Impact of Urbanization on US Surface Climate

The Role of Vegetation

Ping Zhang[1,2], Lahouari Bounoua[1] , Kurtis Thome[1], and Robert Wolfe[1]

1. NASA's Goddard Space Flight Center
2. ESSIC, University of Maryland, College Park

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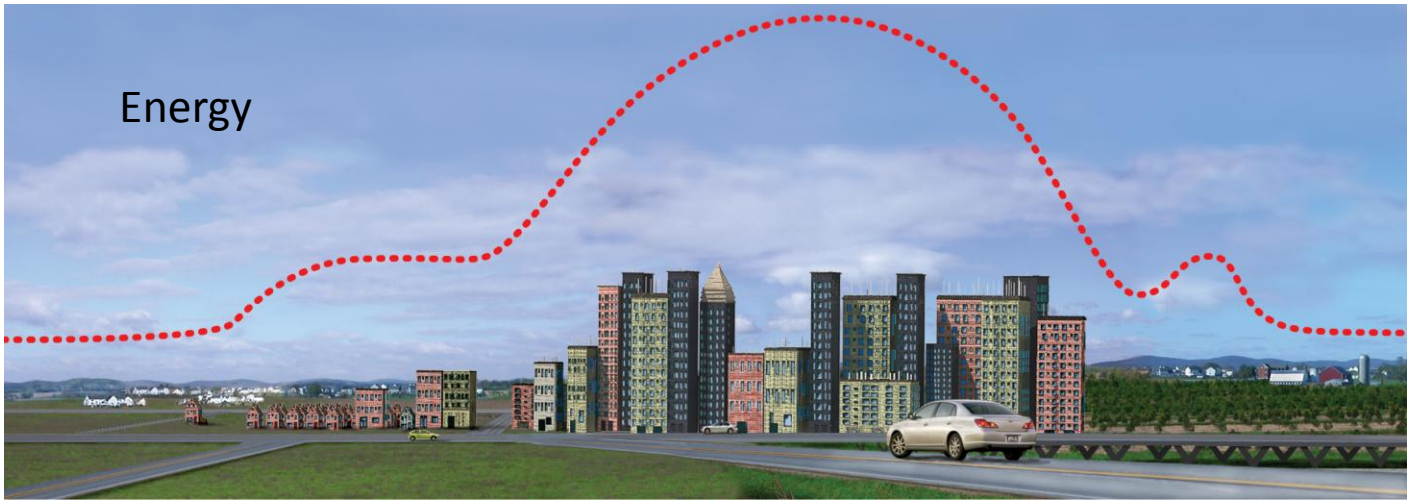
Basics

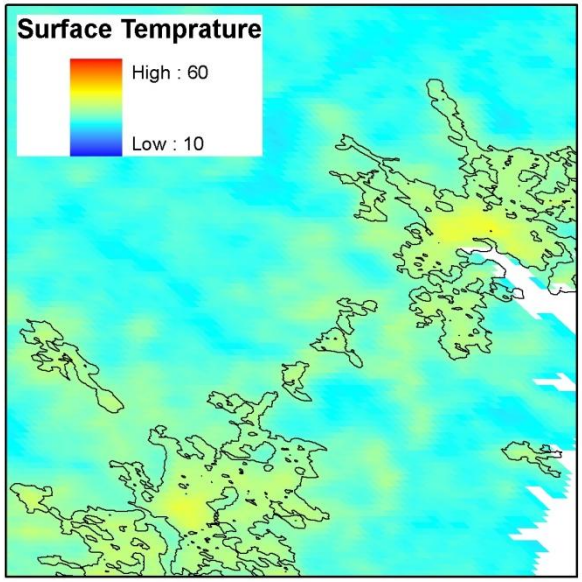


Surface Runoff

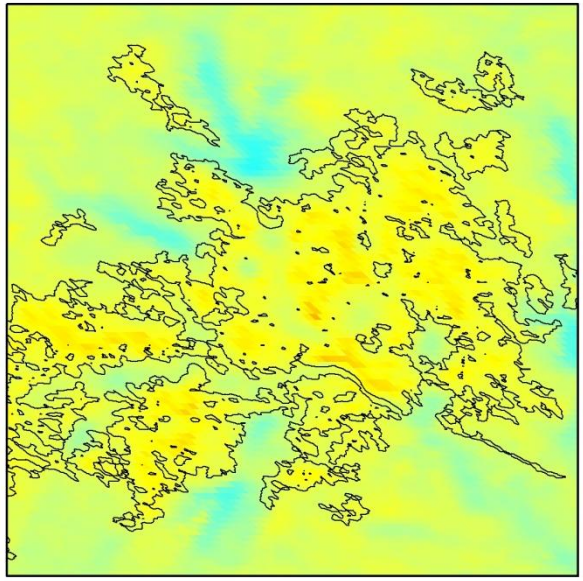
Carbon Sequestration

Background Ecology Matters

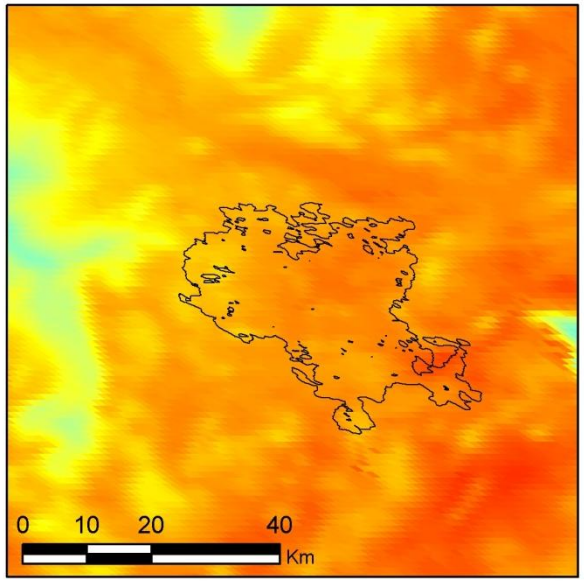
Baltimore-DC area (Forest)



Dallas, Texas (Grass)

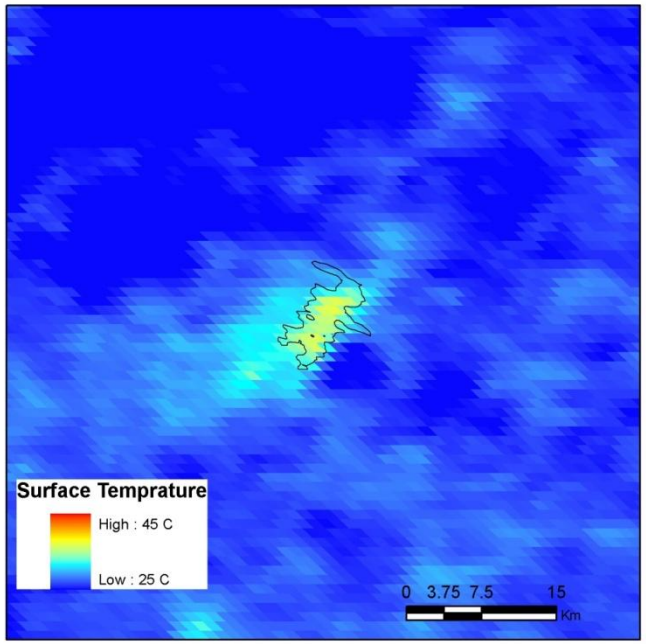


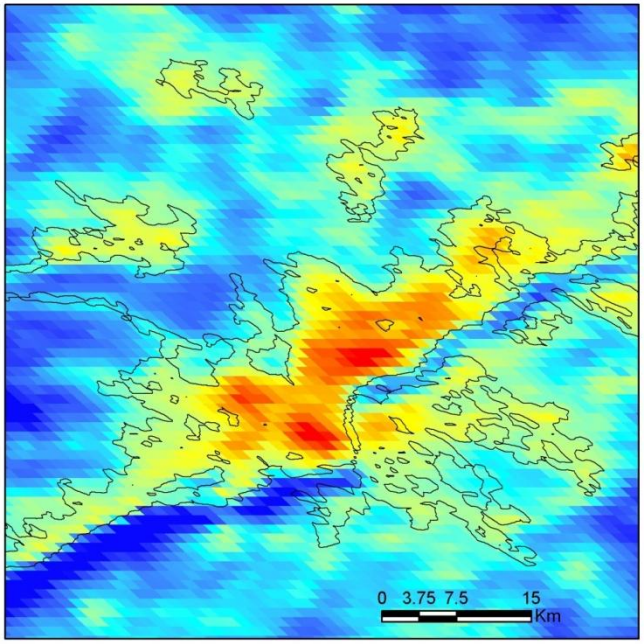
Las Vegas, Nevada (Desert)



- **Cities in forested areas have much larger heat islands than cities in arid areas.**
- **Cities in grassy or agricultural areas are somewhere in the middle**

Size Matters

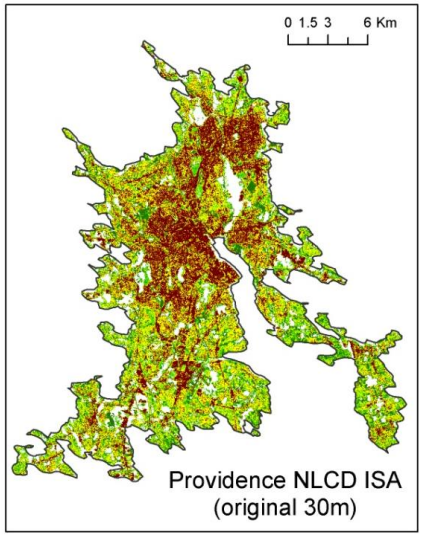


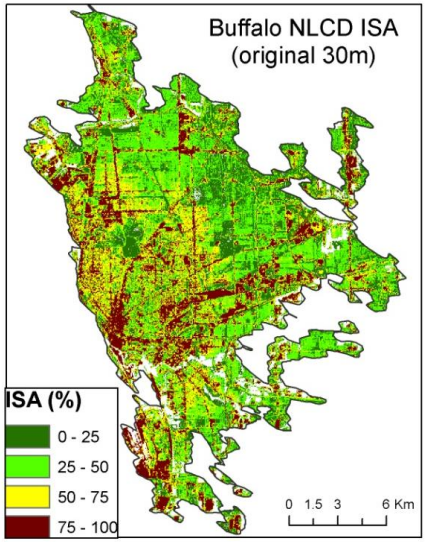


City:	Lynchburg, VA	Philadelphia, PA
Pop:	7000	1563000
Size:	29 km^2 (11.2mi^2)	790 km^2 (11.2mi^2)
Heat Island:	5.5 C (9.9F)	11.7 C (21.1F)

Not a surprise: Bigger cities have bigger heat islands!

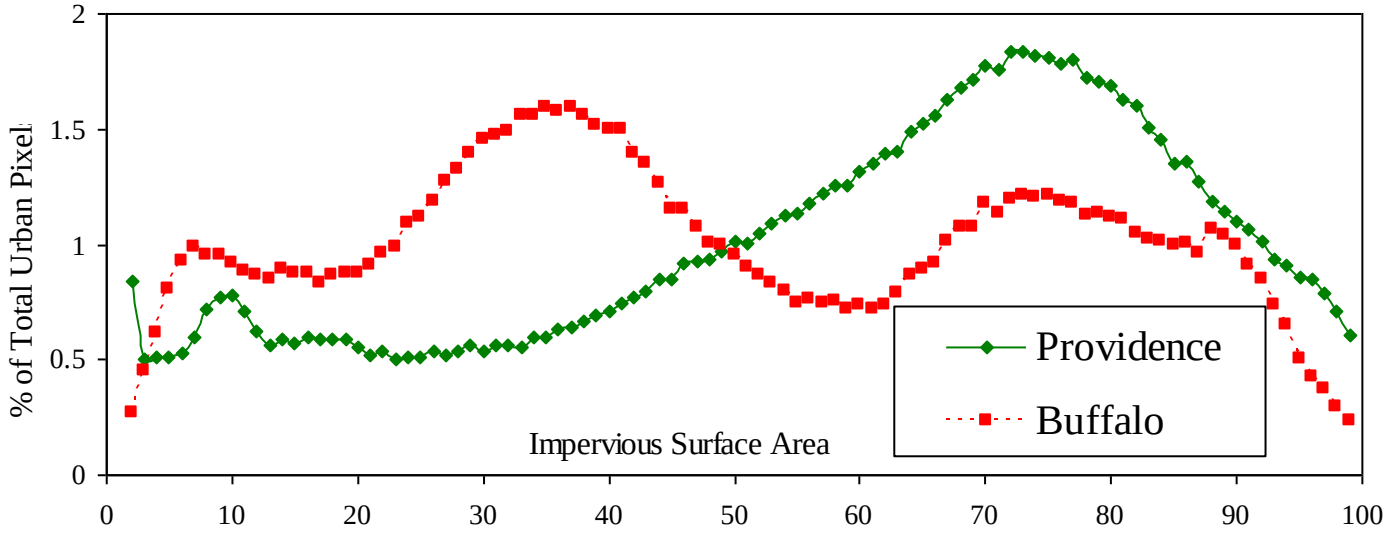
Development Pattern Matters



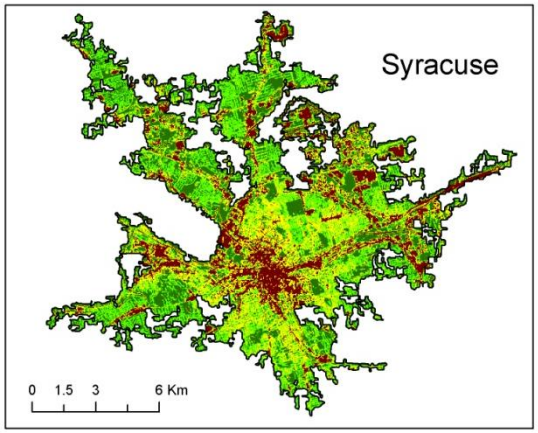


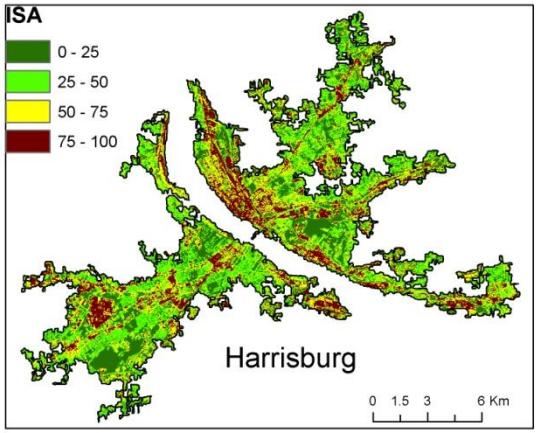
Urban area: 355 km²(137 mi²)
Tree cover at rural: 84%
UHI=12 C (21.6 F)
Providence

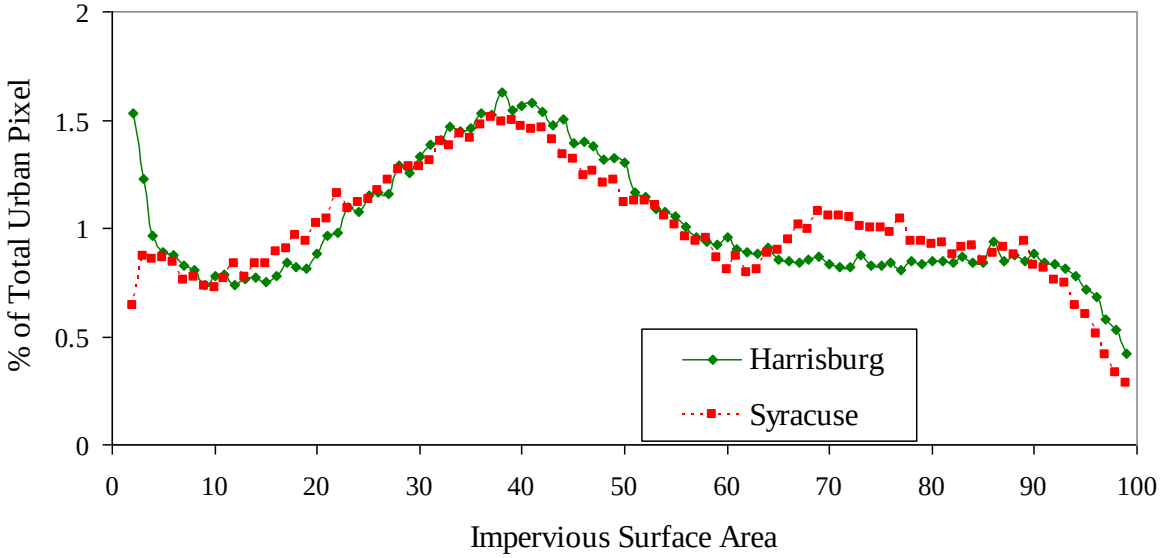
Urban area: 320 km² (124 mi²)
Tree cover at rural: 15%
UHI=7 C (12.6 F)
Buffalo



Shape Matters







Syracuse
Area:152 km²
58.7mi²
UHI: 10.6C
19 F

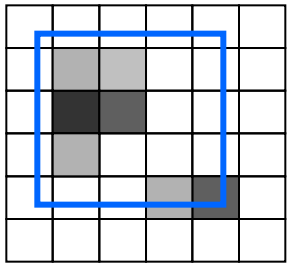
Harrisburg
Area:152 km²
58.7 mi²
UHI: 7.6 C
13.7 F

• Use Area to Perimeter ratio (**A/P ratio**) to characterize the shape and the degree of cohesion of each urban area

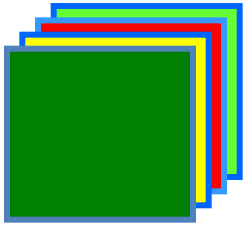
Combining Landsat and MODIS

NLCD 30m

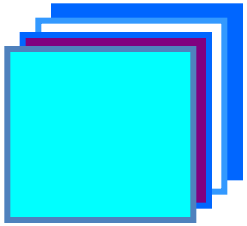
% impervious



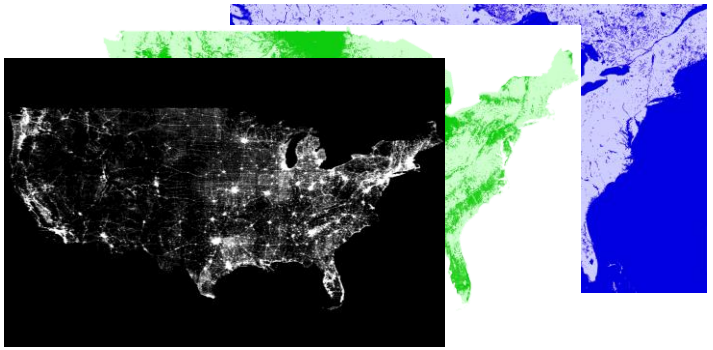
MODIS 1km LC



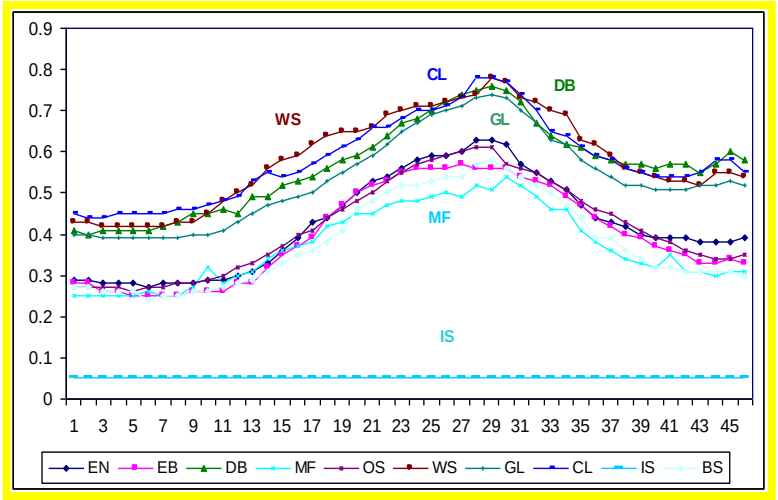
MODIS 1km NDVI



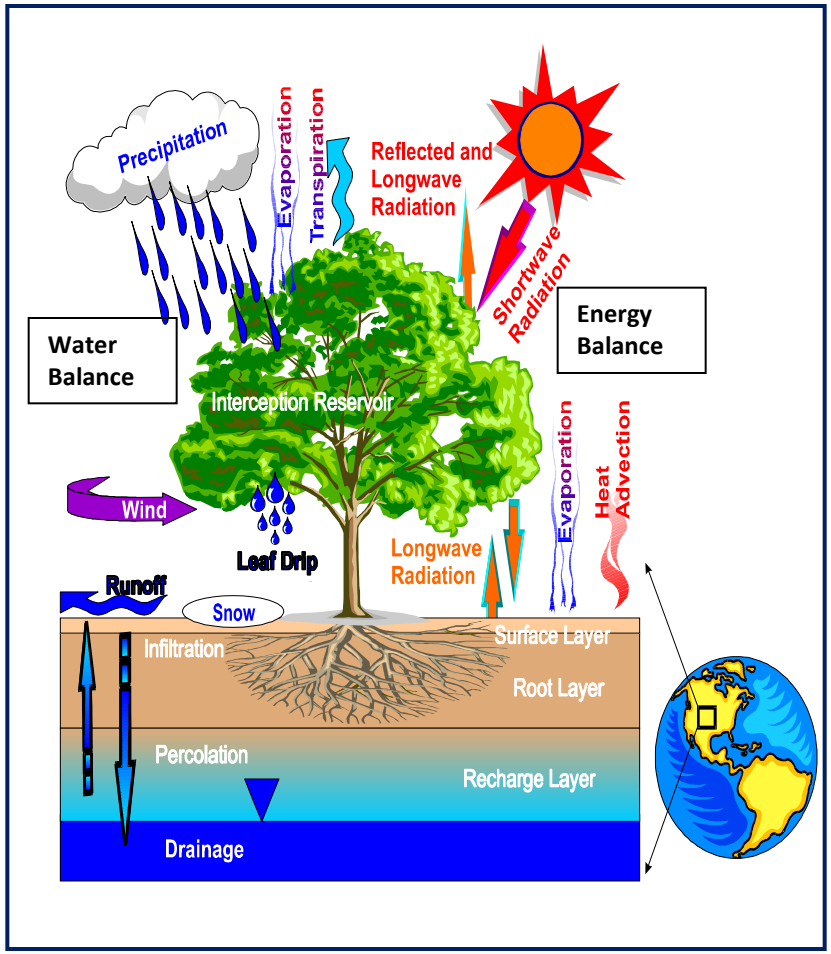
FVC in a CMG (0.05 Deg.)

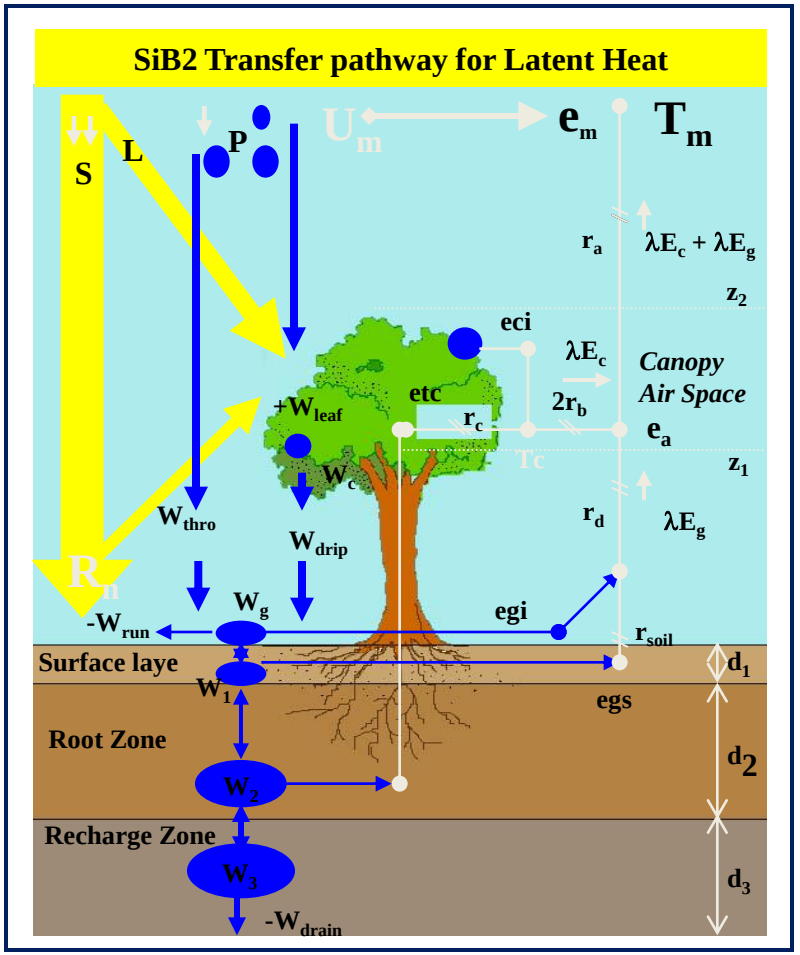


Fractional ndvi in a CMG (0.05 Deg.)



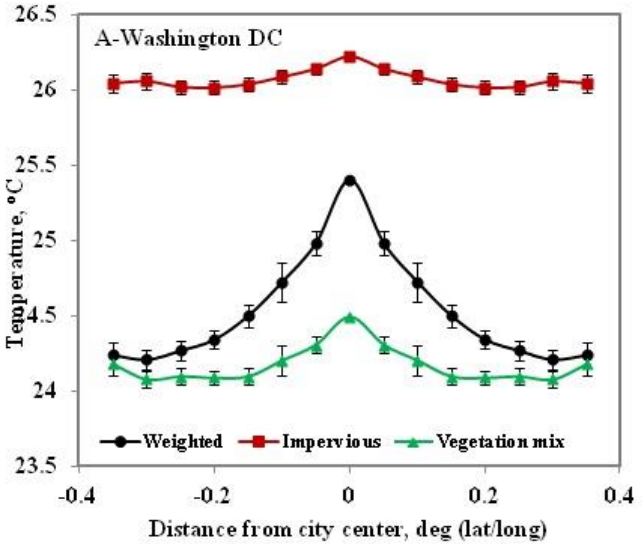
Land Surface Model-SiB2

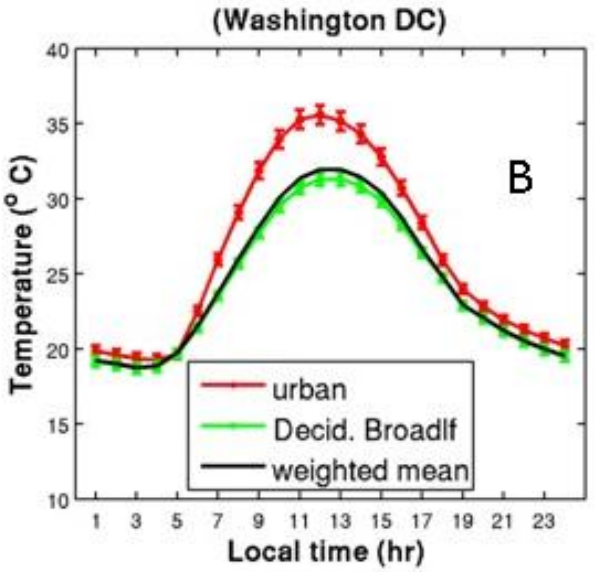




The Simple Biosphere model, developed in the Biospheric Sciences Laboratory code 618

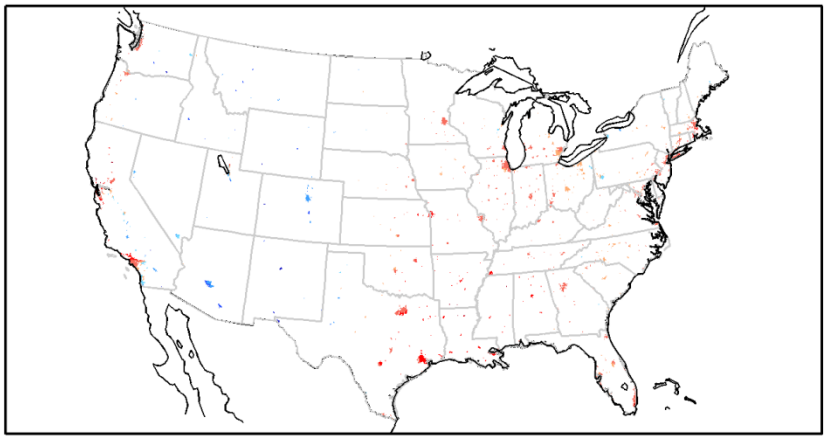
Urban Heat Island



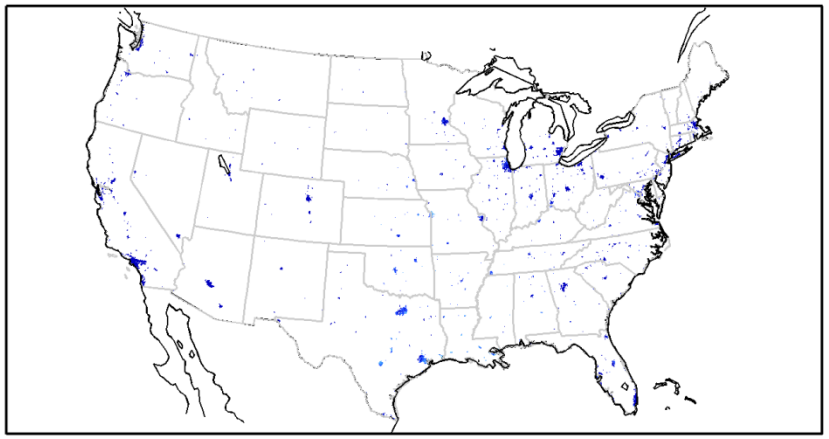


Surface Runoff

a) ISA>20

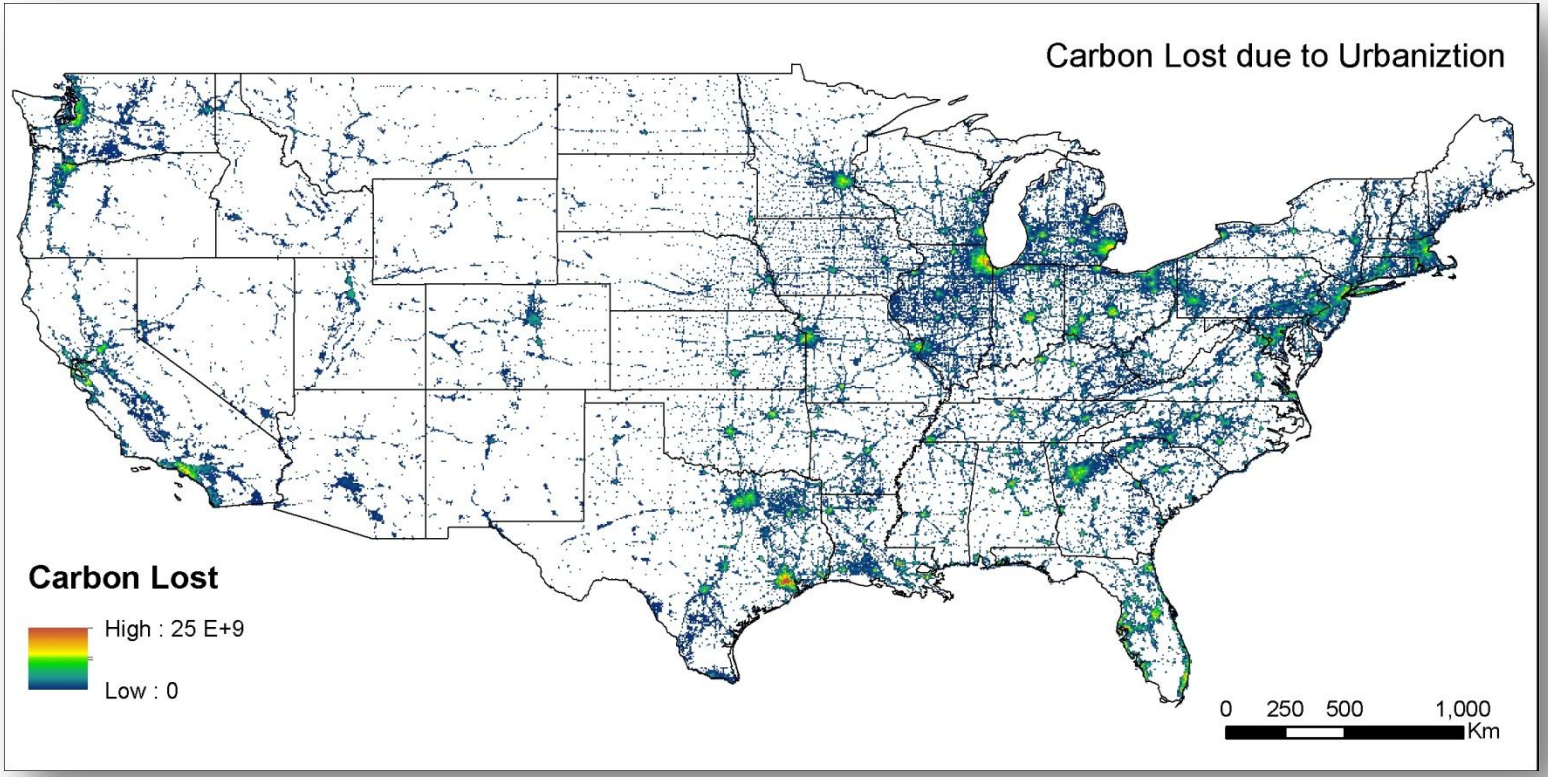


b) Veg. area Runoff for ISA>20



City			DJF Mean		JJA Mean		Annual Mean	
Atlanta	Precipitation		2.71		3.52		2.85	
	Surface runoff	Urban	1.69	**62.4**	1.67	**47.0**	1.58	**55.4**
		MF	0.12	**4.4**	0.11	**3.1**	0.11	**3.9**
Washington DC	Precipitation		1.85		3.70		2.38	
	Surface runoff	Urban	0.95	**51.4**	1.67	**45.0**	1.17	**49.2**
		BD	0.04	**2.2**	0.57	**15.4**	0.24	**10.1**

Carbon Lost



- **About 1.4% of the current GPP is lost due to urbanization.**

Trees are helpful

1. Mitigation of Heat
2. Reduction of flush floods
3. Sequestration of CO2

Thanks!

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