Assessing the impact of fluvial dynamics on floodplain soil contamination and microbiota in the transboundary Drava River Floodplain

Péter Szabó, Gyozo Jordan, Tamás Kocsis, Robert Šajn, Jasminka Alijagić

European Geosciences Union 2020

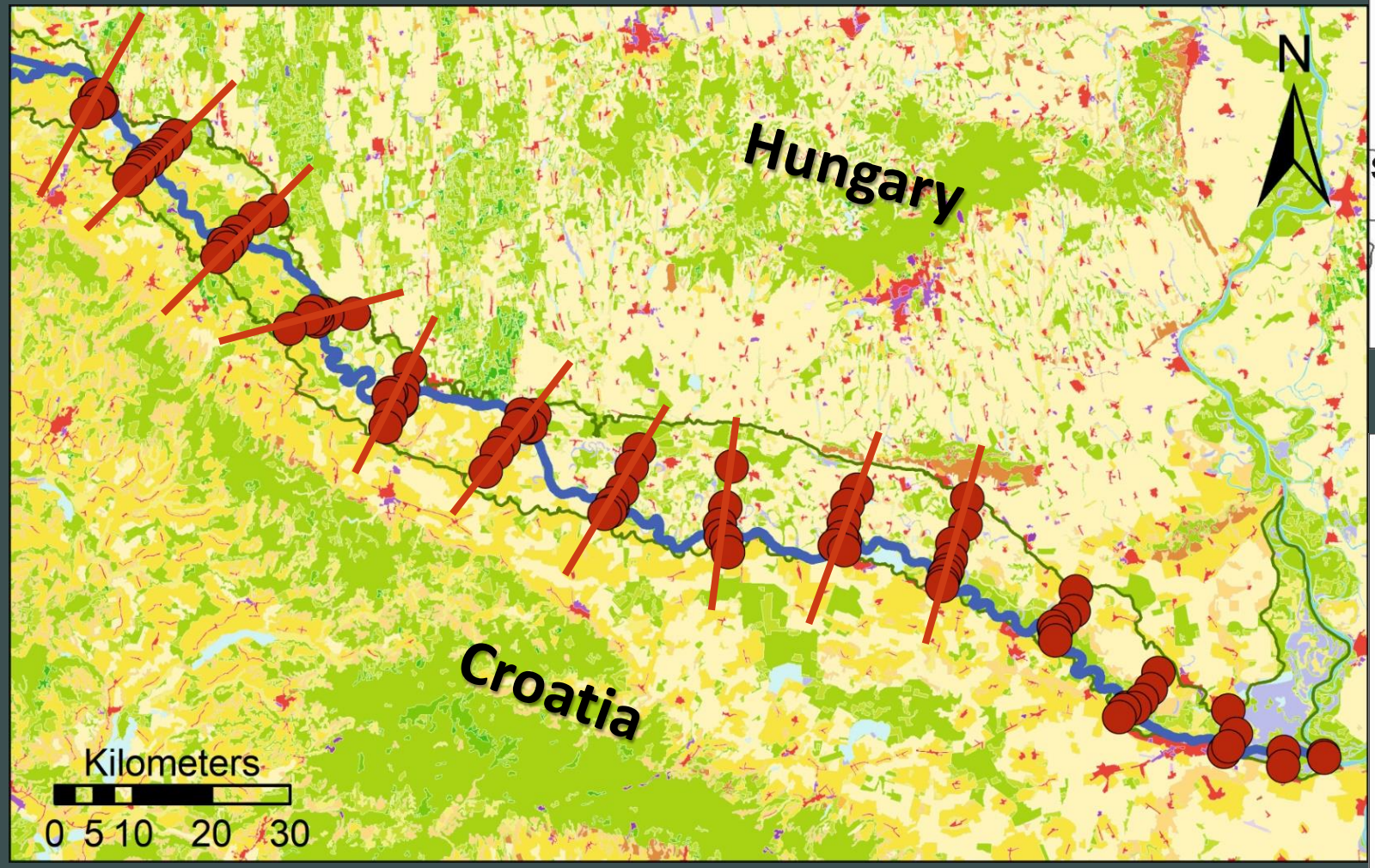
07 May 2020

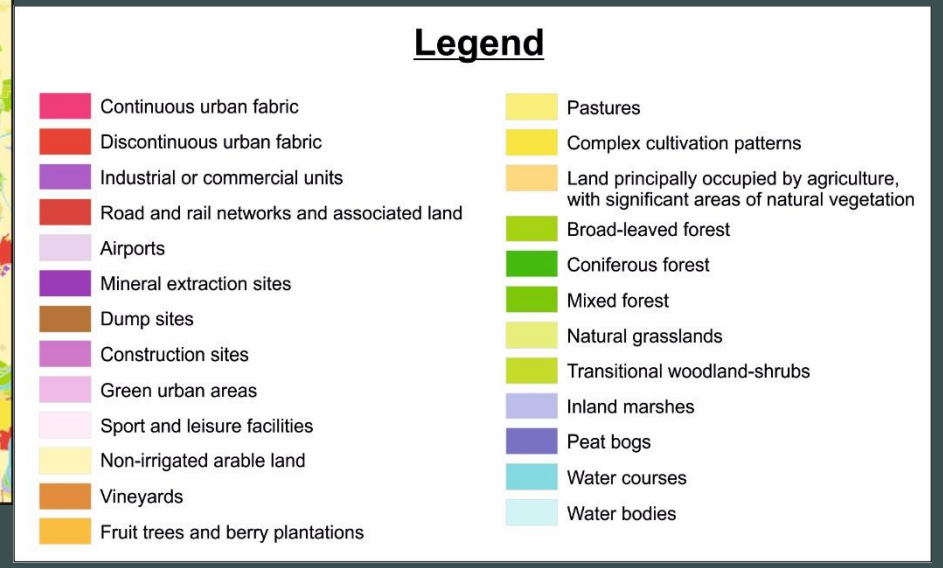
Table of Contents

Background and aim of the research

- Perhaps the most productive agricultural arable lands and grazing lands, diverse riverine habitats
- Floodplains are sensitive receptors of upstream contamination (e.g. smelting, mining, industry)
- Soil and sediment samples were taken from the alluvial plain and river terrace areas of the floodplain
- Assessment of contamination distribution, dynamics and mobility in the floodplain
- Highlighting potential vulnerabilities and endangered territories
- Contributing to a Slovenian-Hungarian Bilateral project (SNN OTKA 118101). The project was co-funded by European Union Fund, ERDF, IPA, ENI (DTP2-093-2.1 SIMONA).

Study area

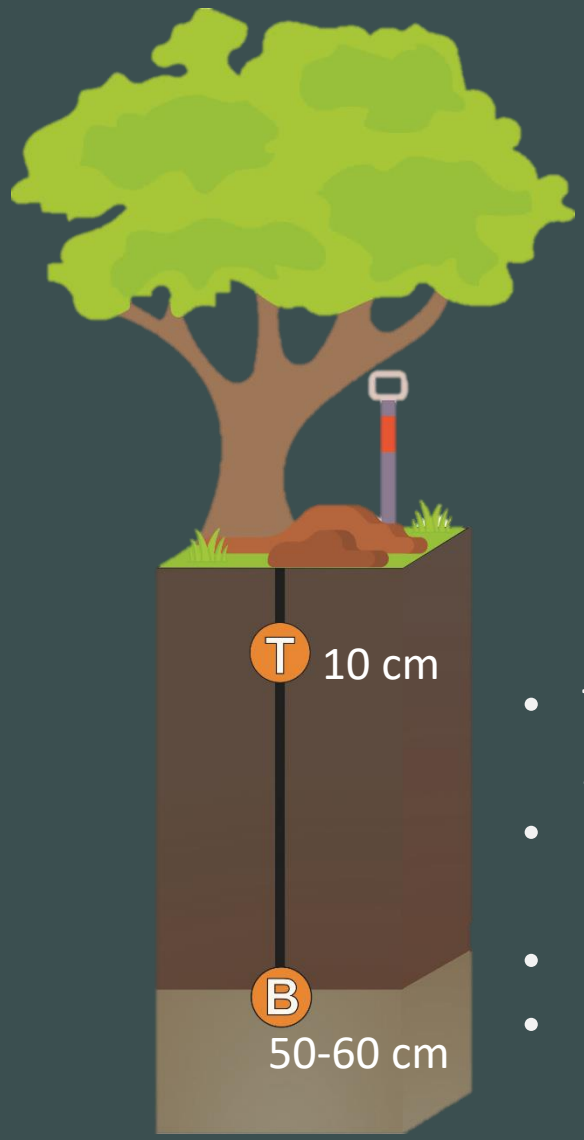




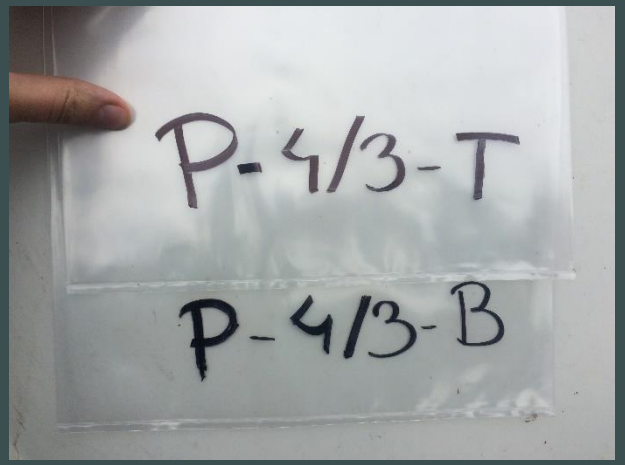
CORINE Landcover 2012

- River Drava, southern border river of Hungary
- Studied **10** cross-sections along the border connected to Hungary

Sampling



- Topsoil, Subsoil and River Sediment samples
- From alluvial plains and river terraces
- ICP-MS
- pH, LOI, carbonate content
- FDA



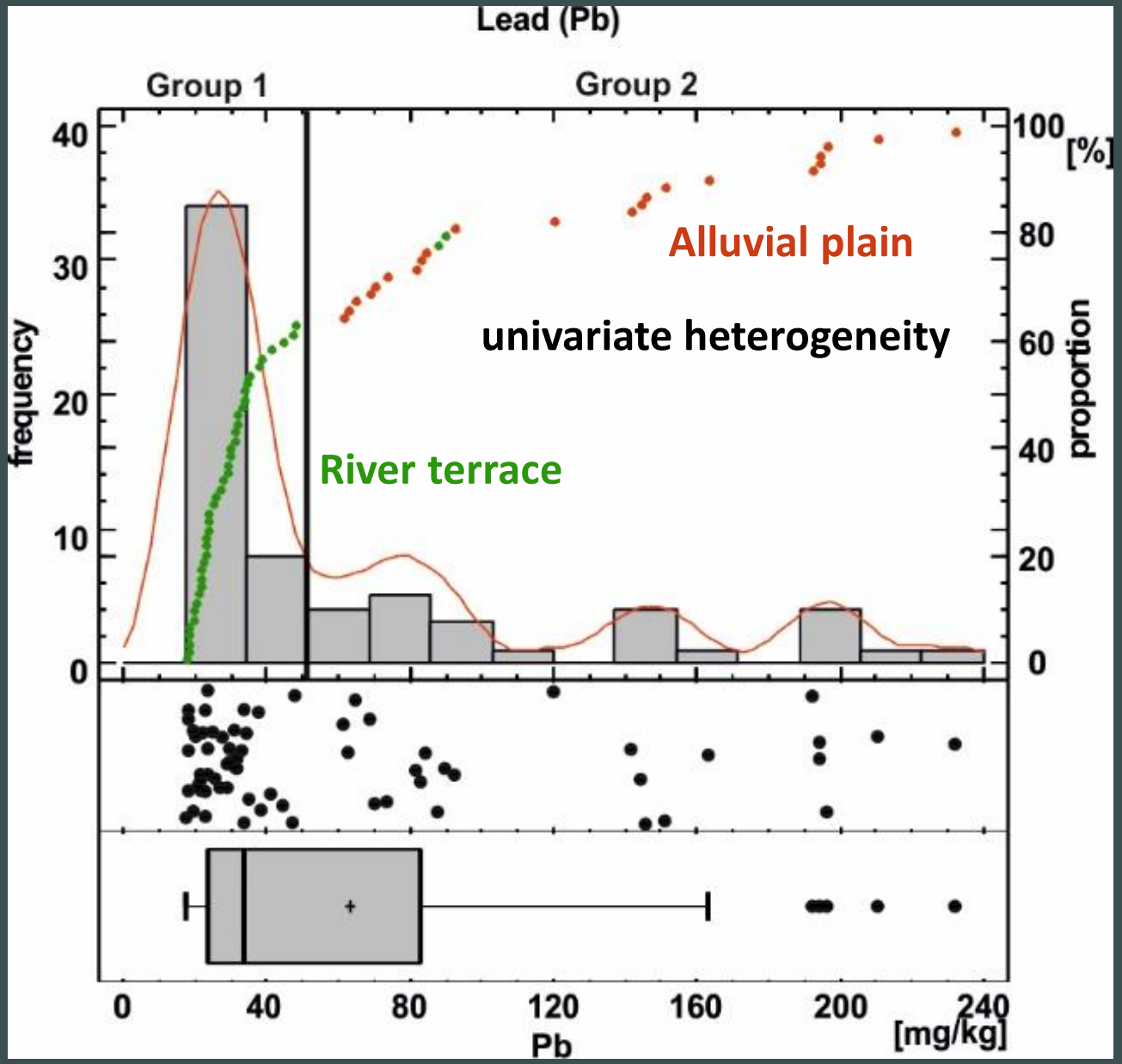
Descriptive statistics

Chemical element	Statistical parameters									6/2009. (IV. 14.) KvVM-EüM-FVM
	Minimum	Lower quartile	Median	Upper quartile	Maximum	MAD	Average	Standard deviation	Relative standard deviation	
	mg/kg	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*		*mg/kg*
Zn	48.00	77.00	107.50	197.00	854.00	45.50	186.94	181.33	0.97	200
Cd	0.10	0.20	0.30	0.90	3.00	0.10	0.64	0.71	1.10	1
Pb	17.70	23.30	33.35	83.10	232.30	13.35	63.21	57.96	0.92	100

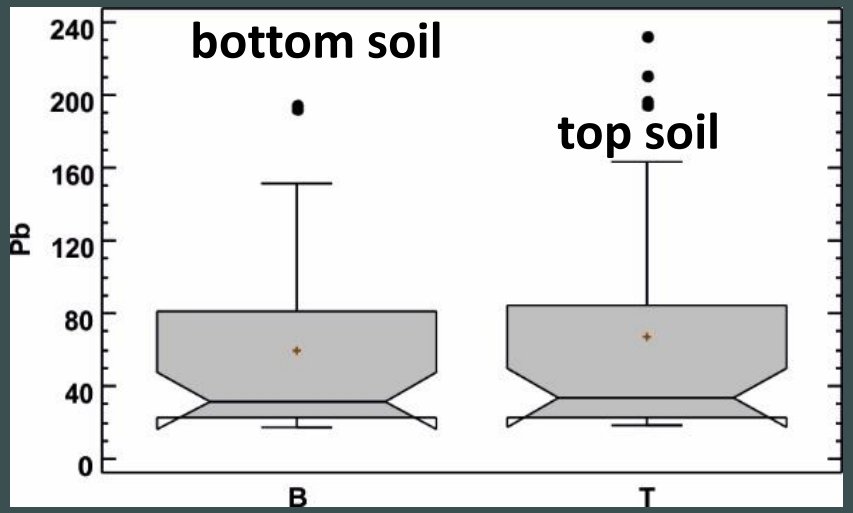
All three elements exceeded the Hungarian regulation

defined in Decree 6/2009. (IV.14.) of the Ministry of Environment and Water, the Ministry of Health, the Ministry of Agriculture and Rural Development for the protection of geological medium and groundwater against pollution and measures of contamination.

One-variable analysis - Pb

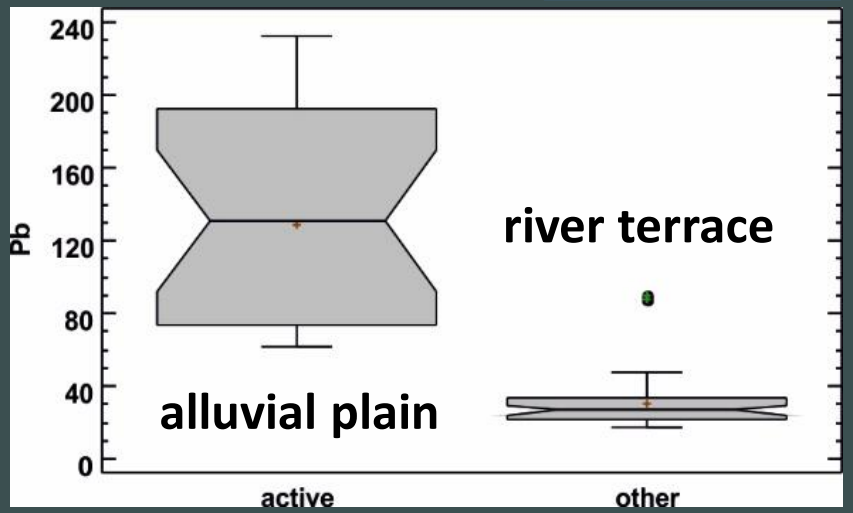


SOIL DEPTH



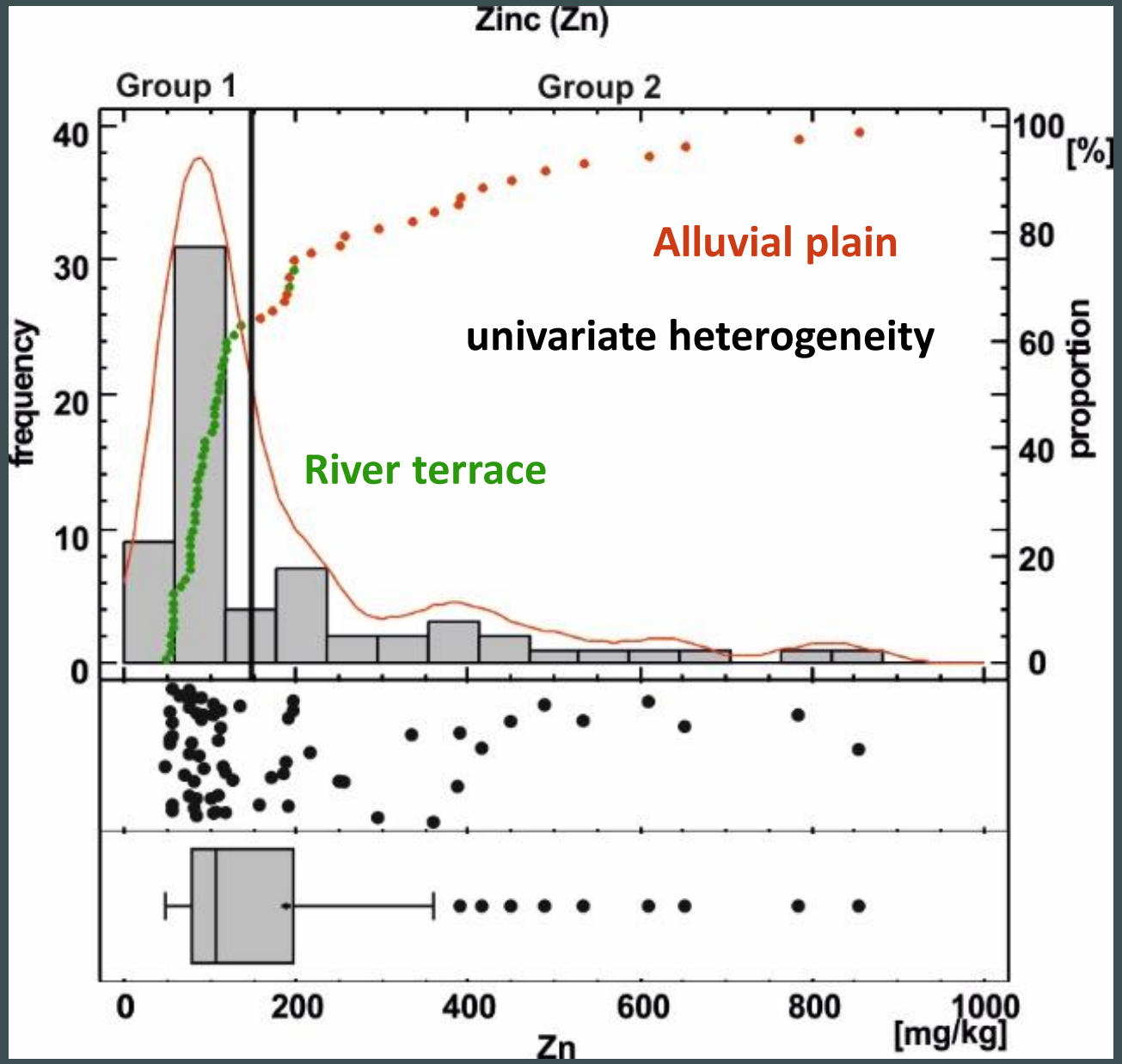
p-value = 0.73

LANDCOVER

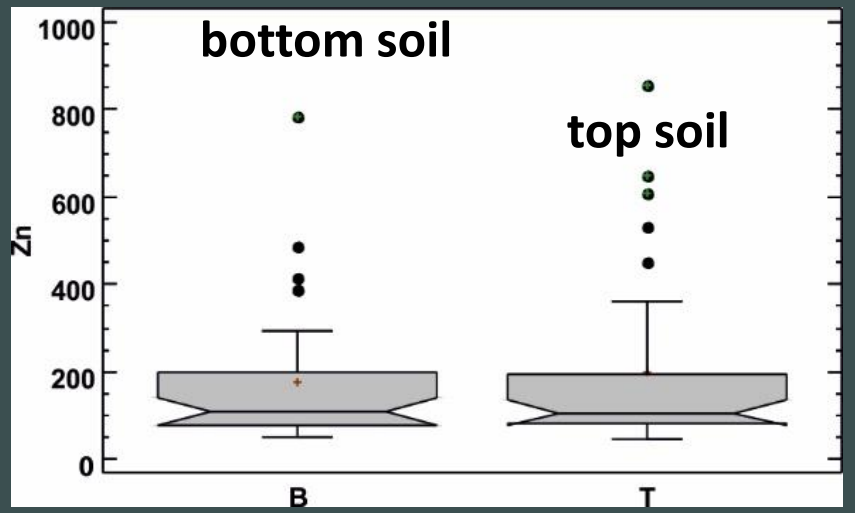


p-value = 0.00

One-variable analysis - Zn

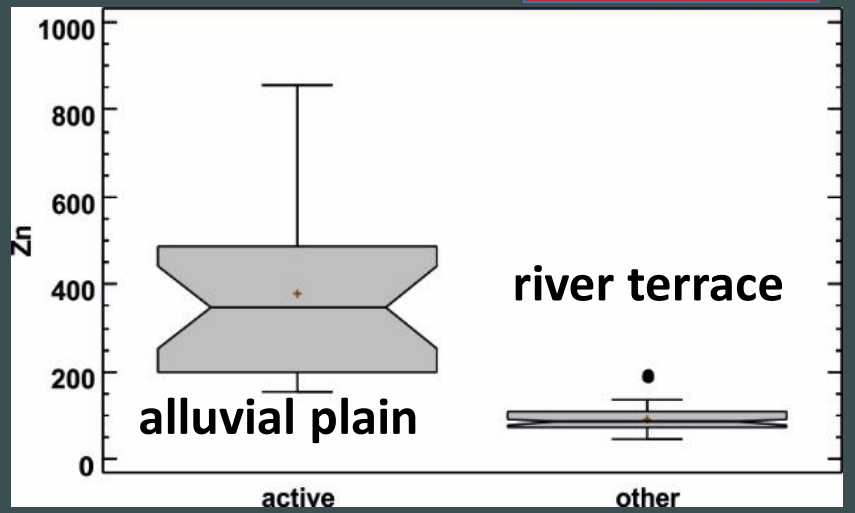


SOIL DEPTH



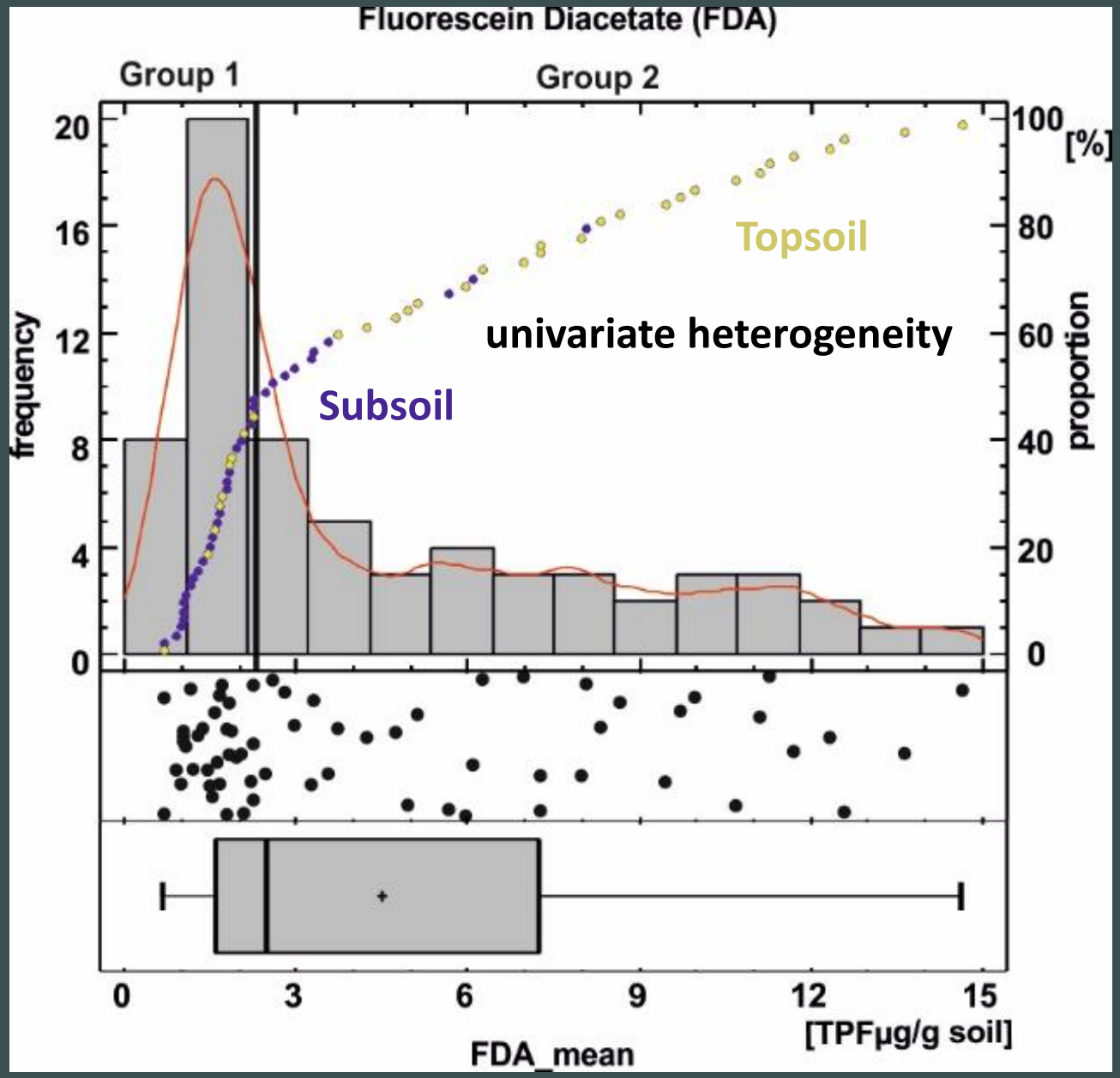
p-value = 0.74

LANDCOVER

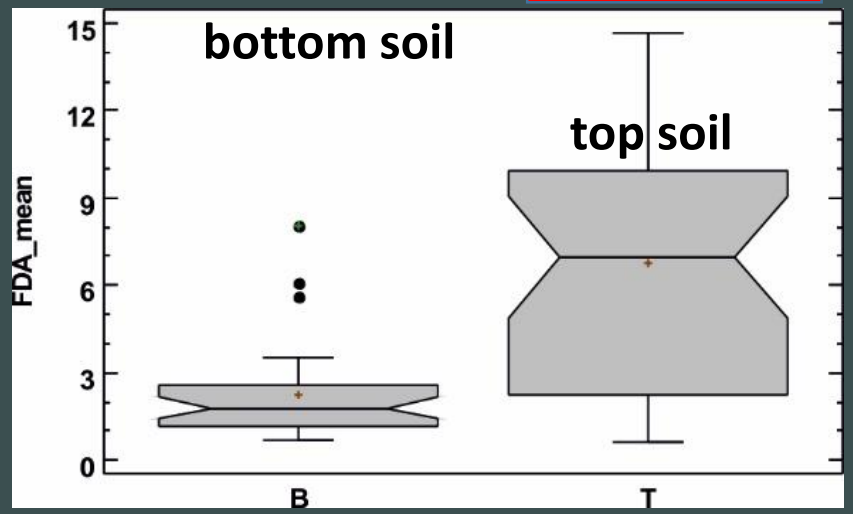


p-value = 0.00

One-variable analysis - FDA

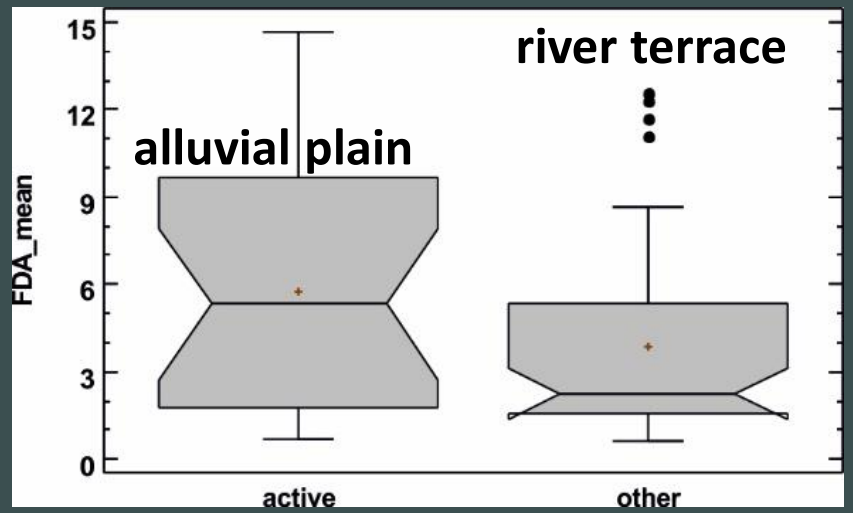


SOIL DEPTH



p-value = 0.00

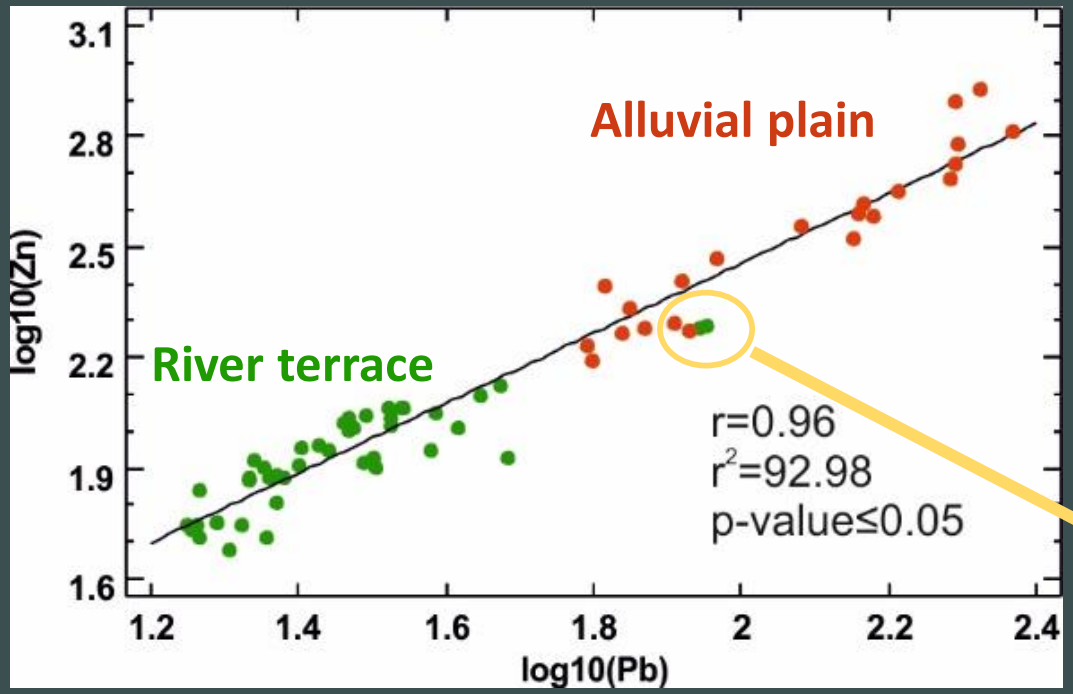
LANDCOVER

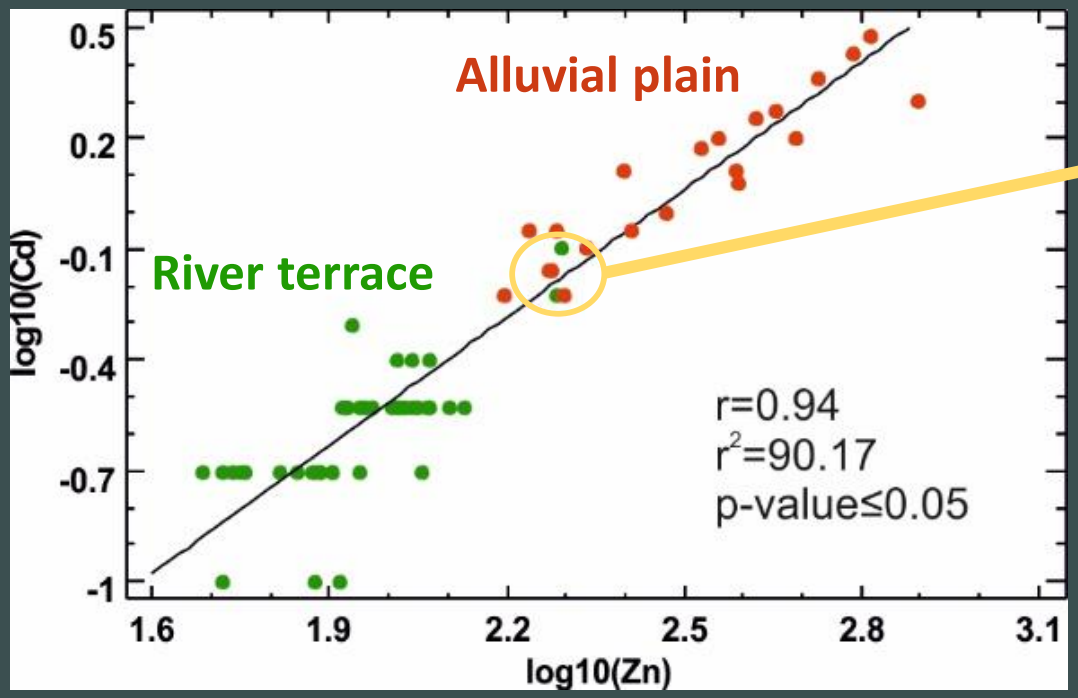


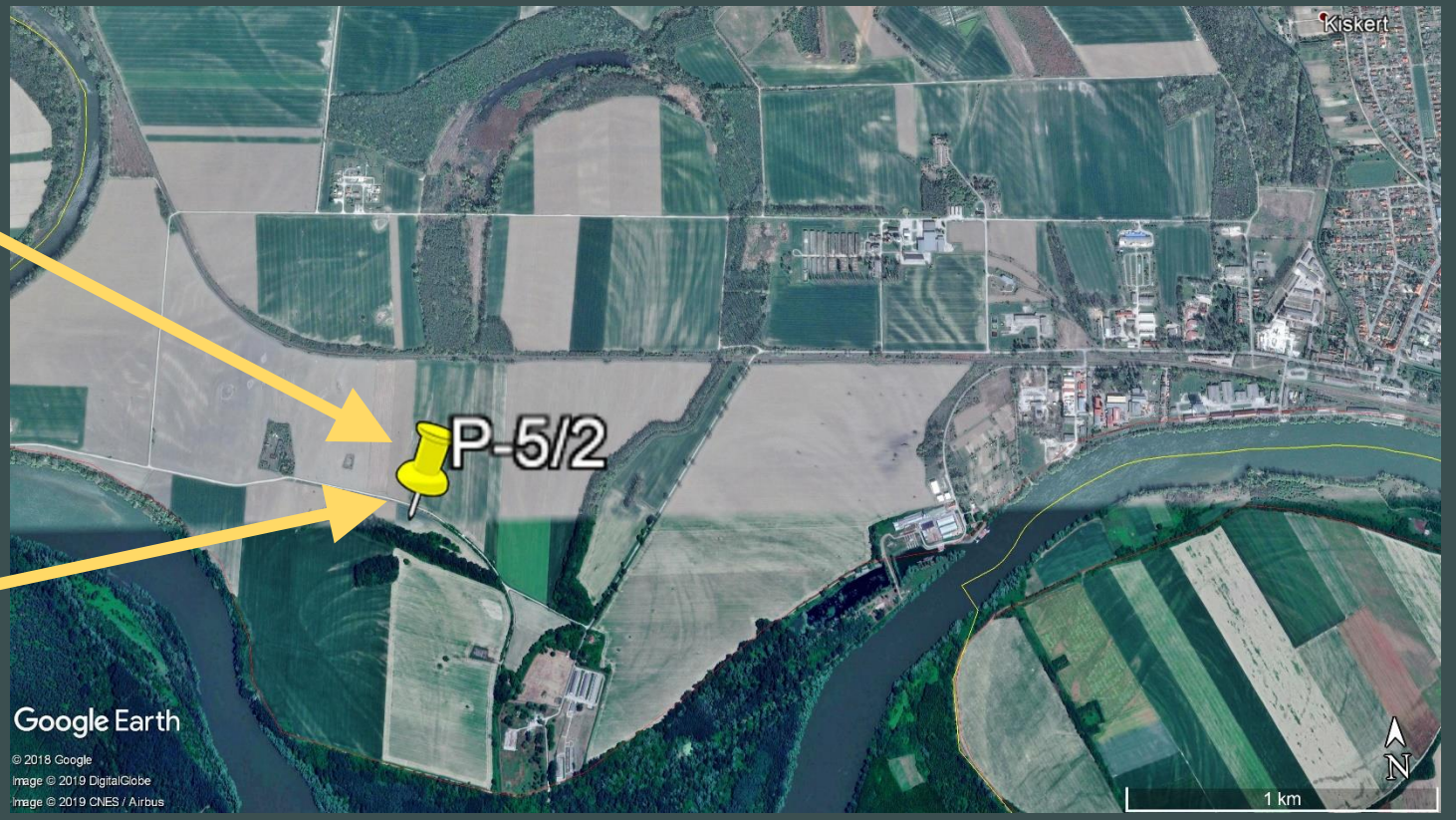
p-value = 0.22

Two-variable analysis

Zn – Pb ; Cd - Zn





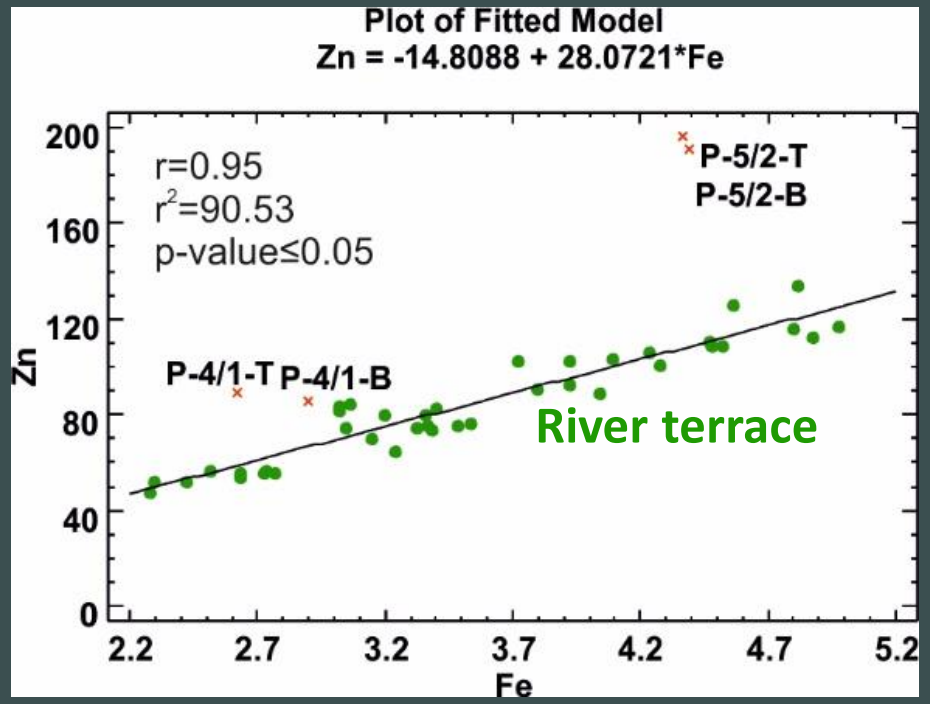


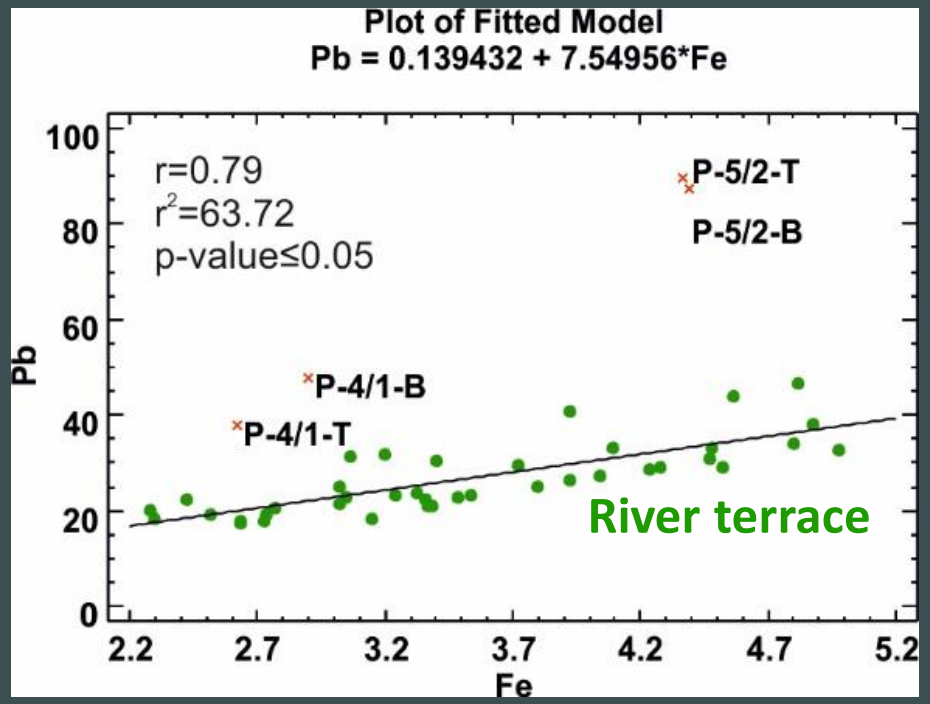
Outlier samples from oxbows/historical channels!

Bivariate heterogeneity!
Different properties and behavior of the contamination

Two-variable analysis

Zn, Pb – Fe



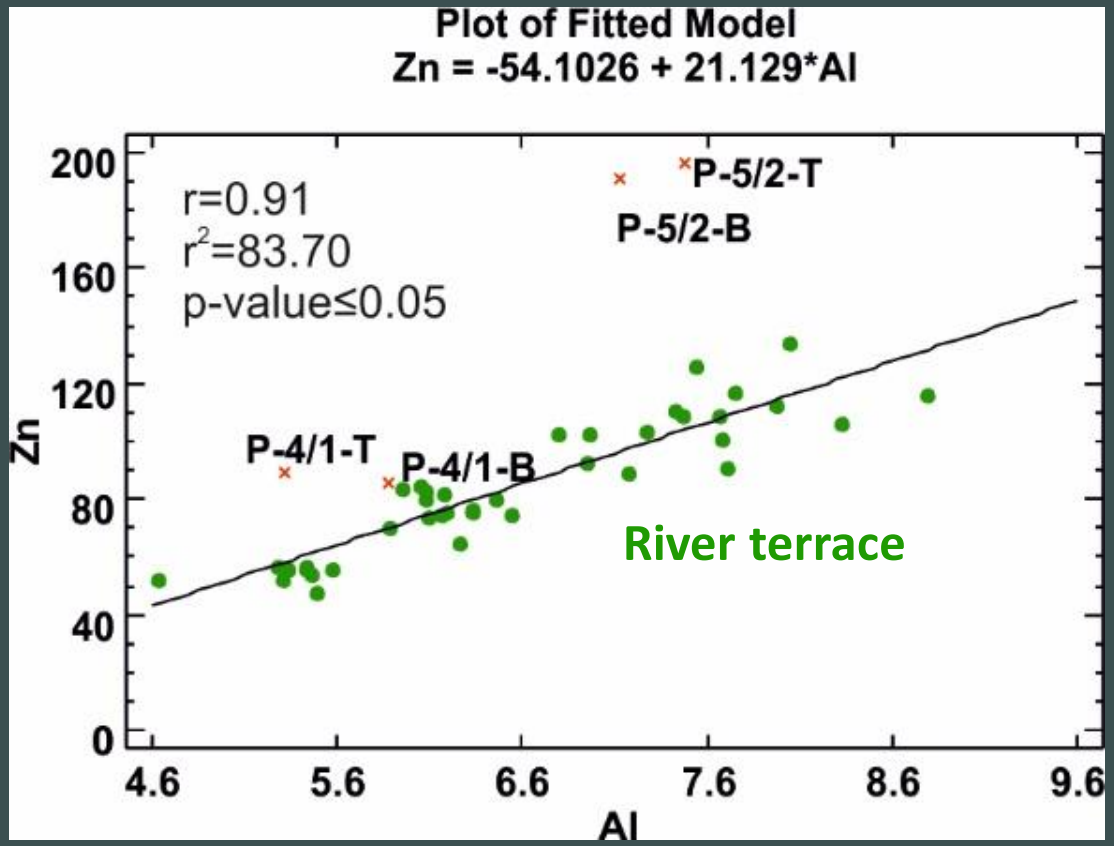


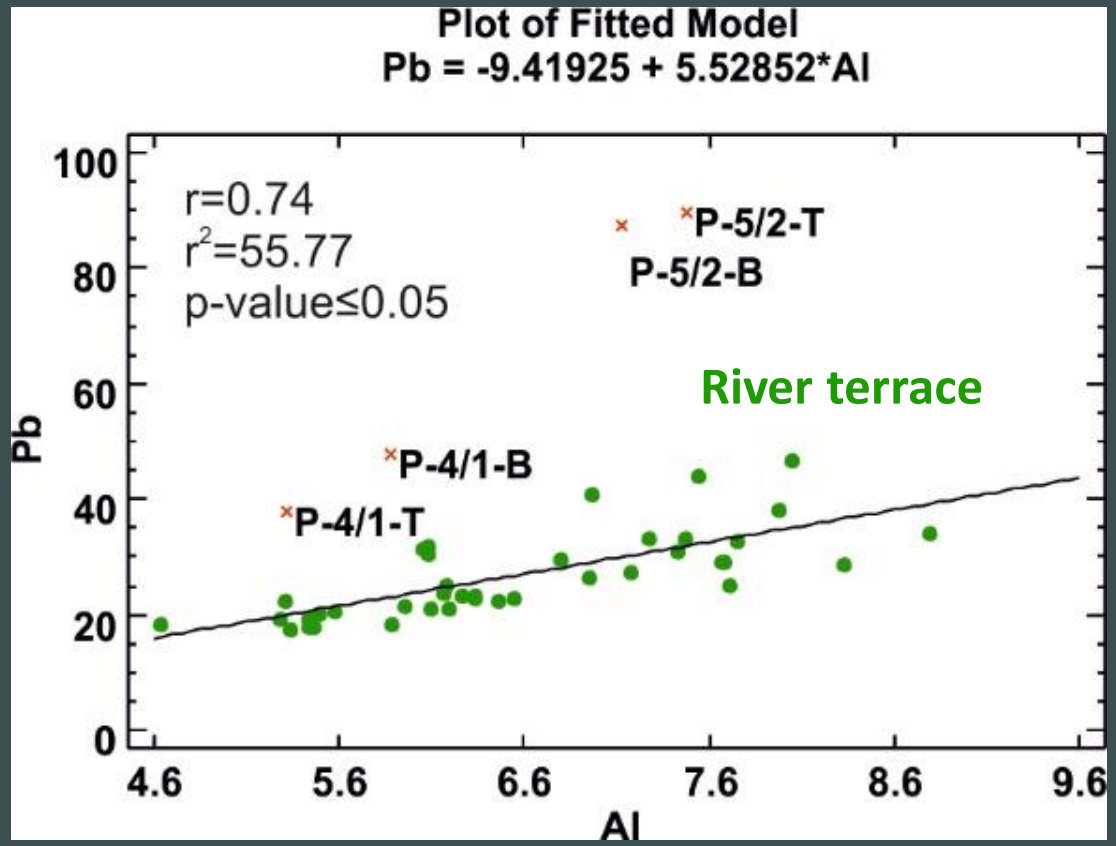
Outlier samples from oxbows/historical channels!

Adsorption of Zn, Pb on iron oxyhydroxides is expected

Two-variable analysis

Zn, Pb - Al

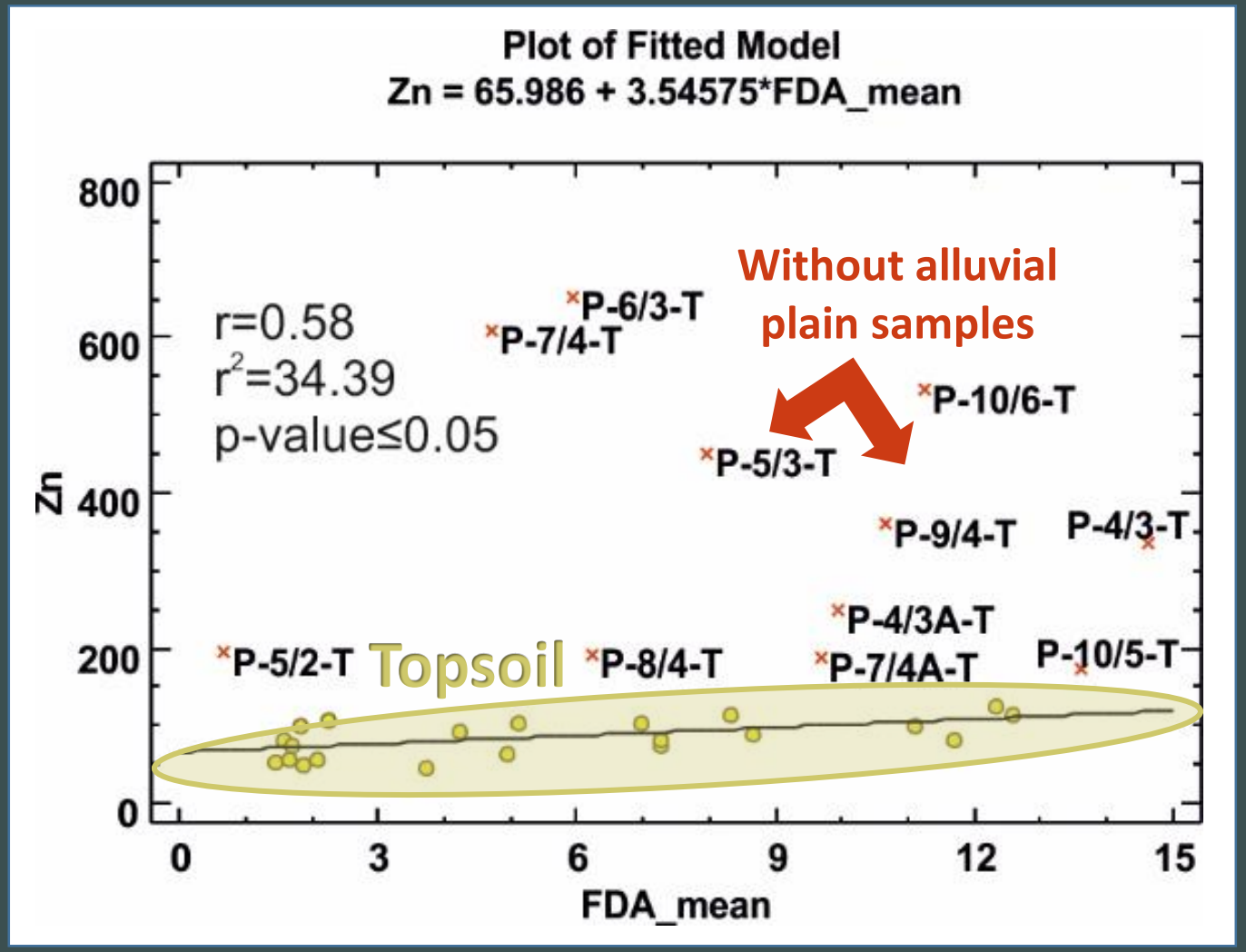




Adsorption of Zn, Pb on clay minerals is expected

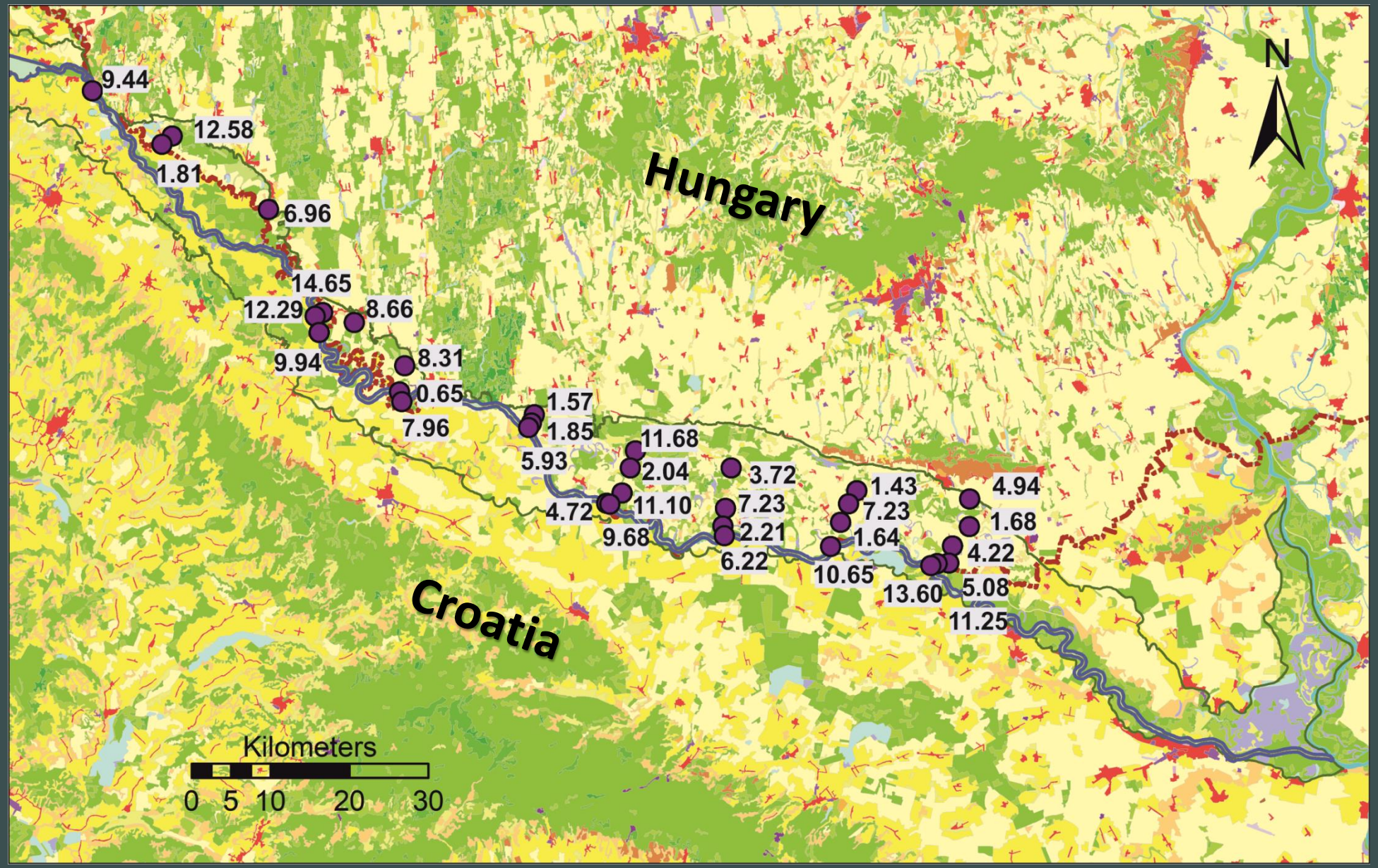
Two-variable analysis

Zn - FDA



- Statistically significant correlation between Zn and total microbial activity (FDA) in topsoil samples from river terrace areas.
  → contradictory to preliminary expectations
- Specific microbes could adapt to elevated concentrations with time
  → which species?
- FDA tests alone are not sufficient for studying potentially toxic elements on floodplains → needs to be coupled with other methods

Microbiological activity (FDA) distribution



- No regional tendencies in FDA
- Works only for local processes

CORINE Landcover 2012

Conclusions and Future

1. The **historical contamination** could be identified.
2. Contamination in the topsoil and in the subsoil as well.
3. Element concentration difference: **active** alluvial plains vs **old** river terraces.
4. For **microbial activity** the difference is according to depth.
5. The Potentially Toxic Elements are not necessarily inhibiting microbial activity.
6. FDA tests seem to be a useful tool for studying the **dynamics of the floodplain**.

Conclusions and Future

1. Distilled water extractions
2. Sequential leaching (BCR)
3. X-ray diffraction (XRD)
4. Multivariate Data Analysis
5. Contamination Risk Assessment


Thank you for the attention!