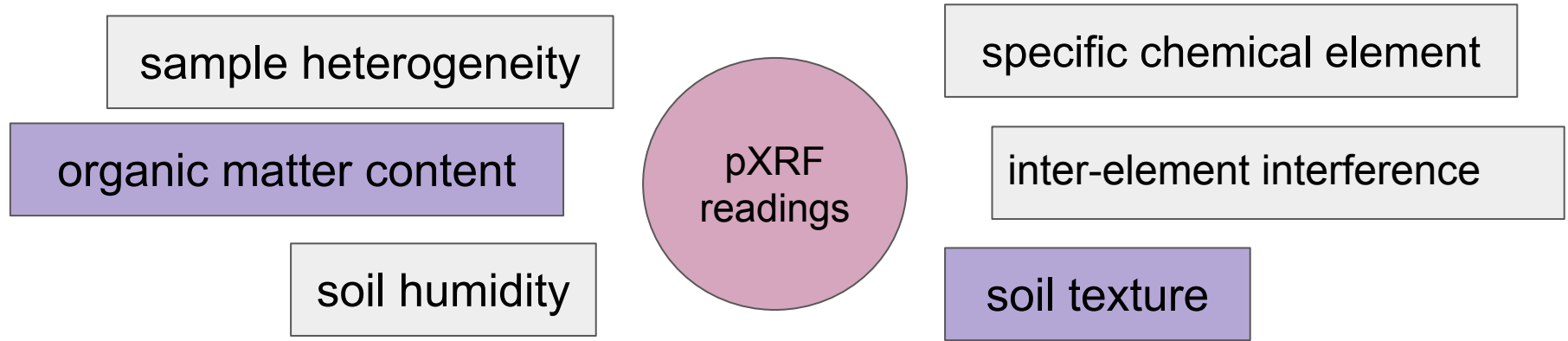# Assessing urban soils' pollution in Moscow megalopolis by portable X-ray fluorescence analyzer

Olga Romzaykina, Marina Slukovskaya, Viacheslav Vasenev,
Anna Paltseva, Dmitrii Sarzhanov, and Artyom Losev

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Introduction

- The study of urban soils of large cities is complicated due to their heterogeneity and continued reconstruction.
- Express methods of chemical elements' content analysis using portable XRF devices allows to quickly assess the pollution level.

sample heterogeneity

organic matter content

soil humidity

pXRF readings

specific chemical element

inter-element interference

soil texture

Our research focused on the development of correction factors for the Olympus Vanta C analyzer for soil mixtures in *organic matter* and *soil texture* wide range.
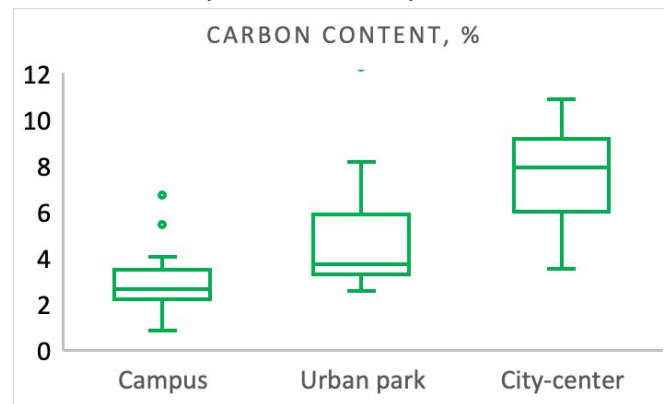
Characteristics of study sites and methods
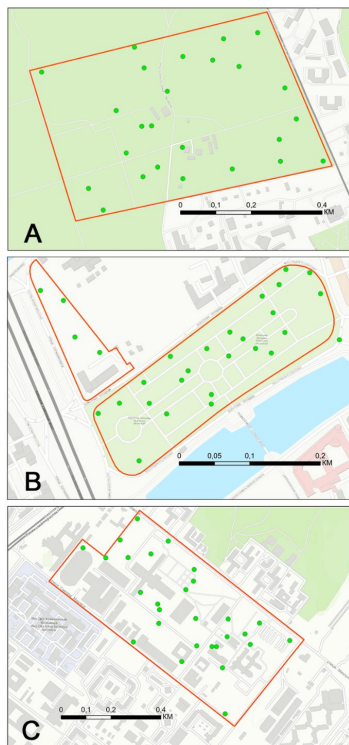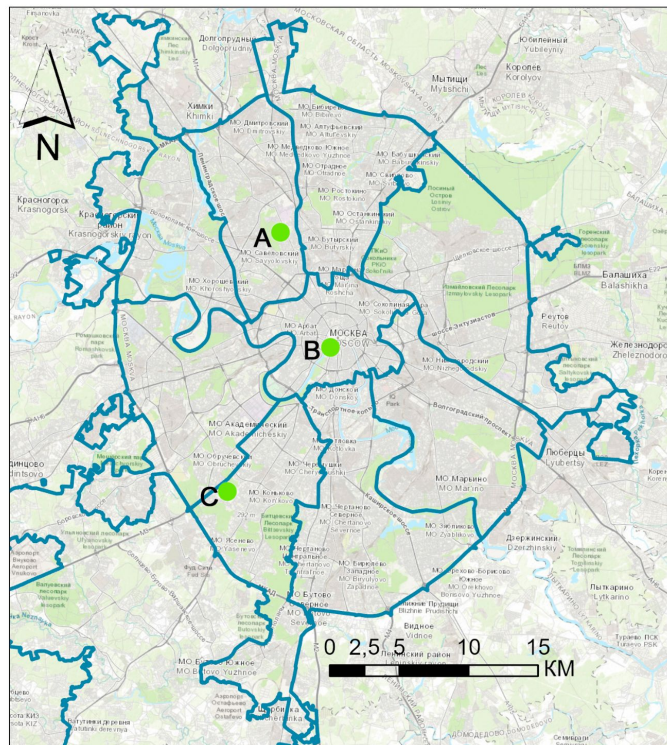
85 soil samples were taken from the depth of 0-10 cm on three sites in the megalopolis.

Heavy metal content was analized by the pXRF Olympus Vanta C analyzer and the ICP-OES (EPA 6010B).

The C content was determined by Vario TOC Select (Elementar).

Three sites with different pollution level (PINemerow): A. the urban park in Moscow Timiryazev Agricultural Academy (PINemerow 1.12), B. the Repin's square in the city-center (PINemerow 7.72), and C. the RUDN University campus (PINemerow 0.84)

Soil texture for sites: sand (S), sandy loam (SL), loam (L), and peat (P) mixture: (SLP, LP, and S3P).
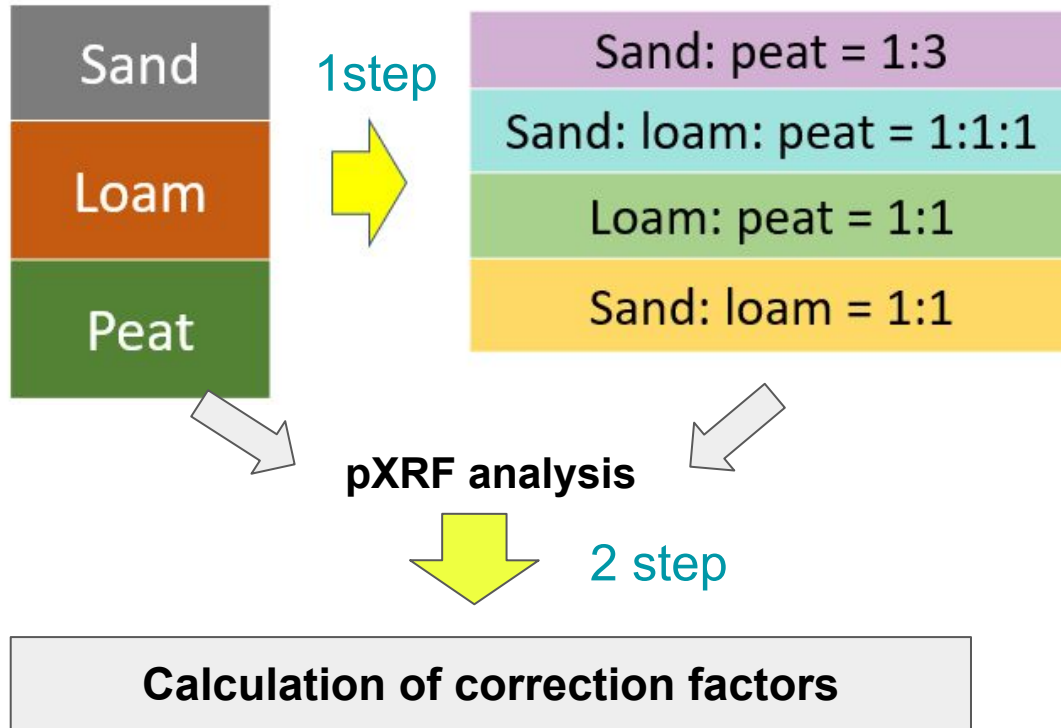
pXRF correction factors for different metals and soil mixtures
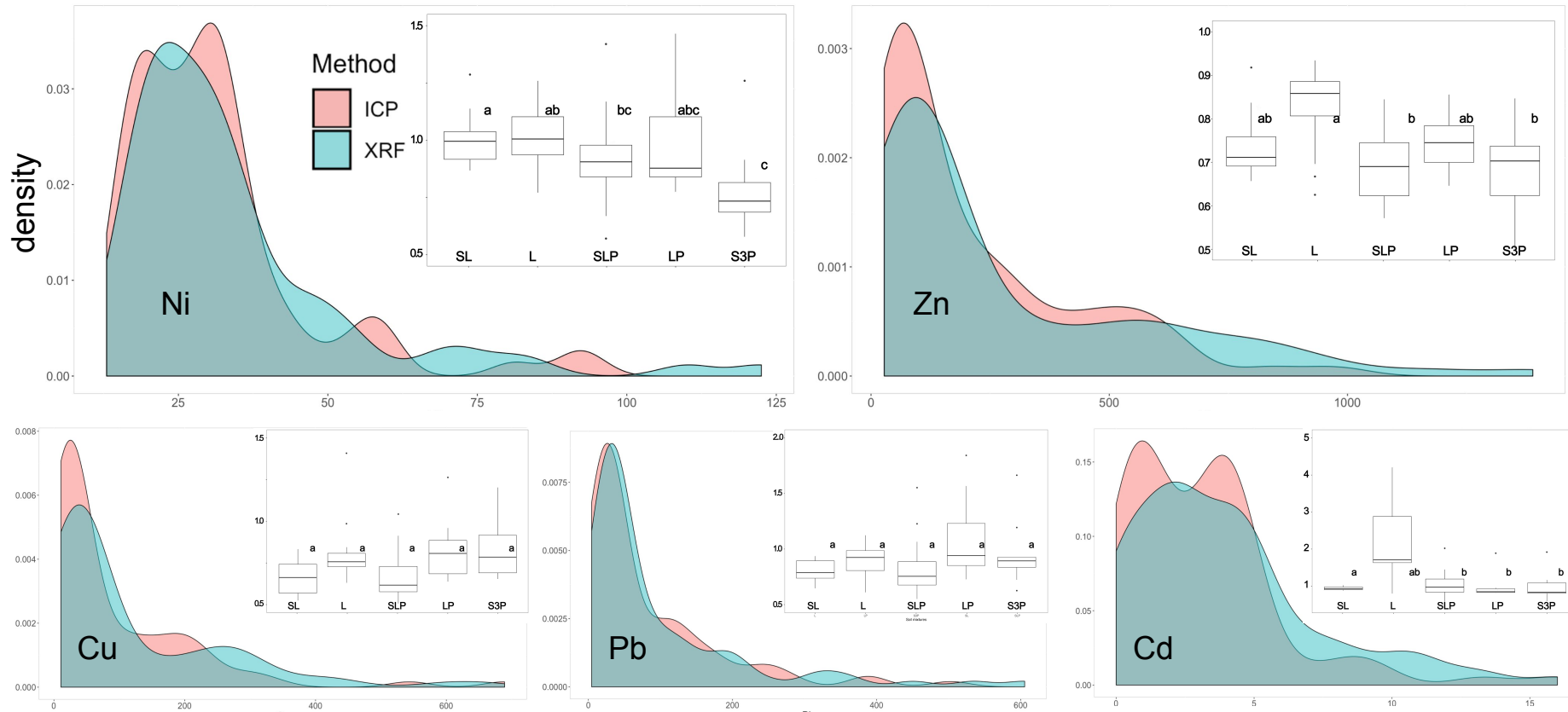
How can we improve the accuracy of pXRF results?

Design of experiment of pXRF correction factors

1step. Preparation of soil mixtures in the wide range of organic matter (OM) and metal content from clean soils and standard metal solutions;

2 step. Calculation of correction factors for different heavy metals.

| Sand |
| Loam |
| Peat |

1step

Sand: peat = 1:3

Sand: loam: peat = 1:1:1

Loam: peat = 1:1

Sand: loam = 1:1

pXRF analysis

2 step

Calculation of correction factors

Metals: Cu, Zn, Pb, Ni, Cd

Concentrations:
1, 2.5, 10, 25, 100, 250, 1000, 2500, 10 000 ppm

Correction factors

1. The calibration factors in the laboratory mixtures showed similar trends with urban soil samples.
2. Significant excess of pXRF values were noted for soil mixtures with OM >13%.
3. But the coefficient variation was insignificant for Pb, Cu and Ni for mixtures with OM <13%.
4. The highest exceedance of pXRF was observed for Zn in all mixtures except sand.
5. Cadmium had a large variation both in the urban soil samples and in the laboratory mixtures, which may be due to the high detection limit for Olympus Vanta C (6 ppm), which is not suitable for moderate concentrations in the urban soils.

Soil mix (OM,%)	Pb	Cu	Zn	Ni	Cd
S (0.09)	0.96	0.76	0.95	0.79	1.07
L (3.46)	0.87	0.89	0.84	0.98	0.66
P (33.37)	0.75	0.56	0.65	0.66	2.06
SL (1.48)	1.06	0.88	0.69	0.93	0.88
LP (10.43)	0.88	0.81	0.77	0.95	0.82
SLP (5.02)	0.94	0.87	0.71	0.87	0.93
S3P (13.05)	0.97	0.68	0.64	0.83	1.45

Applying a correction factor in the mapping of heavy metal pollution in urban areas using ArcGIS Pro
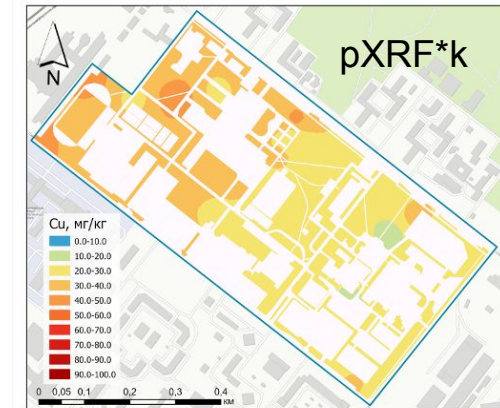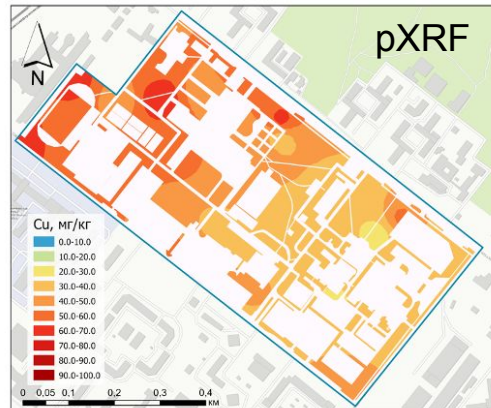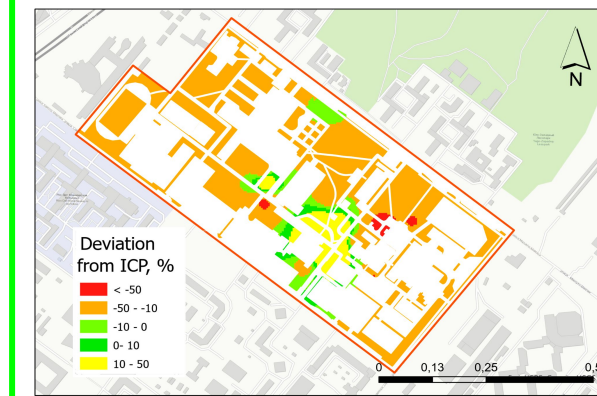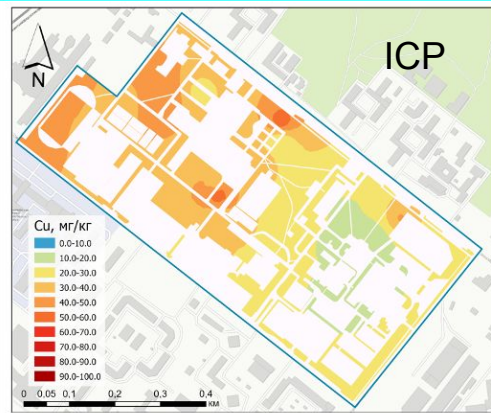
The increasing *of site area with values in the range ± 10% of ICP after using correction factor, %*

XRF	Cu	Pb	Ni	Zn
Urban park	4.3	8.0	53.5	63.6
Campus	35.2	4.6	20.6	-7.2
City-center	28.9	27.9	12.9	60.9

Algorithm for levelling the factors of soil texture and soil organic matter

pXRF analysis of dried, ground, sieved through a sieve
with a 2 mm mesh diameter and pressed soil samples

⬇

Classification by C content (analytical) or soil texture (express)

⬇

Selection of a correction factor for a heavy metal with
concentration more than the detection limit

⬇

Recalculating pXRF data to the final concentration

Thank you for your attention!

romzaykina-on@rudn.ru
m.slukovskaya@ksc.ru
vasenyov@mail.ru