Impact of Urbanization on US Surface Climate
The Role of Vegetation

Ping Zhang¹,², Lahouari Bounoua¹, Kurtis Thome¹, and Robert Wolfe¹

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

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Basics

Energy

Surface Runoff

Carbon Sequestration
• 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
Pop: 7000
Size: 29 km² (11.2mi²)
Heat Island: 5.5 C (9.9F)

Philadelphia, PA
Pop: 1563000
Size: 790 km² (11.2mi²)
Heat Island: 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
• Use Area to Perimeter ratio (\textit{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.)
The Simple Biosphere model, developed in the Biospheric Sciences Laboratory code 618
Surface Runoff

<table>
<thead>
<tr>
<th>City</th>
<th>Precipitation</th>
<th>DJF Mean</th>
<th>JJA Mean</th>
<th>Annual Mean</th>
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<tr>
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<tr>
<td>Urban</td>
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<tr>
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</table>
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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