Smoke Control In Corridors

A Multiparametric Experimental Study And Its CFD Digital Twin

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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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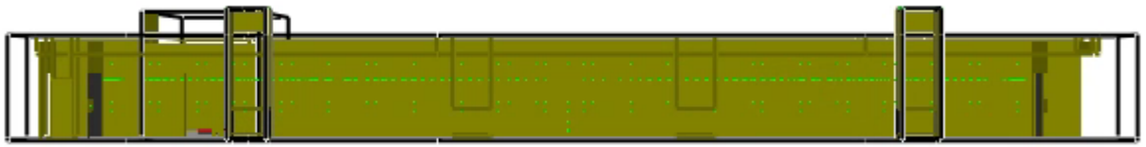

Got a good idea – lets assume that window can fall out at some temperature! BETTER!

the corridor dillema

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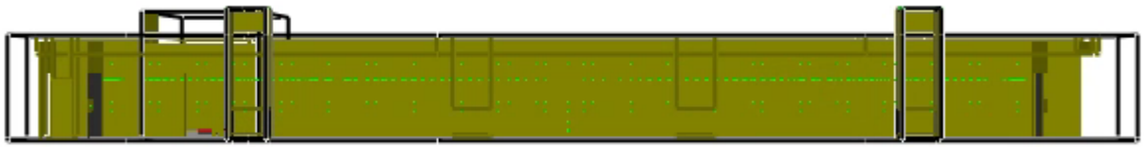
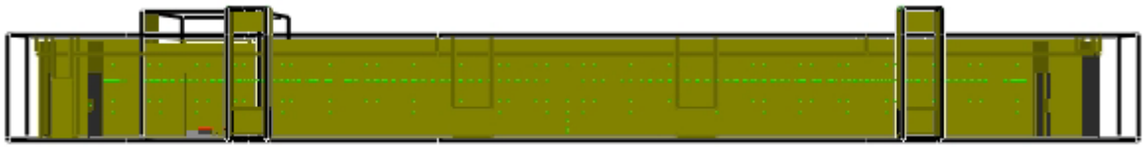


A good idea – lets assume that window can fall out at some temperature! BETTER!



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

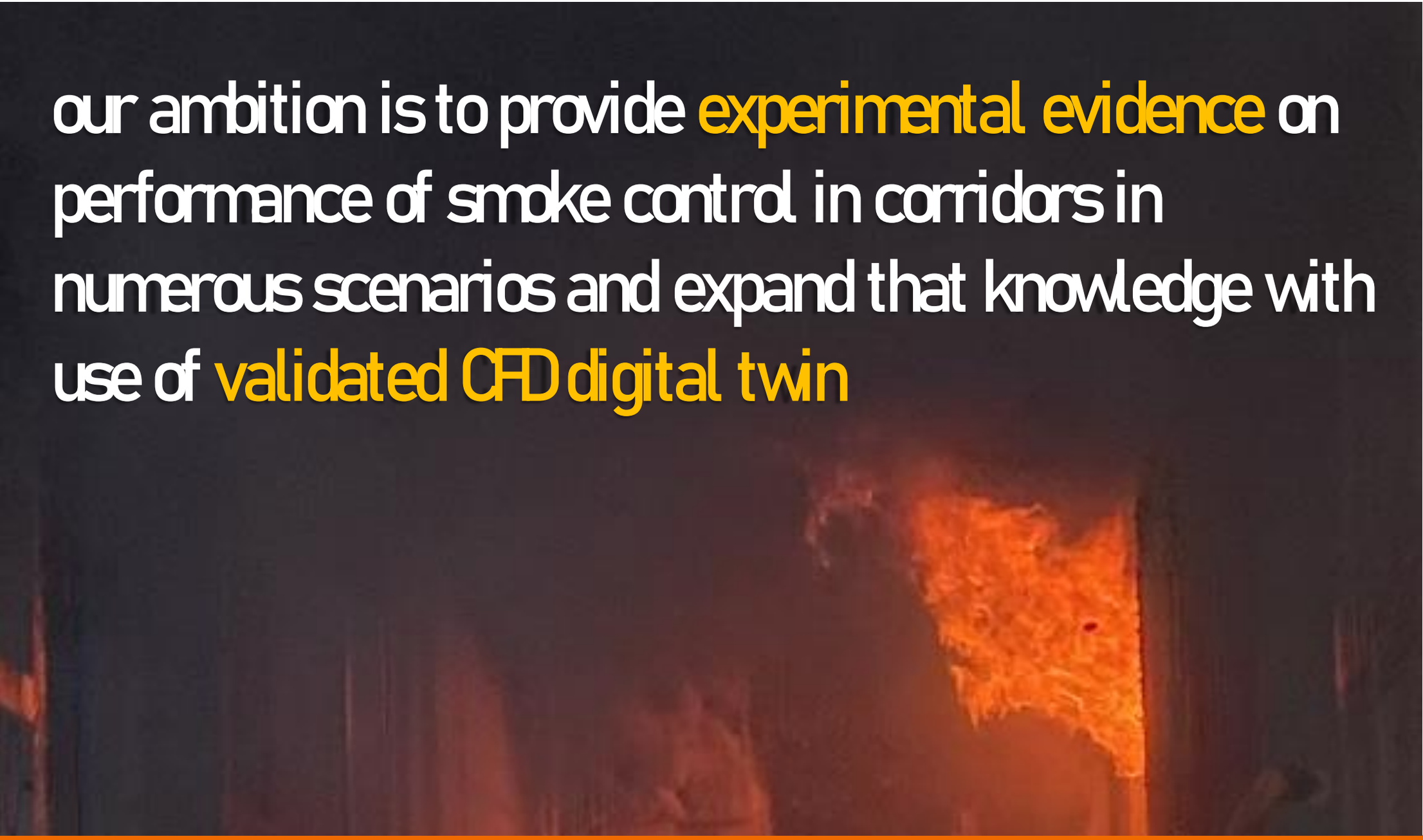
the corridor dillema

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

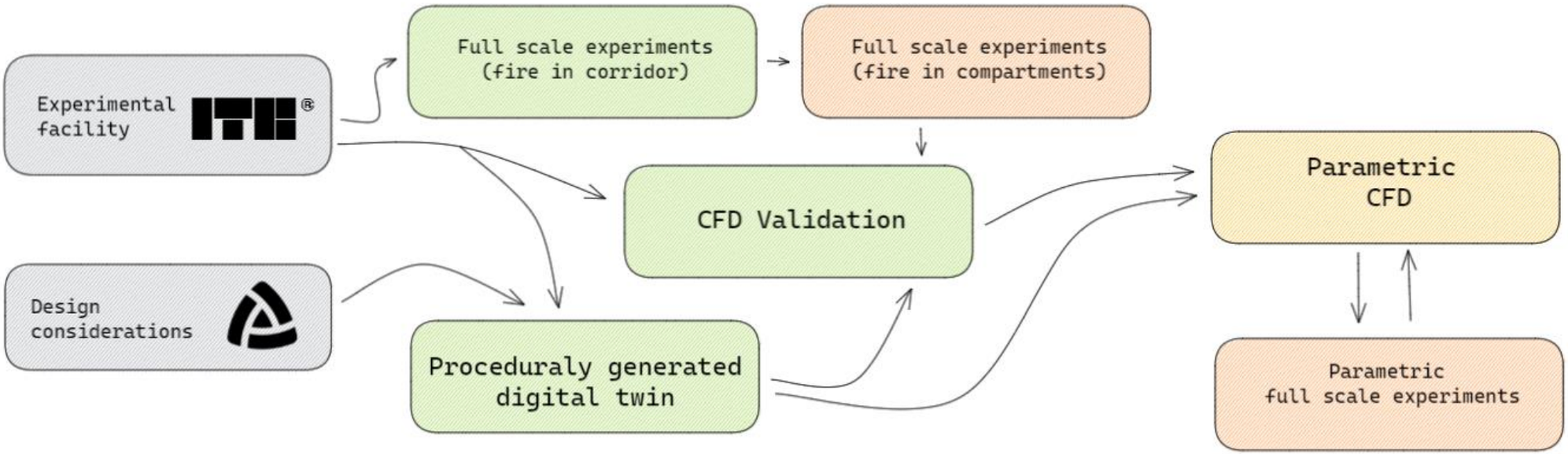
The **design fire scenario** and **assumptions** for modeling will most likely have higher impact on results, than smoke control parameters.

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

our ambition



project structure



the experimental facilty

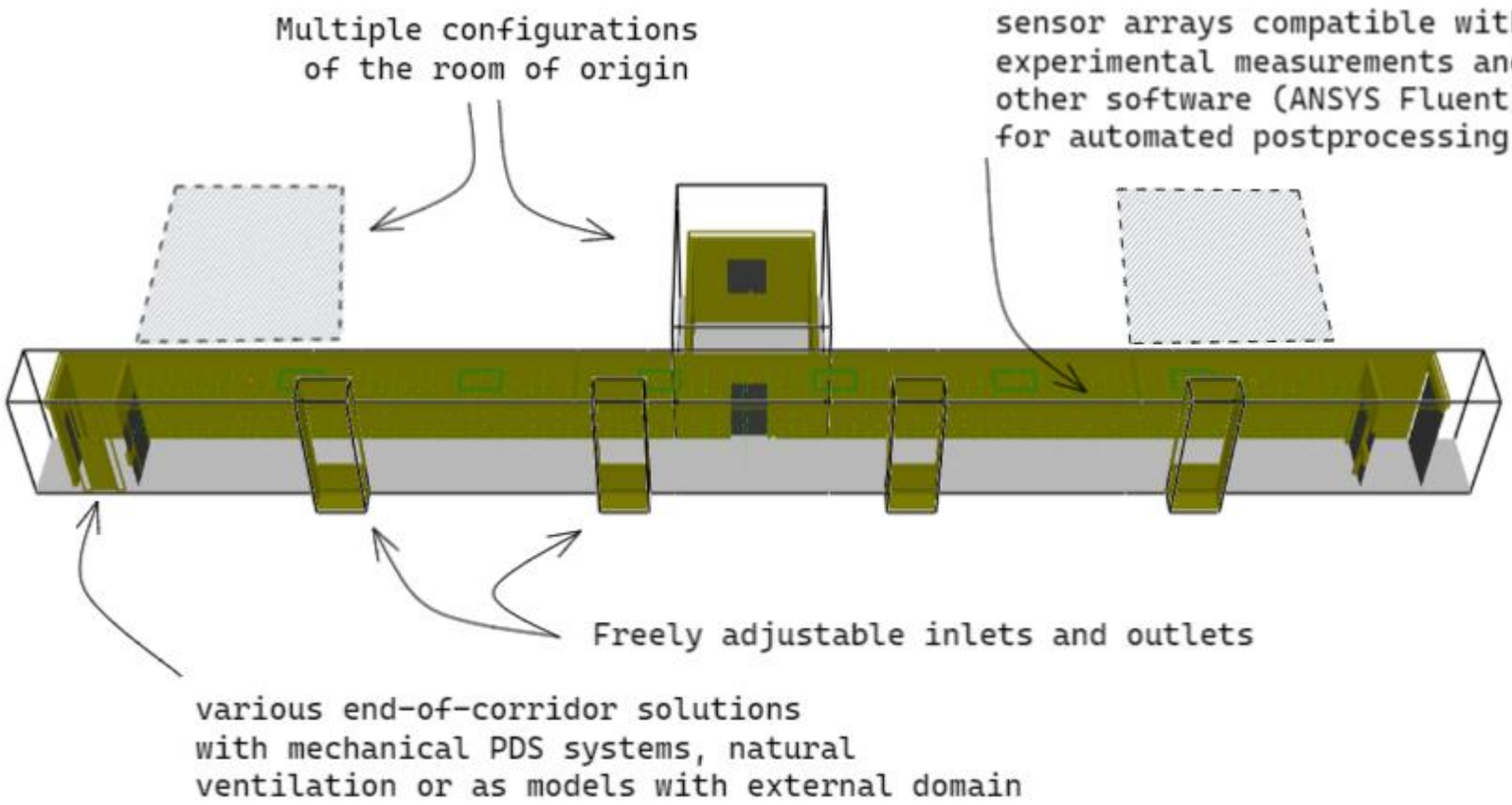
30 m x 1.40 m x 3.00 m full scale fire proofed corridor facility with numerous smoke exhaust / supply solutions and three large compartments supporting up to fully developed fires

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

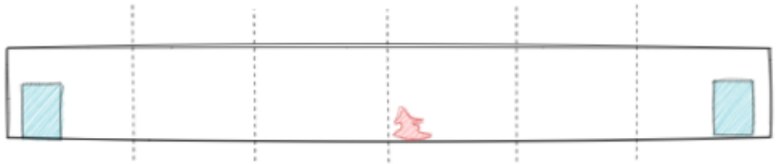
the digital twin

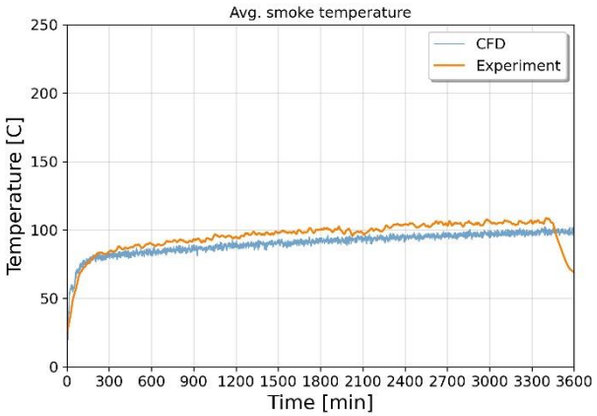
the digital twin facility is a procedurally generated FDS model of the facility, designed to complement the experimental studies and expand our insight into fluid dynamics in corridors

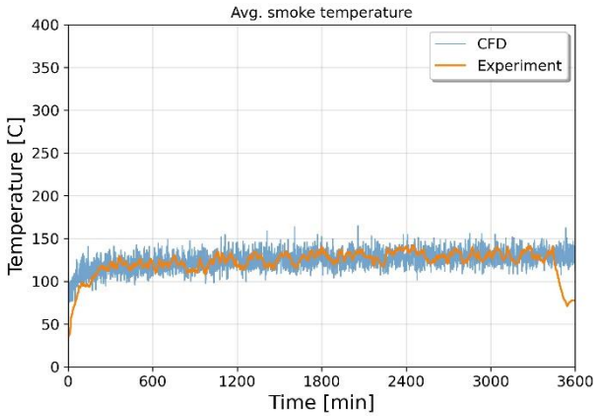


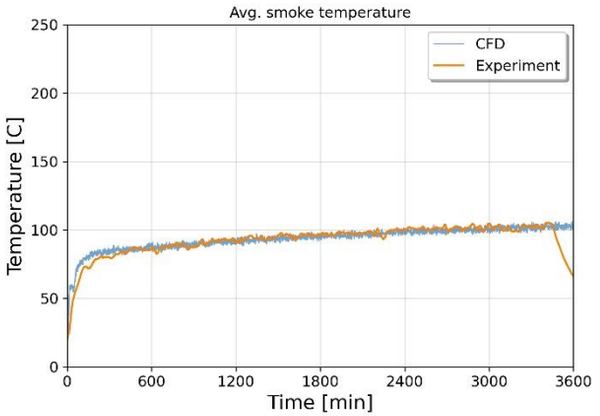
validation

validation

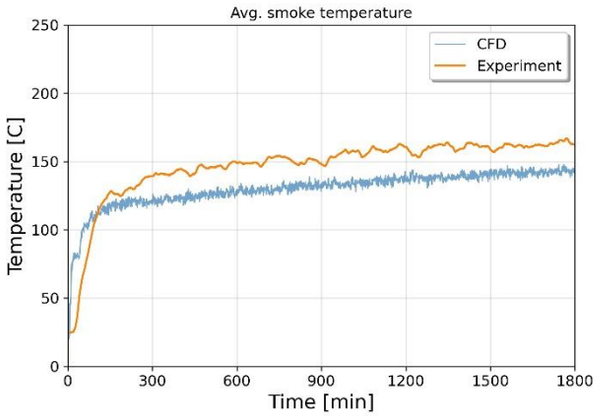


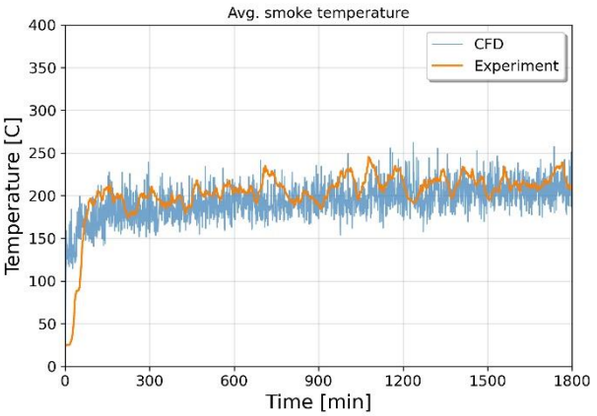


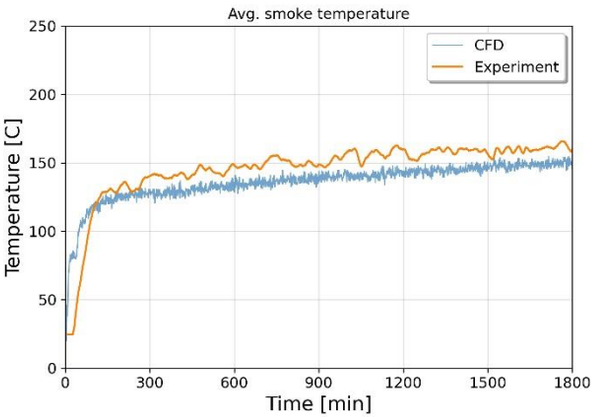




100 kW







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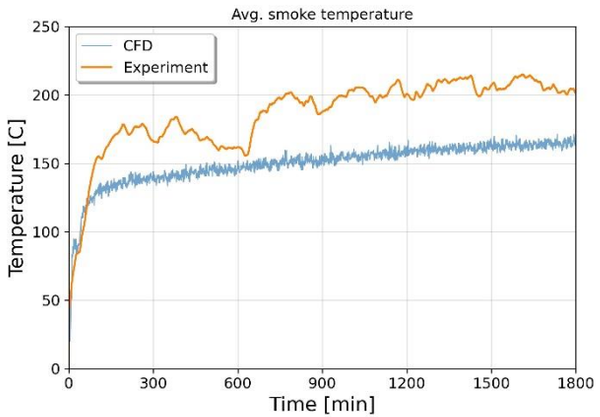
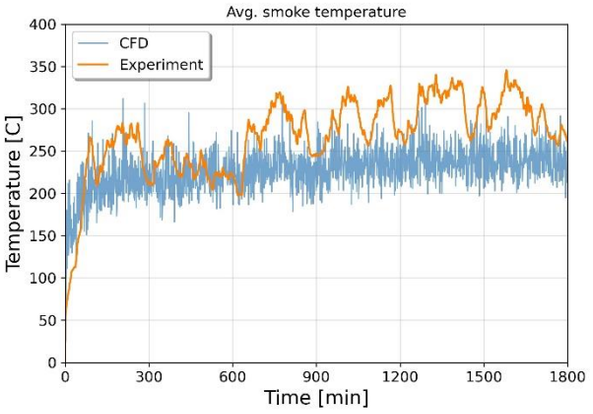
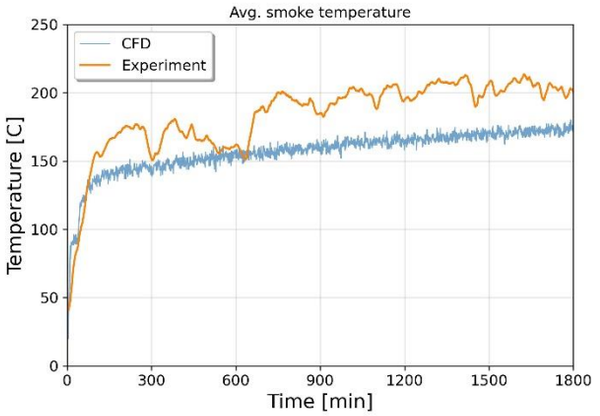
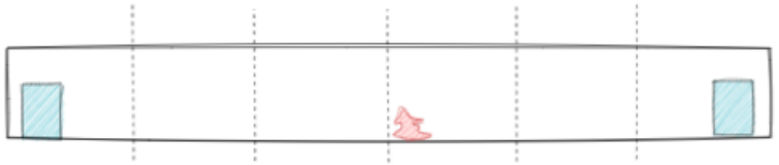


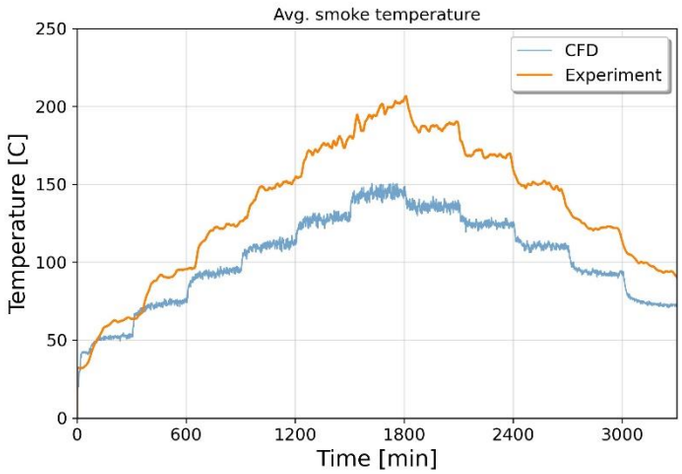


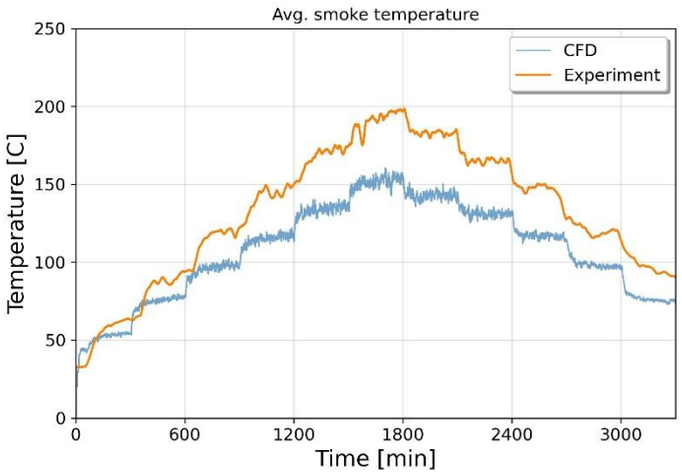


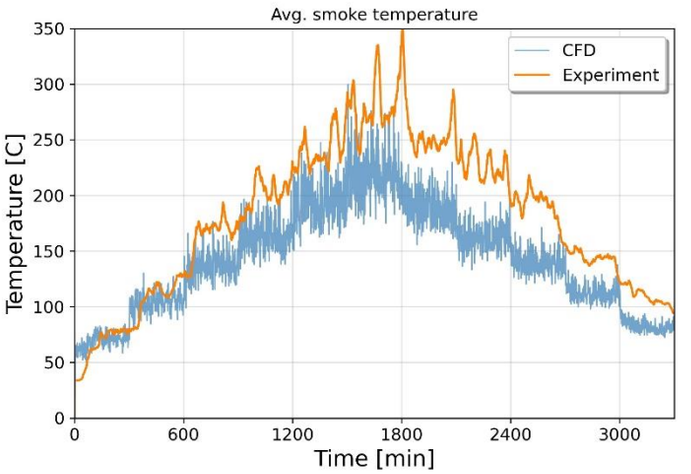
250 kW (wind)

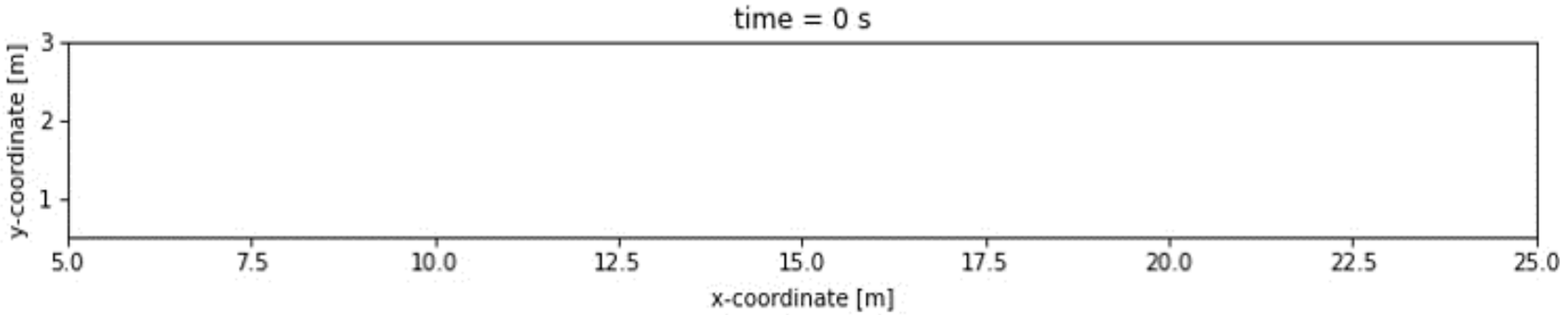
validation



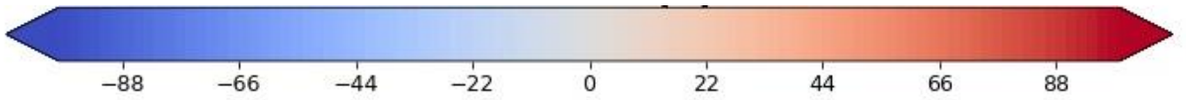






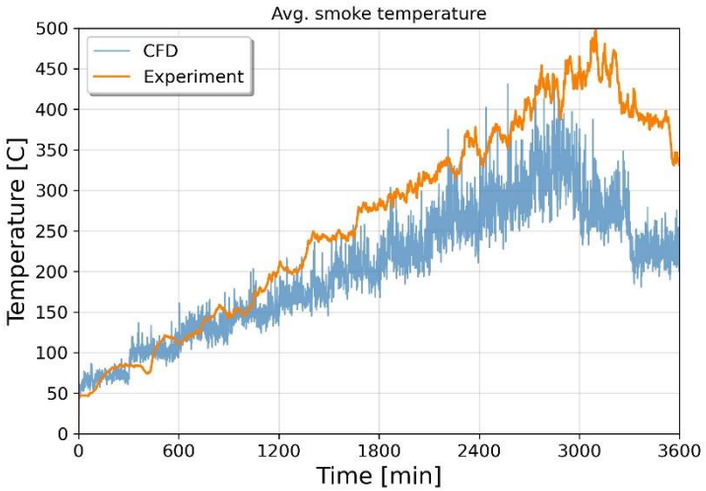


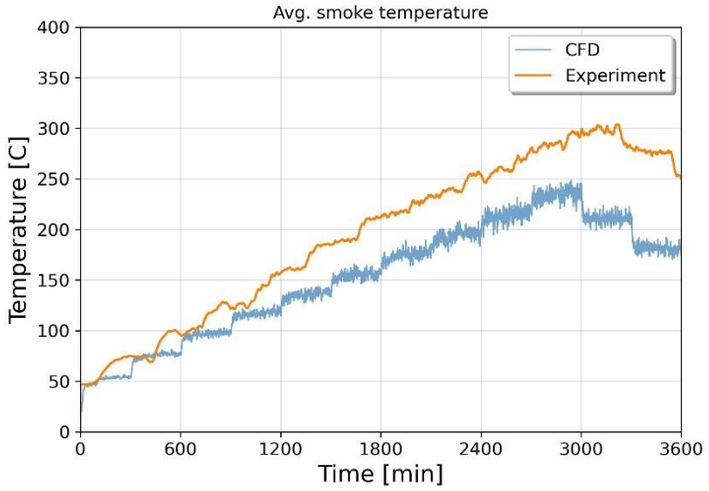
CFD

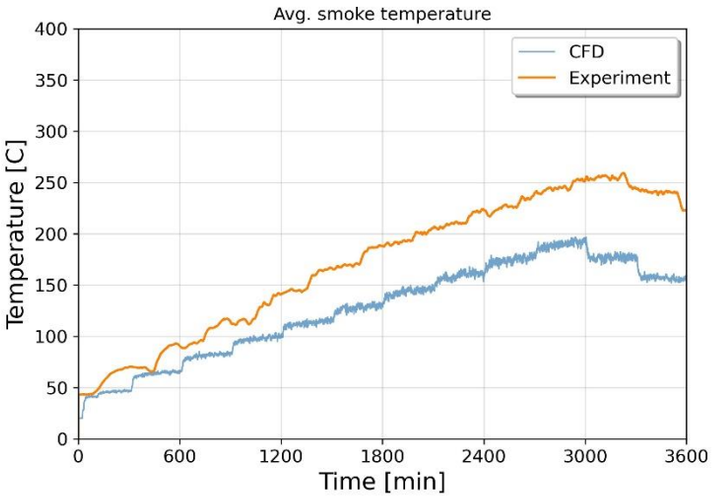


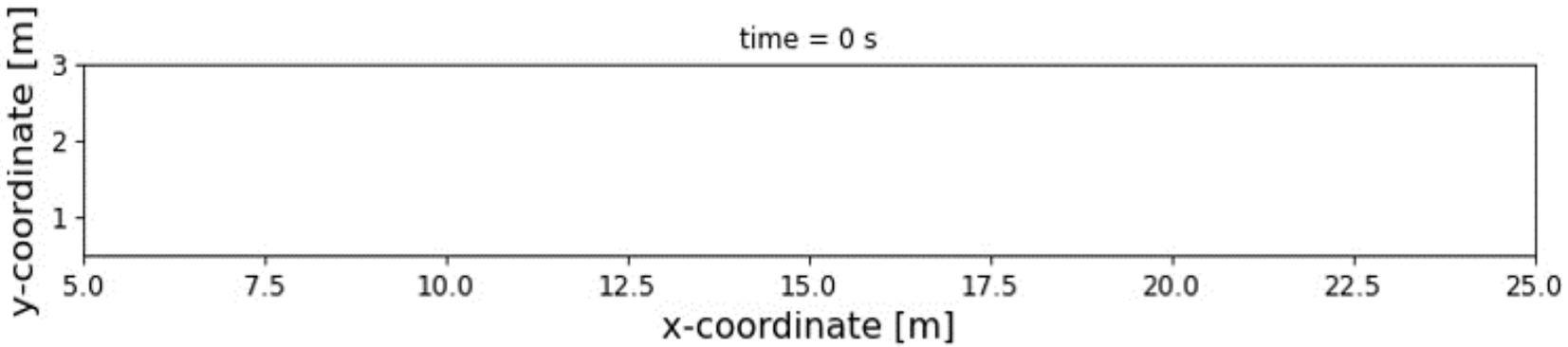
experiment

validation









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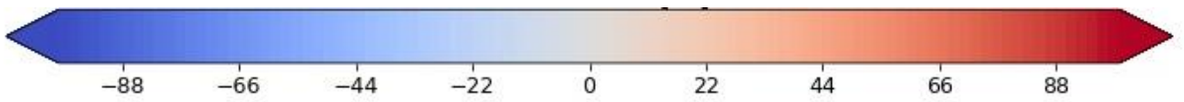
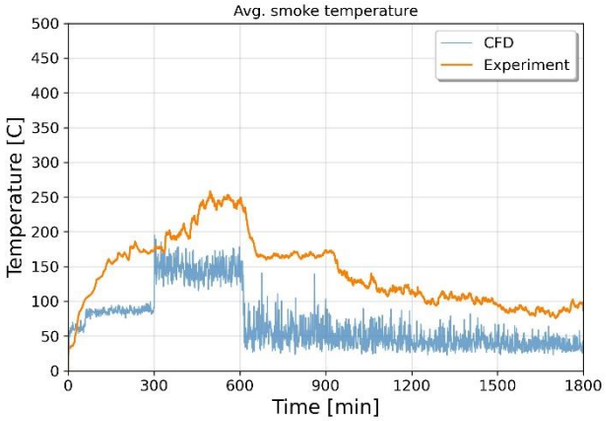
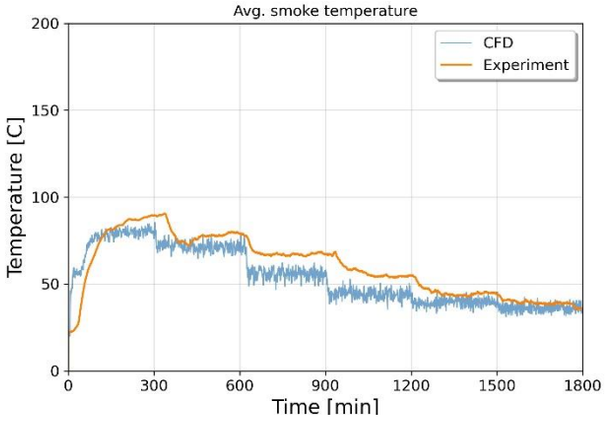
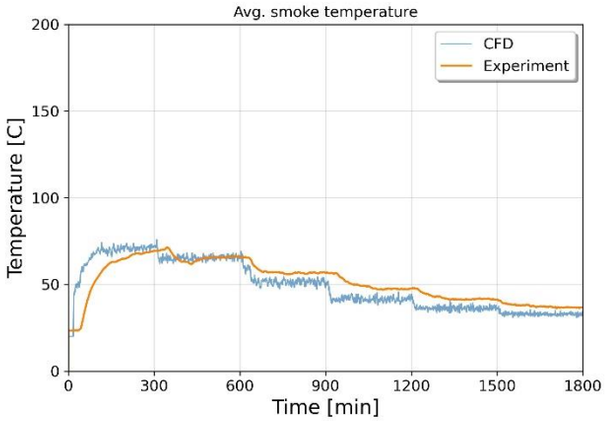


experiment

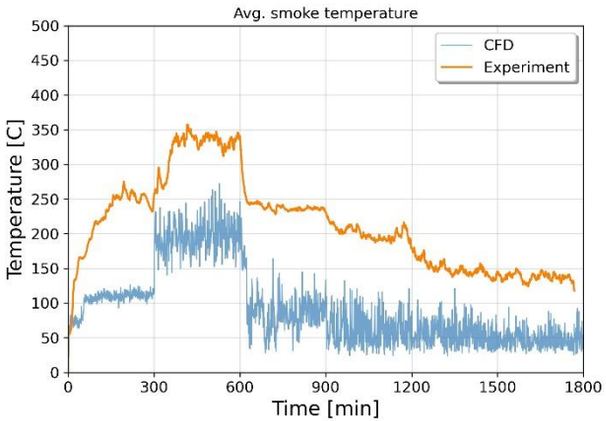
validation

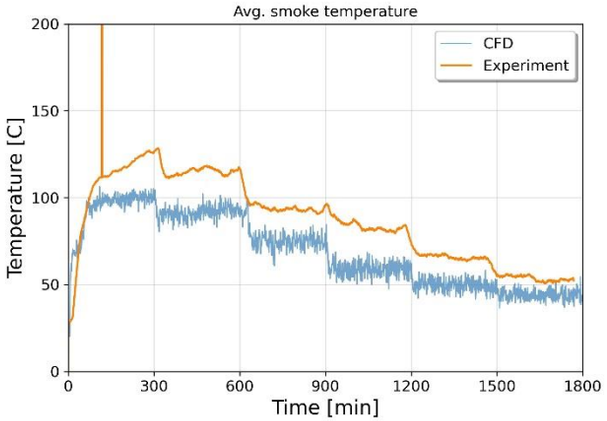


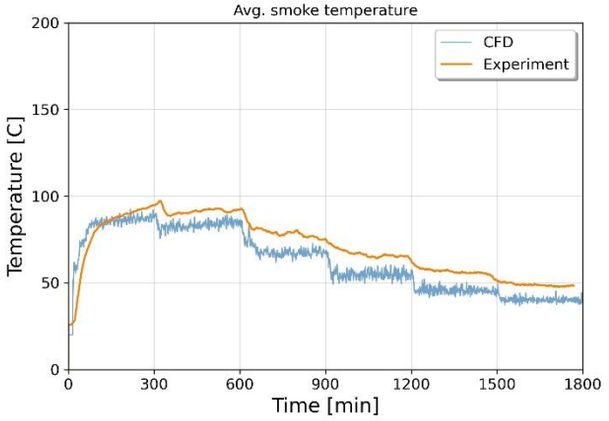




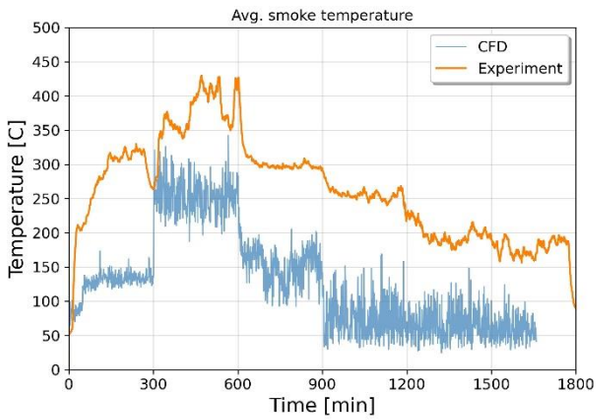
200 kW

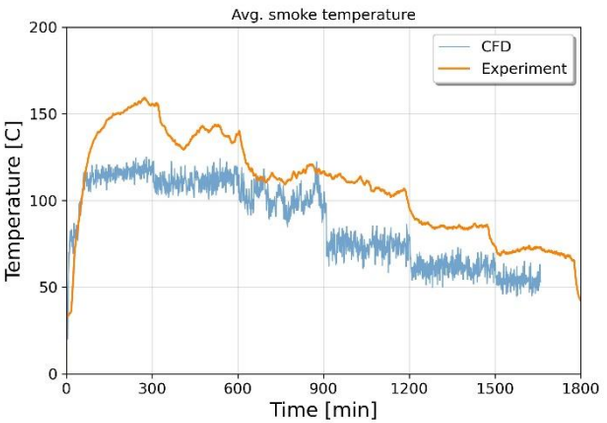


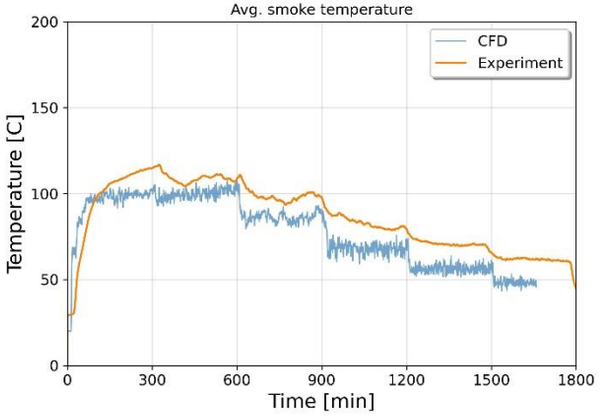




300 kW

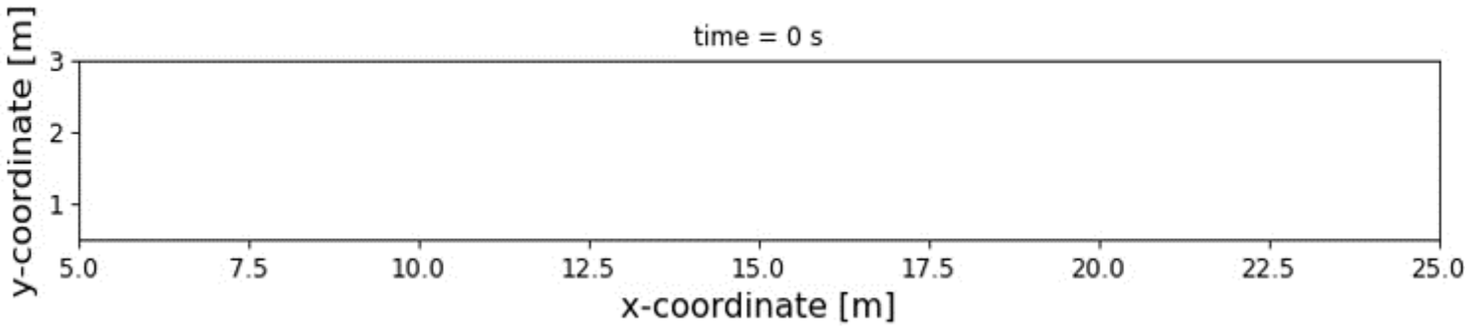




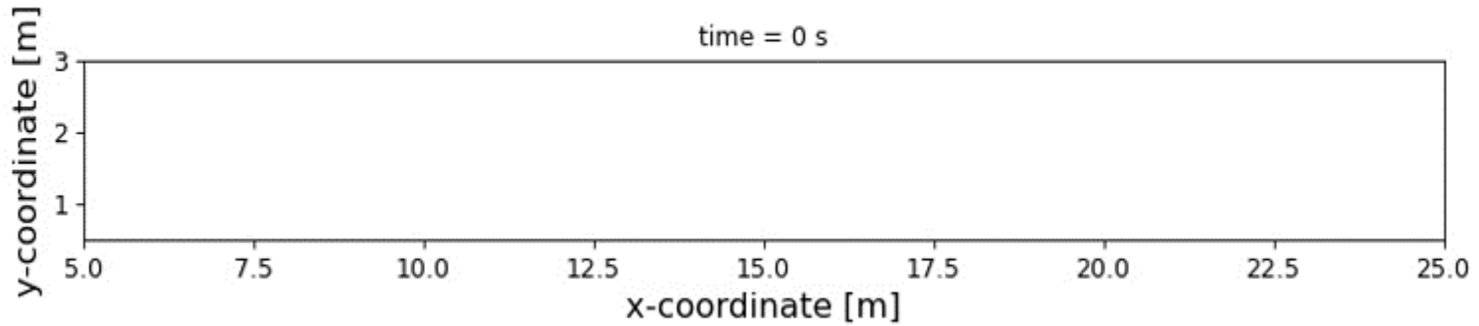


400 kW

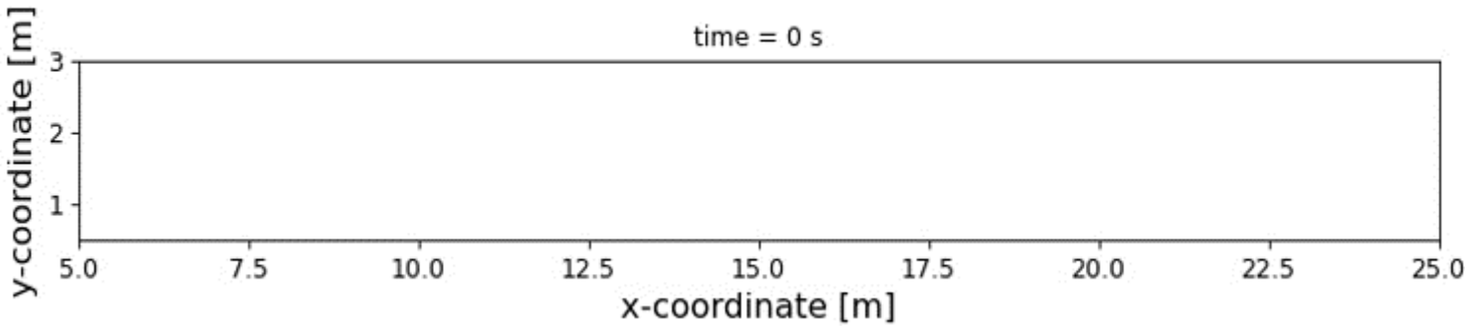
validation



200 kW

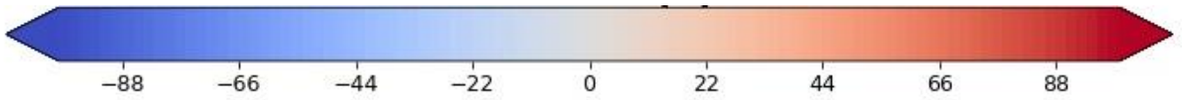


300 kW



400 kW

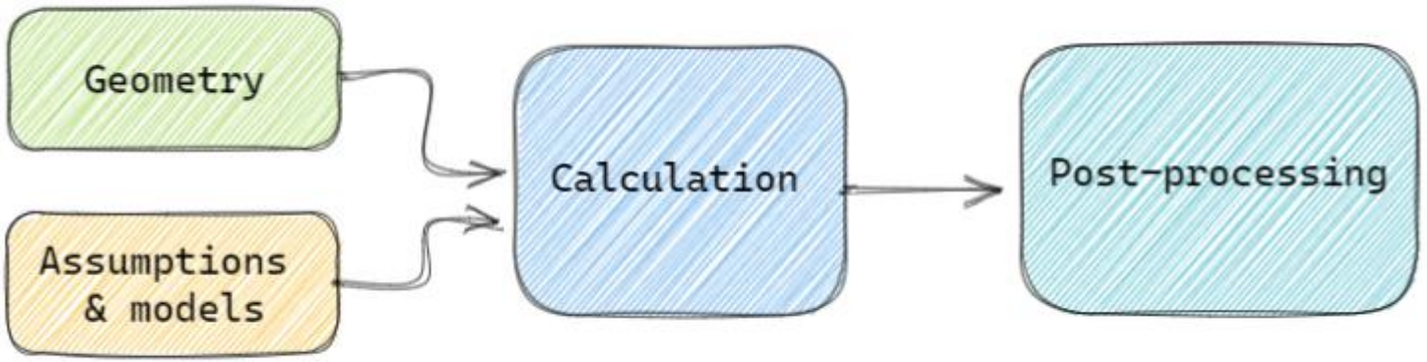
CFD



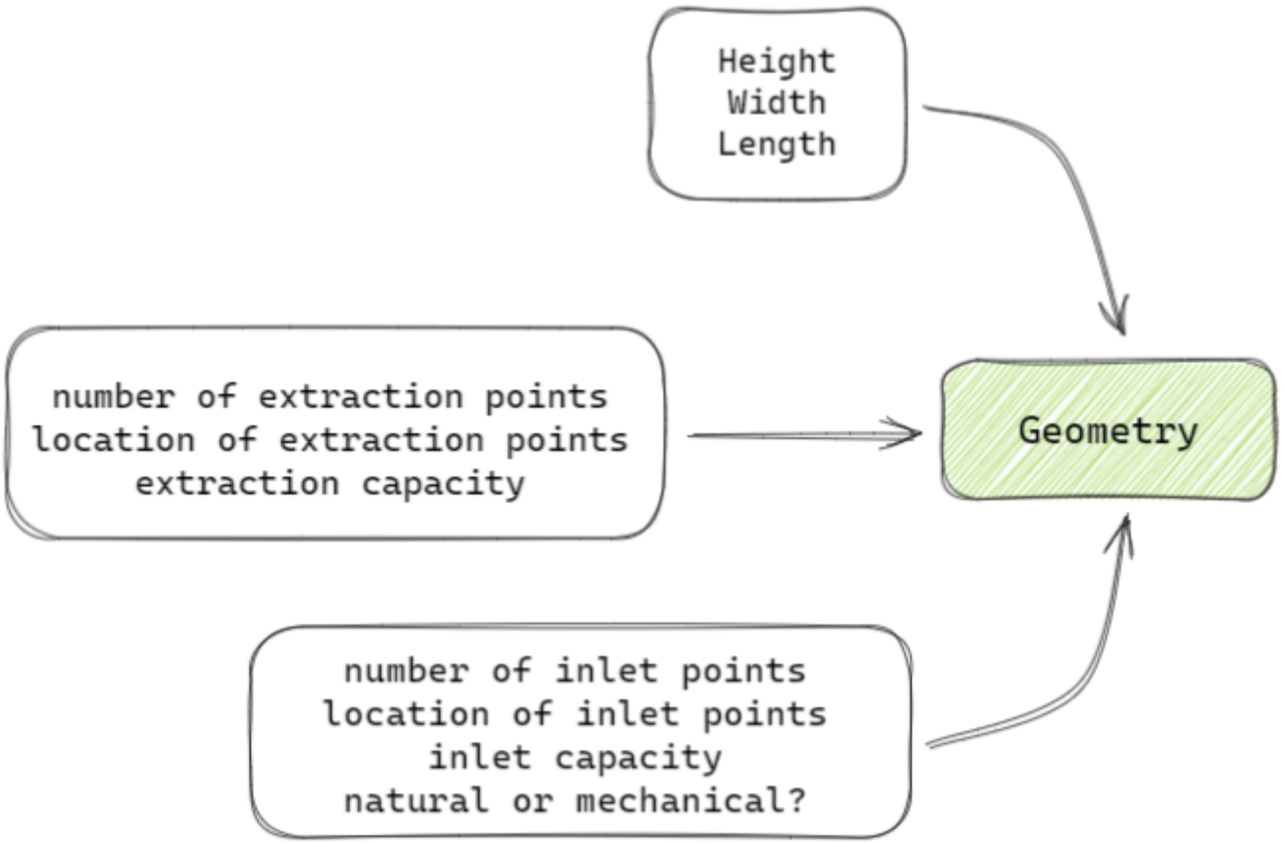
experiment

multiparametric CFD

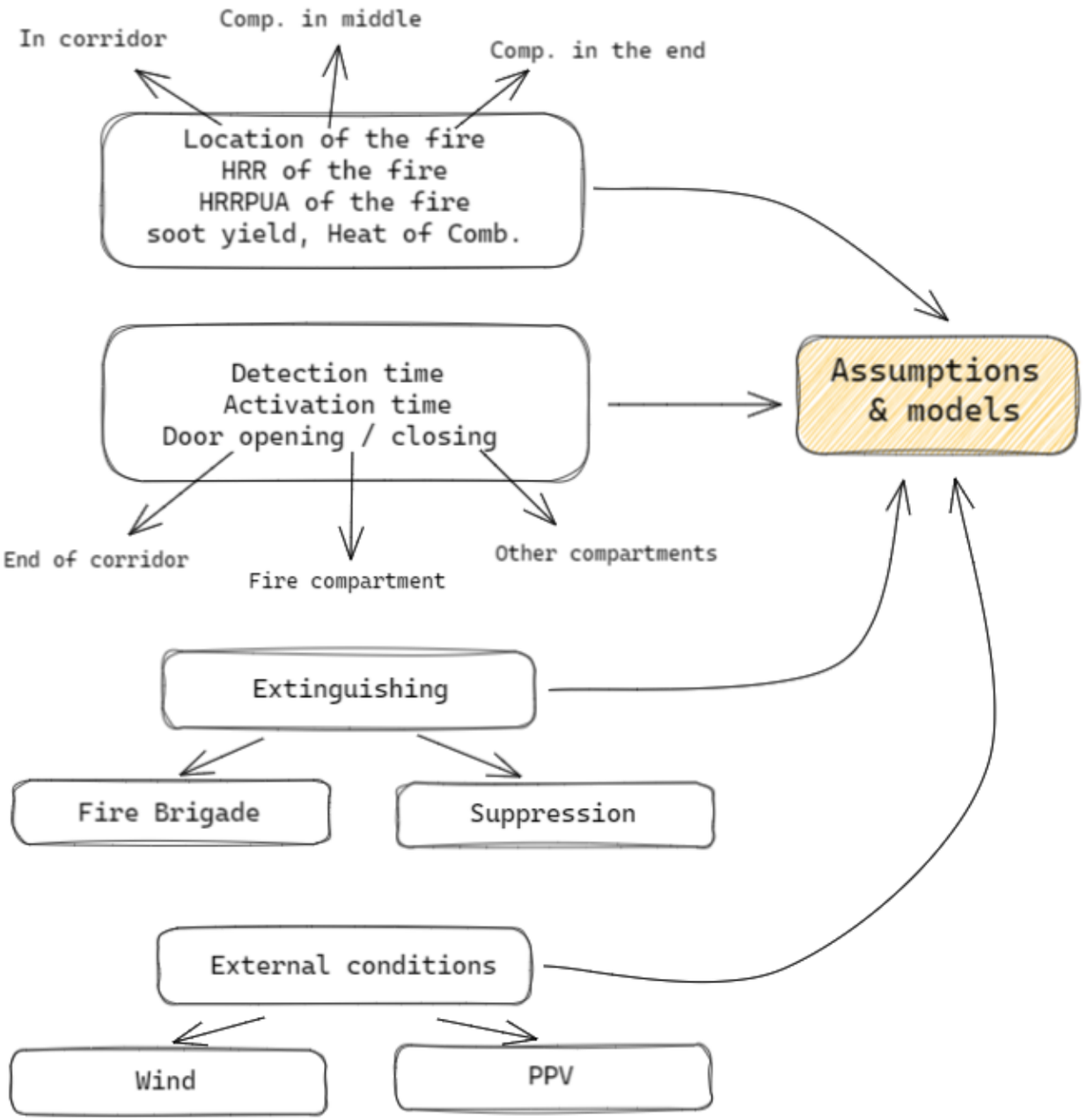
CFD


Geometry
Assumptions & models
Calculation
Post-processing

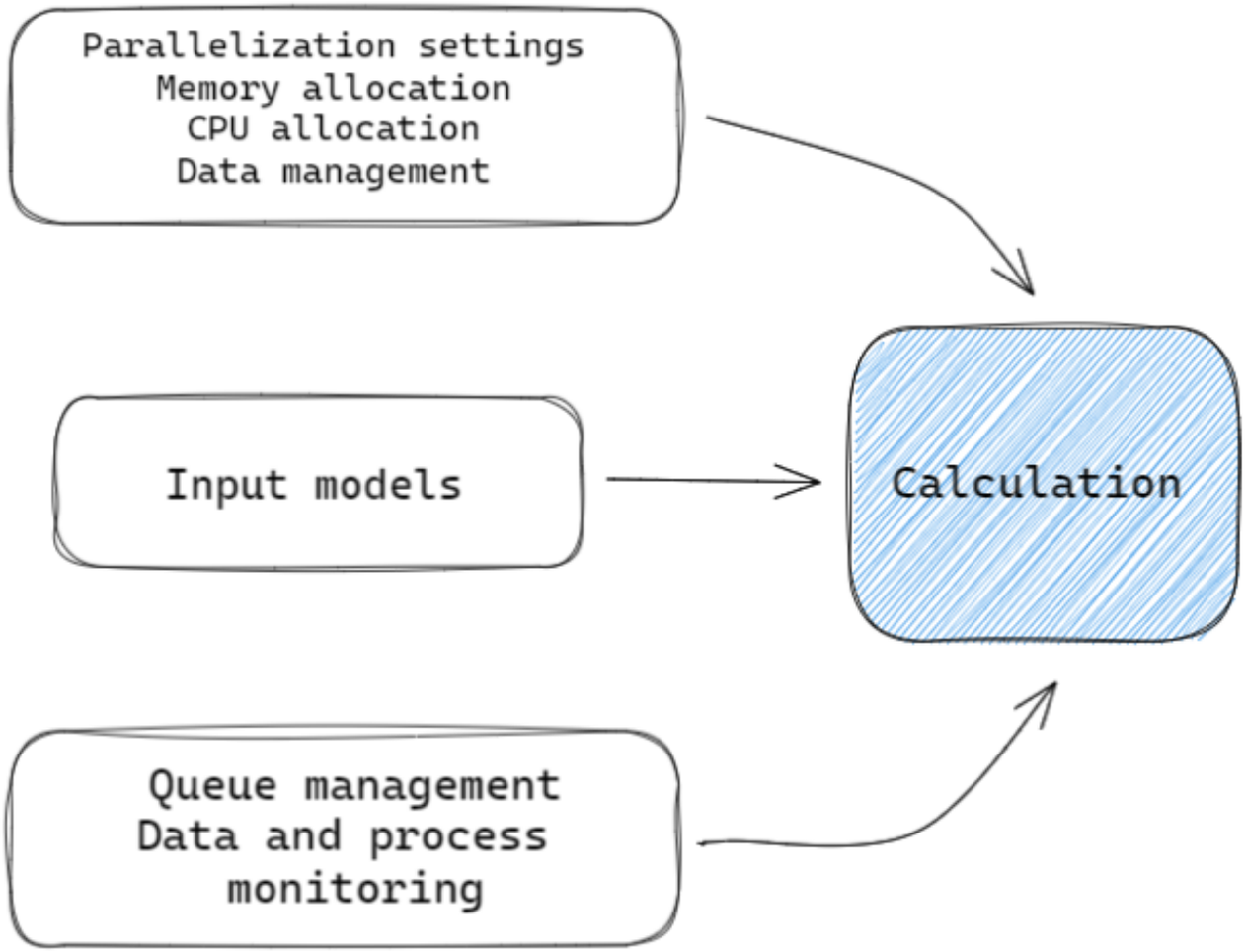
building the model



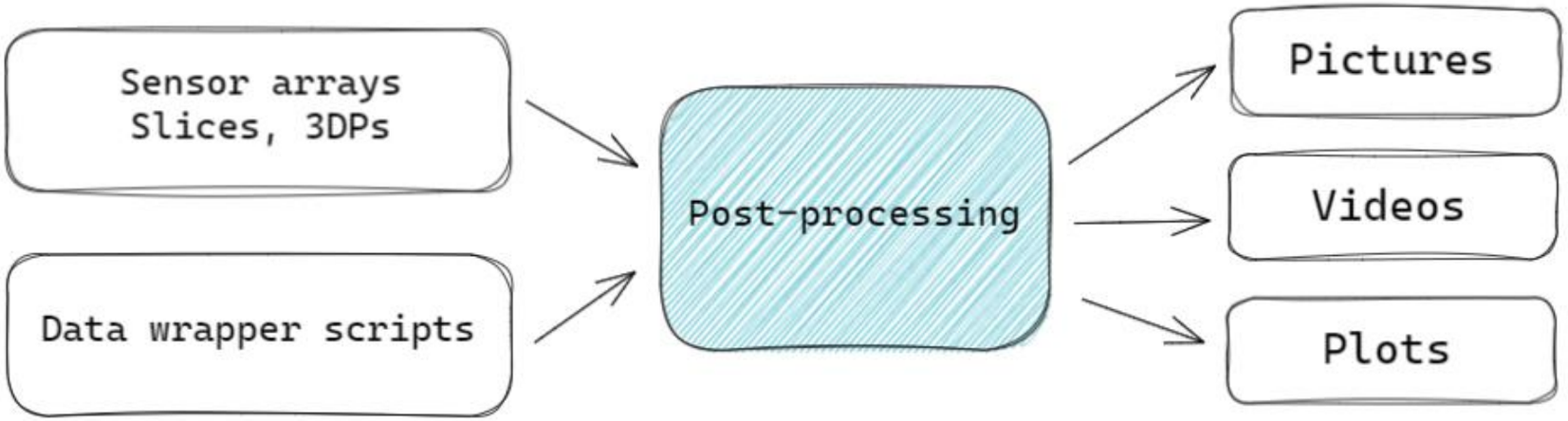
building the model



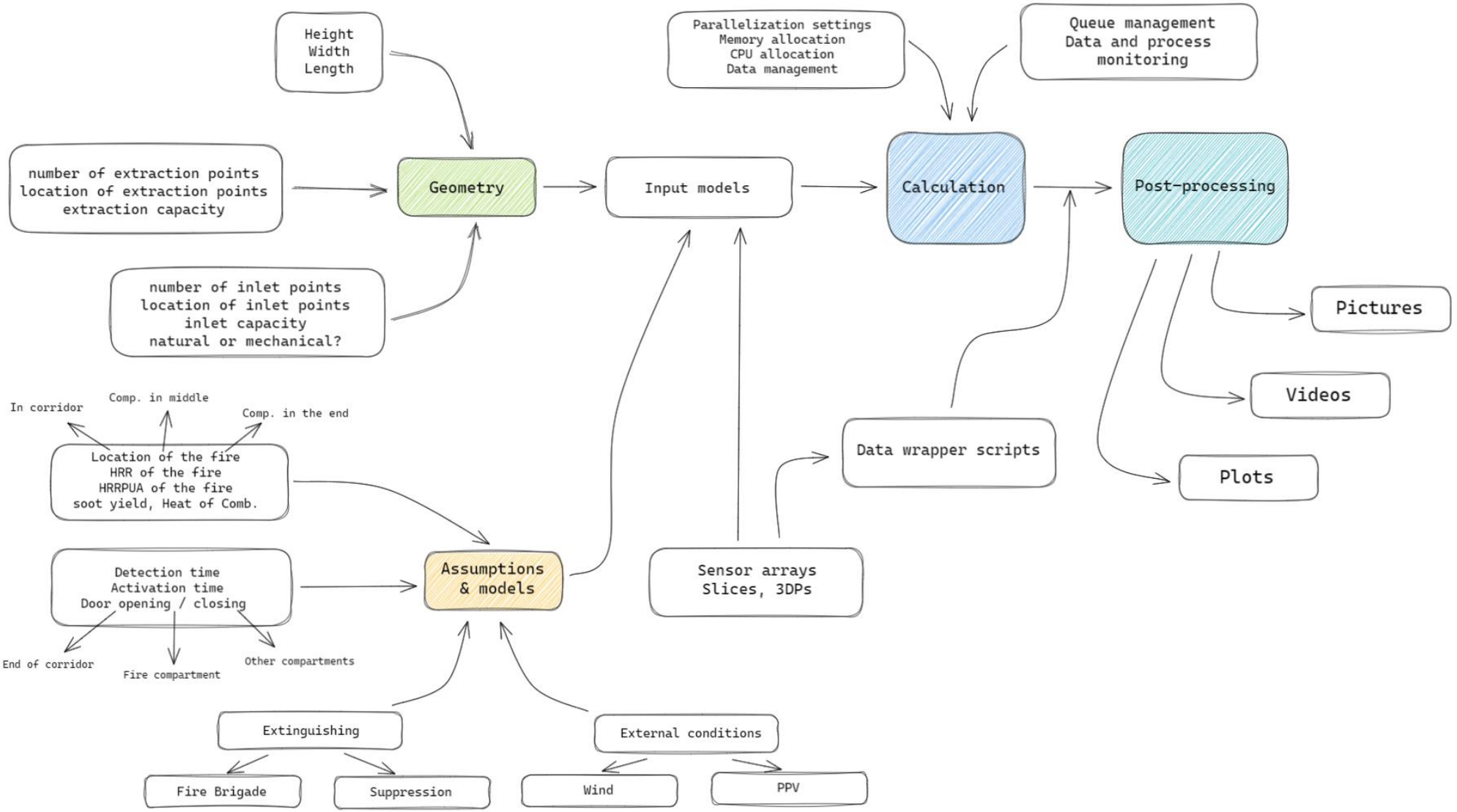
running the model



running the model

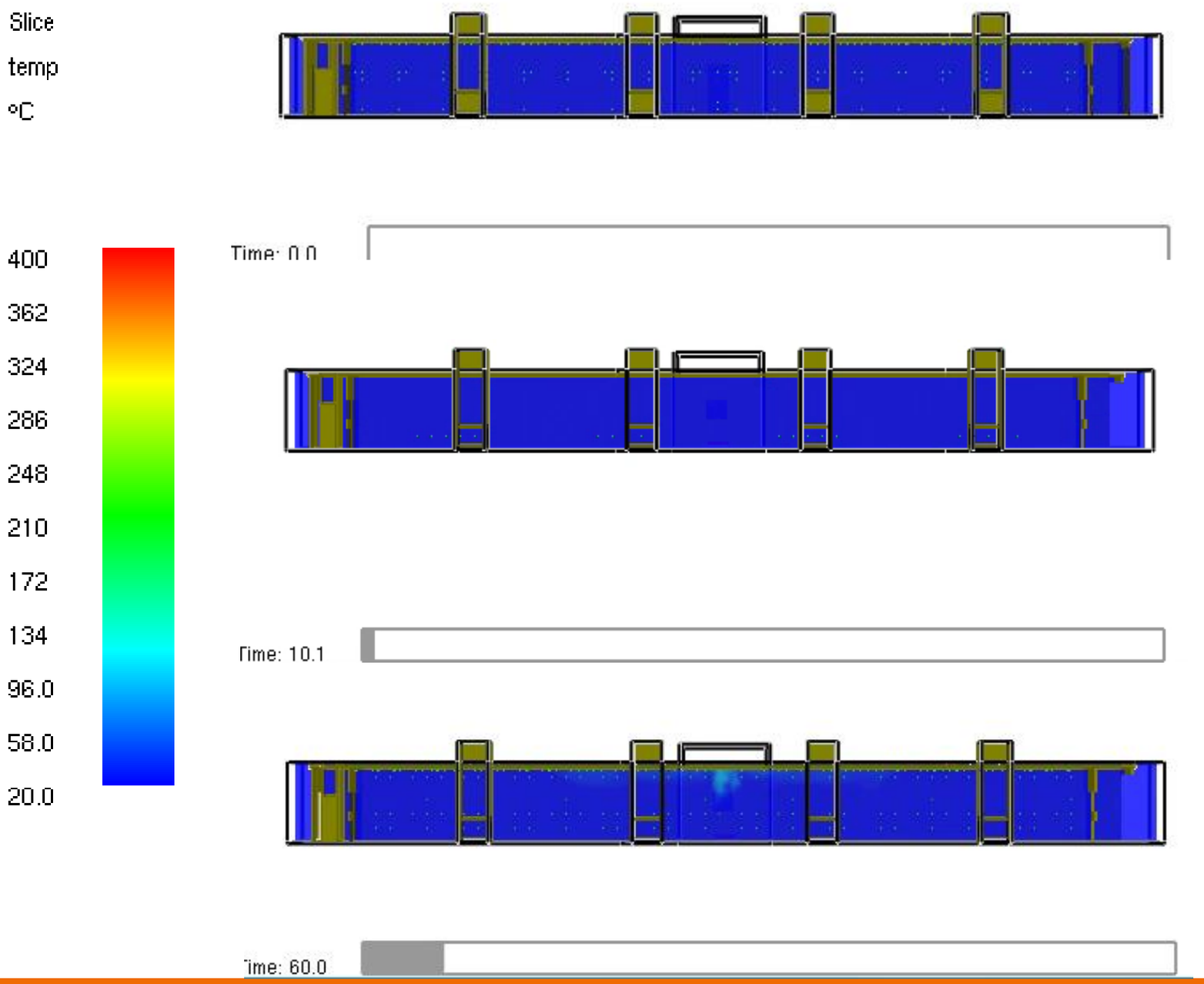


multiparametric CFD

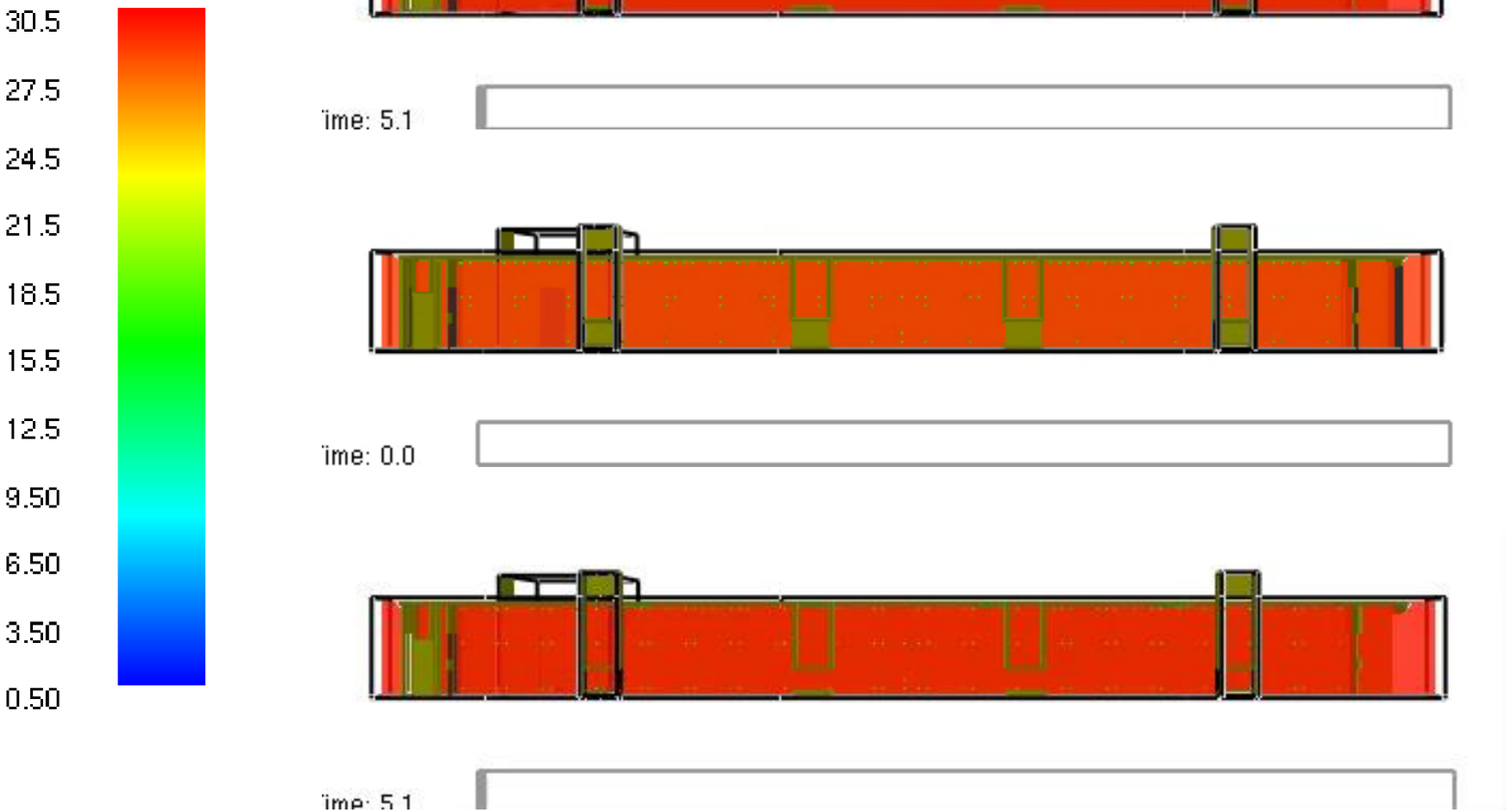


preliminary results

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



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

number of inlets

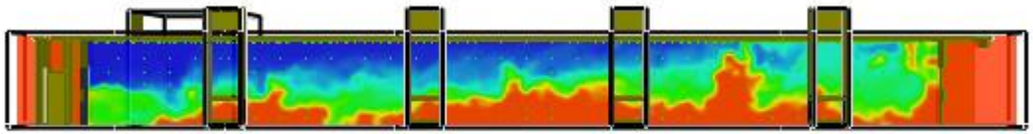
2 m³/s

ime: 5.1

Time: 0.0

4 m³/s

ime: 0.0



Time: 595.0

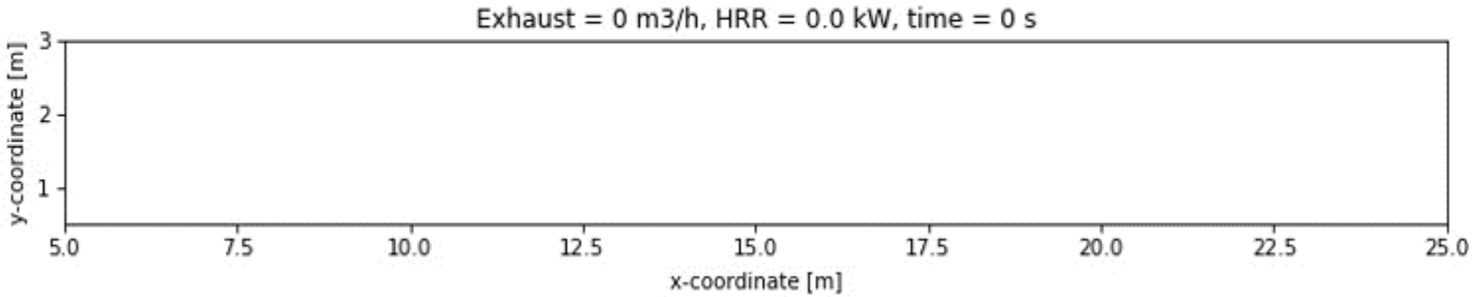
6 m³/s

ime: 5.1

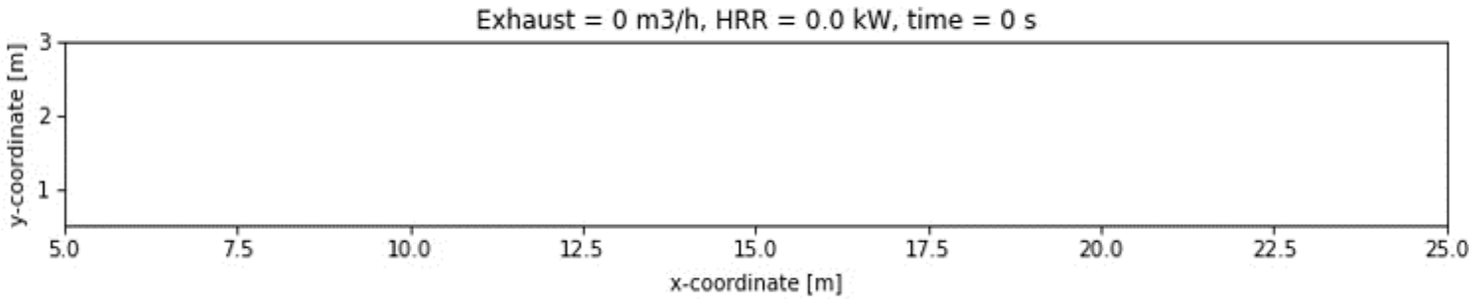
Time: 5.1

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

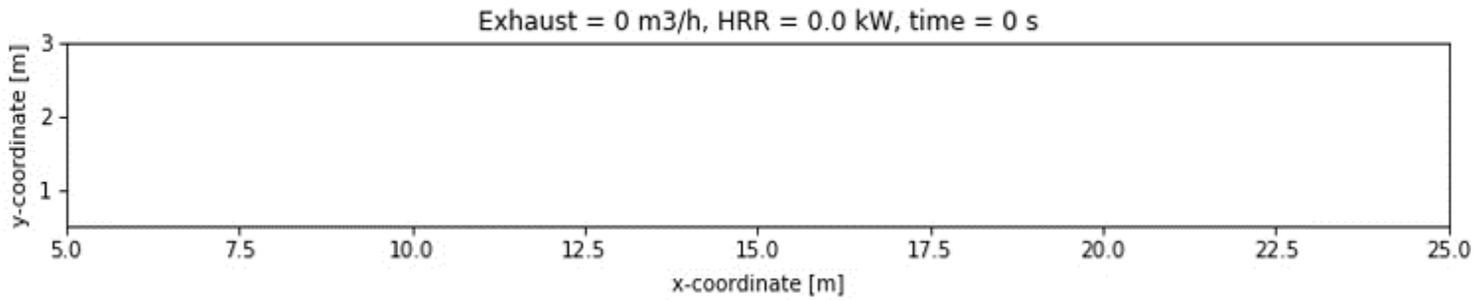
cross vent.



100 kW

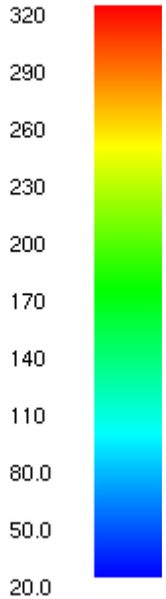


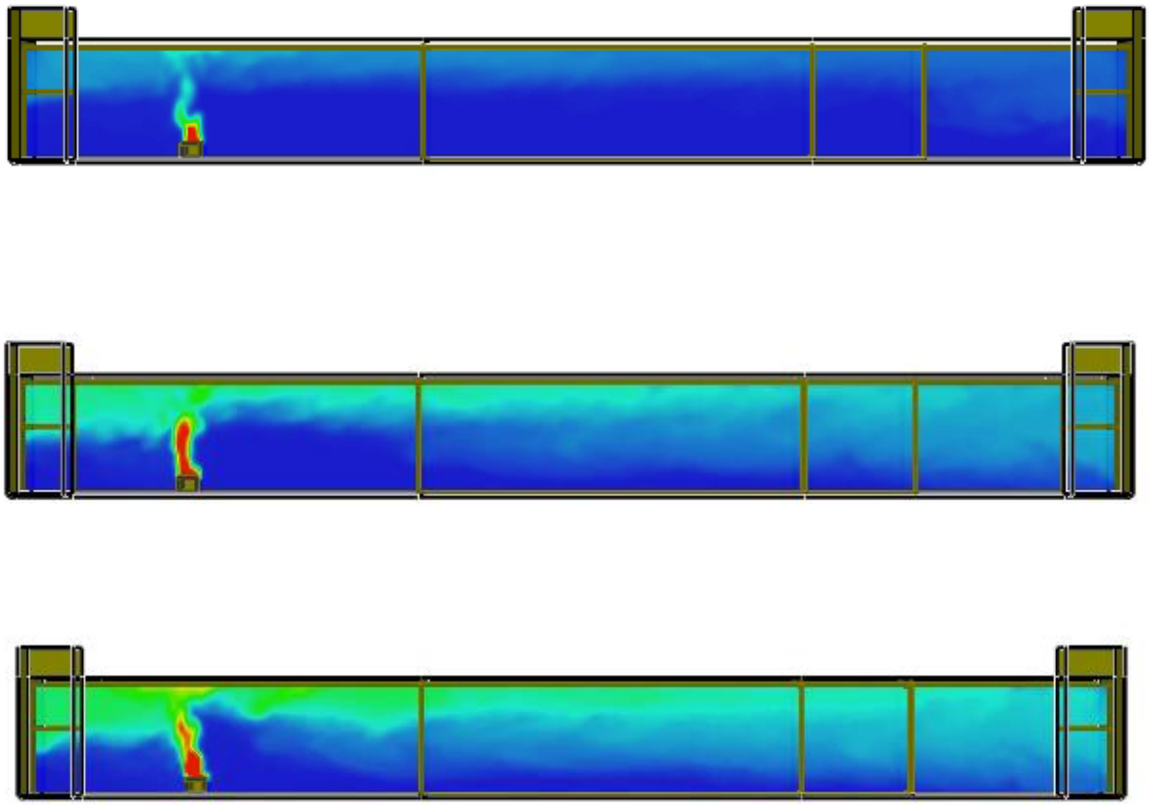
300 kW



400 kW

cross vent.





100 kW

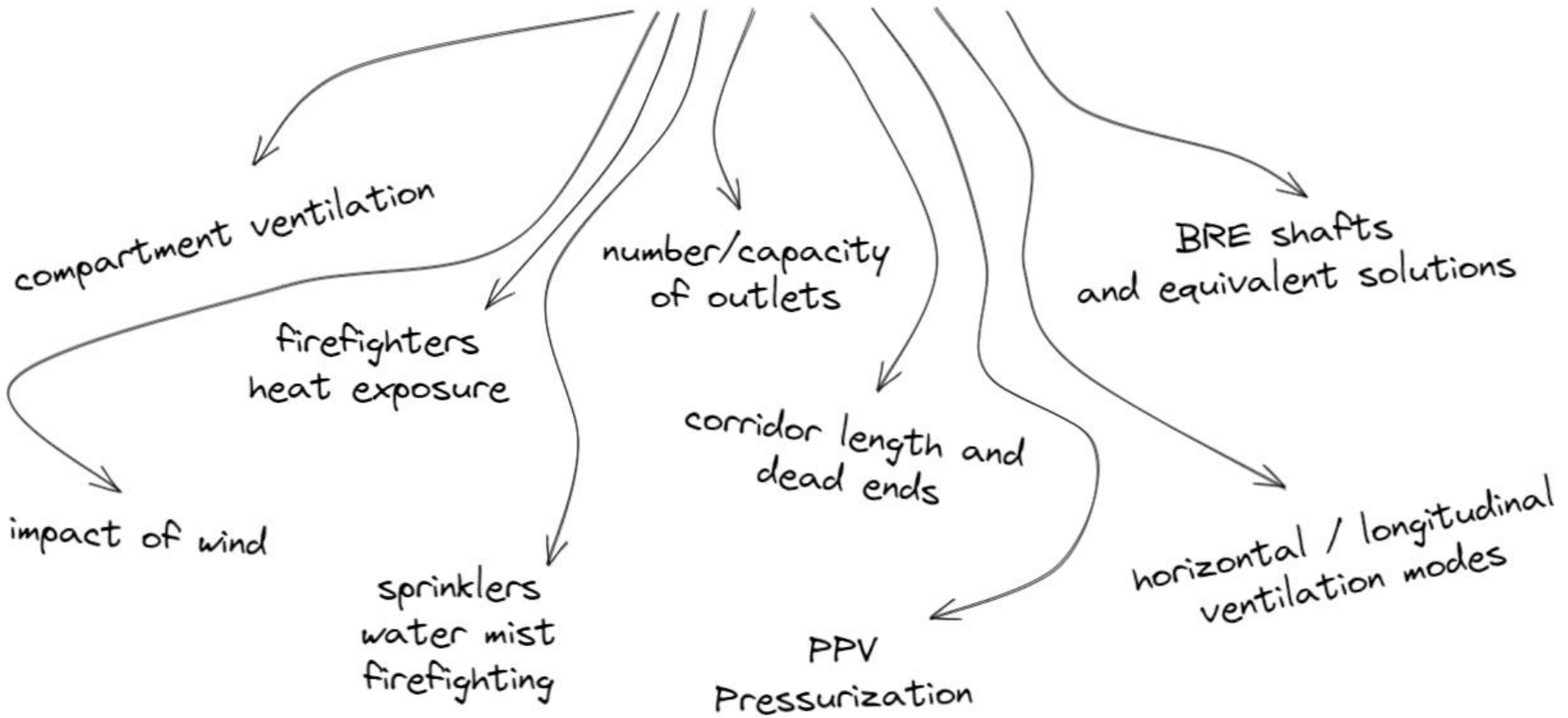
300 kW

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!

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