Simulating the extent of the moderating influence of green space on urban climates

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Motivation
Mortality Ratio vs Ambient Temperature

Ekamper et al, 150 Years of temperature-related excess mortality in the Netherlands, Demographic Research, 21, pp 385-426, 2009
Relative Risk vs Ambient Temperature

Tian et al, Ambient temperature and coronary heart disease mortality in Beijing, China: a time series study, Environmental Health, 11:56, 2012
Increasing **mortality**...
Nanjing
Urban Climate Simulation Process
Urban Form
3D CAD
Landscaping

Solar Exposure
Hourly shade
SVF

Surface Balance
Deardorff
Penman-Monteith

Meteorology
TMY
Hourly

Wind Exposure
OpenFOAM
Velocity Ratio

Perceived Climate
MRT
UTCI
Meteorology
Wind Exposure
Grid
Wind Exposure Streamlines
Perceived Thermal Climate

Average Exposed: 30.52 °C
Average Shaded: 27.55 °C
## Test Cases

<table>
<thead>
<tr>
<th>Test</th>
<th>Road</th>
<th>Plaza</th>
<th>Parke</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Asphalt</td>
<td>100% concrete</td>
<td>100% concrete</td>
<td>No wind</td>
</tr>
<tr>
<td>1</td>
<td>Asphalt</td>
<td>100% concrete</td>
<td>100% concrete</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Asphalt</td>
<td>90% concrete, 10% grass</td>
<td>90% concrete, 10% grass</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Asphalt</td>
<td>80% concrete, 20% grass</td>
<td>80% concrete, 20% grass</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Asphalt</td>
<td>70% concrete, 30% grass</td>
<td>70% concrete, 30% grass</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Asphalt</td>
<td>60% concrete, 40% grass</td>
<td>60% concrete, 40% grass</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Asphalt</td>
<td>65% concrete, 35% grass</td>
<td>100% grass</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Asphalt</td>
<td>65% concrete, 35% grass</td>
<td>50% grass, 50% trees</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Concrete</td>
<td>65% concrete, 35% grass</td>
<td>50% grass, 50% trees</td>
<td></td>
</tr>
</tbody>
</table>

## Surfaces

<table>
<thead>
<tr>
<th>Bulk Surface</th>
<th>Albedo</th>
<th>Emissivity</th>
<th>Specific Heat</th>
<th>Thermal Conductivity</th>
<th>Density</th>
<th>Leaf Area Index</th>
<th>Solar Filter Ground</th>
<th>Solar Filter Human</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass</td>
<td>0.25</td>
<td>0.95</td>
<td>1200</td>
<td>1.5</td>
<td>1200</td>
<td>2.88</td>
<td>0.7</td>
<td>0</td>
</tr>
<tr>
<td>Trees</td>
<td>0.25</td>
<td>0.95</td>
<td>1200</td>
<td>1.5</td>
<td>1200</td>
<td>6.0</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>Concrete</td>
<td>0.35</td>
<td>0.85</td>
<td>880</td>
<td>0.5</td>
<td>2200</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Road</td>
<td>0.05</td>
<td>0.95</td>
<td>920</td>
<td>0.75</td>
<td>2200</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Test 0: Baseline

Daily Average

Afternoon Average
Test 8: Lots of vegetation

Daily Average

Afternoon Average
Future
Downscaling against satellite products
THANKS

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How uses to build

Twitter-driven development
Check Twitter, see if you boned a deploy

Pull requests:
You don’t need to fork anything.

We work asynchronously:
You can do shit without needing to pull me out of The Zone™.

Simple tools + BETTER process = PRODUCT

No meetings - no deadlines - no managers