



# **Monitoring soil geochemistry in the urban environment: A comparison of studies in 1972 and 2005 in Denver, Colorado**

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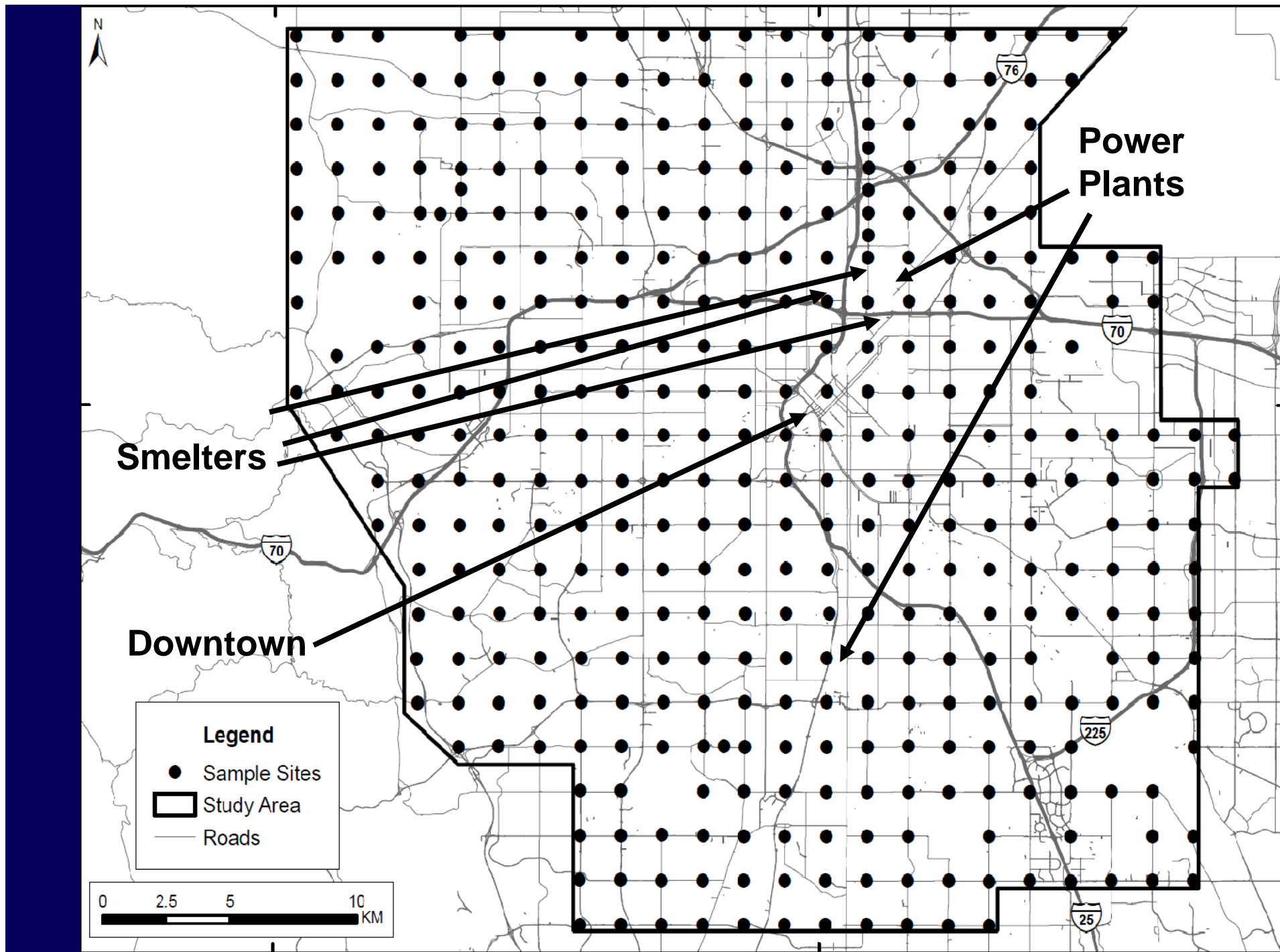
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# Outline

- **Two soil geochemical surveys of the Denver metro area**
  - 1972
  - 2005
- **Abundance and distribution of selected elements from each survey**
- **Observed changes in soil composition between 1972 and 2005**

# 1972 Geochemical Survey

- Skyline Laboratories, Wheat Ridge, CO
- Roadside soils (top 15 cm)
- 433 sites at 1-mile centers (section corners, as defined by the Public Lands Survey System)
- Sieved to less than 250  $\mu\text{m}$
- Analyzed for Cu, Pb, Zn, Cd, Hg





# View from Globe Smelter toward Denver



# 2005 Geochemical Survey

- USGS, Colorado School of Mines
- Collected same sites as 1972 survey
- Sieved to less than 250  $\mu\text{m}$
- Analyzed both 2005 samples and 1972 samples for more than 40 elements







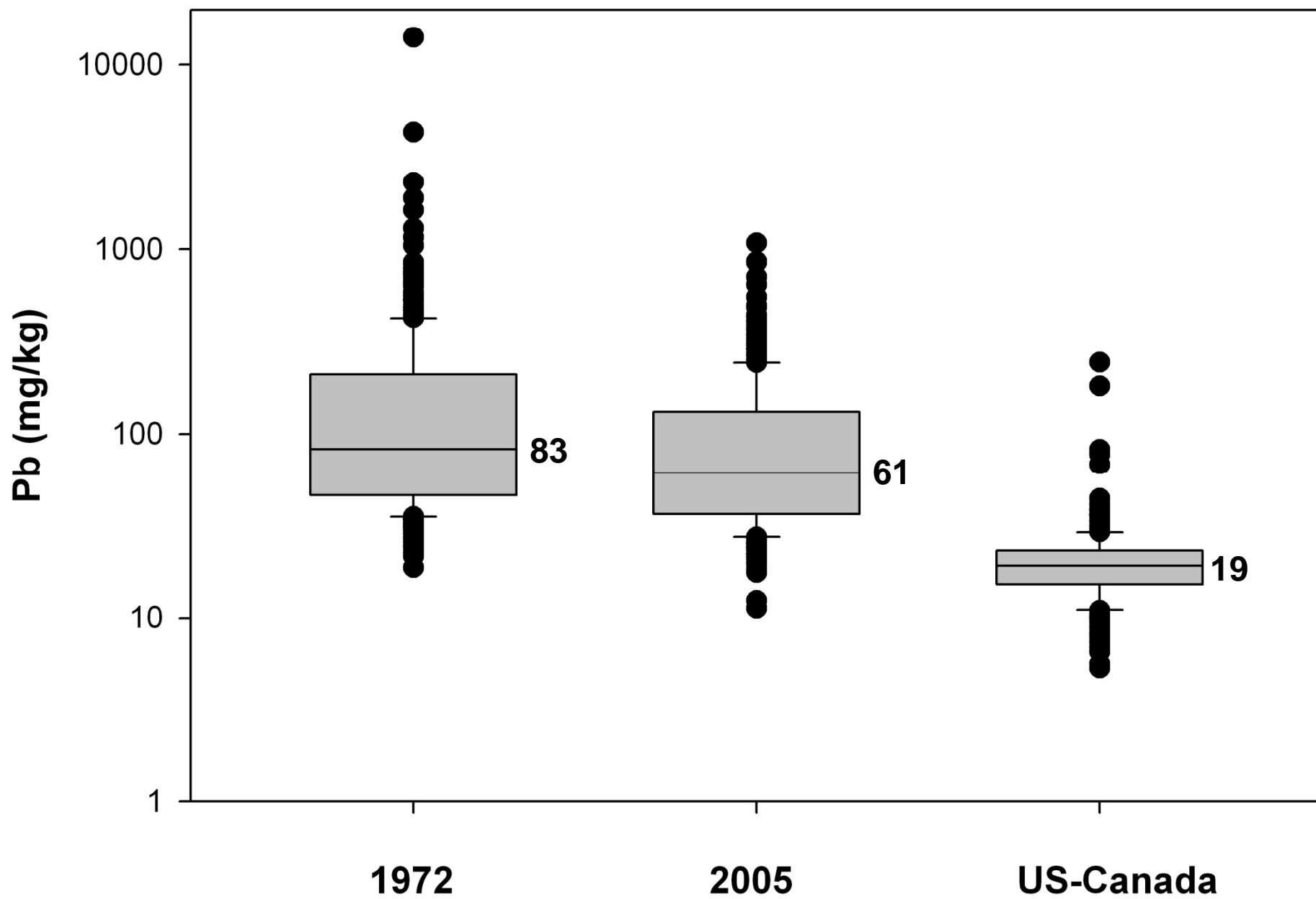




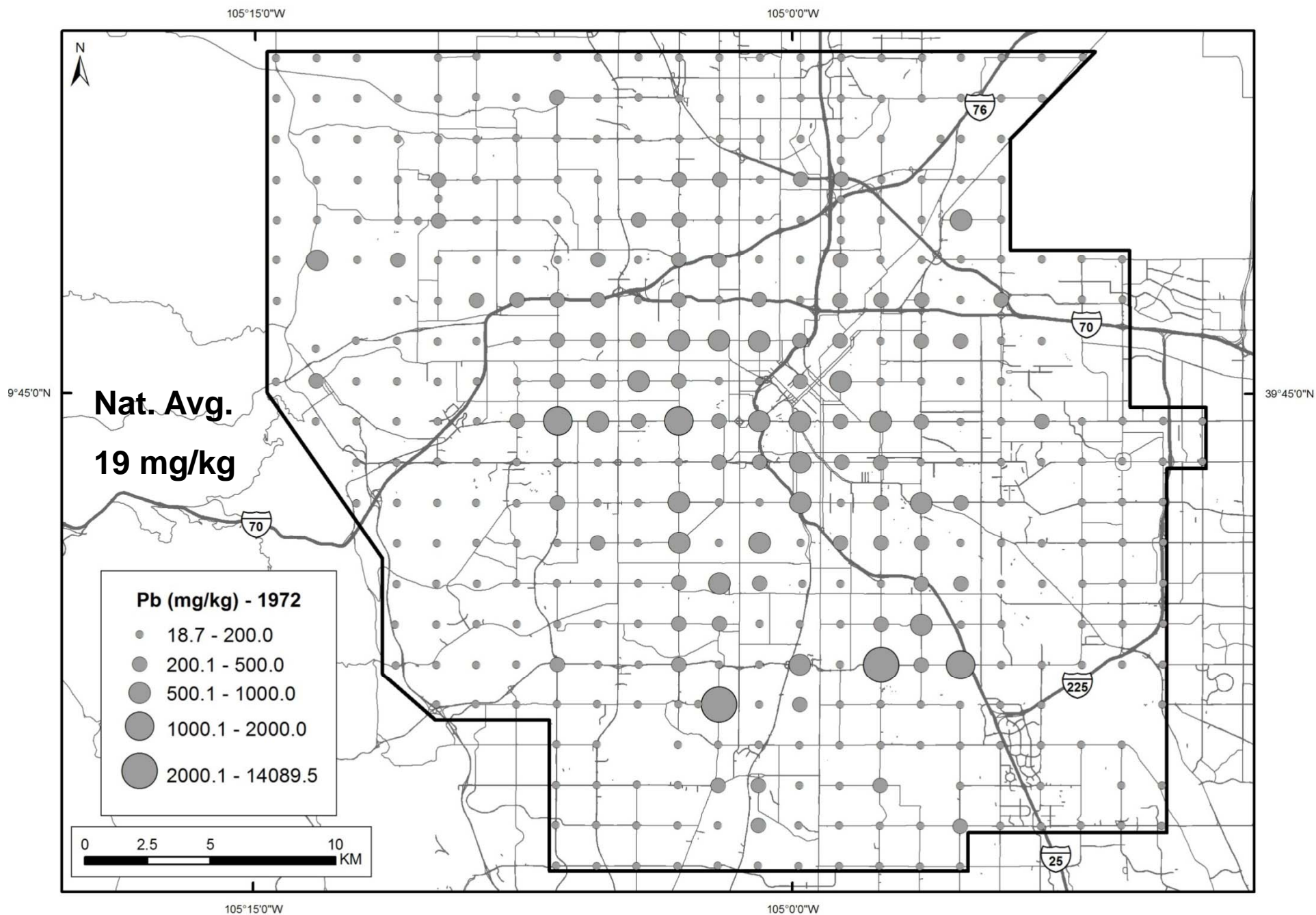
# Change between 1972 and 2005

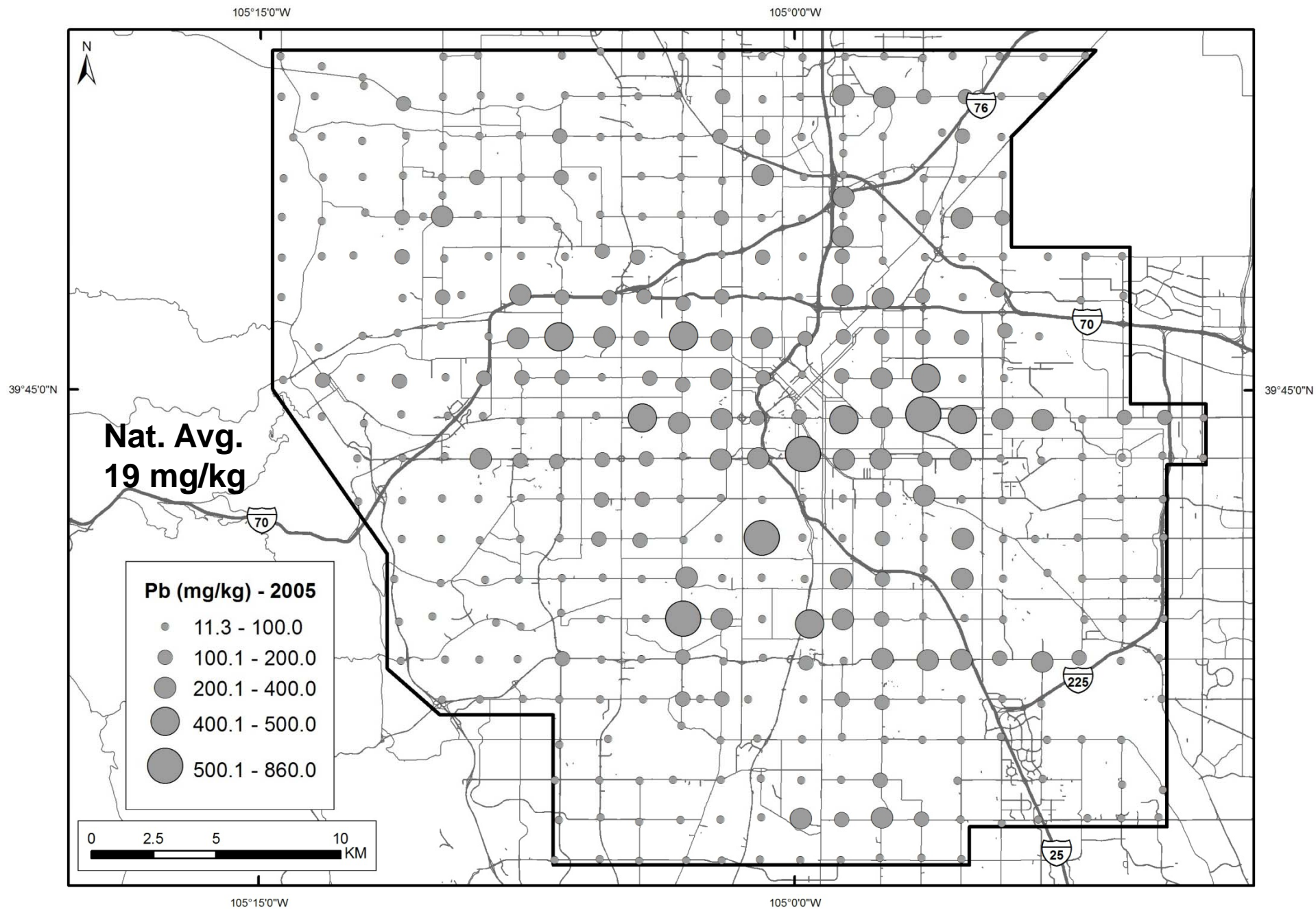
Elements showing most change\*: Pb, As, Hg, Cd, Mo, Al

\*Based on Wilcoxon rank sum test and confirmed by Kolmogorov-Smirnov test at 95% confidence level

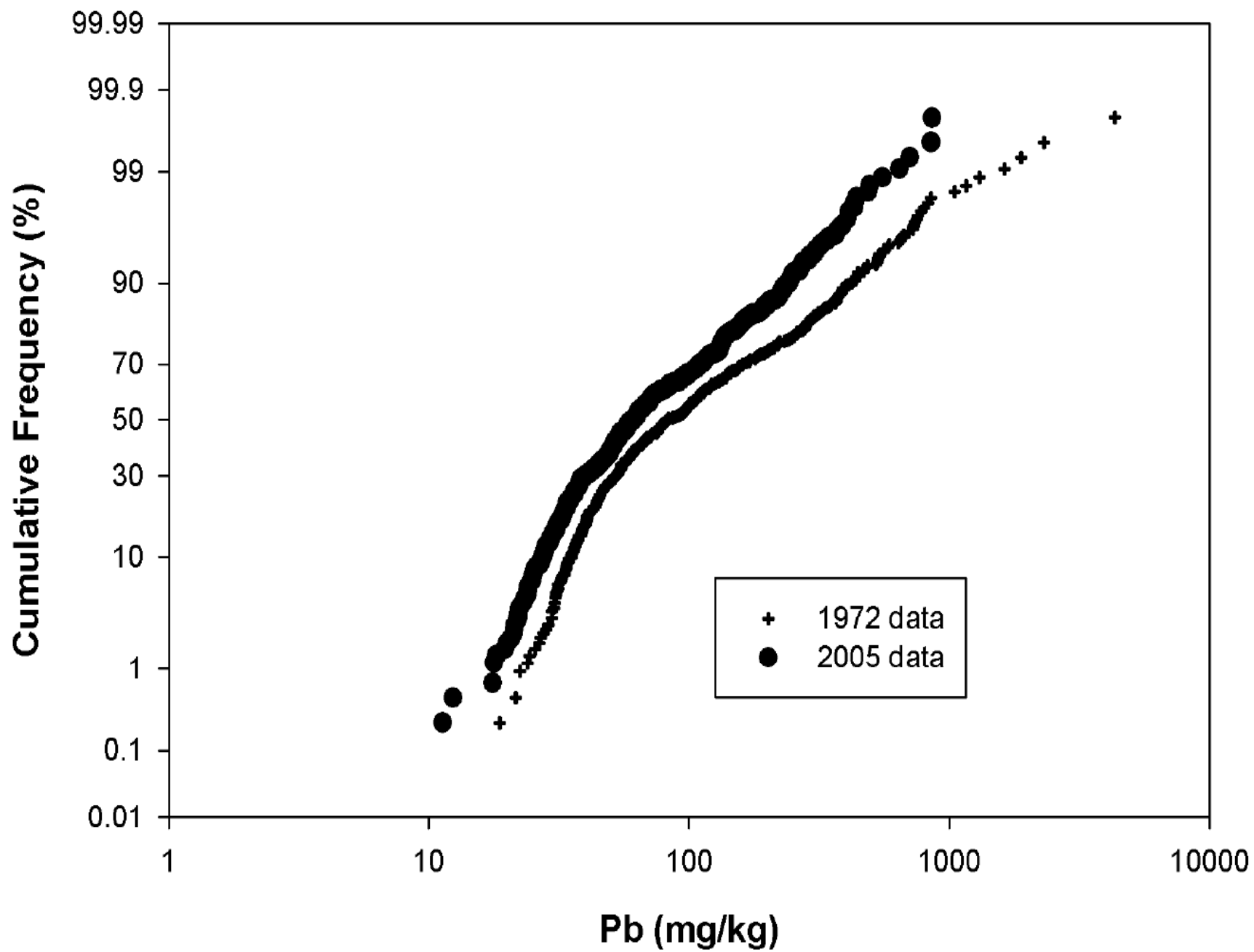




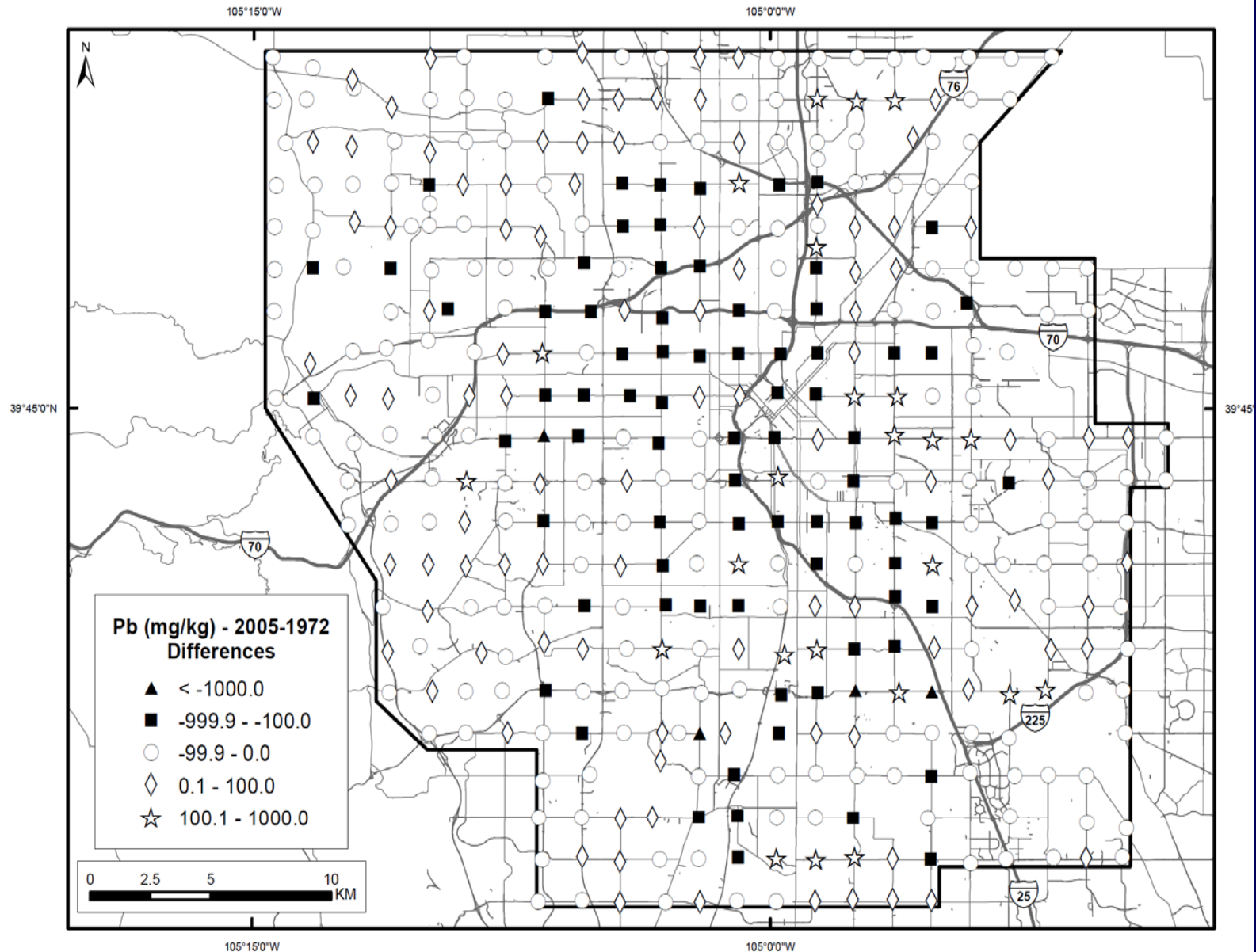




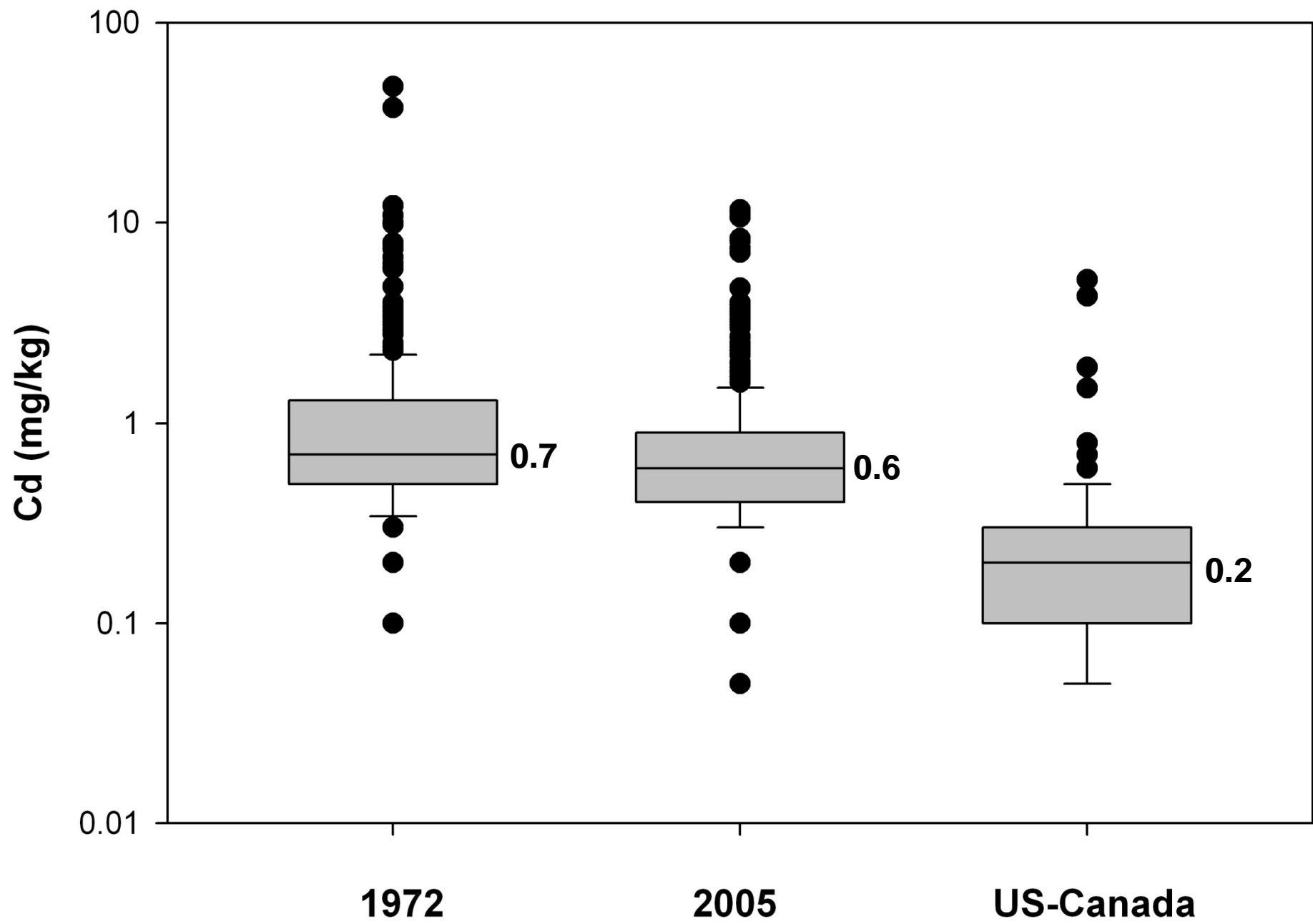


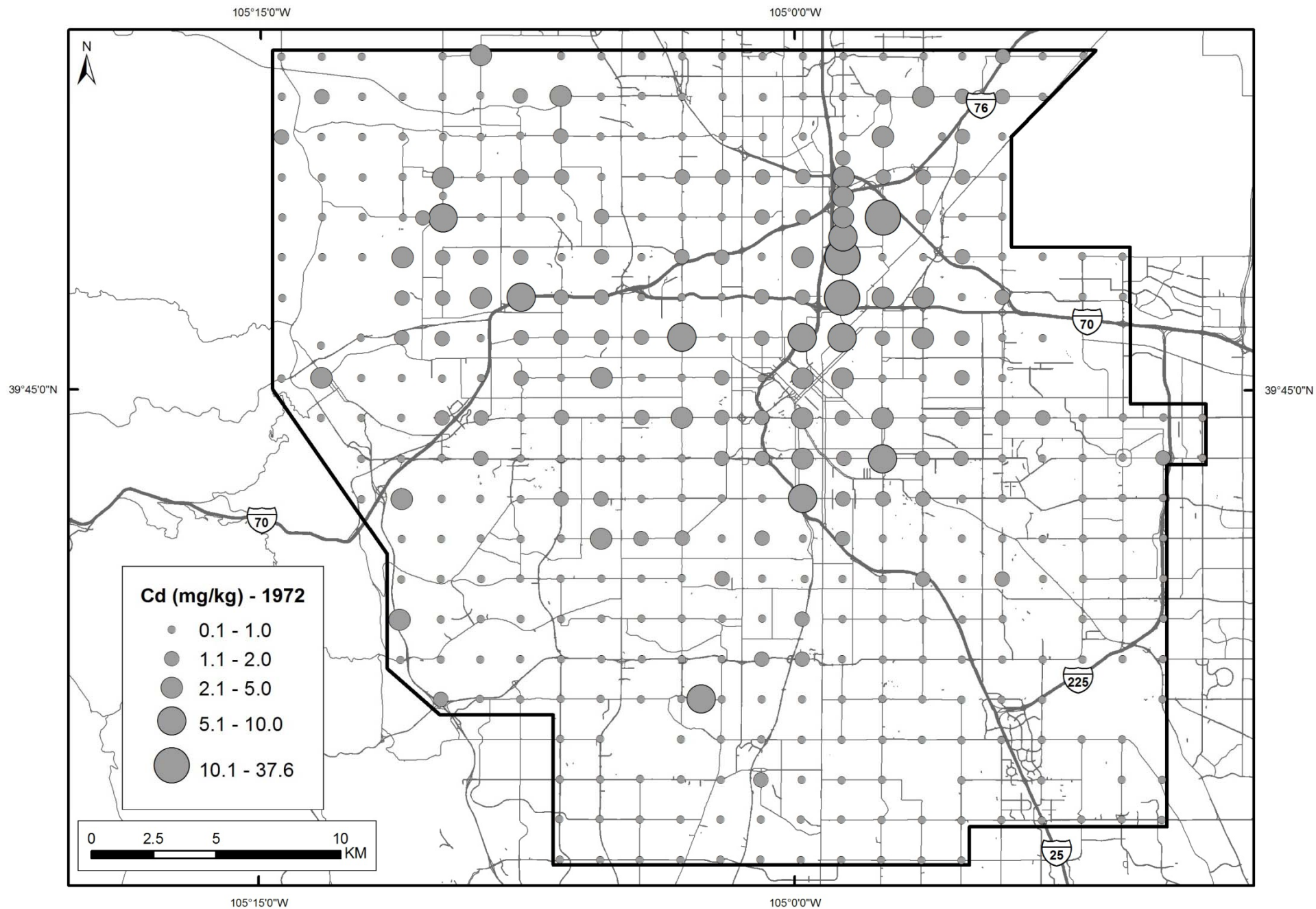


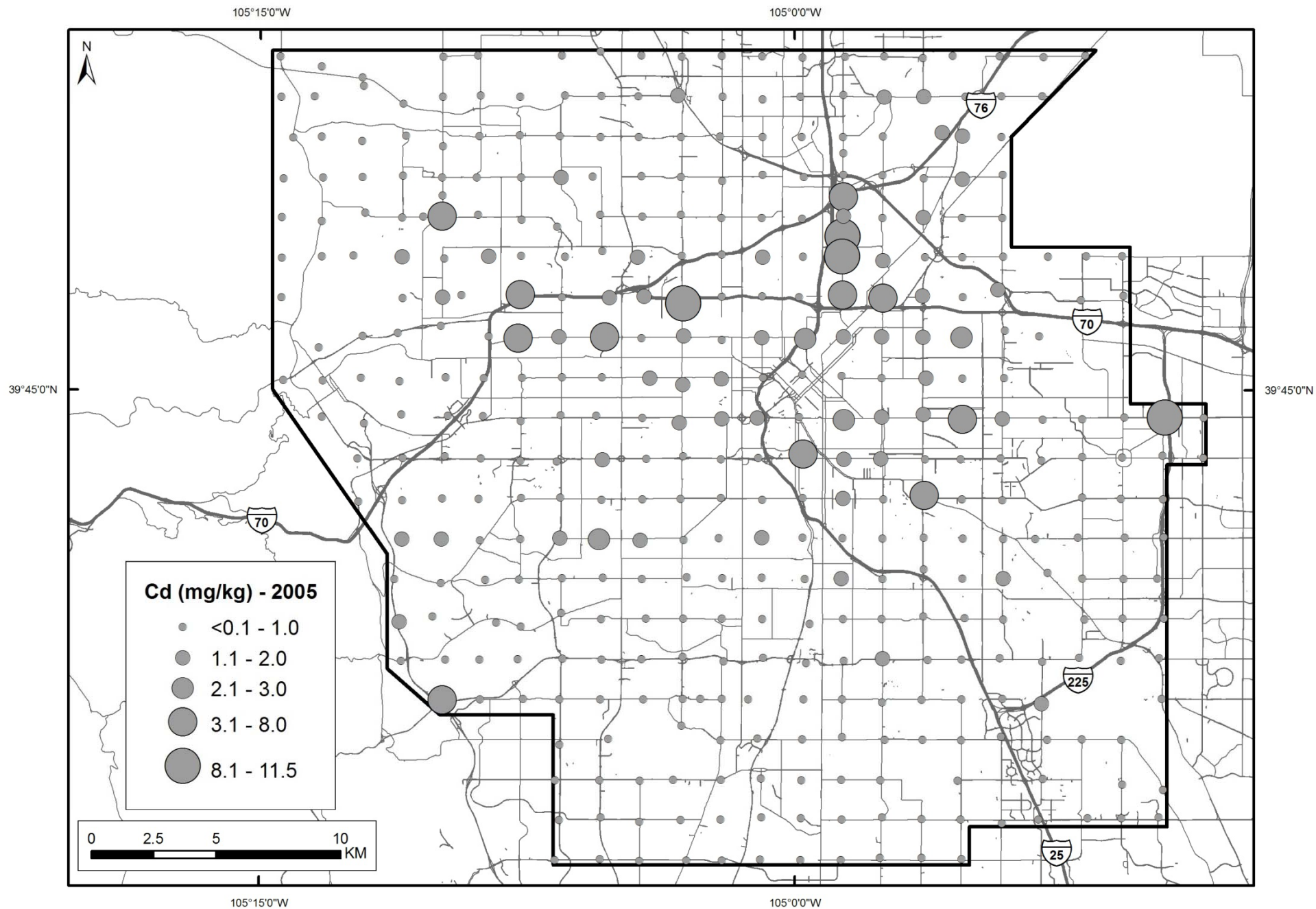
# Concentration in 2005 minus concentration in 1972



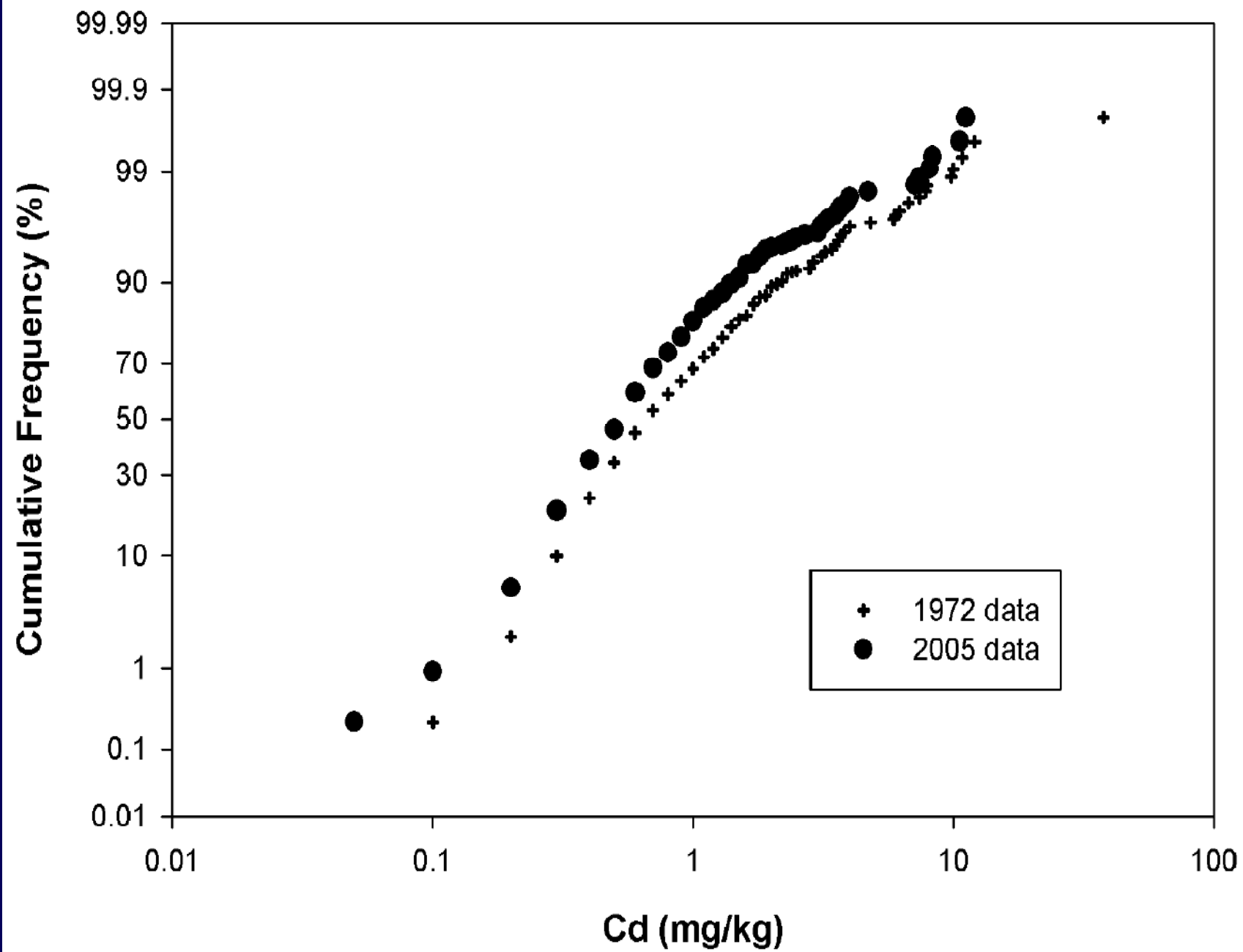


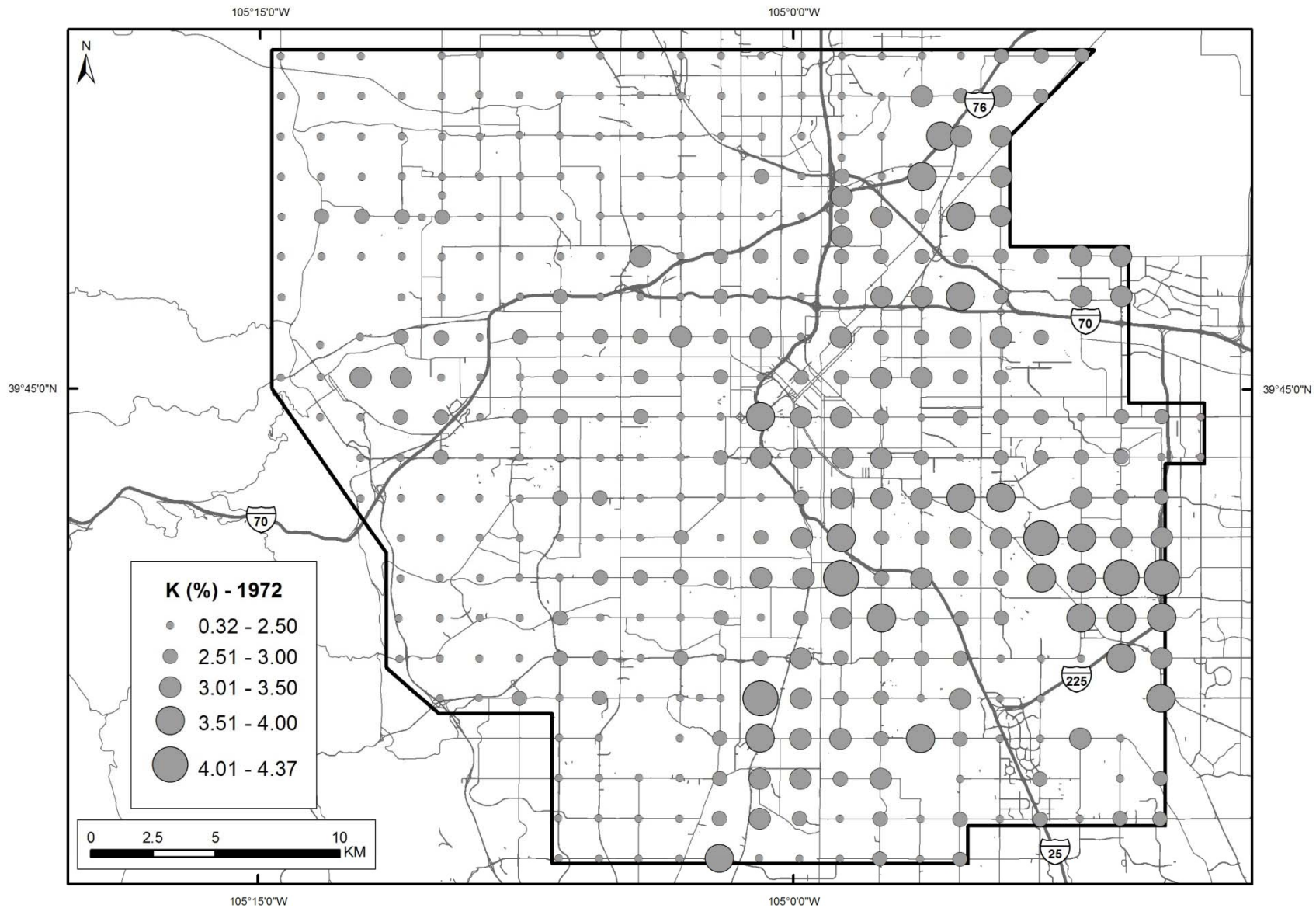


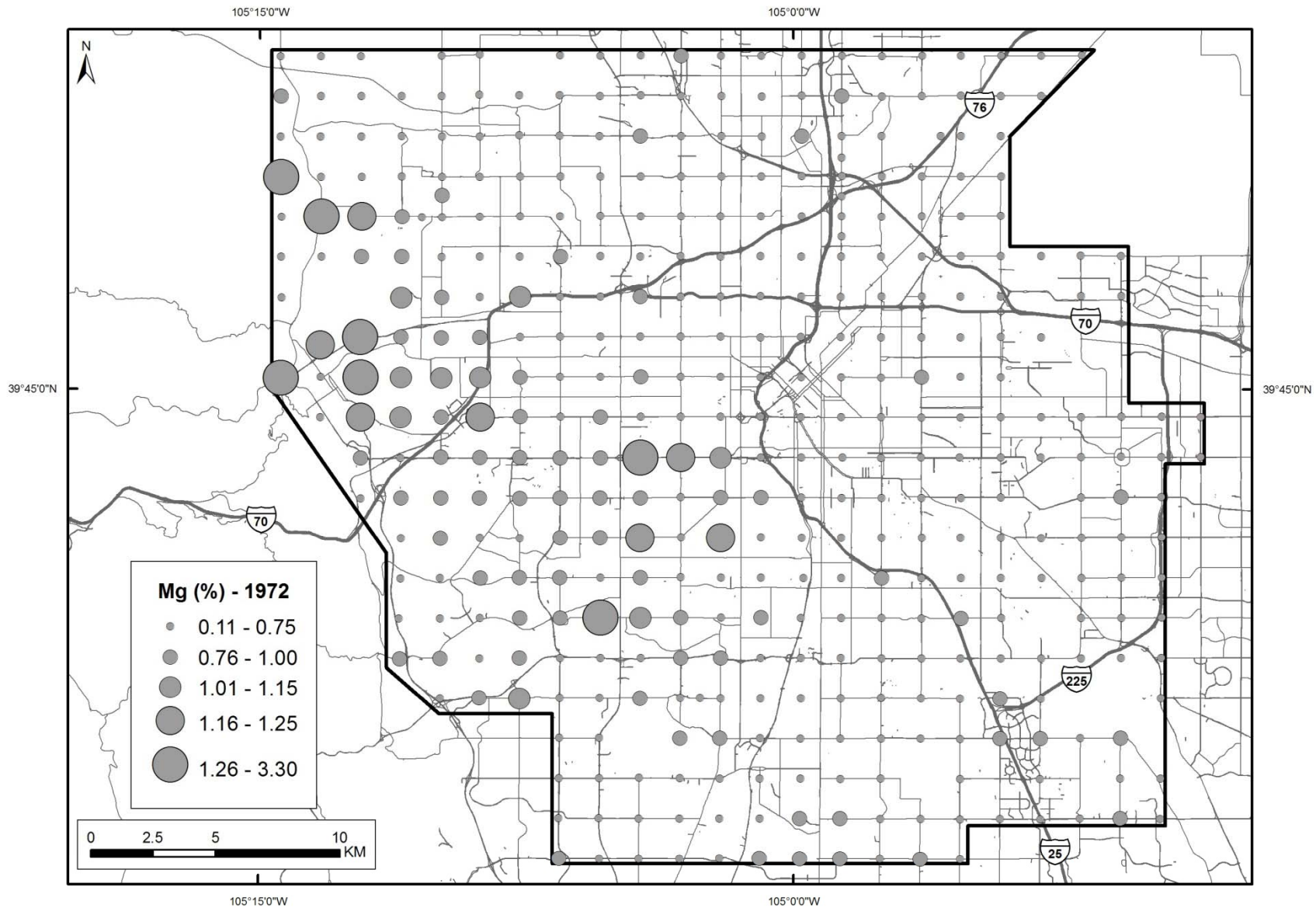




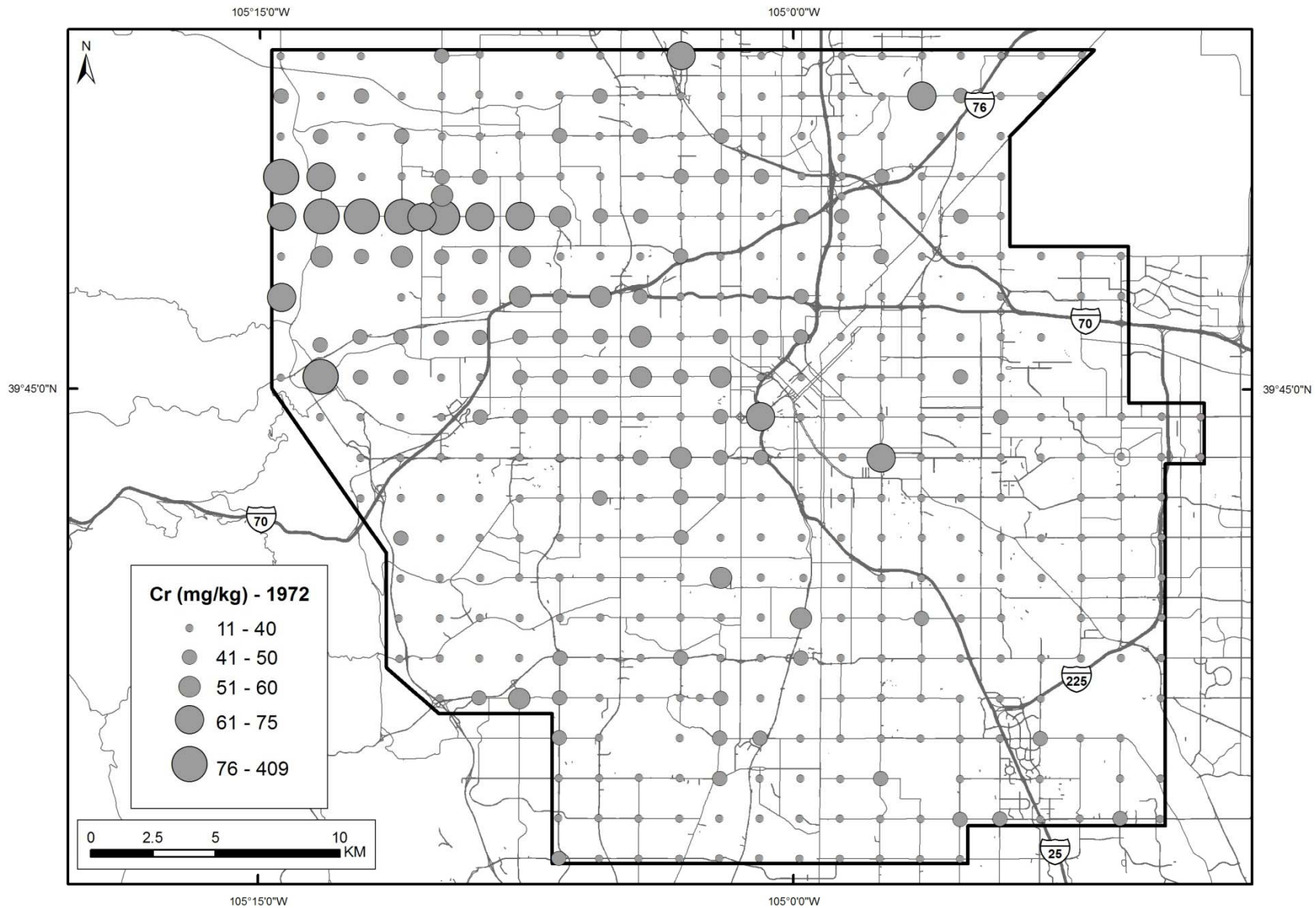












# Summary

- Pb, As, Hg, Cd, Cu, Mo, Sb, Sn, and Zn elevated in “central Denver” in both surveys—Anthropogenic sources
- Greatest change generally for these elements
  - Clean Air Act (1970)
  - Remediation activities
- Urban geochemical “footprint” ~20 – 30 km in diameter
- Mg, K, Fe, Al, V, Ce, La have clear geogenic sources
- Quantifying change not straightforward
  - Site duplication uncertain
  - Roadside soils “dynamic” sample medium
  - Possible dilution from roadside dust and debris over 33 yrs

**Denver study:  
Chapter 30,  
p. 521 - 546,  
published in  
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