Internship offer - M2

Title	**Improvement of URock, a quick urban wind speed model**
Student level	M2 research
Starting date **Duration**	February/March 2023 5 to 6 months
City, Country	Le Bourget du Lac, FRANCE
Laboratory	LOCIE - Laboratoire Optimisation de la Conception et Ingénierie de l'Environnement *https://www.univ-smb.fr/locie/*
Internship description	Context Wind speed and wind direction vary a lot in urban areas due to size, shape and organization of buildings and trees. The wind speed is one of the major variable affecting thermal comfort in outdoor spaces (both in cold and warm periods) and also thermal comfort inside buildings through natural ventilation. Many numerical models have been developed to account for the effect of buildings and trees on the wind but they are rather complex to use and calculation intensive. A new model called URock (https://github.com/j3r3m1/urock_processing), based on Geographical Information System and inspired from the proprietary software QUIC-URB (Brown et al., 2013), has recently been developed by the University of Gothenburg and the LOCIE. The calculation is based on a two step approach: first, wind speed and direction are set around buildings and trees based on empirical laws deduced from wind tunnel observations. Second, the initial wind flow is balanced in order to have a more physically relevant field. A first batch of validation has been performed showing that the accuracy is worse than classical CFD models but quite quicker. Two main limitations have been identified to explain the observed lack of accuracy: (I) the flow on building sides is not set correctly during the first step, which is particularly the case for large buildings facing the wind, (ii) the flow modification due to trees is not set correctly during the first step. Objectives The objective of the intern will be to improve the accuracy of the building model or the tree model. The following methodology may be applied: 1. identify several datasets (observation or numerical simulations) where the effect of a single building (or tree) is investigated (e.g. https://www.aij.or.jp/jpn/publish/cfdguide/index_e.htm) 2. propose several empirical laws to set the wind field around the building (e.g. Kaplan et Dinar, 1996) (or tree – e.g. Nelson et al., 2009) 3. test and compare the new laws proposed in step 2 to the datasets identified in step 1 and also see if it improves the performance of URock in more complex urban dwellings (with several buildings). 4. if the new law works well, implement the new model into a new version of URock.

Candidate	The candidate should have a taste for numerical data analysis and empirical modelling. Knowledge of scripting in Python would be an advantage.	
Traineeship grant	Legal internship gratification (~546 €/month)	
Supervisors	Jérémy Bernard (Gothenburg University, LOCIE – Le Bourget du Lac)	Martin Thebault (LOCIE – Le Bourget du Lac)
Deadline	Send CV + Cover Letter to *jeremy.bernard@gu.se* deadline 7th December	
References	Brown, Michael J., Akshay A. Gowardhan, Mathew A. Nelson, Michael D. Williams, et Eric R. Pardyjak. « QUIC transport and dispersion modelling of two releases from the Joint Urban 2003 field experiment ». *International Journal of Environment and Pollution* 52, n° 3-4 (1 janvier 2013): 263-87. https://doi.org/10.1504/IJEP.2013.058458. Kaplan, H., et N. Dinar. « A Lagrangian Dispersion Model for Calculating Concentration Distribution within a Built-up Domain ». *Atmospheric Environment* 30, n° 24 (1 décembre 1996): 4197-4207. https://doi.org/10.1016/1352-2310(96)00144-6. Nelson, Matthew, Michael Williams, Dragan Zajic, Michael Brown, et Eric Pardyjak. *Evaluation of an urban vegetative canopy scheme and impact on plume dispersion*, 2009.	