HIGH-RESOLUTION URBAN GREENERY MAPPING FOR MICRO-CLIMATE MODELLING BASED ON 3D CITY MODELS

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Objectives

- use of LiDAR and Sentinel 2A technology to assess seasonal changes in urban greenery with ultra-high spatial resolution
- modelling the effects of urban greenery on local microclimate using 3D solar radiation tools

Surface temperature derived from Landsat8 imagery
Study area

Košice – 2nd largest city in Slovakia, cca 240 000 inhabitants
Tools and data

• TLS - Riegl VZ-1000 scanner equipped with the Nikon D700 camera, RiSCAN Pro software
• ALS - Leica ALS70 laser scanner, LAStools
• Photogrammetric imagery - Vexcel UltracamXp digital camera
• LoD2 3D city model
Integration of TLS and ALS point clouds

- ALS – upper parts of trees and buildings
- Point cloud registration and positional correction

black points – TLS, color points - ALS

points after correction

Park in Main street in the city centre
Time series of urban greenery

- Time series of TLS point clouds, 11 time horizons
- Synchronised with Sentinel 2A +/- 1 - 2 days
3D point clouds representing trees

ALS

TLS

Segmentation into individual trees
3D models representing trees

From point clouds to 3D objects

RiSCAN Pro®, Geomagic Wrap®,
3D forest, ArcScene®
Time series of 3D tree models

<table>
<thead>
<tr>
<th>Statistics</th>
<th>26 July 2016</th>
<th>27 October 2016</th>
<th>22 March 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point count</td>
<td>387 500</td>
<td>389 916</td>
<td>206 631</td>
</tr>
<tr>
<td>Mean density (points/m³)</td>
<td>4.297</td>
<td>3.146</td>
<td>2.464</td>
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<tr>
<td>Voxelized (25 cm) tree volume (m³)</td>
<td>99.59</td>
<td>94.25</td>
<td>81.54</td>
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<tr>
<td>Total height (m)</td>
<td>7.710</td>
<td>7.710</td>
<td>7.54</td>
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<tr>
<td>Crown max. width (m)</td>
<td>6.520</td>
<td>6.330</td>
<td>6.27</td>
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<td>Footprint area (m²)</td>
<td>36.89</td>
<td>36.38</td>
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</table>

Parameters of a single tree displayed in Figure for different dates of the TLS survey.
3D tree models with attributes

- field inspections, ArcGIS relational database

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<th>Date</th>
<th>Lat</th>
<th>Long</th>
<th>Species</th>
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<th>Pheno</th>
<th>Cat</th>
<th>Function 1</th>
<th>Function 2</th>
<th>Function 3</th>
<th>Crown diameter (m)</th>
<th>Urbcat 1</th>
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Simulation of shadowing effects by 3D tree models

Shadows in hours

13:00 - 16:00/March/2016

Hlavná ulica, Košice
Future research

- adaptation of the v.sun 3D solar radiation model to include urban greenery effects
- material and albedo of urban surfaces (incl. roads)
- 3D representation of semitransparency of trees for solar radiation modelling (attenuation by leaves)

3D solar radiation modelling for buildings (v.sun)
Thank you for your attention

https://esa-surge.science.upjs.sk/

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