Valuing Urban Forest Ecosystems: i-Tree Landscape

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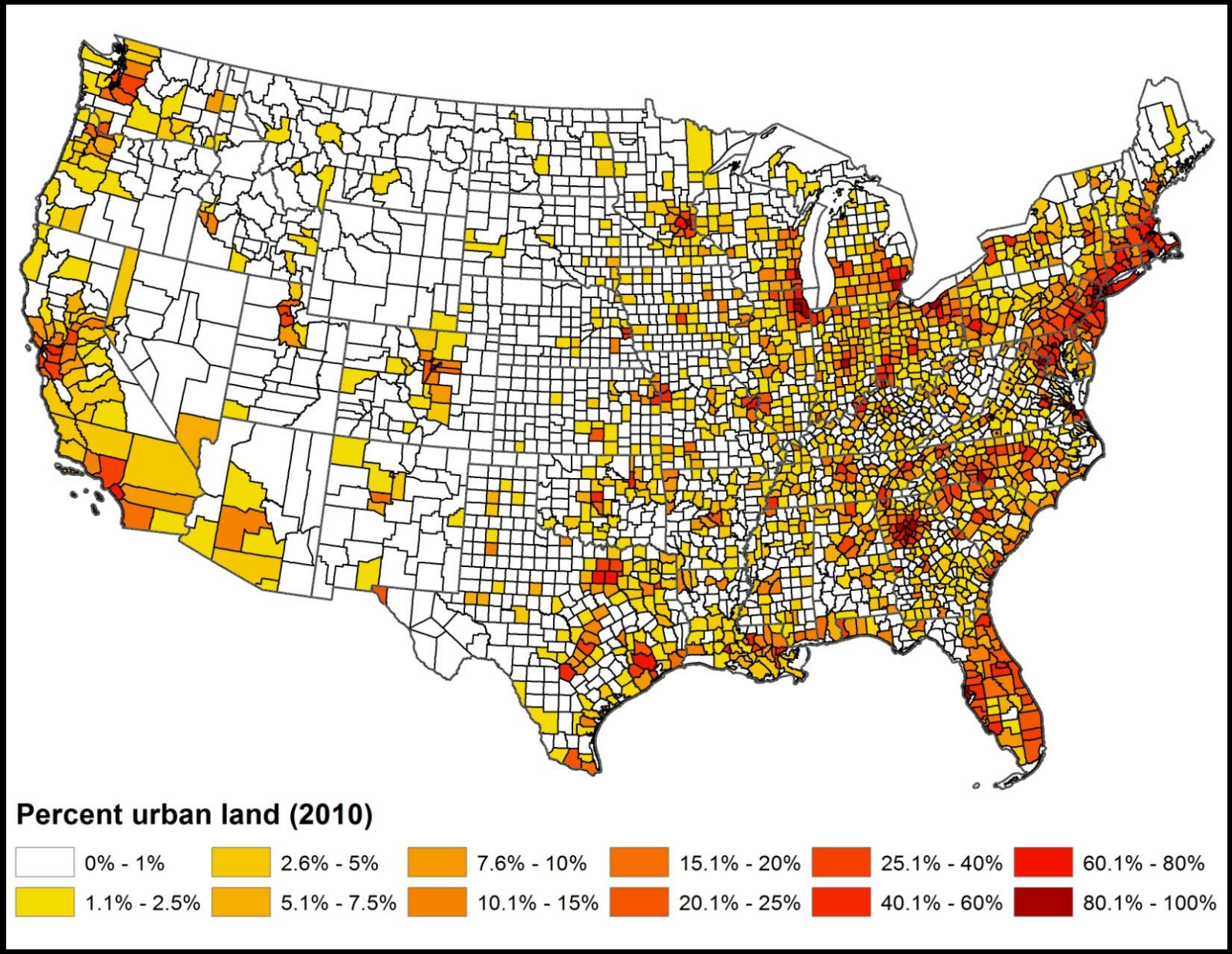
Objectives

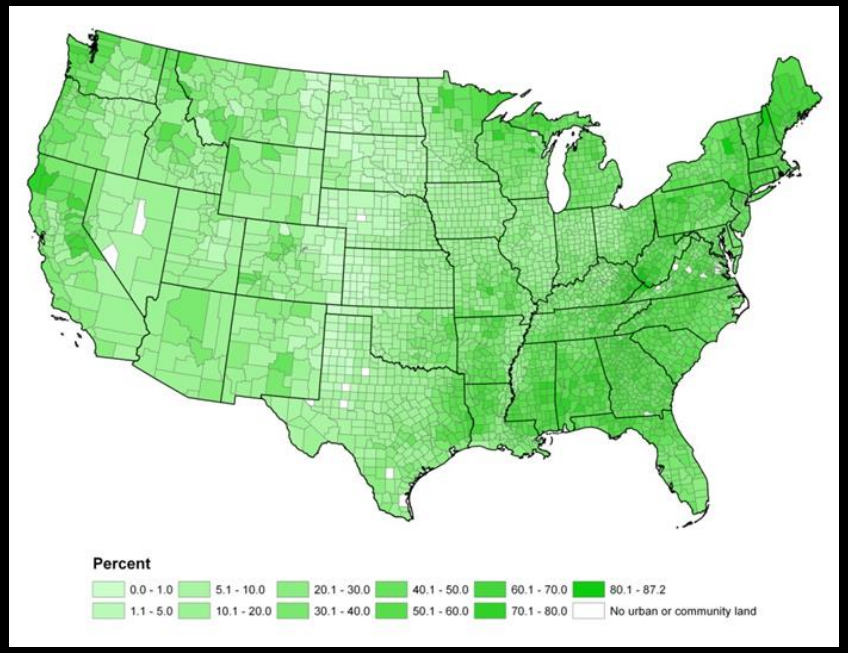
- U.S. Urban Forest Ecosystem Services
- i-Tree Landscape

Urban (2010) = 67.8 million acres (3.6%)



U.S. Urban Tree Cover

	Percent Tree Cover		
State	State	Urban	Rural
Connecticut	72.6	66.5	75.9
Massachusetts	70.8	64.5	74.4
New Hampshire	88.9	64.0	91.5
Maine	83.1	54.0	84.4
Rhode Island	70.3	54.0	82.0
Alabama	70.0	53.0	71.5
Vermont	81.5	53.0	82.3
Georgia	66.4	52.0	67.7
New Jersey	57.0	50.4	59.8
North Carolina	62.6	48.2	63.9
Idaho	37.9	13.0	38.2
New Mexico	19.1	12.0	19.2
Nevada	11.6	12.0	11.6
Montana	27.5	9.0	27.4
Wyoming	14.5	9.0	14.4
US(48)	34.2	35.0	34.1



23.7 million acres of urban tree cover in US

Nowak and Greenfield, 2012. Tree and impervious cover in the United States. Landscape and Urban Planning 107: 21-30.

Carbon Effect

- US urban forests
  - 704 million tons of carbon stored ($50.5 billion)
  - 28 million tons of carbon sequestered per year ($2 billion/year)

Nowak, D.J., E.J. Greenfield, R. Hoehn, and E. LaPoint. 2013. Carbon storage and sequestration by trees in urban and community areas of the United States. Environmental Pollution. 178: 229-236.

Air Pollution Removal and Health Effects

- U.S. urban forests
  - 717,000 tons/year ($4.7 billion/year)
  - Impact, reduction in incidences of:
    - ~580 deaths / year
    - ~580 emergency room visits / year
    - ~330,000 asthma exacerbations / year
    - ~485,000 acute respiratory symptoms / year

Nowak, D.J. S. Hirabayashi, E. Ellis and E.J. Greenfield. 2014. Tree and forest effects on air quality and human health in the United States. Environmental Pollution 193:119-129

National Building Energy Conservation

- 36 million MWh energy production avoided annually ($4.3 billion)
- 228 million MBTU energy production avoided annually ($2.9 billion)

Pollutant	Tonnes avoided/year	$ millions/year
Carbon dioxide	19,800,000	425
Carbon monoxide	16,200	26
Course PM	1,720	97
Fine PM	4,190	590
Methane	459	0.2
Nitrogen oxides	17,100	161
Sulfur dioxide	45,300	405
VOCs	1,100	1
Total		1,705

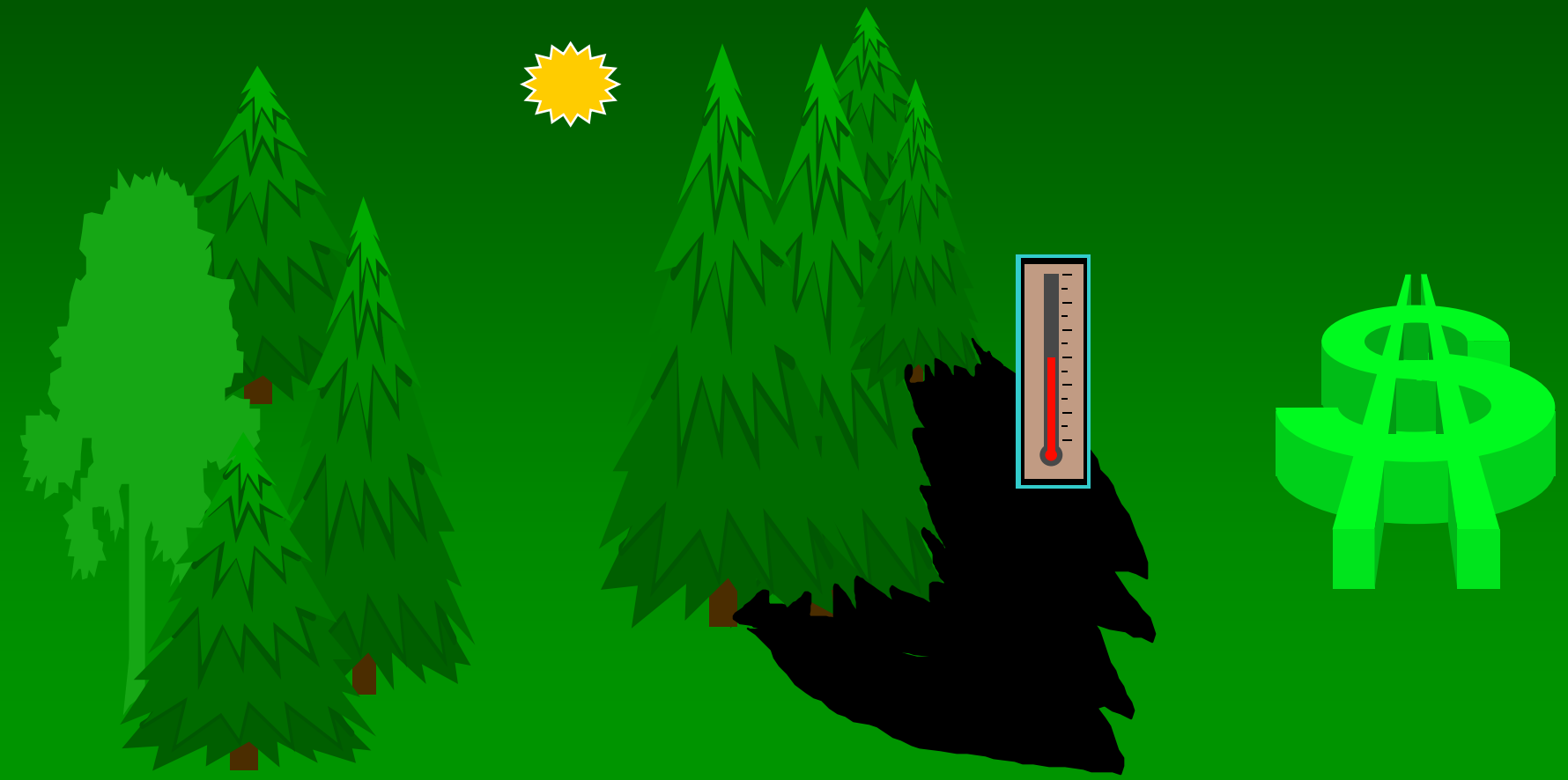
Preliminary results

U.S. Urban Forest Annual Values

- Avoided energy use = $7.2 billion
- Air pollution removal = $4.7 billion
- Carbon sequestration = $2.0 billion
- Avoided emissions = $1.7 billion
- Total = $15.6 billion
  - $760 per acre of tree cover

  - Current carbon storage value = $50.5 billion

Modeling Services and Values



Structure ⇨ Function ⇨ Value

What is i-Tree?

www.itreetools.org

A series of FREE tools to quantify ecosystem services and values from trees (free support also)

International Usage

Urban Vegetation Benefits

- Air quality improvement
- Water quality improvement
- Greenhouse gas reduction
- Building energy use conservation
- Oxygen production
- Health benefits
- Cooler air temperatures
- UV radiation reduction
- Wildlife habitat
- Products: timber, food, fiber, ethanol
- Social / Aesthetics
- Noise reduction
- Economic: jobs

What is i-Tree?

- Core programs—bottom-up approach

All or any trees

Street trees

Individual trees

What are they using?

- **i-Tree Eco assesses:**
  - **Structure**
  - **Function**
    - Energy
    - Air pollution
    - Carbon
    - Rainfall Interception
    - VOC emissions
    - Human health
  - **Value**
  - **Management needs**
    - Pest risk
    - Tree health
    - Exotic/invasive spp.

i-Tree Design v6.0

1614 North Newcastle Avenue, Chicago, IL 60707, USA

Start Over
Save Progress
About

Get started with these easy steps:

1. Draw Structures ?
2. Place Trees ?

Describe your tree:

- Tree species: Elm, American
- Tree diameter: 30 Inches
  or circumference: 94.2
- Tree condition: Excellent
- Tree exposure to sunlight: Full sun

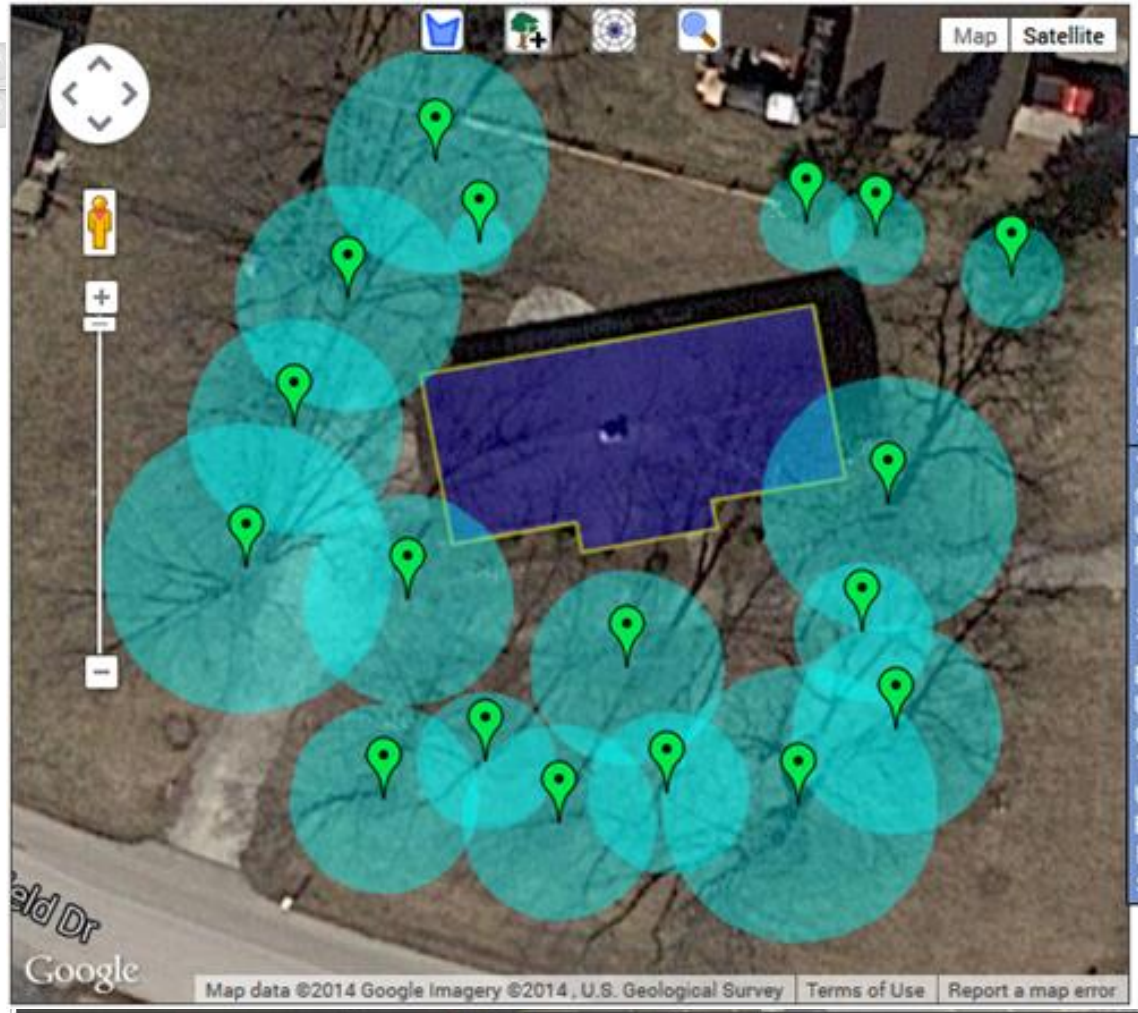
Tree benefit zones:

- The colored zones surrounding the structure, which appear as you describe your tree, illustrate the relative monetary value of energy savings that the tree would provide in each zone.
- Hover over each zone to see that energy benefit information displayed below the map.

To place a tree:

- Drag this icon to the location on the map where you would like to place your tree.
- Repeat to place additional trees.
- Hover over any tree you have placed on the map to display its benefits.

Model the tree(s) future crown growth



Lat: 41.90995
Lng: -87.79631

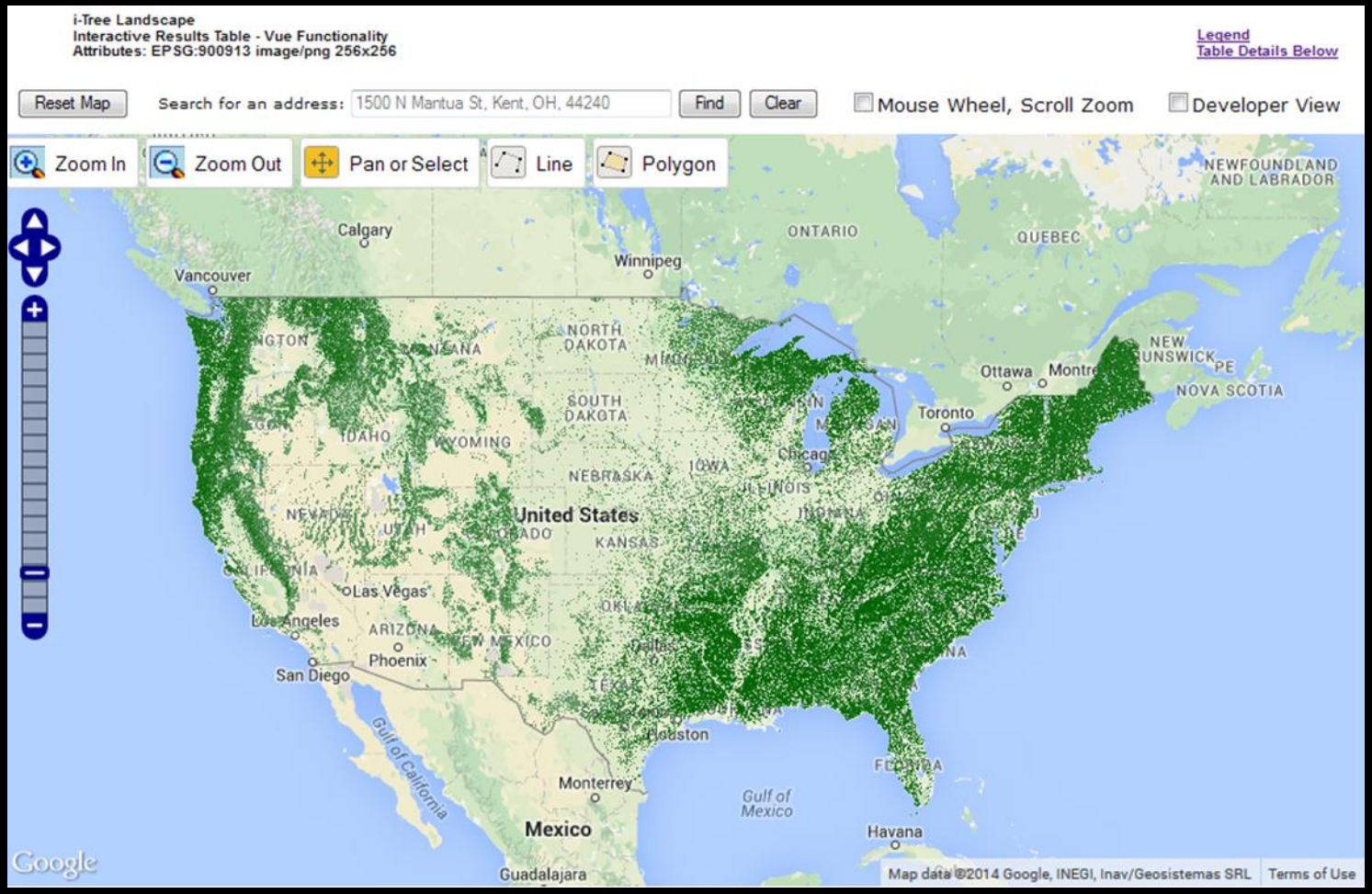
What is i-Tree?

- Top-down approach

NLCD data Photo-interpretation

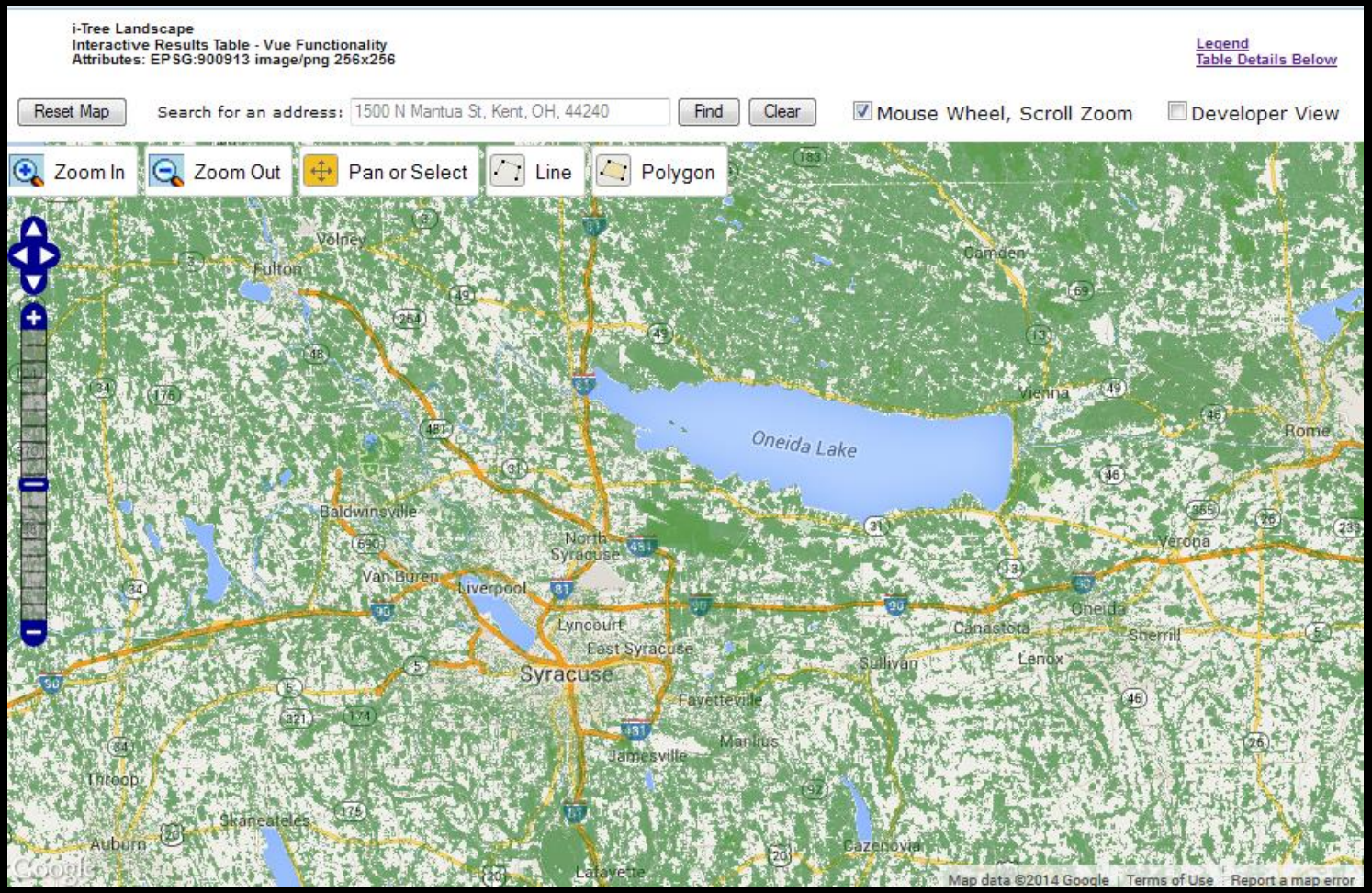
i-Tree Landscape

- National NLCD land cover, tree cover and impervious cover
- Local UTC tree and impervious cover (where available)



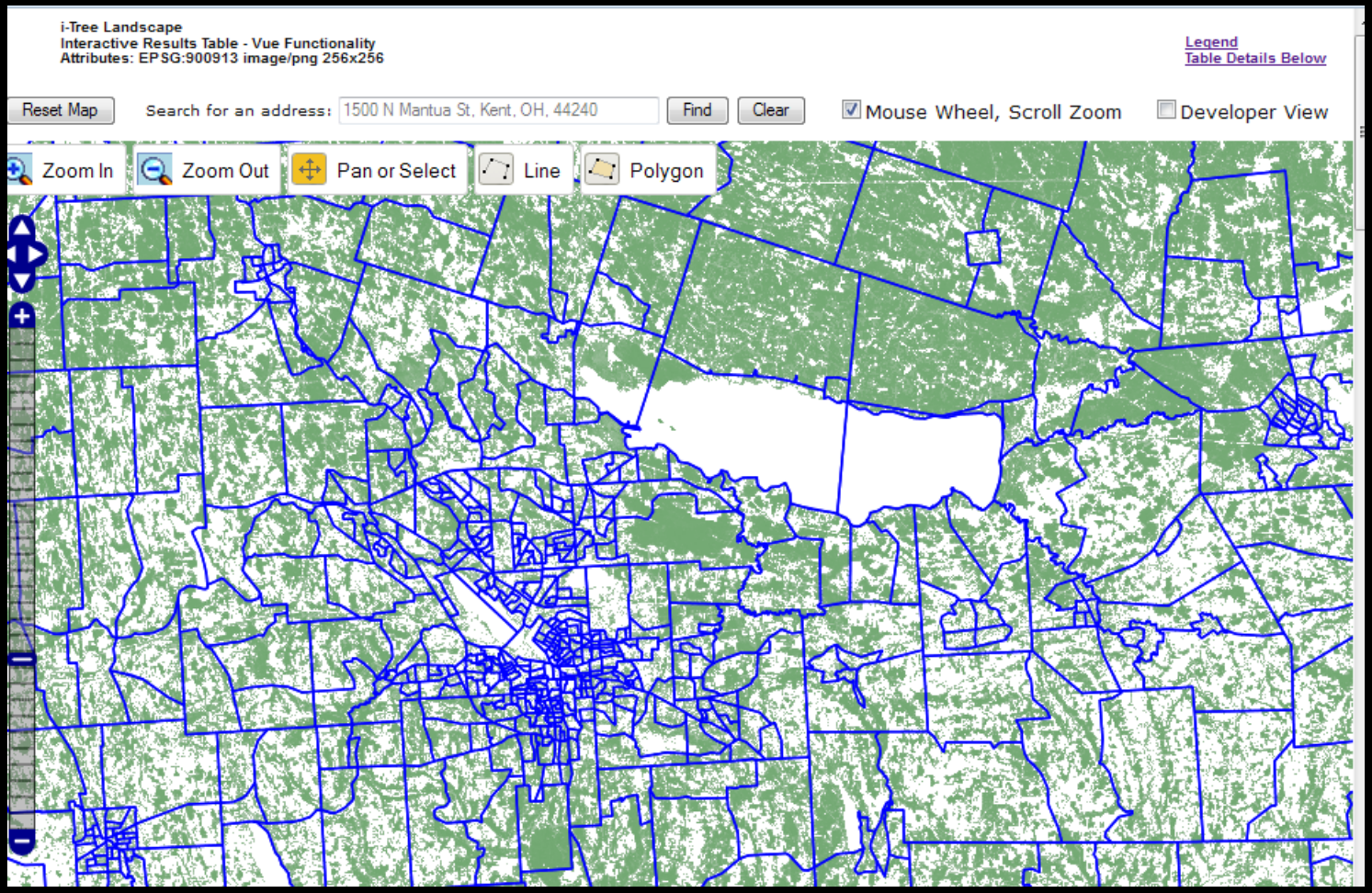
i-Tree Landscape

- Zoom to area



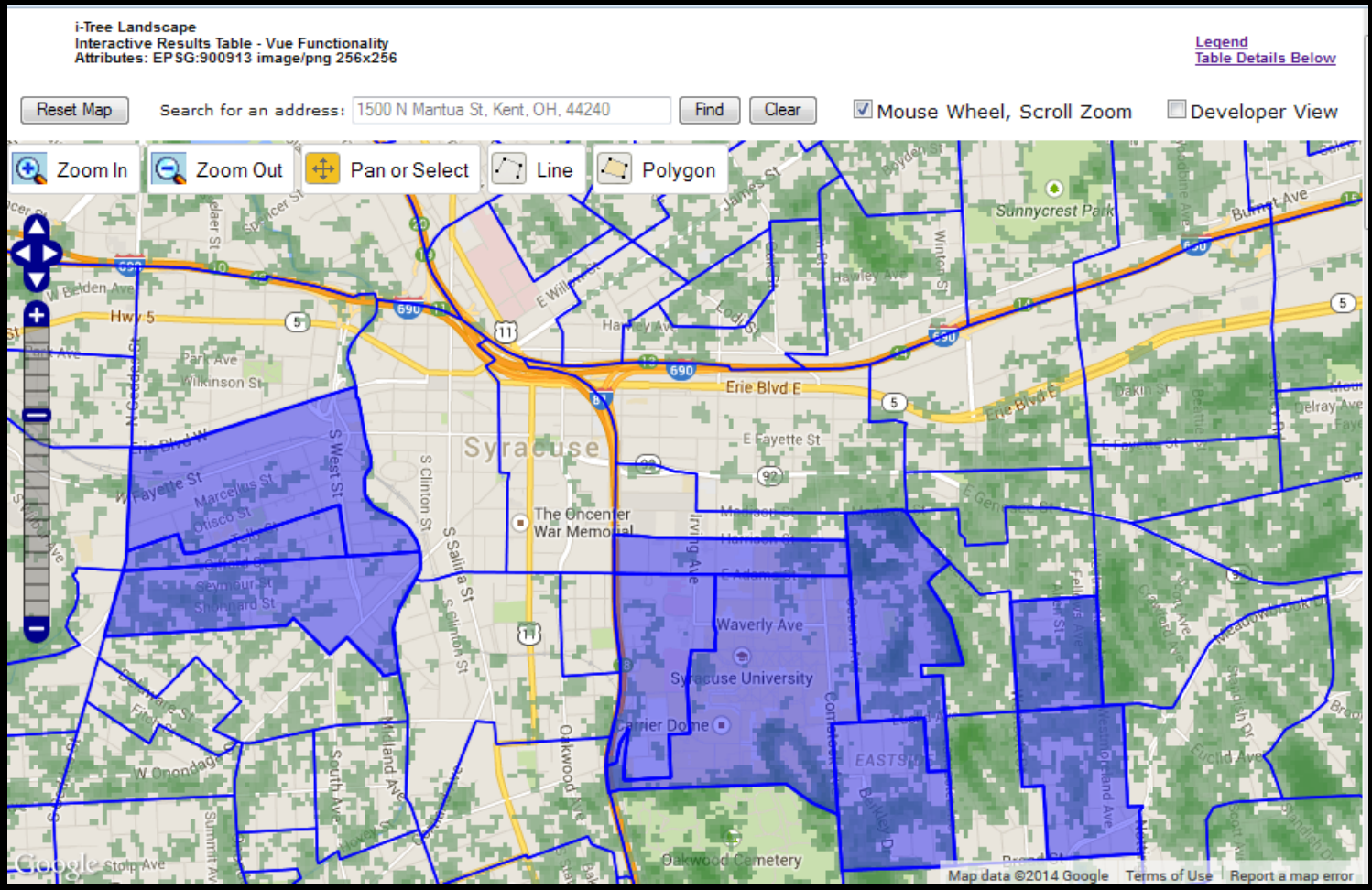
i-Tree Landscape

- Select analysis units (block groups in this example)



i-Tree Landscape

- Select areas of interest

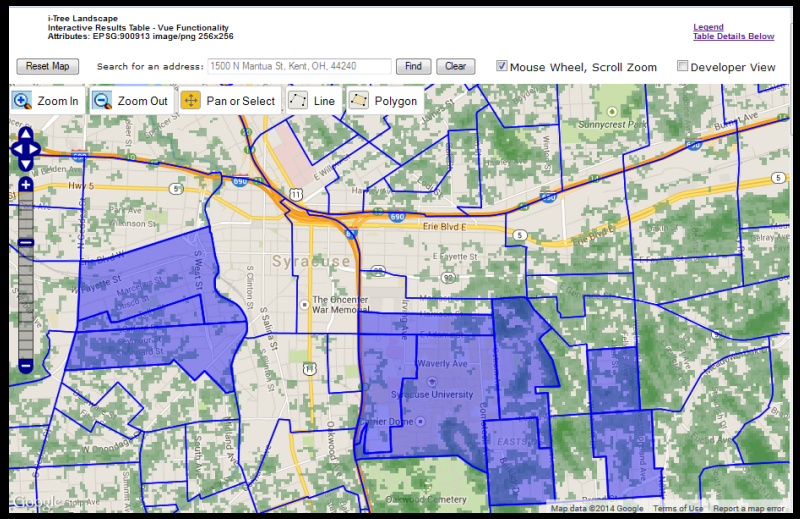


i-Tree Landscape

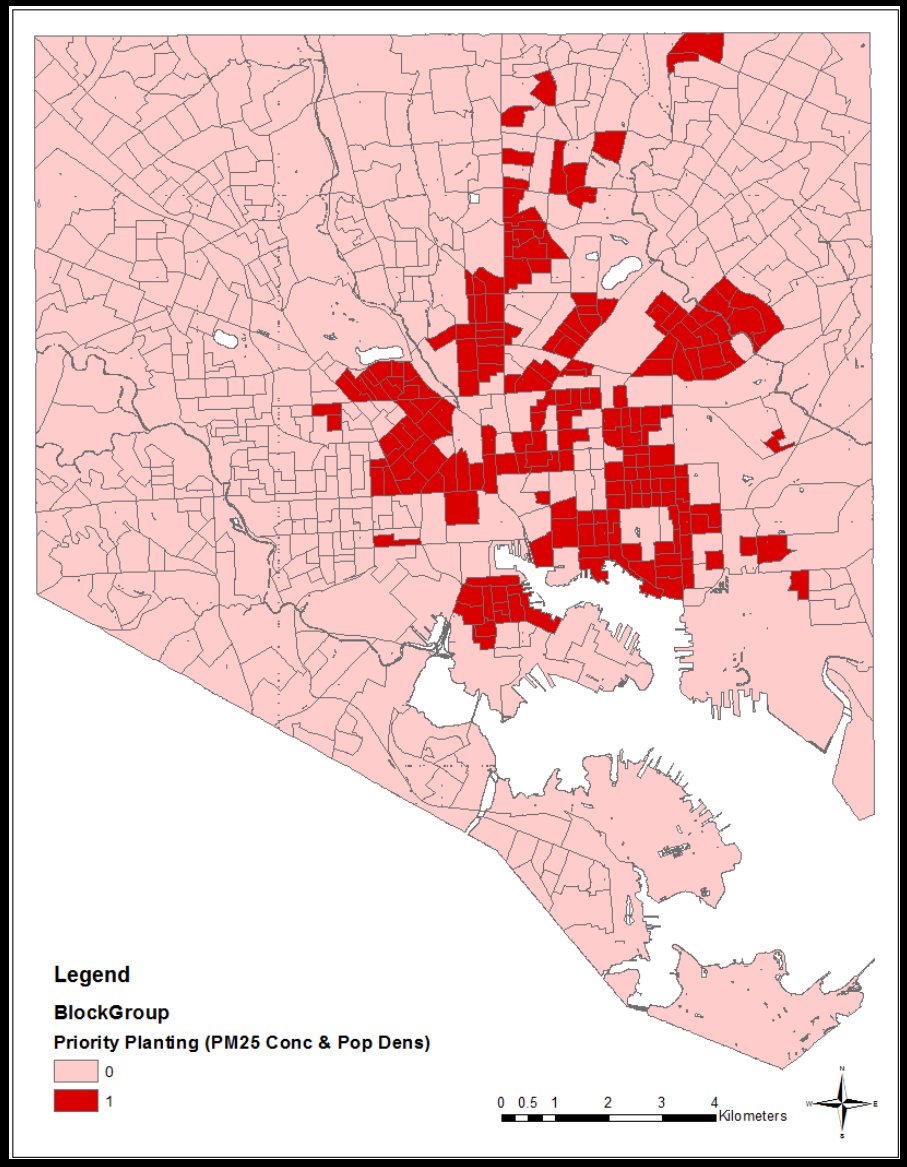
- Display results or:
  - Can change tree cover to see changes
  - Specify areas that meet criteria or custom areas
  - Optimize for planting or protection

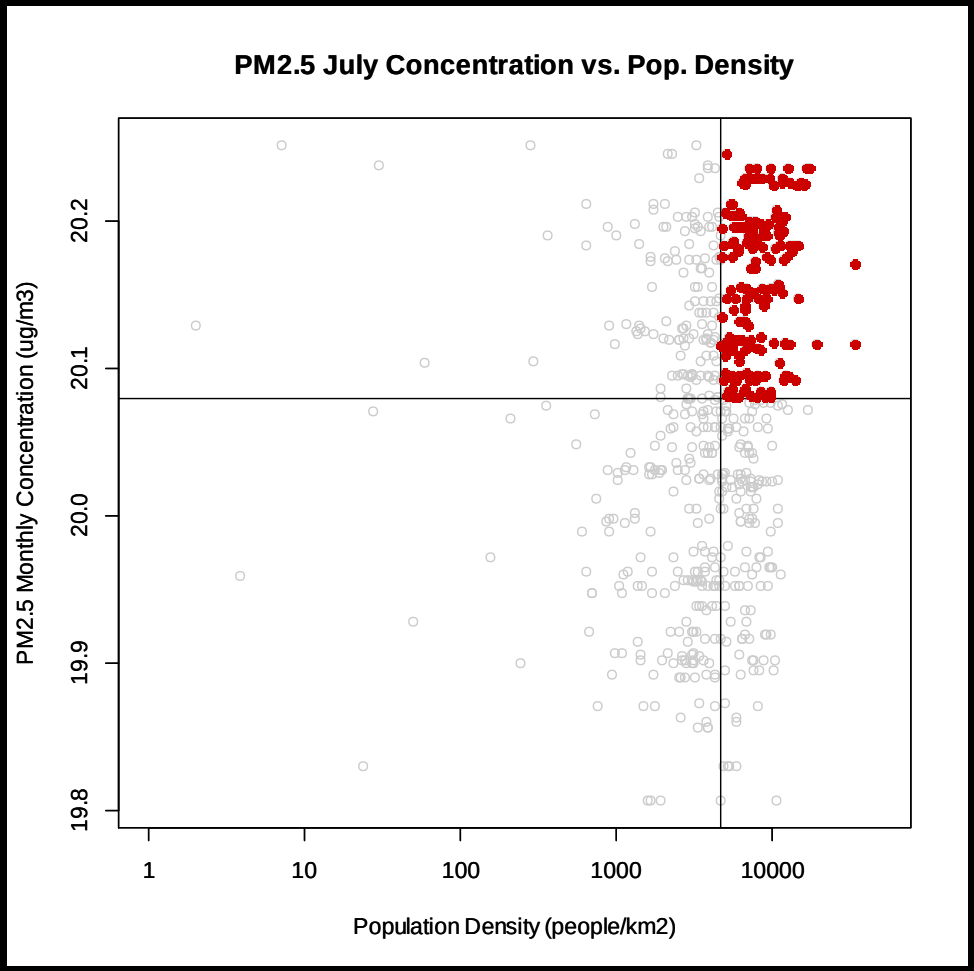
Region	Area	Canopy		Impervious	
	meters squared	Area (m^2)	%	Area (m^2)	%
TOTAL	7458404.98	586845.28	7.88	4218137.81	56.62
360670043011	672462.80	12681.02	1.93	509004.07	77.37
360670043022	1465994.88	80460.00	5.48	886175.63	60.37
360670044001	820188.99	179019.10	21.91	159030.39	19.46
360670043021	361643.78	15642.01	4.20	272429.84	73.12
360670044002	667598.63	85239.22	12.82	313443.01	47.13
360670045001	401836.26	78029.89	19.53	181296.12	45.37
360670045002	621648.92	56420.99	9.03	283517.81	45.39
360670040001	939562.81	52145.99	5.56	590111.59	62.93
360670030002	277780.29	9423.00	3.44	160578.03	58.69
360670030001	1229687.62	17784.05	1.44	862551.32	69.96

Region	CO		NO2		O3	
	$	$g/m^2/yr$	$	$g/m^2/yr$	$	$g/m^2/yr$
TOTAL	108.60	0.073882	13.30	0.034482	6987.36	2.522039
360670043011	2.35	0.001596	0.29	0.000745	150.99	0.054498
360670043022	14.89	0.010130	1.82	0.004728	958.01	0.345787



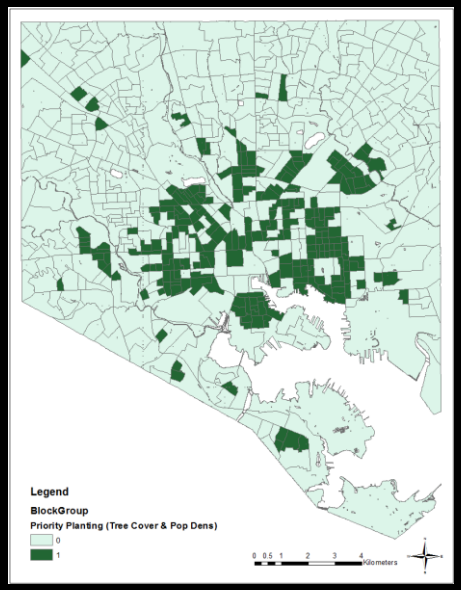
Air Pollution ($PM_{2.5}$) - Priority Planting



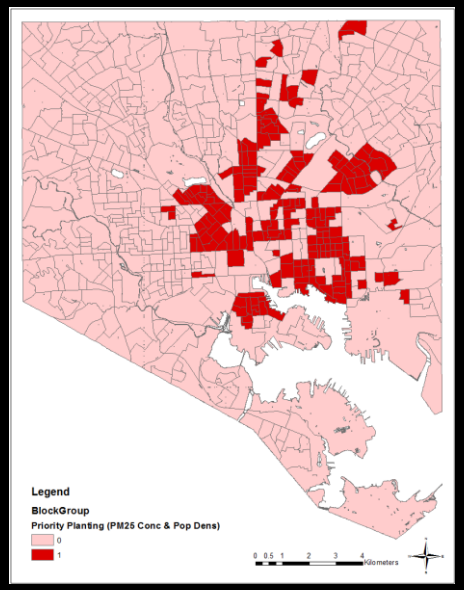


Priority Planting Block Groups

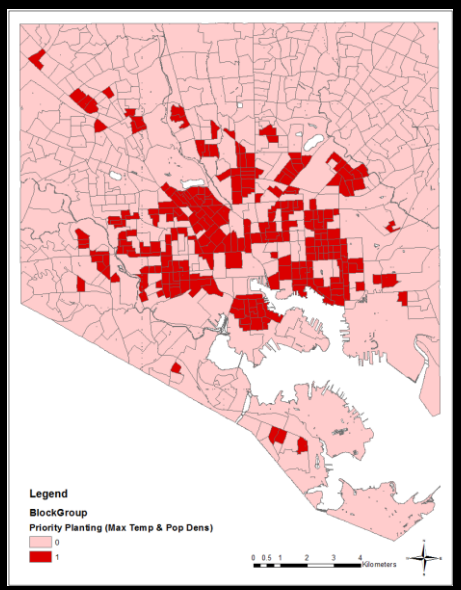
Tree Cover vs. Pop. Dens



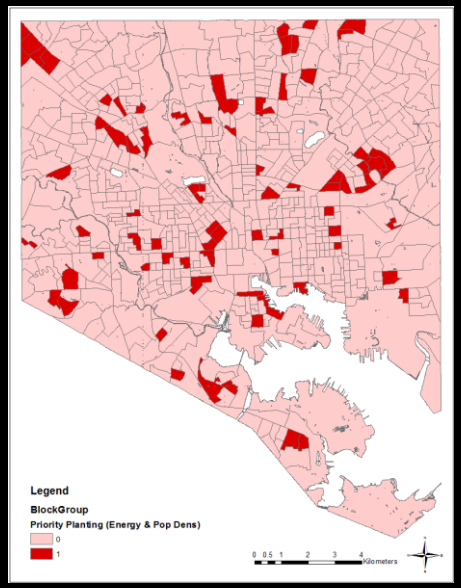
$PM_{2.5}$ Conc. vs. Pop. Dens



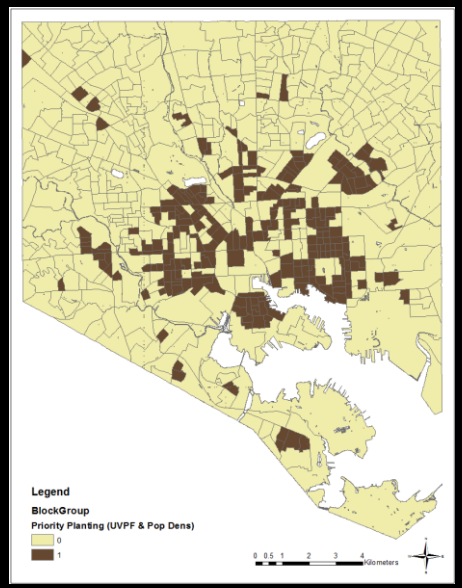
Max. Temp. vs. Pop. Dens



Thermal Comfort vs. Pop. Dens



UV vs. Pop. Dens



Upcoming Features - Landscape

Map Layers and Outputs	i-Tree
Census boundaries	√
Census information	√
Ecosystem services and values	√
Google images	√
Impervious cover	√
Land cover	√
Roads	√
Streams and waterbodies	√
Tree cover	√
Watershed boundaries	√
Air pollution hotspots	2015+
Air pollution monitor data	2015+
Air temperature hotspots	2015+
Air temperature maps	2015+
BenMAP health metrics	2015+
Boundary layer height data	2015+
Crime data	2015+
Ecological corridors	2015+
Elevation maps	2015+
FIA Data	2015+

Upcoming Features - Landscape

Map Layers and Outputs	i-Tree
Flood plains	2015+
Future climate	2015+
Green infrastructure hotspots	2015+
Invasive species	2015+
NEXRAD weather	2015+
Optimization routines	2015+
Ozone impacts of tree health	2015+
Pest distribution and risk maps	2015+
Point source pollution	2015+
Priority planting and protection zones	2015+
Projected development	2015+
Protected lands	2015+
Soils	2015+
Species change maps due to climate change	2015+
Surface temperature	2015+
Topographic index	2015+
UV radiation	2015+
Water pollution hot spots	2015+
Weather data	2015+
Wildlife range maps	2015+

What is i-Tree?

- Specialized utilities

Species selection

Stream flow & quality

i-Tree 2nd Generation (3 Flagship Programs)

On-line Mapping tools

Growth / Mortality / Influx rates

Land / Tree Cover Maps

Projected Development

i-Tree Eco

Field Data

i-Tree Design

Google Maps

i-Tree Landscape

Digital Cover Maps

Local Scale

Regional Scale

i-Tree™

Do you?