Validation of a lumped thermal parameter model coupled with an EnergyPlus model using BUBBLE data

Miguel Martin<sup>1</sup> Afshin Afshari<sup>1</sup> Peter Armstrong<sup>1</sup> Leslie Norford<sup>2</sup> Eberhard Parlow<sup>3</sup> Roland Vogt<sup>3</sup>

> <sup>1</sup>Department of Engineering Systems and Management Masdar Institute of Science and Technology, UAE

<sup>2</sup>Department of Architecture Massachusetts Institute of Technology, USA

<sup>3</sup>Department of Environmental Sciences University of Basel, Switzerland

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• Purpose of coupling an urban canopy model with EnergyPlus

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Image: A match a ma

# Agenda

- Purpose of coupling an urban canopy model with EnergyPlus
- Parameters considered by the urban microclimate model

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- Purpose of coupling an urban canopy model with EnergyPlus
- Parameters considered by the urban microclimate model
- Accuracy of urban temperature estimates in the Sperrstrasse

# Detailed building energy model



Image: A match a ma

# Detailed building energy model



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Coupled scheme validation in Basel

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# Detailed building energy model



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### Purpose

How boundary conditions of a building located in an urban area can be more accurately evaluated to improve estimation of their impact on energy consumption.



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### Sensible heat gains

• Waste releases:  $Q_{waste} = \delta_{waste}(1 - \eta)Q_c$ 

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### Sensible heat gains

• Waste releases:  $Q_{waste} = \delta_{waste}(1 - \eta)Q_c$ 

• Traffic: 
$$Q_{traffic} = I_{traffic} F_{traffic}(h)$$



### Validation environment



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# Validation environment



#### **BUBBLE Met-station**

• Signal based distances:

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- Signal based distances:
  - Root mean square error

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- Signal based distances:
  - Root mean square error
  - Mean bias error

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- Signal based distances:
  - Root mean square error
  - Mean bias error
- Distribution based distances:

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- Signal based distances:
  - Root mean square error
  - Mean bias error
- Distribution based distances:
  - Kolmogorov-Smirnov distance

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- Signal based distances:
  - Root mean square error
  - Mean bias error
- Distribution based distances:
  - Kolmogorov-Smirnov distance
  - Root mean square of Hellinger distances for normal distributions

### Distance of Hellinger



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### Root mean square of Hellinger



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### DNI estimation methods



# DNI estimation methods



#### Winter temperature estimates



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### Spring temperature estimates



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• Urban canopy model coupled with a detailed building energy model

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- Urban canopy model coupled with a detailed building energy model
- Validation protocol for mean urban temperature in the Sperrstrasse

- Urban canopy model coupled with a detailed building energy model
- Validation protocol for mean urban temperature in the Sperrstrasse
- Daily accuracy of temperature estimates using DISC or DIRINT models

- Urban canopy model coupled with a detailed building energy model
- Validation protocol for mean urban temperature in the Sperrstrasse
- Daily accuracy of temperature estimates using DISC or DIRINT models
- Measurements are underestimated in winter and overestimated in spring

Thank you for your attention

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#### Impact on energy consumption



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### Winter night impact

#### +4% average temperature $\Rightarrow$ -7.2% total fuel consumption