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ANIMAL WELFARE INDICATORS AT THE SLAUGHTERHOUSE

awish-project.eu

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aWISH Project Outcomes Thermal Stress Modelling

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Question for you

Where do you think heat ‘hotspots’ most often occur inside a poultry transport truck?

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Context

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- **Annual Impact :** Millions of broilers transported globally in potentially stressful conditions
- **Economic Loss :** Heat stress during transport leads to mortality, weight loss, and meat quality degradation
- **Animal Welfare :** Suboptimal transport conditions compromise bird health and comfort
- **Climate Change :** Rising global temperatures and extreme weather events intensify heat stress risks during transport

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Context

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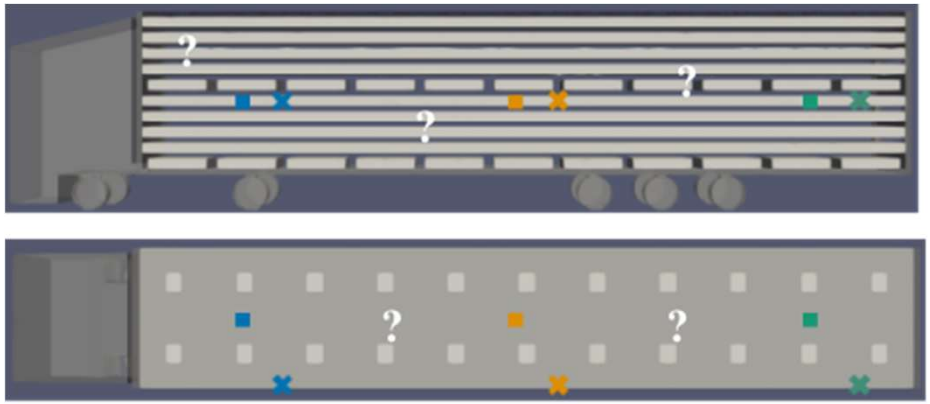
- **Can ambient conditions be estimated without sensors?**
  - Cost reduction
  - Time savings
- **How to extrapolate the measured temperatures to all birds ?**
  - More comprehensive knowledge of heterogeneities
- **What is the air velocity distribution within the containers themselves?**
  - Essential for properly understanding thermal stress

CFD modeling
(Computational Fluid Dynamics)



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Modeling

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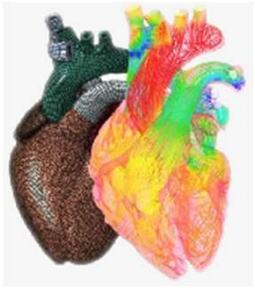
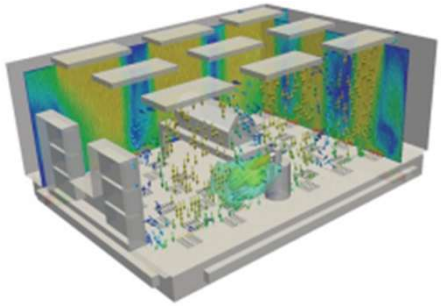
What is CFD ?

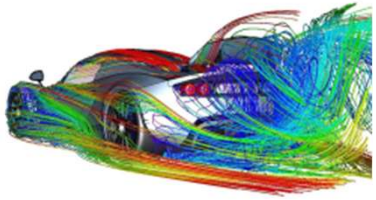
Biomedical



Ventilation



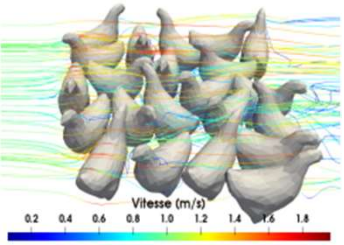
Aerodynamics



Urban planning

Specifications

- Animal layer treated as a porous medium
- Characteristics reflecting density and body weight



Heat emitted by animals:

- sensible
- latent

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Demonstration – Hottest Monitoring

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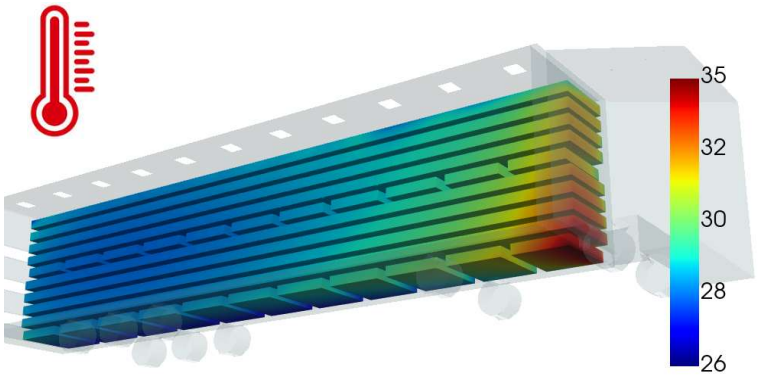
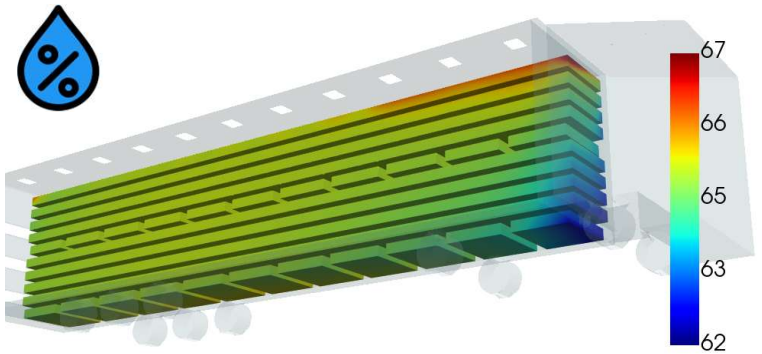


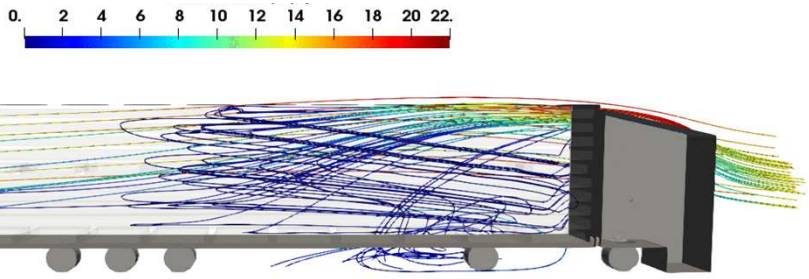
Temperature (°C)



Relative Humidity (%)

T outside	24.8 °C
RH outside	74%
Average Velocity	60 km/h
Number of animals	7788
Body Weight	2.25 kg

Air velocity (m/s)



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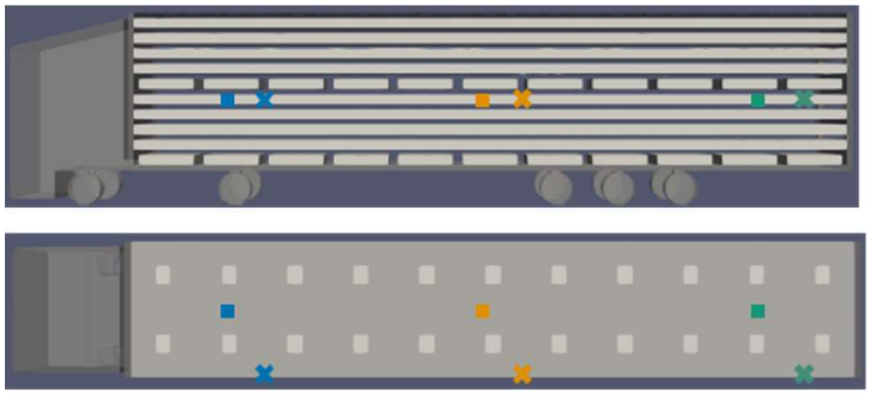
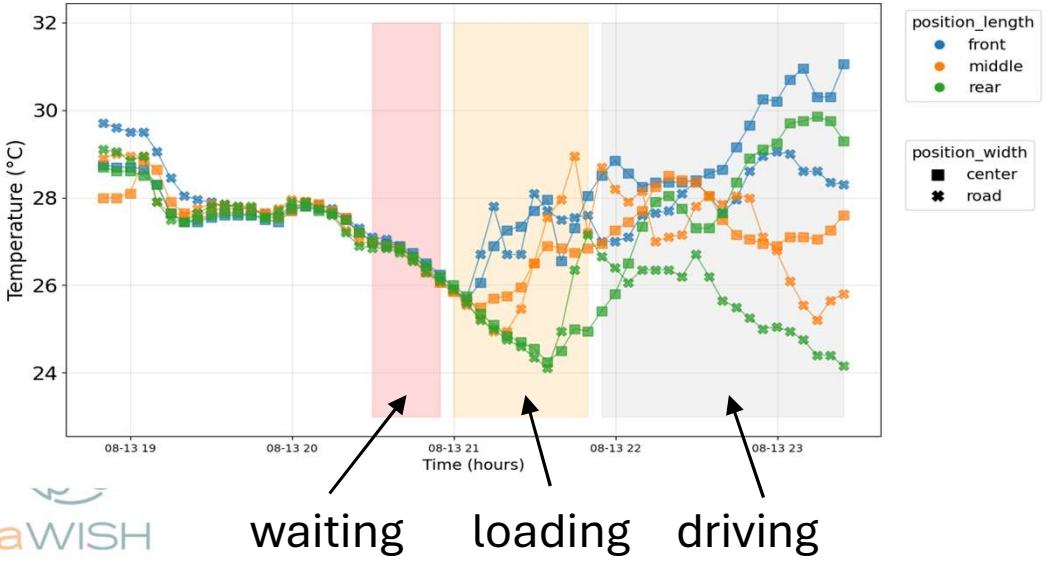
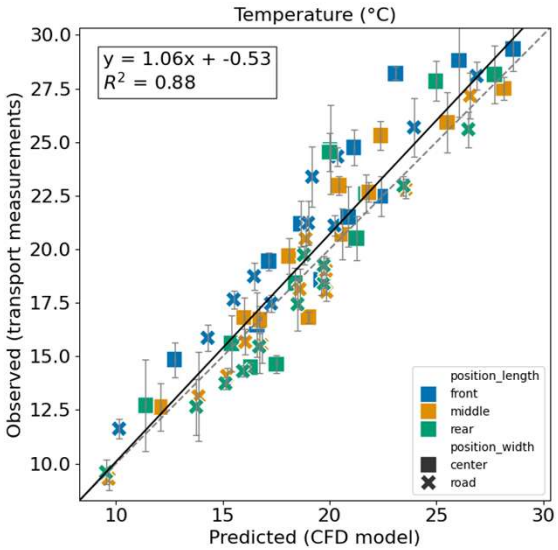
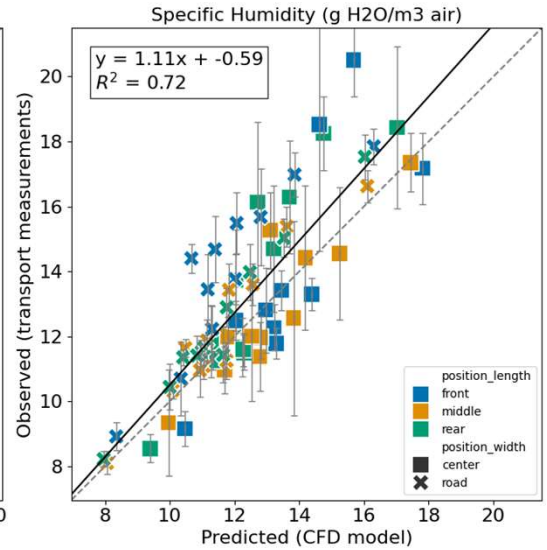
Validation







RMSE = 1.95 °C



RMSE = 1.63 g/m^3

How to transform this physical data into thermal stress indicators?

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Heat Stress

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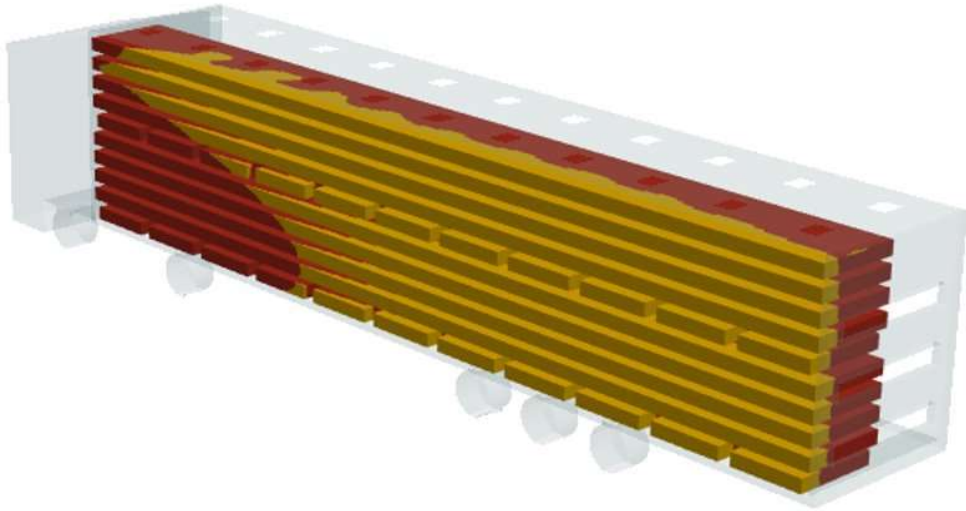
EFSA Journal Extract : Welfare of domestic birds and rabbits transported in containers (30/06/2022)

Apparent Equivalent Temperature **(AET)**



Safe	0%
Alert	20%
Danger	80%

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Heat Stress

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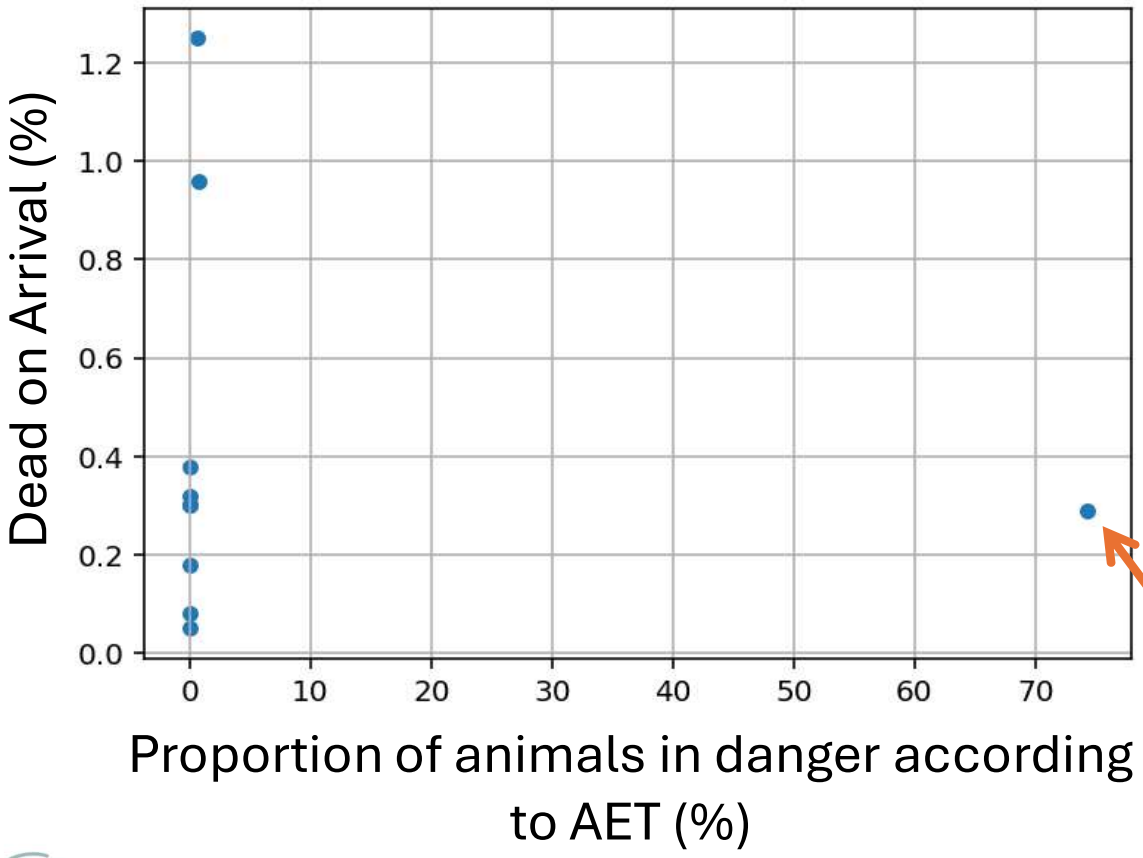

2 factors that may explain this discrepancy:

- Air velocity
- Exposure time

Hottest monitoring

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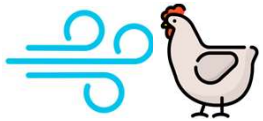
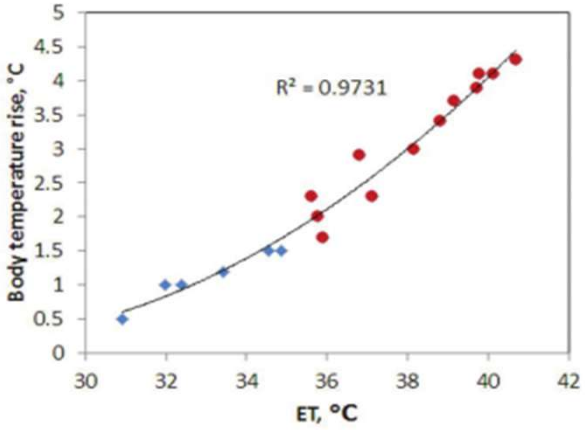
Influence of Air Velocity



Definition of **effective temperature**

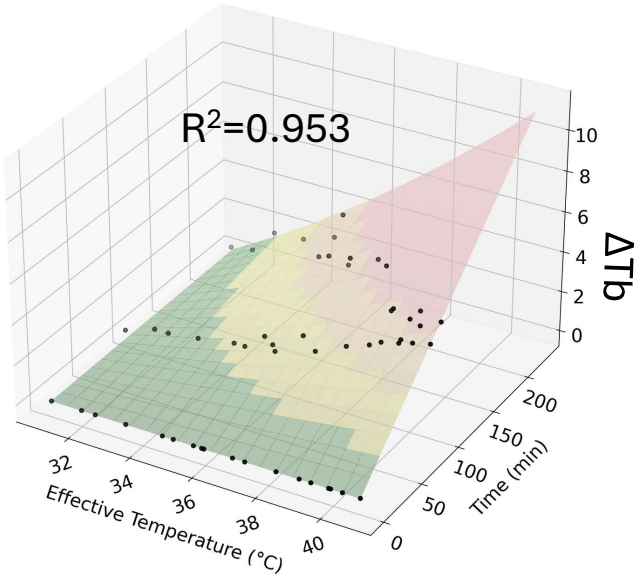
$$ET = 0.794t_{db} + 0.25t_{wb} + 0.70 - c(d - t_{db})(v^e - 0.2^e)$$



Reflects the fact that the cooling effect should decrease as air temperature approaches body temperature.

Influence of Time

ΔTb = **body temperature increase**

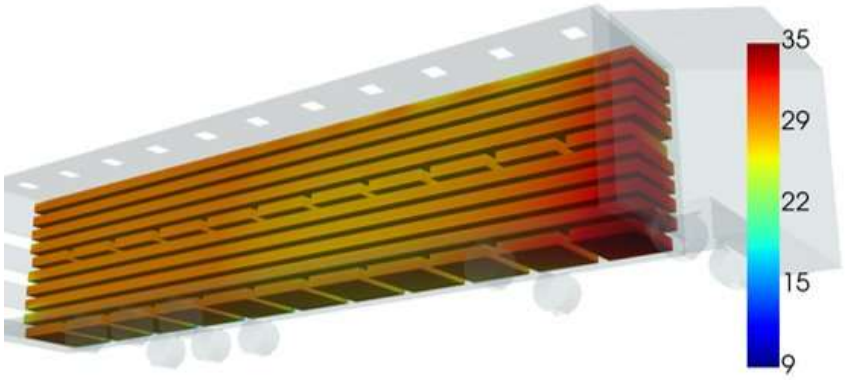


ΔTb<1°C
1°C < ΔTb < 2.5 °C
2.5°C < ΔTb < 4 °C
4°C < ΔTb

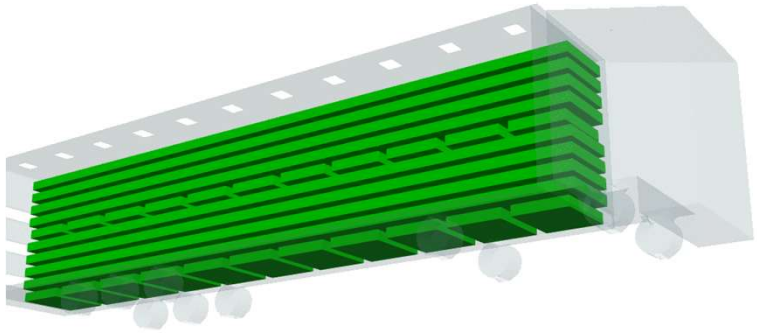
normal
alert
danger
emergency

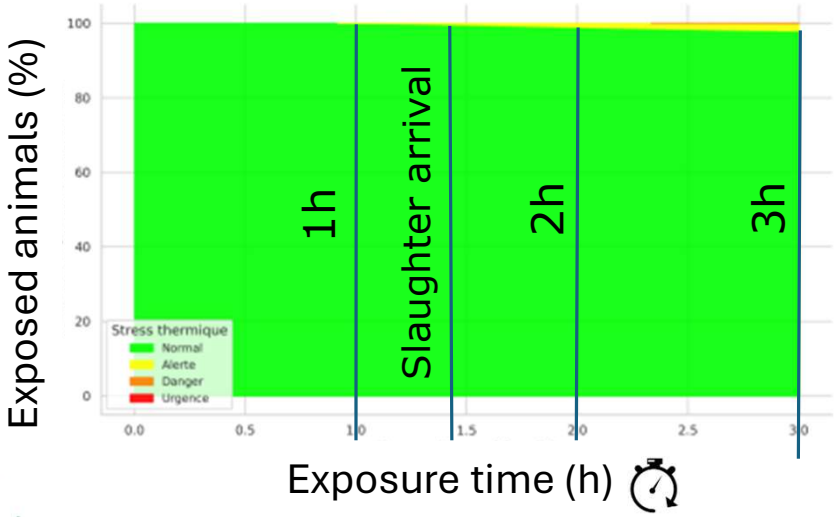
Effective Temperature for Poultry and Pigs in Hot Climate, Bjerg *et al, 2018*

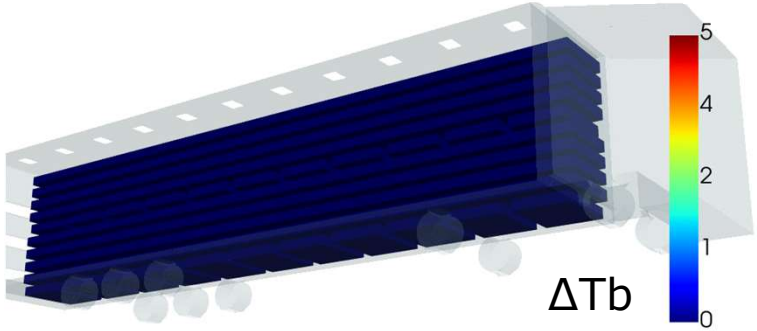
Heat Stress



Temps = 00 min







ΔTb<1°C — normal
1°C < ΔTb < 2.5 °C — alert
2.5°C < ΔTb < 4 °C — danger
4°C < ΔTb — emergency

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Simulations

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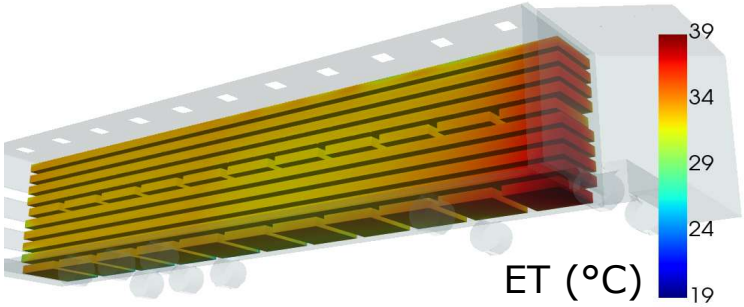
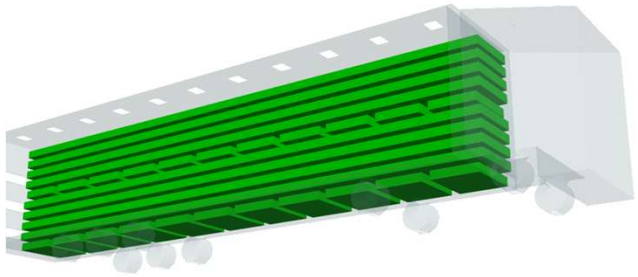
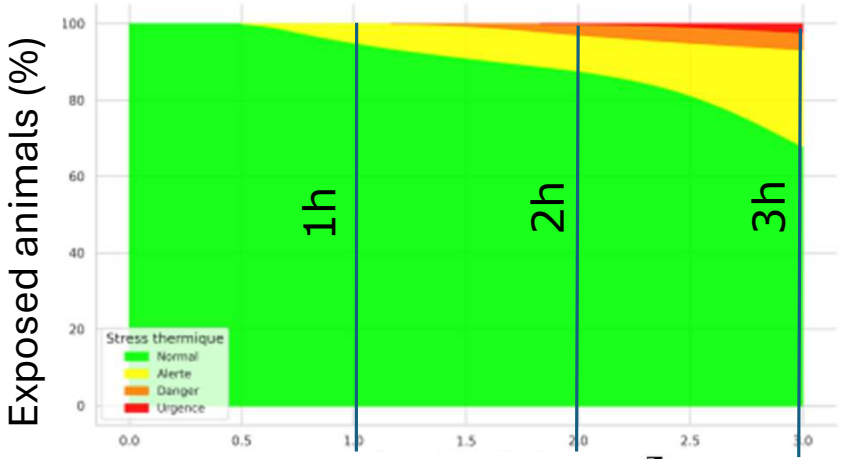
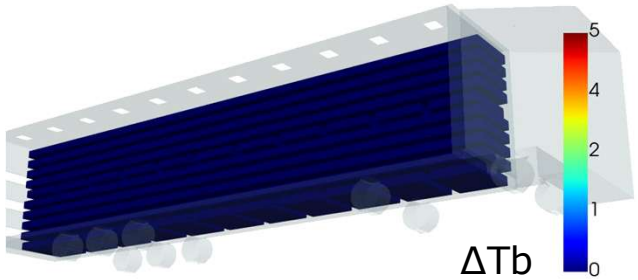


Temps = 00 min



T outside	30 °C
RH outside	40 %
Average Velocity	55 km/h
Number of animals	6600
Body Weight	1.95 kg





Mitigation strategies

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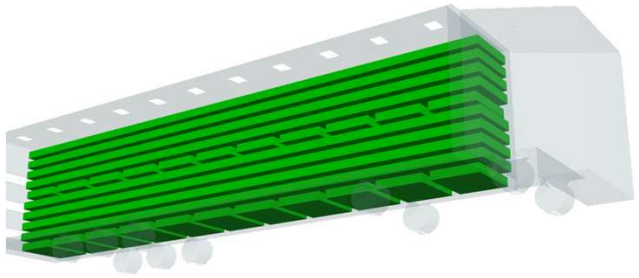
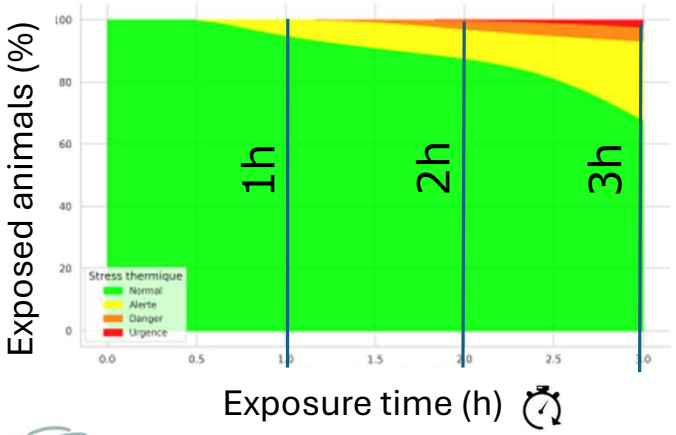
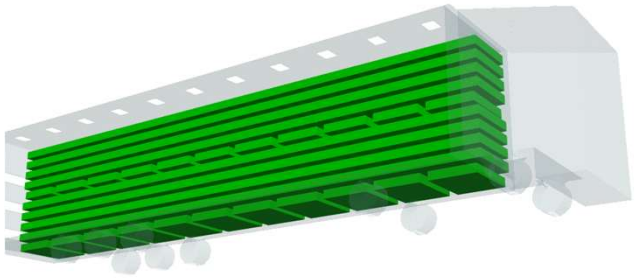
Temps = 00 min

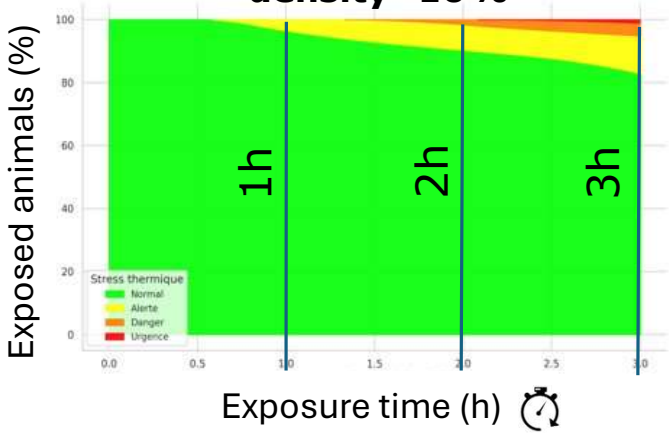




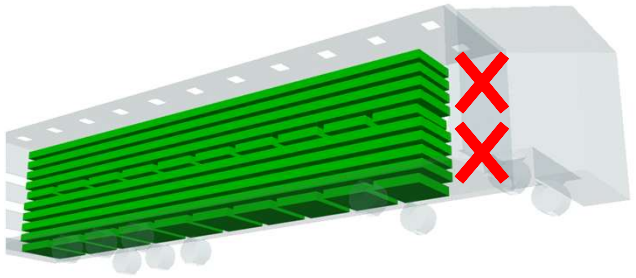
Temps = 00 min



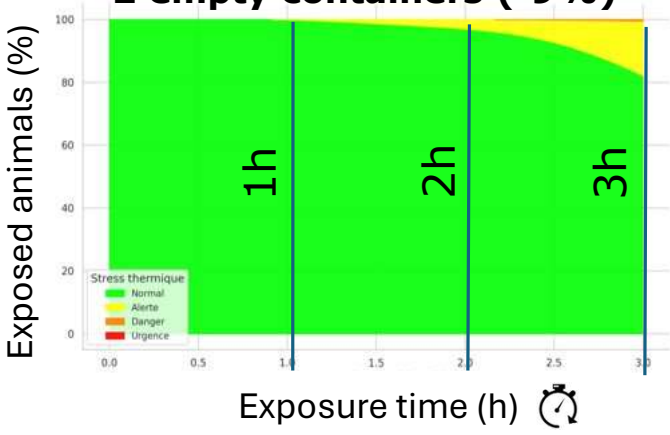
density -10%



Temps = 00 min



2 empty containers (-9%)



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Conclusion

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- A tool capable of quantifying the thermal stress based on:
  - weather conditions
  - loading
  - traffic
- Provide recommendations and mitigation strategies

Future work

- Incorporate variations in driving speed to account for traffic fluctuations
- Use the model for the waiting time at the slaughter house
- Multiply monitoring to add more weight to the model, particularly for mitigation strategies
- Build a chart or meta model of stress levels based on weather conditions