GLOBAL HEAT HEALTH INFORMATION NETWORK

Part 5.1
Urban climate Fundamentals

Most common modeling approaches

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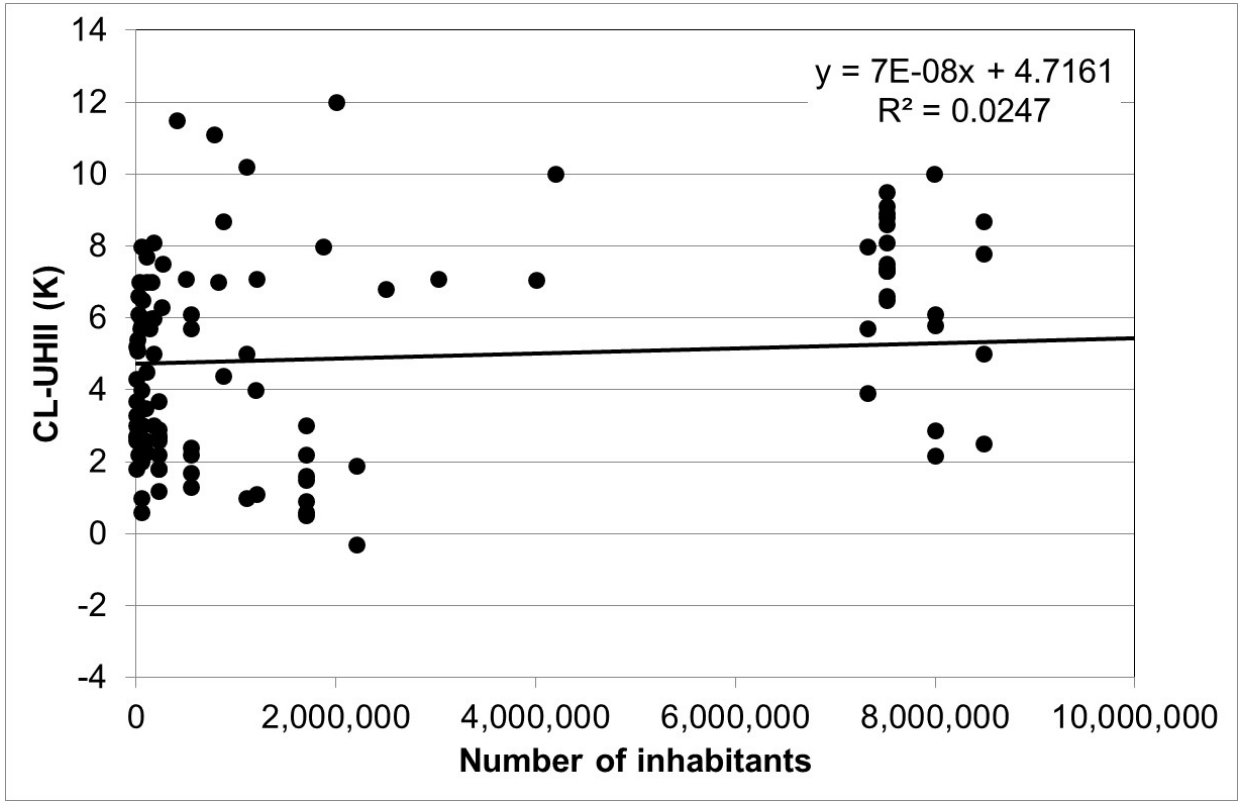

CL-UHI maximum intensity in dependence on city population. Figure idea based on Oke (1973; Atm. Env. 7, 769-779); values from multiple publications, Figure by Schlünzen (2021).

Statistical modeling of UHII

- Number of inhabitants explains too little of UHII.
- Essential elements need to be considered.
- Statistical model based on measurements.

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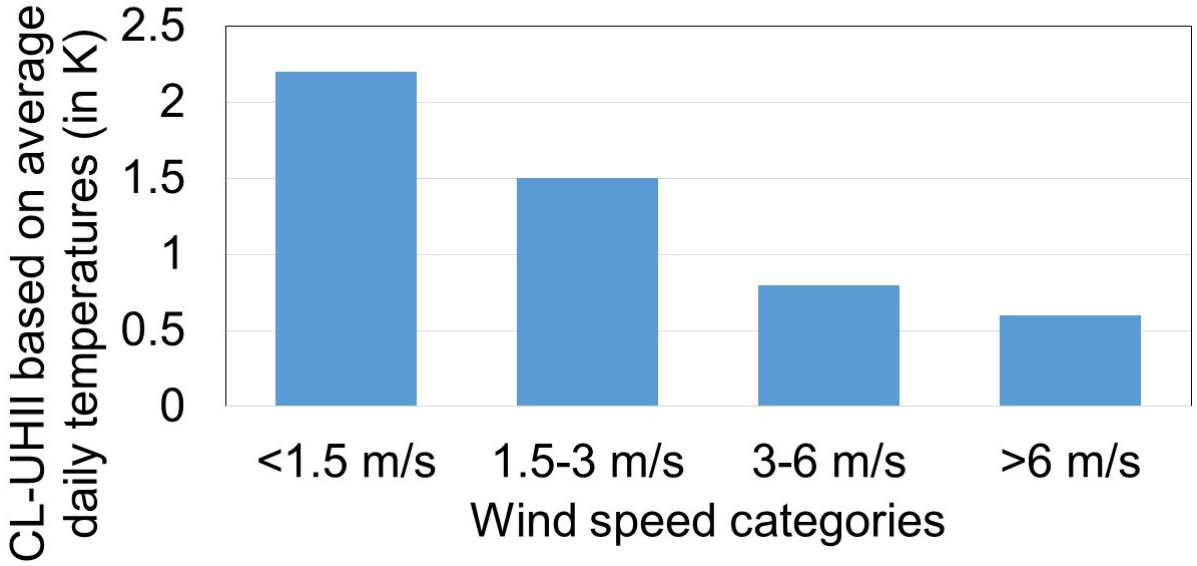
- Typical results
  - **Larger wind speed → smaller CL-UHII.**
  - **Low day time / high night cloud cover → larger CL-UHII.**

(e.g. Hoffmann et al., 2010; doi:10.1002/joc.2348)



Own figure based on data by Schlünzen et al., 2010; doi: 10.1002/joc.1968

Numerical modeling approaches

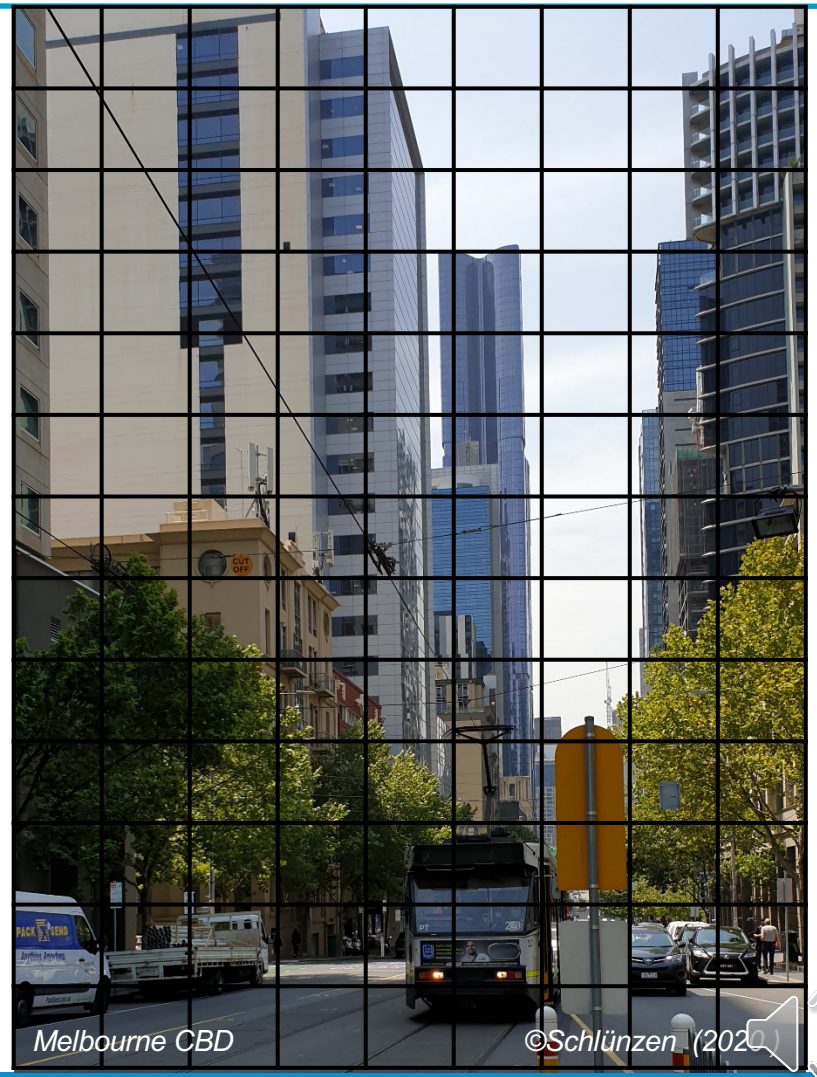
– differences in how to consider effects of the urban canopy layer (UCL)

Type	+	-
Roughness length/ single layer UCL parameterization	• Traditional model approach (weather forecast & climate models). • Fast to integrate.	• Results not at e.g. 2 m. • Vertical interpolation (empirical functions, displacement height, sub-surface).
Multi-layer UCL parameterization	• Vertical heat, moisture, momentum radiation fluxes calculated within UCL. • Vertical changes in heat storage and anthropogenic heat emission considered. • High vertical resolution (< 5 m).	• Intermediate computing resources (time step). • In further development.
UCL resolving	• Each building / tree realistically included. • Fluxes in 3D. • Lowest level < 3 m, direct result use.	• Large computing resources (time and space wise). • In development (e.g. nesting not always available, no humidity fluxes, not precipitation).

Table based on Schlünzen, Grimmond, Baklanov (edts):
"Guidance to Measuring, Modelling and Monitoring the Canopy Layer Urban Heat Island". WMO (2021, in preparation).

What model type to use

- Depends on the purpose of the assessment.
- Statistical models are fast and can be applied to future climate (if urban fabric is the same).
- Numerical models are more resources consuming, and allow
  - assessment of urban development scenarios in current and future climate,
  - temperature and UHII calculations at different heights.
- Using observations / models, you have to know about the data quality and representativeness (space and time).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