

# Soil Lead Matters: Urban Contamination and Children's Health

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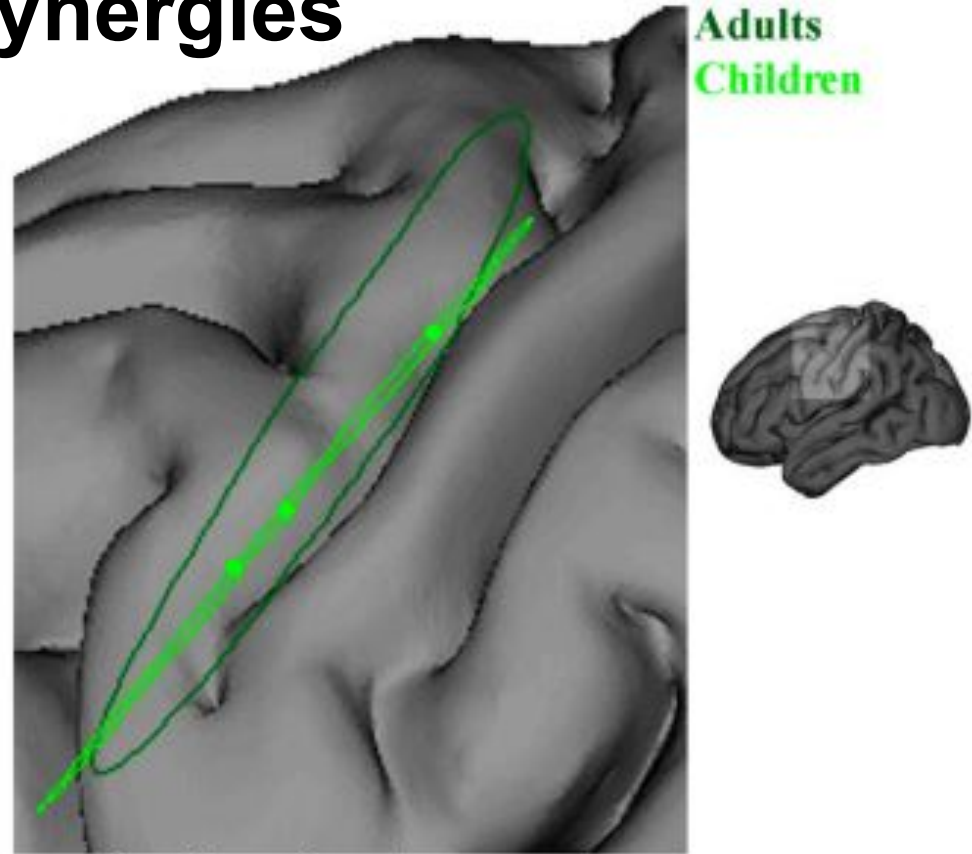


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# Clinical perspective on instinctive behaviors: Inhalation & hand/mouth sensory/motor synergies



synergies



Hand/mouth motor synergies

**Desmurget et al. 2014. PNAS 111:5718-5722.**

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# Clinical perspective on health issues:

## **CDC 2012 “No known safe level of lead exposure”**

- Irreversible fetal brain damage
- Telomere length
- **Learning disabilities (<2 µg/dL)**
- Hearing problems
- **Behavioral problems and violence**
- Alzheimer's disease
- Schizophrenia in the era of leaded gas to present
- **Eclampsia** and perhaps autism?
- Hypertension
- All cause and cardiovascular mortality at  $\geq 2 \mu\text{g/dL}$
- Chronic kidney disease
- **Motor Neuron Disease (Amyotrophic Lateral Sclerosis)**
- Diabetes (2004 *Environ Health Perspect* 112:1178-82)
- Impaired bone synthesis & Osteoporosis

# Clinical perspective on interventions: The medically prescribed intervention is ineffective for preventing children's lead exposure

## Evidence-based medicine:

The Cochrane Collaboration: Household interventions for preventing domestic lead exposure in children—The Cochrane Library 2012, Issue 4.

*Yeoh, Woolfenden, Lanphear, Ridley, Livingstone*

This review of 14 studies found that educational and household dust control interventions **are not effective** in reducing blood lead levels of young children.

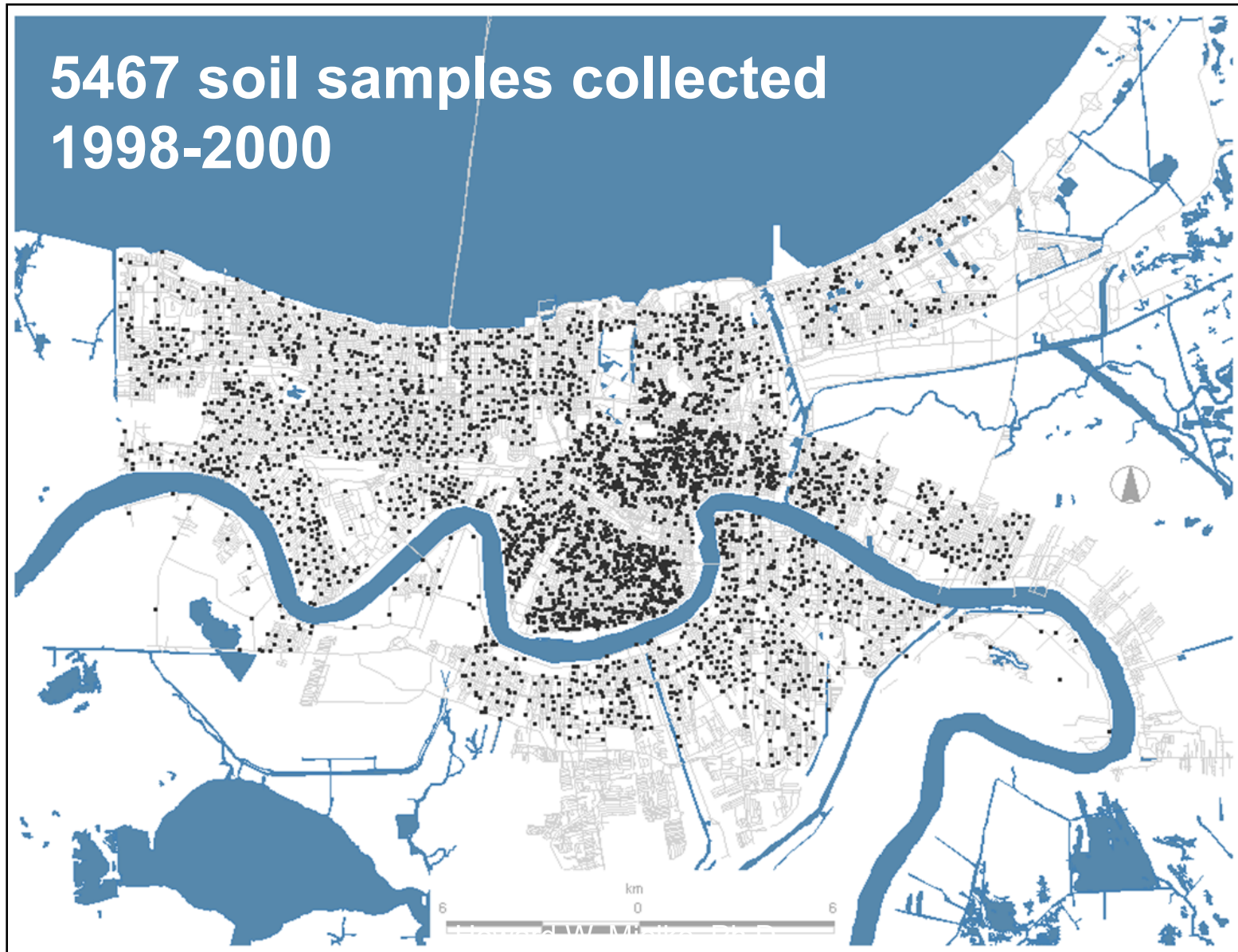
**Does soil lead play a role in exposure?**

# Geochemist Clair C. Patterson's statement about urban lead:

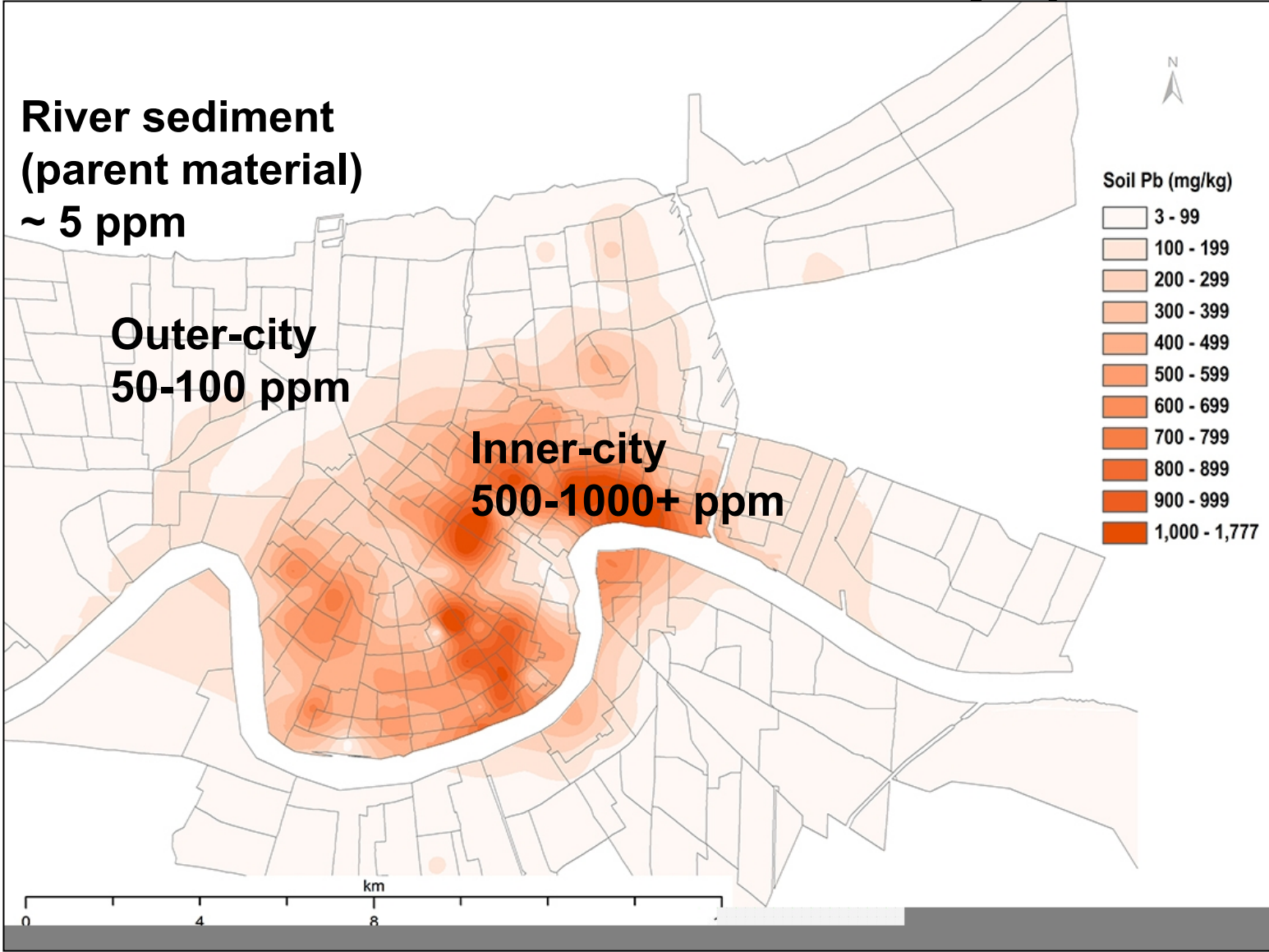
**“...older urban areas of the United States have been rendered more or less uninhabitable by the millions of tons of poisonous industrial lead residues...”**

*1980, Lead in the Human Environment,  
National Academy of Sciences*

# New Orleans Residential survey (ATSDR)

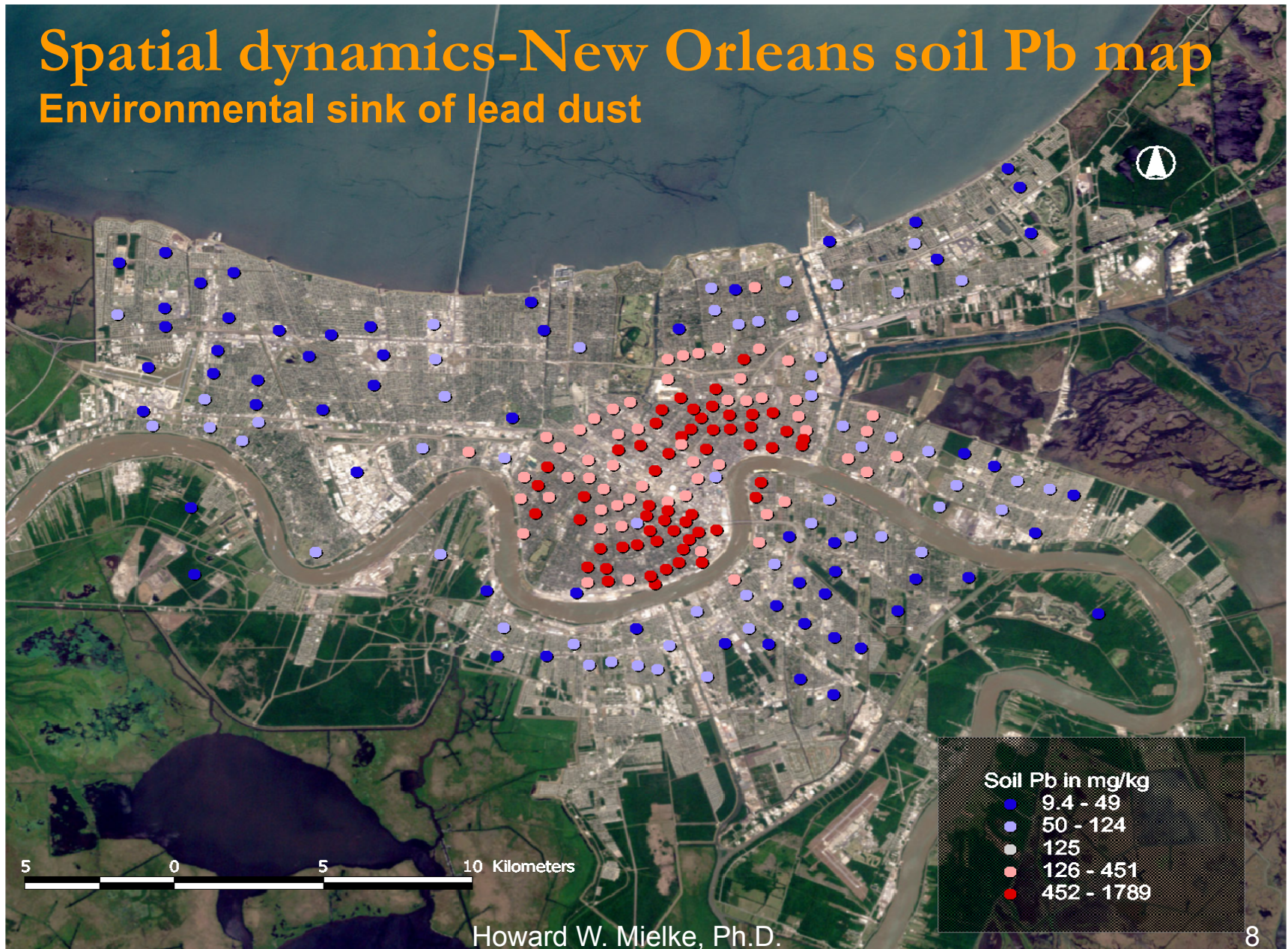


# 2001 New Orleans soil Pb map (ATSDR)



# Spatial dynamics-New Orleans soil Pb map

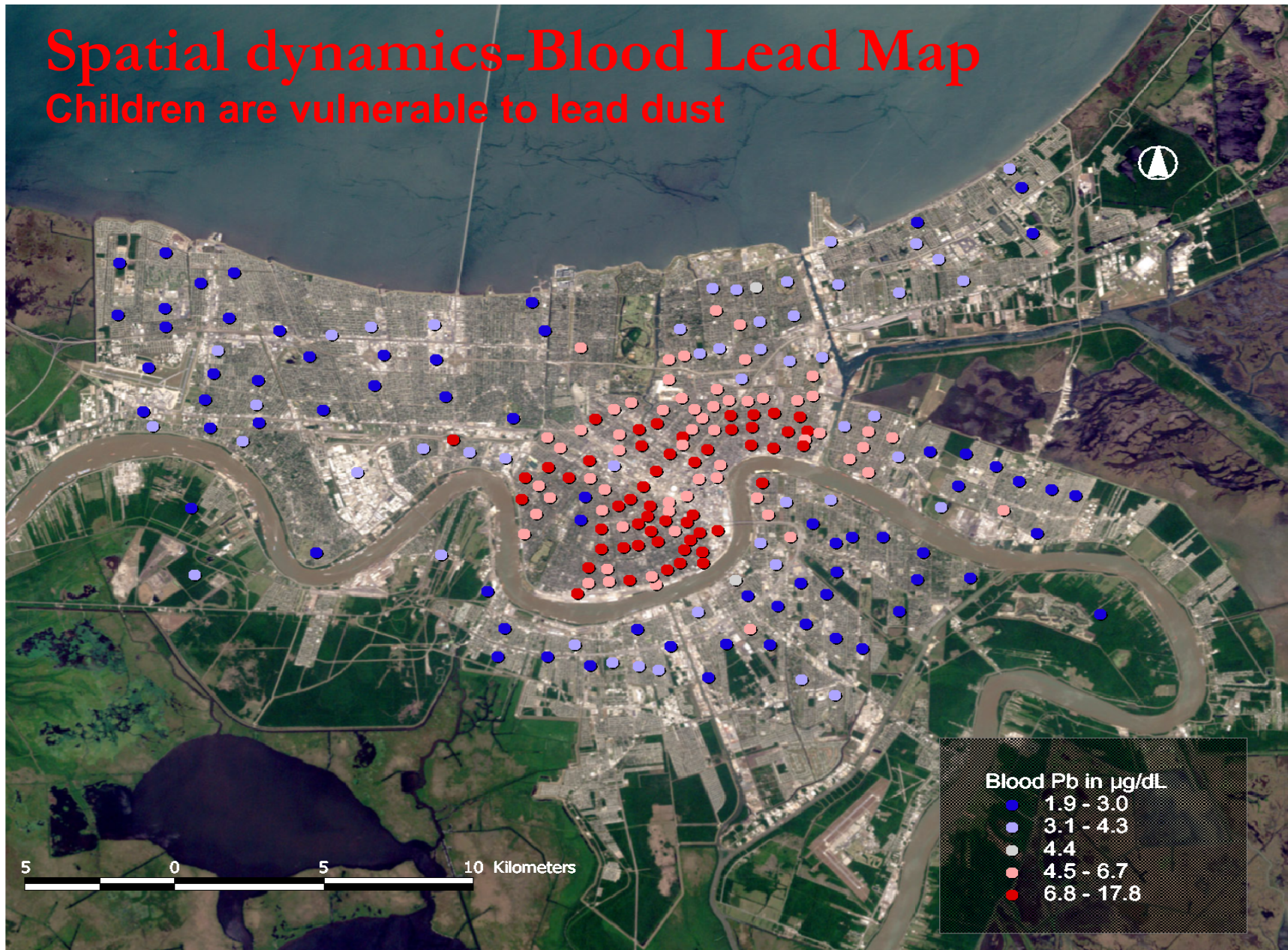
## Environmental sink of lead dust





# Spatial dynamics-Blood Lead Map

Children are vulnerable to lead dust



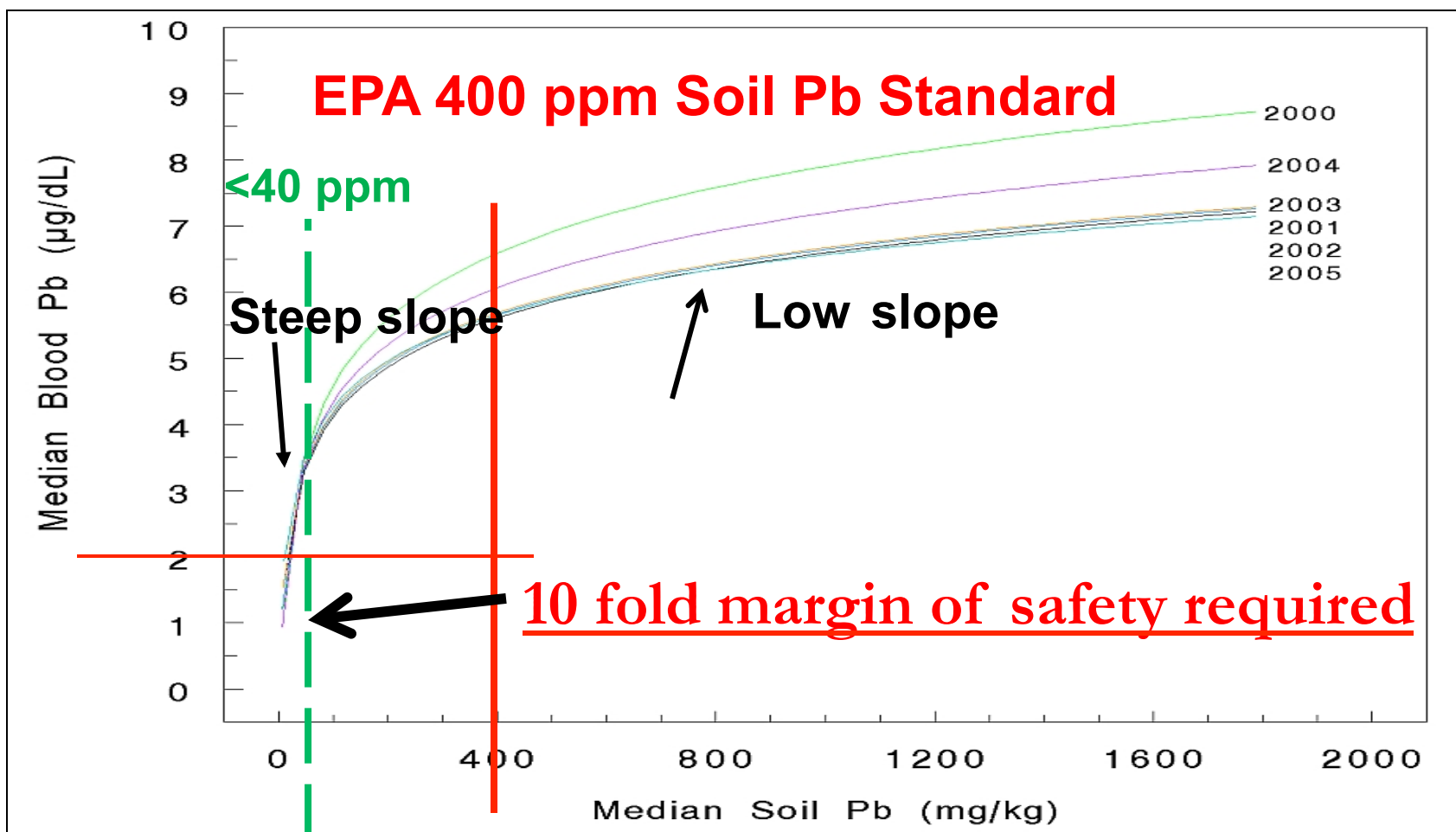
# Place Matters: Expected life span



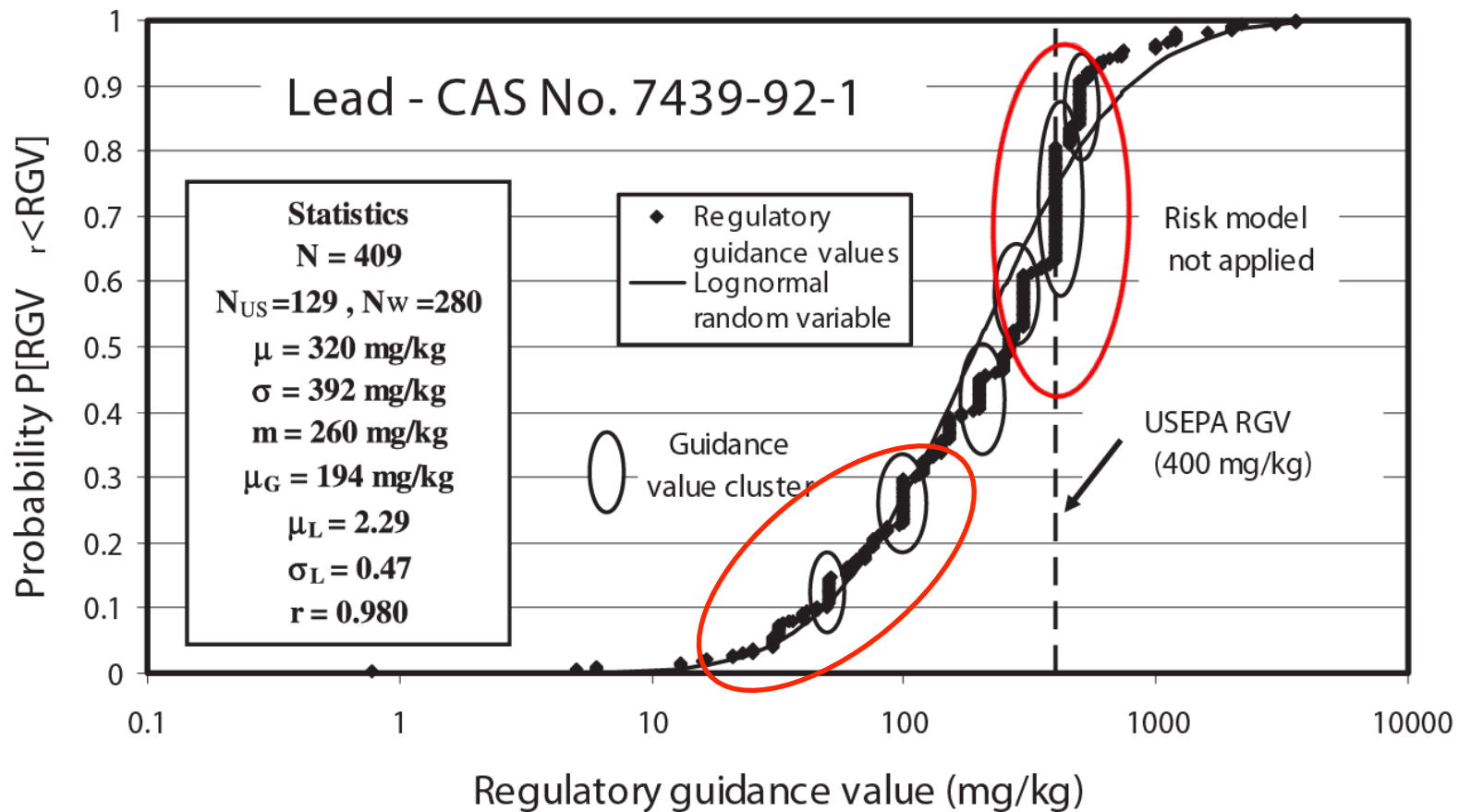
# The spatial dynamic responses of children to soil Pb

55,551 children's median BL matched with median SL (281 CTs)

Overall model:  $BLL=2.038+0.172 \times (SL)^{0.5}$  [ $r^2$  of 0.528, P-value of  $1.0 \times 10^{-211}$ ]



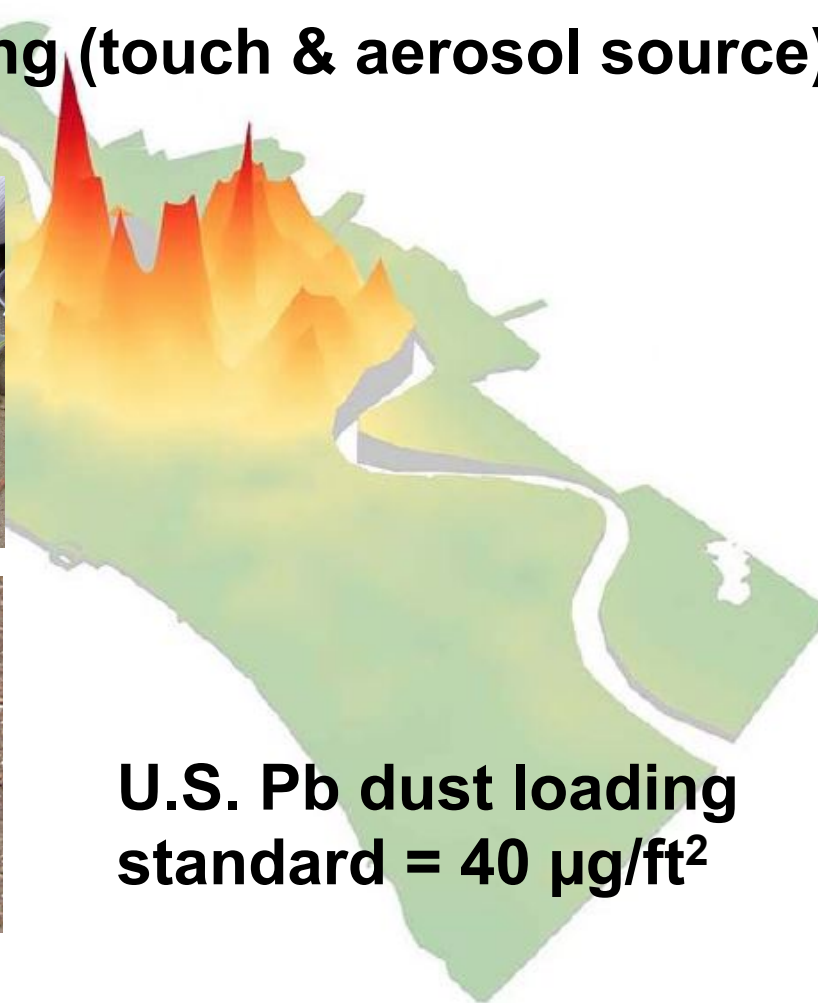
# International soil lead regulatory guidance values



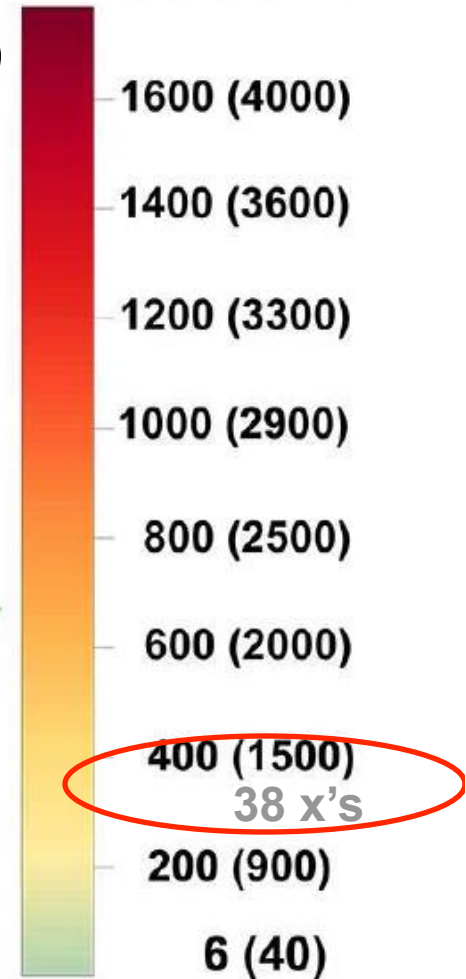
# Measuring spatial dynamics of soil Pb content and loading (HUD)

Soil Pb in  $\mu\text{g/g}$  ( $\mu\text{g}/\text{ft}^2$ )

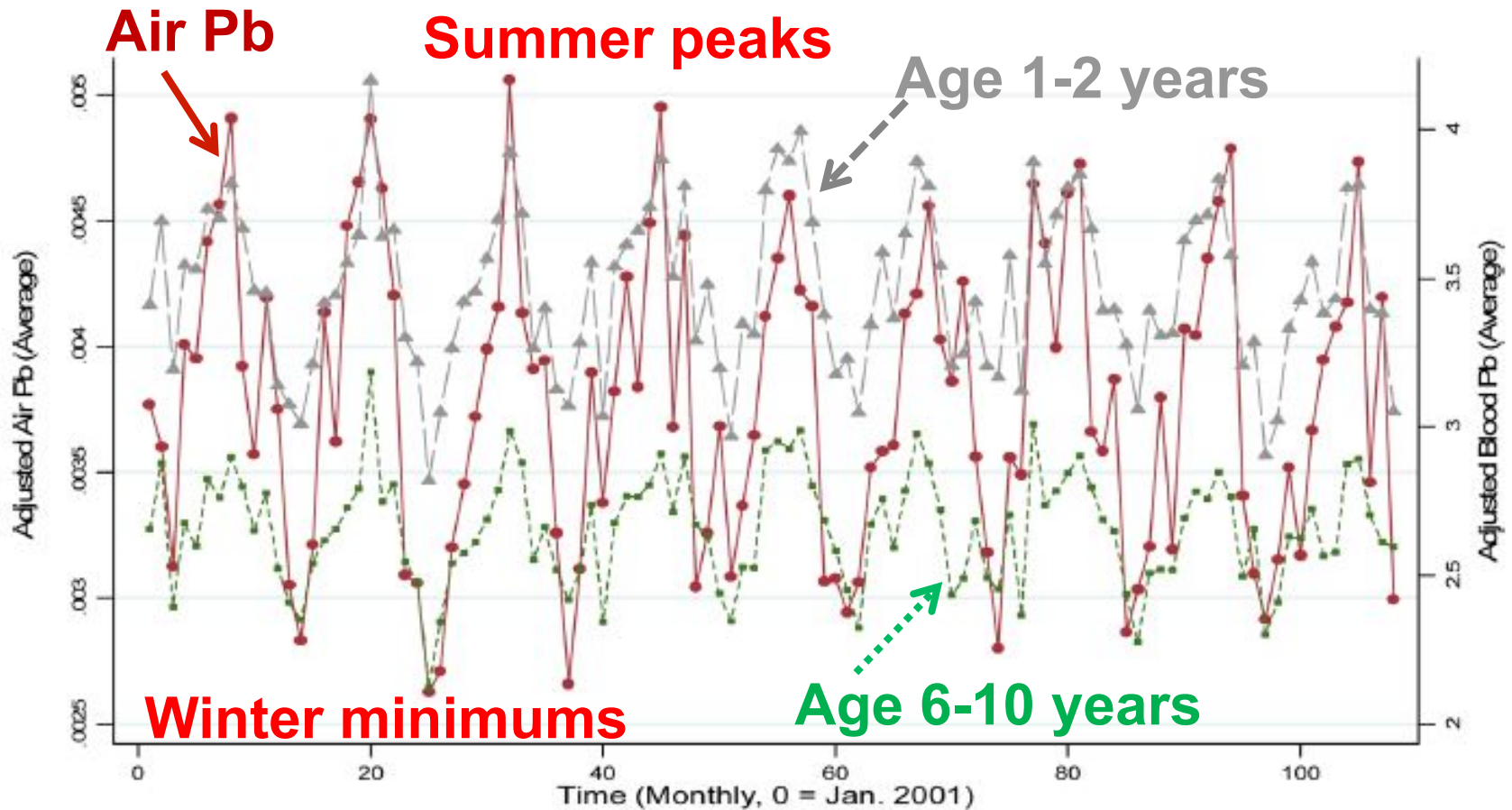
## Soil surface loading (touch & aerosol source)



U.S. Pb dust loading standard =  $40 \mu\text{g}/\text{ft}^2$



# Air Pb seasonality and children's BLL (1-2 yrs and 6-10 yrs) “The Summer Disease”-Detroit



**Zahran et al. 2013, *Environ. Sci. Technol.* 47:2839-2845**

# Hurricane Katrina *storm surge* floods 80% of New Orleans



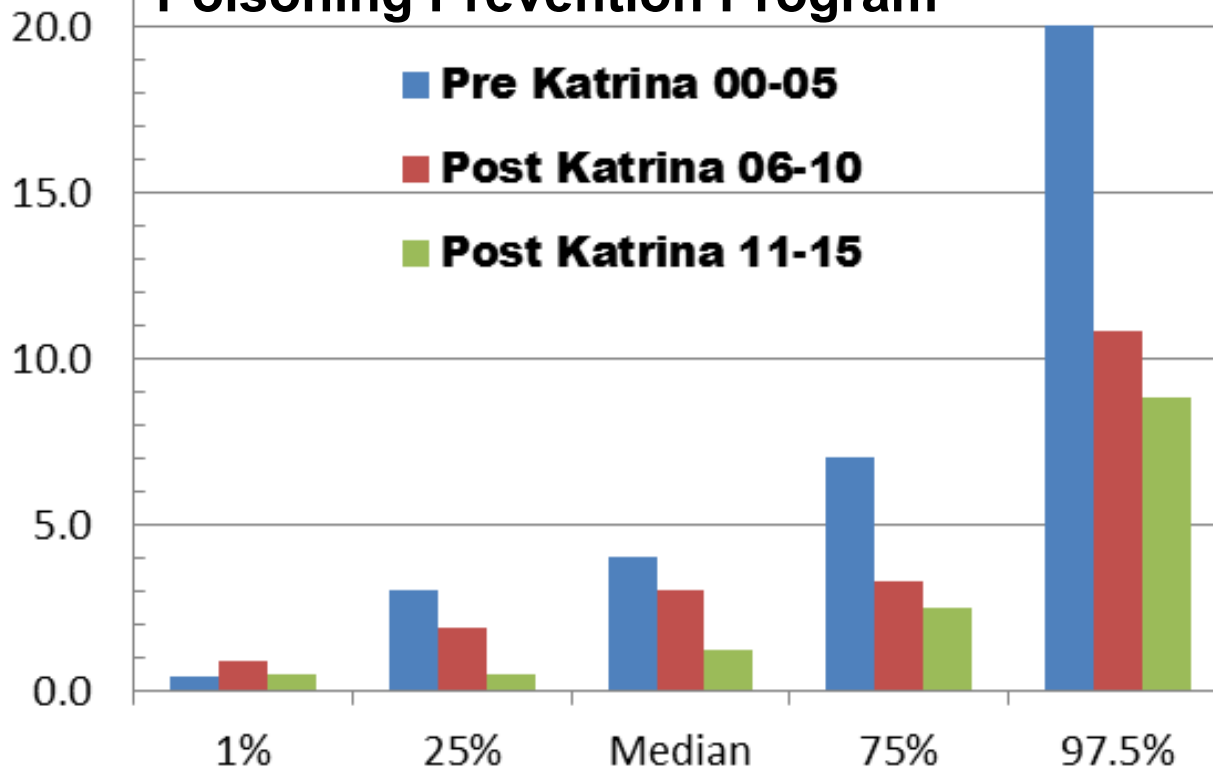
Greek : purity “cleansing”



## BLL ( $\mu\text{g}/\text{dL}$ ) results pre-Katrina vs. post-Katrina (2 surveys)

<u>Years</u>	<u>N</u>	<u>1%</u>	<u>25%</u>	<u>50%</u>	<u>75%</u>	<u>97.5%</u>
2000-2005	55551	0.4	3.0	4.0	7.0	20.0
2006-2010	33145	0.9	1.9	3.0	3.3	10.8
2011-2015	28868	0.5	0.5	1.2	2.5	8.8

Source: LA Healthy Homes and Childhood Lead Poisoning Prevention Program



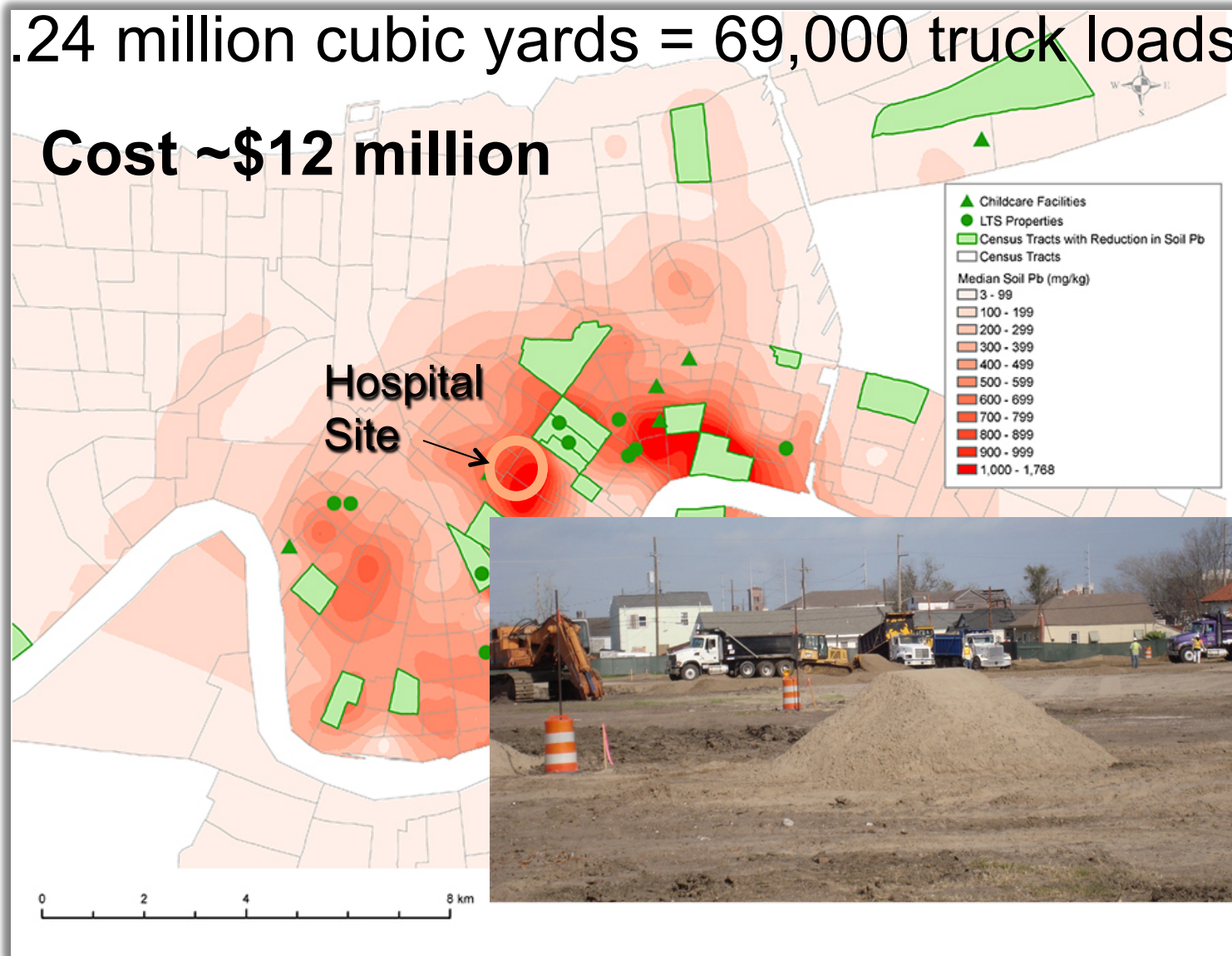


# Construction after Hurricane Katrina-hospital sites

## Convoy of 770 acre feet of 5 mg Pb/kg alluvium

1.24 million cubic yards = 69,000 truck loads

Cost ~\$12 million

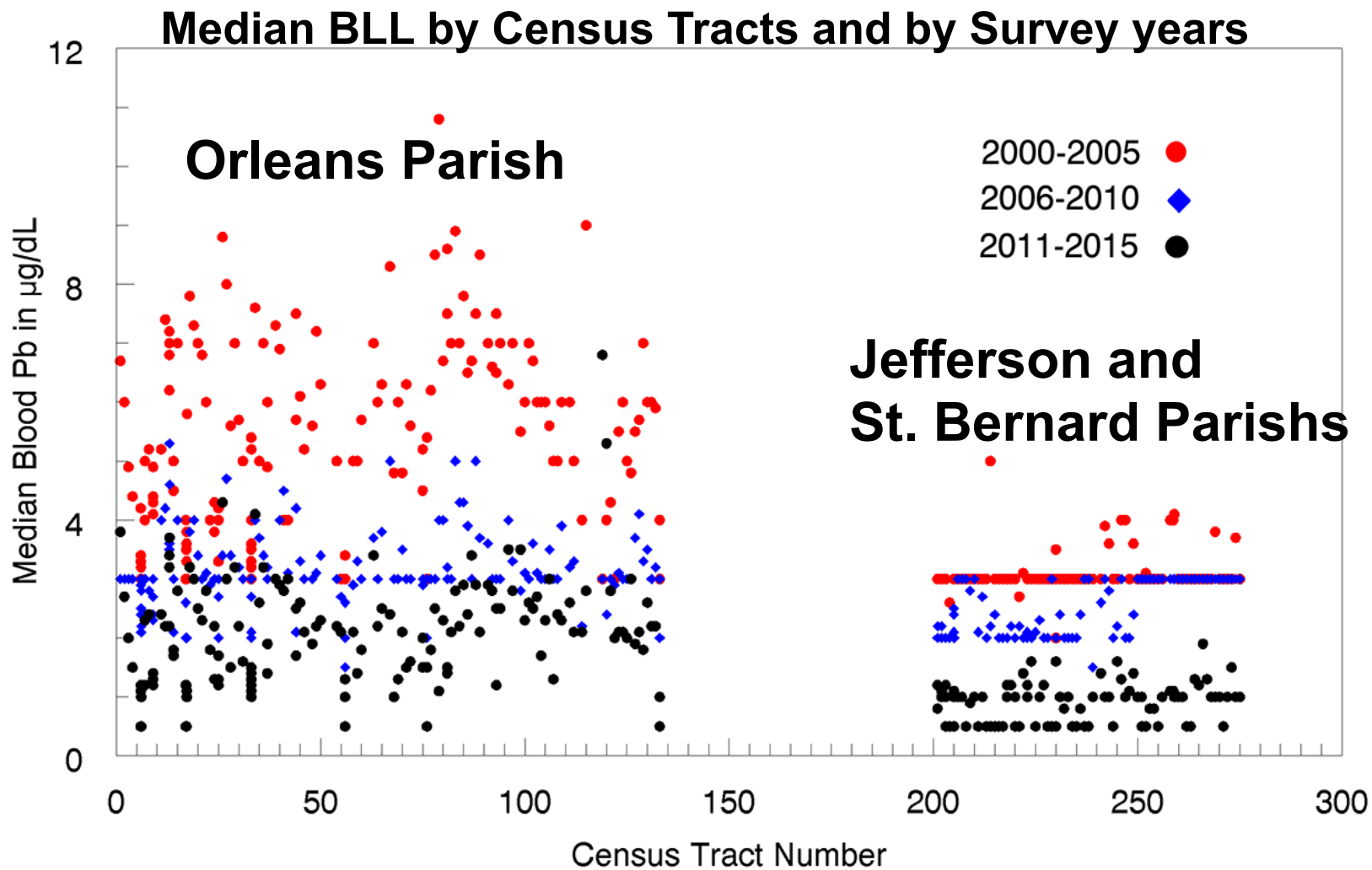


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# BLLs in Orleans vs. Jefferson & St. Bernard Parishes



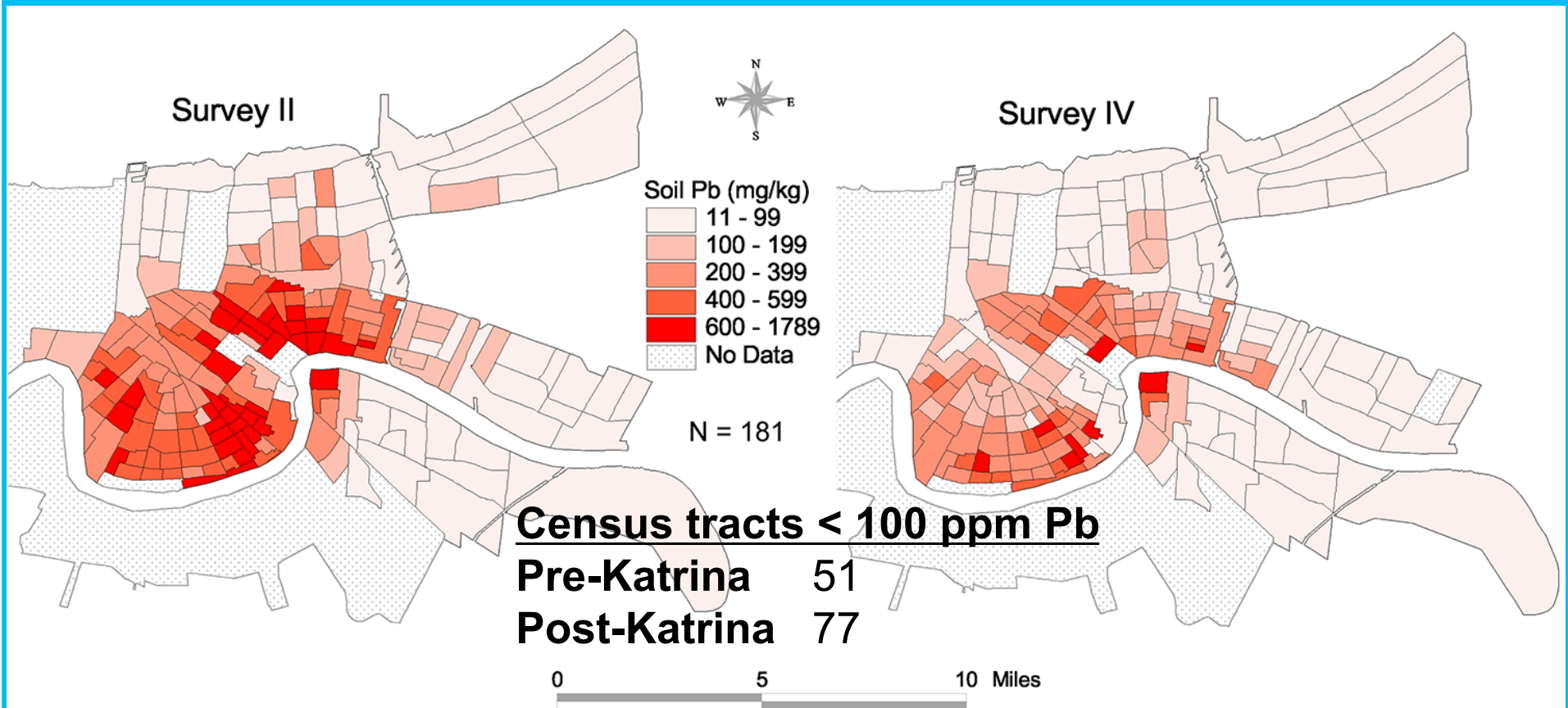
# Temporal-Spatial dynamics of BLL before and after Katrina



# Post Katrina NOLA Pb map (181) Survey 2001 vs. 2015 (preliminary)

Pre-Katrina

Post-Katrina



# **Evolving understanding of soil Pb & BLL**

- **Soils of inhabited older urban communities are excessively contaminated with Pb dust.**
- **Inhalation and hand-to-mouth behaviors render children extremely vulnerable to soil Pb and Pb dust; a margin of safety is essential for health and welfare of children.**
- **Hurricane Katrina and construction reduced the Pb content of the soil in New Orleans.**
- **The changes of soil Pb in New Orleans demonstrate the feasibility and cost-effectiveness of soil Pb intervention for reducing children's BLL.**