Representing Urban Vegetation in Land Surface Models

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1: Introduction

- Vegetation has the potential to mitigate heat stress

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
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<tbody>
<tr>
<td>• Urban heat mitigation</td>
<td>• Reduction in solar receipt (increased energy use)</td>
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<tr>
<td>• Enhanced latent heat flux</td>
<td>• Enhanced air pollution (disrupts flow &amp; VOC’s)</td>
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<tr>
<td>• Improved thermal comfort (shading)</td>
<td>• Sustainable / Practical?</td>
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<tr>
<td>• Human happiness</td>
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- How do we represent urban vegetation in land surface models (LSMs)?

- How well do we represent urban vegetation?
2: Vegetation in LSMs

Slab / Bulk  Single Layer  Multi Layer


Representing Urban Vegetation in Land Surface Models
2: Vegetation in LSMs

Slab / Bulk  Single Layer  Multi Layer

None  Tiled / Mosaic  Integrated

- Poor performance simulating $Q_E$ relative to observations (Grimmond et al. 2010; 2011)

Representing Urban Vegetation in Land Surface Models
An integrated urban vegetation scheme with an improved representation of moisture within an urban canyon model will lead to improvement in RMSE of $Q_E$ relative to observations and existing urban land surface schemes.
3: TUrban Model

Radiation

\[ \theta_z \]

\[ SW, LW \]

Flow & Surface Exchange

\[ T, q, U \]

Vegetation Physiology (Grass & Tree)

Hydrology
(water stress, interception, irrigation)

Canopy Structure
(LAI, LAD, \( \tau_{can} \), phenology, heat capacity)

Leaf Scale Processes
(photosynthesis, stomatal conductance, big leaf approach)

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4: Conclusions & Questions

- Sustainable urban vegetation has potential to mitigate urban heat. **How to achieve in a sustainable manner?**
- Urban vegetation represented in an integrated manner, but room for improvement. **Multi-source modelling capability soon?**
- TUrban in development with the aim to improve simulation of $Q_e$ by capturing the interactions between urban surfaces and vegetation
- **Need more data for model development and evaluation!**

Representing Urban Vegetation in Land Surface Models
5: DVD Extras

- Difference in $\varepsilon_{\text{eff}}$ between no tree and tree of dimension $\lambda_x = 0.5; \lambda_z = 0.5$

- Two regimes identified that account for patterns in difference in $\varepsilon_{\text{eff}}$

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