Using biophysical modelling to assess heat exposure across London

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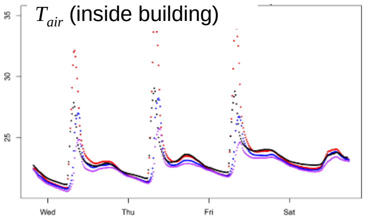
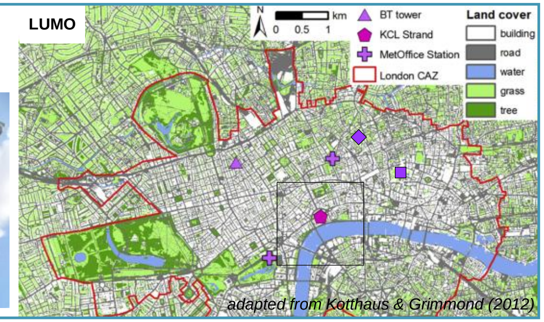
Motivation

- Greater London is home to more than 8.6 million people (GLA, 2015).
- Heat-related mortality shown to increase for temperatures > 19°C in London (Hajat et al. 2002).
- More frequent and more intense heatwaves expected in future (IPCC 2012).
- Recent extreme events with health impacts in 2003, 2006, 2009, 2011 (Wolf and McGregor 2013).
- Urban areas can exacerbate heat stress due to the materials and form of the built environment.
- Considerable spatial variability across the city in terms of exposure.

Meteorological observations

LUMO: London Urban Micrometeorological Observatory

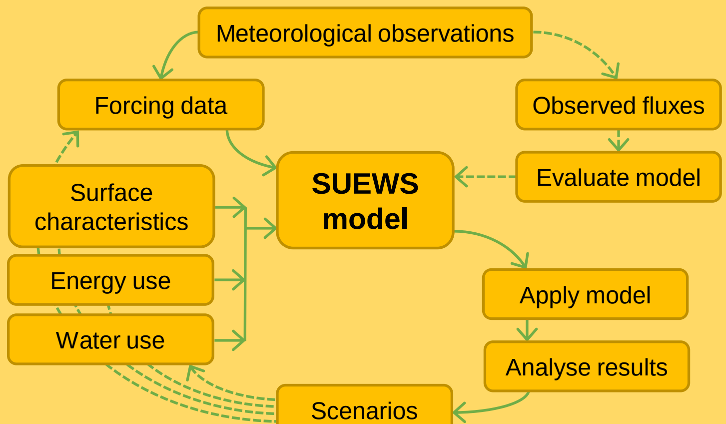




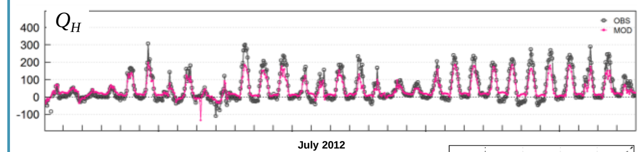
How can models help?

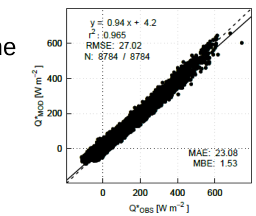
- Management of heat risk involves social measures to reduce vulnerability and urban design options to moderate heat stress.
- Biophysical modelling used to assess potential feedbacks resulting from decisions (by citizens or government) or future climate scenarios.
- For effective management of heat risk it is important to focus resource.
- Models can help identify regions most at risk in terms of exposure and identify factors that could be modified to enhance resilience.

Methodology



Model evaluation





- Incoming energy mainly heats the surface and atmosphere (Q_H).
- Evaporation rates low in central London but larger in vegetated suburbs.
- Accurate estimation of anthropogenic energy release (Q_F) is important for simulating turbulent fluxes.
- Radiative fluxes are well modelled.

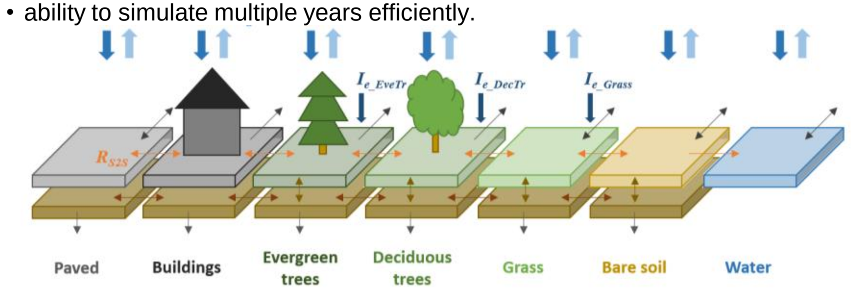
The biophysical model: SUEWS

SUEWS: *Surface Urban Energy and Water balance Scheme*

- Specifically designed for urban areas (7 surface types).
- Simulates both energy and water fluxes.

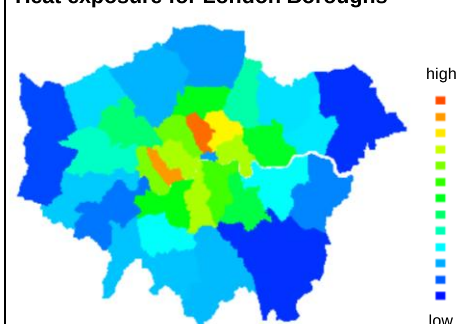
Advantages include

- relatively simple input requirements: basic meteorological variables and surface characteristics
- ease-of-use: no specialist computing facilities needed
- ability to simulate multiple years efficiently.



Results

Heat exposure for London Boroughs



High exposure for central boroughs, due to
(i) high population density (more people at risk)
(ii) little vegetation cover (little evaporative cooling)
(iii) additional heat energy resulting from human activities – traffic, temperature regulation of buildings, human metabolism.

Example scenario:
As temperatures rise, increased use of air conditioning releases additional heat into the environment, further augmenting temperatures and exacerbating heat stress.

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