Aero-thermal simulation of a refrigerated truck under open/closed door cycles

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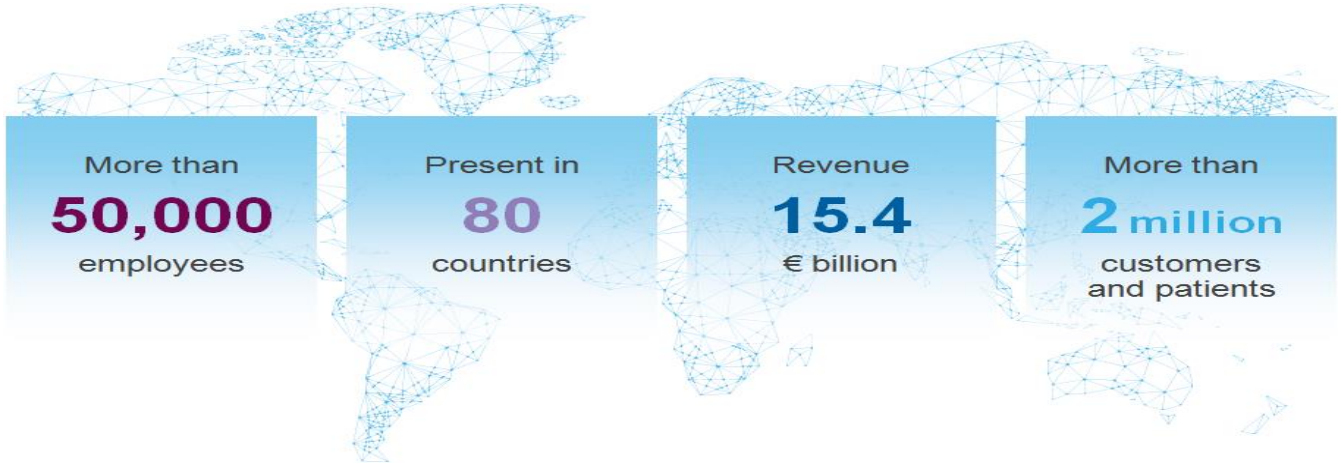

- SIMTEC

✓ Comsol certified consultant

✓ **Fields of expertise:**
- Electromagnetism
- Structural mechanism
- Heat transfer modeling
- CFD
- Chemical Engineering

COMSOL Certified Consultant

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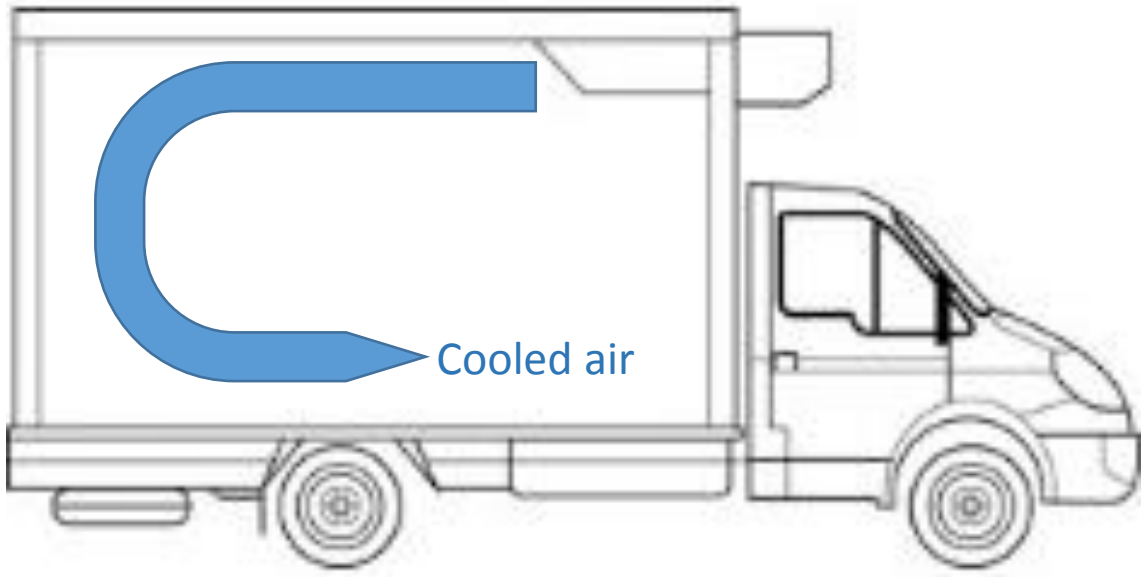
Content

1. Purposes of the study

Refrigerated truck

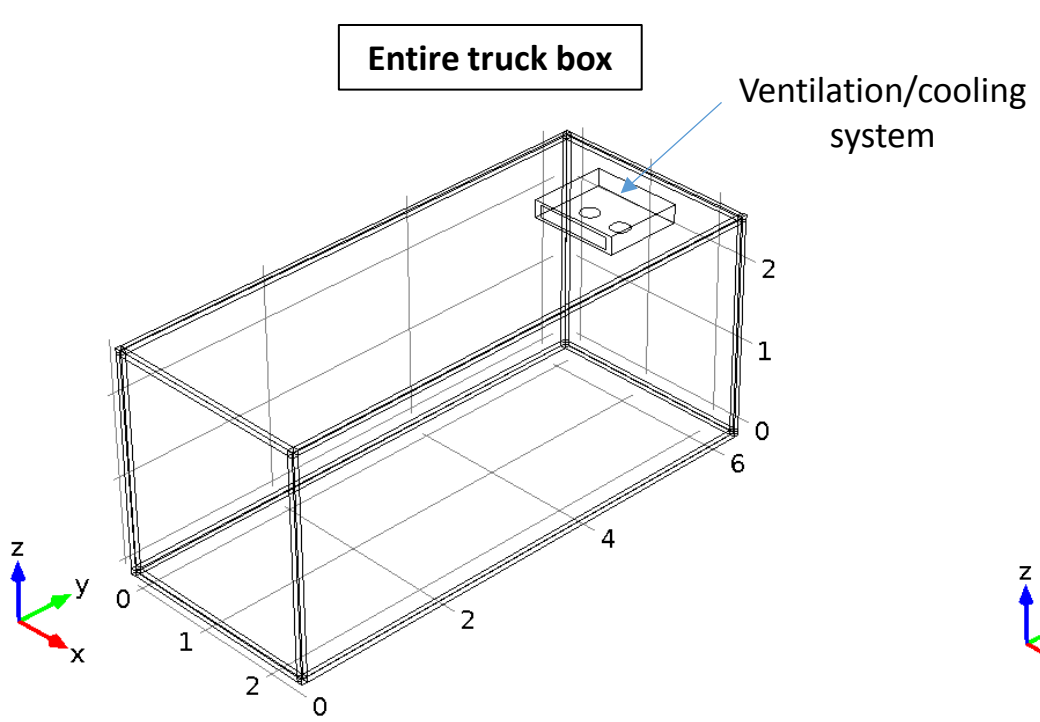


- Predict the temperature/air velocity distribution in the refrigerated box
- What happens when the rear door is open?
- Design efficient insulating walls

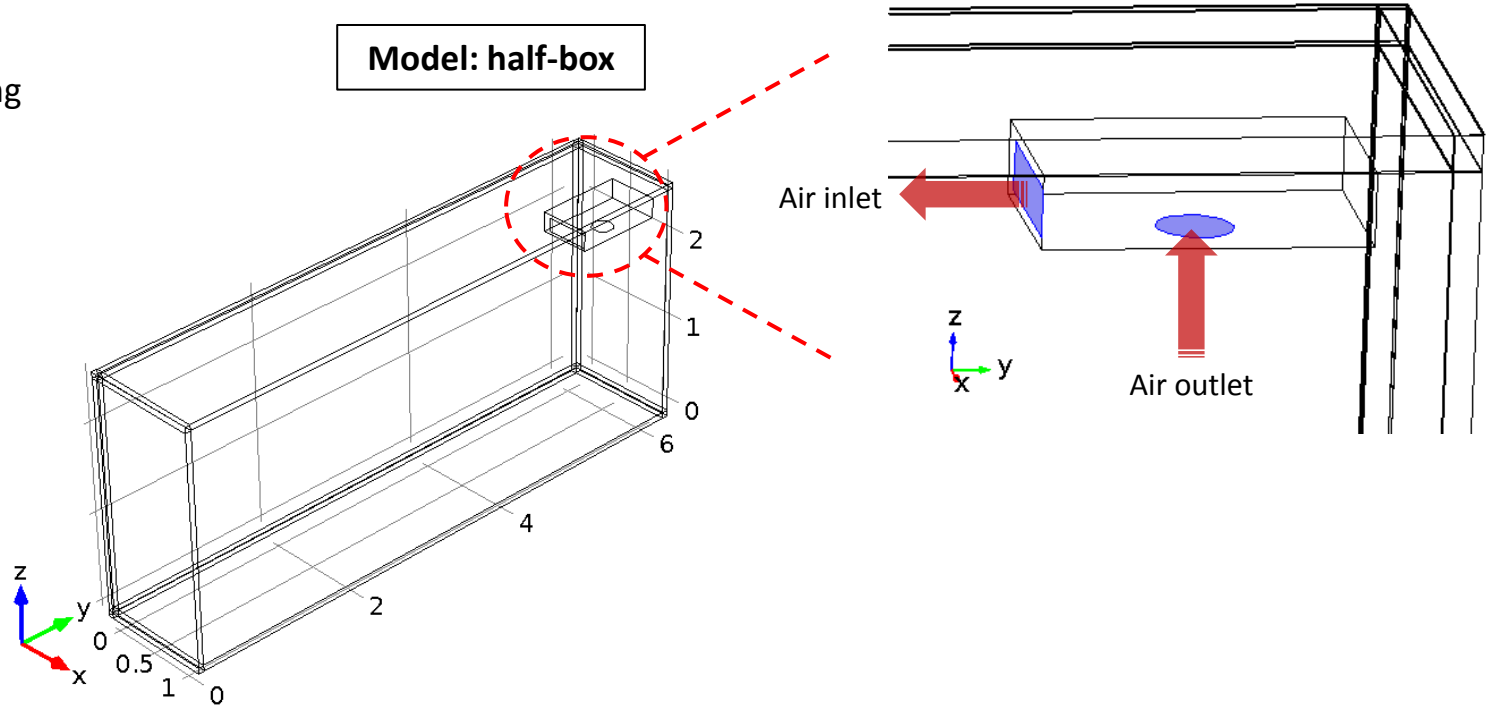
2. Model description

- Geometry

Entire truck box

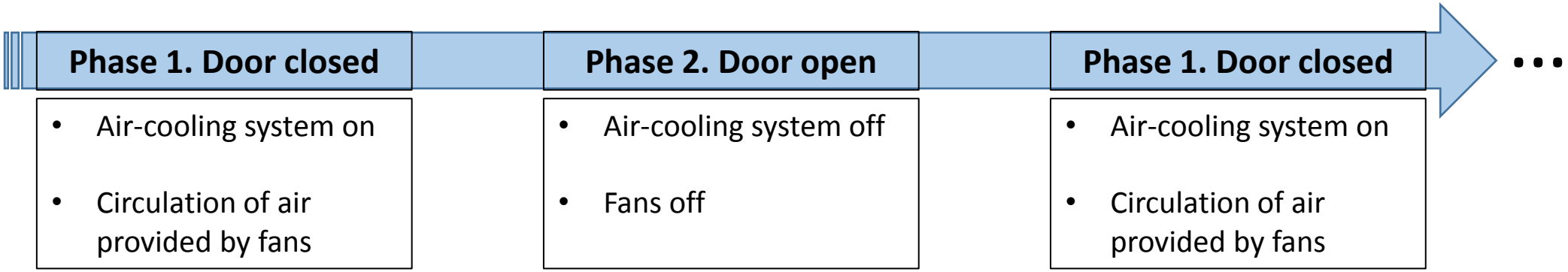


Model: half-box



2. Model description

- Refrigerating cycles to be simulated

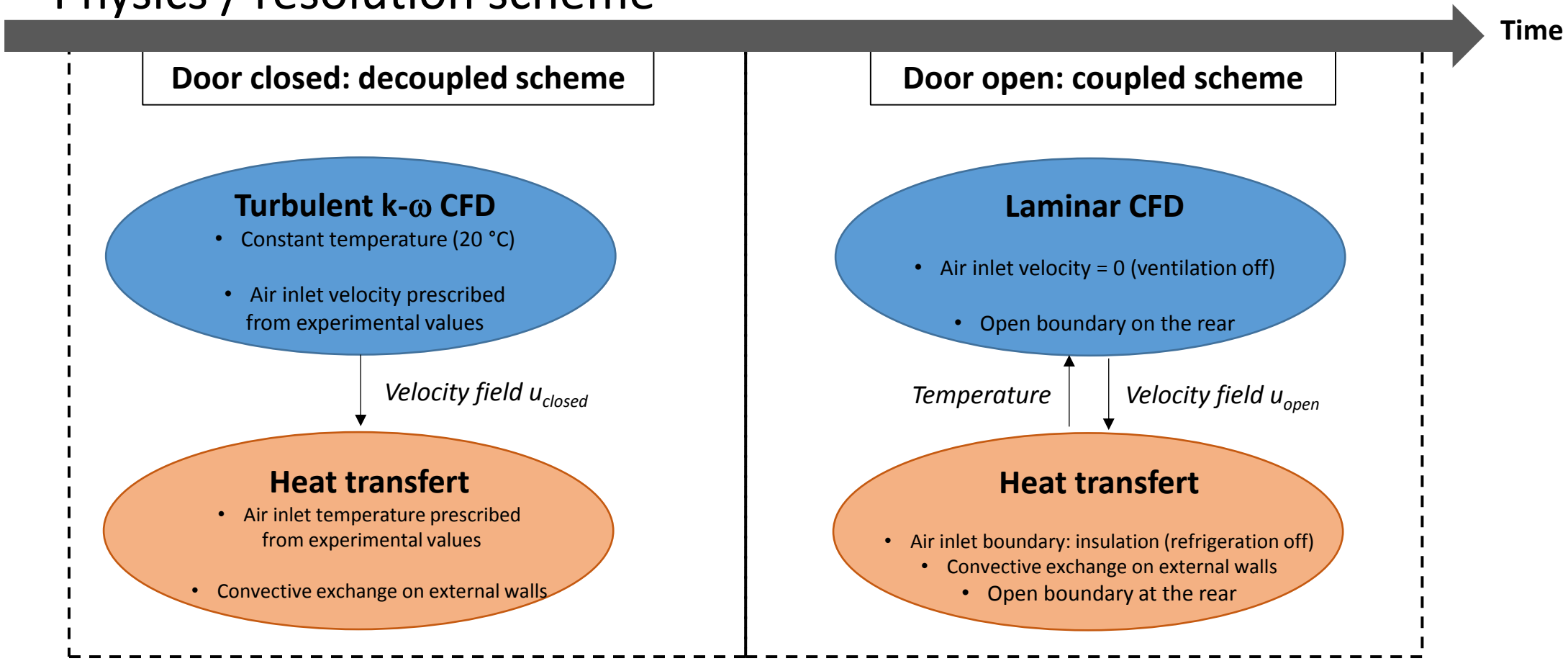


✓ **Data to be reproduced:** air temperature inside the box as a function of time

✓ Flow rate of the fans, air inlet temperature, external temperature: set to experimental data

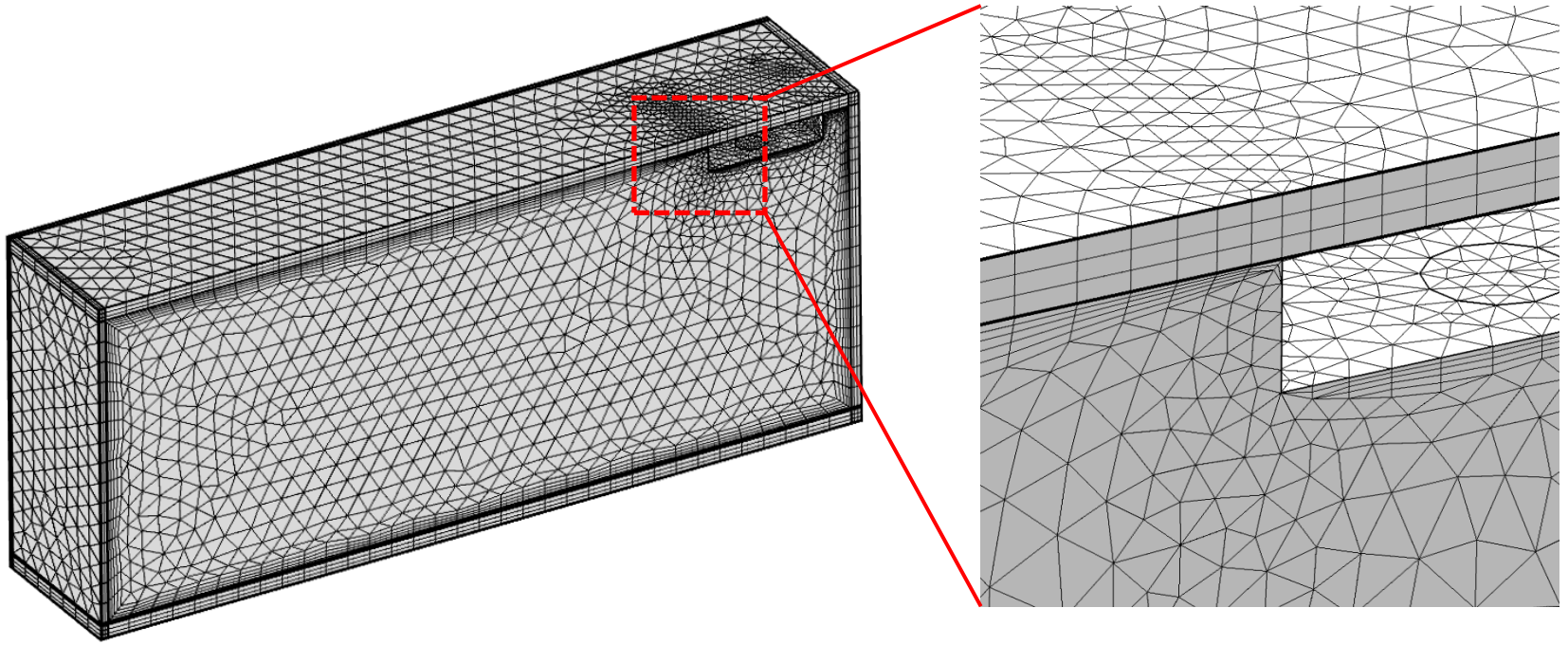
2. Model description

- Physics / resolution scheme



2. Model description

- Mesh

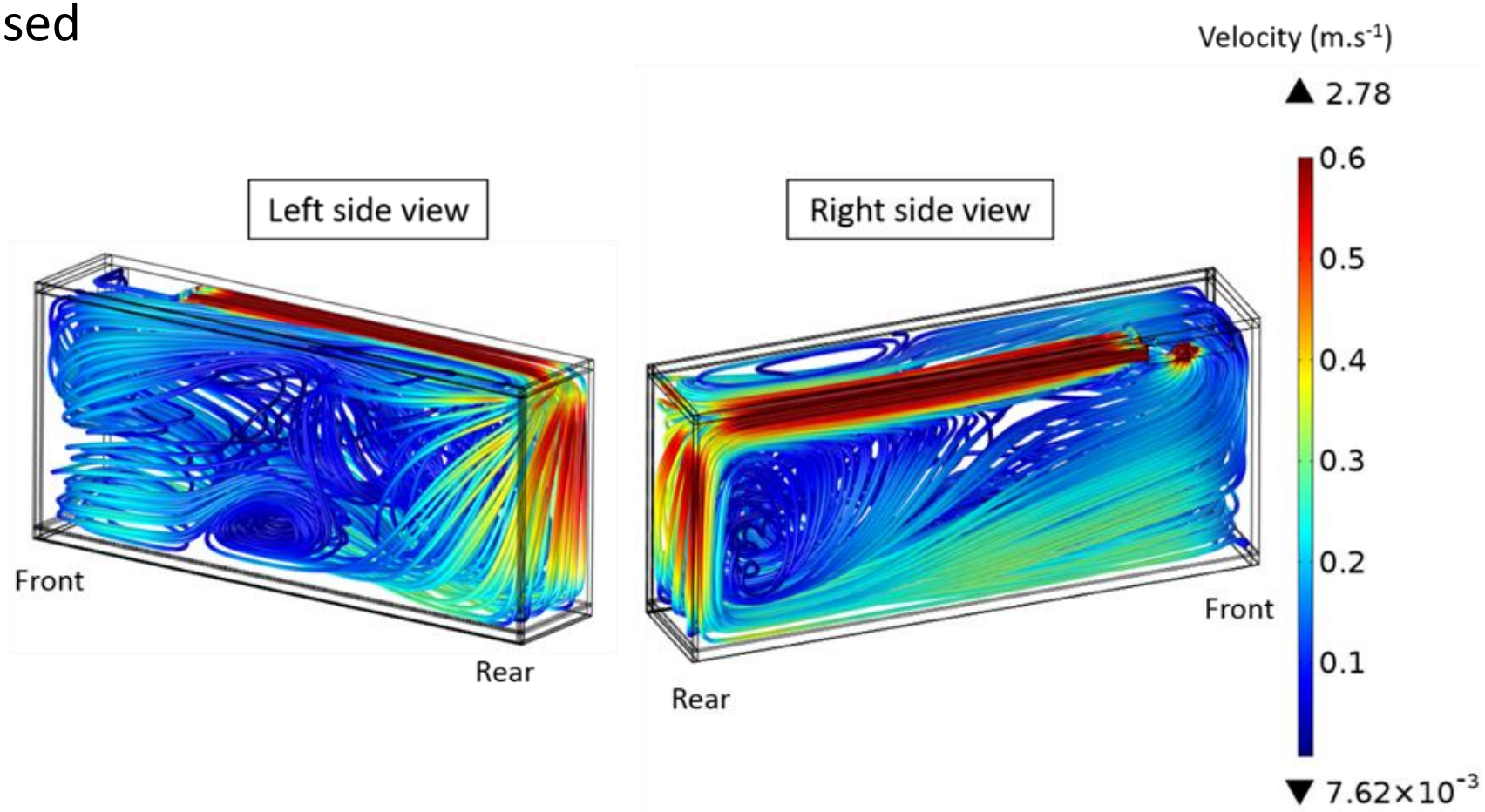


- Volume box: tetragonal mesh
- Boundary layers mesh on the inner walls
- Swept prismatic elements in the wall depth

3. Results

- Phase 1. Door closed

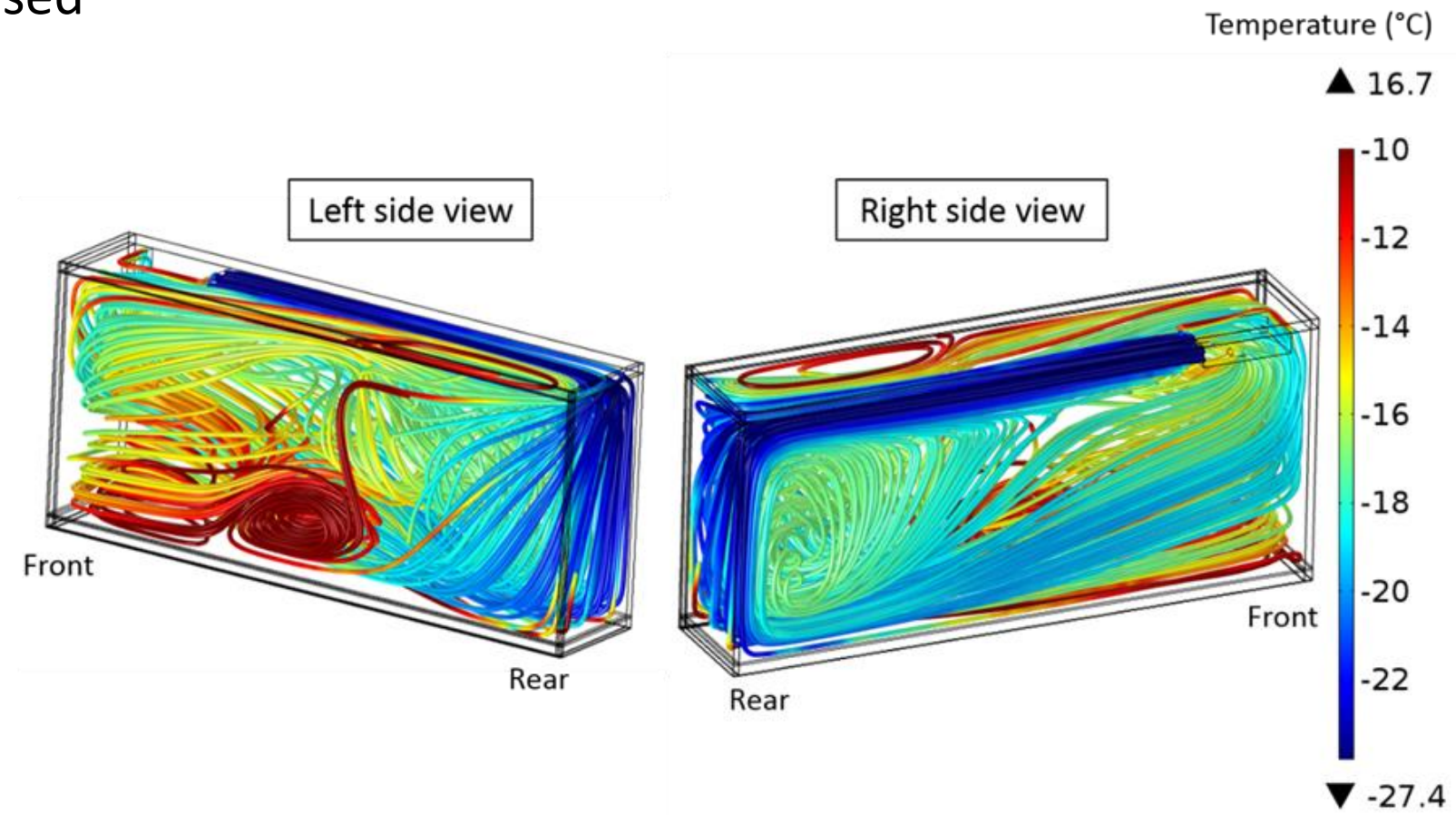
Steamlines representation of the air flow velocity simulated under quasi-steady state conditions



3. Results

- Phase 1. Door closed

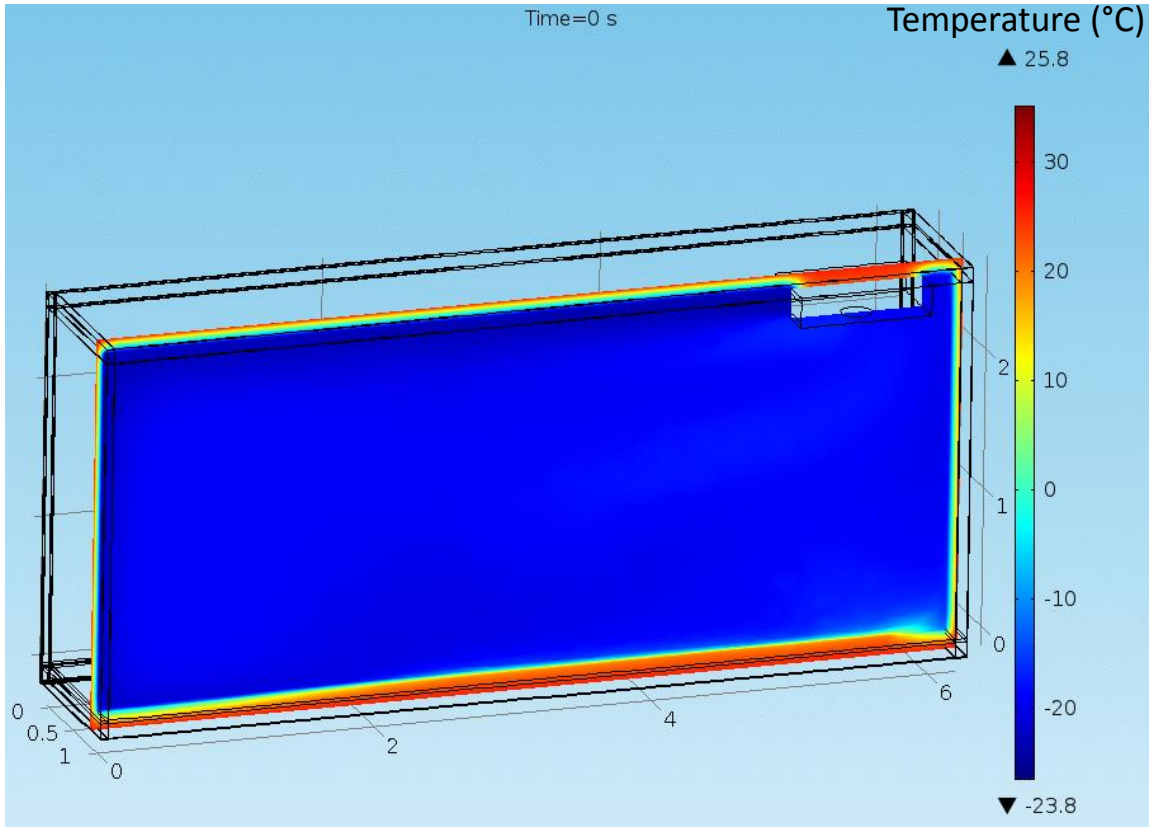
Steamlines representation of the air temperature simulated under quasi-steady state conditions



3. Results

- Phase 2. Door open

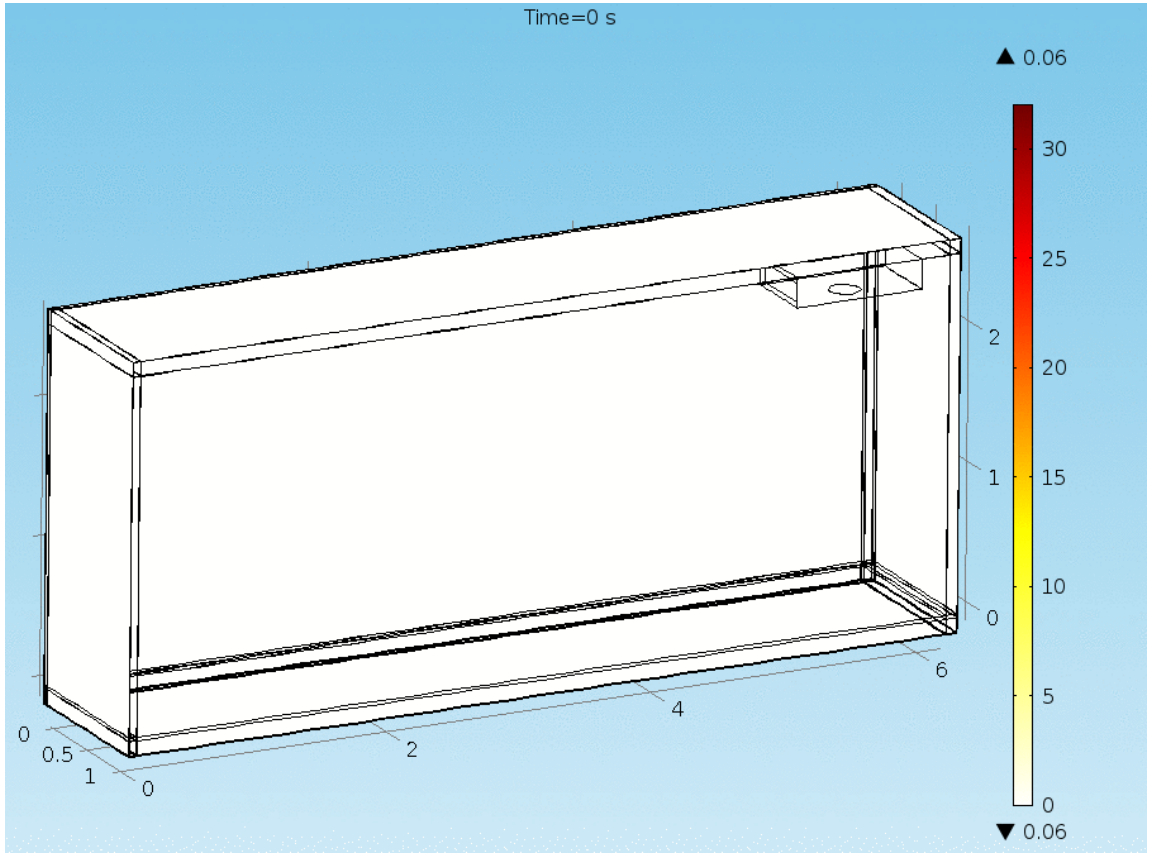
Temperature evolution inside the truck box after opening of the rear door (ventilation and cooling system switched off)



3. Results

- Thermal losses of the truck box

Thermal flux towards the outside (W/m²) during phase 1 (closed door)

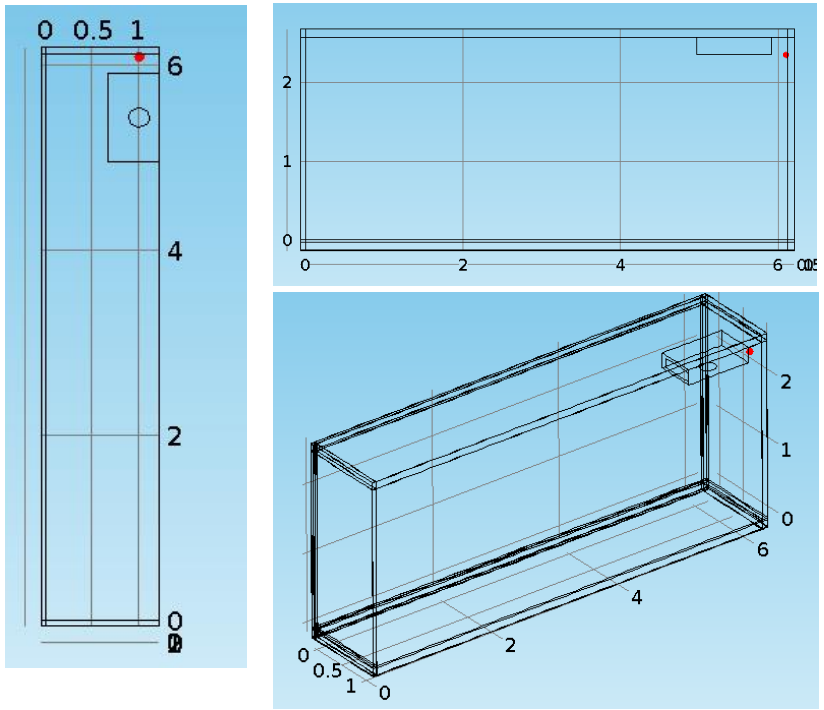


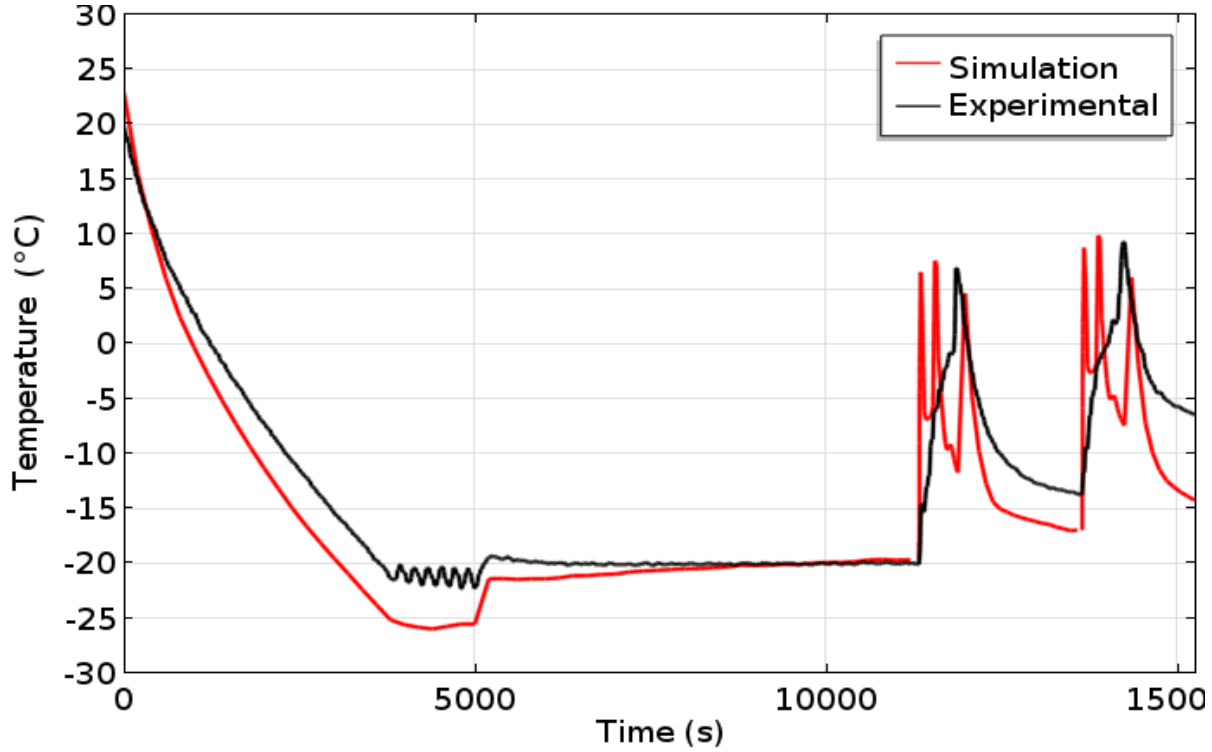
→ Optimisation of the box wall design and chose of appropriate insulation materials

3. Results

- Comparison with experimental temperatures

Position of the sensor





4. Conclusions

- Aero-thermal simulation of the truck box: 2 different modelling approaches

- Door closed/ventilation on : turbulent CFD model decoupled to heat transfer

- Door open/ventilation off: laminar CFD coupled to heat transfer (natural convection model).

- Good agreement between simulated temperature and experimental measures:

→Coupling problems involving **turbulent CFD** and **thermal transfer** easy to solve with Comsol

- Assessment of the heat losses through the box wall: possibility to optimize the wall materials and design.

Thanks for your attention… and your questions!

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