Using New Technologies to Enhance your Research

Built Environment Audits with Google Street View

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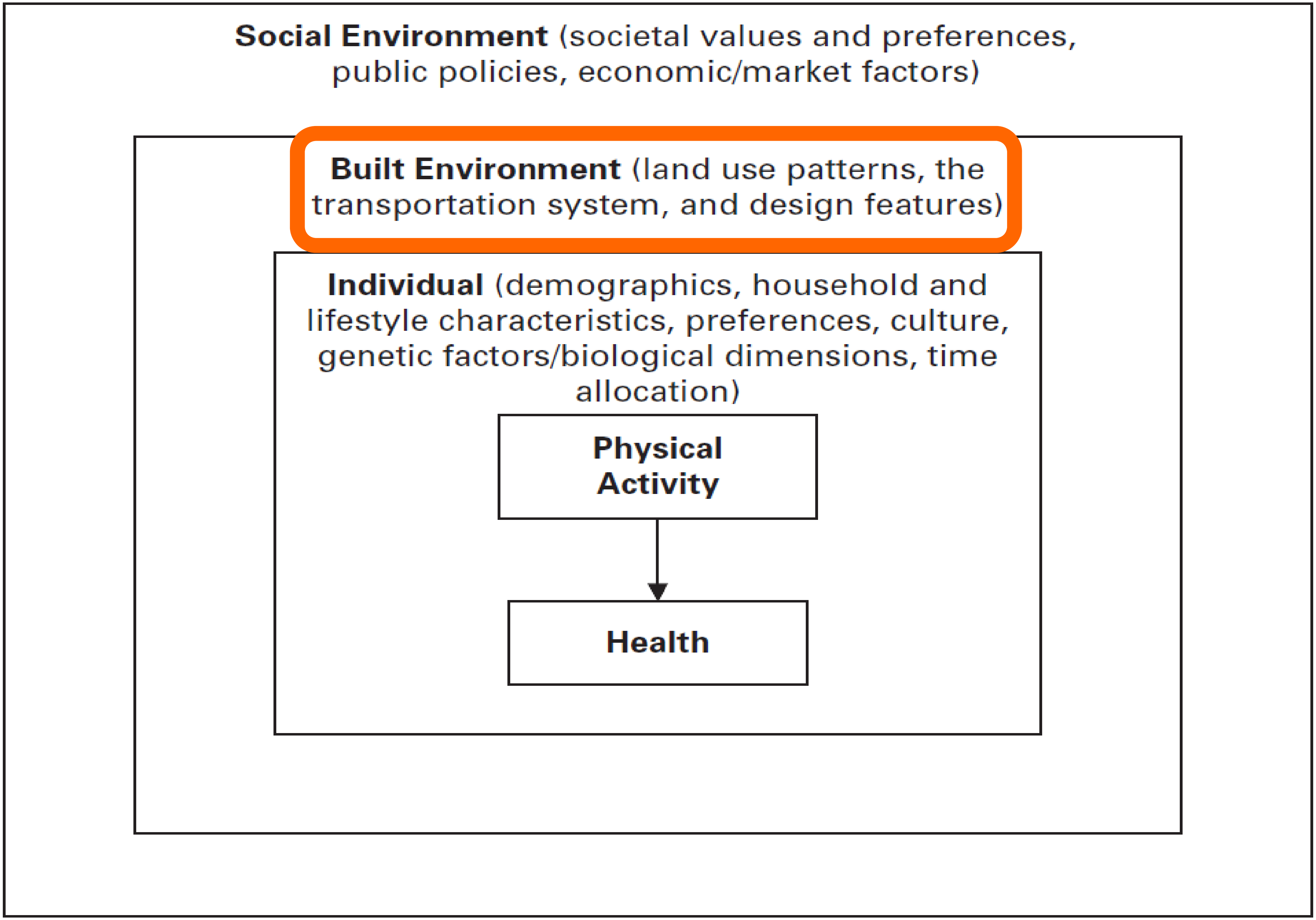
Objectives

- Review the rationale for using Google Street View to conduct built environment audits
- Discuss the advantages and disadvantages of this approach
- Experiment with auditing using Street View imagery
- Discuss current challenges and future directions for implementing image-based audits



Committee on Physical Activity, Health, Transportation, and Land Use. 2005. *Does the Built Environment Influence Physical Activity? Examining the Evidence.* Transportation Research Board, Special Report 282.

Measuring the Built Environment

Brownson et. al (2009) identified 3 general approaches:

1. Perceived measures obtained from surveys of participants — Subjective / Self-report
2. Obtaining measures from existing data sets (e.g., using GIS)
3. Systematic observational audits by trained observers

} Objective (2 and 3)

Brownson RC, Hoehner CM, Day K, Forsyth A, Sallis JF. 2009. Measuring the Built Environment for Physical Activity: State of the Science. *American Journal of Preventive Medicine,* 36(4): S99-S123.

GIS Measures of the Built Environment

- General Approach
  - Spatial databases (map layers) are used to develop metrics of BE variables within some area that is assumed to represent exposure
  - e.g. intersection density w/in buffer around home, recreational facilities w/in a census tract, count of abandoned buildings along route to school

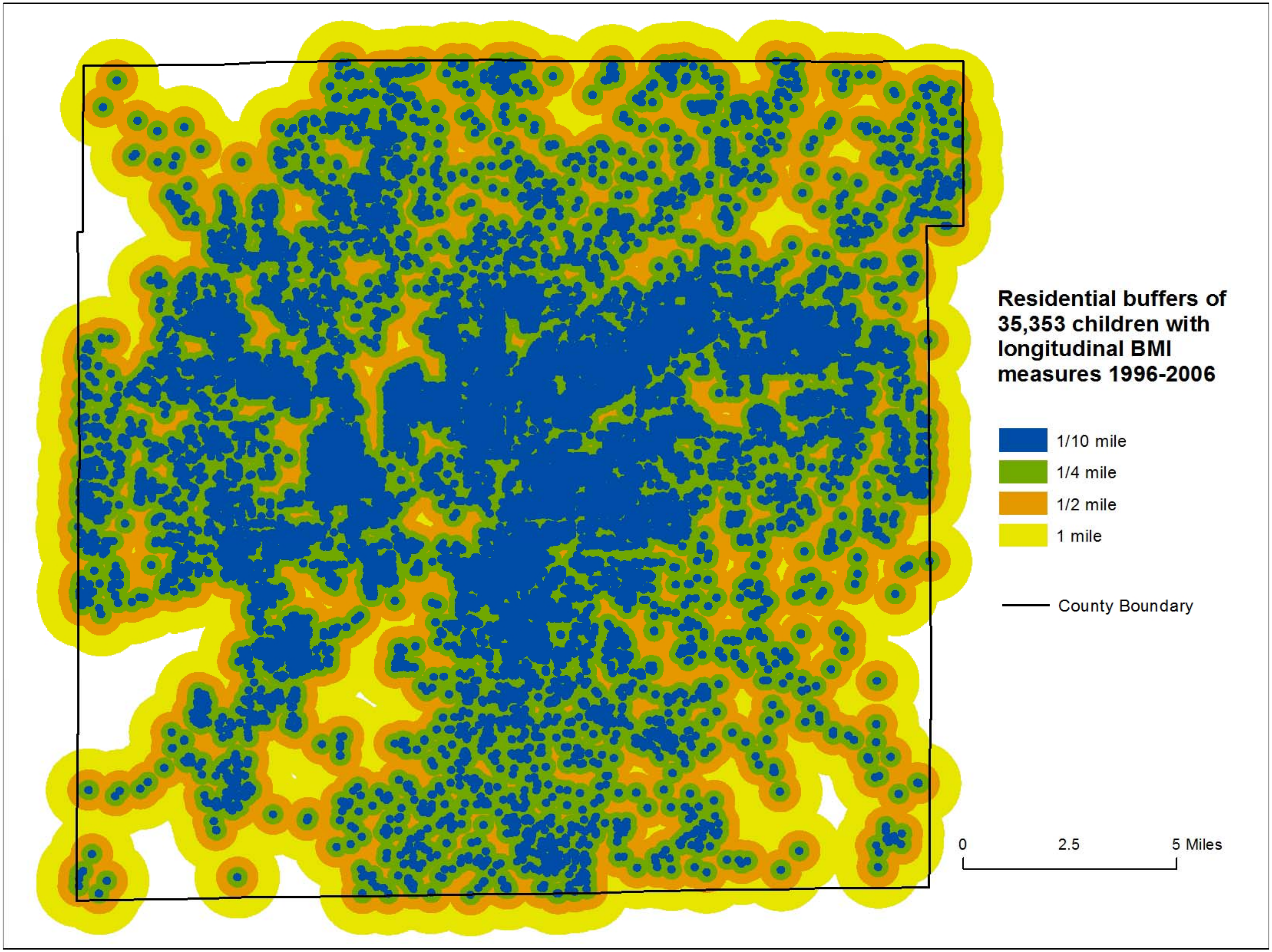
GIS Measures of the Built Environment

- Limitations
  - Availability of large-scale GIS data varies geographically (typically better in urban areas)
  - GIS layers may not include the spatial detail or descriptive detail (attributes) needed for research purposes
  - Linking behavior to GIS layers can be complex (where do we measure?)

GIS Measures of the Built Environment

- Spatial variability in GIS data coverage


McDonald's
CRIME SCENE-D
FreeFoto.com



Residential buffers of 35,353 children with longitudinal BMI measures 1996-2006
1/10 mile
1/4 mile
1/2 mile
1 mile
County Boundary
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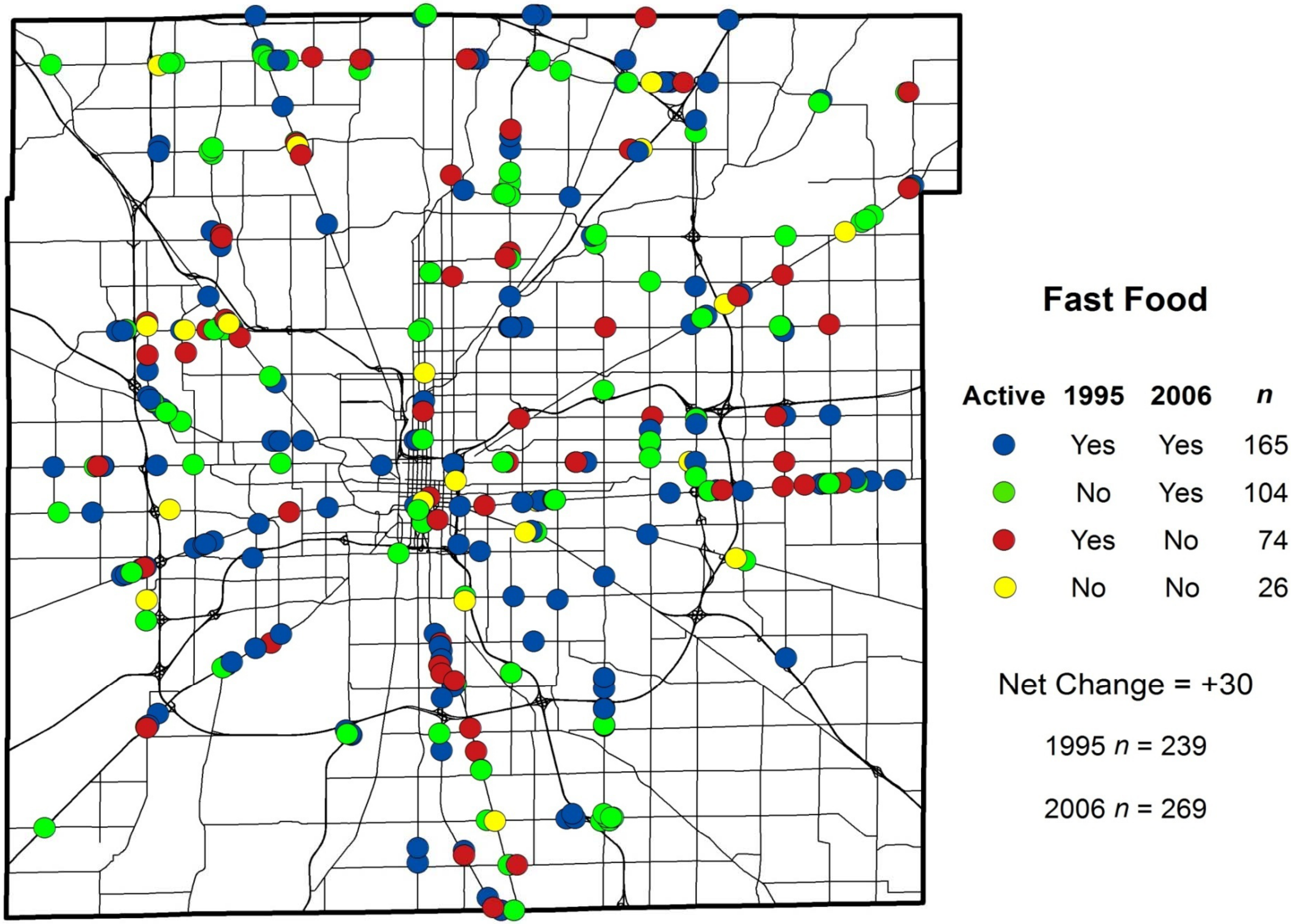
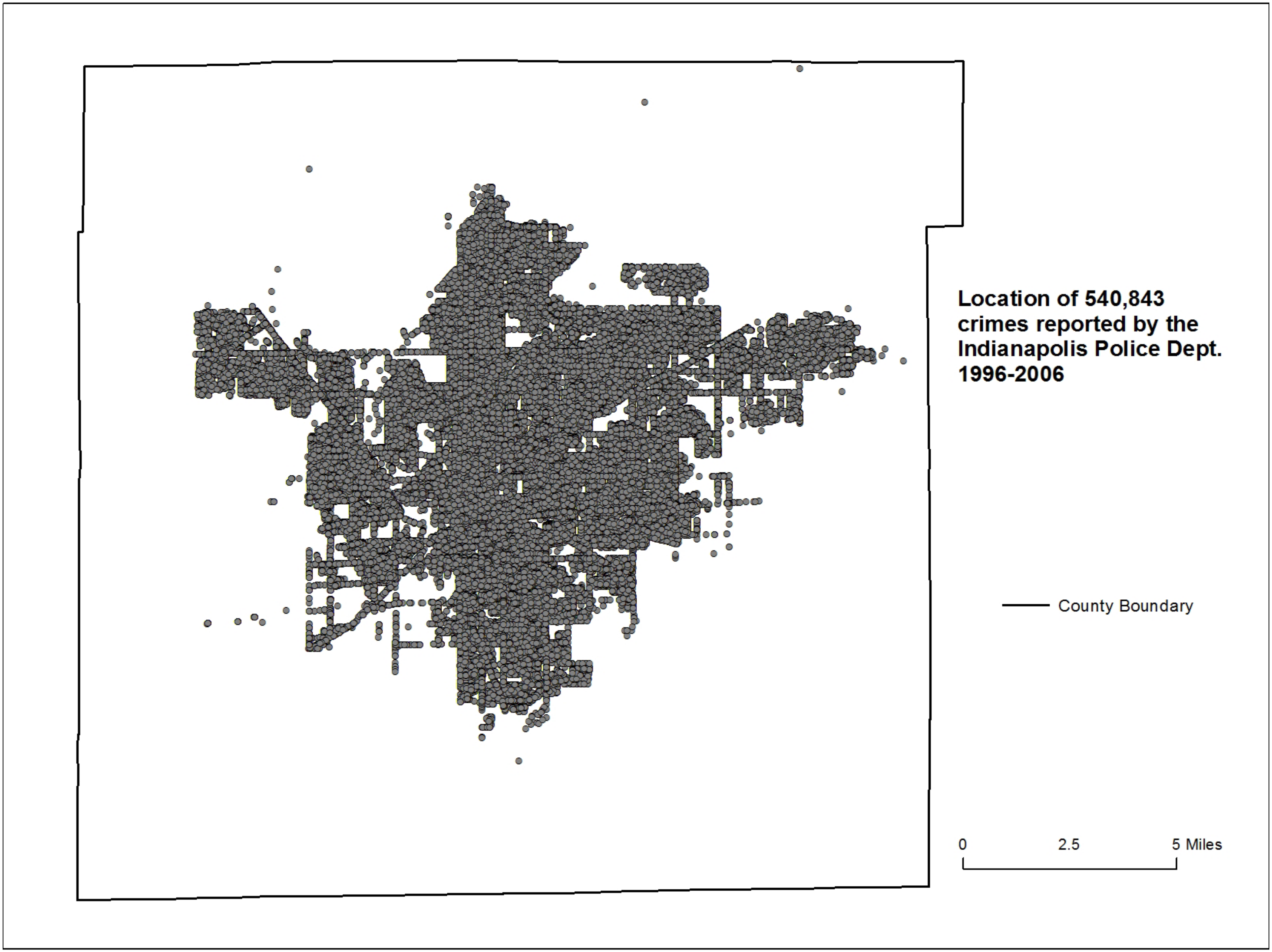
2.5
5 Miles


Fast Food
Active 1995 2006 n
Yes Yes 165
No Yes 104
Yes No 74
No No 26
Net Change = +30
1995 n = 239
2006 n = 269

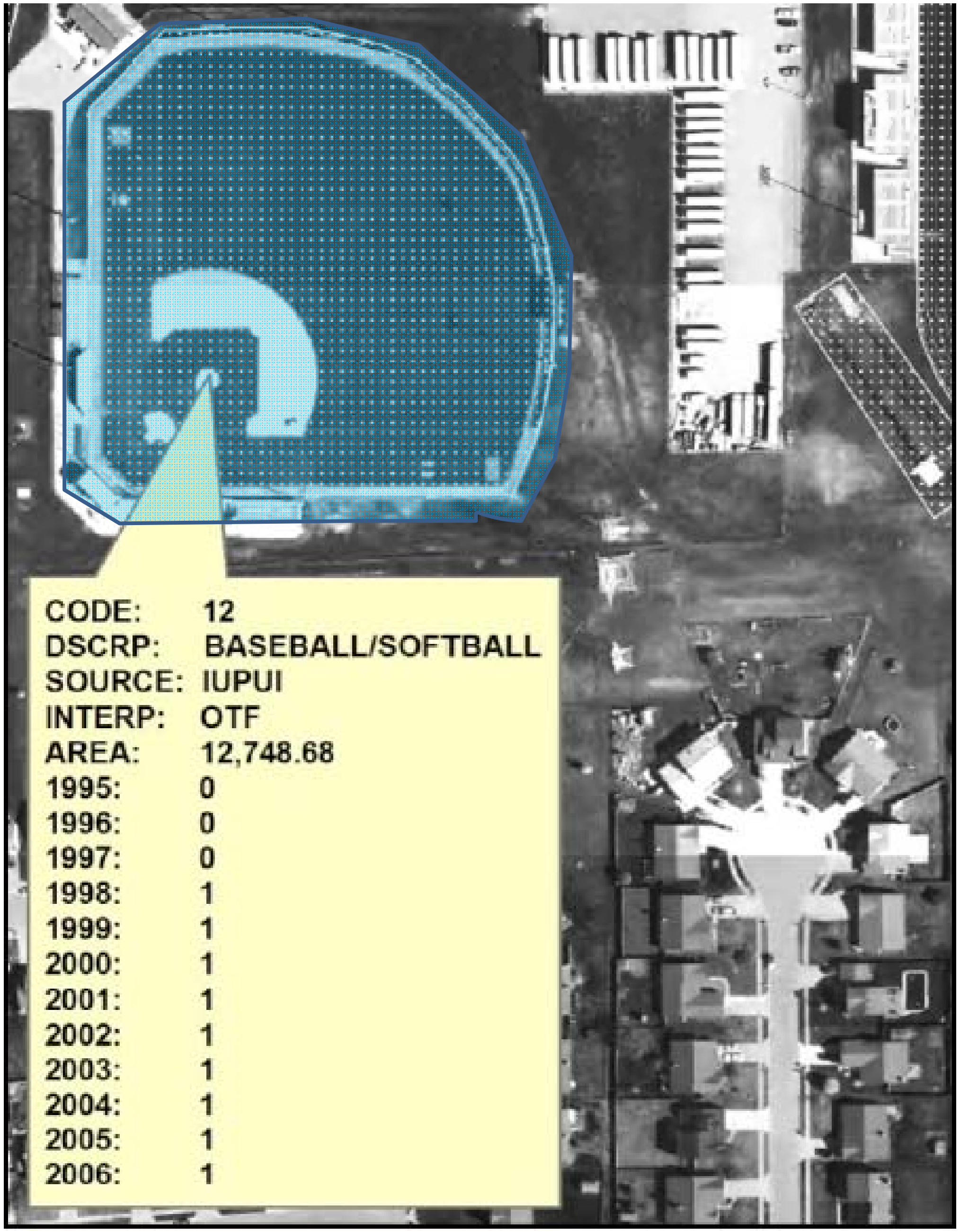

Location of 540,843
crimes reported by the
Indianapolis Police Dept.
1996-2006
County Boundary
0
2.5
5 Miles

GIS Measures of the Built Environment

- Lack of detail

Park locations were available in GIS, but distribution and timing of recreational amenities w/in parks and elsewhere (e..g, schools and neighborhoods) needed to be manually interpreted.

Historical aerial photos proved useful for interpreting this variable.



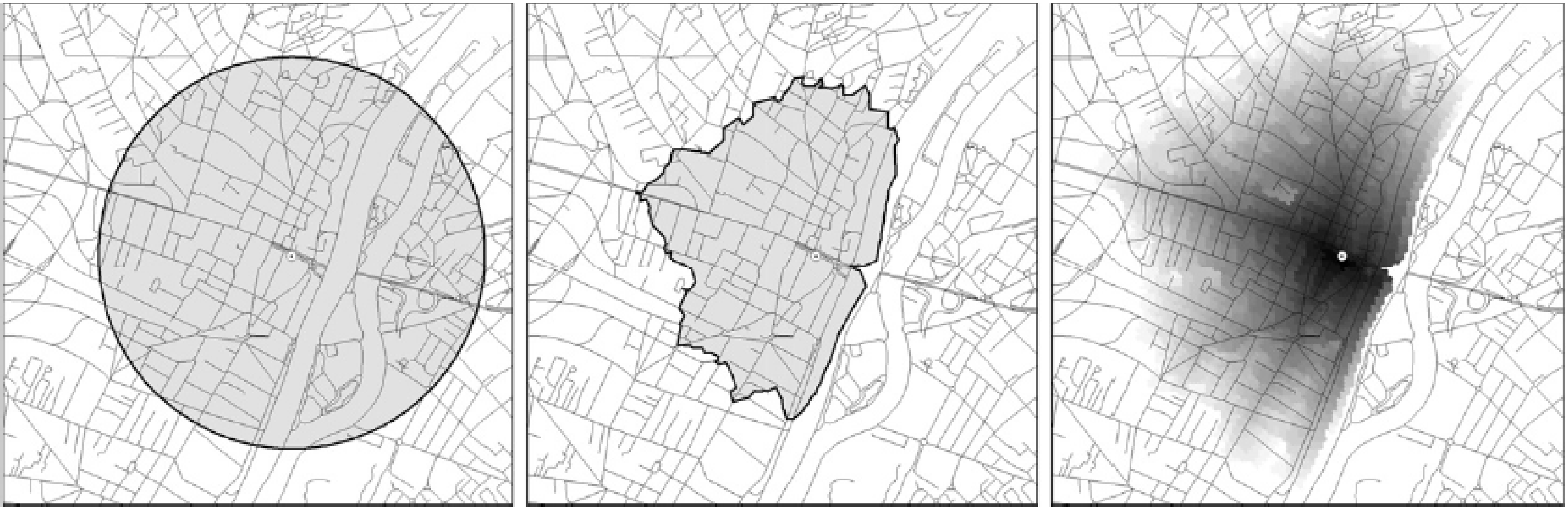
GIS Measures of the Built Environment

- Exposure –where do we measure?

Social Science & Medicine 69 (2009) 1306–1310

Neighbourhoods in eco-epidemiologic research: Delimiting personal exposure areas. A response to Riva, Gauvin, Apparicio and Brodeur

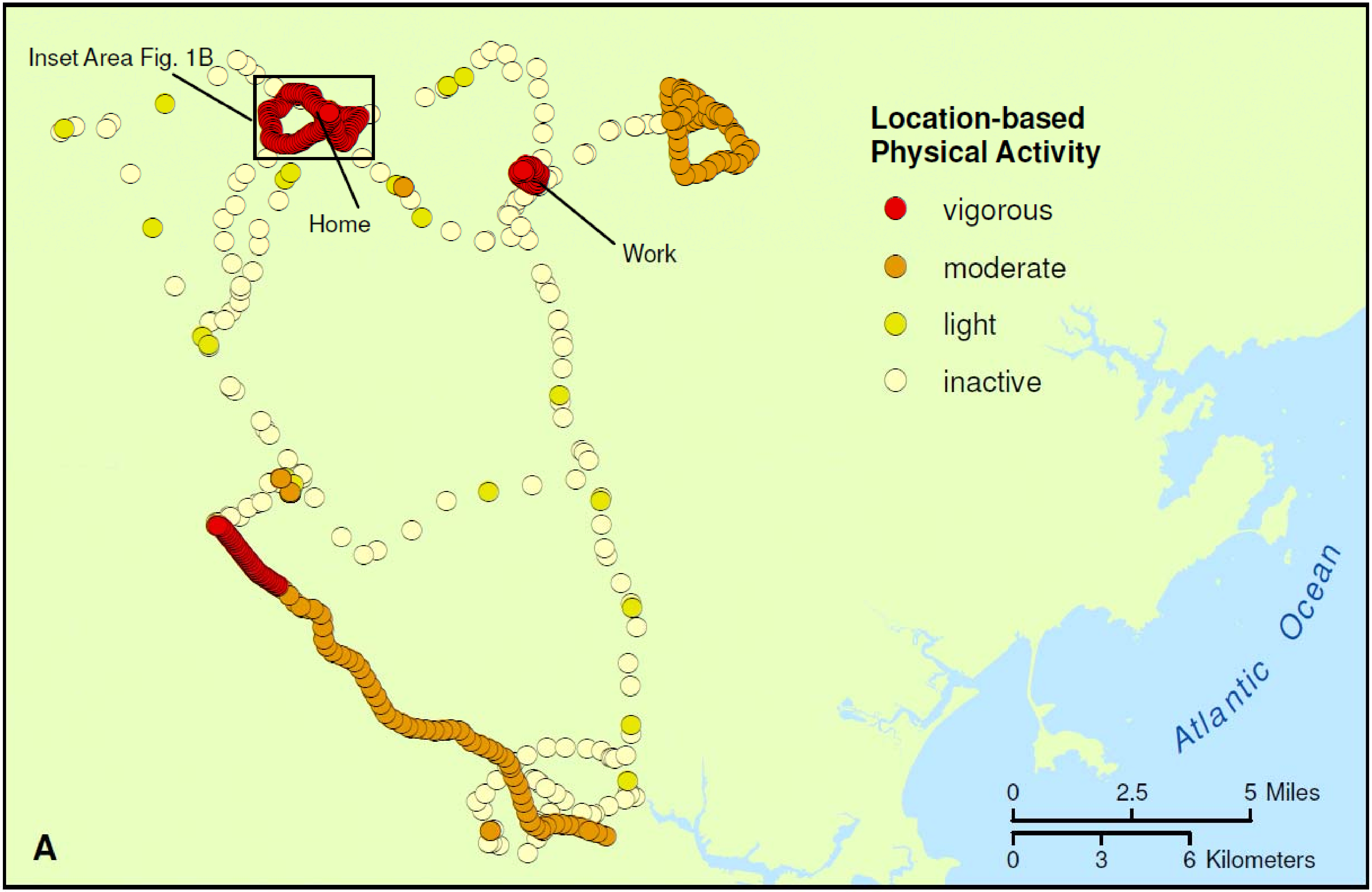
Basile Chaix[a,b,*], Juan Merlo[c], David Evans[a,b,d], Cinira Leal[a,b], Sabrina Havard[a,b]



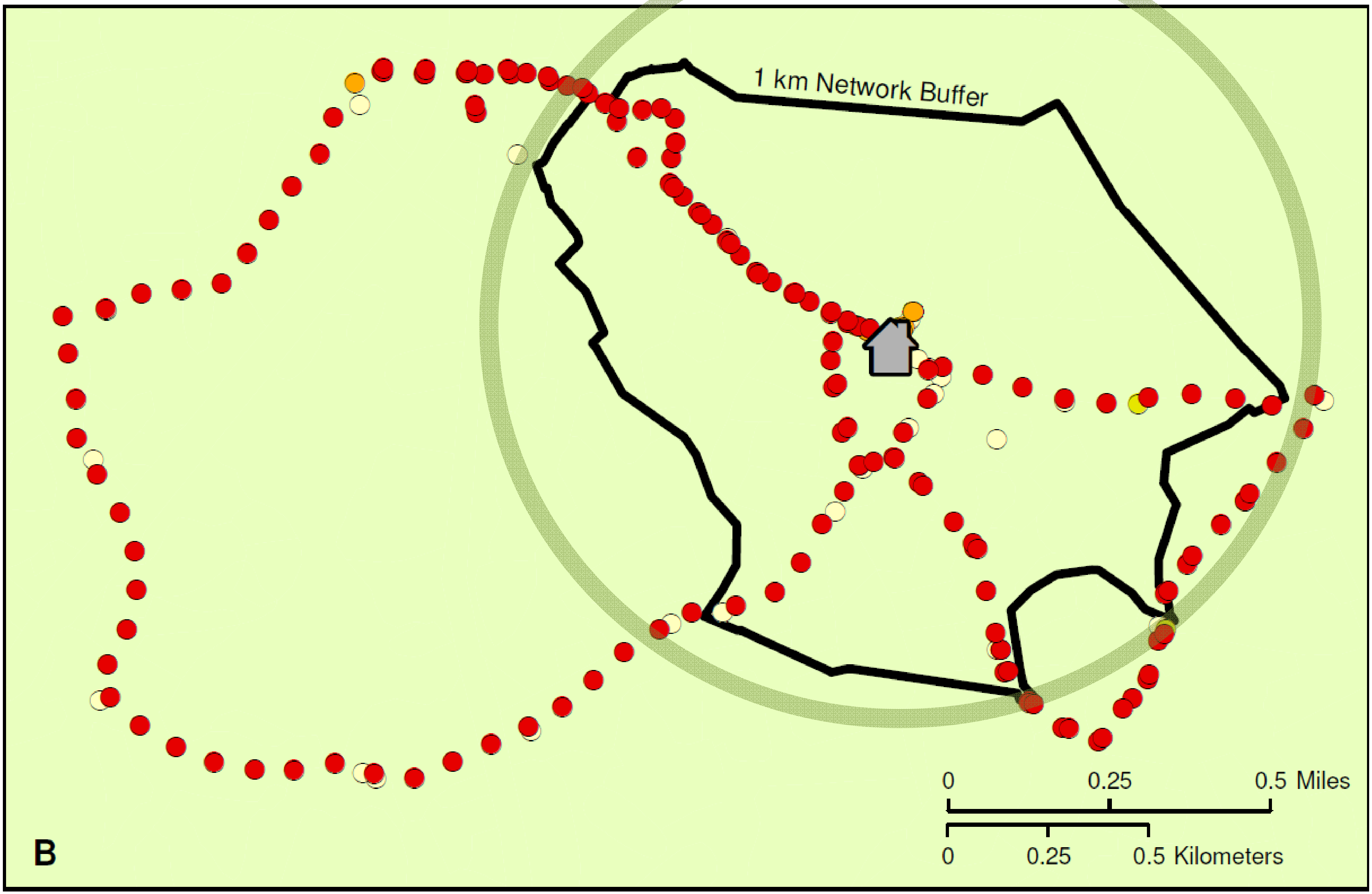
Int. J. Epidemiol. Advance Access published March 21, 2007

Commentary: Investigating neighbourhood effects on health—avoiding the 'Local Trap'

Steven Cummins



Troped PJ, Wilson JS, Matthews CE, Cromley EK, Melly SJ. 2010. The built environment and location-based physical activity. *American Journal of Preventive Medicine,* 38(4):429-438.


1 km Network Buffer
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0.25
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0.25
0.5 Kilometers
B

Systematic Observations

- Field Audits
  - Trained observers walk or drive through the study area and identify the presence/absence of built environment characteristics and their condition
  - e.g., are sidewalks present?, are they in good shape? recreational facilities? levels of physical disorder? etc.
  - Provides a human perspective that is not captured in most “top-down” GIS data

Systematic Observations

- Limitations of Field Audits include...
  - Time and expense if data are needed for large or geographically dispersed areas
  - May need to train large groups of people to collect data
  - It's not possible to go back in time to evaluate environmental conditions as they existed in the past (e.g., to support retrospective longitudinal studies)

New Methods to Measure Built Environment

- Omnidirectional Imagery
  - Simultaneous collection of images in multiple directions from a single location producing a panoramic view
  - Allows the viewer to virtually walk or drive through a community to observe characteristics
  - Imagery provides a visual record of built environment characteristics (potential for retrospective studies)

What's Omnidirectional Imagery?

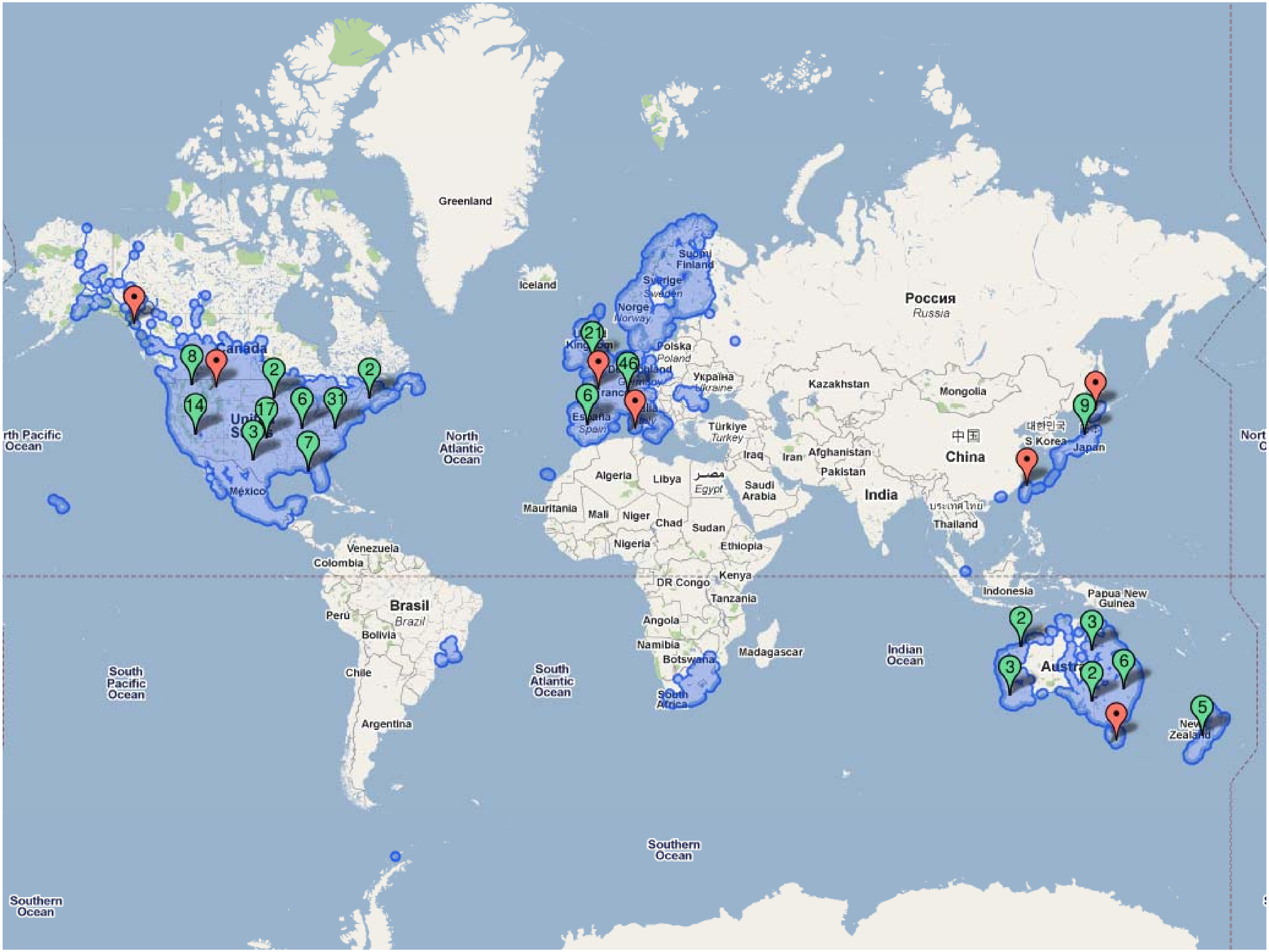
- Example of an omnidirectional imaging system

Street View

Image coverage continues to expand

- North America
  - US, some of Canada & Mexico
- Western Europe
- Australia and NZ
- Africa
  - South Africa
- Asia
  - Japan, Hong Kong, Shanghai
- South America
  - Brazil

Coverage along pedestrian routes is being added selectively via cycle and person-mounted systems


Greenland
Iceland
Canada
United States
México
North Pacific Ocean
North Atlantic Ocean
Venezuela
Colombia
Brasil
Brazil
Perú
Bolivia
Chile
Argentina
South Pacific Ocean
South Atlantic Ocean
Suomi
Finland
Sverige
Sweden
Norge
Norway
United Kingdom
Polska
Poland
Deutschland
Germany
France
España
Spain
Italia
Italy
Україна
Ukraine
Türkiye
Turkey
Россия
Russia
Kazakhstan
Mongolia
中国
China
대한민국
S Korea
Japan
Iraq
Iran
Afghanistan
Pakistan
India
Thailand
Algeria
Libya
مصر
Egypt
Saudi Arabia
Mauritania
Mali
Niger
Chad
Sudan
Nigeria
Ethiopia
Kenya
DR Congo
Tanzania
Angola
Namibia
Botswana
South Africa
Madagascar
Indian Ocean
Indonesia
Papua New Guinea
Australia
New Zealand
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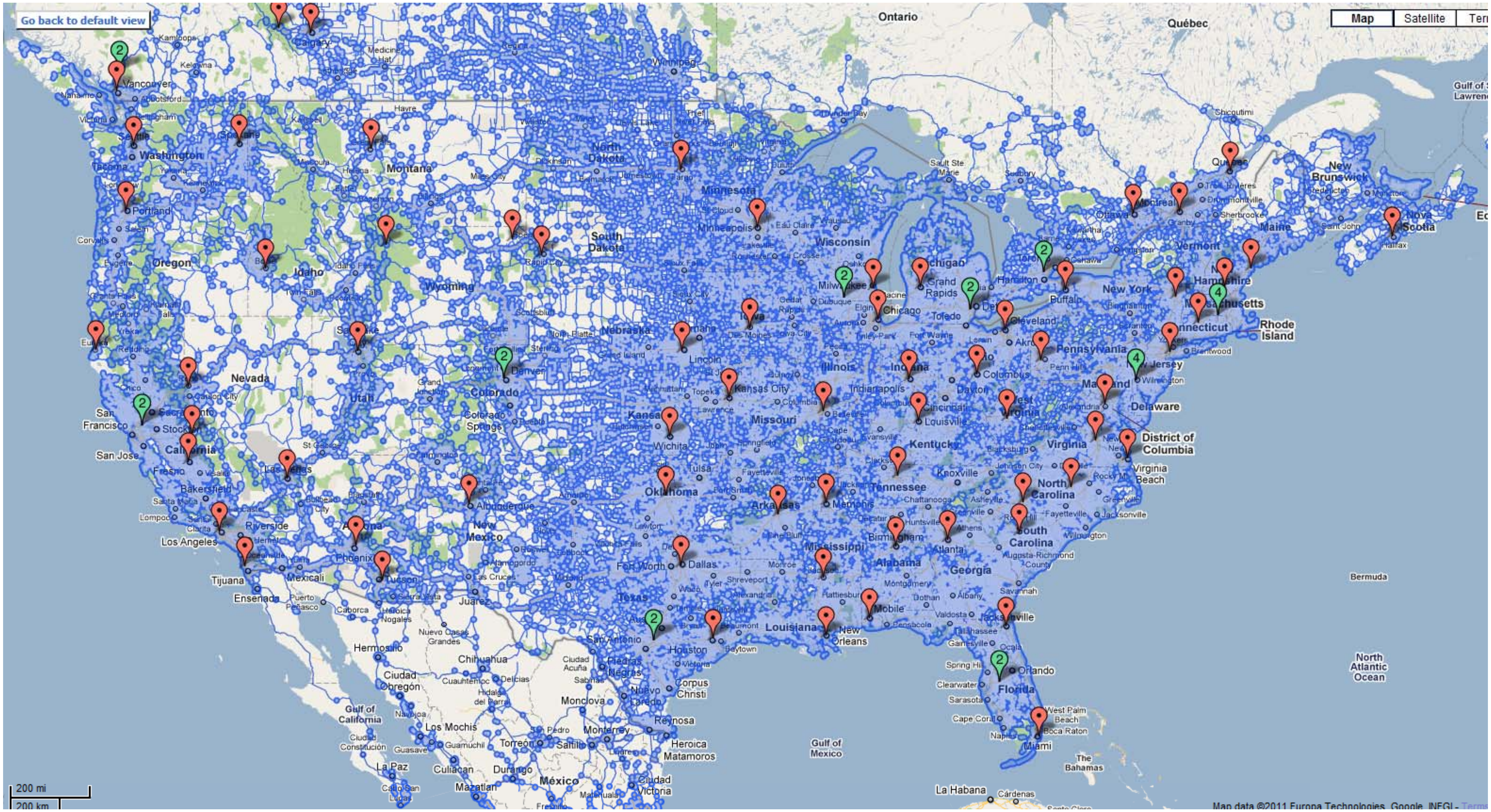
Go back to default view
Map
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Vancouver
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Idaho
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Michigan
Grand Rapids
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Denver
Nebraska
Kansas City
Wichita
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Illinois
Indianapolis
Indiana
Louisville
Kentucky
Cincinnati
Columbus
Dayton
Toledo
Cleveland
Buffalo
New York
Pennsylvania
Vermont
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New Brunswick
Nova Scotia
Montreal
Ottawa
Rhode Island
Delaware
District of Columbia
Virginia
Virginia Beach
North Carolina
South Carolina
Tennessee
Knoxville
Memphis
Arkansas
Oklahoma
Tulsa
Dallas
Fort Worth
Texas
Houston
San Antonio
Corpus Christi
Louisiana
New Orleans
Mississippi
Alabama
Birmingham
Atlanta
Georgia
Mobile
Jacksonville
Orlando
Florida
Miami
West Palm Beach
Boca Raton
San Francisco
San Jose
Fresno
Bakersfield
Los Angeles
Riverside
Tijuana
Ensenada
Mexicali
Phoenix
Tucson
Albuquerque
New Mexico
Juarez
Chihuahua
Hermosillo
Monterrey
Torreon
Gulf of California
Gulf of Mexico
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Bermuda
North Atlantic Ocean
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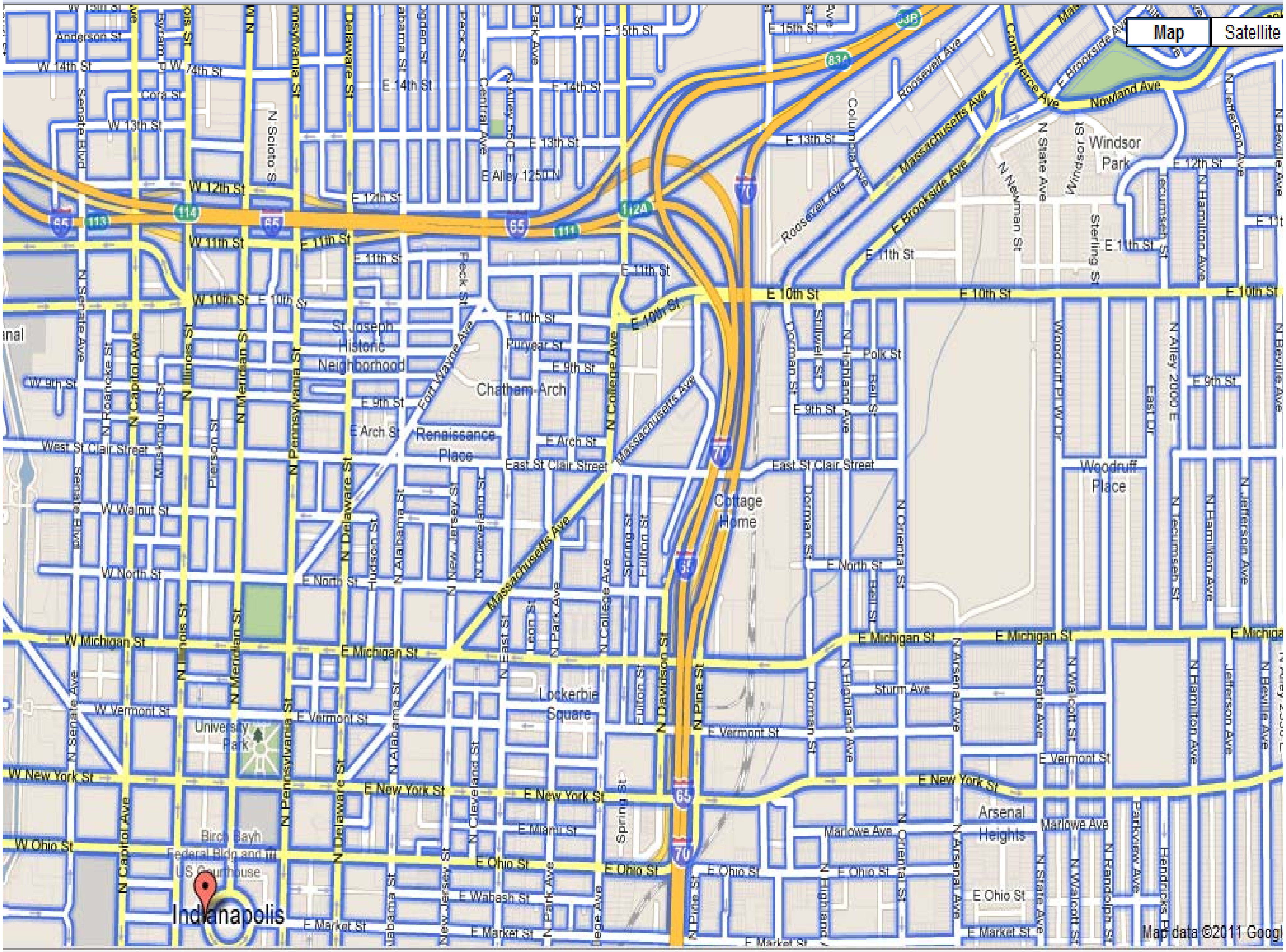
200 mi
200 km
Map data ©2011 Europa Technologies, Google, INEGI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N Delaware St
Central Ave
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Park Ave
Roosevelt Ave
Commerce Ave
E Brookside Ave
Nowland Ave
Columbia Ave
Massachusetts Ave
Windsor Park
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Windsor St
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N Beville Ave
N Hamilton Ave
Tecumseh St
Sterling St
E 11th St
Roosevelt Ave
E Brookside Ave
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N Senate Ave
St Joseph Historic Neighborhood
Fort Wayne Ave
Chatham-Arch
Puryear St
E 9th St
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N Roanoke St
N Capitol Ave
N Illinois St
N Meridian St
N Pennsylvania St
Peck St
N College Ave
Massachusetts Ave
Dorman St
Stillwell St
N Highland Ave
Polk St
Bell St
Woodruff Pl W Dr
N Alley 2000 E
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E 9th St
E Arch St
Renaissance Place
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Pierson St
Muskingum St
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Woodruff Place
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Hudson St
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N Cleveland St
Spring St
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Indianapolis
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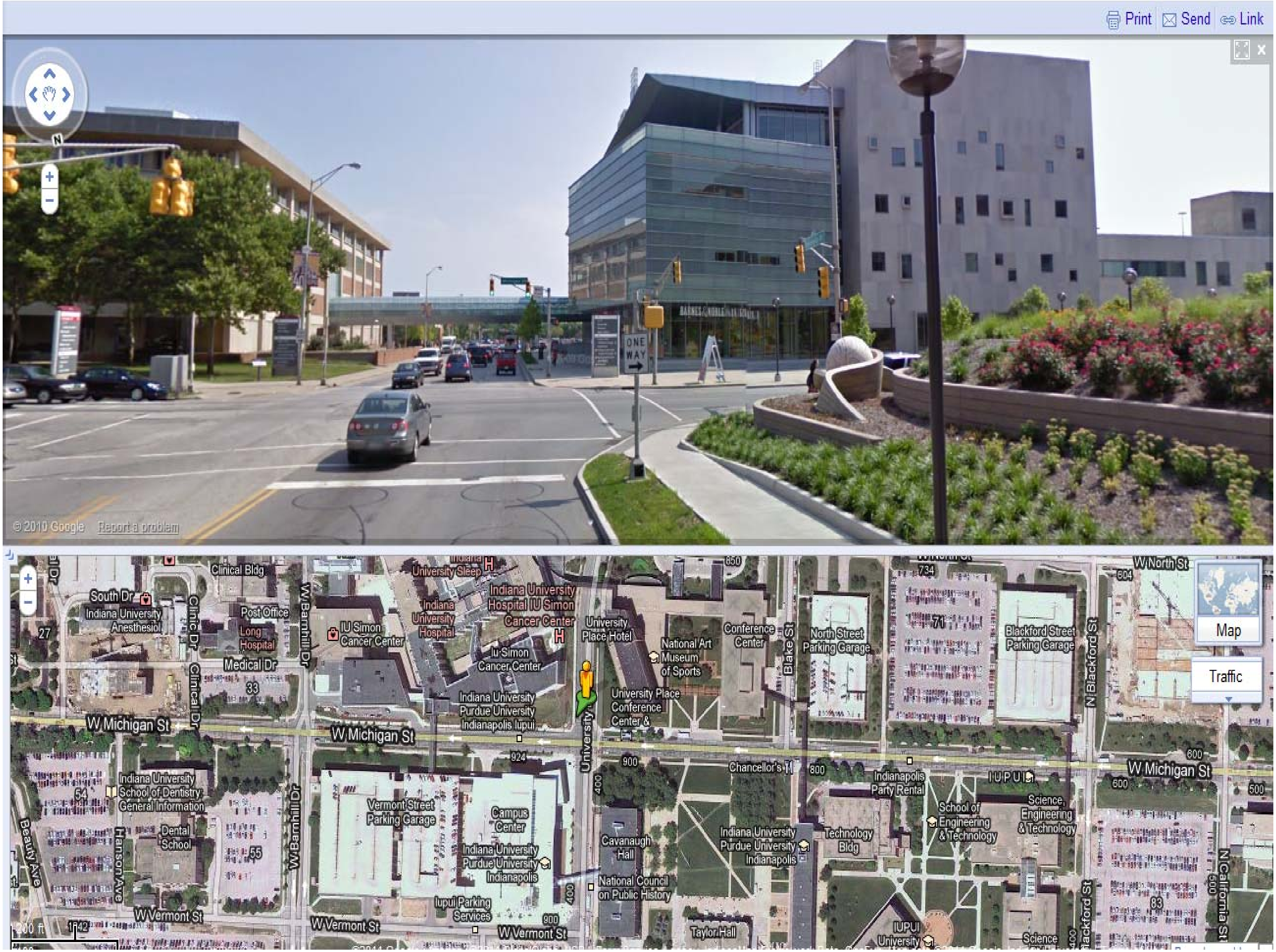
Map data ©2011 Googl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© 2010 Google
Report a problem
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Long Hospital
Medical Dr
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Clinic Dr
Clinical Dr
IU Simon Cancer Center
Indiana University Hospital
University Sleep
Indiana University Hospital IU Simon Cancer Center
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Indiana University Purdue University Indianapolis Iupui
University Place Hotel
National Art Museum of Sports
University Place Conference Center &
Conference Center
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North Street Parking Garage
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Blackford Street Parking Garage
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Traffic
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Chancellor's
Indianapolis Party Rental
IUPUI
School of Engineering & Technology
Science, Engineering & Technology
Indiana University School of Dentistry: General Information
54
Dental School
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Vermont Street Parking Garage
Campus Center
Indiana University Purdue University Indianapolis
Iupui Parking Services
Cavanaugh Hall
National Council on Public History
Indiana University Purdue University Indianapolis
Technology Bldg
Taylor Hall
IUPUI University
83
N California St
Beauty Ave
Hanson Ave
W Vermont St
W Vermont St
W Vermont St
800
400
400
Science

New Methods to Measure Built Environment

- Omnidirectional Imagery
  - How useful is this type of imagery for replacing or supplementing field audits?
  - Can it support more efficient and extendable alternatives to field-based observational surveys?

ALR Funded Study

1. **Examine the agreement between observational measures of the built environment derived from the interpretation of omnidirectional imagery and in-person field audits conducted using the same measurement instrument.**

2. Work with practitioners and researchers to develop easy-to-use training materials and protocols for conducting built environment audits with omnidirectional imagery

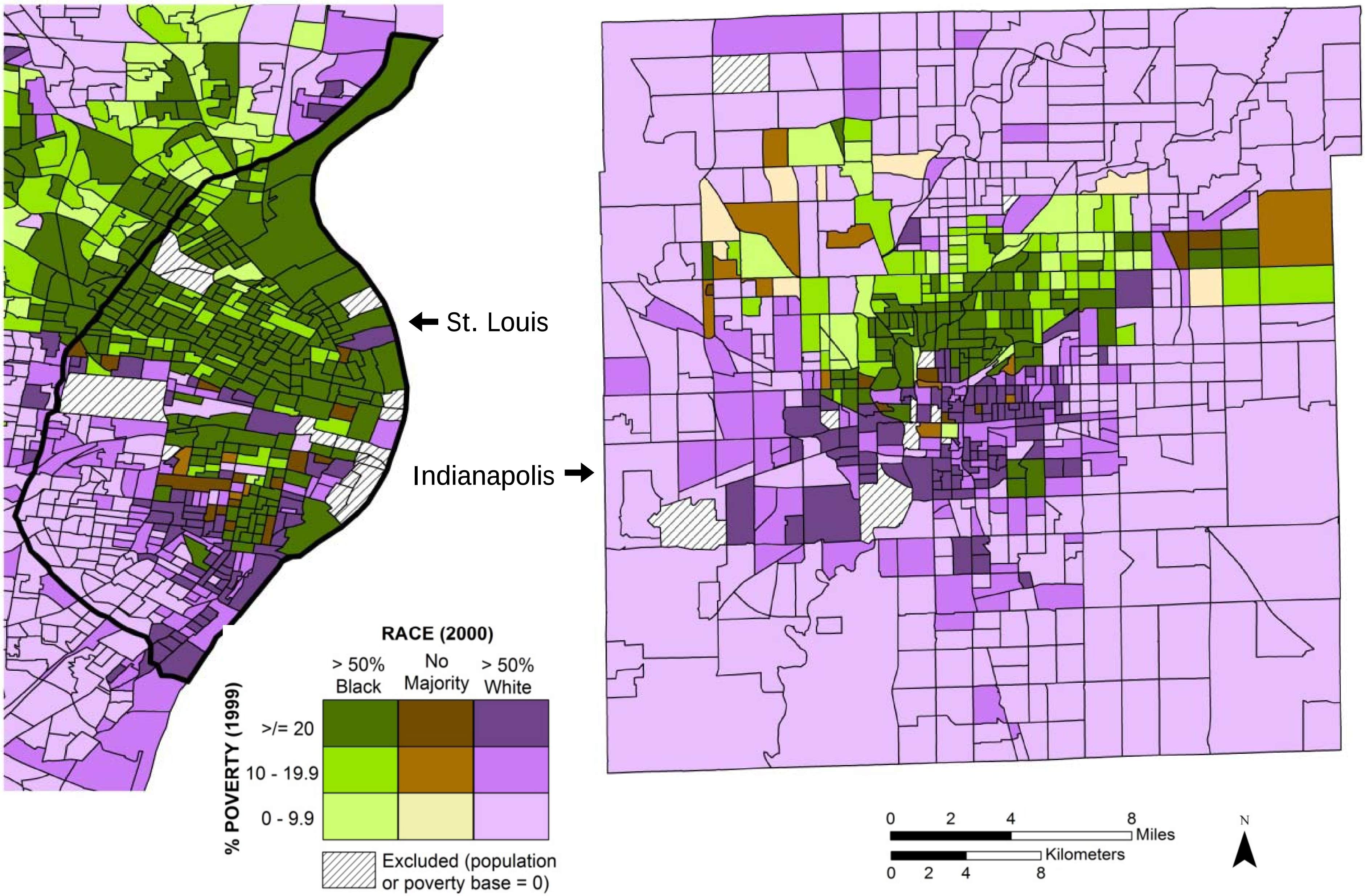
Rundle AG, Bader MDM, Richards CA, Neckerman KM, Teitler JO. Using Google Street View to Audit Neighborhood Environments. *American Journal of Preventive Medicine* 2010;40(1):94-100.

Taylor BT, Fernando P, Bauman AE, Williamson A, Craig JC, Redman S. Measuring the Quality of Public Open Space Using Google Earth. *American Journal of Preventive M*edicine 2010;40(2):105-112.

Badland HM, Opit S, Witten K, Kearns RA, Mavoa S. Can virtual streetscape audits reliably replace physical streetscape audits? *Journal of Urban Health* 2010;87(6):1007-1016.

Methods

- Examine agreement with Field Audits
  - New Imagery (collected concurrently with field audits)
  - Archived (collected 6-12 months prior)
  - Street View (public, but no time stamp)


St. Louis
Indianapolis
RACE (2000)
> 50% Black
No Majority
> 50% White
% POVERTY (1999)
>/= 20
10 - 19.9
0 - 9.9
Excluded (population or poverty base = 0)
0 2 4 8 Miles
Kilometers 0 2 4 8
N

Indy & St. Louis Combined

Block Group Class	Archived & New Imagery Available		Only New Imagery Available	
	Segments	Length (miles)	Segments	Length (miles)
≥ 50% Black / ≥ 20% Poverty	64	4.9	40	3.2
≥ 50% Black / <10% Poverty	41	3.8	38	3.2
≥ 50% White / ≥ 20% Poverty	115	6.5	46	4.2
≥ 50% White / <10% Poverty	42	3.7	25	3.3
Subtotals	**262**	**18.9**	**149**	**13.9**
Total Segments	**411**			
Total Miles	**32.7**			

Measurement

- Active Neighborhood Checklist
  - Land Use Characteristics
  - Sidewalks
  - Shoulders & Bike Lanes
  - Street Characteristics
  - Quality of the Environment

Analysis

- Reliability between field audits & 3 sources of imagery
  - Cohen's Kappa (K)
  - All variables were dichotomized
    - Ex. Sidewalk present or not present (captured as not present, present one side or present on both sides)

Results

- Similar across all three imagery sources
- Land use (n=45):
  - At least moderate agreement with approximately 25 nearly perfect agreement
- Street characteristics (n=10)
  - All substantial & nearly perfect agreement

Results

- Quality of Environment (n=7)
  - Moderate to Substantial agreement
- Sidewalks (n=10)
  - Moderate to nearly perfect, with exception of alignment (fair)
- Shoulder & Bike Lanes (n=2)
  - Nearly perfect agreement

Advantages & Next Steps

Implications:

- Improved efficiency of collecting data
- Potential to audit from a distance
- Longitudinal studies

Next steps:

- Measure association with behavior on streets audited by foot and by imagery

Acknowledgements

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Research assistants (SLU & IUPUI)

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