Smoke Control In Corridors

A Multiparametric Experimental Study And Its CFD Digital Twin

Dr Wojciech Węgrzyński, prof. ITB

Dr Grzegorz Krajewski

the corridor dillema

Time: 0.0

I designed a corridor smoke control, 4 m³/s but it does not please me @ 1 MW fire source

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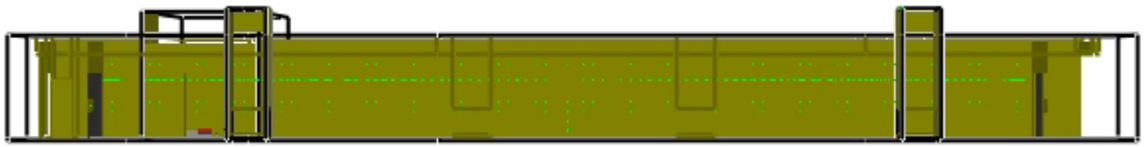

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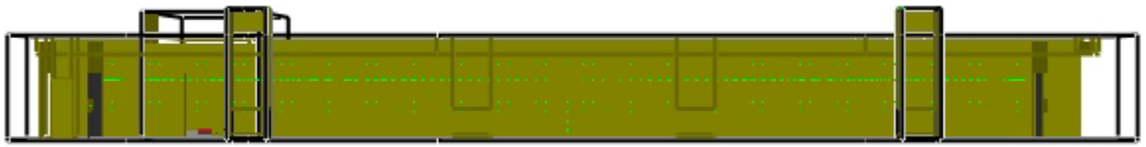
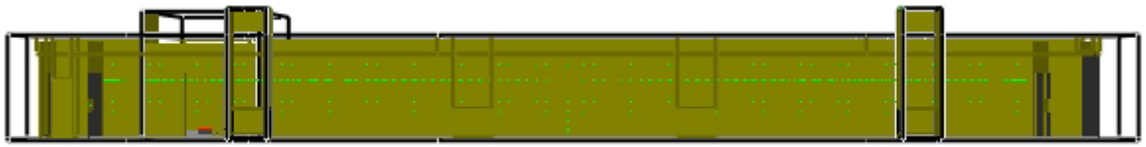


A good idea – lets assume that window can fall out at some temperature! BETTER!



And of course, there is an unblocked self-closing devc in the office... NOW ITS PERFECT!

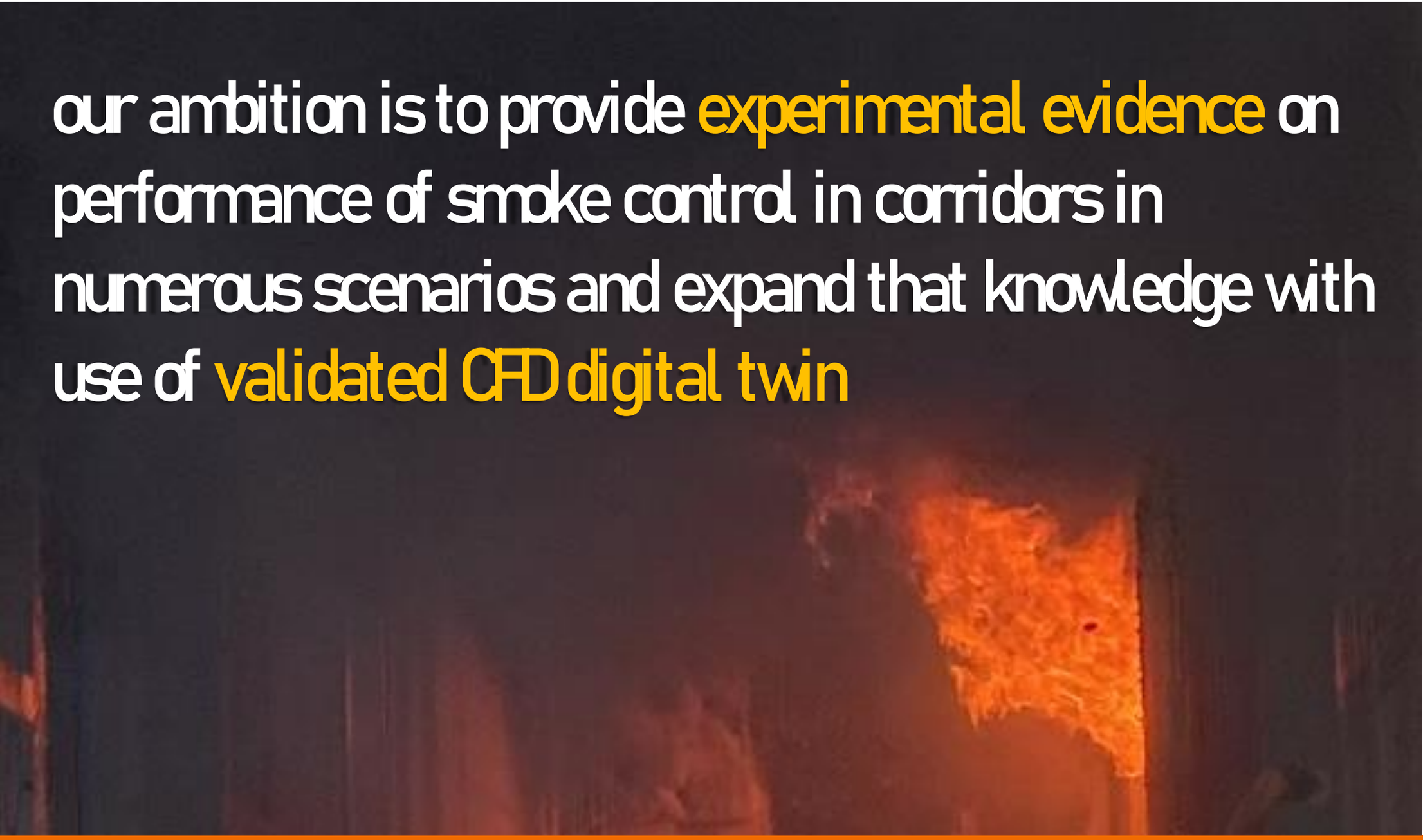
the corridor dillema

In different countries, **the obejctives** of the smoke control in horizontal evacuation pathways are different.

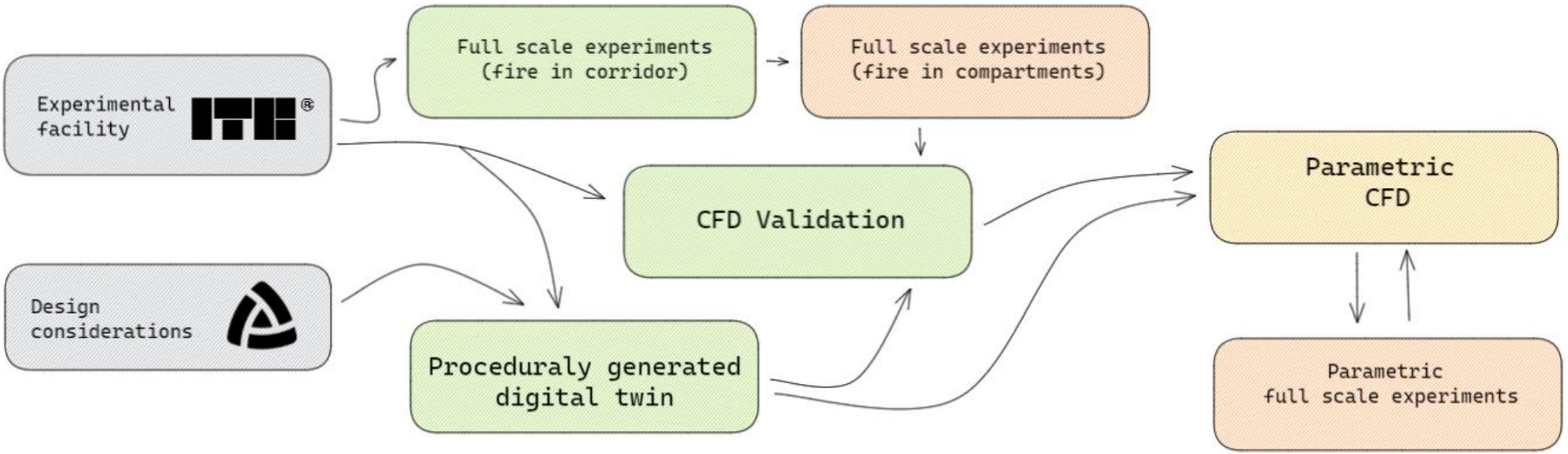
The **design fire scenario** and **assumptions** for modeling will most likely have higher impact on results, than smoke control parameters.

If so, does an **objective measure** of smoke control performance exist?

our ambition



project structure



the experimental facilty

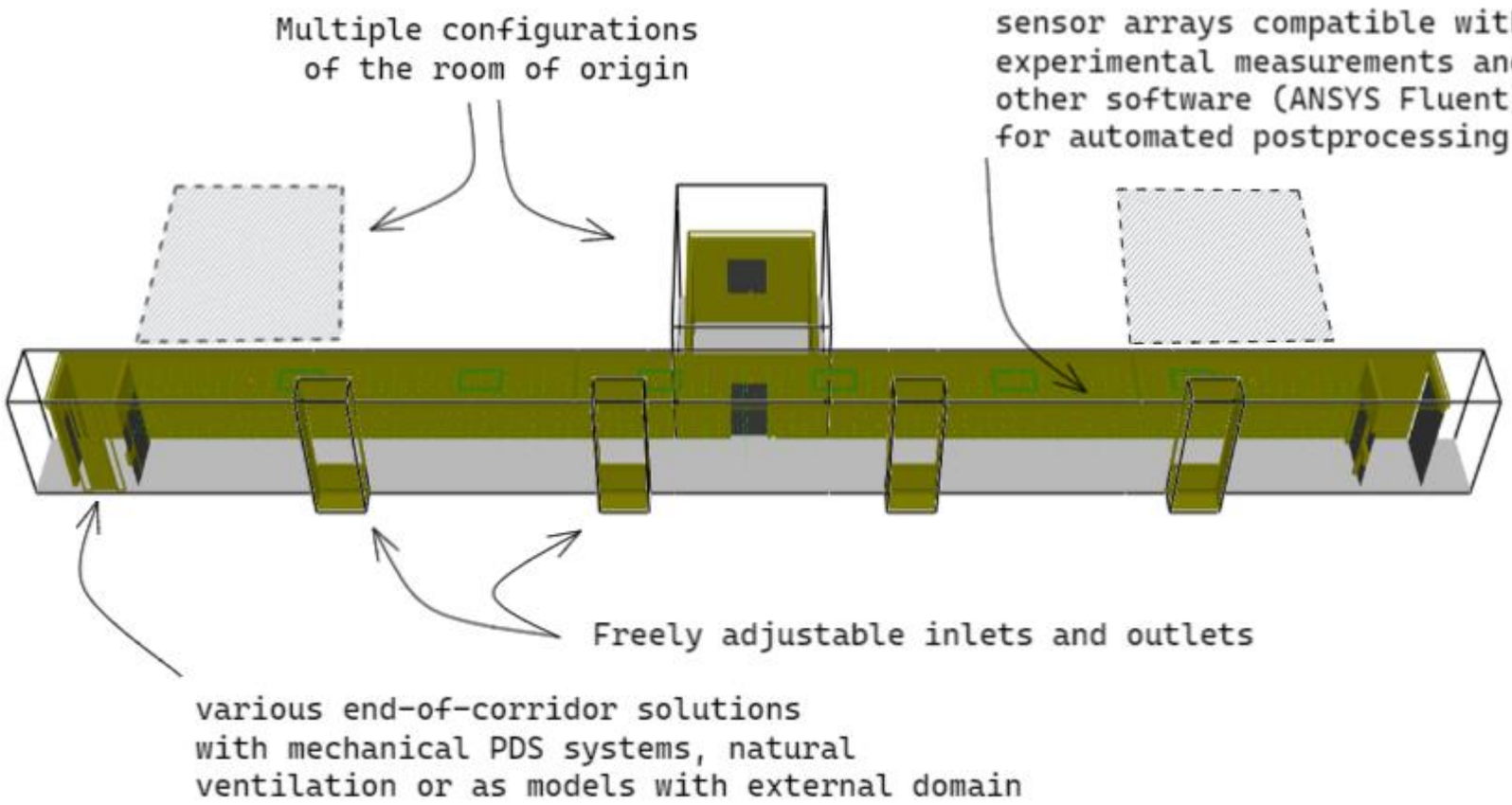
30 m x 1.40 m x 3.00 m full scale fire proofed corridor facility with numerous smoke exhaust / supply solutions and three large compartments supporting up to fully developed fires

the experimental facilty

For a detailed description of the faiclity refer to Wed. Talk 11 – Smoke Control In Corridors – Towards A Next Generation Experimental Facility by Dr Grzegorz Krajewski

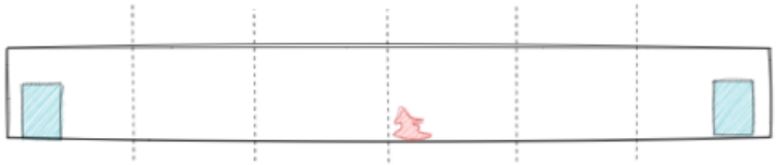
the digital twin

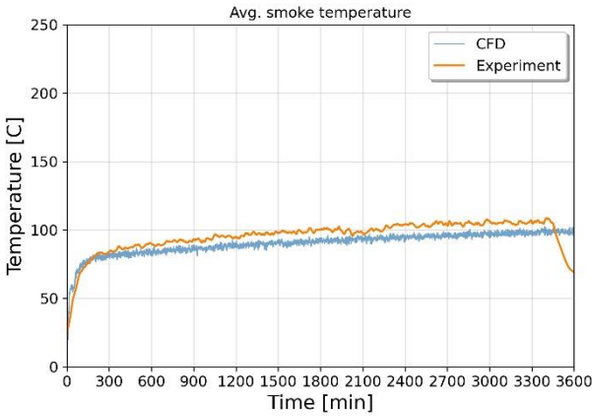
the digital twin facility is a procedurally generated FDS model of the facility, designed to complement the experimental studies and expand our insight into fluid dynamics in corridors

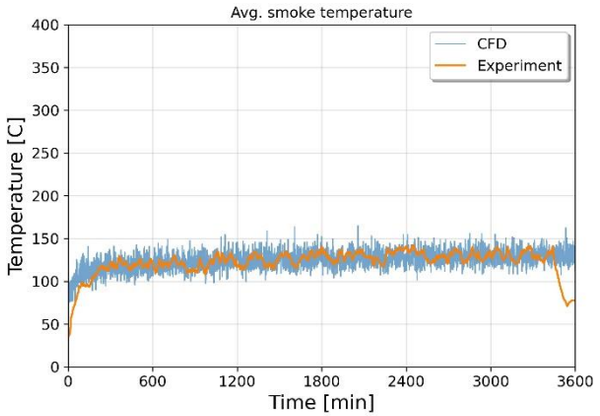


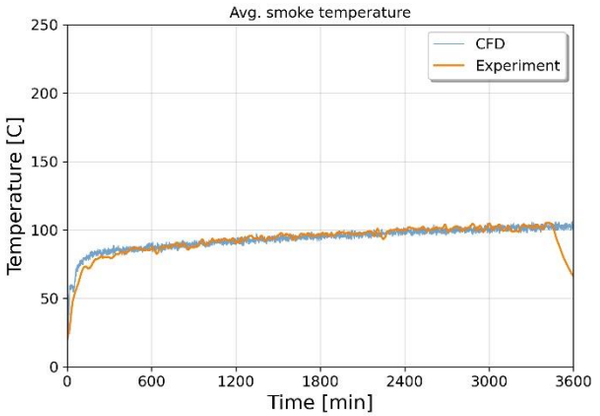
validation

validation

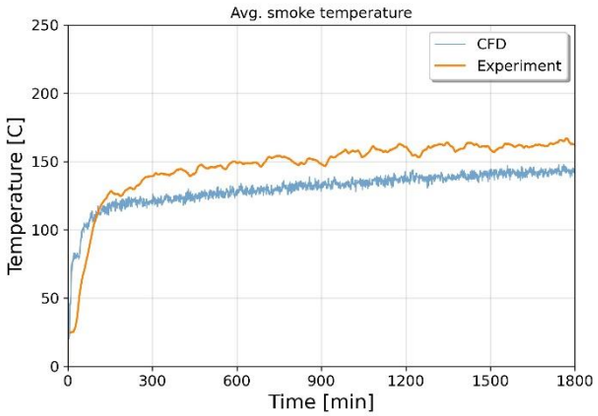


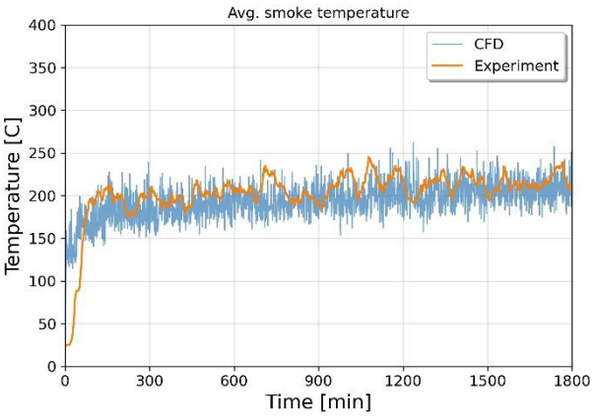


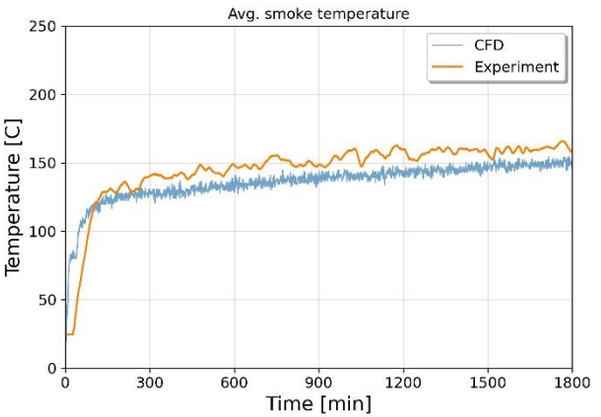




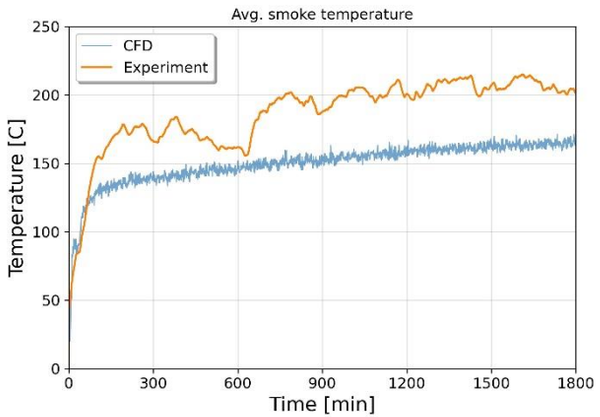
100 kW

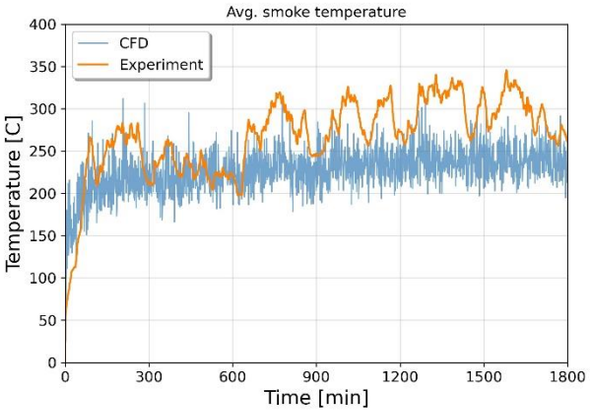


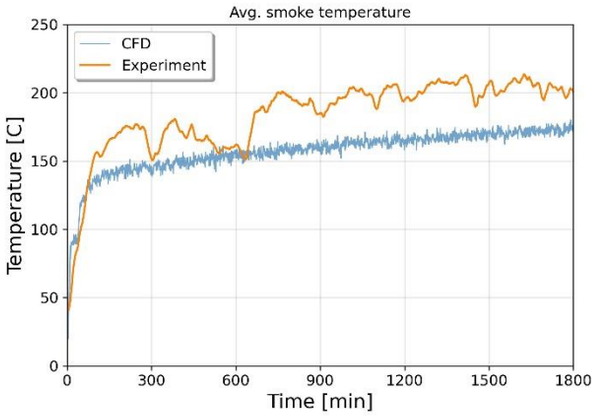




200 kW

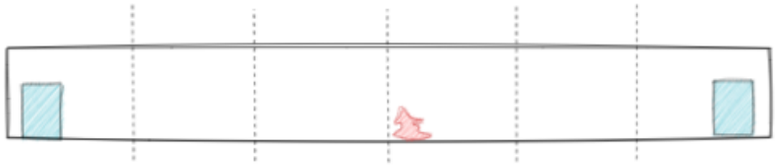


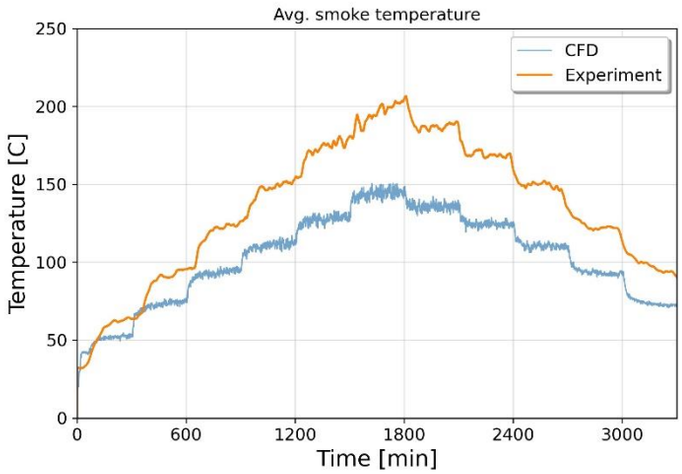


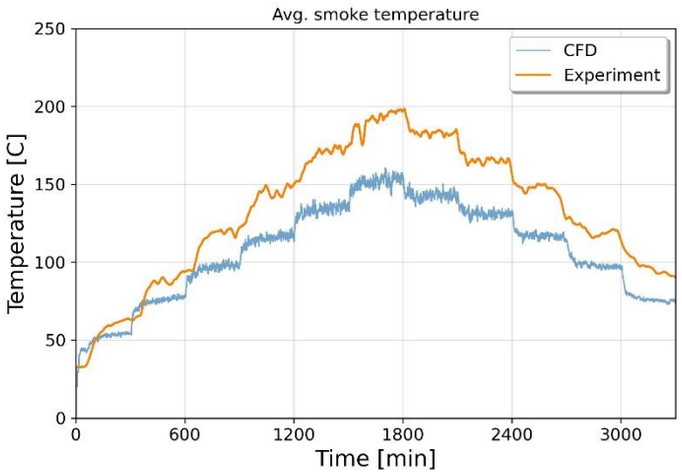


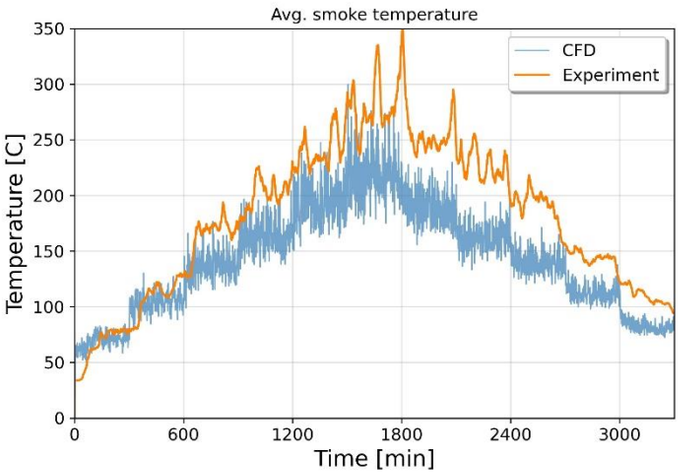
250 kW (wind)

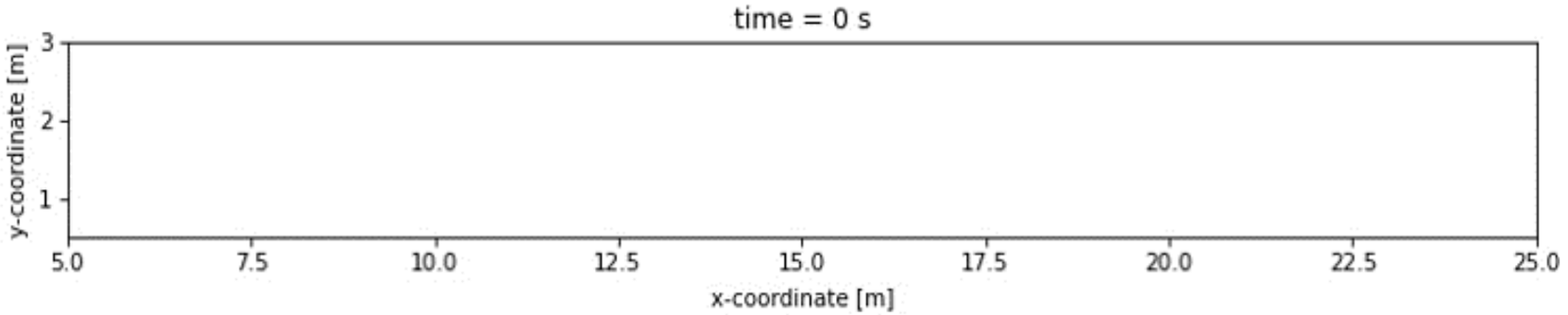
validation



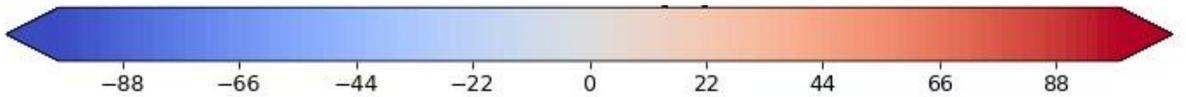






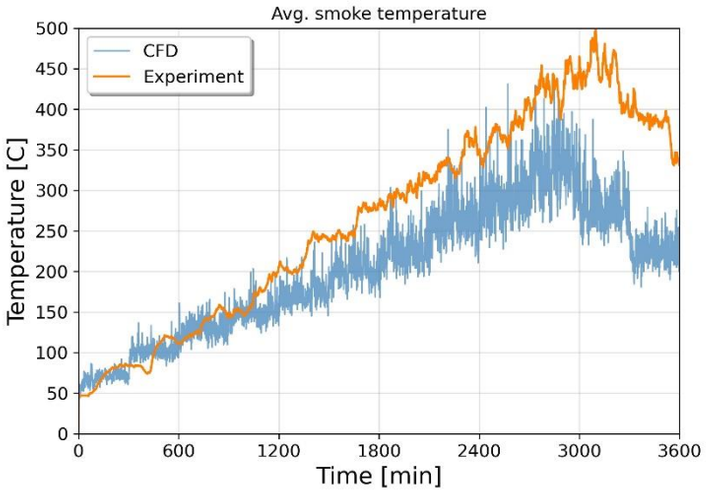


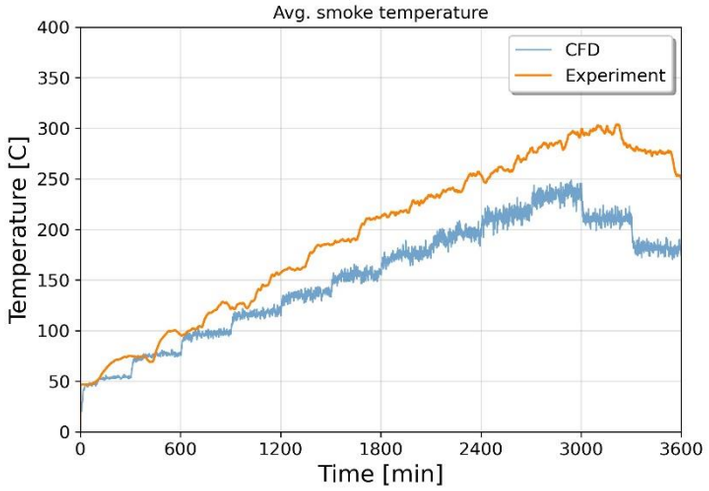
CFD

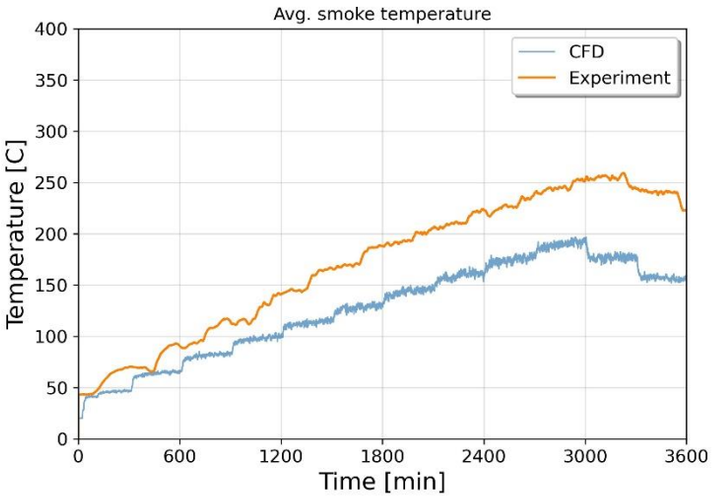


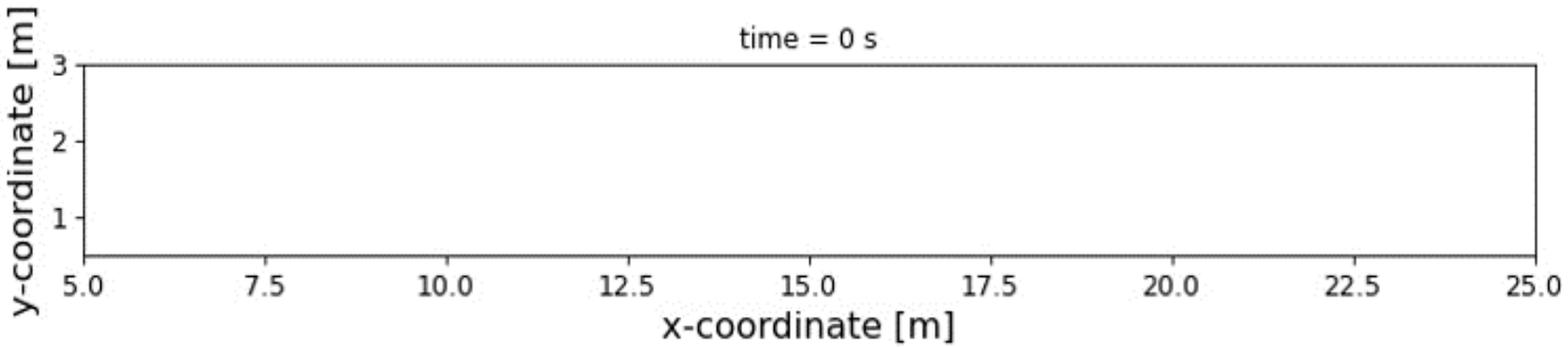
experiment

validation









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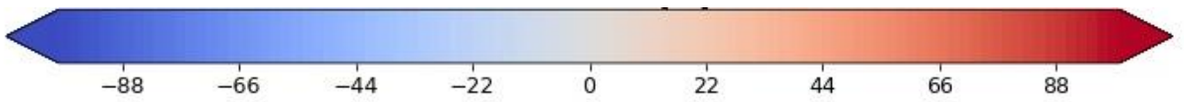

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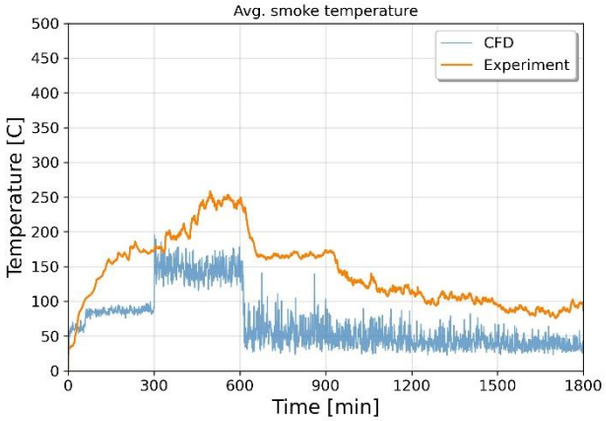
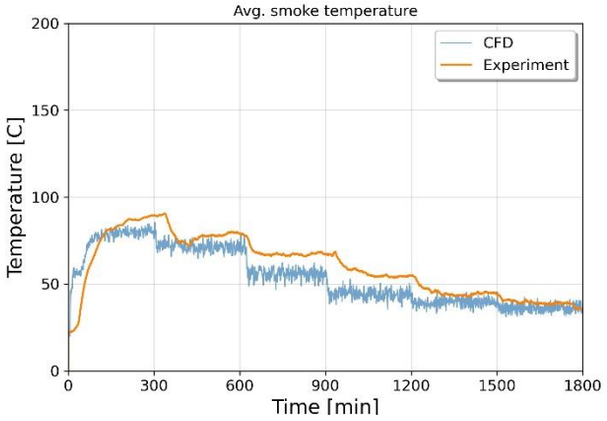
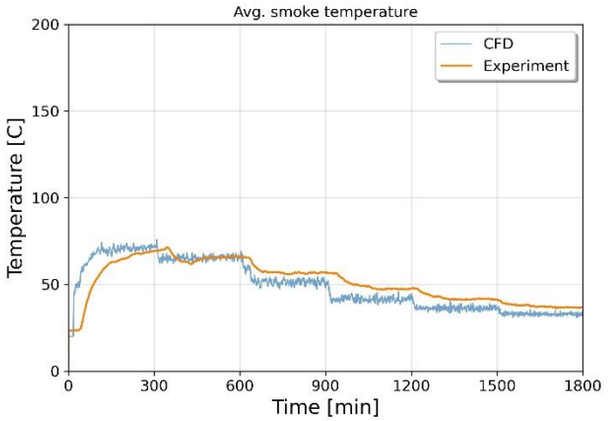
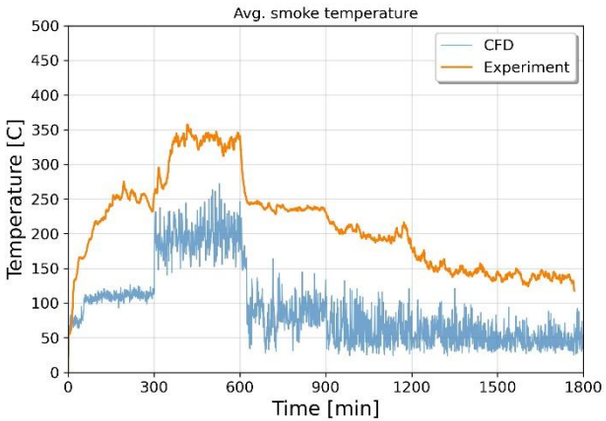
validation

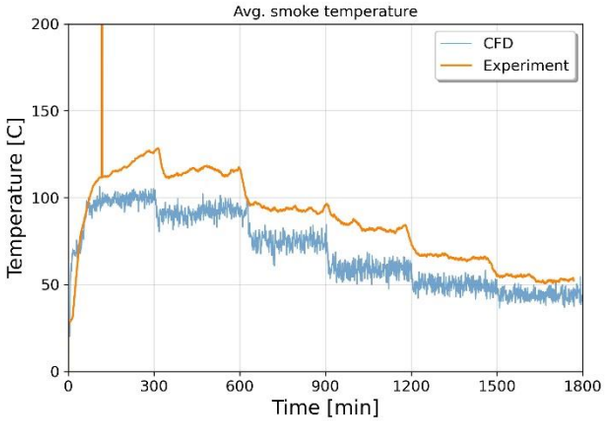


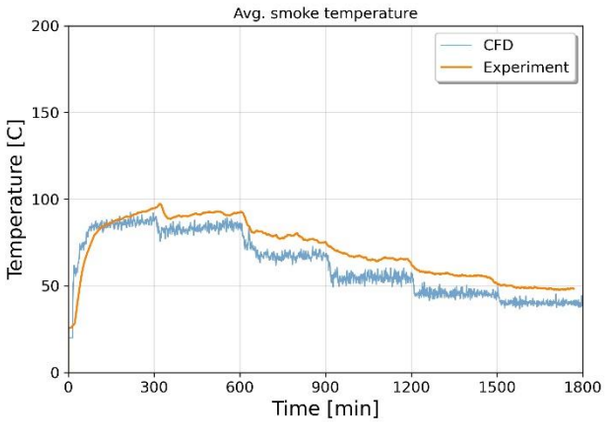




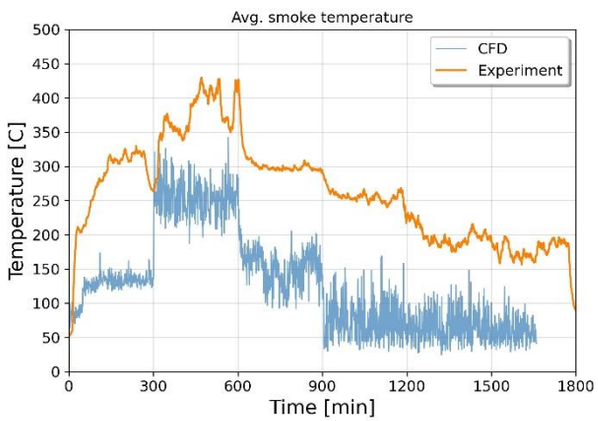
200 kW

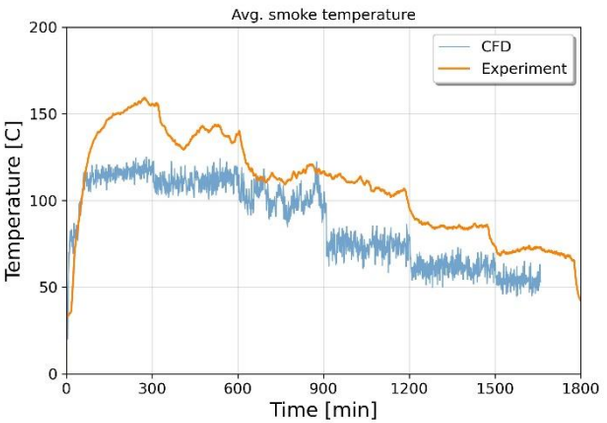


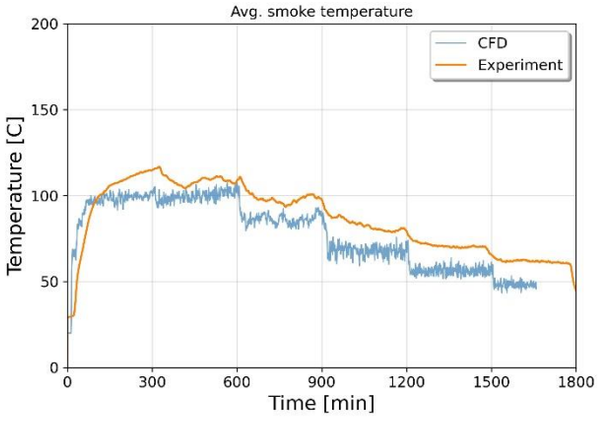




300 kW

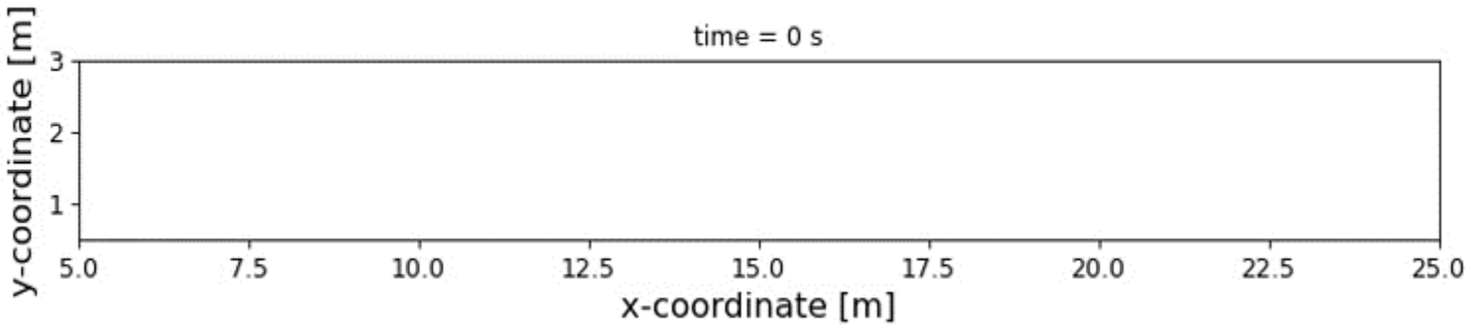




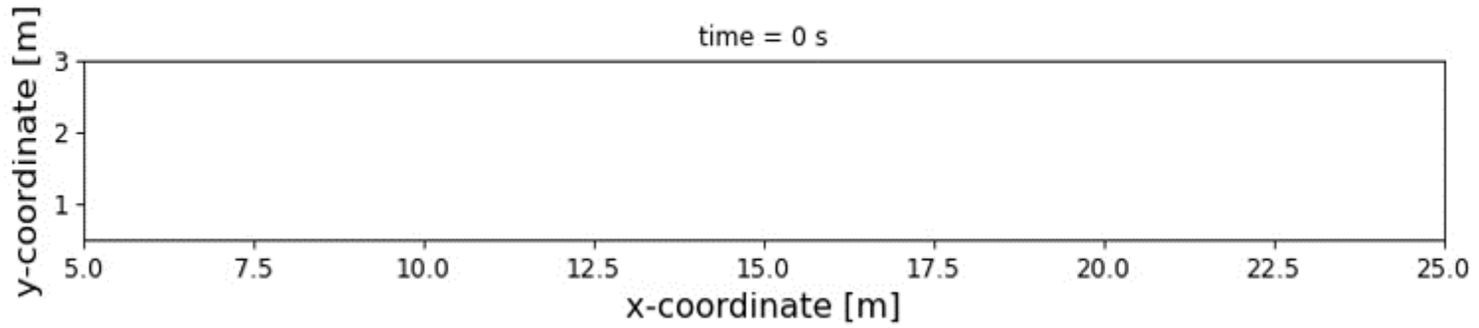


400 kW

validation



200 kW



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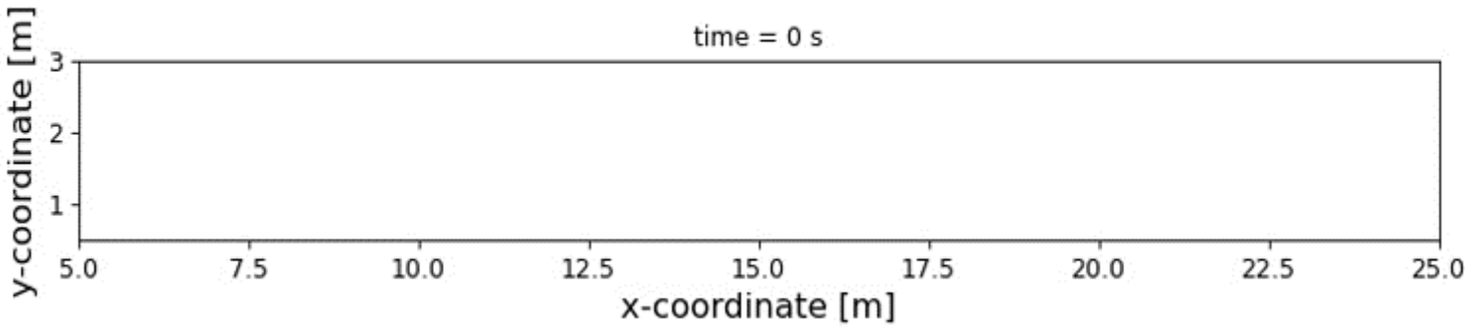
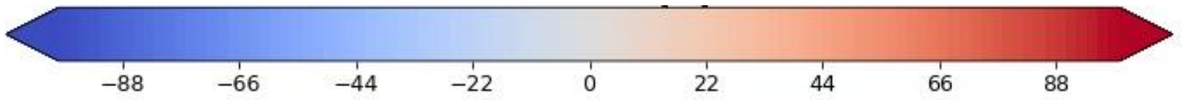


400 kW

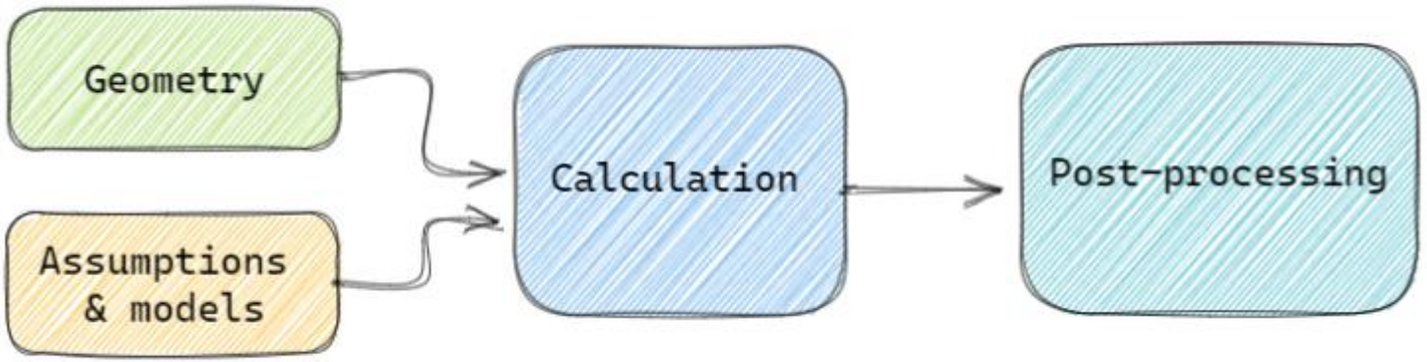
CFD



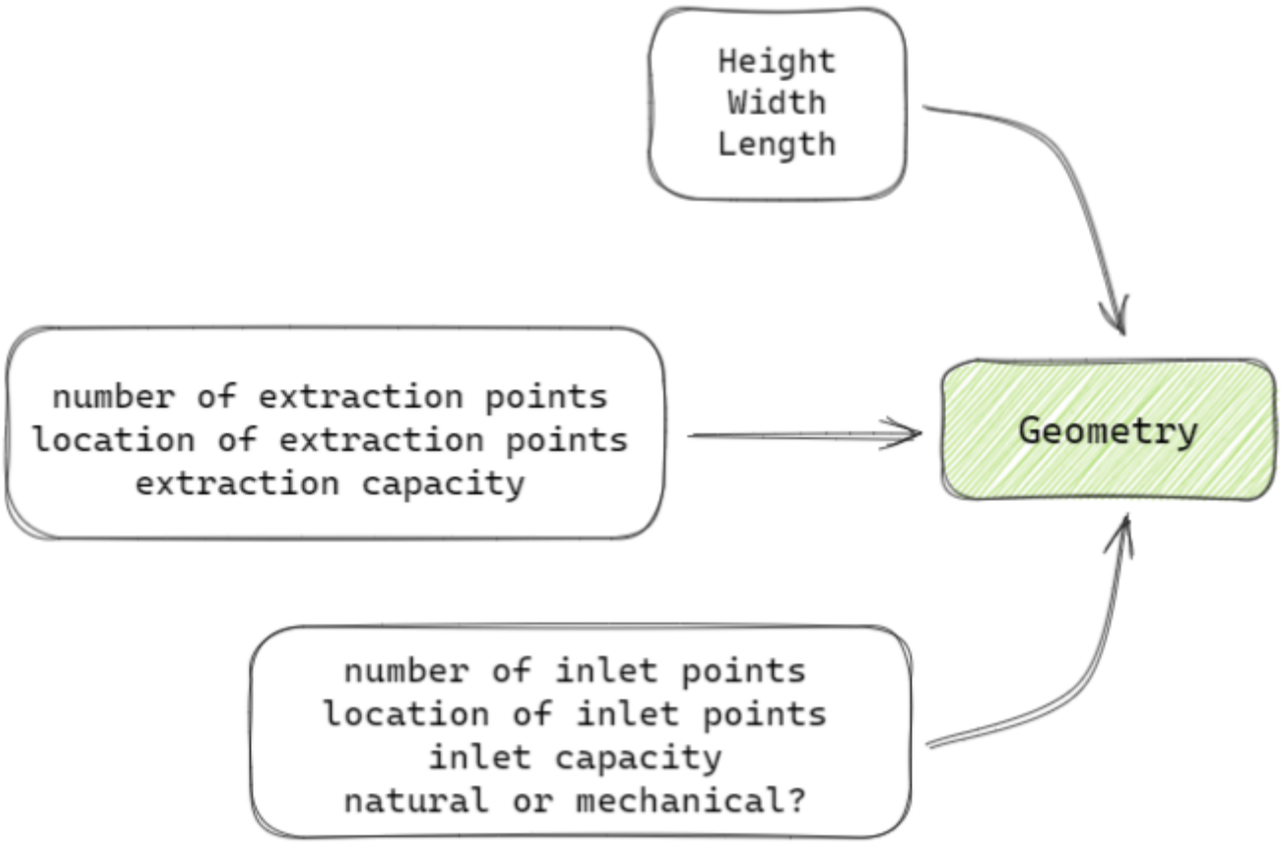
experiment

multiparametric CFD

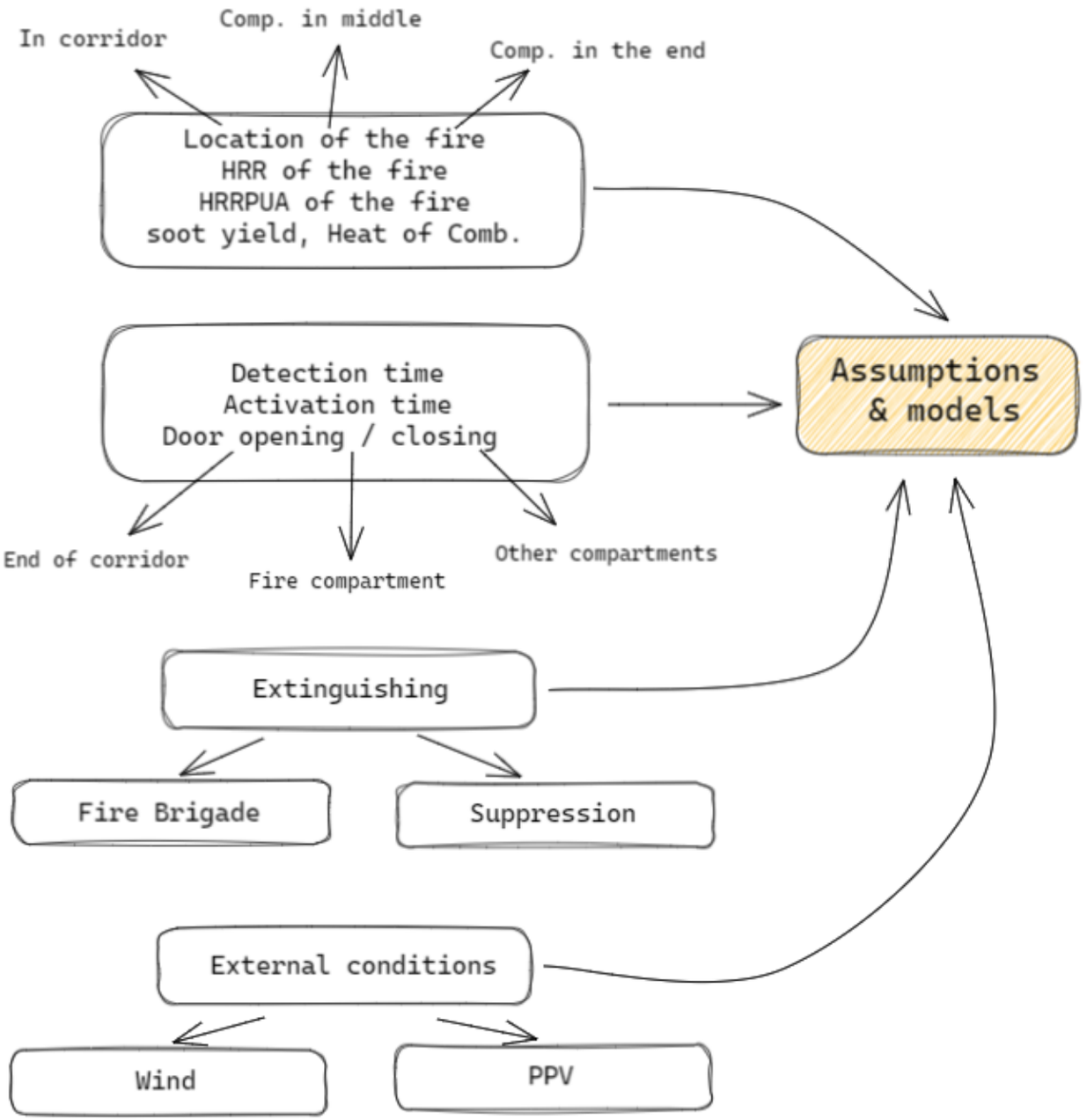
CFD


Geometry
Assumptions & models
Calculation
Post-processing

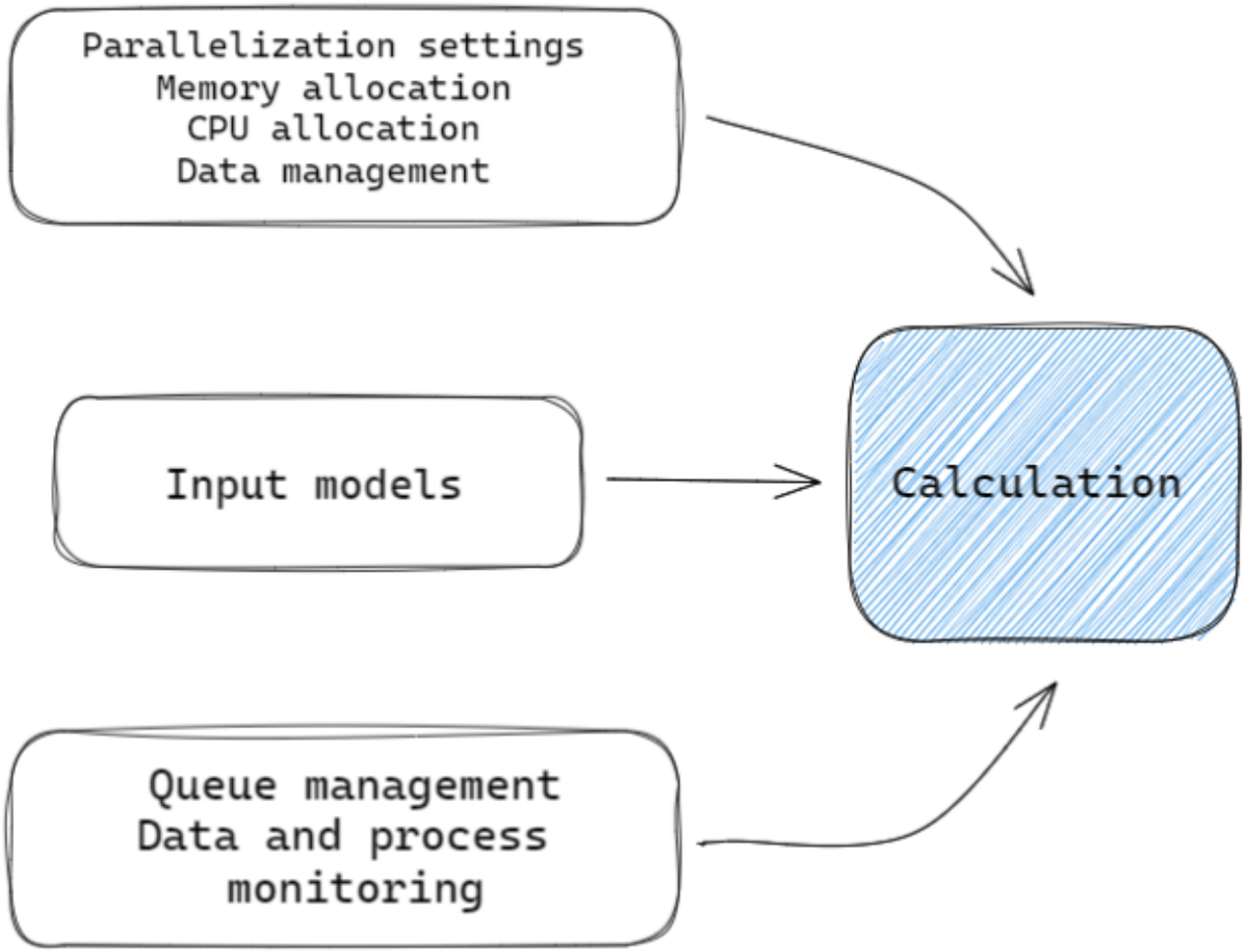
building the model



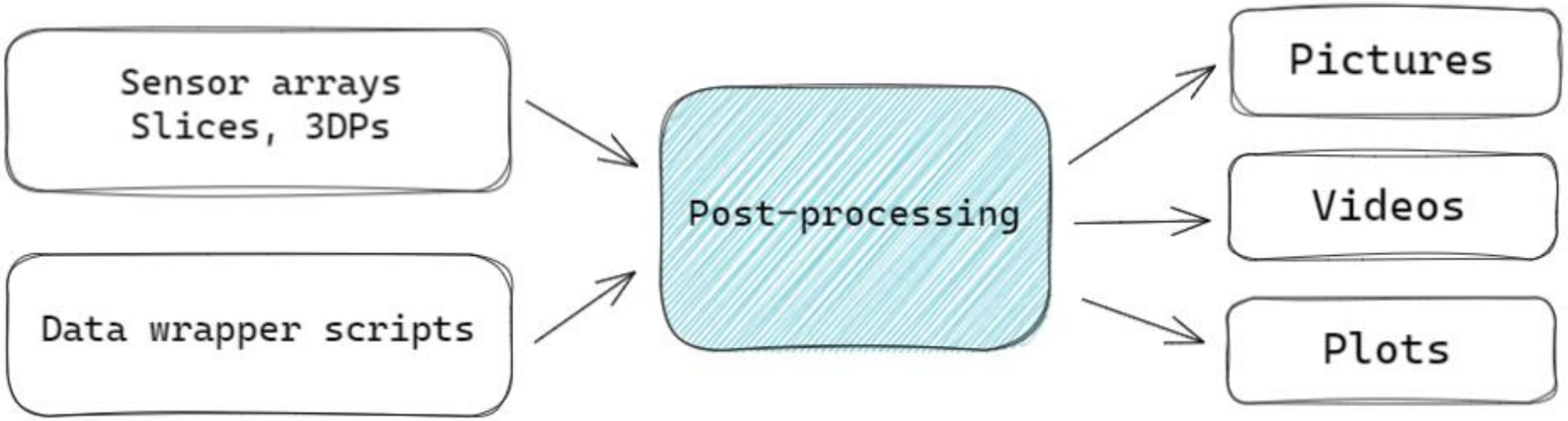
building the model



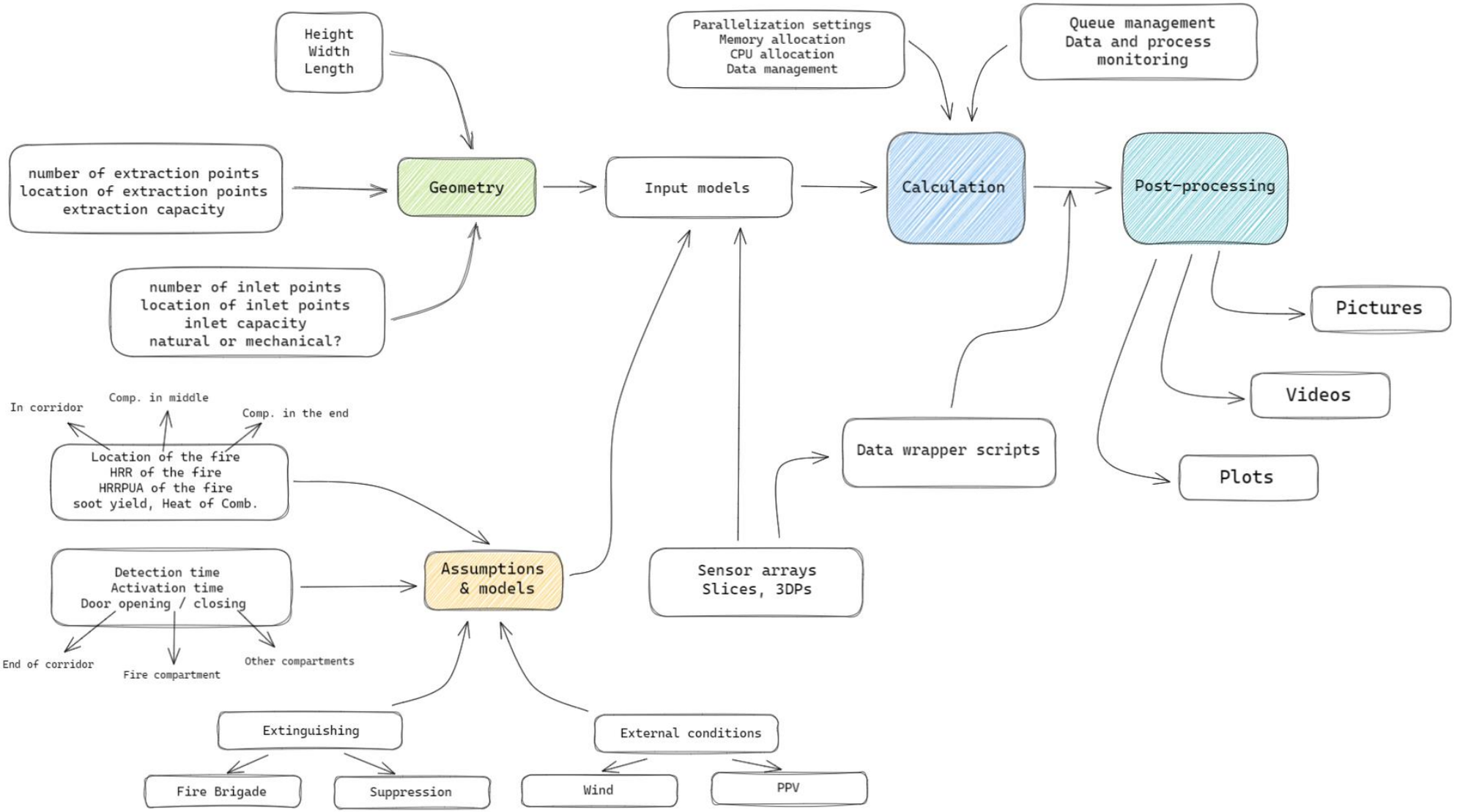
running the model



running the model

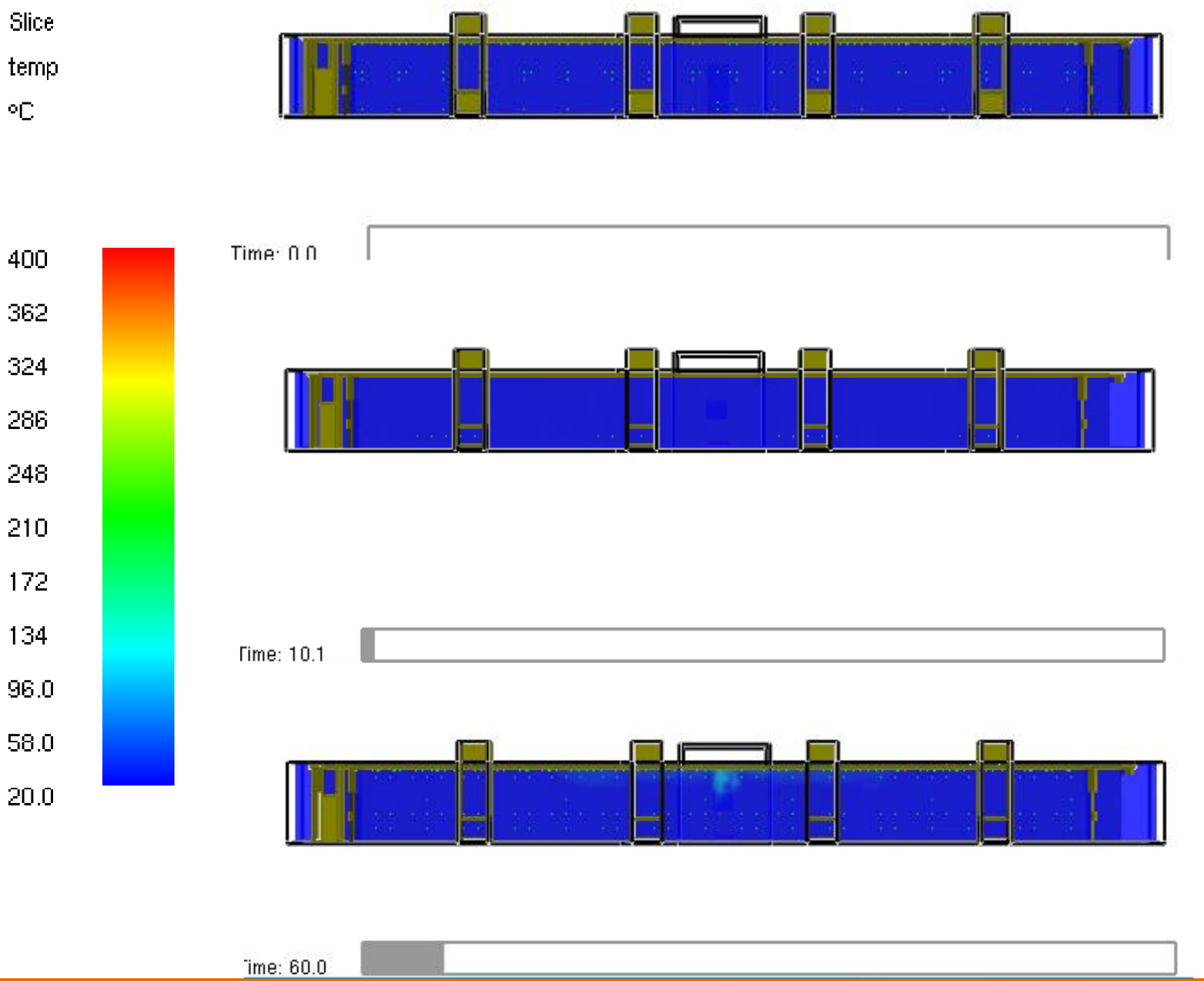


multiparametric CFD

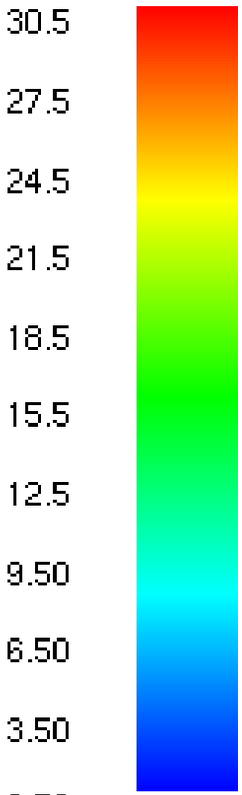


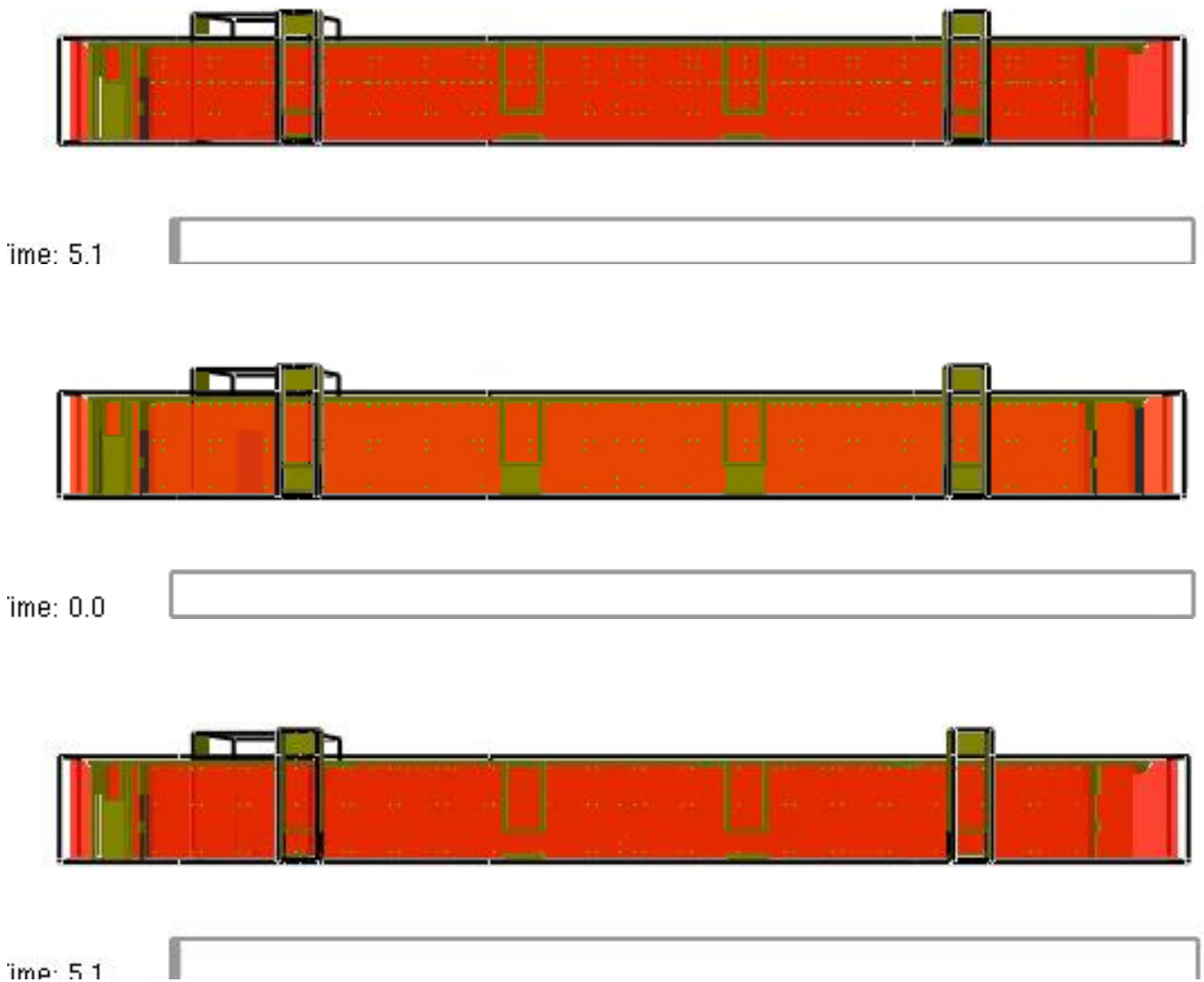
preliminary results

HRR impact


Slice
temp
°C
400
362
324
286
248
210
172
134
96.0
58.0
20.0
Time: 0.0
Time: 10.1
Time: 60.0
500 kW
1000 kW
3500 kW

exhaust capacity





2 m³/s

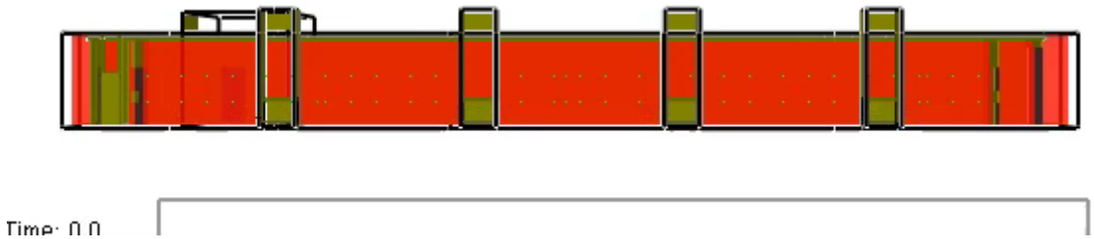
4 m³/s

6 m³/s

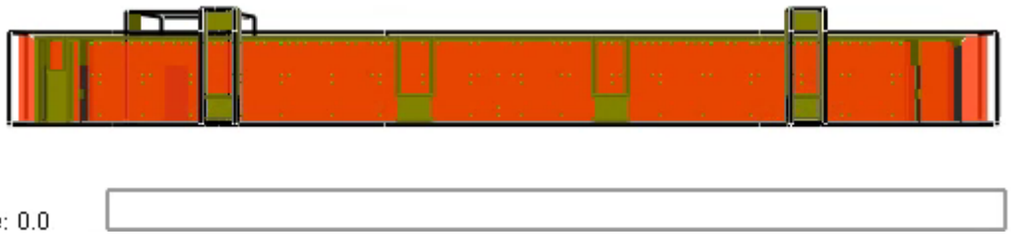
500 kW | 3,00 m tall ceiling | 4 exh. pts | 2 inl. pts

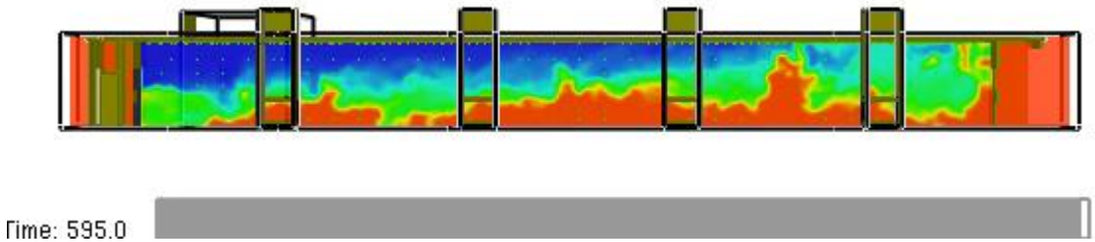
number of inlets

2 m³/s

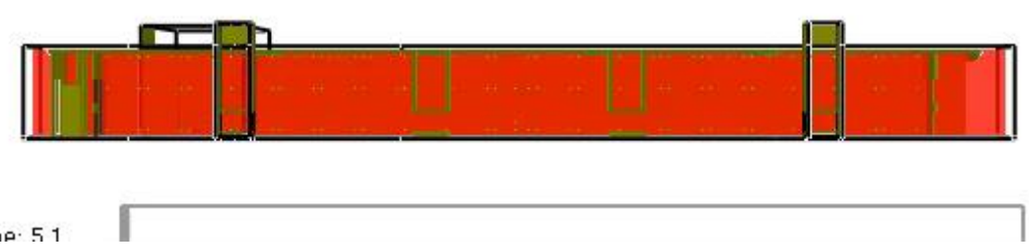


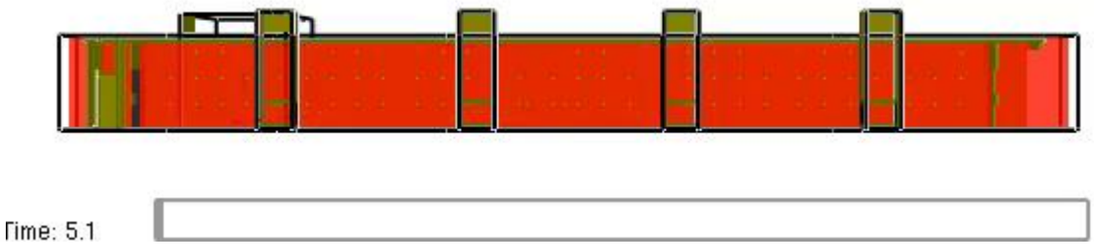
4 m³/s





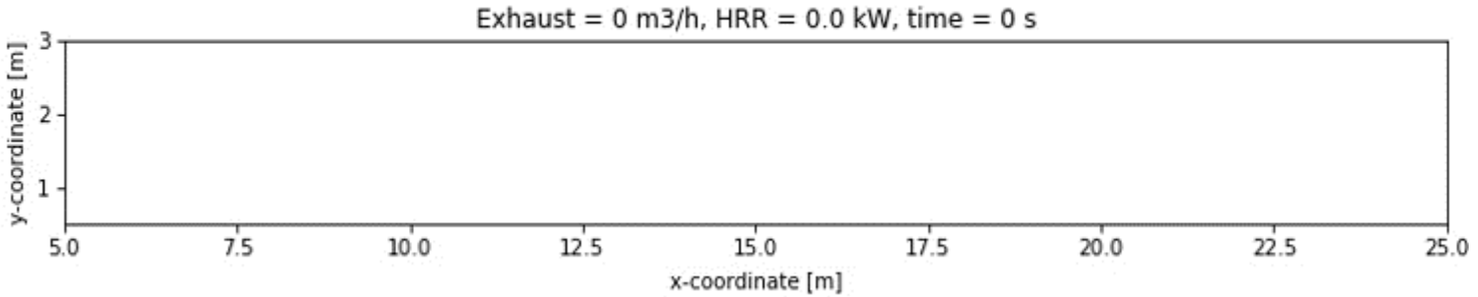
6 m³/s



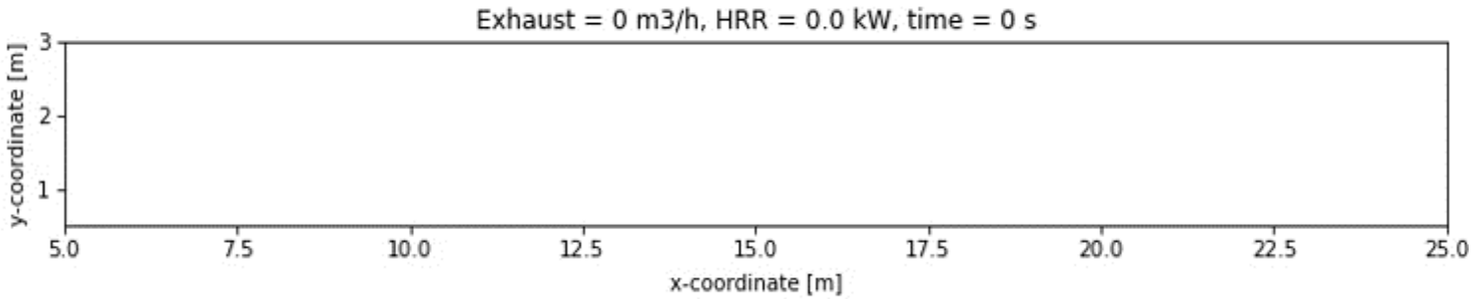


500 kW | 3,00 m tall ceiling | 4 exh. pts | 2 / 4 inl. pts

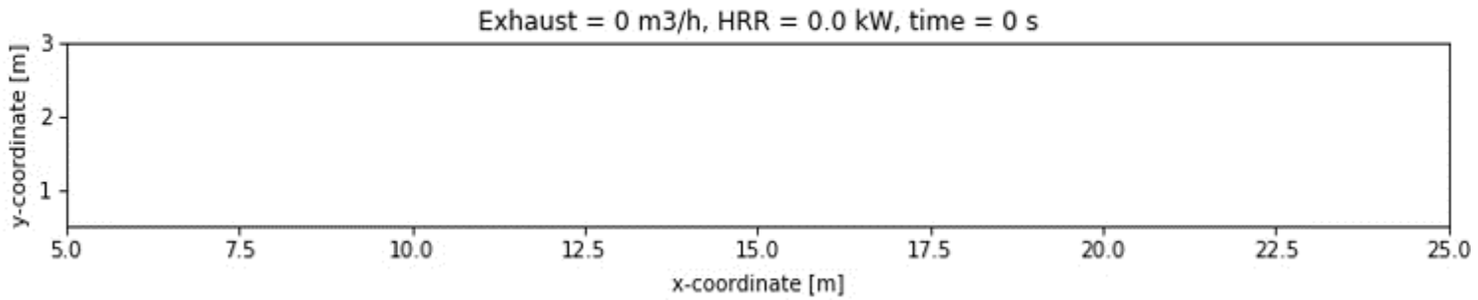
cross vent.



100 kW

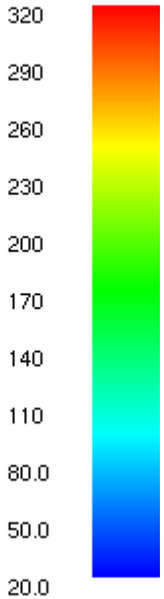


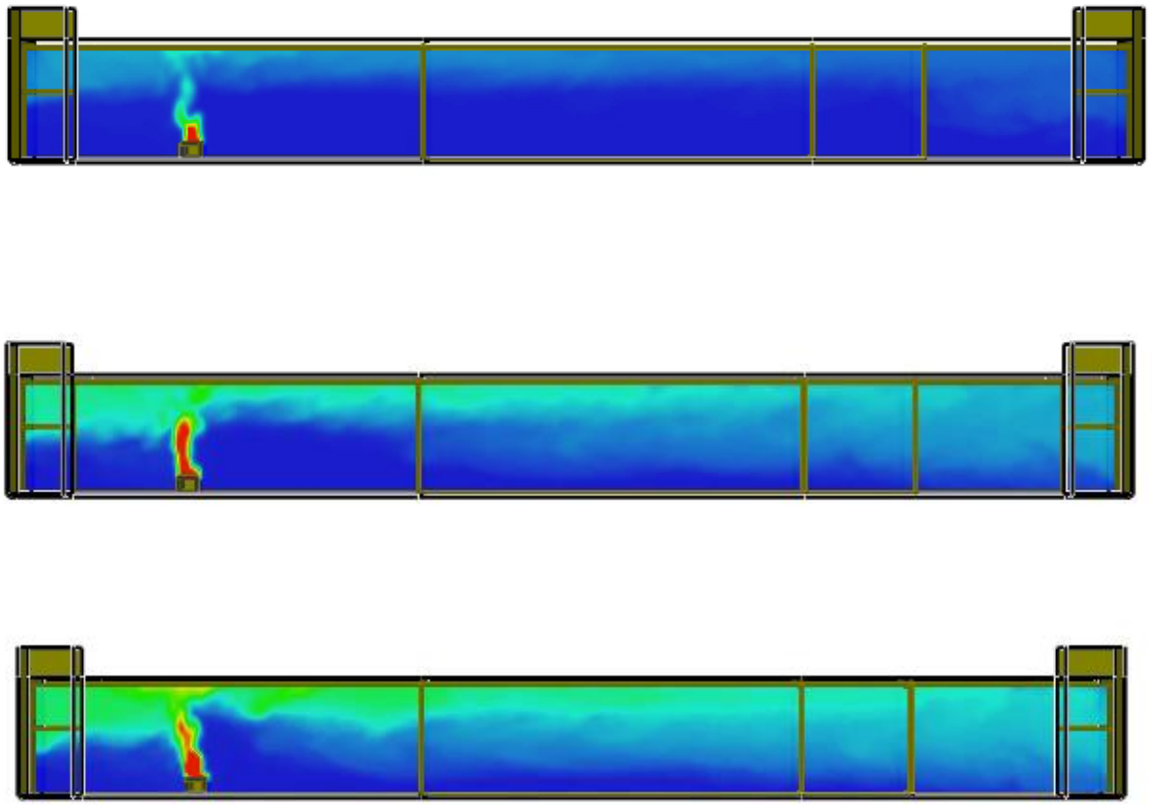
300 kW



400 kW

cross vent.





100 kW

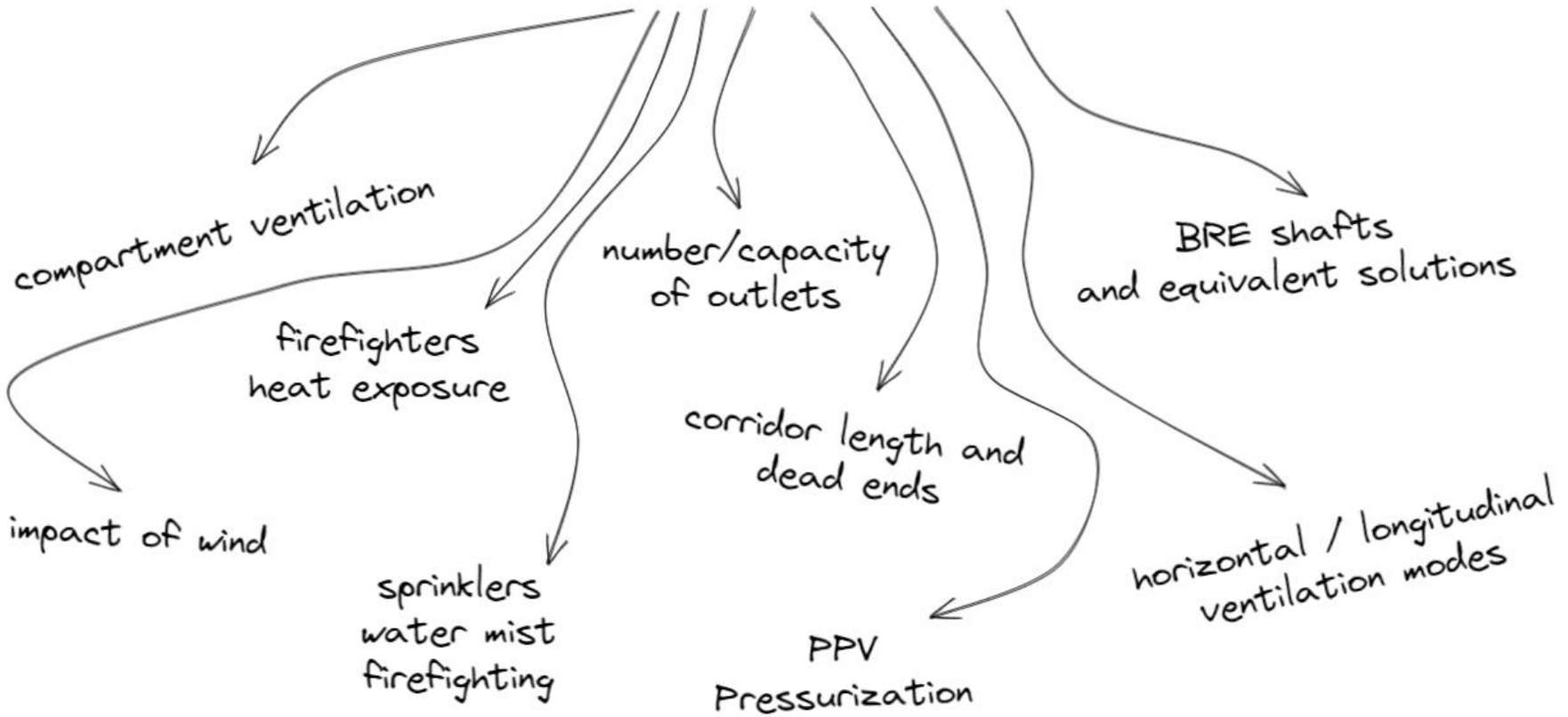
300 kW

400 kW

3,00 m tall ceiling | cross ventilation

conclusions

- we have (finally) built a full scale corridor facility which allows for extensive, multiparametric testing of smoke control performance under varied fire scenarios. The facility is operational, and experiments are planned for the next 3 years!



conclusions

- so far we have performed experiments within the corridor itself, which have been used for validation of the first round of CFD
- near-plume temperatures and smoke layer temperatures require further attention and determination of the sources of uncertainties, to better match the CFD to the experimental results
- far-field temperatures in mechanicaly ventilated corridors show excellent agreement between CFD and experiment
- Initial simulations confirmed our initial hypotheses that the scenario of the simulation (opening/closing of the doors, presence of openings) has higher influence on the simulation results than the size of the fire or presence of smoke control systems

Dziękuję!

dr hab. inż. Wojciech Węgrzyński, prof. ITB
w.wegrzynski@itb.pl
fire@itb.pl
@WojciechITB

www.FireScienceShow.com