The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

Lattice-Boltzmann simulations of traffic-related atmospheric pollutant dispersion in urban areas

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Keywords: *Lattice-Boltzmann, pollutant dispersion, turbulent atmospheric flows, traffic emissions*

The developing field of urban physics includes computational fluid dynamics (CFD) as a tool to model wind comfort, heat management and pollutant dispersion in cities. In particular, road traffic emissions significantly contribute to air pollution and should be considered in atmospheric dispersion simulations. To this end, the lattice-Boltzmann method (LBM) offers a promising alternative to traditional finite-volume CFD solvers in terms of computational cost and accuracy.

At IFPEN, a recent emission model relying on real-life driving data recorded with a mobile application was used to construct urban emission maps [1]. However, it has not been coupled yet with a precise unsteady CFD solver, which could provide local unsteady and accurate information about local concentration fields.

We propose to combine the LBM open-source code OpenLB [2] with the emission model designed at IFPEN to simulate traffic-induced pollutant dispersion in an urban-like environment. The LBM code is used to solve the Navier-Stokes equations as well as the passive scalar transport with a double distribution function (DDF) approach. Inlet turbulence generation and stability issues at high Reynolds number are addressed. The solver is successfully validated on the well-known CODASC test case [3], with both uniform and non-uniform line sources to represent traffic emissions and a first evaluation of the impact of a representative urban setting on pollutant dispersion is proposed.

REFERENCES

[1] G. de Nunzio, M. Laraki and L. Thibault, Road Traffic Dynamic Pollutant Emissions Estimation: From Macroscopic Road Information to Microscopic Environmental Impact.. *Atmosphere*, Vol. **12**, 2021.

[2] M.J. Krause *et al.*, OpenLB – Open source lattice Boltzmann code. *Computers & Mathematics with Applications*, Vol. **81**, pp. 258—288, 2021.

[3] C. B. Gromke, CODASC : a database for the validation of street canyon dispersion models. *Proceedings of the 15th International Conference on Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purposes (HARMO), May 6-9, 2013, Madrid, Spain*, 2013.