Multi-scale computational assessment of ventilative cooling as an energy-efficient measure to avoid indoor overheating

Name **Katarína Košútová**
Contact k.kosutova@tue.nl
Promoter Prof.dr.ir. Bert Blocken
2nd Promoter Prof.dr.ir. Jan Hensen
Daily supervisor Dr.ir. Twan van Hooff
Groups Building Physics and Services

Introduction

People spend 80-90% of their time indoors, which leads to higher energy consumption for heating, ventilation and cooling. The use of non-renewable sources of energy to cover this energy demand has negative effects on climate change and the Urban Heat Island effect, therefore new, sustainable solutions are necessary. Ventilative cooling can be one of the sustainable solutions. It refers to the use of natural ventilation driven by wind and/or buoyancy to either replace or supplement traditional air-conditioning systems. It can be an energy-efficient measure to avoid indoor overheating, and it can contribute to high indoor air quality as well as thermal comfort levels.

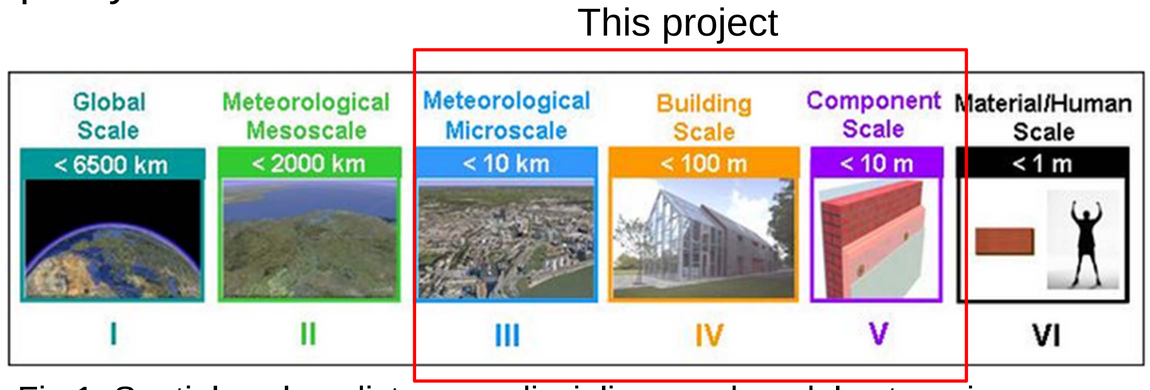

Fig 1: Spatial scales, distances, disciplines and model categories with indication of the focus of the present project.

Objectives

This project focuses on the multi-scale computational assessment of ventilative cooling as an energy-efficient measure to avoid indoor overheating in buildings. It can be divided into three main objectives:

- Model development: Development of high-accuracy and efficient coupling strategy between Computational Fluid Dynamics (CFD), Building Energy Simulation (BES) and Building-Envelope Heat and Moisture (BE-HM) transfer models for the analysis of ventilative cooling.
- Model application: Application of the developed coupled model to assess the potential of ventilative cooling for case study buildings in the cities of Copenhagen, Munich, Lausanne and Eindhoven.
- Strategy development: Suggestion of optimal building design and building renovation strategies, and provide suggestions for optimal ventilative cooling strategies for these buildings.

Fig 2: Cities of Euro-Tech consortium, in which ventilative cooling strategies for generic buildings will be applied.

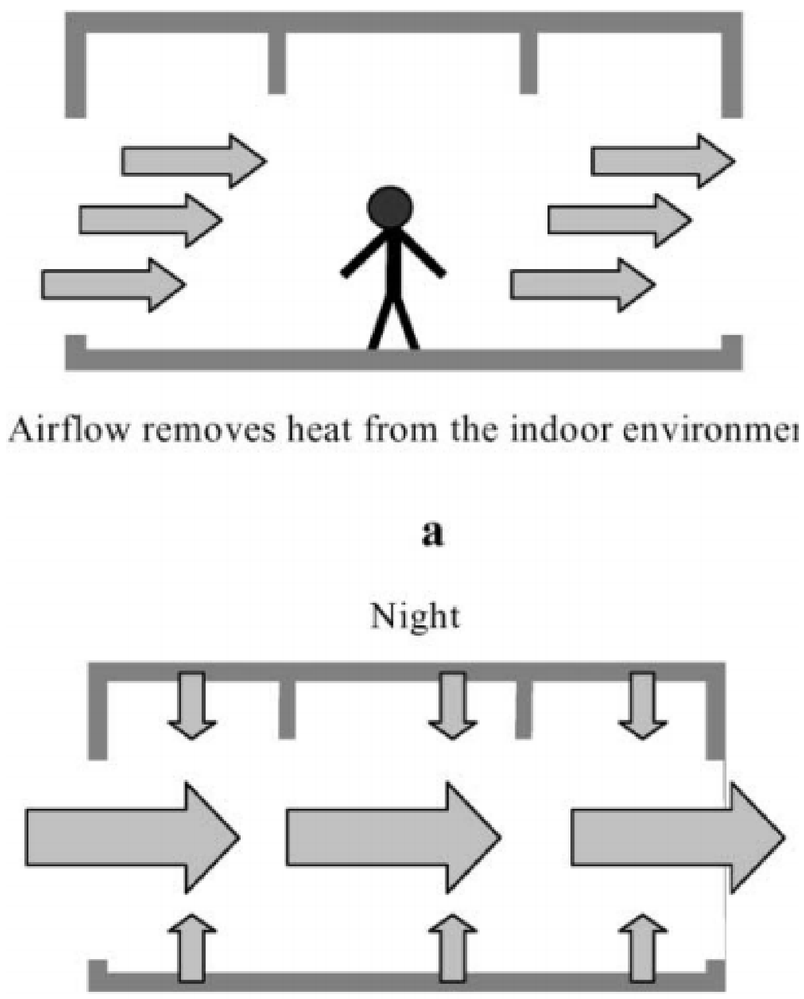

Fig 3: Principle of operation of the two ventilative cooling strategies:
(a) daytime ventilation removes indoor heat by bringing in outdoor air;
(b) night cooling cools the thermal mass during night;
(c) night cooling uses the thermal mass to absorb heat during the day. [1]

References:

[1] G.Carrilho da Graça, Q.Chen, L.R Glicksman, L.K Norford, Simulation of wind-driven ventilative cooling systems for an apartment building in Beijing and Shanghai, Energy and Buildings, Volume 34, Issue 1, 2002, Pages 1-11.