



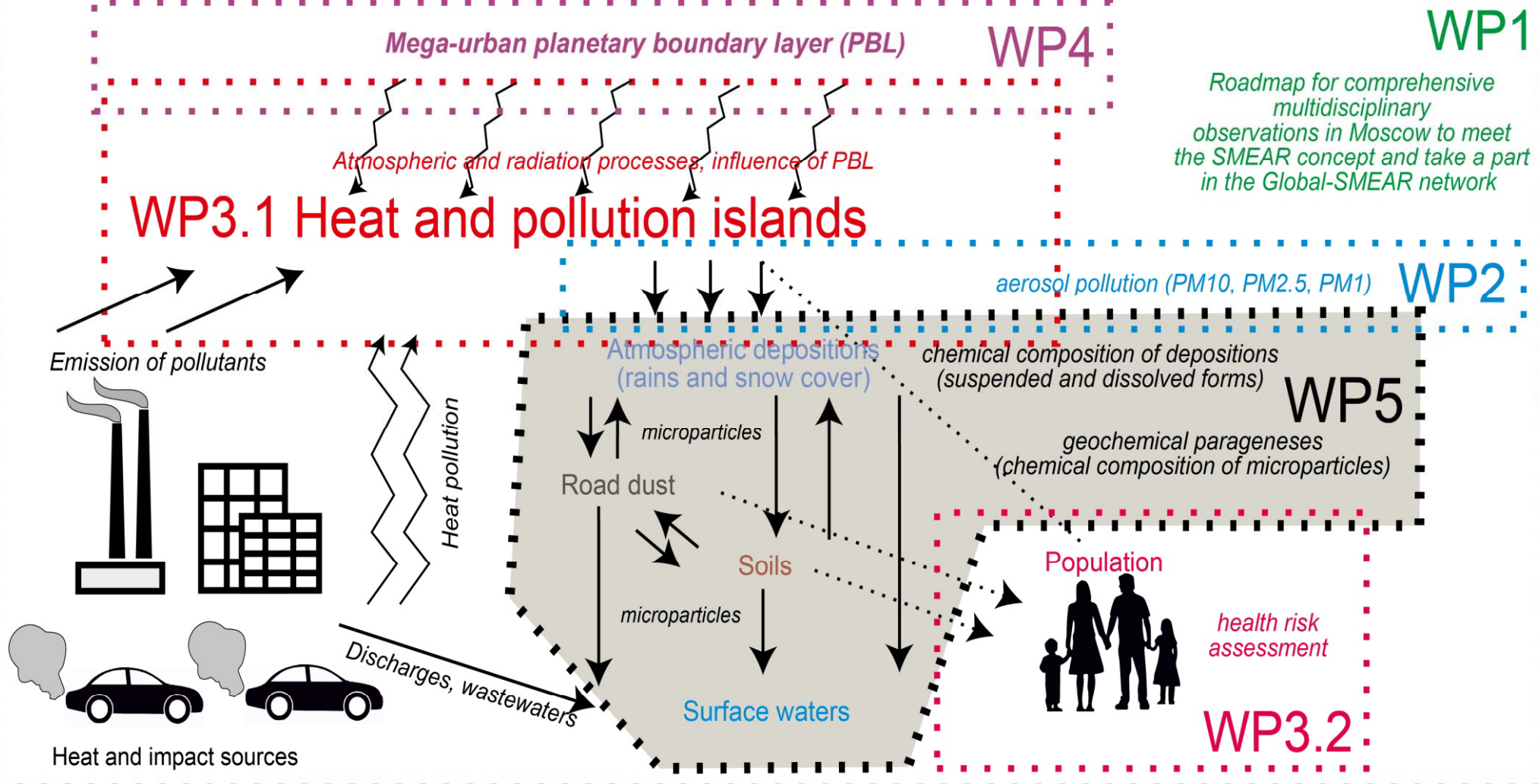
Lomonosov Moscow State University  
Faculty of Geography  
Department of landscape geochemistry and soil geography



Russian Geographical Society

# Geochemical interactions between the urban environments: component-based analysis

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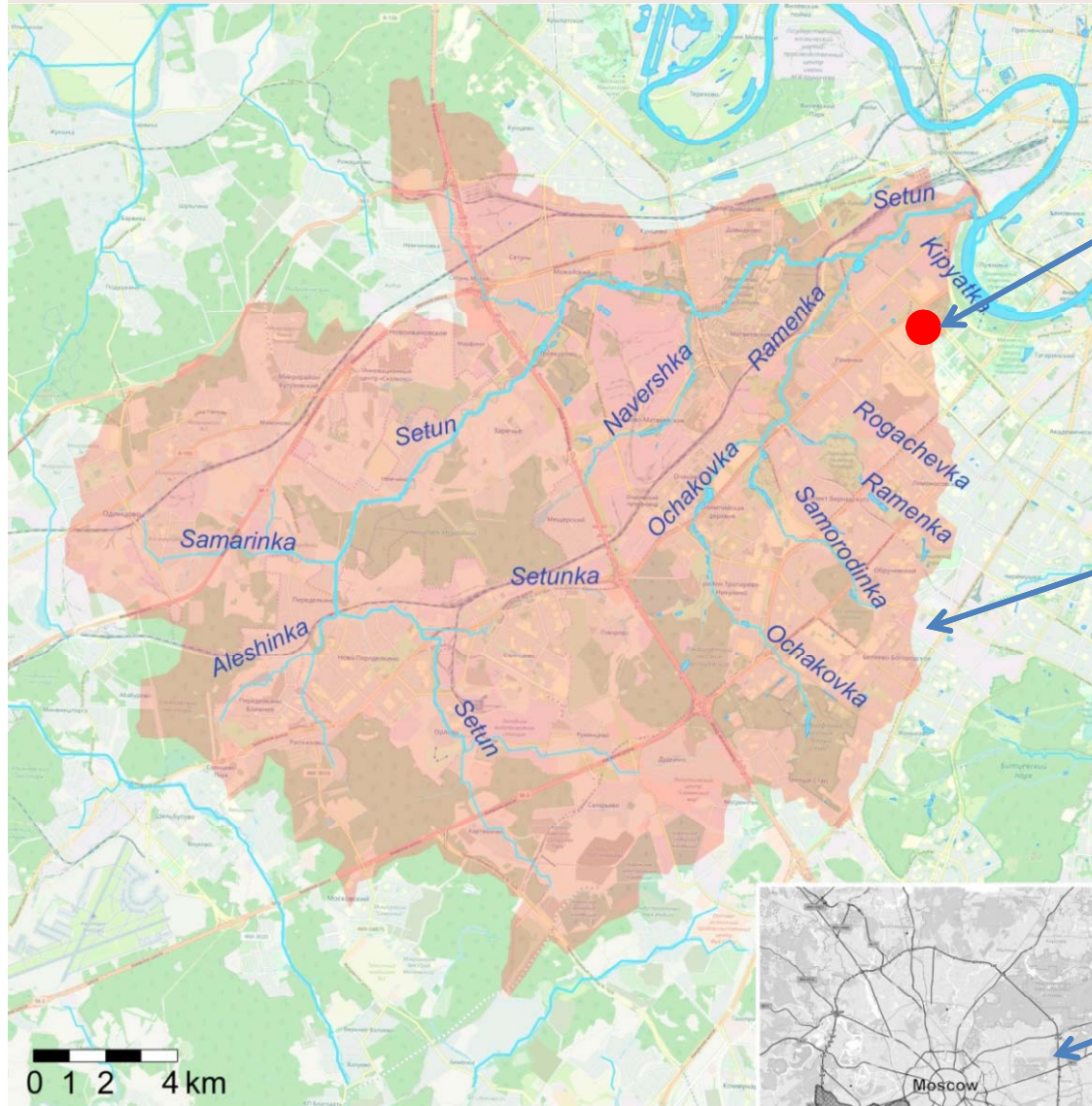
**WP7** Laboratory of Urban Environment and Climate

Interdisciplinary approach to study microparticles, toxic elements and substances formation within heat and pollution island

**WP6**



# Geochemical research on different scales (WP5)



## Legend

-  Setun basin
-  Rivers



## MO MSU STATION

chemical composition of precipitation and atmospheric aerosols

## SETUN RIVER BASIN

chemical composition of microparticles in road dust, snow cover, soils, bottom and suspended sediments in rivers

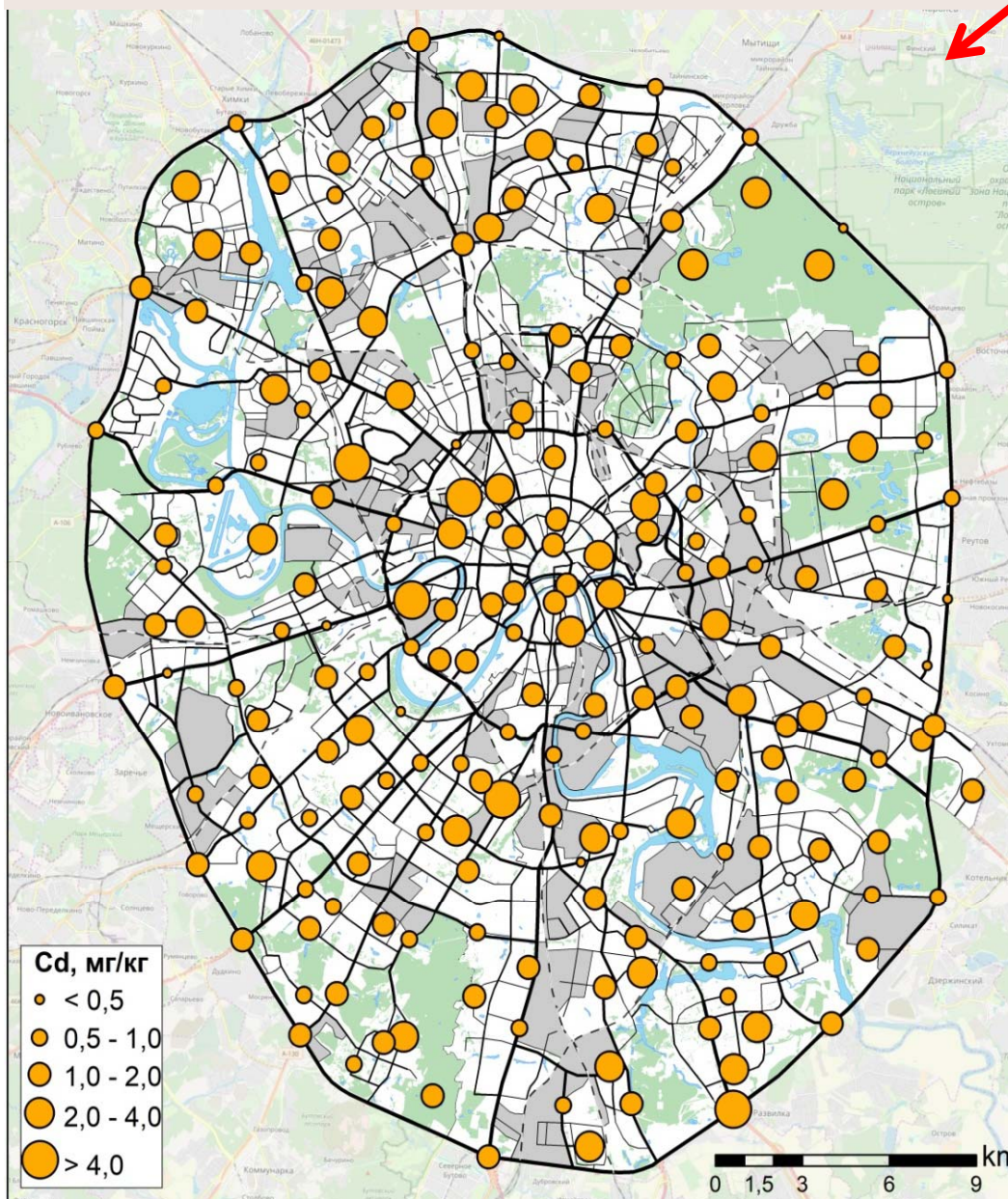
## MOSCOW CITY

the influence of urban canyons parameters on the pollution of road dust microparticles with toxic elements





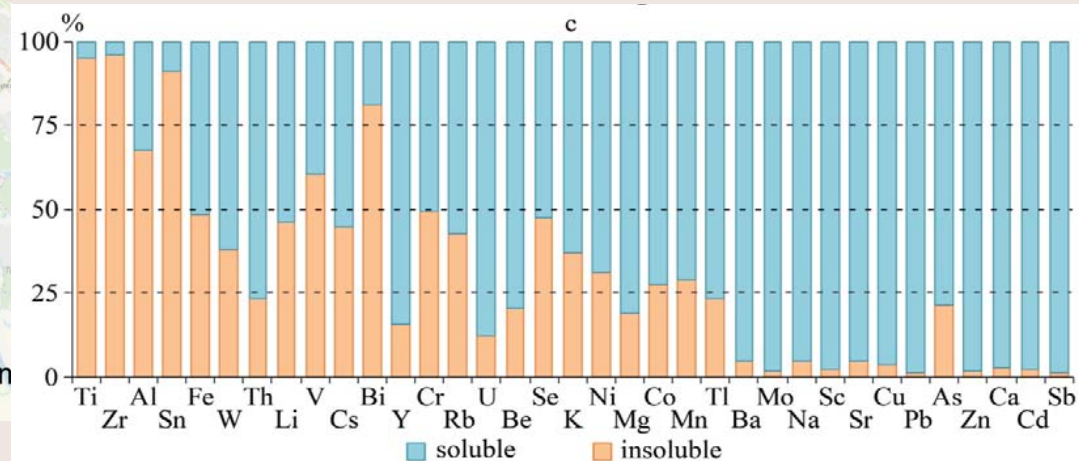
*Pollution of PM1 fraction of road dust with Cd*



- Elemental geochemical profile of road dust, PM10 and PM1 fractions of dust in Moscow (city level)
- Chemical composition of soils, road dust and snow cover in the western part of Moscow (district level)
- Toxic elements in soils and road dust of the Setun river basin (basin level)
- Elemental profile of atmospheric PM10 on MO MSU (station level)
- Partitioning of toxic elements in atmospheric precipitation on MO MSU (station level)



*Partitioning of toxic elements in Moscow rains*





# List of works (WP5)

5



## 2021

- Characterization of composition of the fractions and groups for toxic element compounds in road dust of the Western (transport) and Eastern (industries) administrative districts of Moscow;
- Sampling of snow cover in the Setun river basin. Development of database with the results of geochemical sampling of snow cover, soil, road dust in the Setun river basin.

## 2022

- Study of regularities of transfer and accumulation of road dust microparticles of different sizes in urban environment, depending on the geometry of urban canyons, with spatial detailing to the scale of individual streets and buildings in Moscow;
- Examination of spatial patterns in the distribution of geochemical load and soil pollution in the Setun river basin according to data on the composition of the snow cover;
- Description of the spatial heterogeneity of the Setun river basin area and the identification of units with homogeneous natural and anthropogenic conditions for the erosion model (based on land use zoning of the territory, inventory of the main sources of pollution, identification of elementary geochemical landscapes, analysis of maps of parent rocks, relief, vegetation, conditions of water migration).

## 2023

- Assessment of the state and degree of pollution with HMMs and PAHs for components of terrestrial landscapes in the Setun river basin using the composition of PM10 microparticles;
- Identification of paragenetic associations of potentially toxic elements in the components of the urban environment - atmospheric precipitation, road dust, topsoils, surface waters as indicators of pollution sources and migration routes between the components of the urban environment.

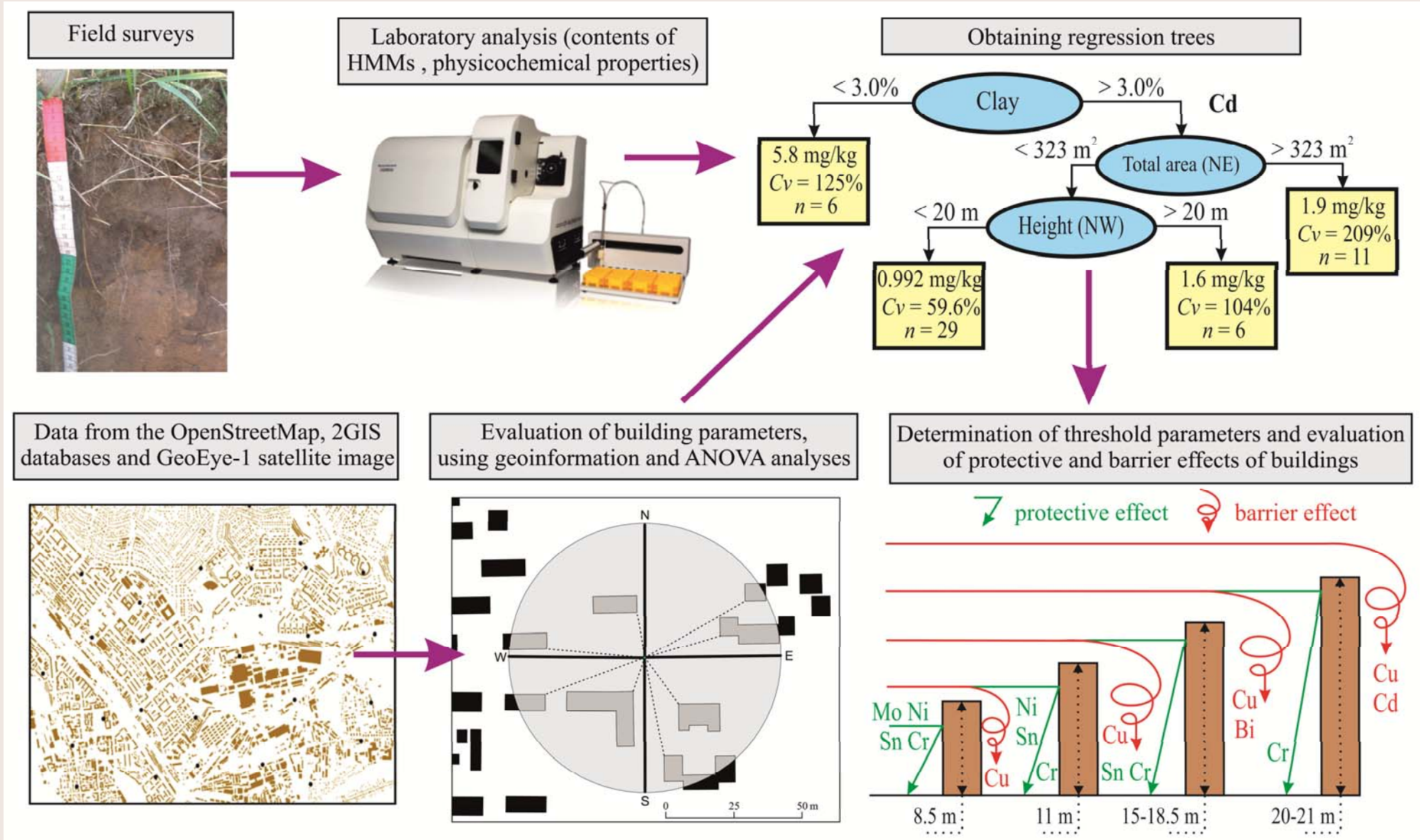
## **Deliverable 1 (city level):**

**assessment of the influence of  
urban canyons geometry on  
pollution of microparticles  
with toxic elements**





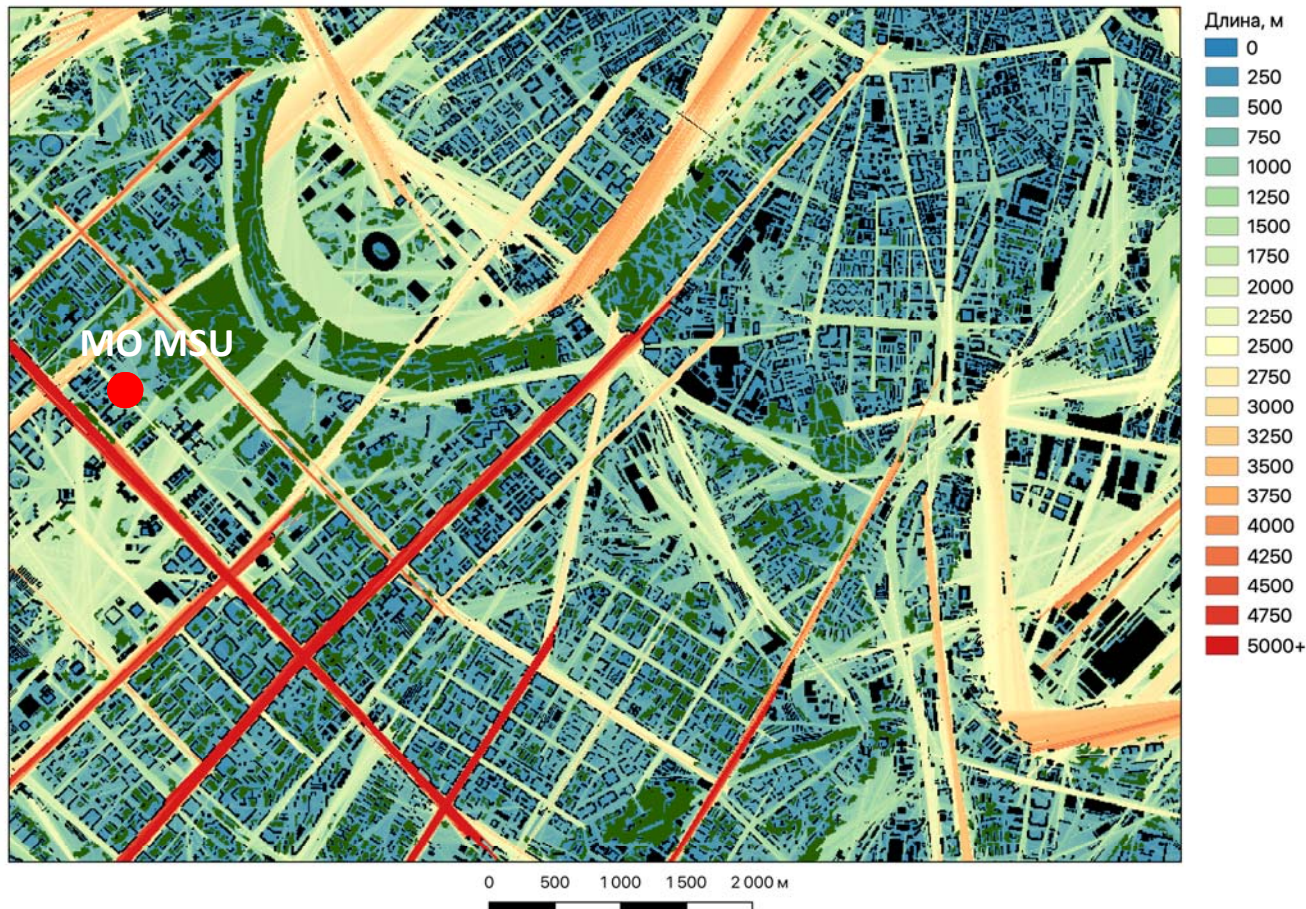
## Study of regularities of transfer and accumulation of road dust microparticles in urban environment, depending on the geometry of urban canyons, with spatial detailing to the scale of individual streets and buildings in Moscow







Regularities of transfer and accumulation of road dust microparticles in urban environment, depending on the **geometry of urban canyons**, with spatial detailing to the scale of individual streets and buildings



Variables affecting dust particle contamination: **width** and **length** of the canyon, **the ratio of the distance** from a point to the beginning of the canyon to the total length of the canyon, **distance** to nearest obstacle, **vehicle mileage** along the entire length of the canyon and **vehicle emissions** along the entire length of the canyon, **industrial impact**, **physicochemical properties** of road dust.

Length of the urban canyons in the western part of Moscow (data provided by T. Samsonov)

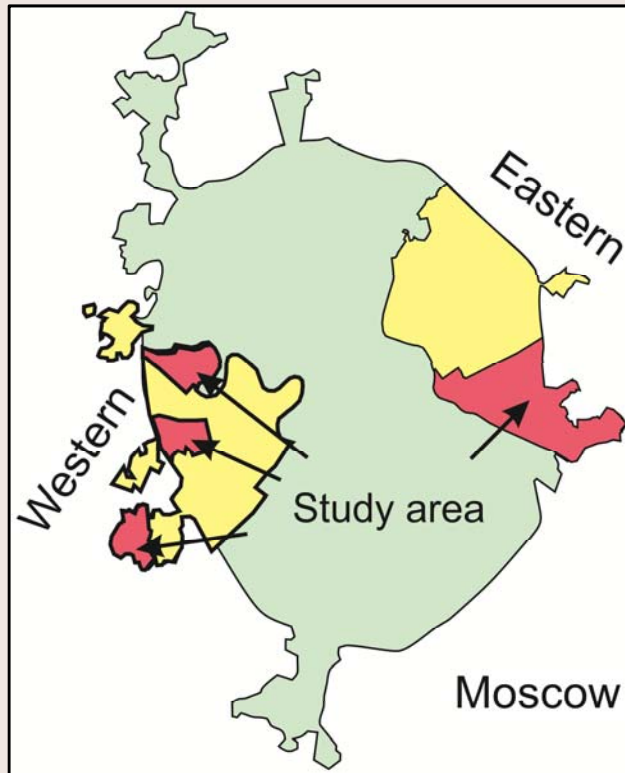


## **Deliverable 2 (district level):**

**influence of different sources on  
microparticles pollution  
with toxic elements**



## Characterization of composition for the fractions and groups of toxic element compounds in road dust of the Western and Eastern districts of Moscow

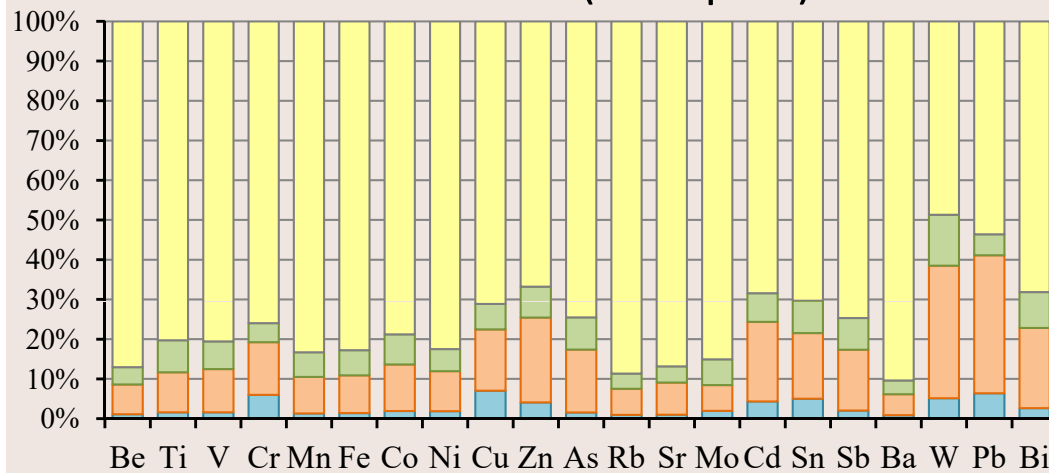


### Topics:

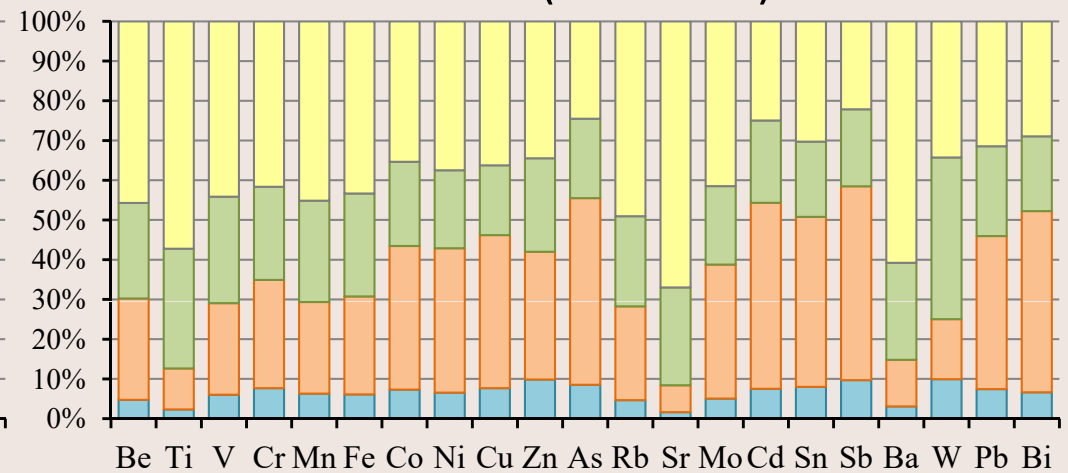
- Differences in the particle size distribution in road dust in the Eastern and Western Moscow
- Toxic elements in size-fractionated road dust
- Enrichment of road dust particles with toxic elements on roads of different sizes

*Toxic elements in size fractions of road dust on small roads and courtyards with parking lots in the Western transport and Eastern industrial districts of Moscow*

Western (transport)



Eastern (industrial)



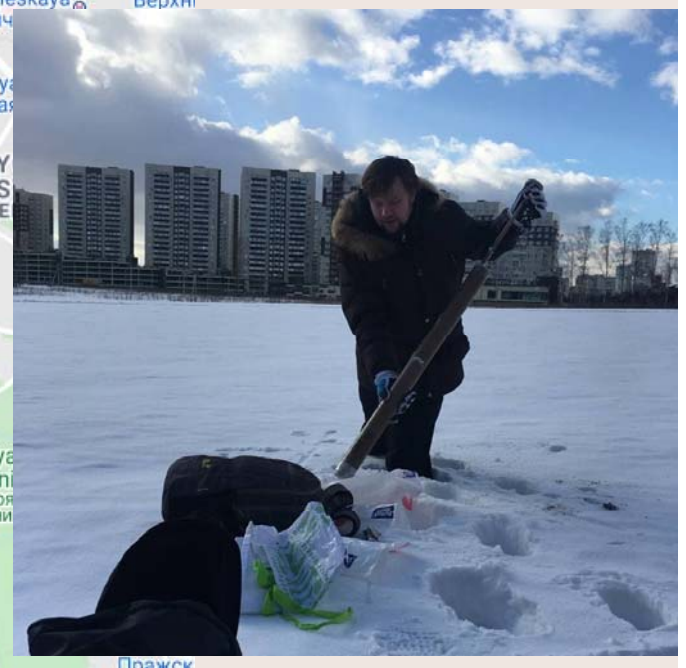
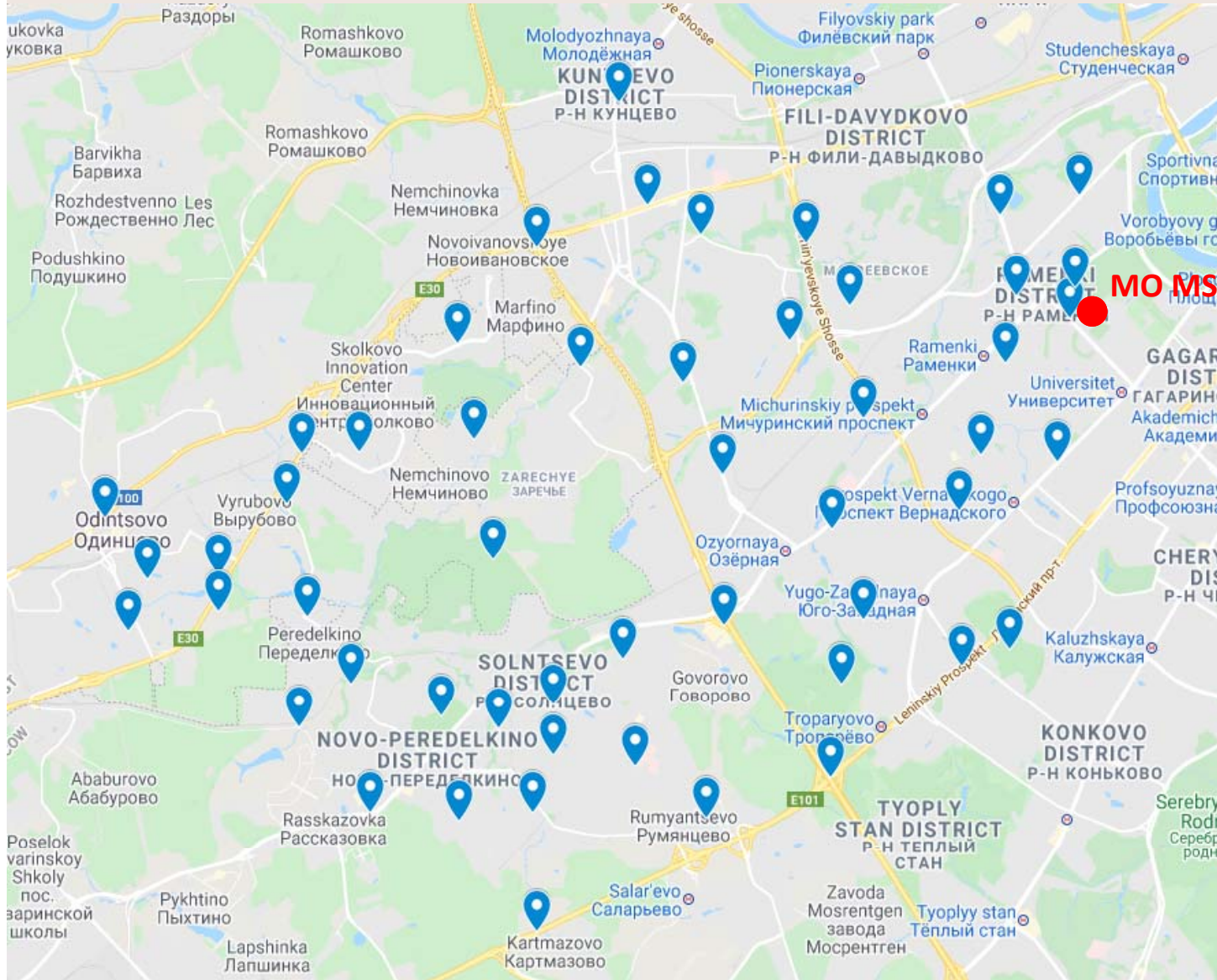


**Deliverable 3 (basin and station level):**

**spatial heterogeneity of microparticles  
pollution with toxic elements and PAHs  
in the Setun river basin**



## Sampling of snow cover in the Setun river basin (05-09 March, 2021)

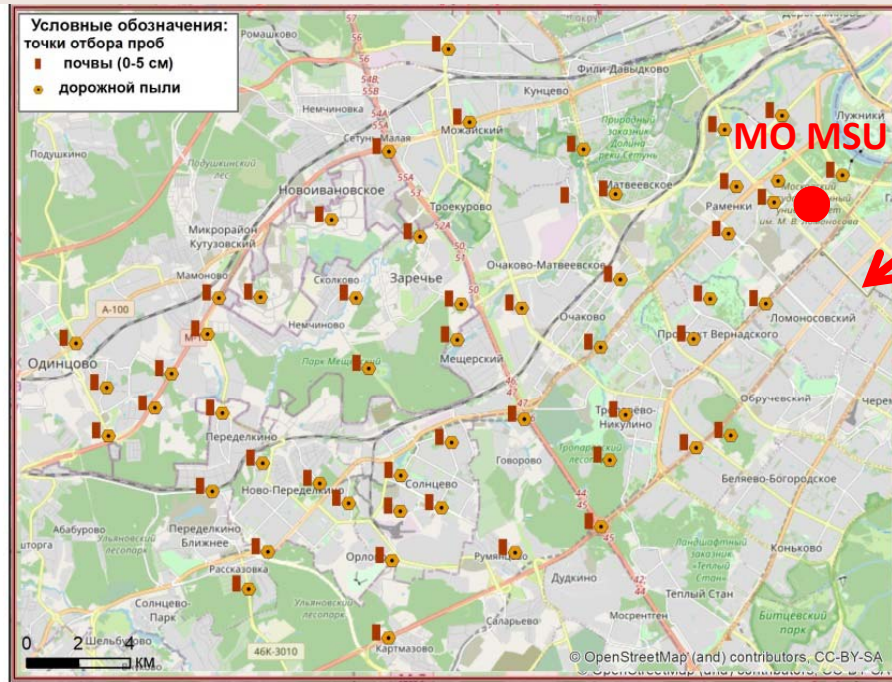


**Scheduled chemical analytical works: suspended and dissolved toxic elements + polycyclic aromatic hydrocarbons (PAHs) + chemical composition of PM10 in snow + PAHs in soils and in PM10 of soils (summer 2021)**





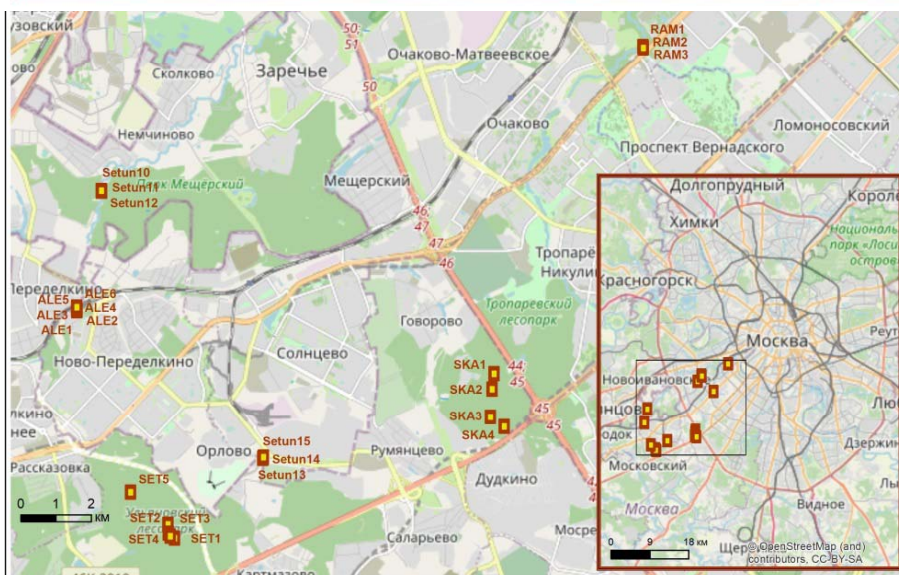
## Development of database with the results of geochemical sampling of snow cover, soil, road dust in the Setun river basin



### *Soils and road dust*

Indicators included in the database :

- Samples metadata (coordinates, address, type of impact, depth of sampling, etc.)
- pH-value
- Electrical conductivity
- Total organic carbon
- Particle size distribution
- Content of macroelements (Na, Mg, Al, K, Ca, Ti, Mn, Fe)
- Content of potentially toxic elements (Li, Be, Sc, V, Cr, Co, Ni, Cu, Zn, Ga, As, Se, Rb, Sr, Y, Zr, Nb, Mo, Rh, Pd, Ag, Cd, Sn, Sb, Te, Cs, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, W, Re, Ir, Pt, Au, Tl, Pb, Bi, Th, U)
- Content of polycyclic aromatic hydrocarbons
- Soil-geochemical catenas

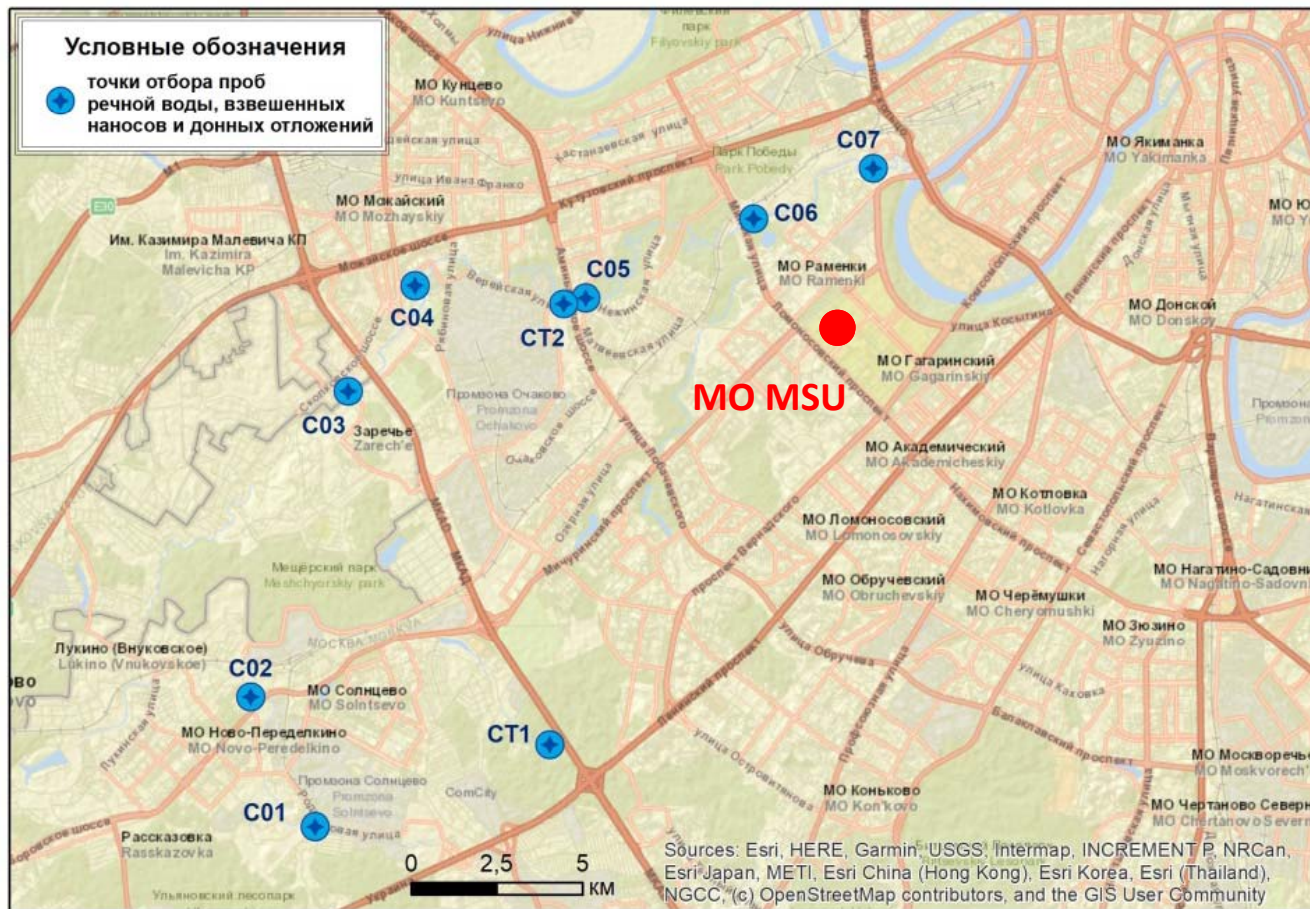






## Development of database with the results of geochemical sampling of snow cover, soil, road dust in the Setun river basin

### *River waters, suspended particles and sediments*



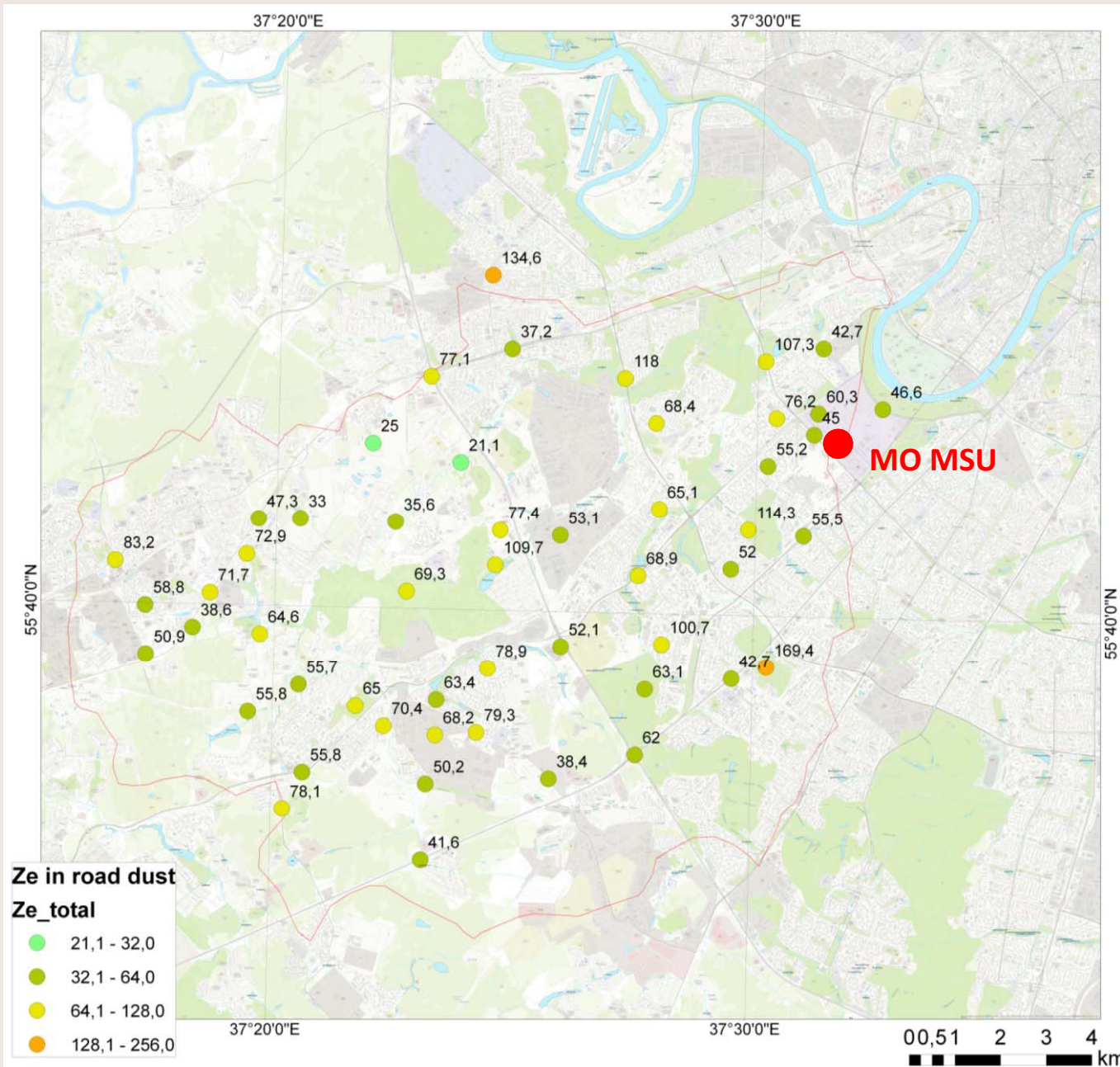
### Indicators included in the database:

- **Samples metadata** (coordinates, height, catchment area at the sampling point; distance from the mouth, characteristic of anthropogenic impact, etc.)
- **Hydrological characteristics** of the river basin Setun at sampling sites:
  - ✓ Water level in relative marks above "0" station
  - ✓ Water level in absolute heights
  - ✓ Flow velocity
  - ✓ Cross-section area
  - ✓ Water discharge
- **Physical and chemical properties of surface waters:**
  - ✓ Temperature
  - ✓ Electrical conductivity
  - ✓ Dissolved oxygen content
  - ✓ Percentage of water saturation with dissolved oxygen
  - ✓ pH-value
  - ✓ Optical turbidity value
  - ✓ Suspended sediment concentration





## Distribution of geochemical load and soil pollution in the Setun river basin according to data on the composition of the snow cover



Total enrichment of road dust with toxic elements in the Setun river basin according to

$$Ze = \sum EF - (n - 1),$$

where  $EF = (C / C_{La})_{dust} / (C / C_{La})_{crust}$ ,  $La$  – reference element,  $EF > 1$ ,  $n$  – number of metals and metalloids with  $EF > 1$

**Next steps:** determination of toxic elements and PAHs in soils and snow cover



2022

16



**Description of the spatial heterogeneity of the Setun river basin area and the identification of units with homogeneous natural and anthropogenic conditions for the erosion model**

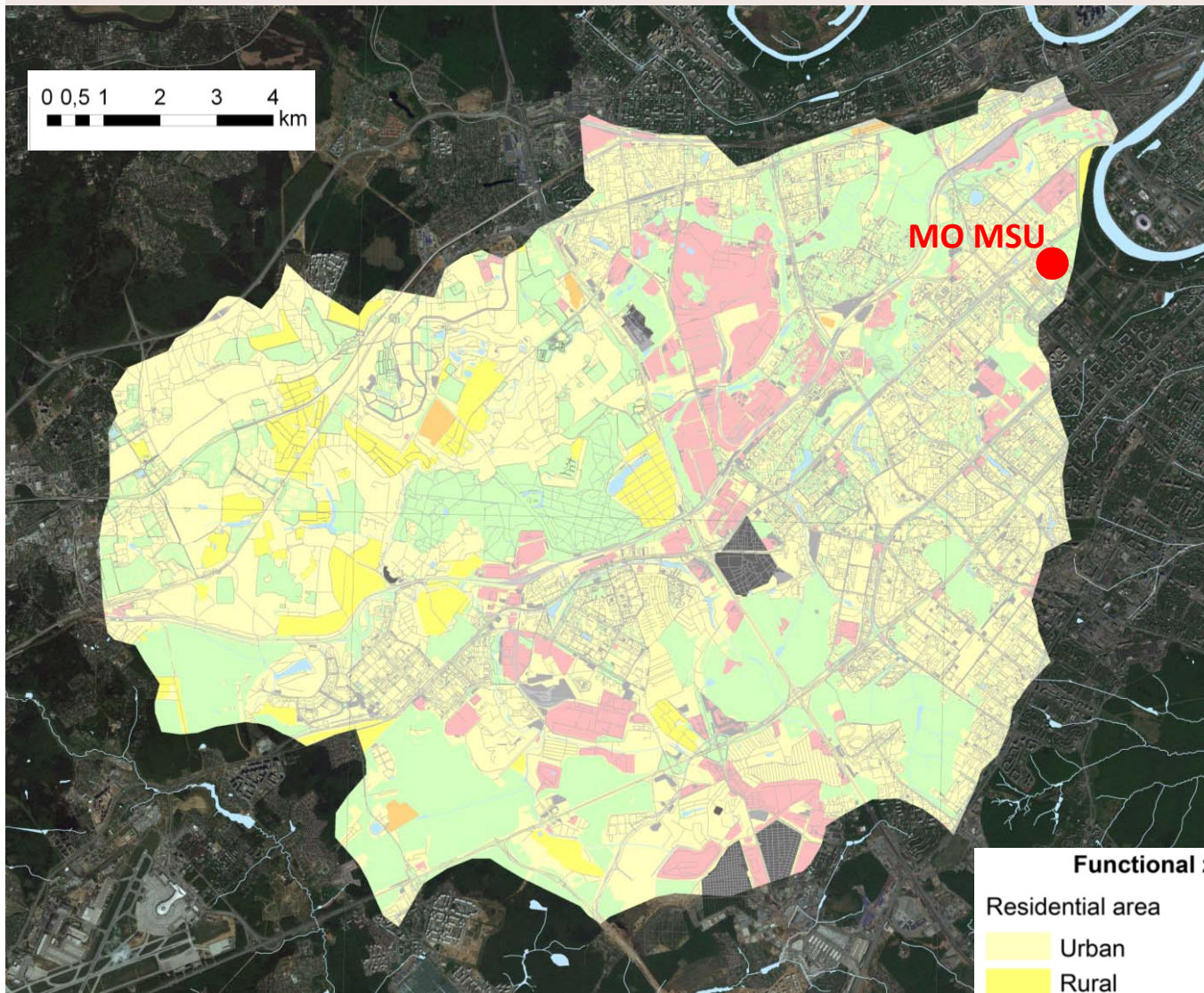
***Basic information for the erosion model***

- land use zoning of the territory
- inventory of the main sources of pollution
- elementary geochemical landscapes
- soils and parent rocks
- relief
- vegetation
- conditions of water migration
- etc.



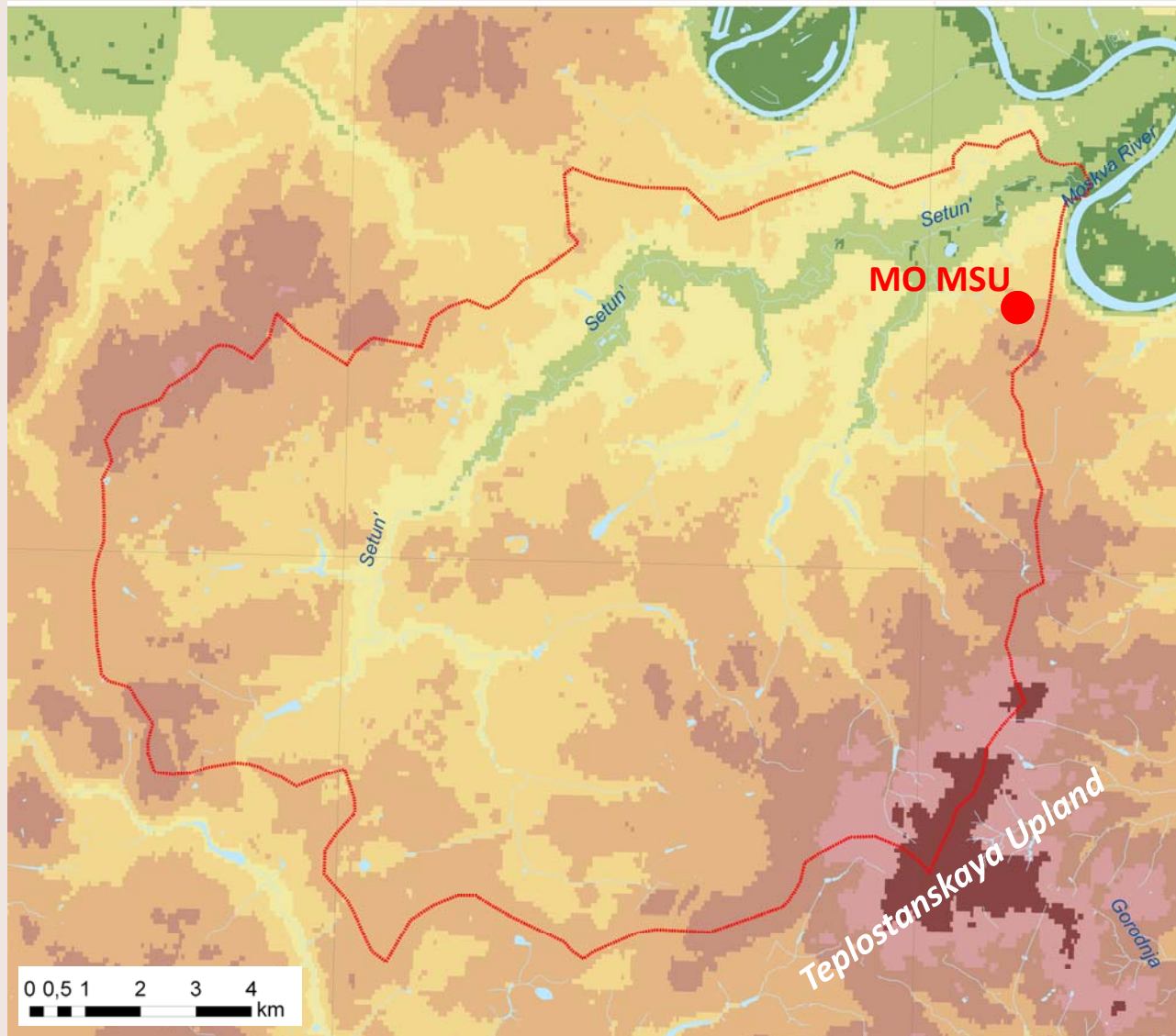


## Description of the spatial heterogeneity of the Setun river basin area and the identification of units with homogeneous natural and anthropogenic conditions for the erosion model

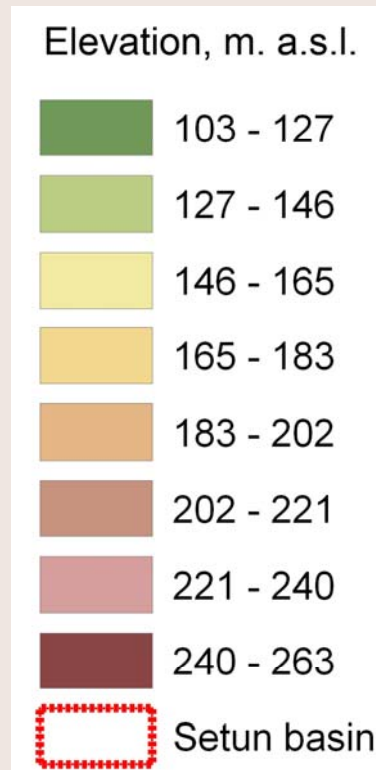


Land use zoning of the Setun river basin

## Description of the spatial heterogeneity of the Setun river basin area and the identification of units with homogeneous natural and anthropogenic conditions for the erosion model



Terrain elevation of the Setun river basin







# The laboratory equipment needs in 2021

1. Electric stoves and evaporation bowls for separation of microparticles after centrifugation
2. Laboratory sieves for separation of large particles
3. pH meters and conductometers for field work
4. Filter sets for separation of microparticles from solutions (river waters, snow, precipitation)
5. Sample storage refrigerator

TOTAL: 9 thousand Euros (650 thousand Rubles)

+ Chemical analyses ~ 25 thousand Euros (1.65M Rubles) per year





**Thank you for your attention!**