

Infection modelling in classrooms

– results from MSc project and
previous CFD

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- CFD
- Point kinetics and linking with data
- Individual modelling of infections in a classroom

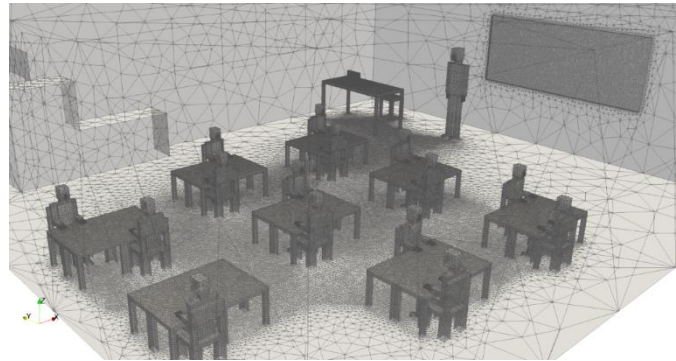
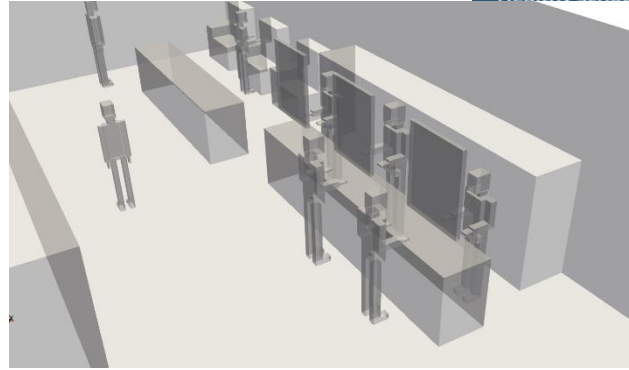
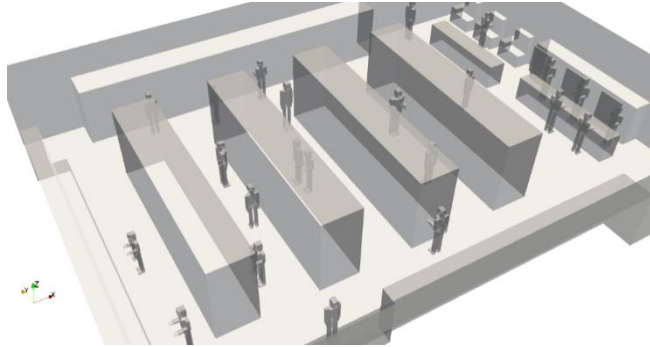
[1] Adam et al. Clustering and superspreading potential of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections in Hong Kong.

CFD

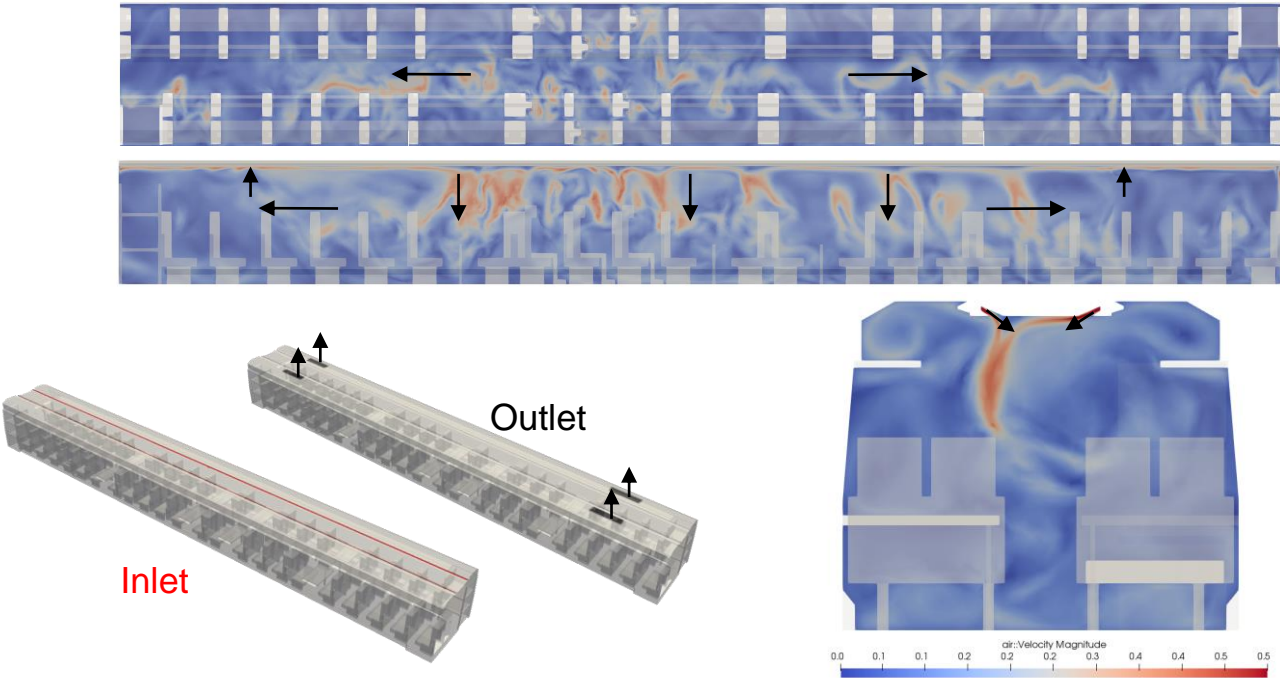
Automatic geometry generation for CFD

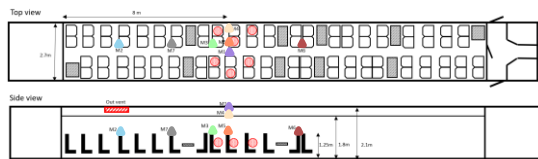
CO-TRACE

Healthy schools through air-quality science

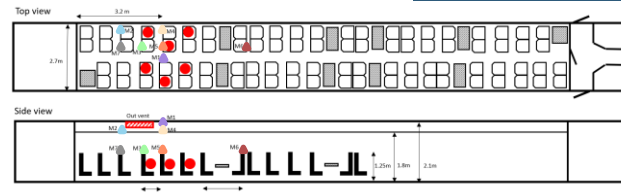


Velocity field

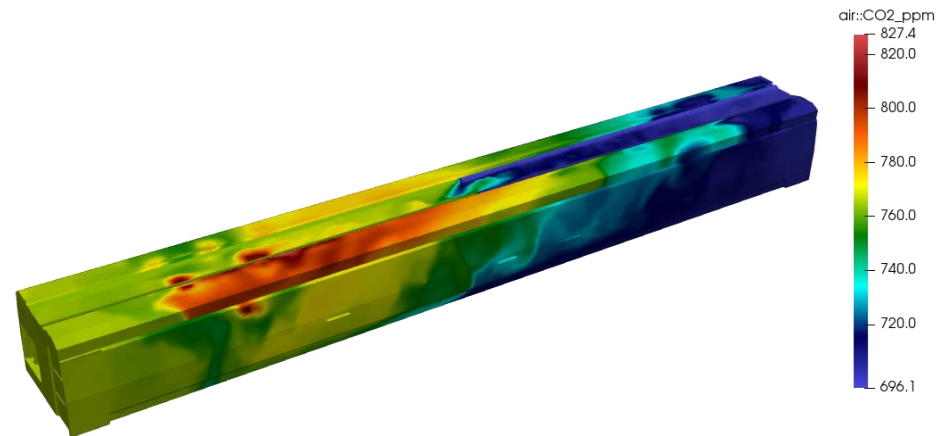
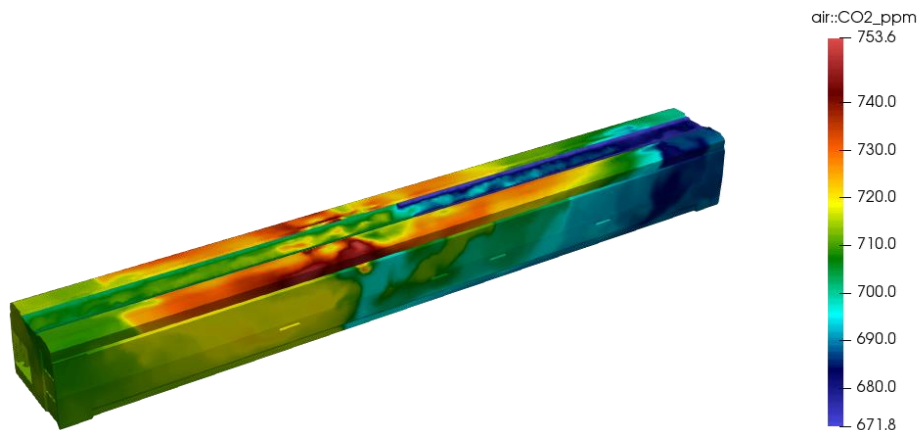




Middle experiment



End experiment

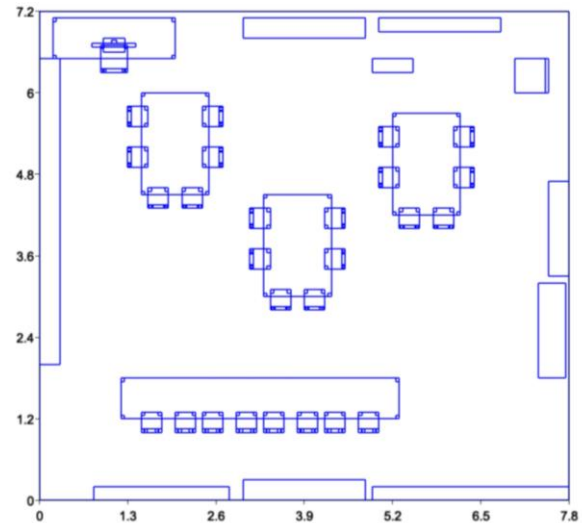
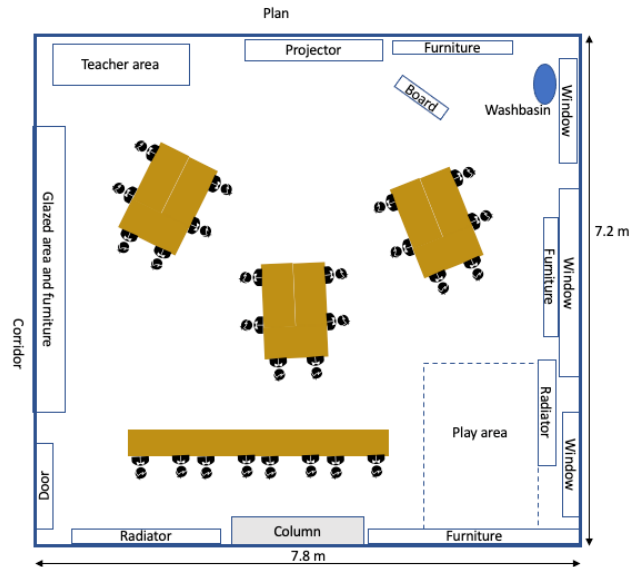


Simulation of selected classroom

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Healthy schools through air-quality science

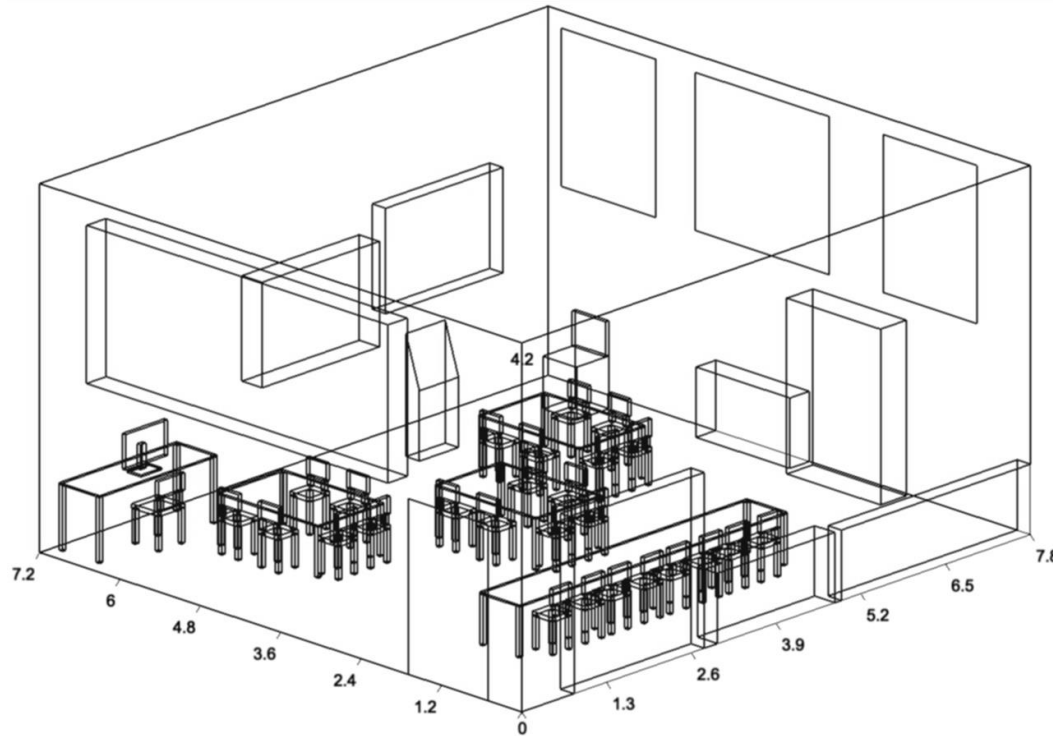




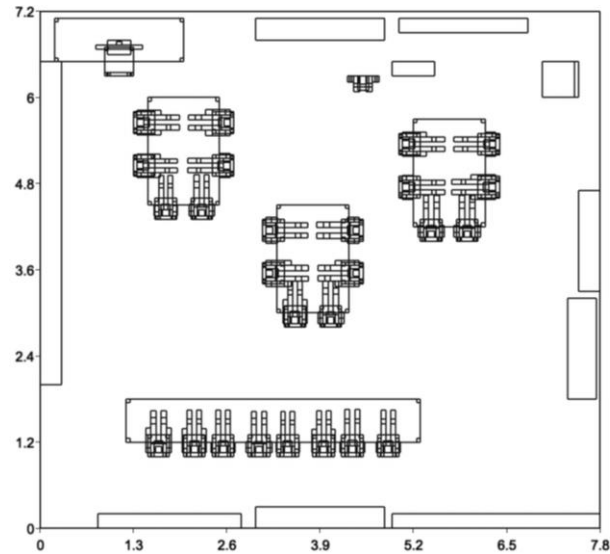
Empty classroom

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Healthy schools through air-quality science



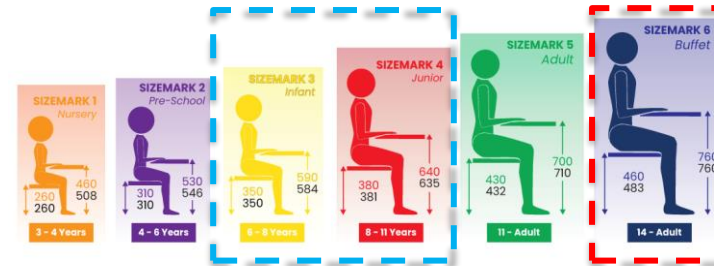
Classroom in class



27 people in total

26 children whose height is from 140 mm to 155 mm

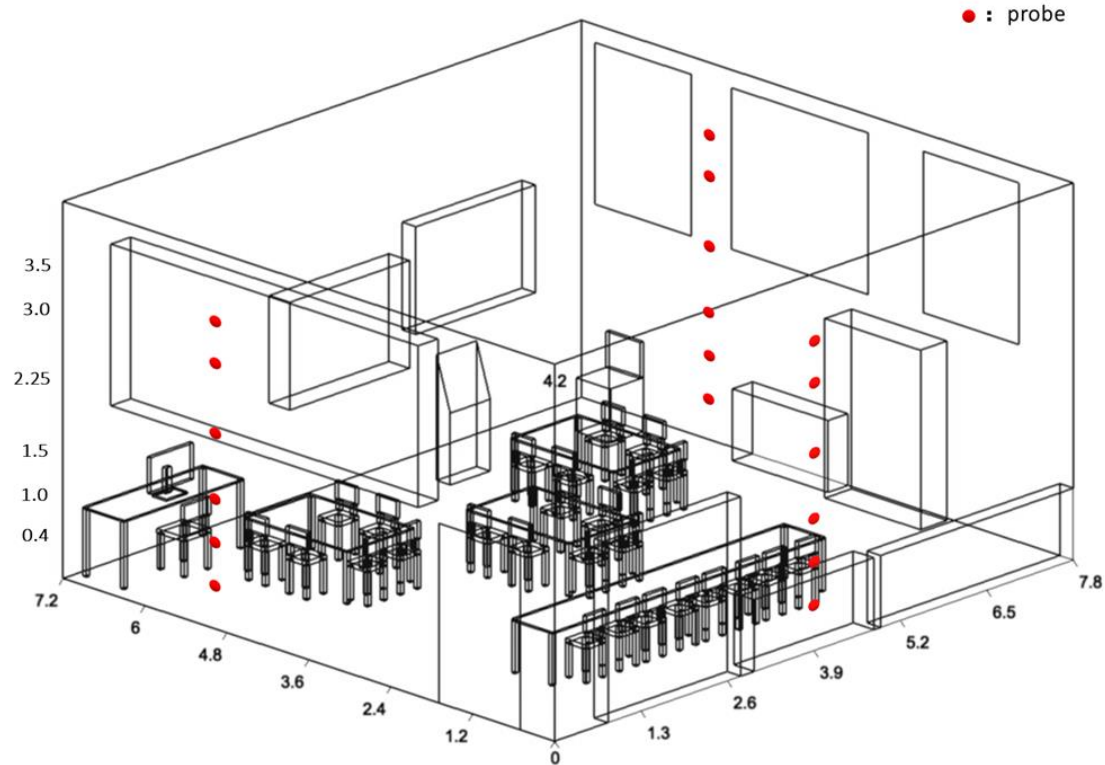
1 lecturer whose height is 170 mm



Numerical probe in classroom

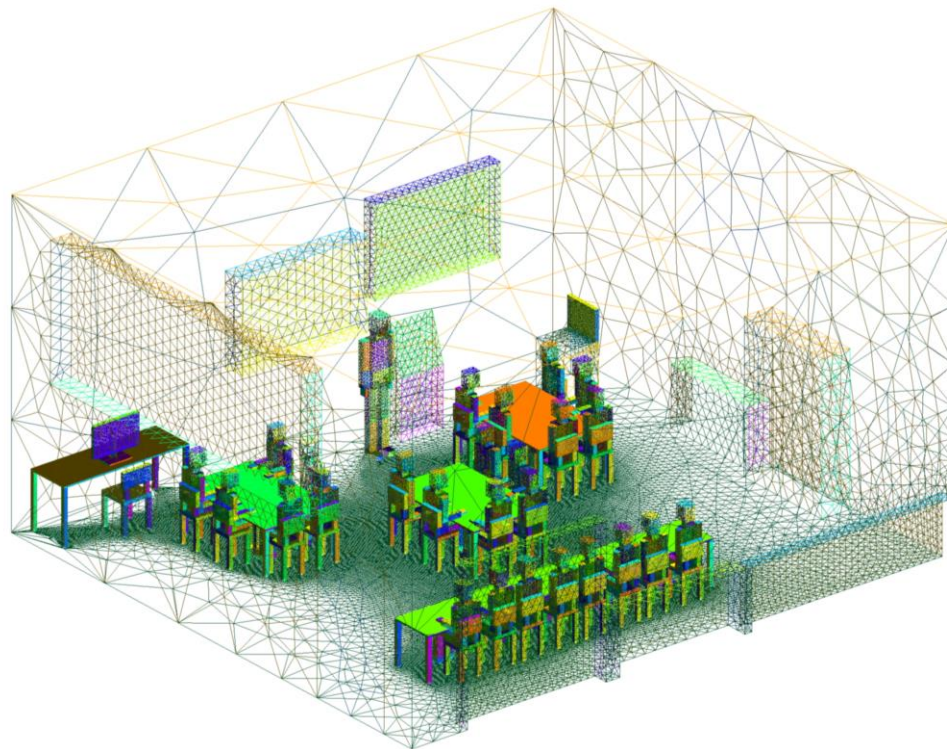
CO-TRACE

Healthy schools through air-quality science



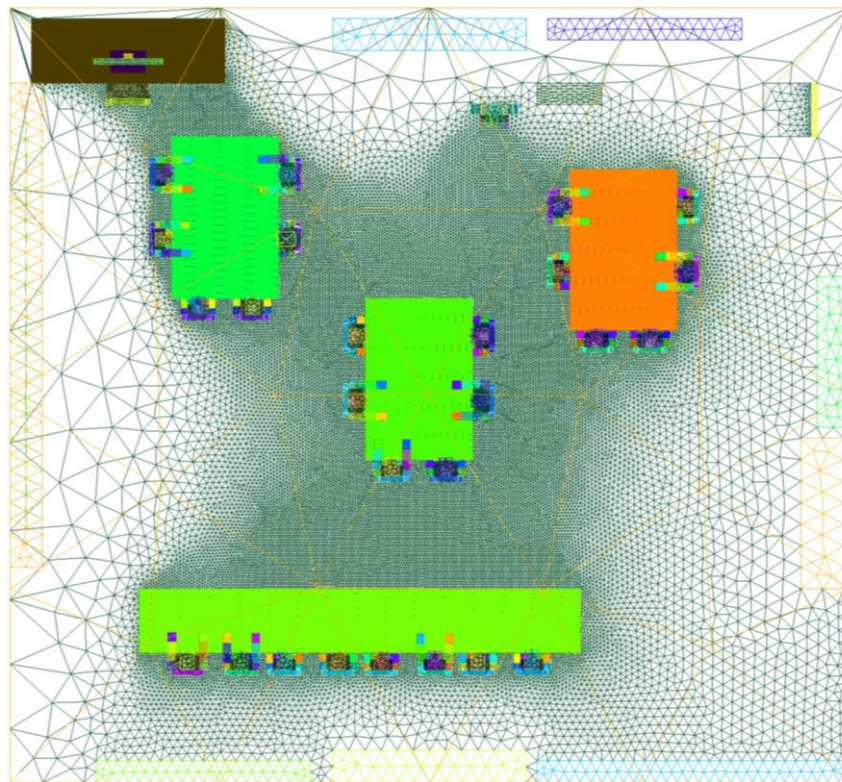
CO-TRACE

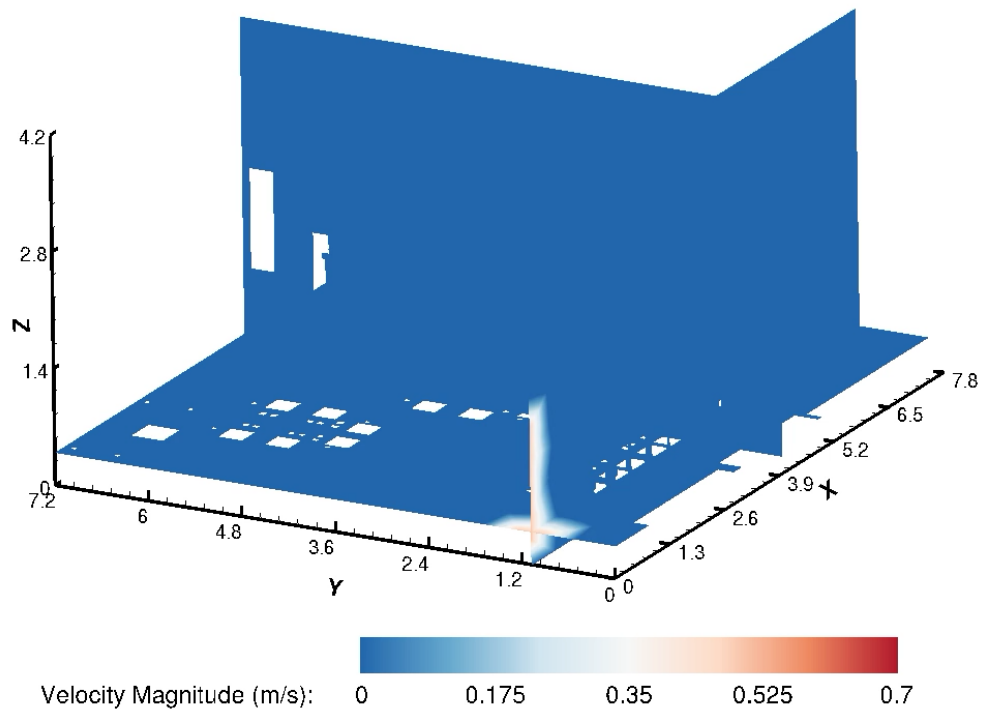
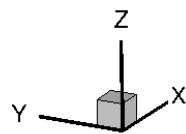
Healthy schools through air-quality science

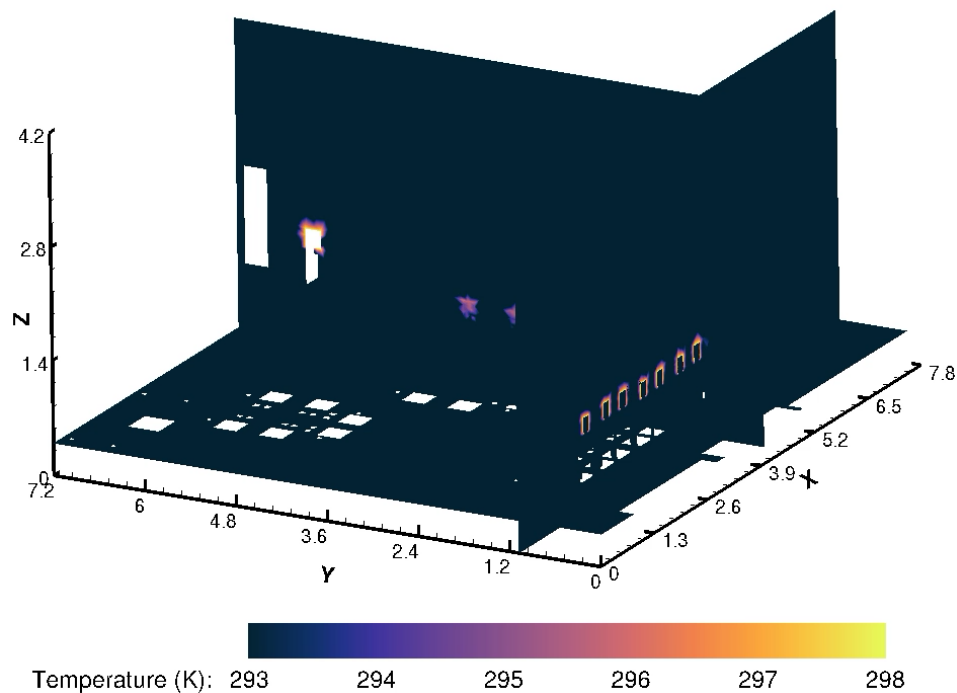
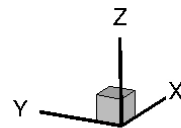


CO-TRACE

Healthy schools through air-quality science







Rapid models



Point Kinetics: Time series prediction from eqns and Data Assimilation (DA) in enclosed space – tube station.

How fields co-vary, prediction, COVID

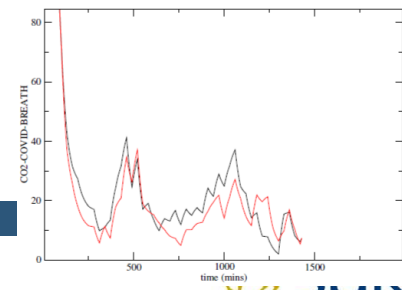
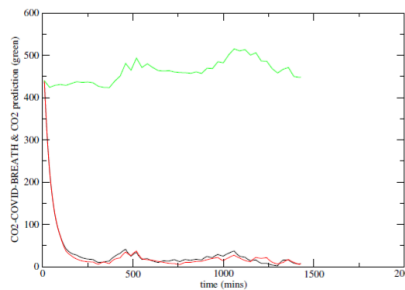
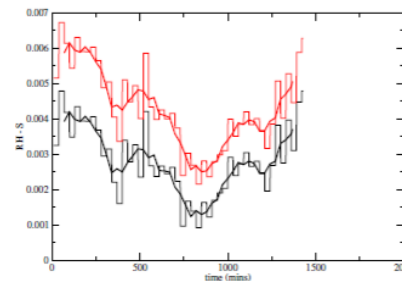
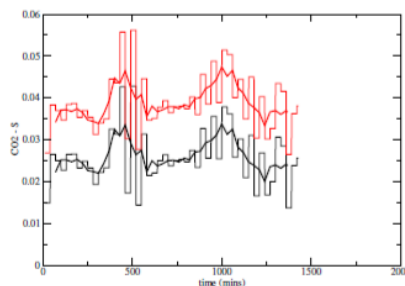
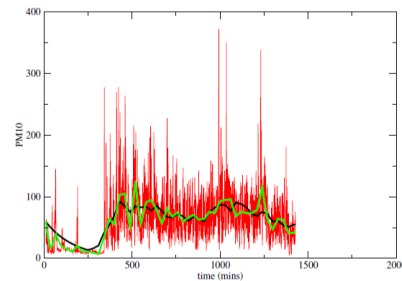
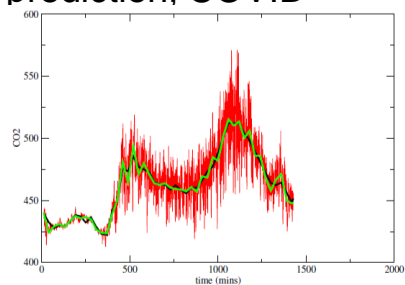
CO-TRACE

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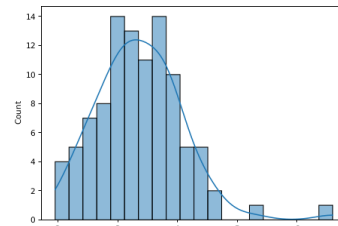
Top row: CO₂, PM₁₀ measurements and DA models in green.

Middle row: DA CO₂ and Humidity sources.

Bottom row: CO₂ DA and model converted into infected CO₂ concentration



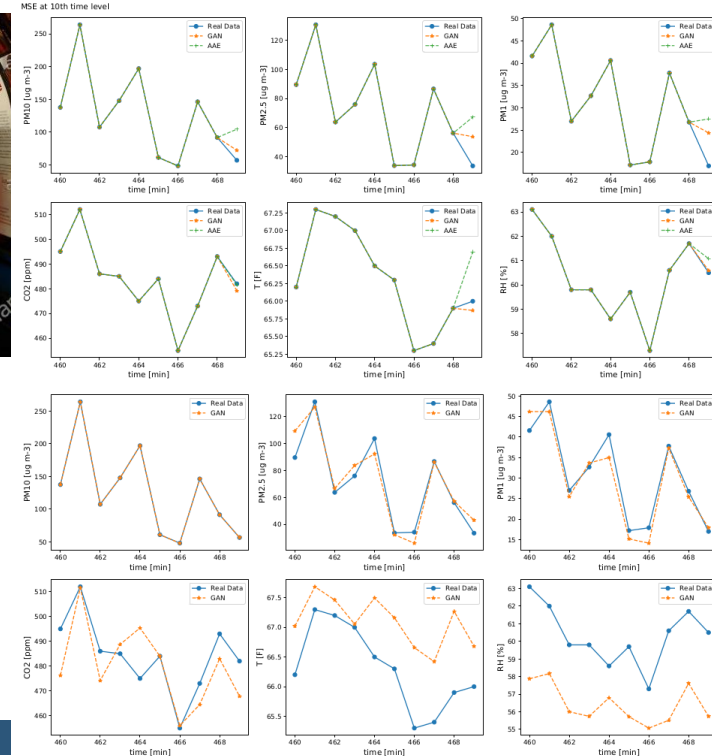
Point Kinetics: Time series prediction from AI – model – pollution in enclosed space – tube station.
How fields co-vary, prediction, COVID



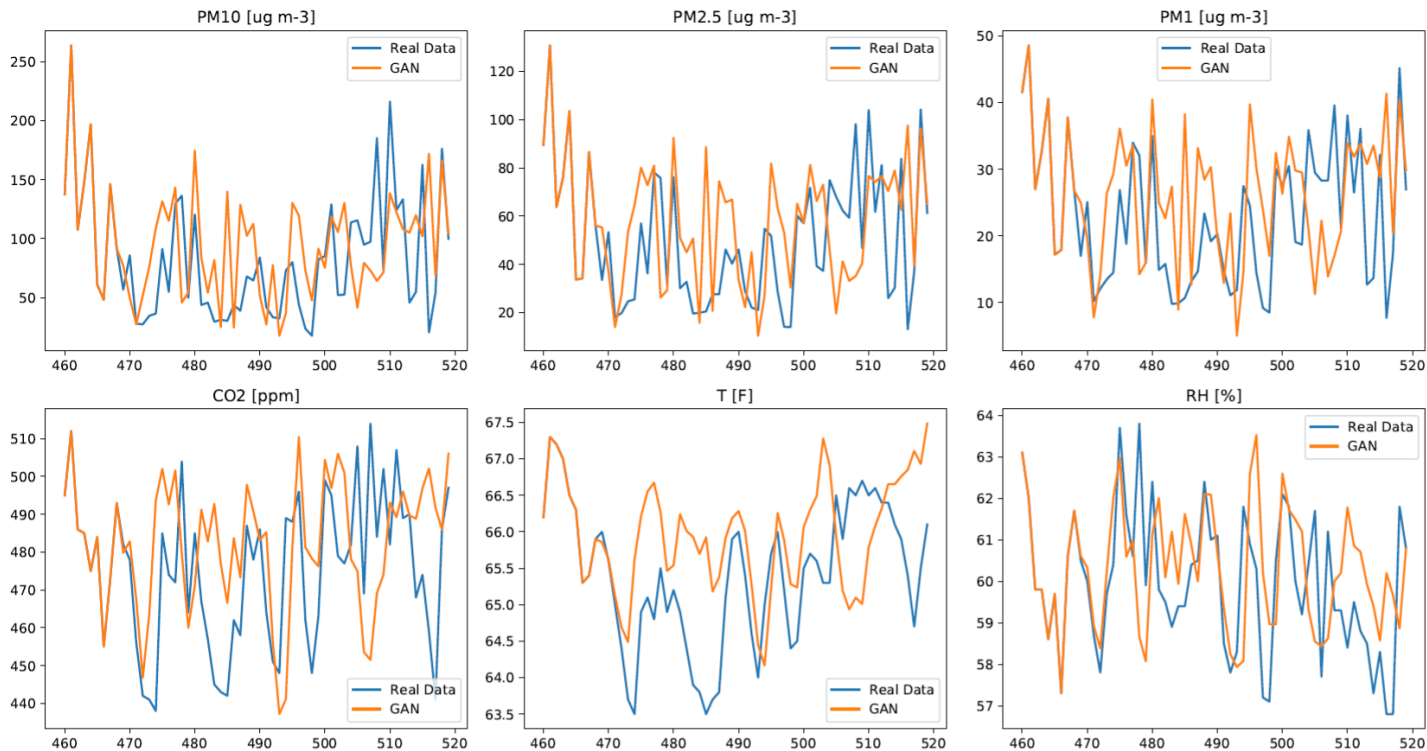
TOP: Uncertainty in predicting next time level.

MIDDLE: Predicting next time level.

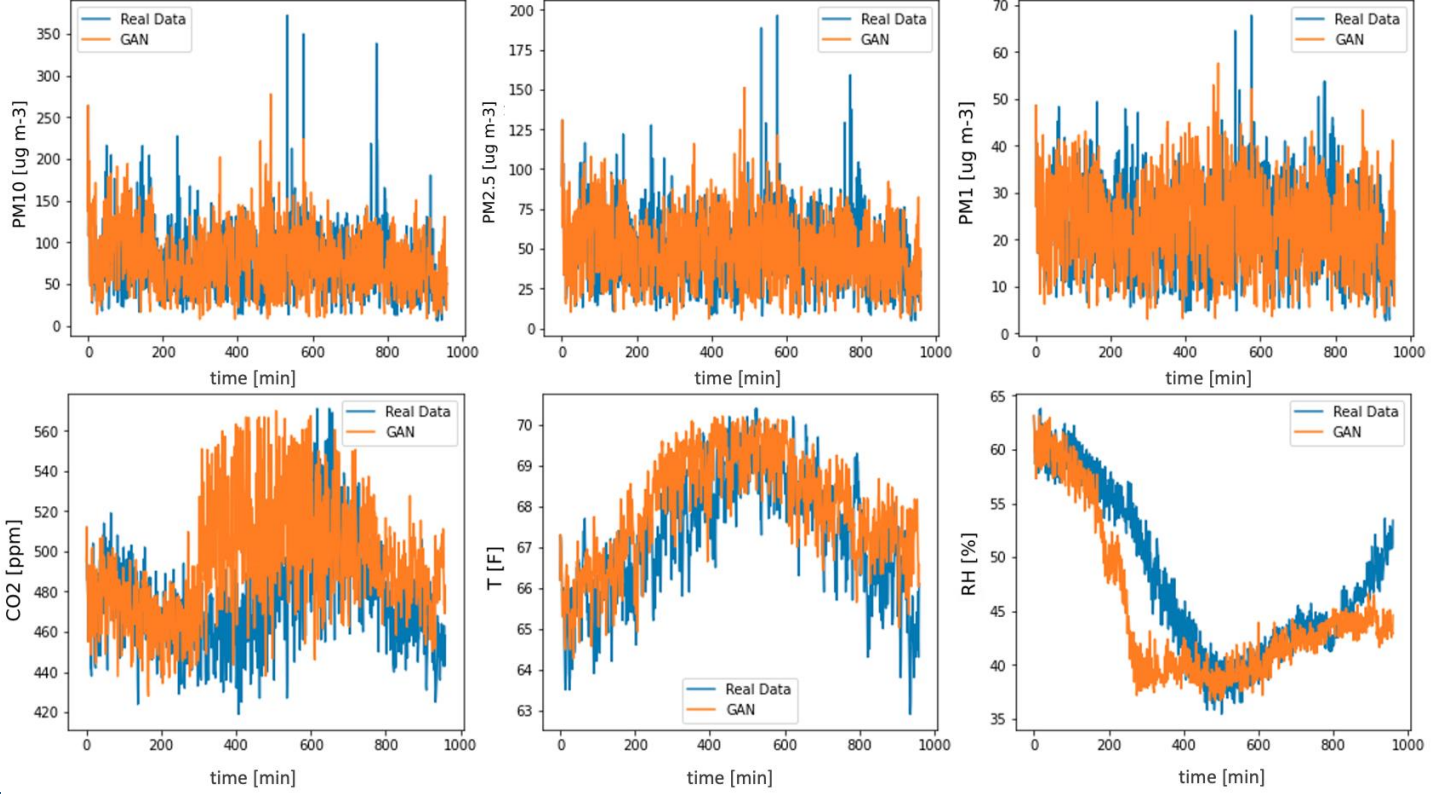
BOTTOM: Predicting time series from CO₂ time series.



Point Kinetics: Time series prediction over 1 hour from AI – model –
pollution in enclosed space – tube station.
Prediction and measurements against time (mins).

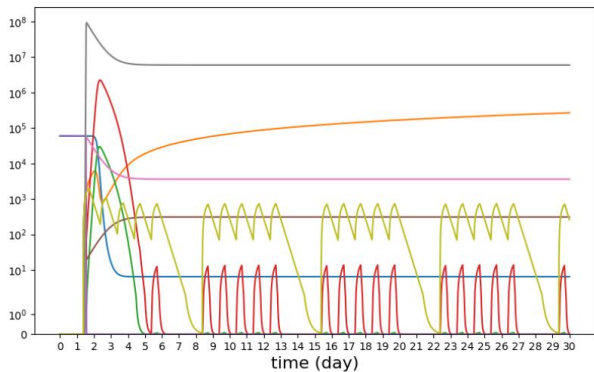
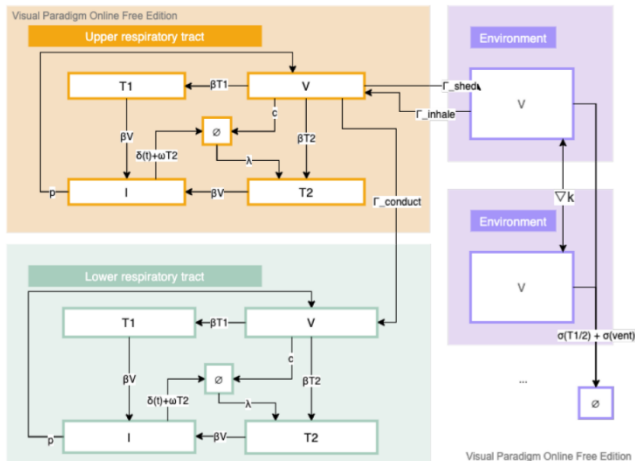


Point Kinetics: Time series prediction (from 7:40am) from AI – model – pollution in enclosed space – tube station. Predictions and measurements against.

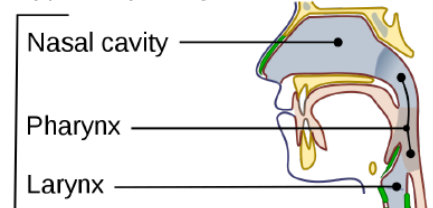


Individuals in a classroom

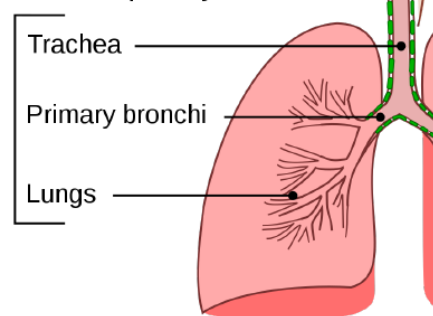
In-host models (bottom left – viral load in room air over days –green curve) – transport theory (top left) and AI models



Upper respiratory tract

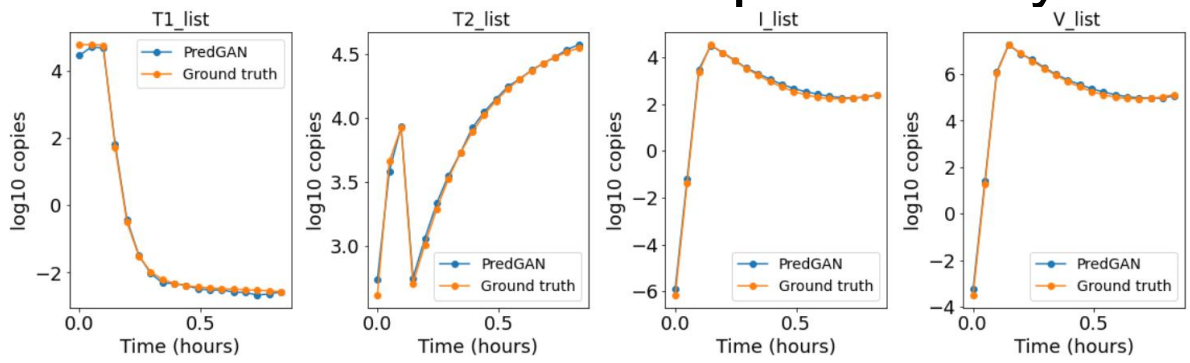


Lower respiratory tract

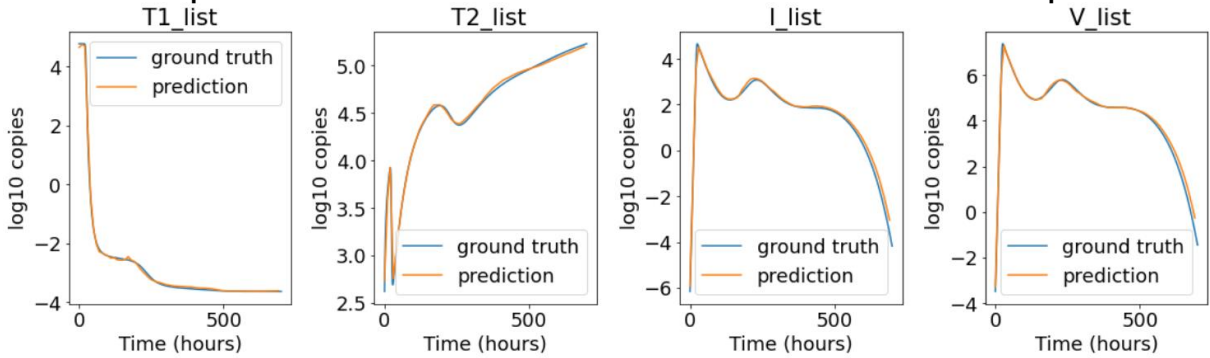


URT and LRT compartments. (Wikipedia 2021)

In-host models – transport theory and AI



URT AI prediction over an hour – similar to differential eqns



AI prediction over days

In-host viral dynamics model to calculate the concentration of pulmonary epithelial cells (T1), T lymphocytes (T2), infected cells (I) and SARS-CoV-2 load (V) in both URT & LRT, as well as the concentration of virus in the air VE

Integration of modelling and data:

- CFD
- Point kinetics and linking with data
- Individual modelling of infections in a classroom

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