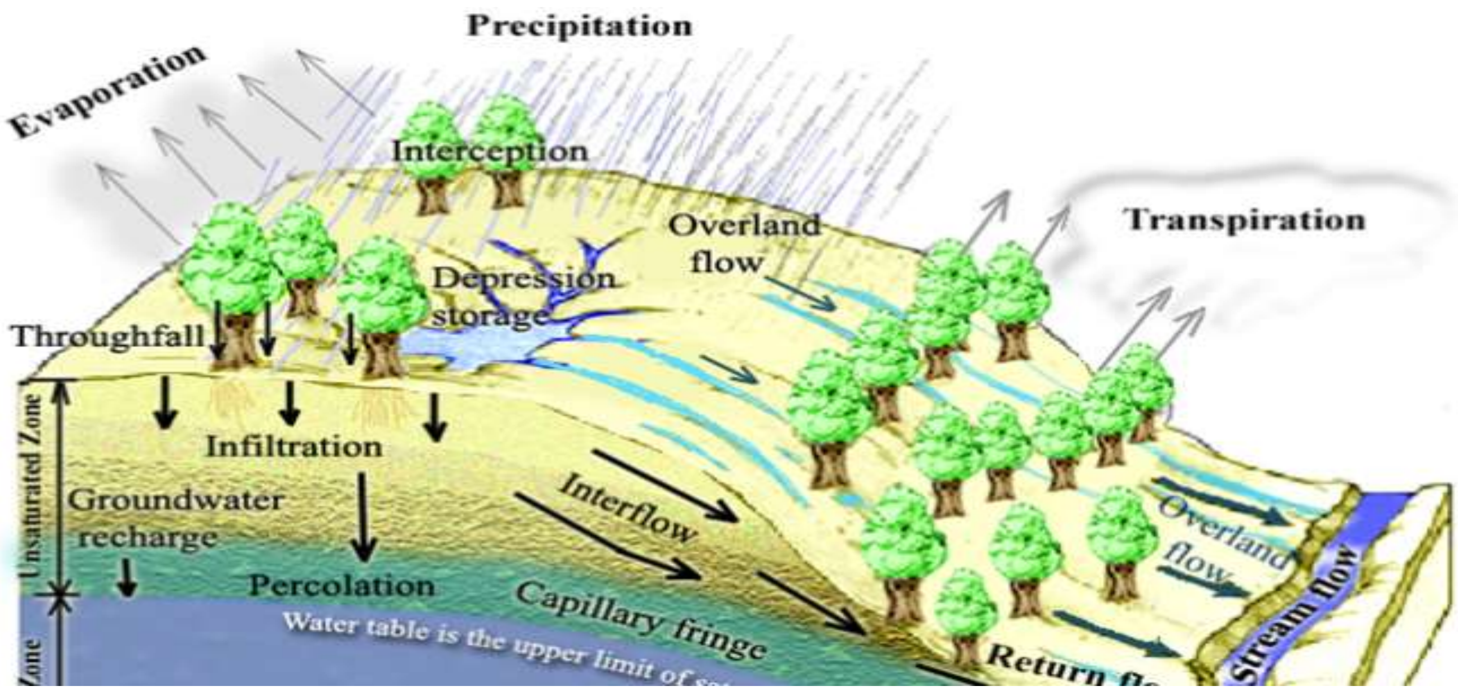
- Very important related to Science Diplomacy (both with air pollution)

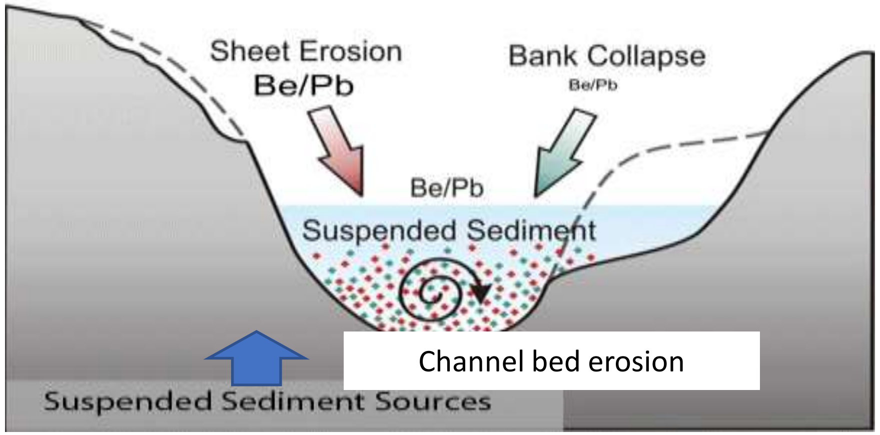


Budget: from 1 mln Rubles

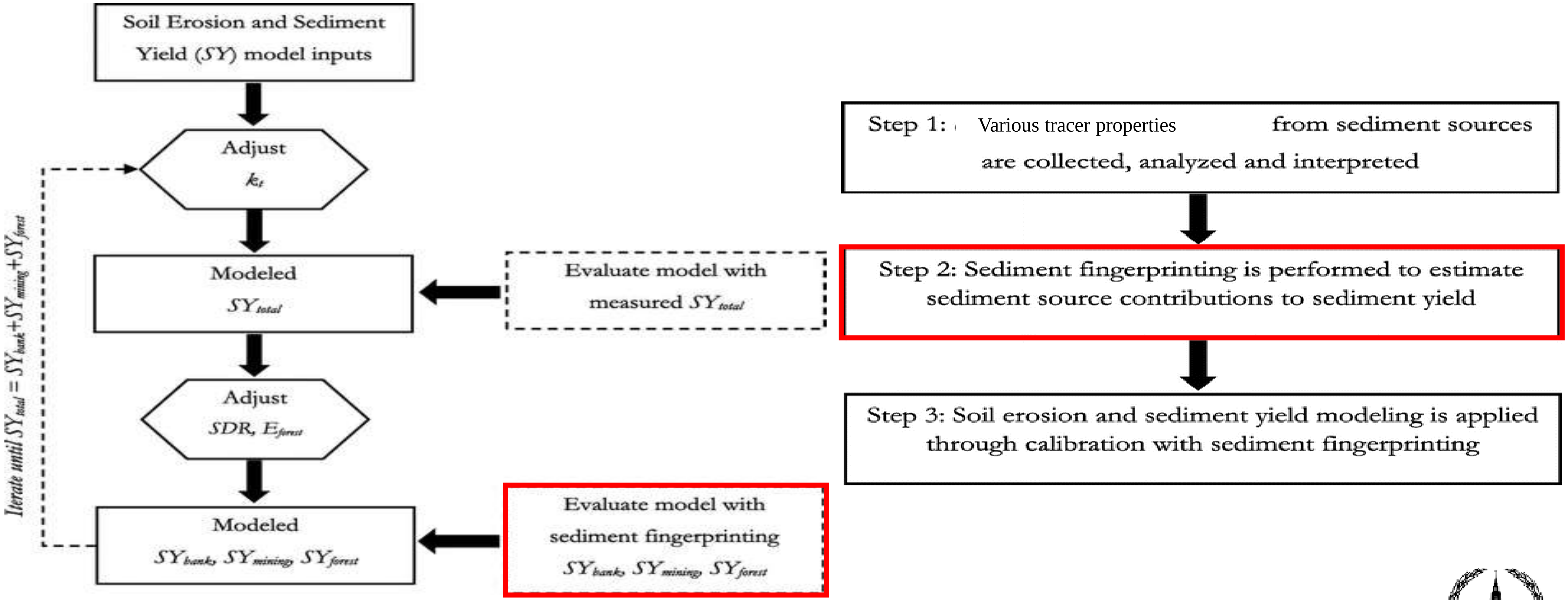
Measured parameters:
TSS, ph, level-water discharge, TDS + nutrient(?), PAH …

Potential types of fine sediment sources:





Riverine particulate matter yield modeling and partitioning – Strategic principles of calibration and validation:



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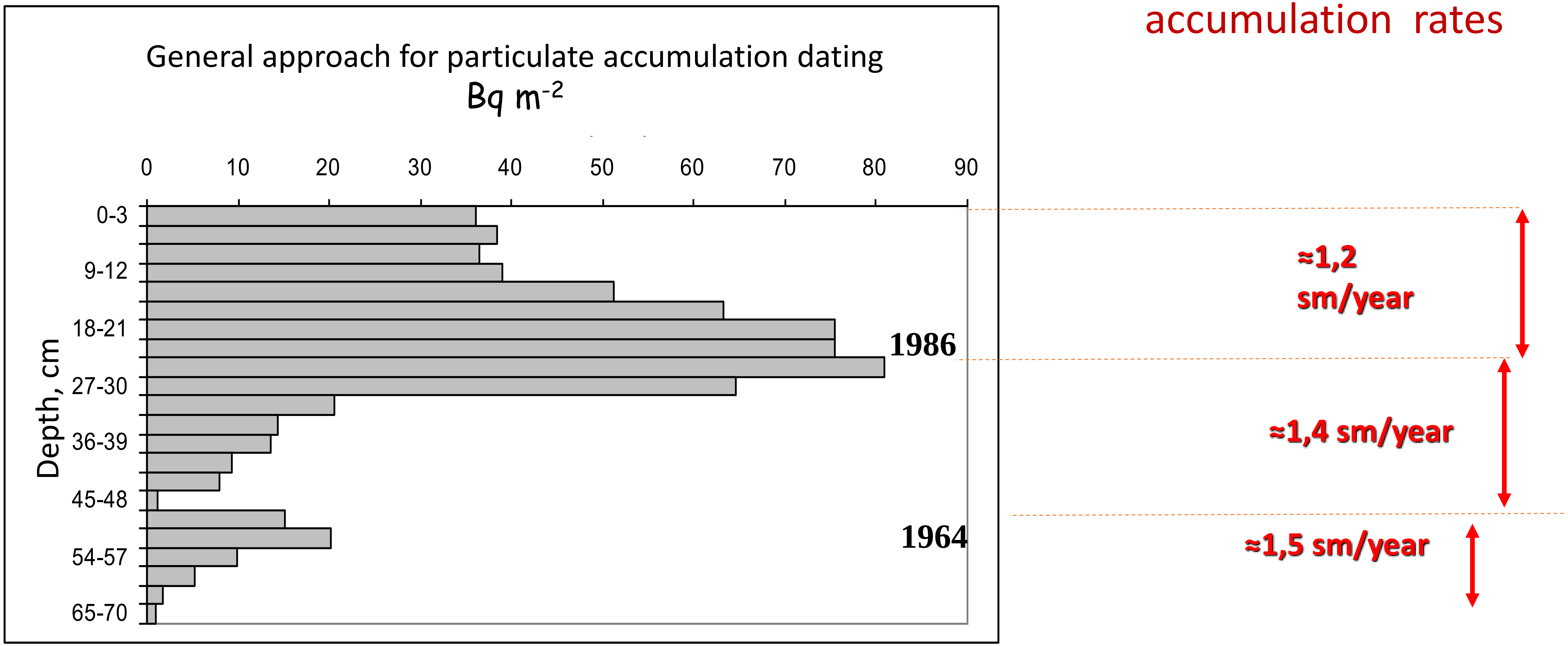
Lake coring for dating and pollutants accumulation in surface waters

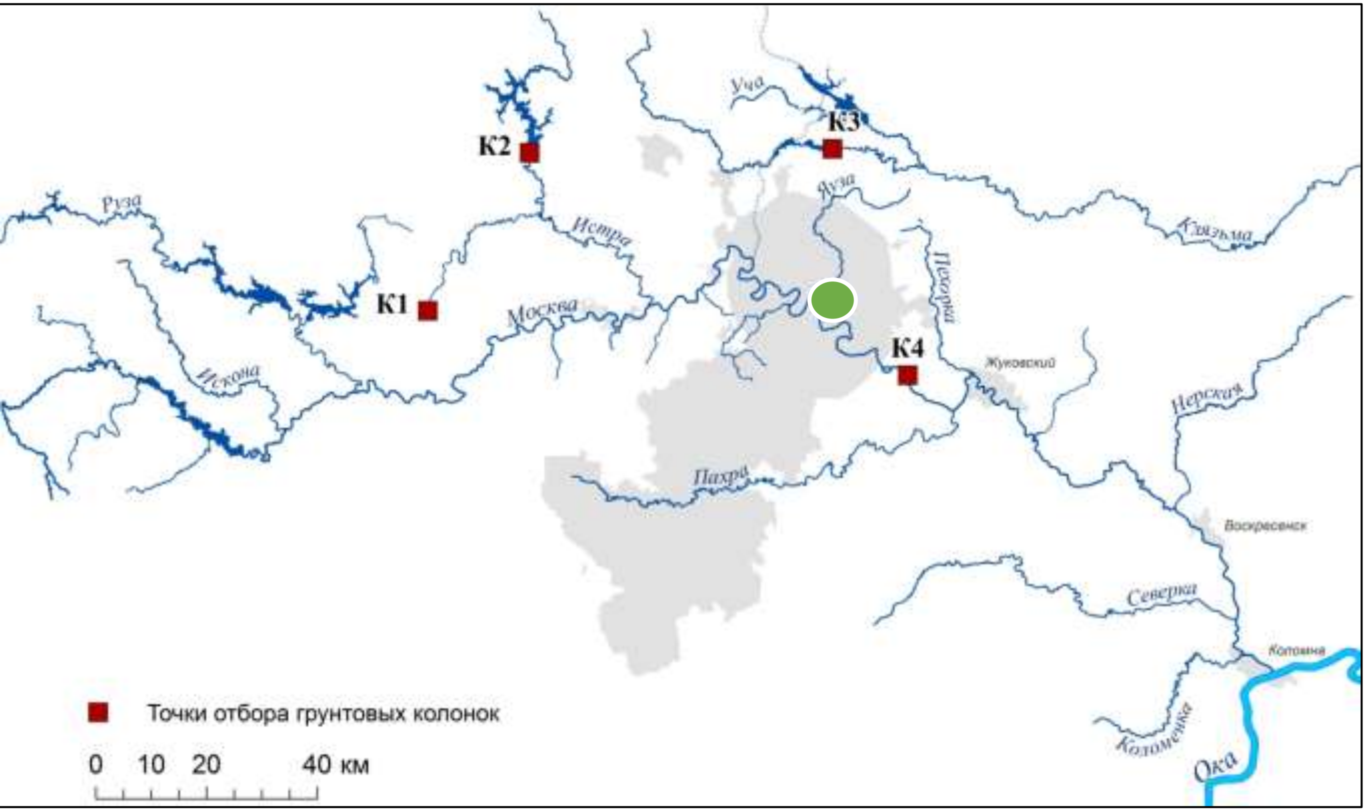
(1) Dating using Cs-137 → (2) Identification of pollutants accumulation rates



Lake coring for dating and pollutants accumulation in surface waters

■ "Clear" natural lakes and reservours

● Urban lake without recent dredging or reclamation works



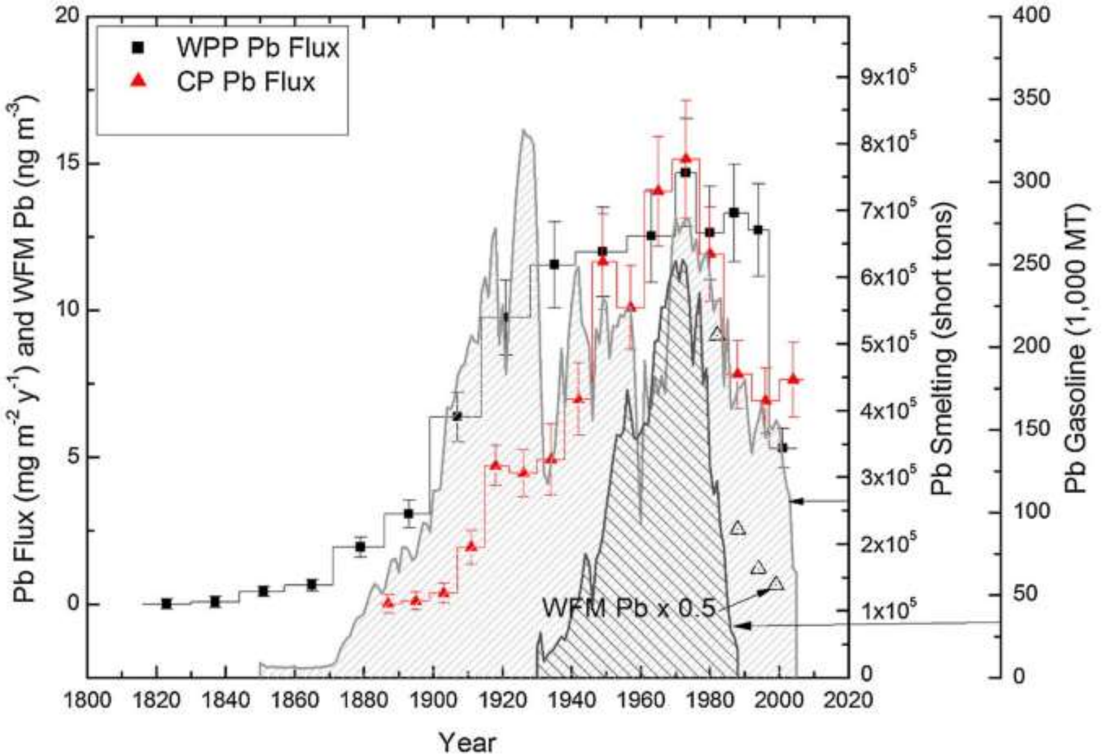


Figure 4. Flux of Pb (mg m^{-2} yr^{-1}) at WPP and CP as functions of chronology. The vertical bars show the propagated 1 sigma uncertainty in the flux. Also shown are primary (smelting) production data (short tons) for Pb between 1850 and 2005 (from "Historical Statistics of the United States 1789–1945" for the period of 1840–1899 and U.S. Geological Survey statistics for 1900–2005), leaded gasoline consumption data (000 t) between 1930 and 1988 [*Nriagu*, 1989b], and atmospheric Pb data (6 yearly average) (ng m^{-3}) at Whiteface Mountain from 1979 to 2001 [*Husain et al.*, 2004].

From Sarkar et al., 2015

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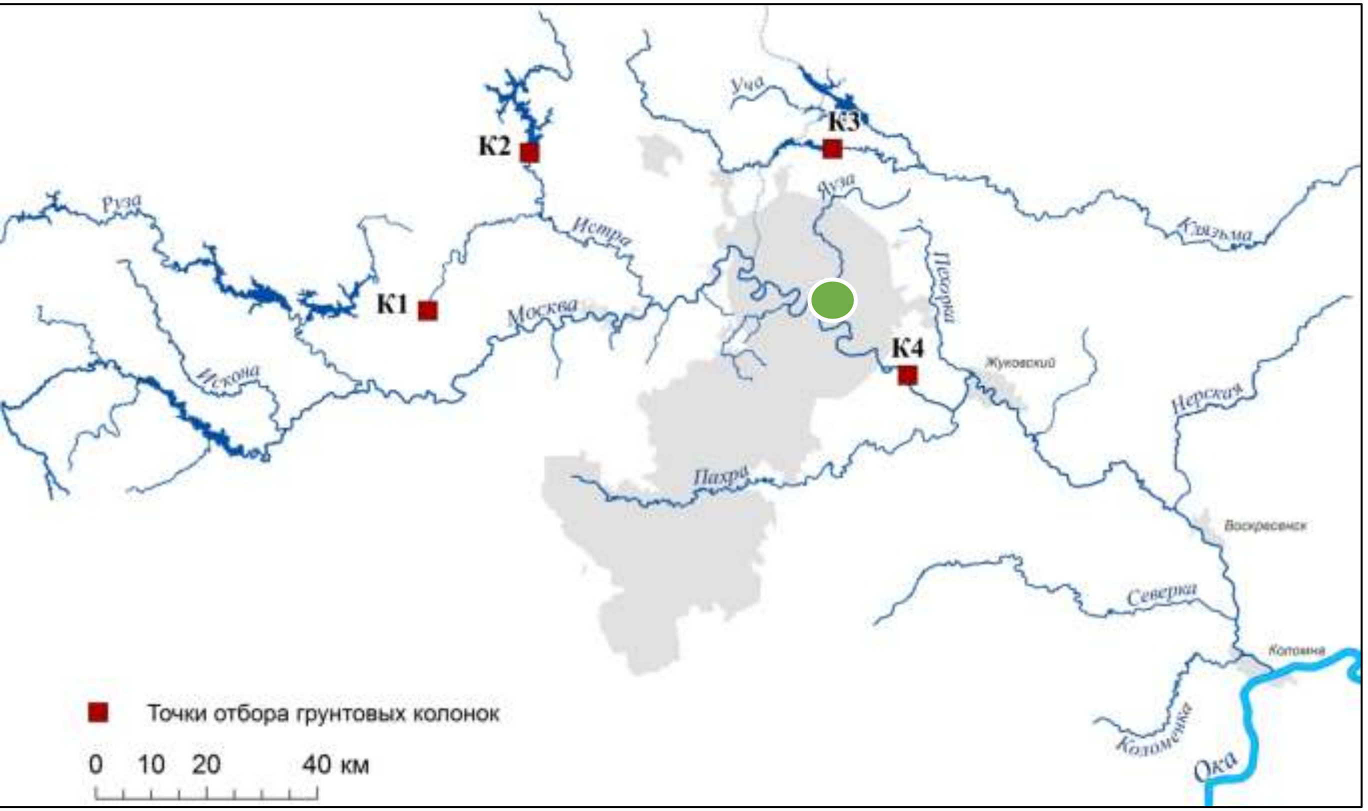
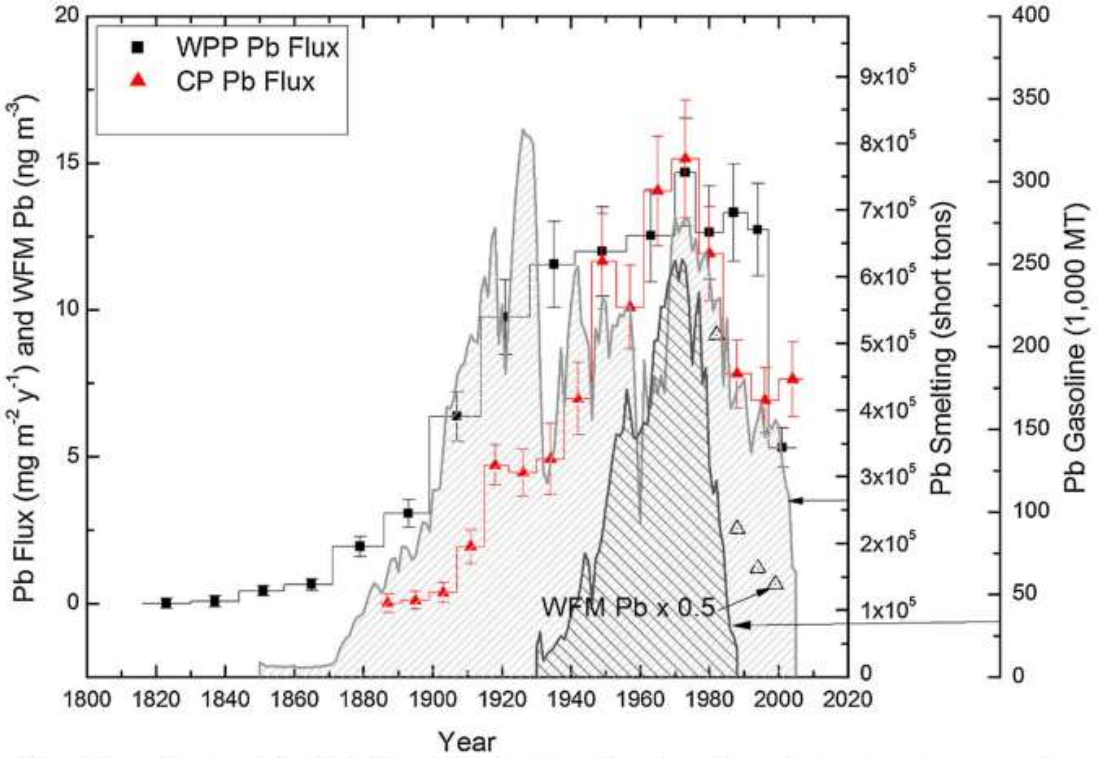
Urban lake without recent dredging or reclamation works





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From Sarkar et al., 2015

THANK YOU FOR YOUR ATTENTION

DISCUSSION

MAIN COMING STEPS

1. Decision on the list of purchased equipment and sequence of purchases (beginning of February)

2. Preparing the contract (program of work, deliverables for 1 year, list of purchases) (middle of February)

You comments and suggestion should be summarized until 10 Febraury.

!!! Discussion within groups - between groups (Russian and Finish teams) are needed

3. Project deliverables:

- web-site – cloud for project material (open and limited access)
- Project youtube channel

Further steps

4. Planning the project publications - suggestions during Febraury

5. Planning of the exchange (research visits to Helsinki – candidates, people?) during March after signing contract