BES with FEM:
Building Energy Simulation using
Finite Element Method

dr. Jos van Schijndel

TU/e Technische Universiteit
Eindhoven
University of Technology

Where innovation starts

Scale levels Building physics

~Mm   ~km   ~m   ~mm
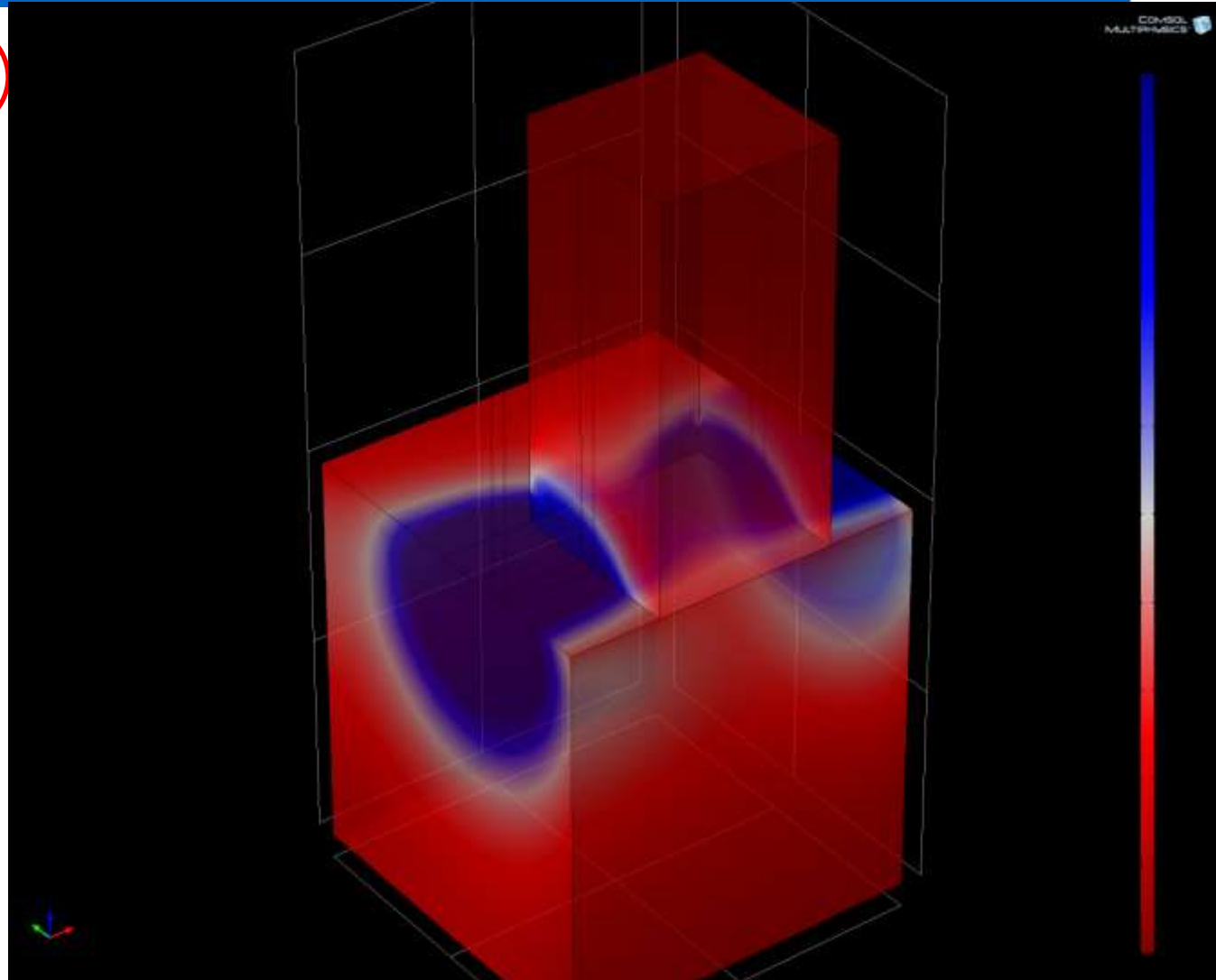
Scale levels, from left to right: EU; Urban area; Building; Material;

- **[mm] Material Physics**
- **[m]   Building Physics**
- **[km] Urban   Physics**
- **[Mm] Climate Physics**

Scale level [mm] Material Physics Moisture induced damages

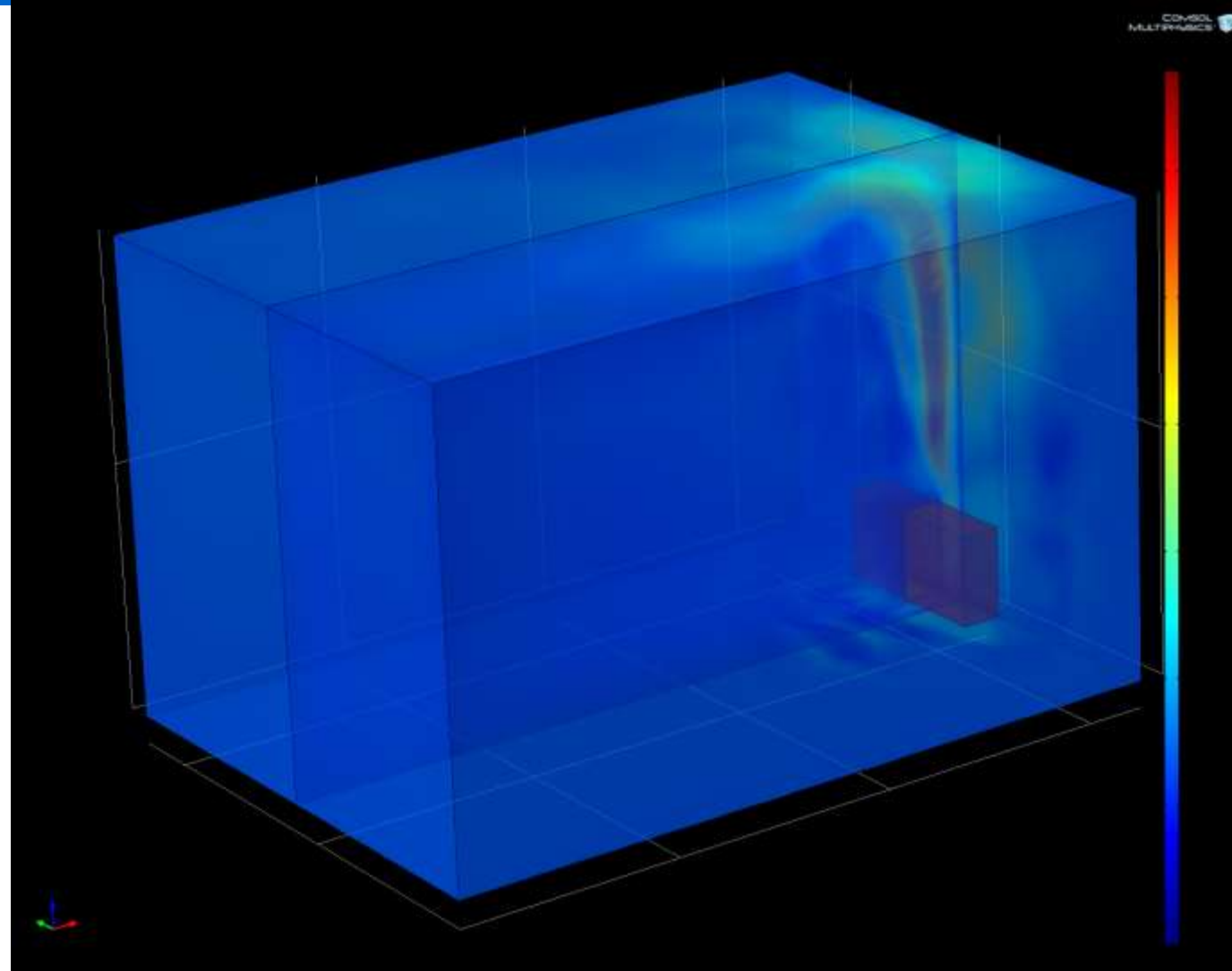Scale levels, from left to right: EU; Urban area; Building; Material;
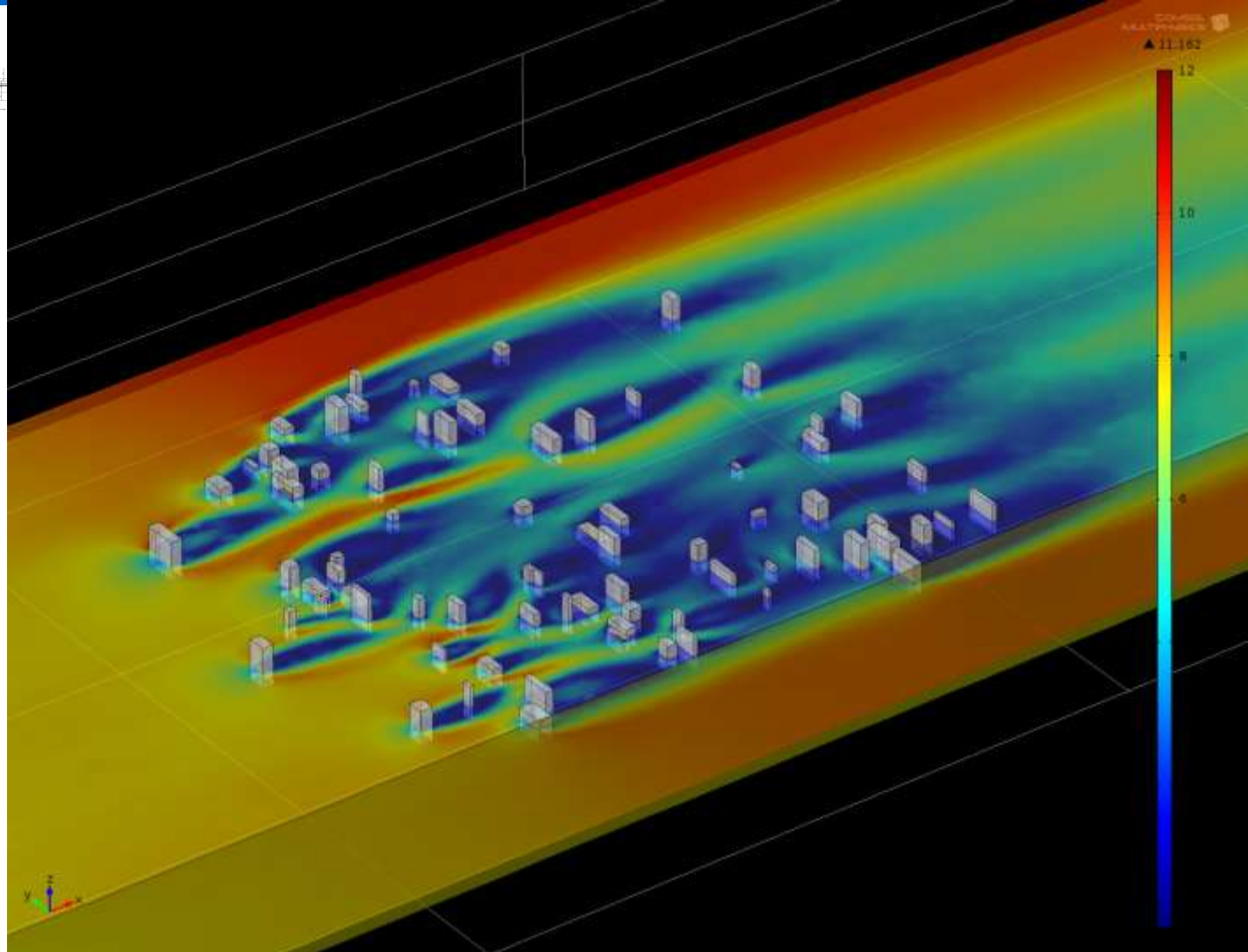
Scale level [m] Building Physics
Indoor climate performance & design

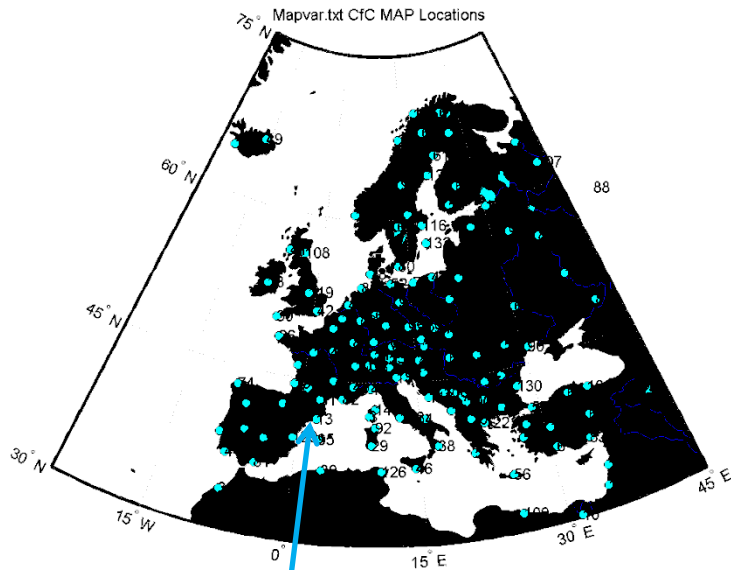Scale levels, from left to right: EU; Urban area; Building; Material;

Scale levels, from left to right: EU; Urban area; Building; Material;

Scale level [Mm] EU physics
EU climate scale performance & design

Scale levels, from left to right: EU; Urban area; Building; Material;

Mapvar.txt CfC MAP Locations

Virtual building placement
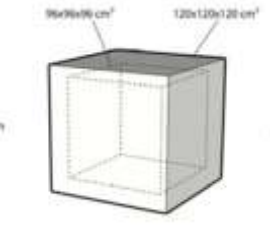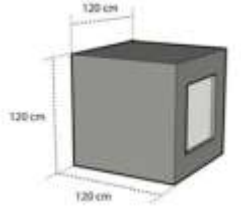

BESvar.txt CfC MAP Locations Column 7
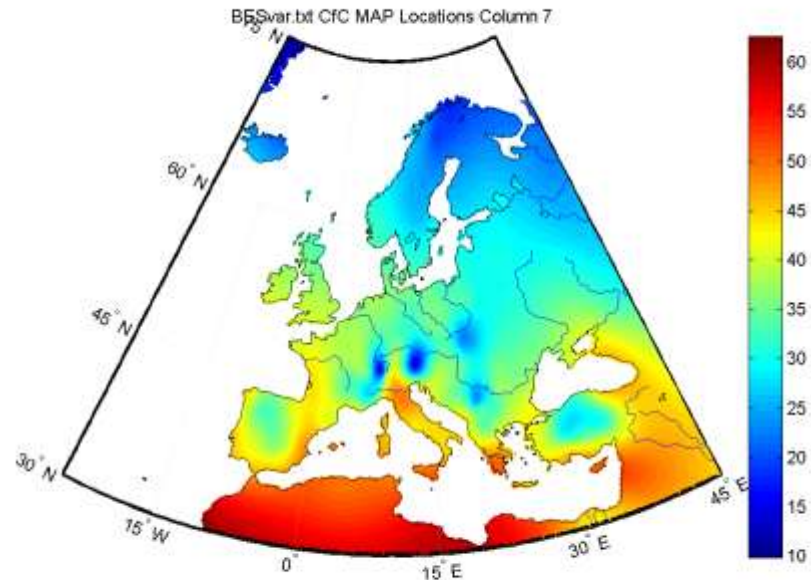
# Building Energy Performance Simulation tools

- **Existing Software: Energy plus, WuFi, IES,..**
- **One temperature for each zone**
- **Output: energy for heating & cooling**
- **Based on** **Lumped** **parameter modeling**

- **Research question: What about** **distributed** **parameters modeling?**
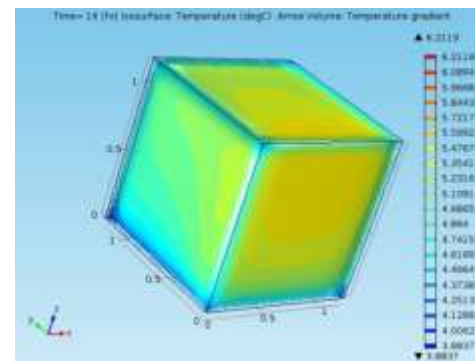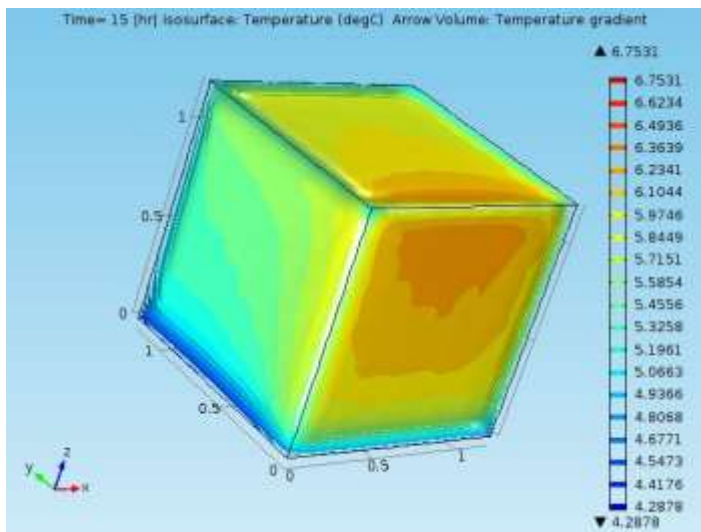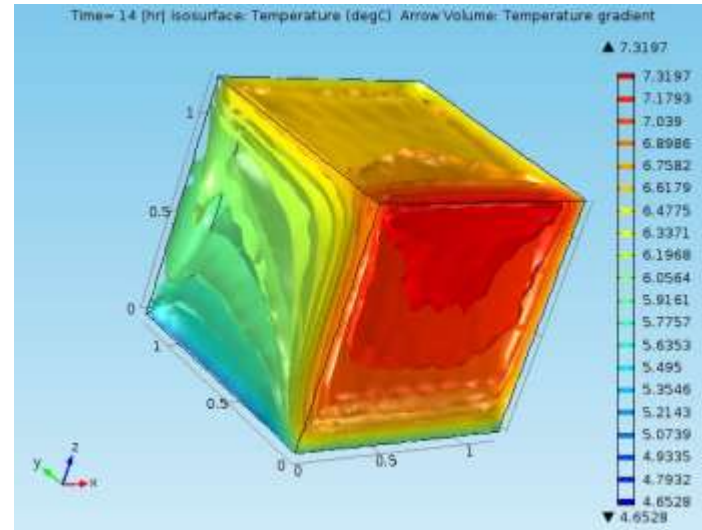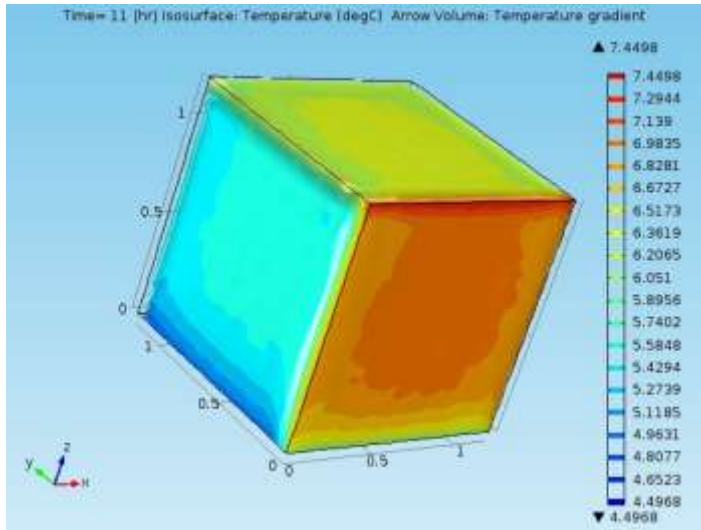- **How to 'calibrate' a distributed model with a lumped model?**
-

Method

Complexity	Lumped (HAMBase)	Distributed (Comsol)
	√	√
	√	√
Towards Realistic Buildings	√	…

TU/e Technische Universiteit
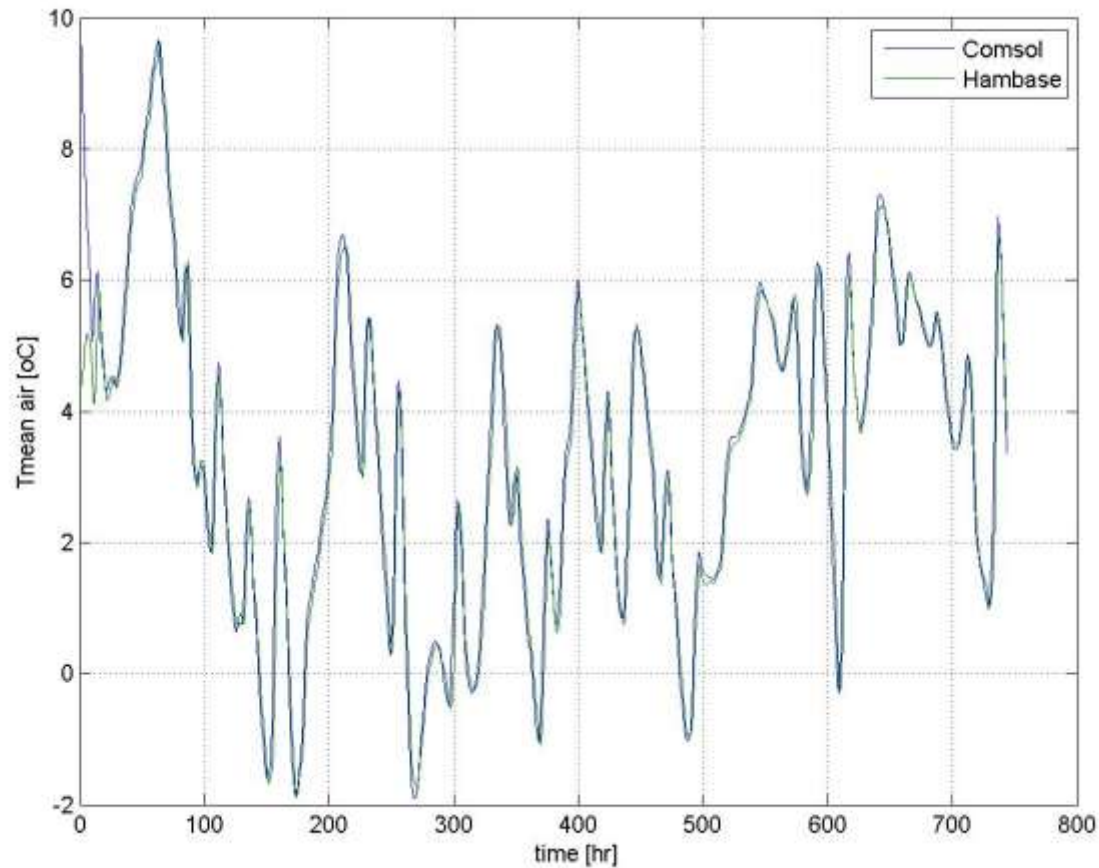**Eindhoven**
University of Technology

Opaque box
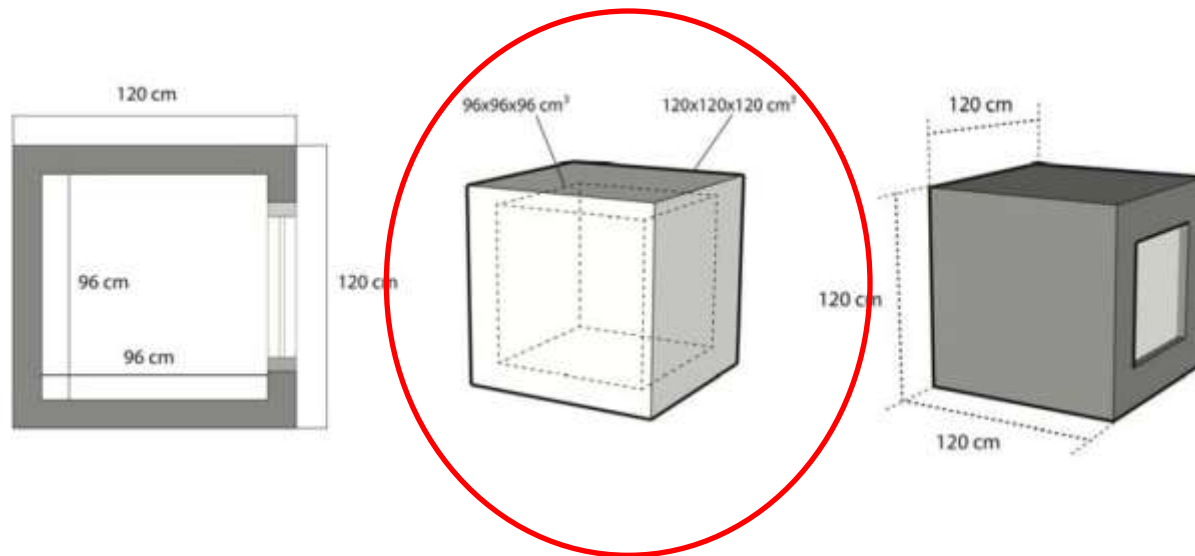
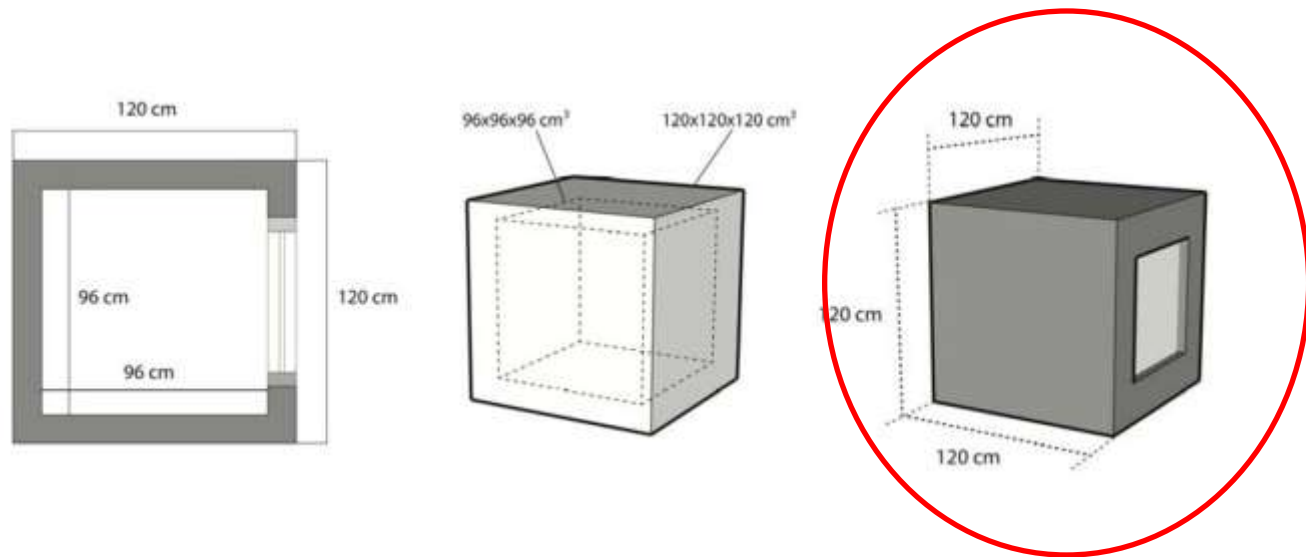# Response to external climate simulated with Comsol

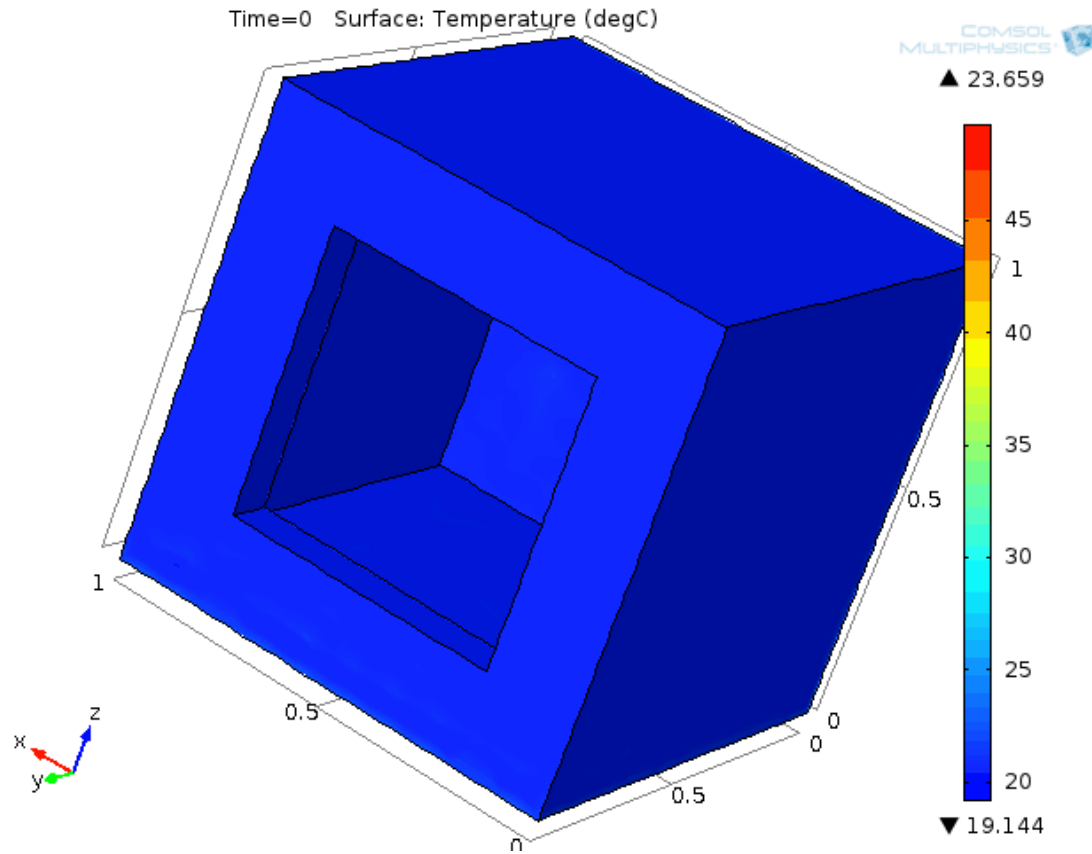# Distributed (Comsol) vs Lumped (HAMBase)

Calibration in Comsol:

• air: equivalent heat conduction k=d/Req

•mean(Tair)

Box with a single window

Box with a single window

Conclusion

- **Preliminary results are very promising**

- **Future research:**
  - **Towards realistic buildings**
  - **Include CFD**