IM3 INTEGRATED MULTISECTOR MULTISCALE MODELING

Structural uncertainty in the sensitivity of urban canopy air temperature to anthropogenic heat flux

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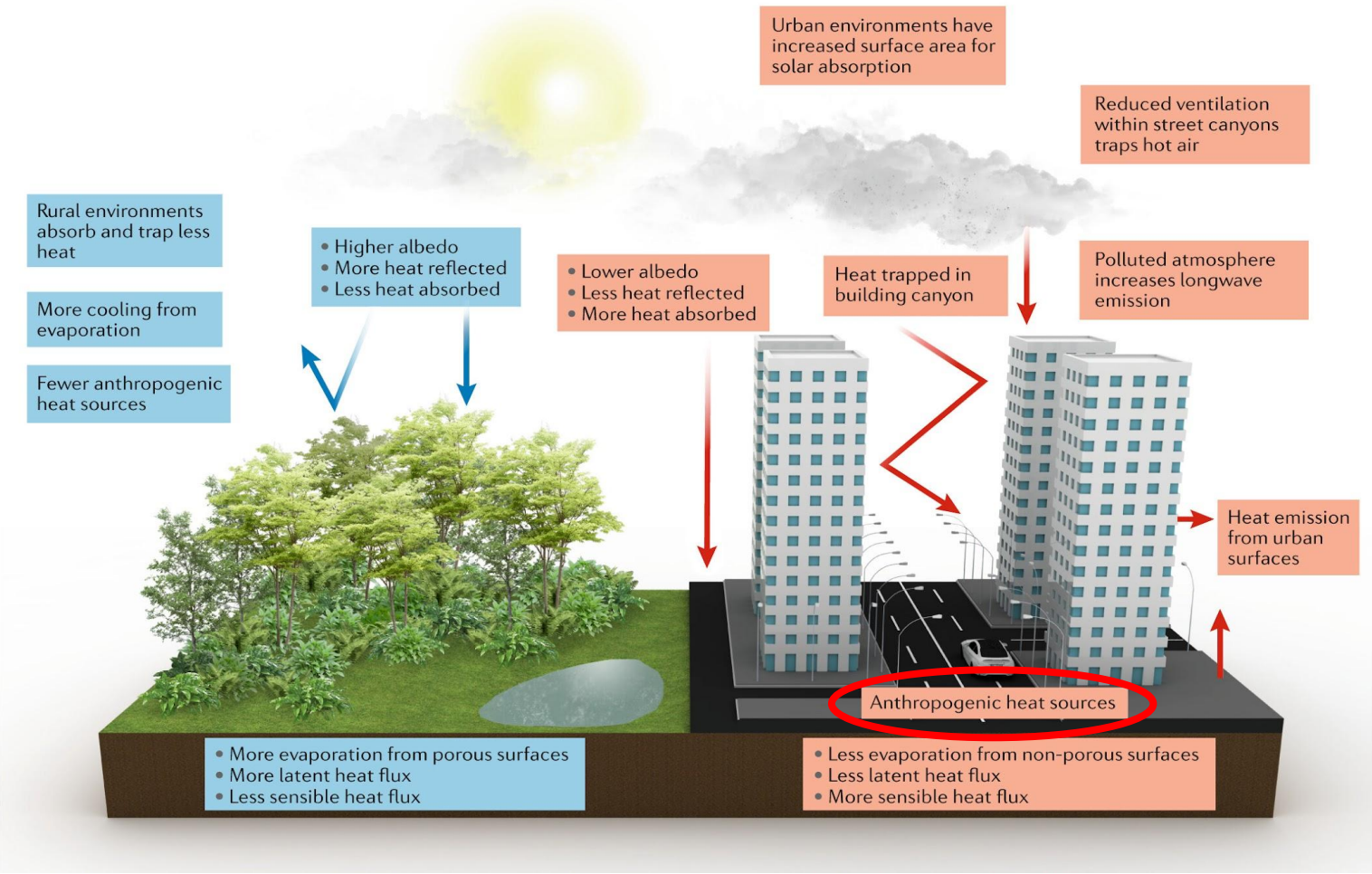
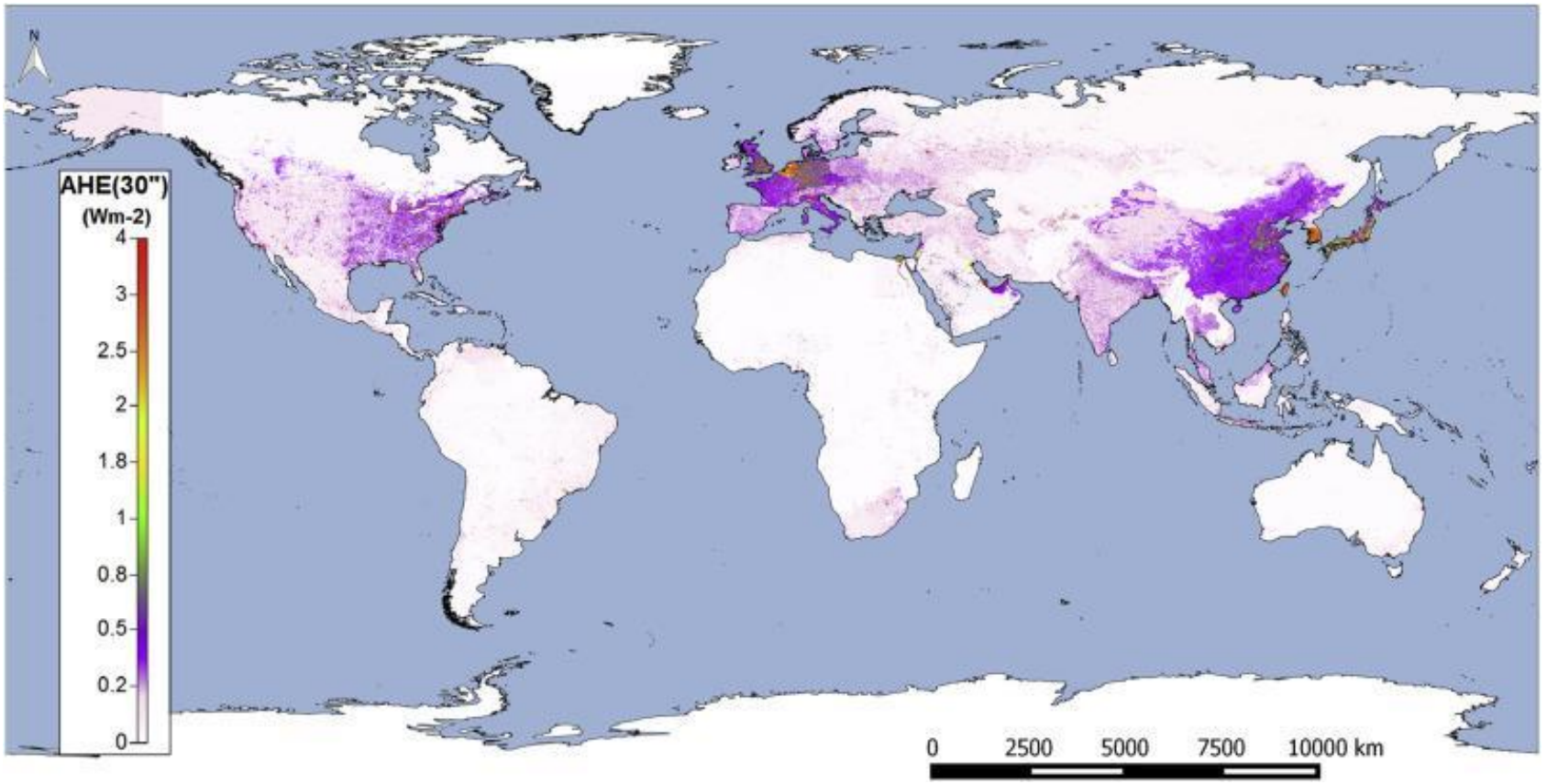
ANTHROPOGENIC HEAT FLUX (Q_{AH})



Wong et al. (2021)

ANTHROPOGENIC HEAT FLUX (Q_{AH})

The global average is 0.13 W m^{-2}, and the maximum is 493 W m^{-2} in Hong Kong.



Dong et al (2021)

URBAN WARMING CAUSED BY Q_{AH}

- Much of the urban climate research on anthropogenic heat flux has focused on quantifying its magnitude (ΔQ_{AH}) and its uncertainty.

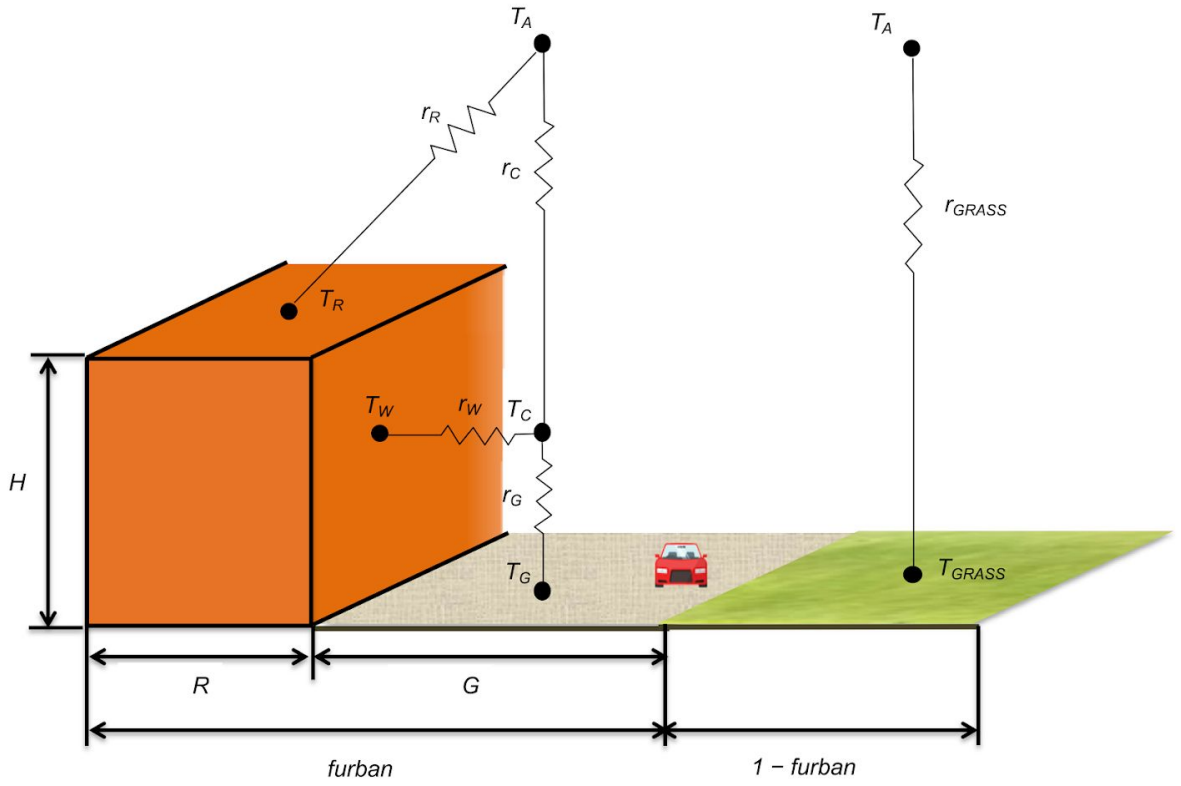
- However, of equal importance is the sensitivity of urban temperatures to anthropogenic heat flux ($\frac{dT}{dQ_{AH}}$), which can practically only be quantified using numerical models.

$$\Delta T = \frac{dT}{dQ_{AH}} \Delta Q_{AH}$$

Practically can be only obtained from numerical models

STRUCTURAL UNCERATINTY

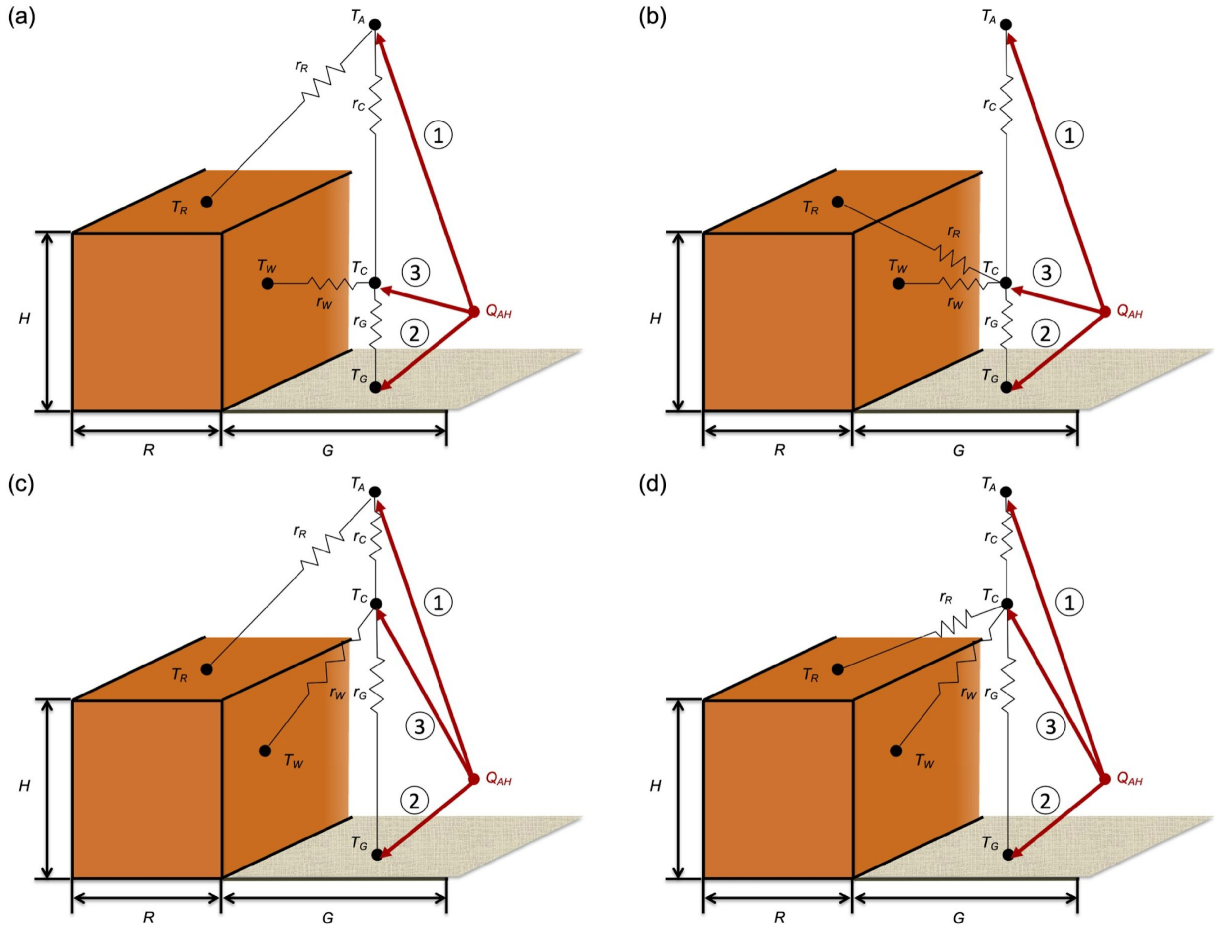
- Weather/climate models must simplify or approximate complex physical, chemical, and biological processes that occur in the real world.
- One case in point is the 3-D urban environment, which is often approximated by a 2-D canyon structure, as in WRF (WRF-SLUCM) and CLM (CLMU).
- The abstraction of the urban environment can be structured in multiple legitimate ways.



Li et al. (in revision)

STRUCTURAL UNCERATINTY

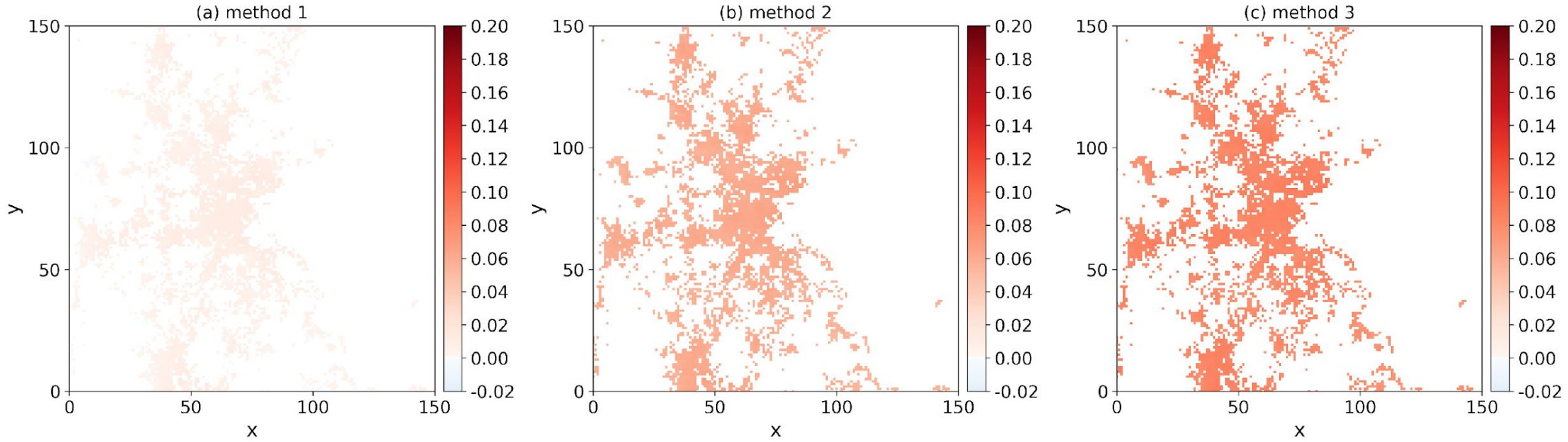
- Q_{AH} release methods (1, 2, 3)
- Model structural variants (4 panels)



Li et al. (in revision)

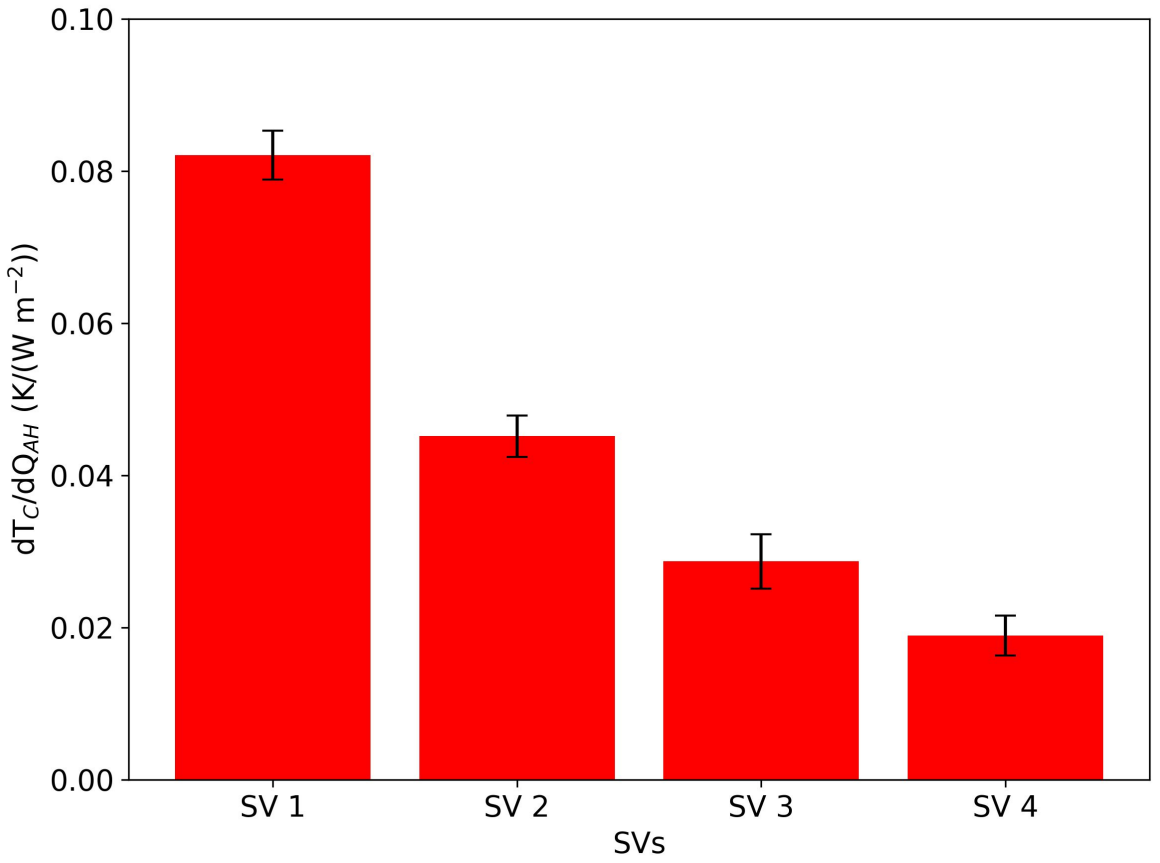
KEY RESULT 1

$\frac{dT_c}{dQ_{AH}}$ unit: K/ (W m^{-2})



The Q_{AH} release methods can cause the sensitivity to differ by an order of magnitude.

KEY RESULT 2



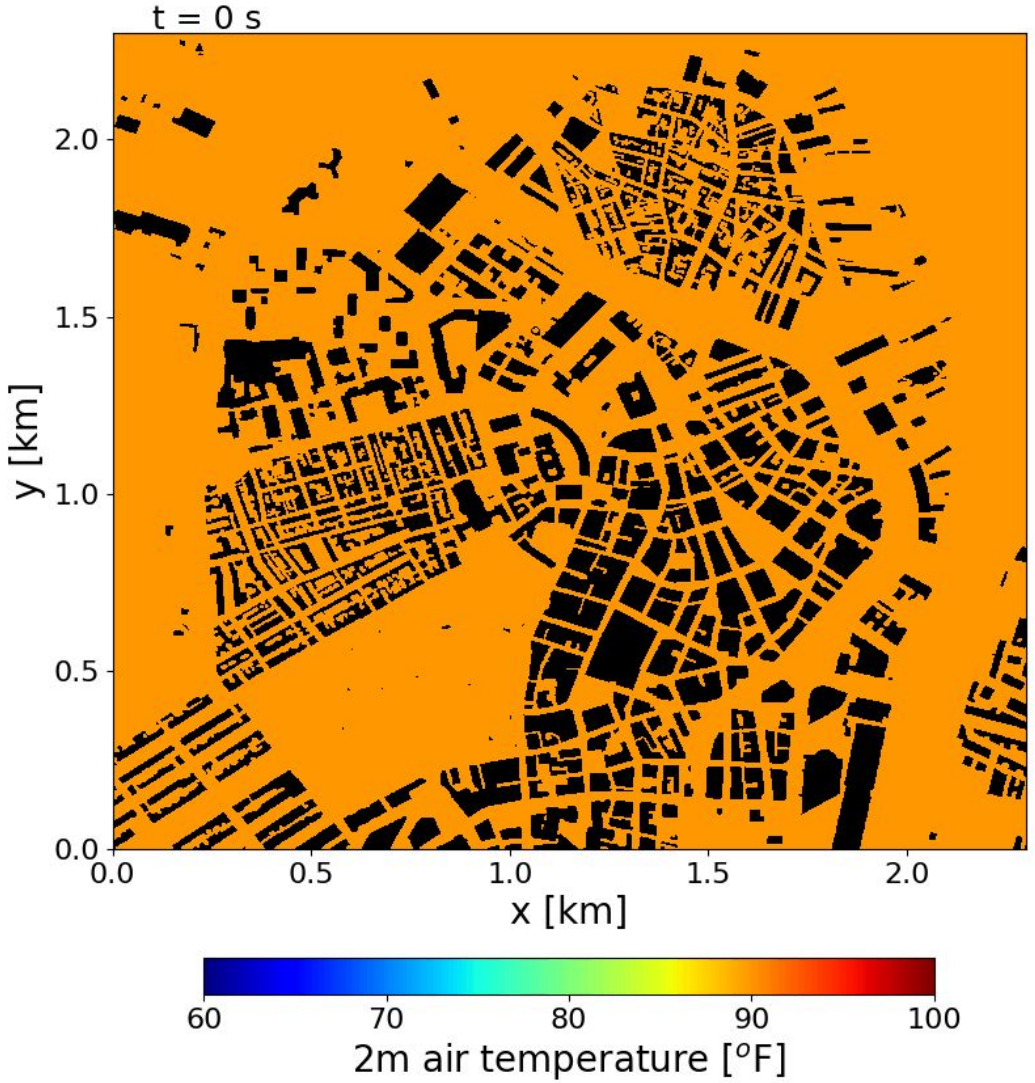
Changing the structural variants (SVs) can cause the sensitivity to differ by a factor of 4.

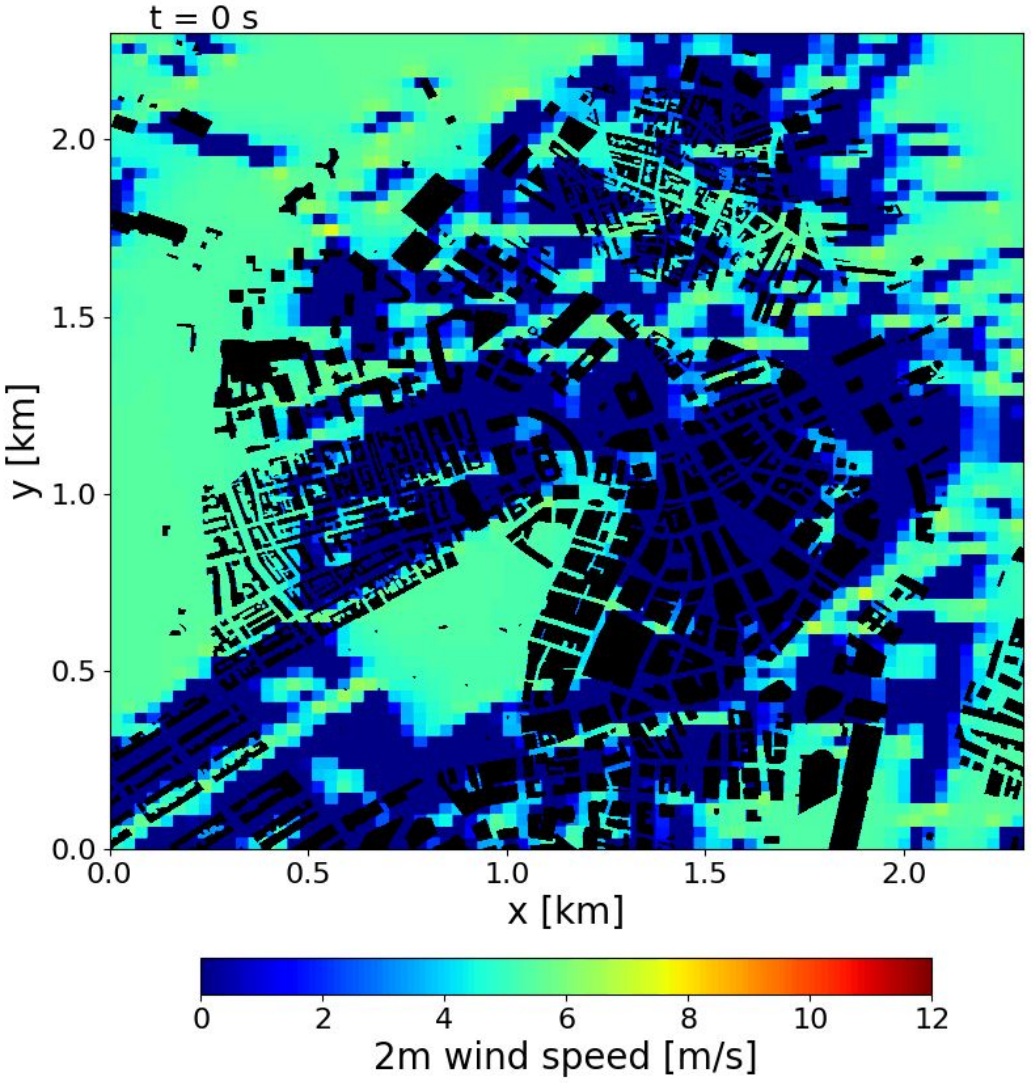
IMPLICATIONS

- This work provides some guidance as to how much uncertainty in the magnitude of Q_{AH} could be tolerated and what other information of Q_{AH} needs to be collected in addition to its magnitude (e.g., its source distribution vertically).

- The large structural uncertainty is fundamentally related to the challenges of simplifying complex urban environments in coarse-resolution (building non-resolving) numerical models.

MOVING FORWARD: BUILDING RESOLVING SIMULATIONS





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