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# PHYSMOD 2024

## International Workshop on Physical Modelling of Flow and Dispersion Phenomena

Ecole Centrale de Lyon, Ecully, France – August 28-30, 2024

# Book of Abstracts

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# Comparison between simulation and wind-tunnel experiment for an idealised industrial site

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## Abstract

### Introduction

Industrial sites can be subject to accidents such as leaks or fires which lead to potential environmental and sanitary risks. To monitor preventively such risks at the local scale fast operational models able to consider the impact of the site geometry are needed. In this study, we evaluated the performances of one of such models, namely PMSS, by comparing simulations to wind tunnel measurements taken on the small-scale model of an idealised industrial site.

### Methods

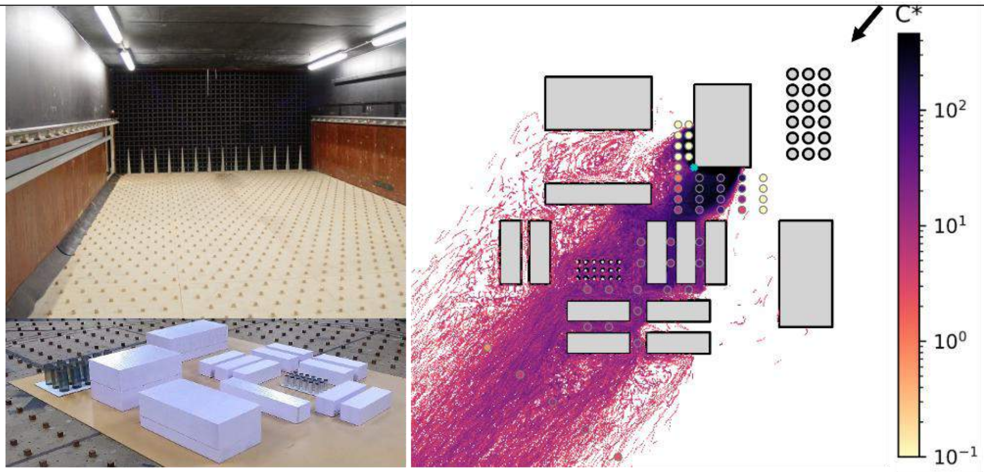
We simulated pollutant dispersion on an idealised industrial site including elements of interest in its geometry such as a courtyard, zones of storing of tanks and groups of elements forming a complex porous structure, representing for instance a piping system. We chose a neutral incident boundary layer and a passive scalar in order to neglect stratification and buoyancy effects.

This study focuses on simulations obtained with PMSS (Parallelised Micro SWIFT SPRAY) which is a modelling system able to simulate pollutant dispersion at microscale (resolution lower than 10 m). The model is composed of a wind and turbulence model based on empirical laws named PSWIFT, and a Lagrangian dispersion model named PSPRAY (Tinarelli et al, 2012). Both PSWIFT and PSPRAY consider obstacles and are parallelised in order to reduce computation times (Oldrini et al, 2017).

Concentration and velocity measurements were performed in the wind tunnel of the Ecole Centrale de Lyon on a model of the industrial site at a scale 1/200 using a boundary layer of 0.8 m high with a free-stream velocity of 5 $ms^{-1}$. More details about the boundary layer can be found in Nironi et al (2015). Concentration and velocity were respectively measured with a flame ionisation detector (FID) and a laser doppler anemometer (LDA). Both measurement methods are described in Marro et al (2020).

### Numerical simulations compared to wind tunnel experiments

Results of the comparison of simulations and wind tunnel experiments are shown in Figure 1.




(a) (b)

*Figure 1: (a) View of the wind tunnel and small scale model of the industrial site. (b) Map of the simulated dimensionless concentration field and measurement points (filled dots). Source position and incoming wind direction are indicated by the blue cross and the arrow.*

Plume shapes are correctly reproduced in the simulations even though local discrepancies appear within the recirculation zone of the highest obstacle (see the light dots close to the source in Figure 1). Differences may be due to approximations of the velocity field in the PSWIFT computation. Model to experiment agreement increases with the distance to the source, the impact of recirculation being less significant in the far field.

## Conclusion

We compared simulations from the dispersion model PMSS to wind tunnel measurements of concentration with a focus on how the impact of complex geometry is reproduced in the simulations. Recirculations are globally well considered in the simulations despite inaccuracies due to local impacts of some obstacles. Further analysis would consider more configurations of the site notably to deepen the analysis of complex porous elements.

Computational resources were provided by HPC@POLITO (http://www.hpc.polito.it)

## References

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