COMMUNITY HEALTH MAPPING
IN A WORLD AWASH WITH GEOGRAPHIC DATA & TOOLS

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Community Health Maps Symposium
7-8 June, 2016

USC Dornsife
Dana and David Dornsife
College of Letters, Arts and Sciences

Spatial Sciences Institute

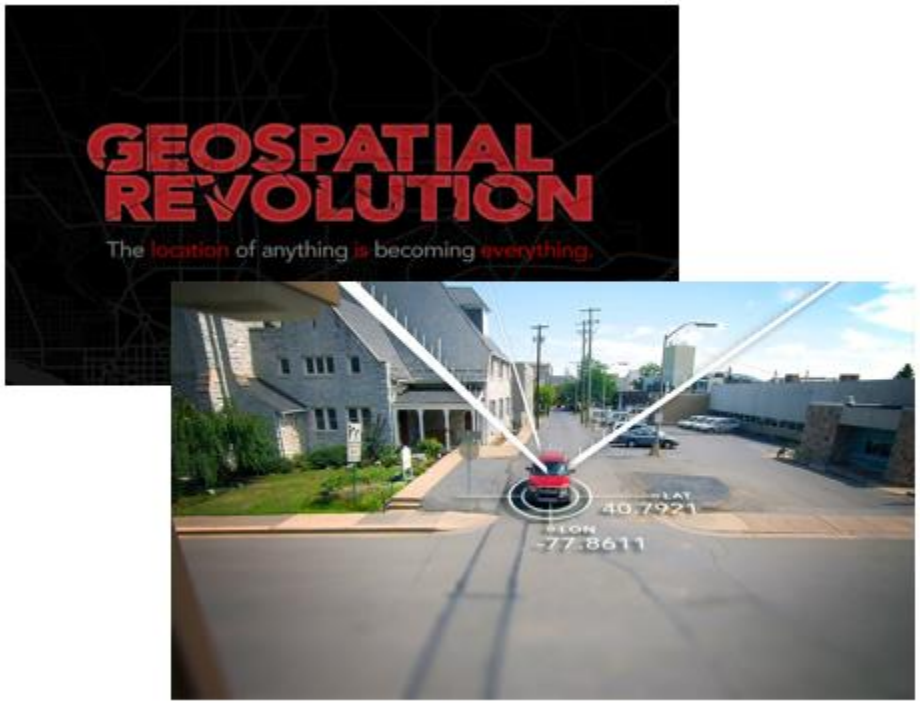
Today's Itinerary

- The Value Proposition
- The Spatial Sciences
- Connecting Health & Place
- Role of Geographic Data
- Role of Geospatial Tools
- ~~Community Mapping Applications~~
- Some Enduring Challenges
- Conclusions

The Value Proposition

- A single database supports multiple maps
- The visual trumps both text & numbers
- Future is 4D (latitude, longitude, height & time)

UN-GGIM
UNITED NATIONS INITIATIVE ON
GLOBAL GEOSPATIAL
INFORMATION MANAGEMENT



Spatial Sciences Institute

- Established 1st July, 2010
- Rapid growth
- People
  - 15 core faculty
  - 21 faculty affiliates
  - 7 staff
- Facilities
  - Faculty & staff offices
  - Dedicated classrooms & laboratories
  - Large computing infrastructure
- Substantial research enterprise
- Full suite of academic programs

SSI's unique and competitive academic position: Interdisciplinary courses and degrees at every level

- Large General Education courses
- Minor in Spatial Studies
- Minor in Human Security & Geospatial Intelligence
- **B.S. in GeoDesign**
- GC in GIScience & Technology (online)
- GC in Geospatial Intelligence (online)
- GC in Geospatial Leadership (online)
- **M.S. in GIScience & Technology**
- **M.S. in Spatial Informatics**
- GeoHealth track in MPH degree (online)
- **Ph.D. in Population, Health & Place**

MPH | GeoHealth

- Keck School of Medicine of USC
- Online degree
- Six core courses
- Four concentrations
  - Biostatistics & Epidemiology
  - Health Education & Promotion
  - Global Health Leadership
  - GeoHealth
- **GeoHealth Concentration**
  - **Concepts for Spatial Thinking**
  - **Spatial Analysis**
  - **Spatial Modeling**
  - **Remote Sensing for GIS**
  - **Cartography & Visualization**
- Practicum

Population, Health & Place

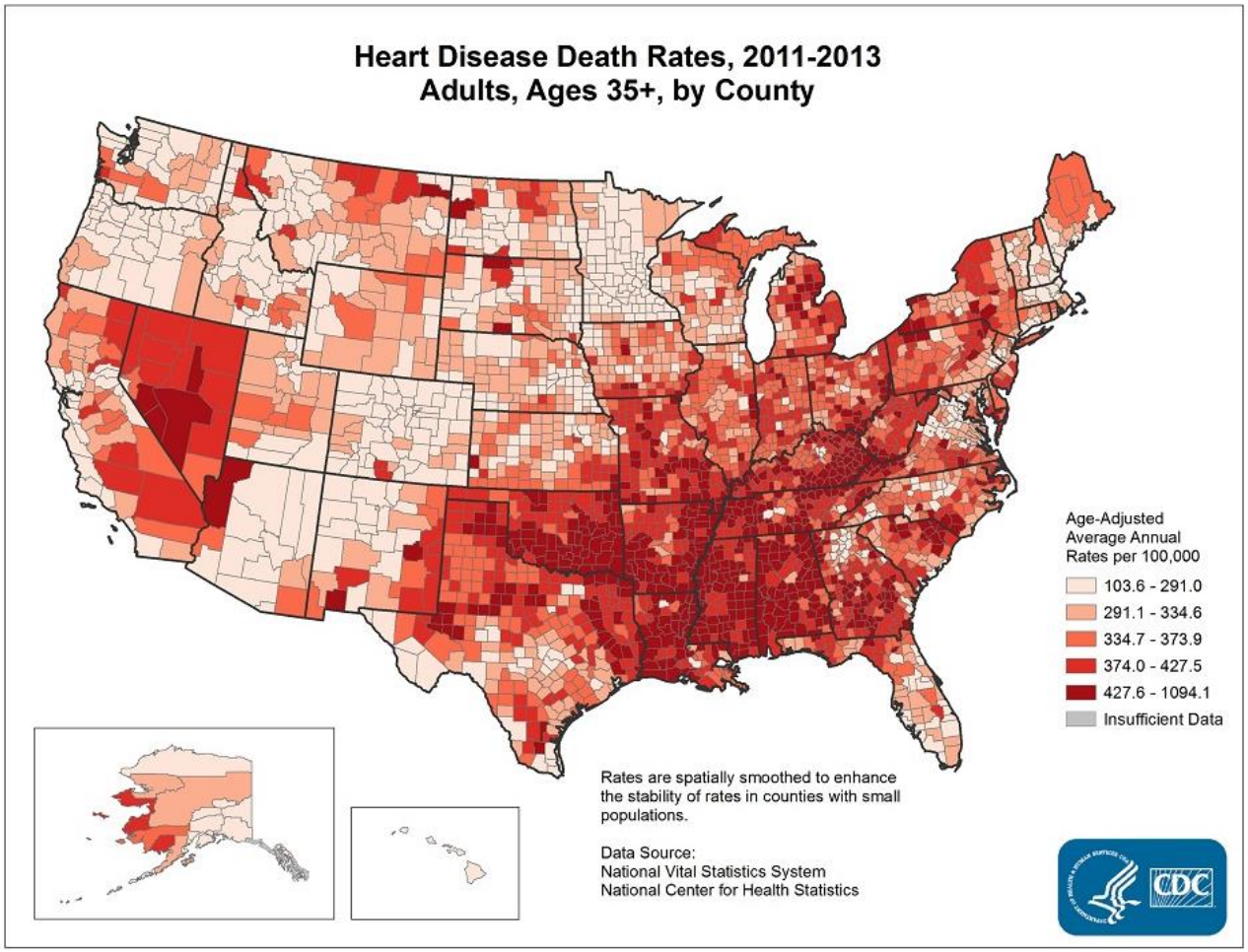
- Geography of Life and Death
- PHP Research Practicum
- **Population**
  - Quantitative Methods and Statistics II
  - Social Demography
  - Demographic Methods
- **Health**
  - Principles of Biostatistics
  - Principles of Epidemiology
  - Environmental Health: An Epidemiological Approach
- **Place**
  - Principles of Spatial Data Analysis
  - Spatial Modeling with GIS
  - Spatial Computing
- Electives
- Dissertation

Health & Place

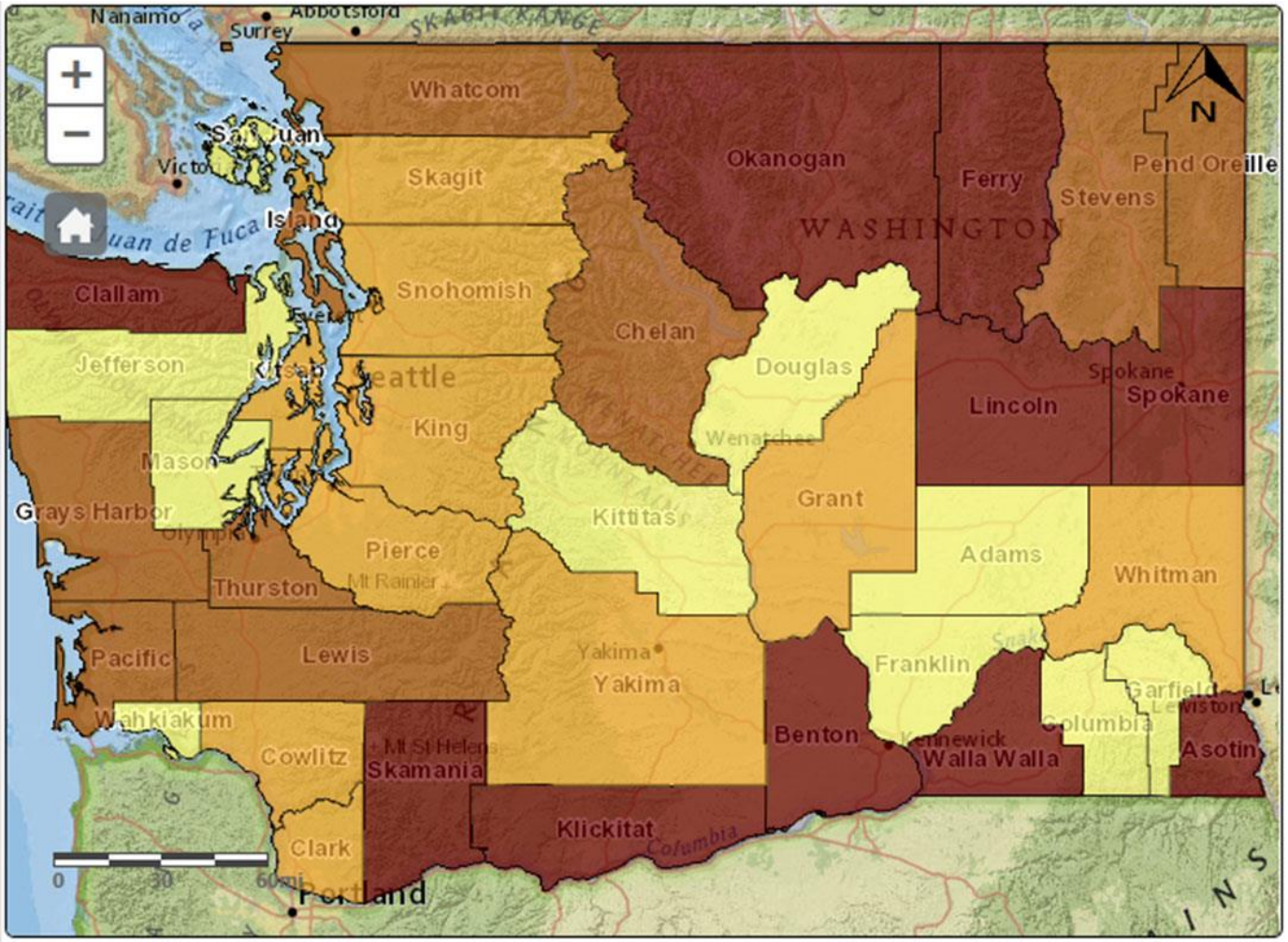
- **Disease surveillance**
  - Exploratory disease mapping to generate hypotheses for subsequent etiological studies
  - Disease modeling to inform policy related to public health initiatives
- **Risk analysis**
  - Impact of environmental exposures on health outcomes
  - Point- or line-source studies
- **Health access & planning**
  - Network analysis & market segmentation studies
- **Community health profiling**
  - Compilation of community infrastructure & other data which influence health (SES, health-related policies & behaviors)

(Source: Nykiforuk & Flaman, 2011)

Disease Surveillance

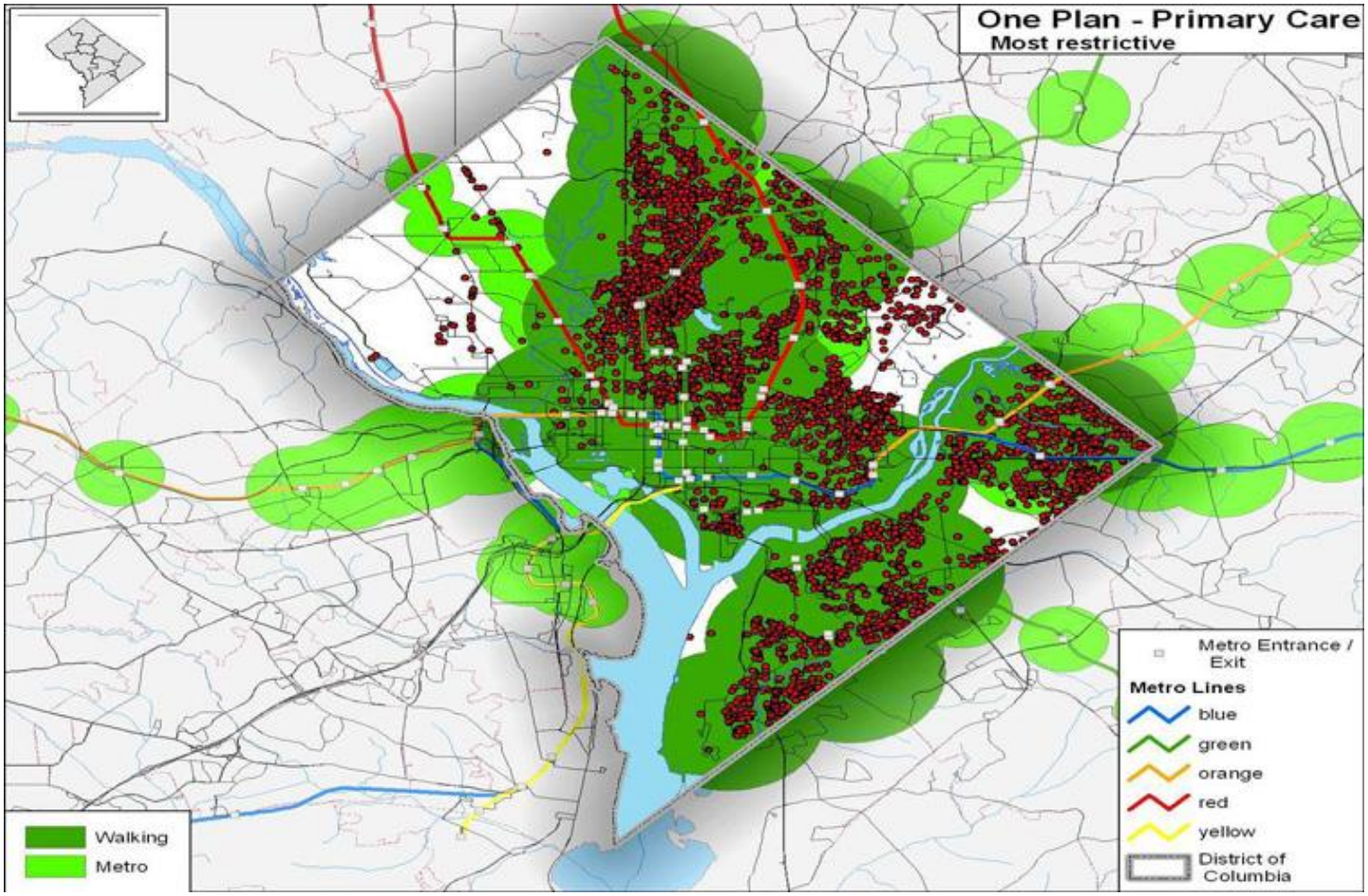


Risk Analysis



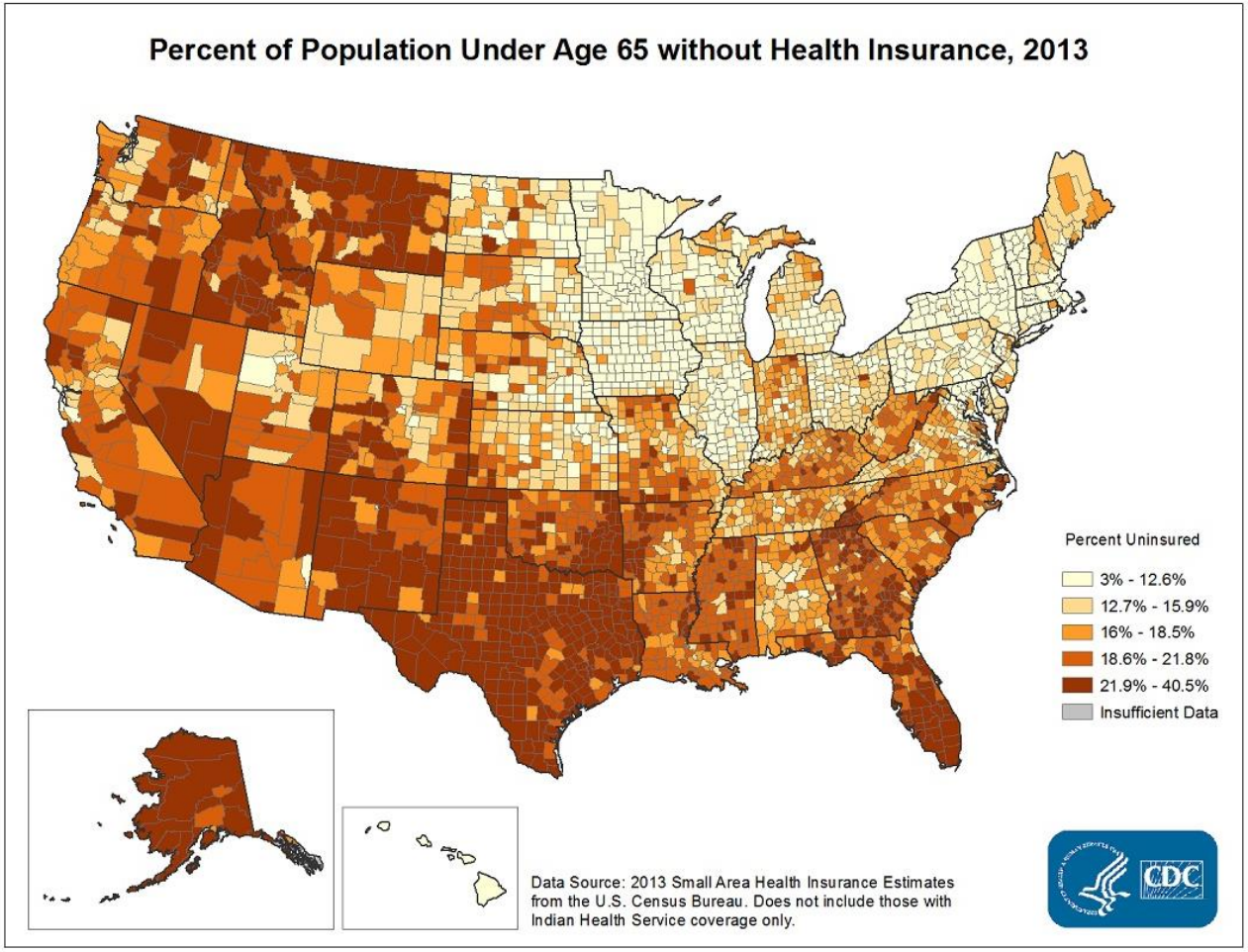
Washington Radon Exposure Risk Map
Source: CDC

Health Access & Planning

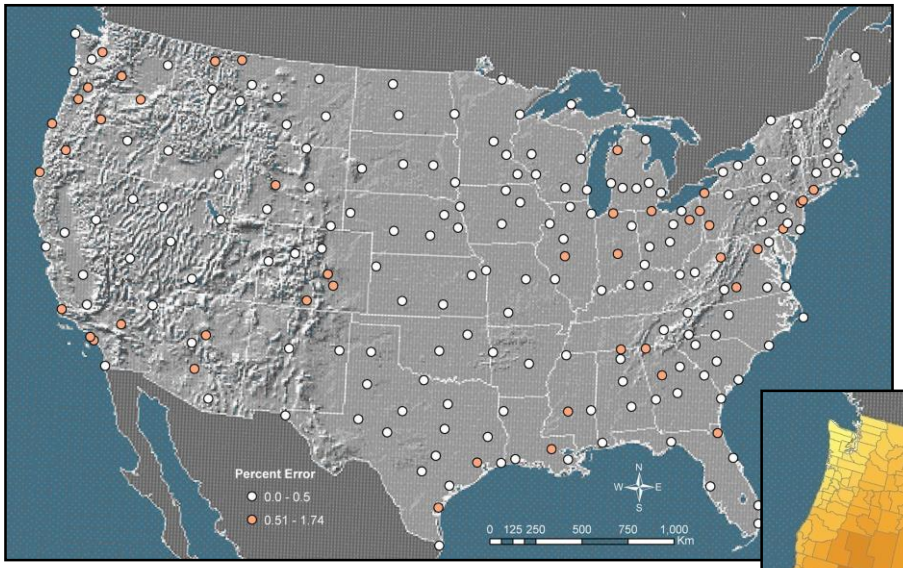


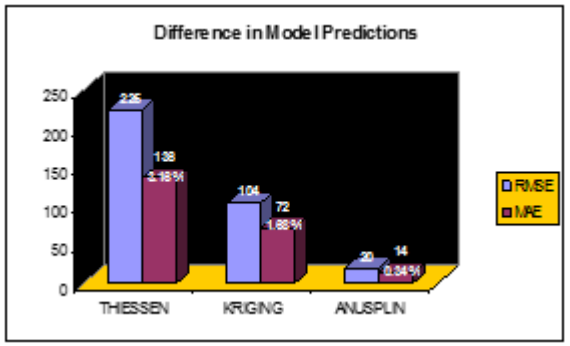
Source: Abt Associates

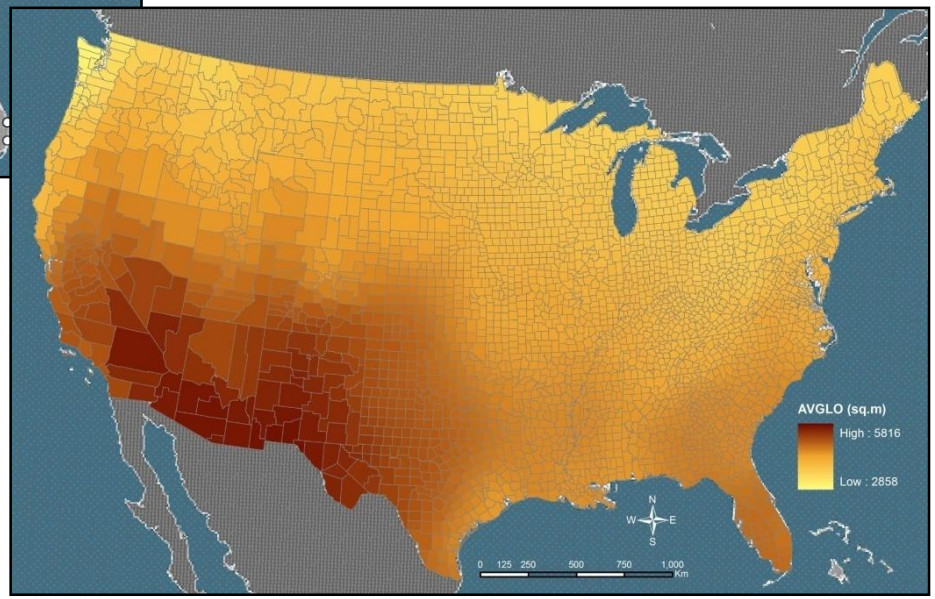
Community Health Profiling



Atmosphere







PM 2.5
Precipitation
Temperature
UV Radiation

Elevation

NED
National
Elevation
Dataset

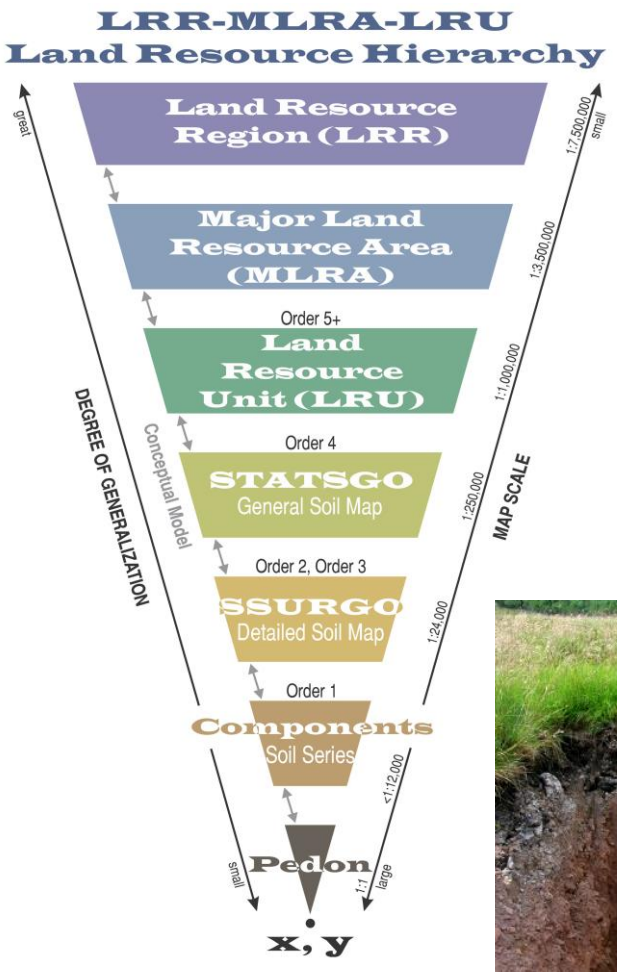
1 arc-second

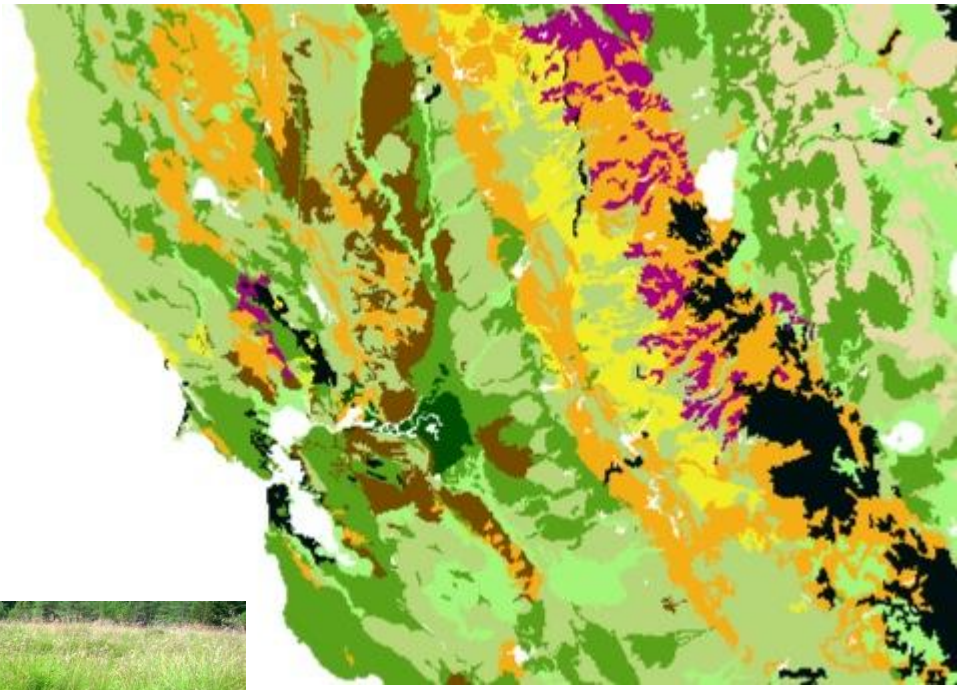
1/3 arc-second

LiDAR SRTM ASTER

Maps courtesy of Dean Gesch

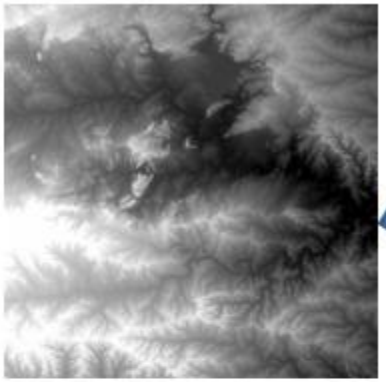
Digital Soil Geographic Databases





NHDPlus Version 2.1

Foundation for a Geospatial Hydrologic Framework for the United States

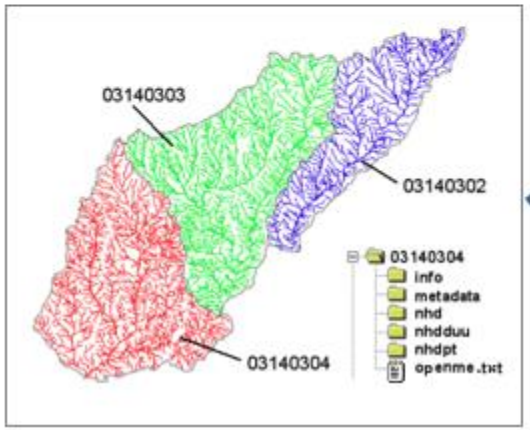


National Elevation Dataset

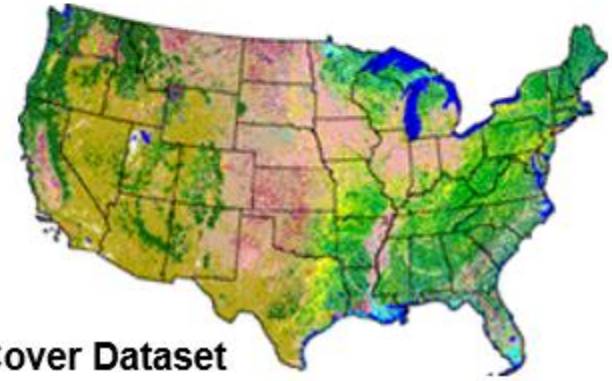
NHDPlus

2.7 million reach catchments in US
average area 3 km^2
reach length 2 km
Uniquely labelled

Watershed Boundary Dataset



National Hydrography Dataset

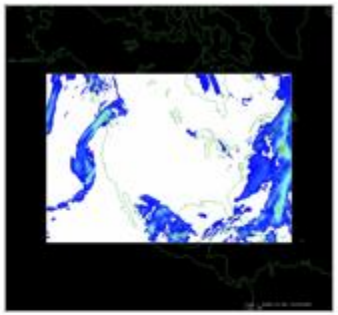


National Land Cover Dataset

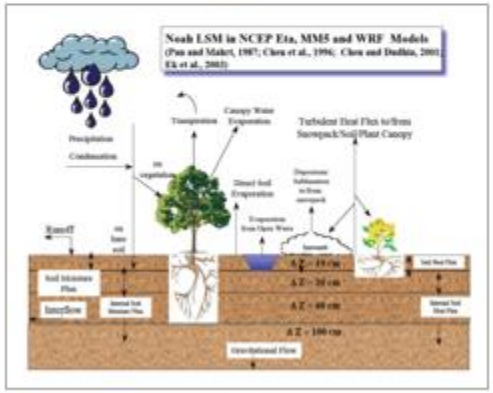
Slide courtesy of David Maidment

WRF-Hydro Forecasting Model

Weather model and forecasts (HRRR)



Weather → Precipitation

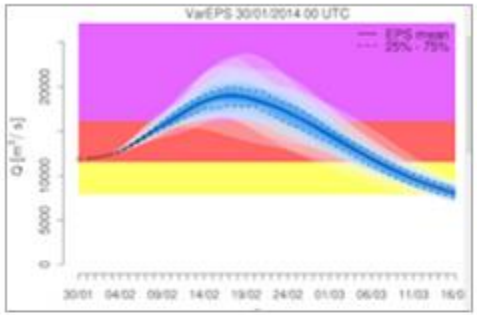


Land-Atmosphere Model (NOAH-MP)

Catchment-level forecasts

Runoff →

Probabilistic flood forecasts

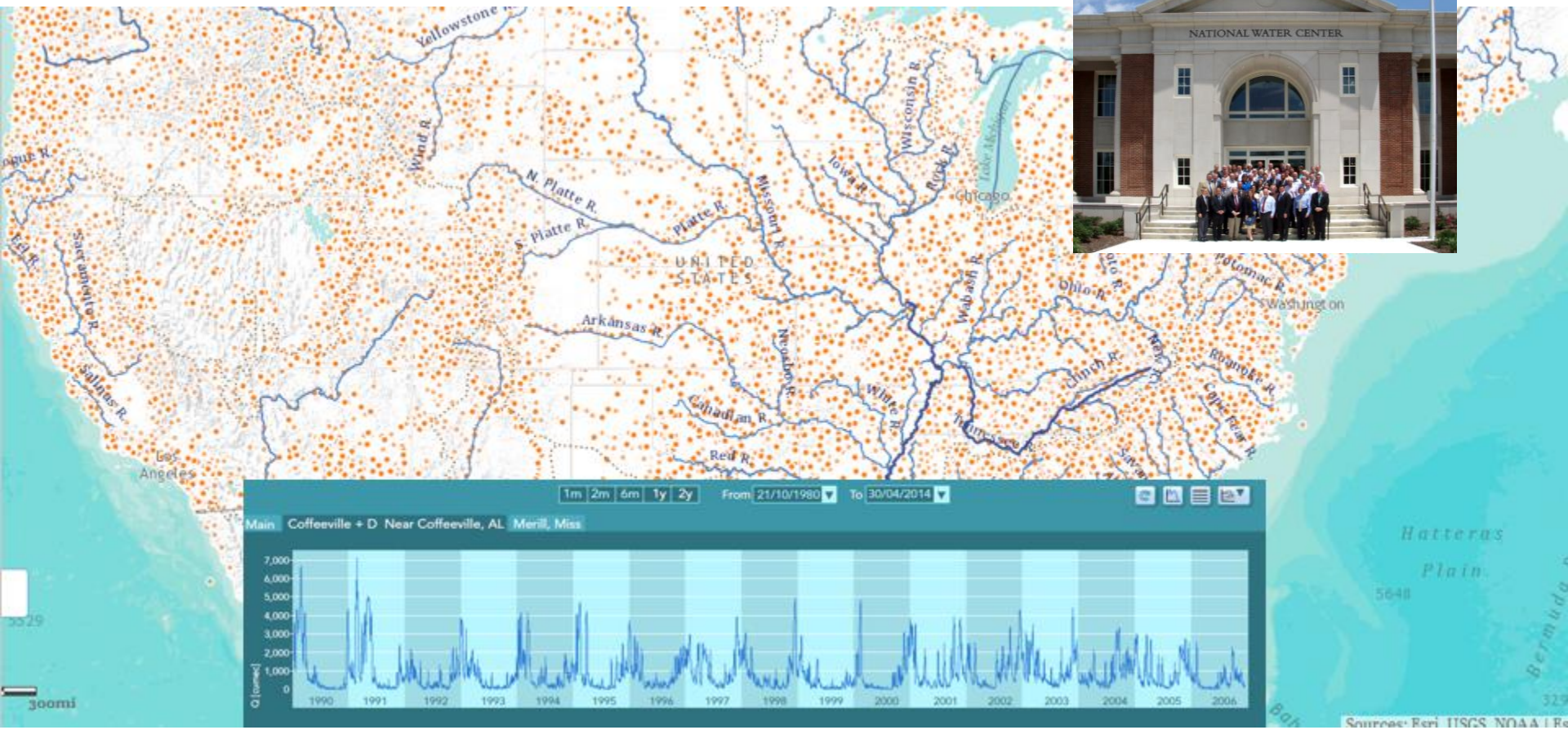


Streamflow ↑

RAPID flow routing (for continental US)

Slide courtesy of David Maidment

National Water Data Infrastructure



Slide courtesy of David Maidment

People | Residences

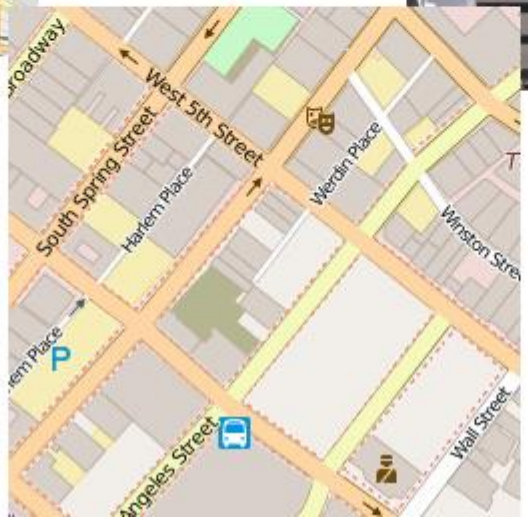
LA County Building Outlines

Utah GIS Framework Data

People | Transportation

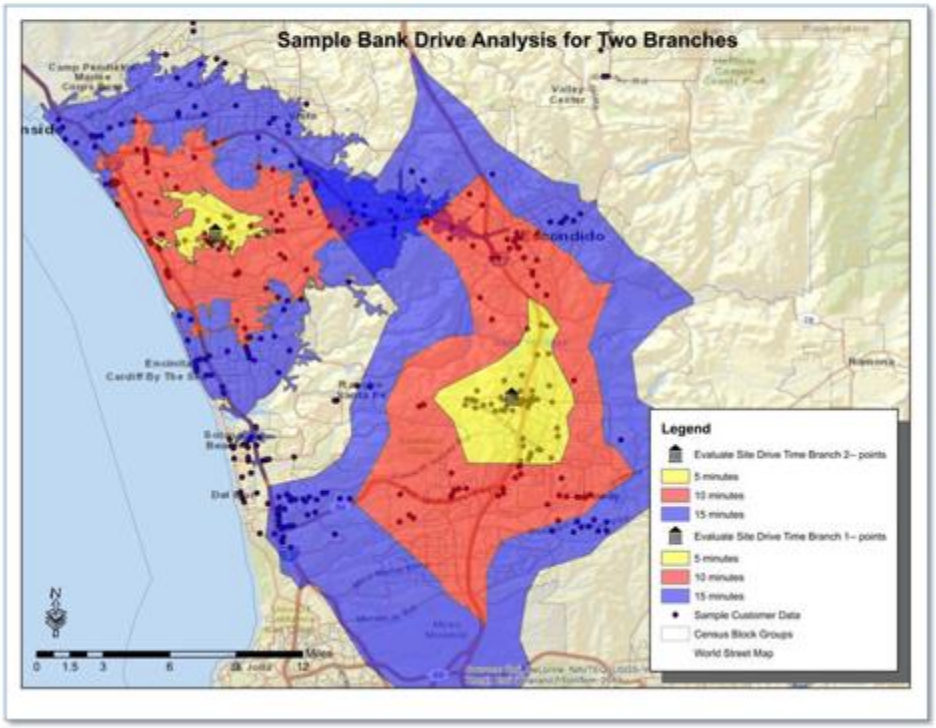
OpenStreetMap
Los Angeles

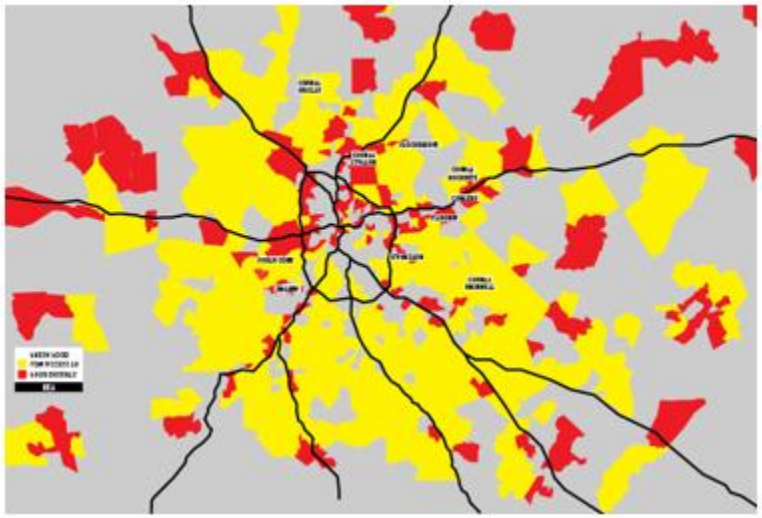
LOS ANGELES COUNTY BICYCLE COALITION
WWW.LA-BIKE.ORG



People | Employment | Commerce

esri Understanding our world.
Business Analyst



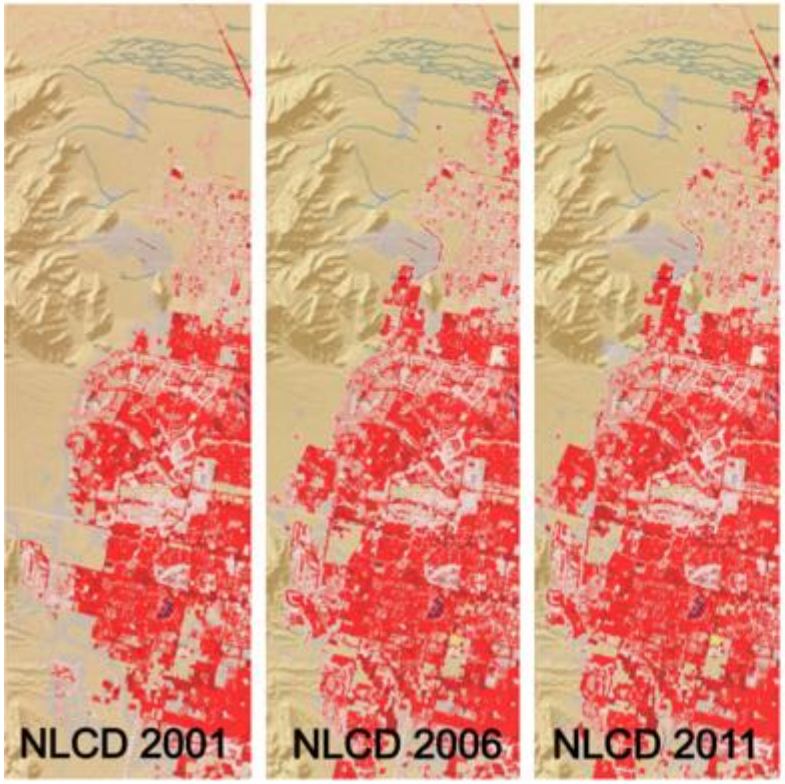


Food Deserts – Atlanta, GA

LandScan USA – Houston, TX

Land Cover

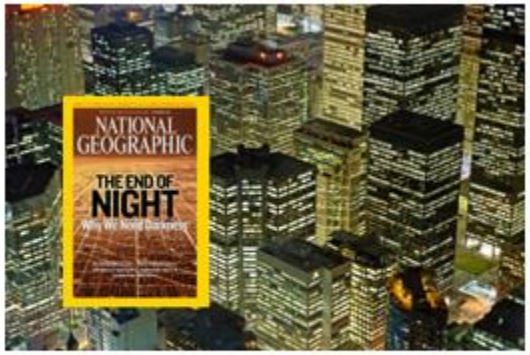

USGS
esri
AAG
New Global Ecological Land Units Map


NLCD 2001
NLCD 2006
NLCD 2011


Yearly Eco Impact
Selected trees in the region
Total Benefits
$6,228,787 saved
Greenhouse Gas Benefits
24,441,384 lbs CO2 reduced
$488,827 saved
Water Benefits
107,453,195 gallons conserved
$196,639 saved
Energy Benefits
10,951,542 kWh conserved
$1,783,020 saved
Air Quality Benefits
60,809 lbs pollutants reduced
$3,760,299 saved


View Satellite

Nightlight | Noise



Volunteered Geographic Information

Public Lab is a community where you can learn how to investigate environmental concerns. Using inexpensive DIY techniques, we seek to change how people see the world in environmental, social, and political terms.

AirBeam

Westwood Park

St. Augustine Catholic Elementary School

Geospatial Tools – Proprietary systems

- Clark Labs
  - TerrSet Constellation
- Esri
  - ArcGIS Platform
  - **ArcGIS Online**
  - **Business Analyst**
  - GIS Apps
- Trimble
  - e-Cognition
  - TerraSync | Pathfinder

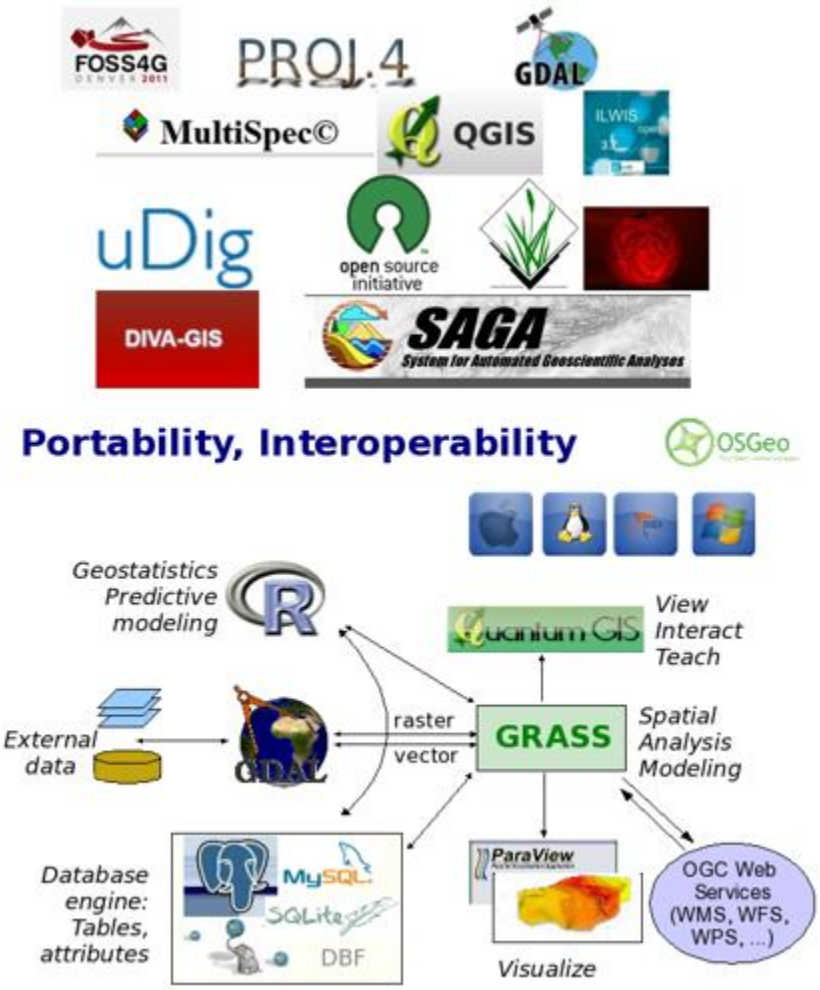
Open source solutions

- **Fulcrum**
- GRASS
- **QGIS**
- SAGA
- GeoDa
- R
- MapServer
- Open Layers
- **CartoDB**

MapBox

CARTODB
Geospatial database on the cloud

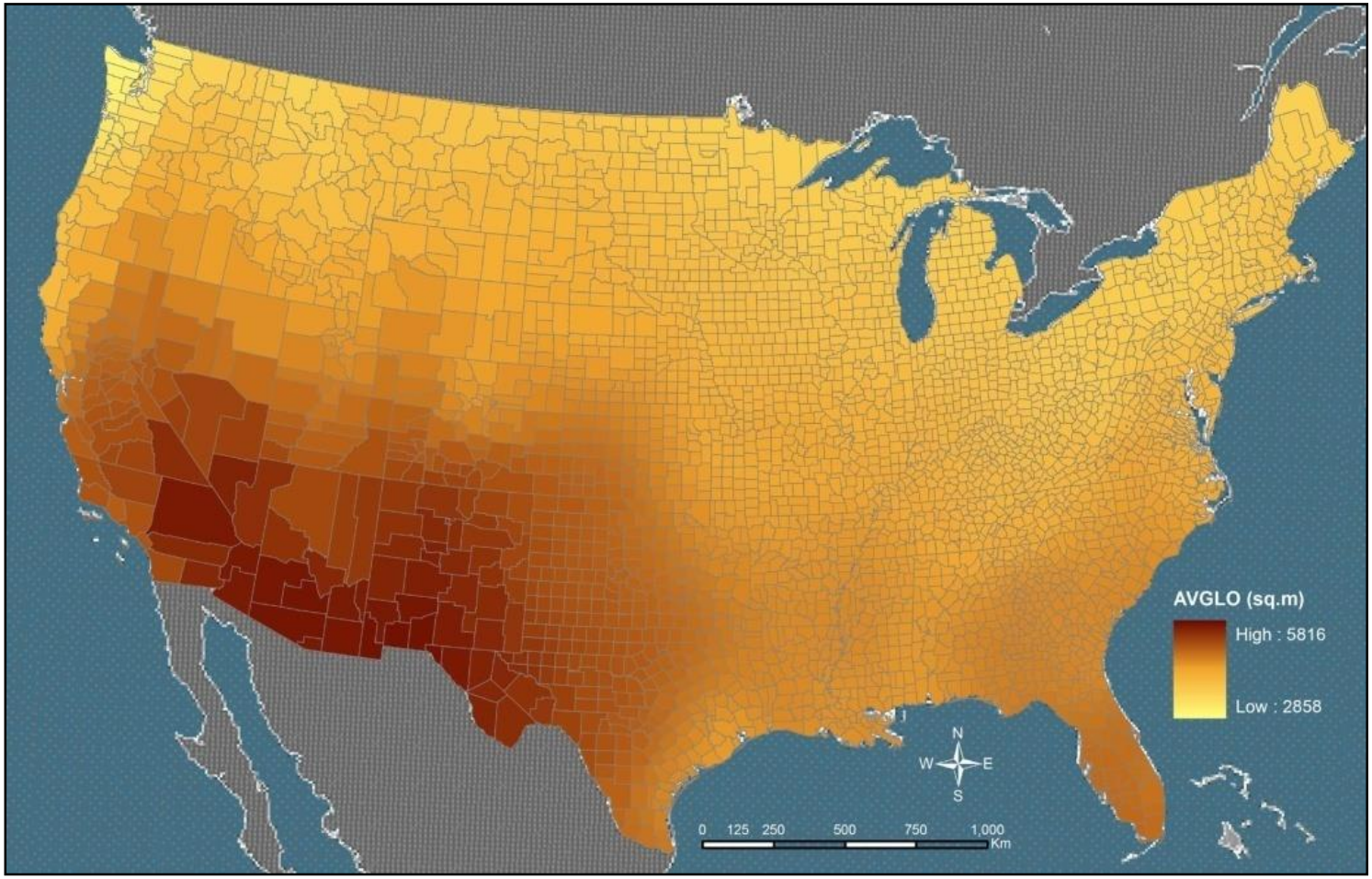
GeoDa™



Enduring Challenges

- **Disentangling cause & effect in cancer control**
  - Defining personal environments for cancer risk
  - Physical environment & cancer risk
  - Built environment, segregation & cancer risk
  - Social environment & cancer risk
- **Maximizing healthcare access, delivery & cancer screening**
  - Accessibility to health care services
  - Geography of screening & vaccine uptake
  - Geography of health care delivery
  - Identifying priority areas for cancer control activities
- **Impact & consequences of spatial scale on data relationships**
  - Modifiable Area Unit Problem (MAUP)
  - Strominger, Anthopolos, & Miranda (2016)
- **Using geospatial tools & data wisely**
  - Escobedo – Using the ACS to support melanoma control & prevention

Disentangling cause & effect …



Cumulative UV Exposure

Cumulative exposure (Wh/m^2)	Case-control	OR
< 150,000	118/143	1
150,000-200,000	160/174	1.62
200,000-250,000	168/201	2.64
> 250,000	215/191	6.01
p-Value		< 0.0001

Tatalovich, Wilson, Mack, Ying, & Cockburn. (2006) The objective assessment of lifetime cumulative ultraviolet exposure for determining melanoma risk. *Journal of Photochemistry & Photobiology B, Biology* 85: 198-204.

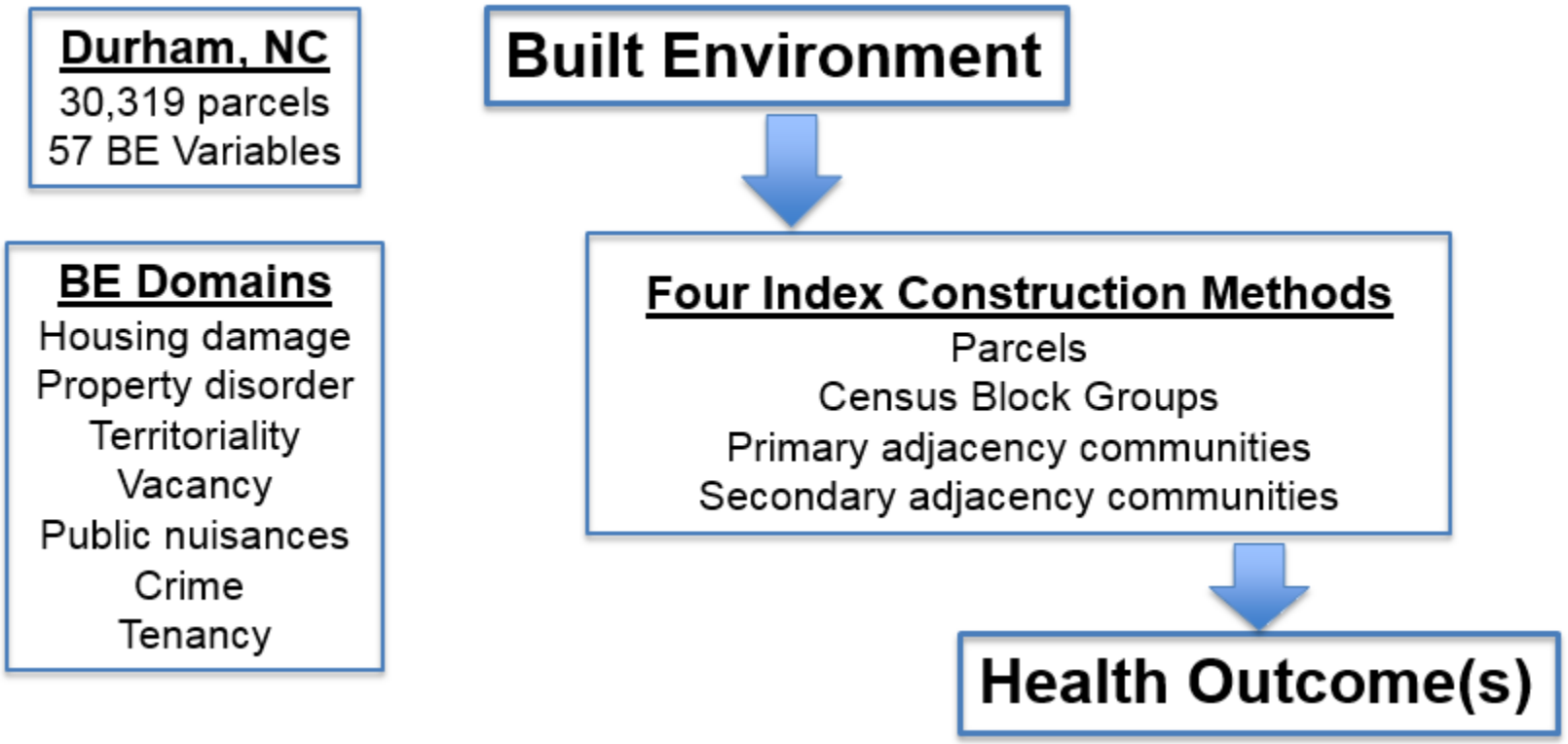
Average Annual UV Exposure

45+ years	Case-control	OR	*p*-Value
Average annual exposure 15-24 years			
< 4,043	92/122	1	
4,043-4,840	107/124	1.23	
> 250,000	215/191	1.74	0.0209 (0.0060)
Average annual exposure 25-44 years			
< 4,736	67/122	1	
4,736-5,080	121/116	1.91	
> 5,080	153/131	2.29	0.0002 (0.0001)
Average annual exposure 44+ years			
< 5,080	31/43	1	
> 5,080	310/326	1.20	0.48

UV Adjusted Time Spent Outdoors

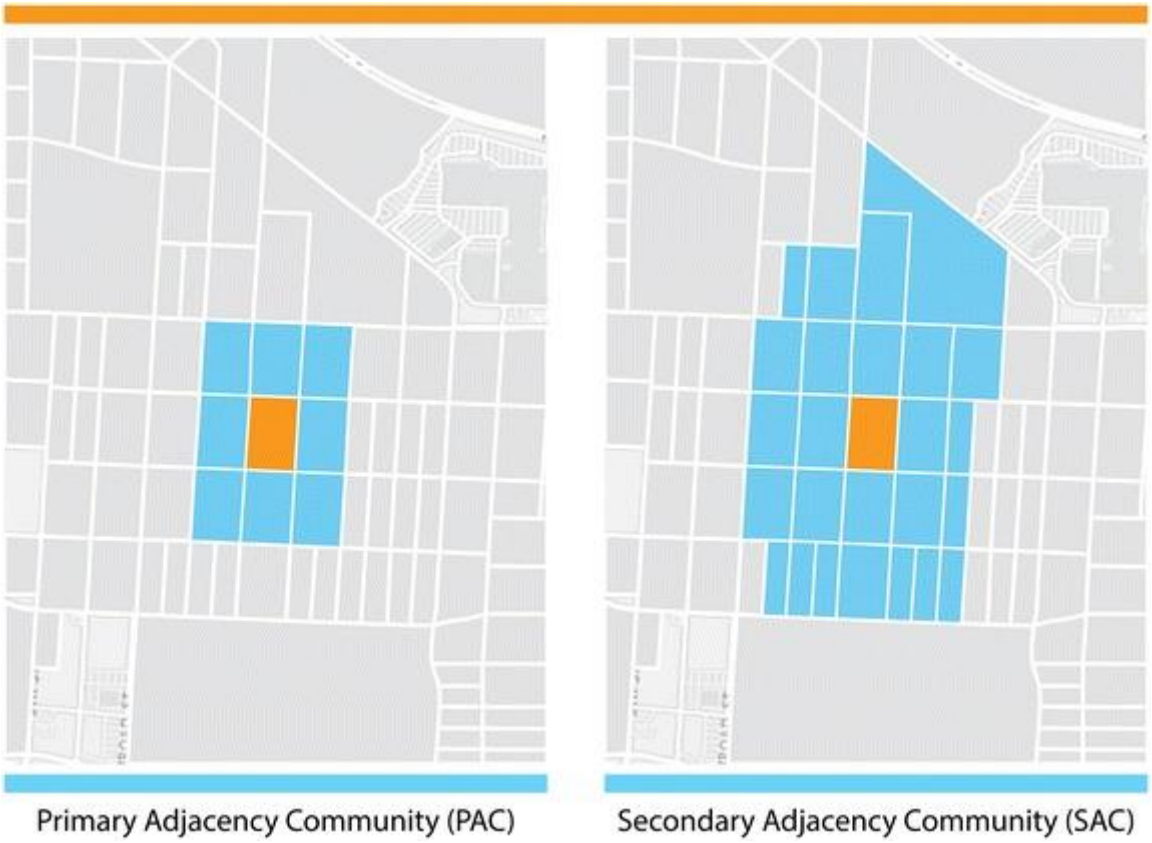
45+ years	Case-control	OR	*p*-Value
UV adjusted outdoor 15-24 years			
< 558,800	90/121	1	
558,800-1,042,671	123/124	1.33	
> 1,042,671	122/122	1.55	0.0955 (0.0333)
UV adjusted outdoors 25-44 years			
< 294,330	110/120	1	
294,330-645,333	125/125	1.91	
> 645,333	105/121	0.99	0.74 (0.61)
UV adjusted outdoor 44+ years			
< 299,720	123/121	1	
299,720-609,600	99/120	0.86	
> 609,600	116/127	0.91	0.74

Impact & consequences of spatial scale …

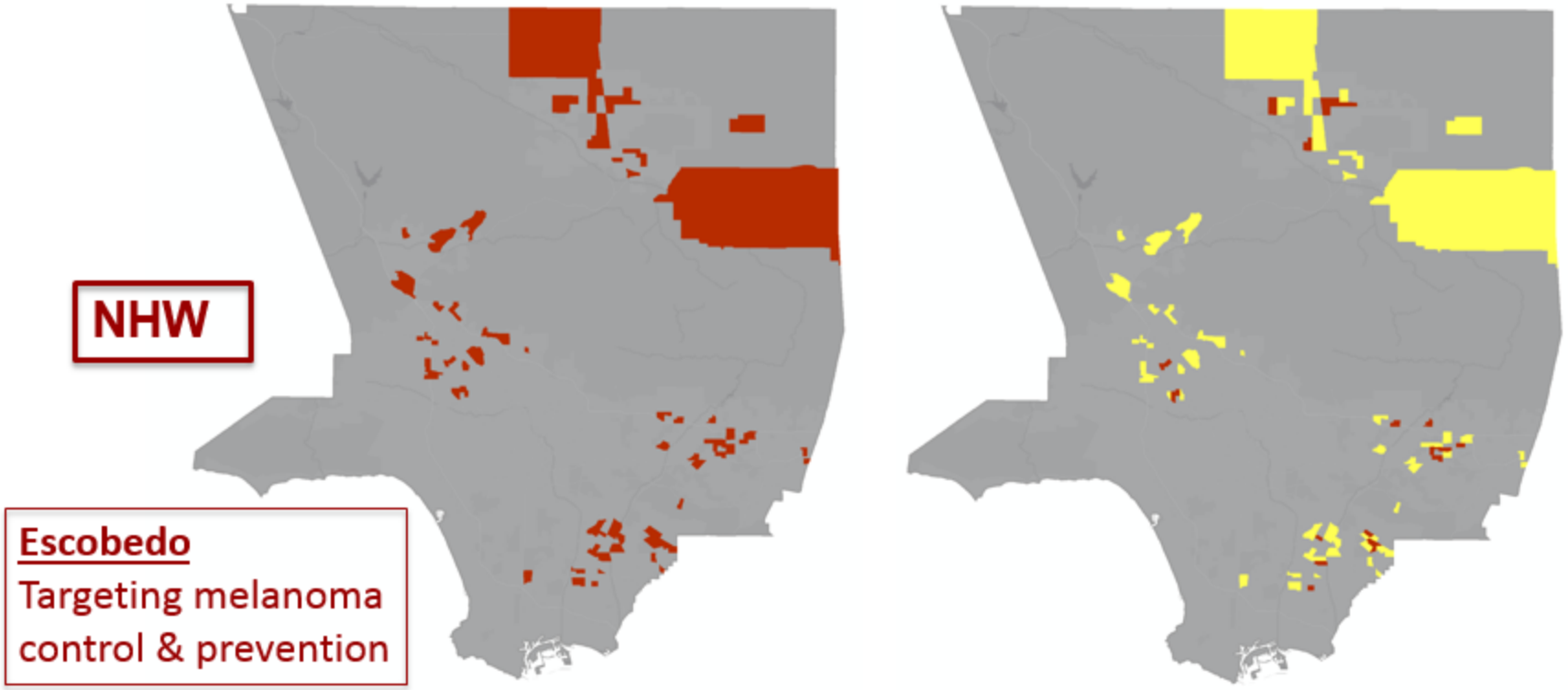


Strominger, Anthopolos, & Miranda. (2016) Implications of construction method and spatial scale on measures of the built environment. *International Journal of Health Geographics, 15, 15.*

Primary & secondary adjacency communities …



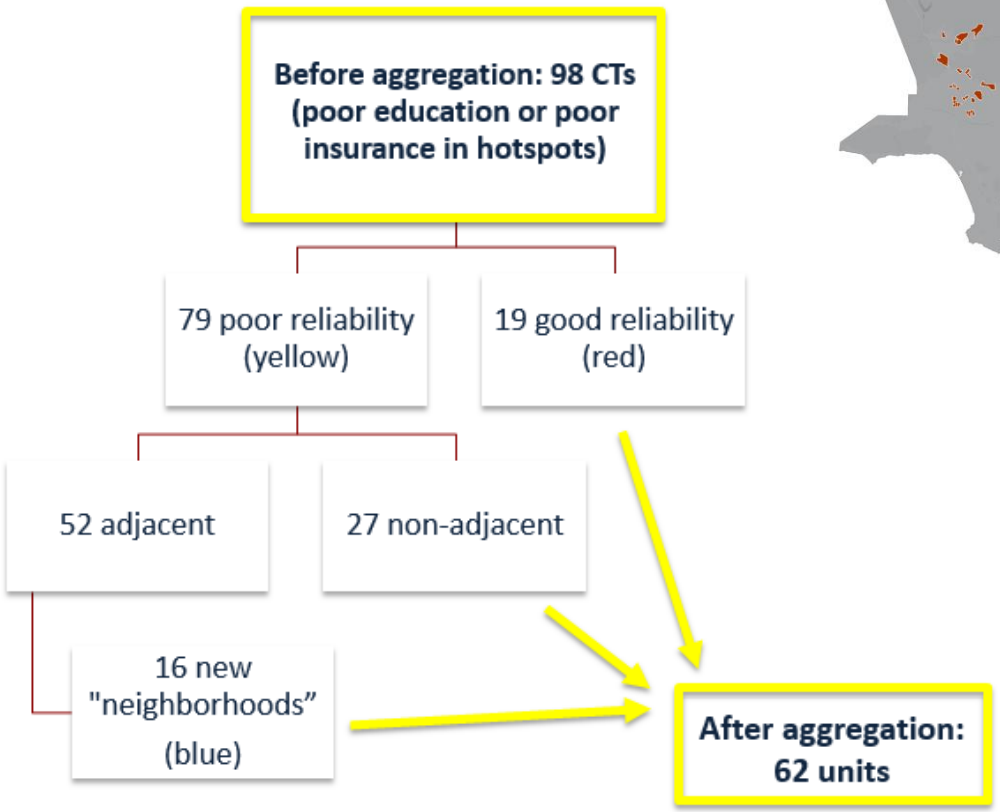
Working with American Community Survey (ACS)

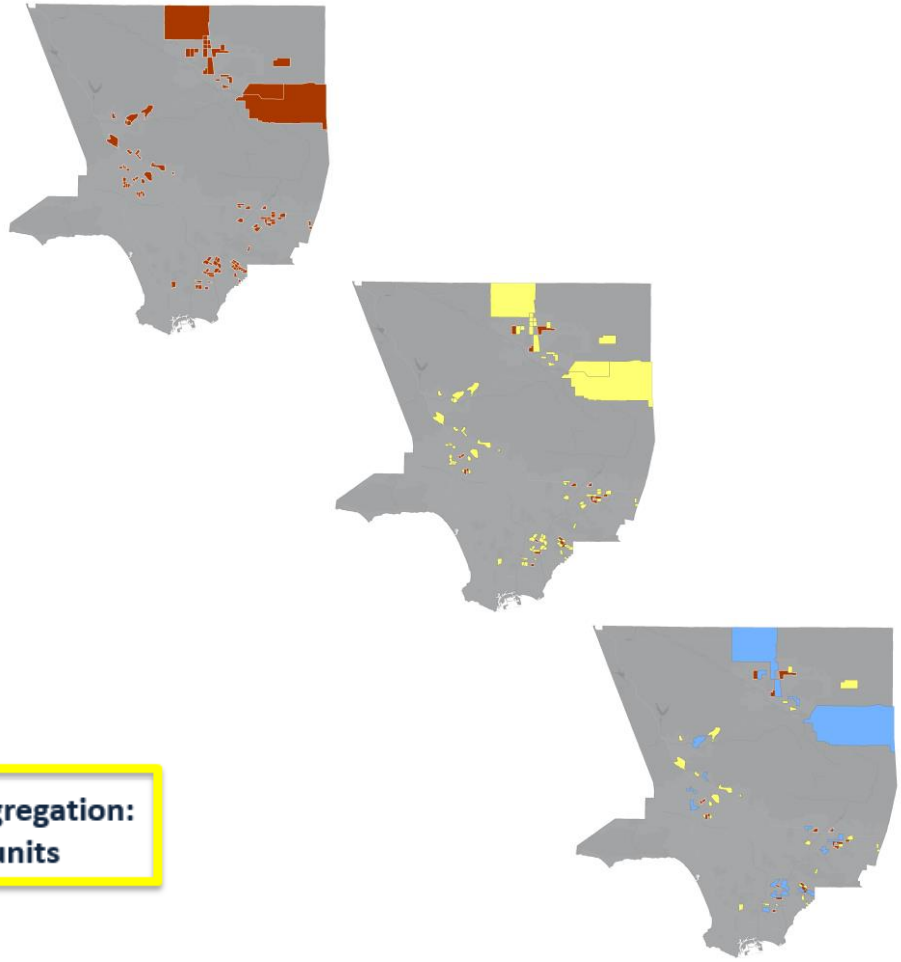


Among hotspot CTs,
CTs with poor education or poor insurance coverage

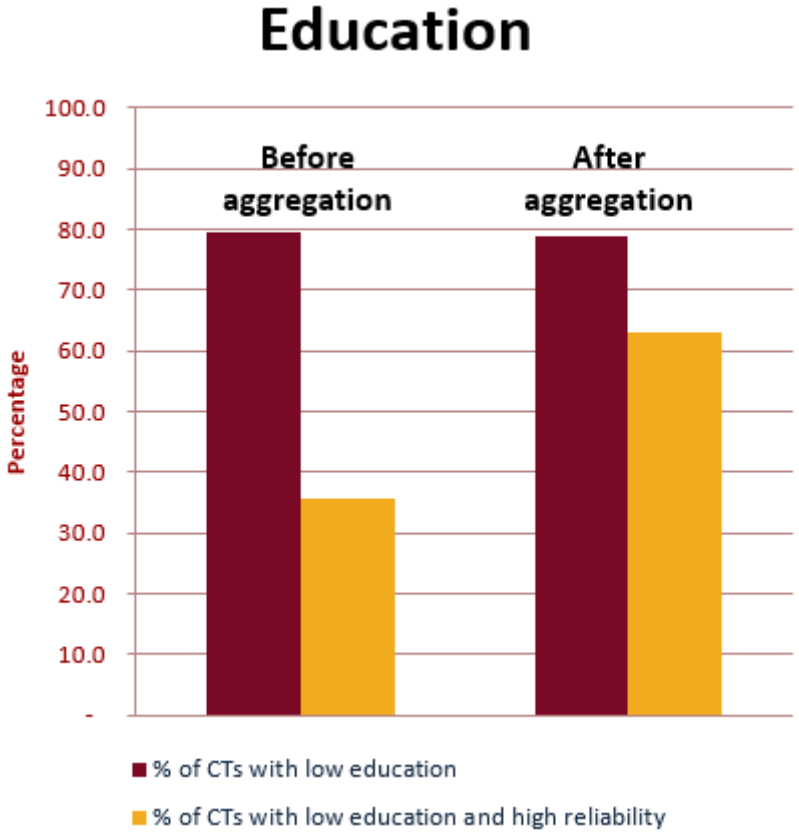
Among the CTs on the left,
yellow indicates poor reliability (CV>15)

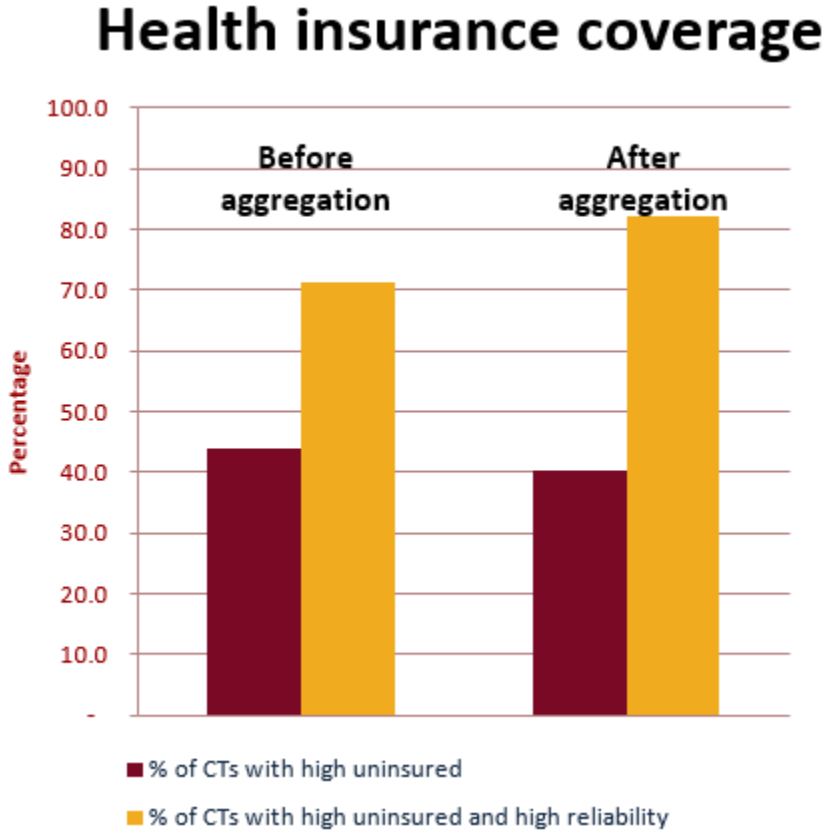
Before and After Aggregation (NHW)





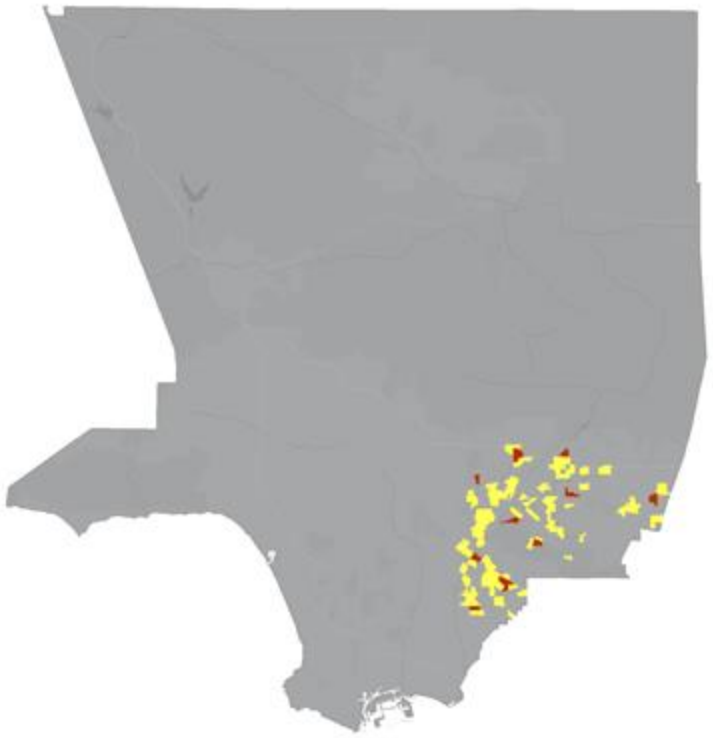
Results (NHW)


Education
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
-
Percentage
Before aggregation
After aggregation
% of CTs with low education
% of CTs with low education and high reliability


Health insurance coverage
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
-
Percentage
Before aggregation
After aggregation
% of CTs with high uninsured
% of CTs with high uninsured and high reliability

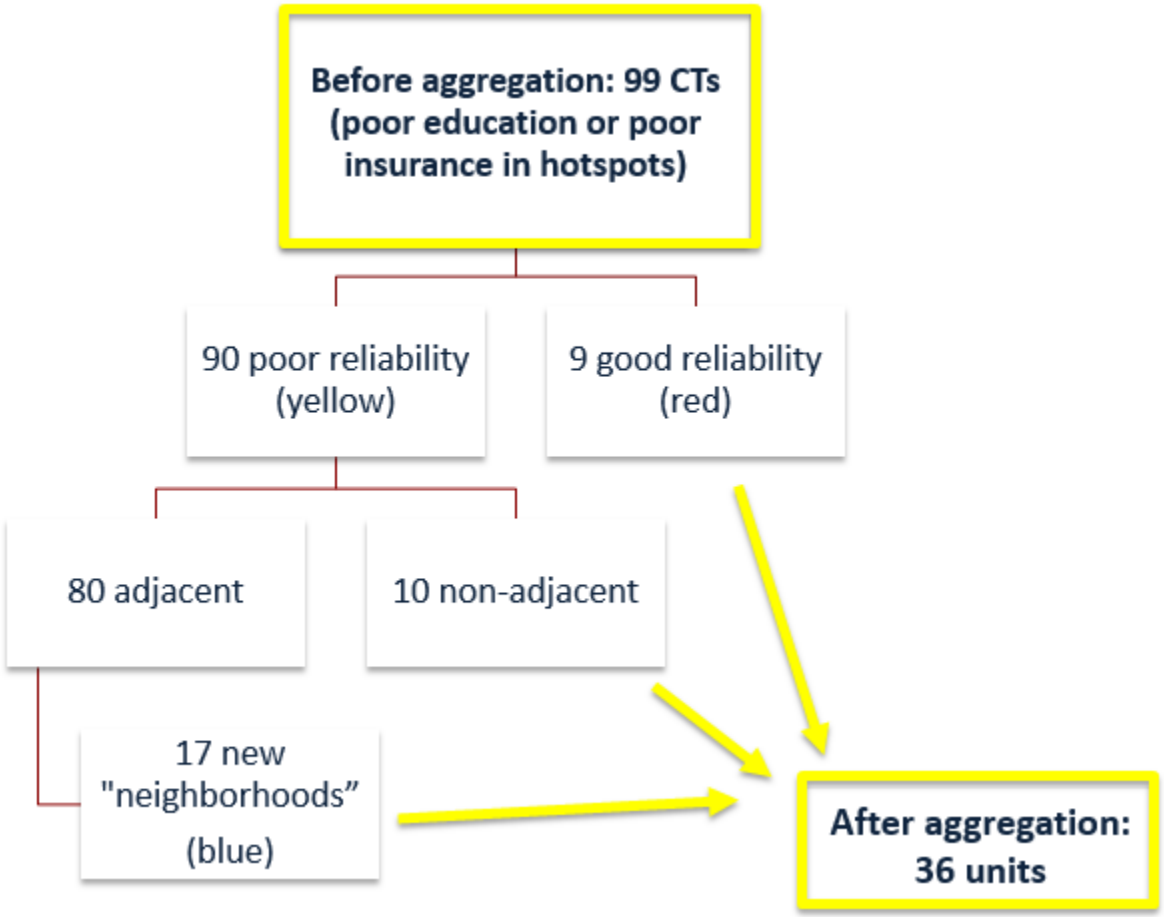
ACS Indicators (HW)

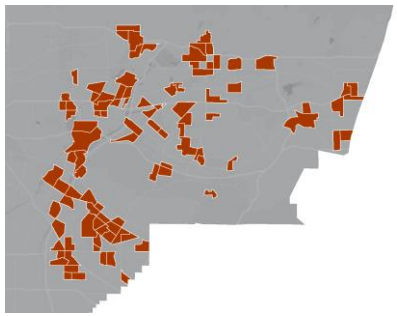
Among hotspot CTs,
CTs with poor education or
poor insurance coverage

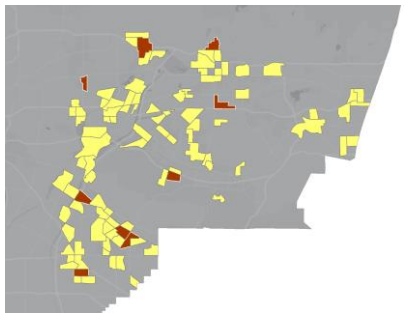


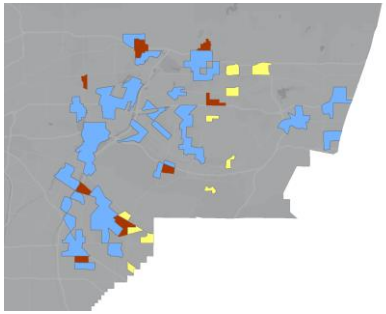
Among the CTs on the left,
yellow indicates poor
reliability (CV>15)

Before and After Aggregation (HW)

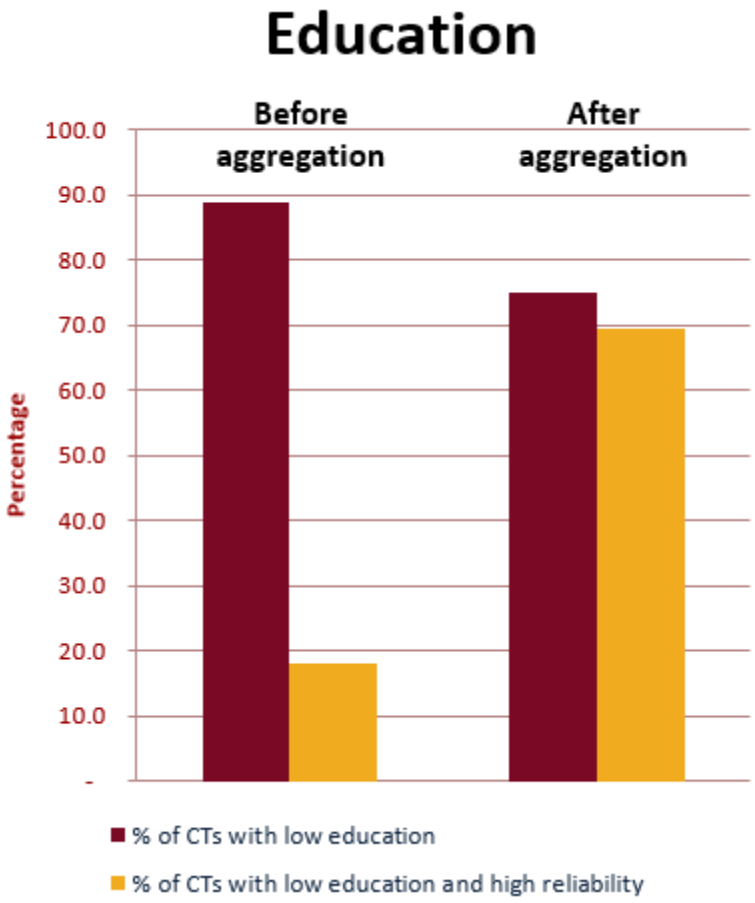


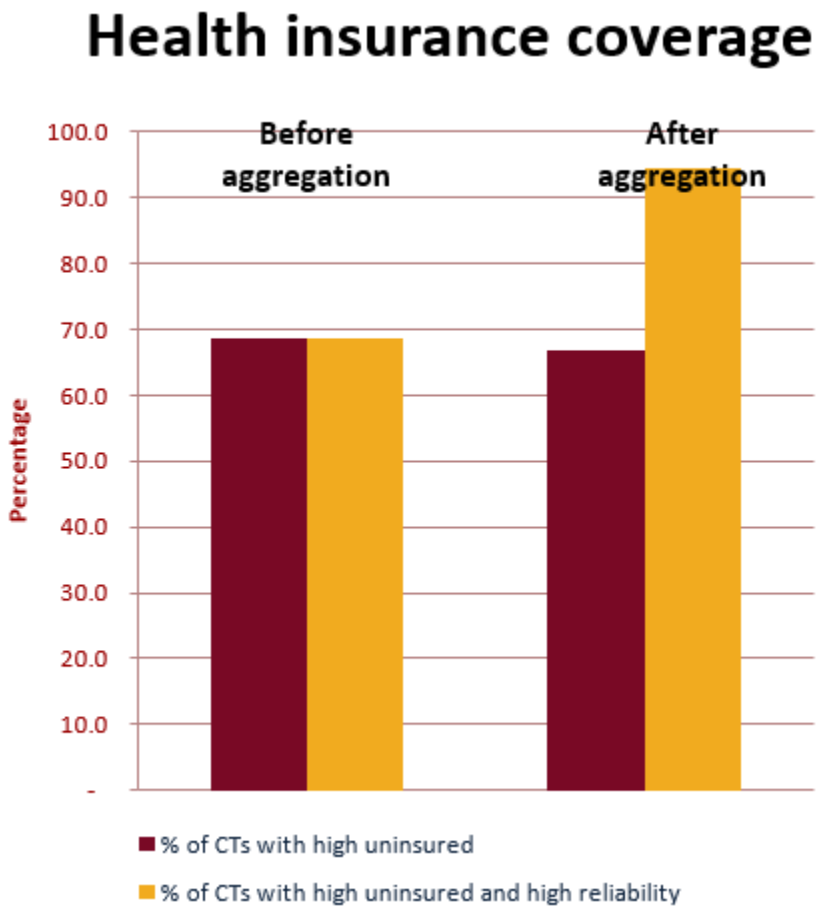






Results (HW)


Education
Before aggregation
After aggregation
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
-
Percentage
% of CTs with low education
% of CTs with low education and high reliability

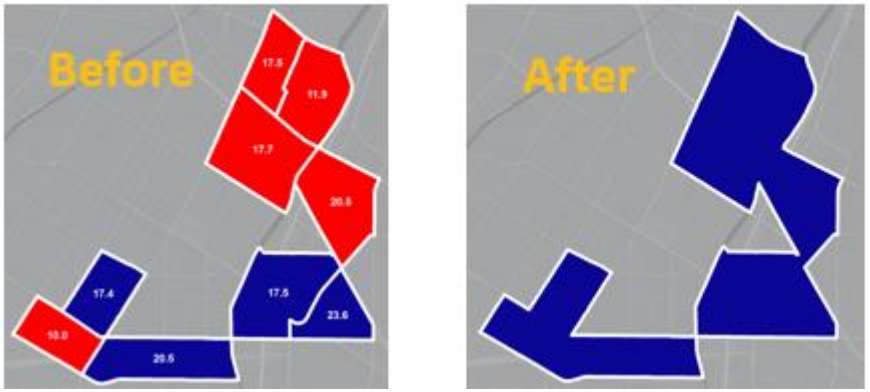

Health insurance coverage
Before aggregation
After aggregation
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
-
Percentage
% of CTs with high uninsured
% of CTs with high uninsured and high reliability

Strengths & Weaknesses

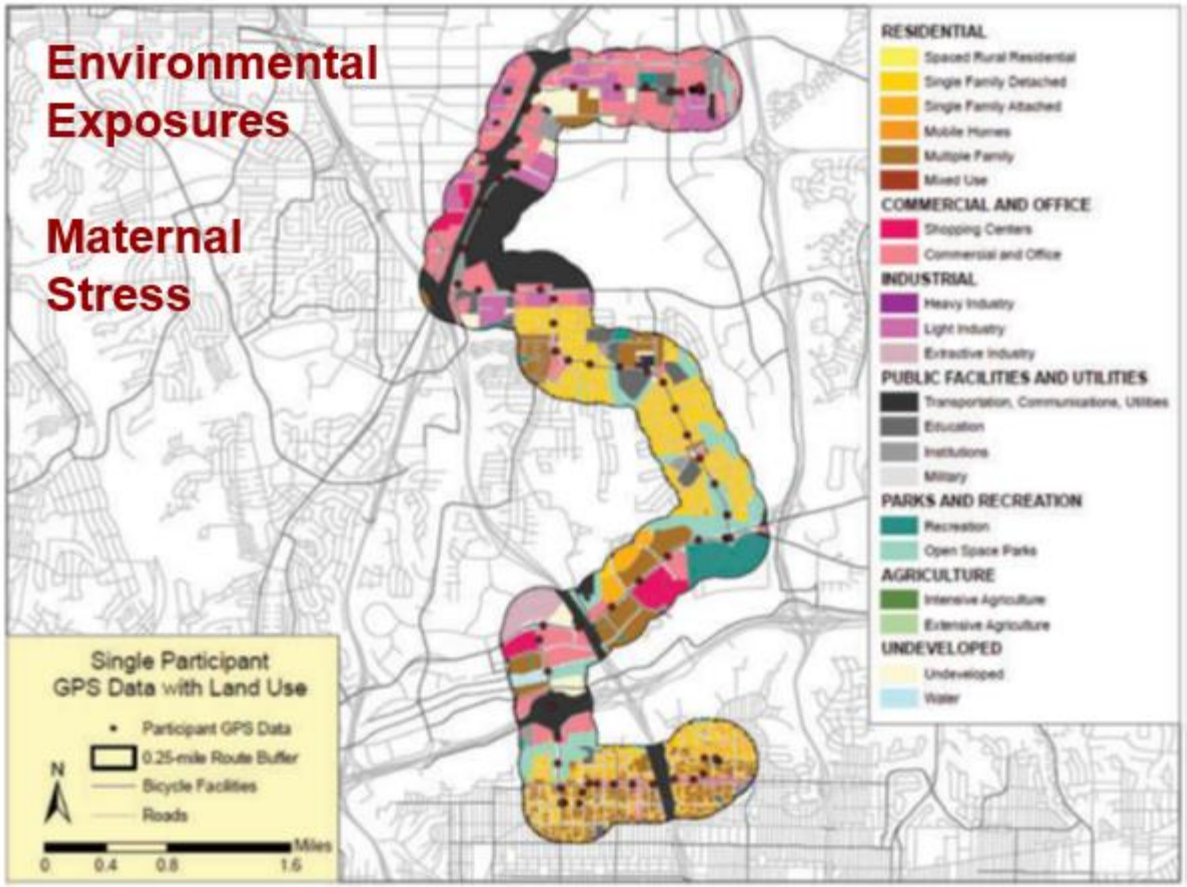
- Geographic pattern maintained & reliability improved
- Geographic pattern not maintained but reliability improved
- Geographic pattern maintained but reliability not improved

Education (HW)

Health insurance coverage (NHW)

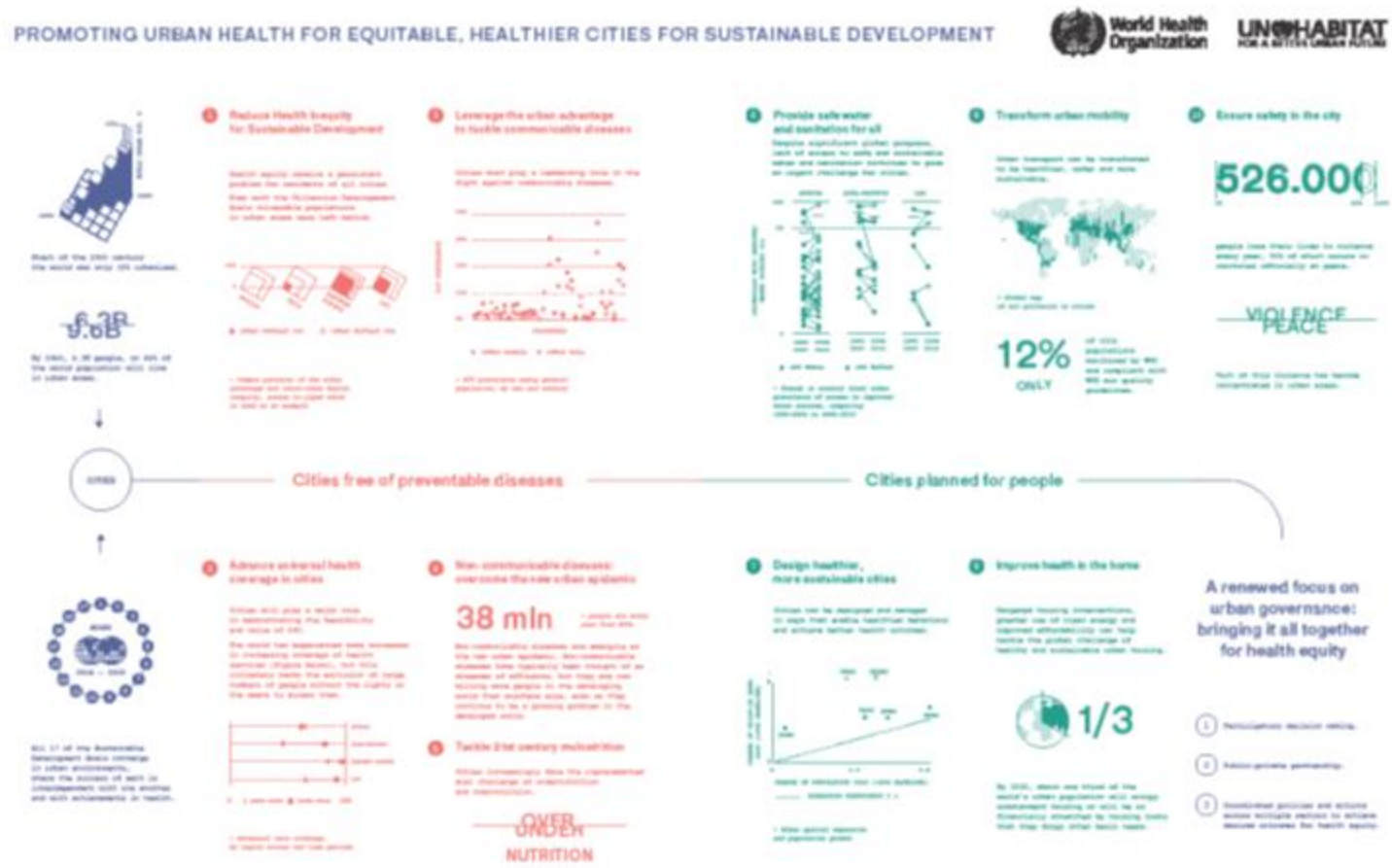


Spatiotemporal Trajectories | Activity Spaces



Haislip (2011)

WHO | Global Report on Urban Health



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