

# The RAMET Project: A Regional Survey On Heavy Metals Content In Cultivated Soils From Lombardy

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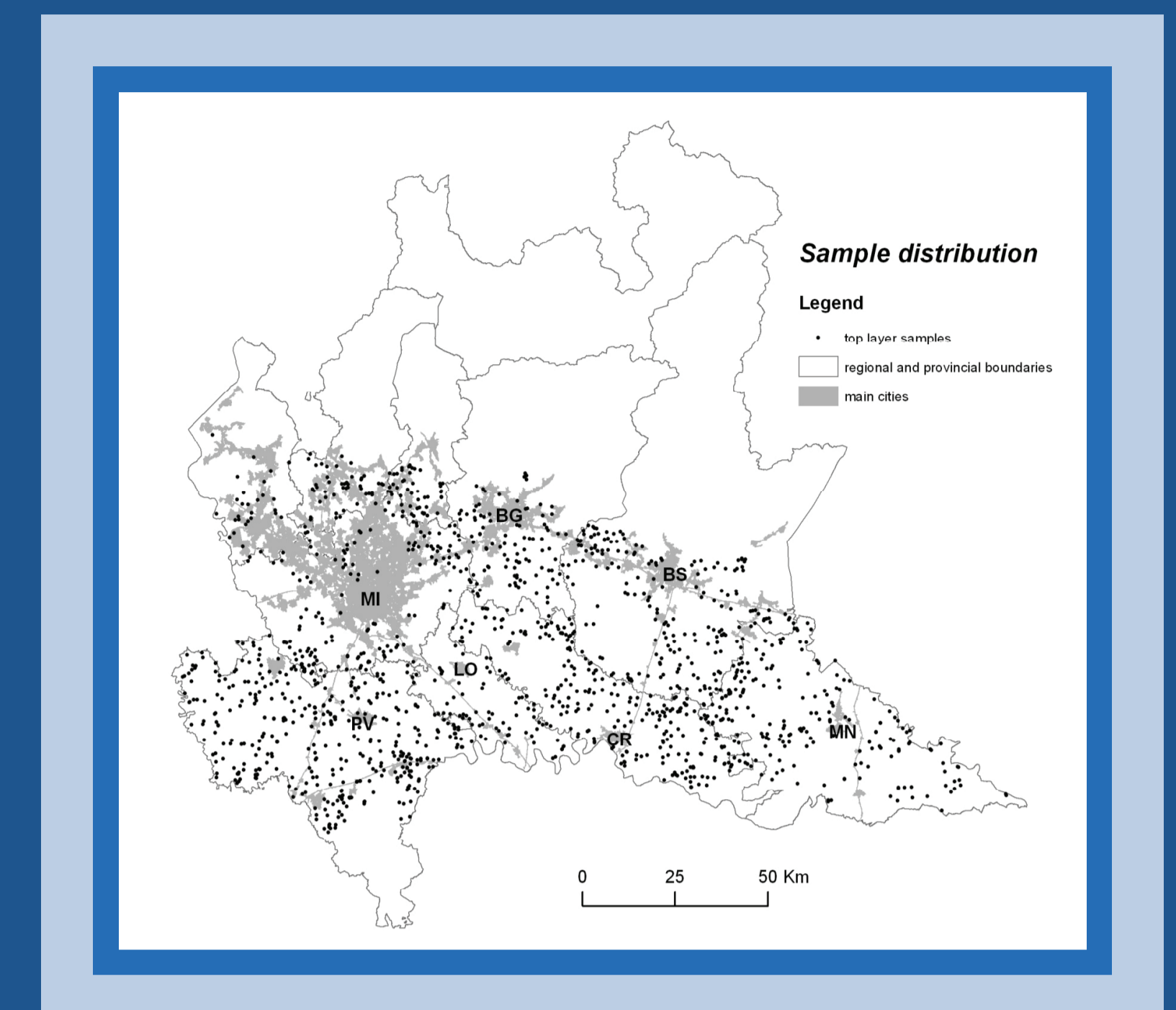
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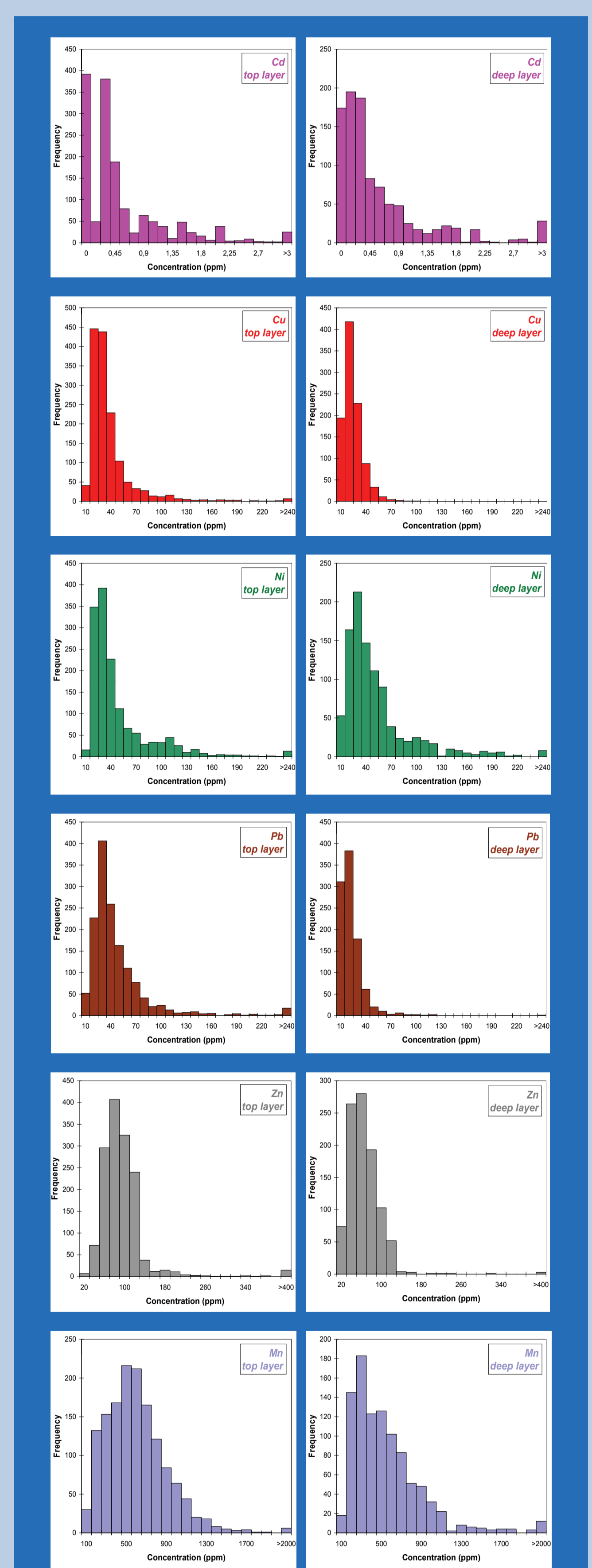
## Introduction

The Lombardy plain is characterised by both by **intensive agriculture** and a strong anthropic pressure exerted by **industrial and urban settlements**. This results in a large production of both animal waste and sewage sludge, often containing high concentrations of heavy metals, which need to be correctly disposed of. Their re-use in agriculture has been therefore strongly encouraged both at the institutional and the commercial level. The RAMET Project, which was completed by ERSAF and the University of Pavia in 2006, aims at investigating **diffuse pollution** in cultivated soils, at quantifying the **input** and the **sustainability** of agricultural practices, and at providing a sound basis for long term **monitoring** of the soil quality, according to EU prescriptions.

Approximately 1000 soil profiles were selected from the ERSAF collection, set off in the last decades for the elaboration of the regional soil map (scale 1:50.000), in order to homogeneously survey the plain and the foothill areas of Lombardy. Heavy metals analyses (Cd, Cu, Ni, Pb, Zn and Mn) were conducted by *acqua regia* digestion and Atomic Absorption Spectrometry on two samples per soil profile, one representative of the A horizon (1456 samples), and the second one (981 samples) corresponding approximately to a depth of 100 cm (generally belonging to a B or C horizon).



## Distribution curves



- > log normal distribution
- > top layer often enriched (anthropic input)

## Geochemical baseline concentrations

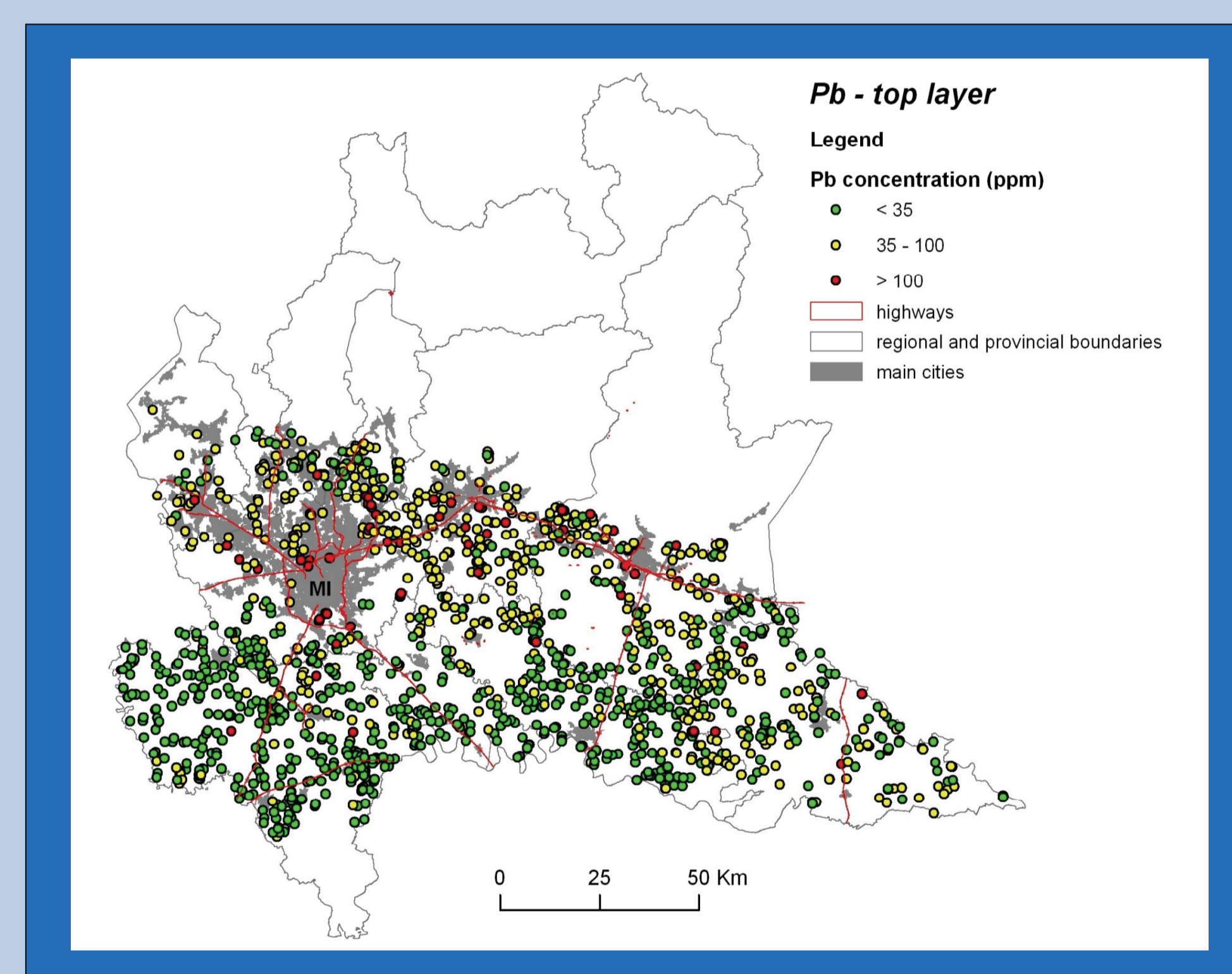
top layer	geometric mean (ppm)	geometric standard deviation	baseline concentration range (ppm)
Cd (#0)	0,46	2,51	0,07 - 2,91
Cu	26,72	1,91	7,34 - 97,27
Ni	33,23	2,06	7,81 - 141
Pb	32,85	2,17	7,00 - 154
Zn	76,6	1,6	29,81 - 197
Mn	465	1,9	128 - 1682

deep layer	geometric mean (ppm)	geometric standard deviation	baseline concentration range (ppm)
Cd (#0)	0,37	2,91	0,04 - 3,14
Cu	16,45	1,78	5,19 - 52,19
Ni	34,97	2,18	7,36 - 166
Pb	12,49	2,61	1,84 - 84,88
Zn	47,37	1,82	14,29 - 157
Mn	400	2	100 - 1592

- > strong enrichment in the top layer
- > anthropic contribution of Cu, Zn and Pb
- > mostly natural origin for Mn and Ni

## Distribution maps

- > carried out for all metals using ESRI® ArcGIS 9.0
- > example, the Pb distribution map is shown



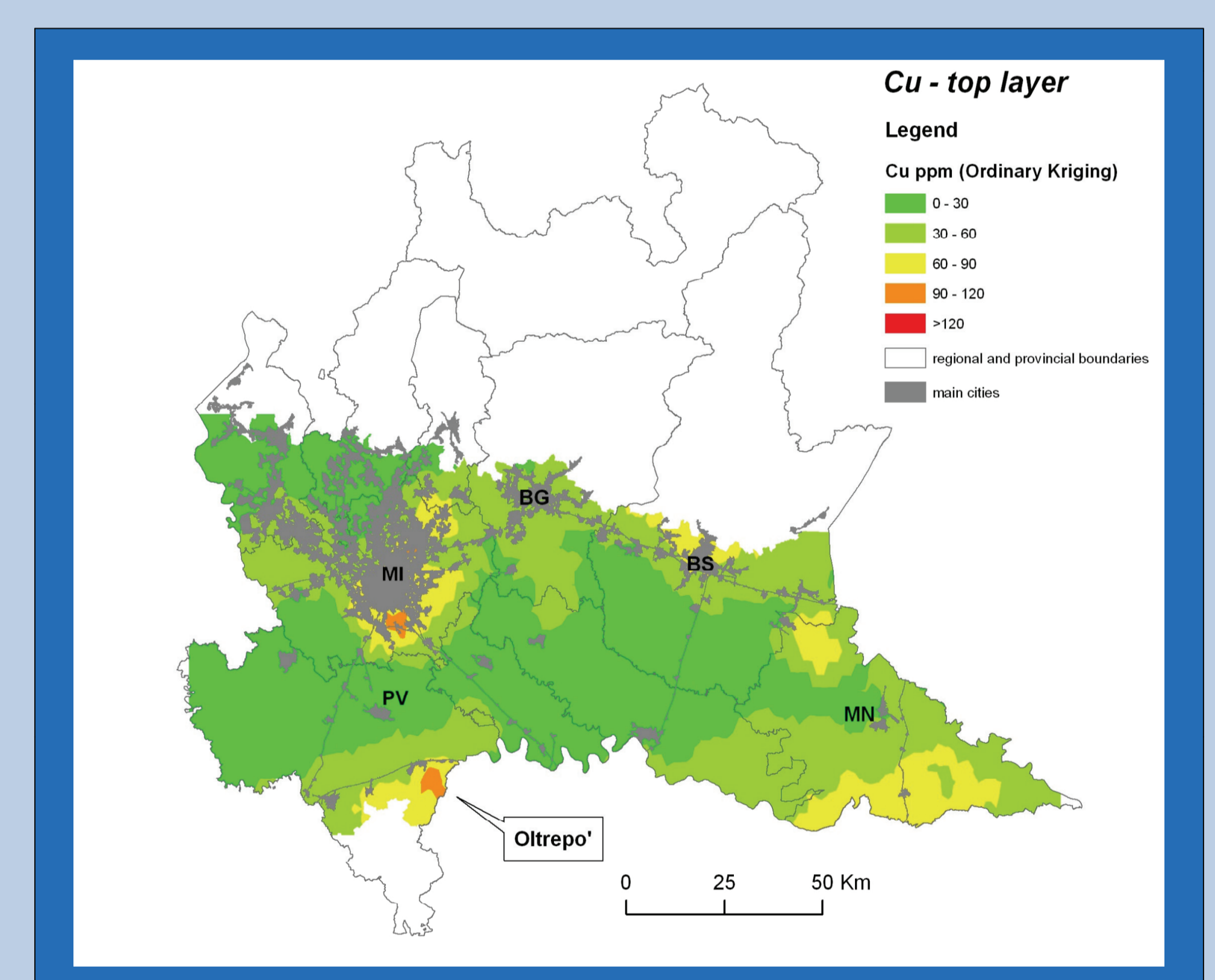
- > high concentrations occur in northern Lombardy, one of the most important Italian industrial districts, around cities and in correspondence of the main regional traffic axes (ring road of Milan, TO-VE highway)

## Comparison with threshold values and mandatory limits

- > less than 5% of the samples exceed these limits, with the exception of Pb.
- > several soils are not suited for sewage sludge disposal (high Ni and Cd content both in the top and in the deep layer).
- > agricultural soils generally not heavily impacted by heavy metal contamination.

## Spatial interpolation maps

- > carried out using the geostatistical tool in ESRI® ArcGIS 9.0 (Kriging)
- > example, the geostatistical Cu distribution map



- > strong enrichment around the main cities, in the eastern sector of the Oltrepo region (Pavia province), and in the plain sector of the Mantova province.
- > Cu content seems dominantly of anthropic origin, as well as for associated metals (Zn and Cd)
- > the Oltrepo region is one of the most important vine-growing areas in Italy, and the Cu input is due to the long-lasting use of Cu-based pesticides

**Conclusion** In cultivated soils from Lombardy, heavy metals contents are usually below the regulatory limits, with the exception of Cu in vineyard soils.

- > A strong enrichment in the top soil for Cd, Cu, Pb and Zn is observed, especially south of Milan and other urban areas, which can be attributed to an anthropic input. In these areas, the contribution of industrial and vehicular emissions is dominant.
- > The Ni content often exceeds regulatory thresholds, but its association with Mn and its distribution with depth points to a natural origin.
- > Although an input from agricultural practices certainly occurs, especially in vineyards and intensively cultivated areas, it is largely exceeded at the regional scale by the input due to industrial pollution and road traffic.
- > Given the contribution of both parent rock and non-point-source pollution to the chemical properties of soils, background values are impossible to fix without a broad data collection.
- > In addition, it is necessary to apportion anthropogenic and lithogenic inputs; this is an important and difficult task in populated and industrial areas, where totally unpolluted soils are almost impossible to find.

Therefore, a correct geochemical interpretation of the data is a prerequisite to establish both reliable and realistic guidelines.

The results of this study are published in a report (Regione Lombardia, 2007) and are collected in a database aiming to serve as a basis for long term monitoring of cultivated soil quality. The report is available for download on the website [www.ersaf.lombardia.it](http://www.ersaf.lombardia.it)

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