Feedback to the anonymous reviewer #2

The authors would like to thank this anonymous reviewer on his/her comments on the manuscript, and provide the point-to-point responses to his/her comments as follows,

There is also a general lack of details regarding model description, test case preparation and discussion on preliminary results. Based on the information presented in the MS, I do not get the sense that the authors have performed significant original work on this coupling framework to warrant a standalone publication.

Although the authors recognizes that the present study is built upon the existing coupling library of PreCICE, the effort is still worth for a standalone publication. This is because

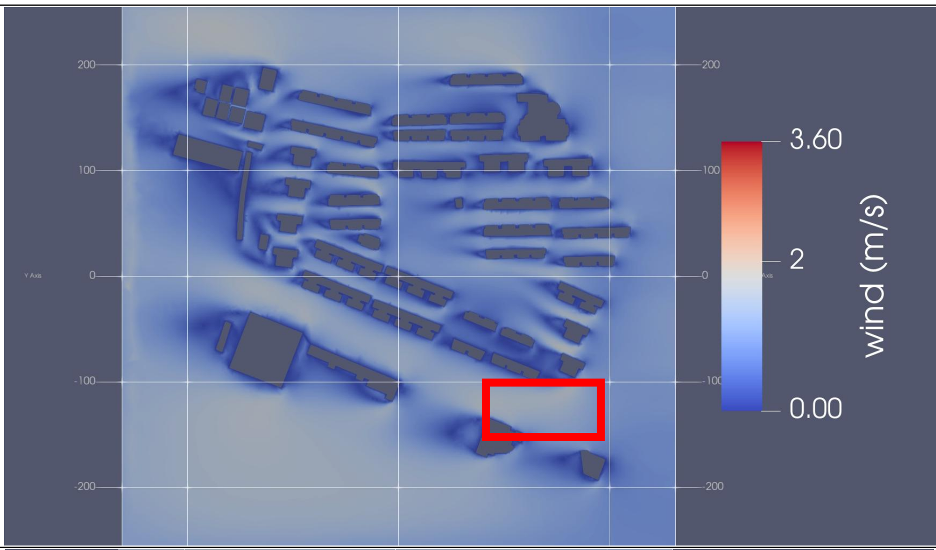
a. It is the adaption made to the source code of various existing numerical models that makes the PreCICE library a useful tool. Therefore, the adaptions made to both widely-used numerical models of WRF and OpenFOAM extends the applicability of PreCICE and WRF/OpenFOAM. In fact, the WOCSS proposed in the present study can be used in simulating the wind flow, predicting air qualities and retracing the source of pollutants with much finer resolution.

b. The existing studies coupled the runs of WRF and OpenFOAM often ignores either the temporal or the spatial variations in the wind field, which makes only a small fraction of the simulation data are exchanged at the coupling interface. The present study resembles the attempt to include the spatial and temporal variations at the scales corresponding to the finest grid of the meso-scale model in coupling the WRF and OpenFOAM, which could be the foundation for the development of a numerical weather prediction tool dealing with the flow at the scales of atmospheric circulation down to the viscous flow near the building surface.

c. The complex architecture of the WRF model, which contains more than 100000 lines of source code, make the adaption to include the communication with PreCICE a challenging task. In fact, the authors have continuously made efforts to extract the required information to drive the micro-scale simulation for a couple of years. The experience with running the WRF simulation and general coding finally enables the authors to spot out the piece of source codes inside the WRF model to be adapted. In addition, debugging, documentation and finalization of the source code based on a publicly available git repository makes it a piece of work worthwhile to be published in a journal like GMD

To illustrate the influences of including the temporal variations in wind field into the couped simulation, the micro-scale simulation of the case study is repeated with the boundary conditions determined by the meso-scale simulation results at the moment starting the coupled simulation (termed as snapshot simulation). The simulated wind fields at the 75s from the starting moment are shown in Figure 1.

coupled



snapshot

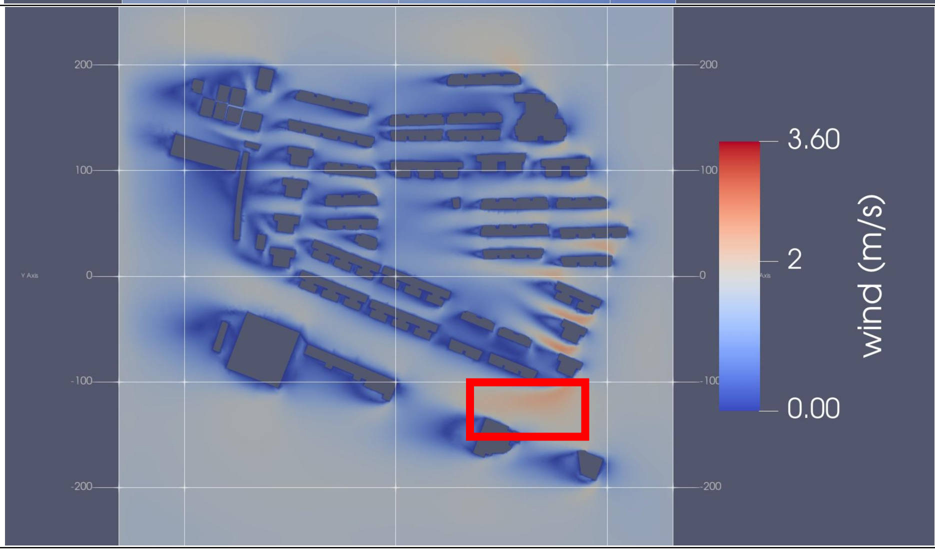


Figure 1 the comparison of the wind velocity magnitude at the height of 2m

In addition, it is not intersting to reiterate OpenFOAM solver settings (viz. Table 2) without indicating which OpenFOAM solver is being used (I assume the default solver simpleFoam was used), or to show a mesh of the urban geometry (viz. Fig 5) without providing sufficient context on how the mesh is generated or the mesh statistics (i.e., how many cells, what type of cells, and mean/max/min cell size).

It is indeed the drawbacks of the original manuscript as the solver of the OpenFOAM package and the statistics of the mesh influences the reliability and the accuracy of the simulation results. In fact, the pimpleFoam, not the simpleFoam, is used for the simulation at the micro-scale side and will be explicitly articulated in the revised manuscript. In addition, the statistics of the CFD mesh will be added to the revised manuscript as well.

Description of the parent mesoscale model is equally sparse, as with the configurations for the PreCICE coupling scheme.

Since the WRF model is widely applied in the field of meteorology in simulating the atmospheric flow at the city scale (~10km), the configuration to run the WRF simulation is attenuated into a Table. Considering the popularity of the WRF model, the WRF-LES simulation scheme will be emphasized in the revised manuscript to include the origin, development and a few exemplar application of the WRF-LES simulation. In addition, the configuration of the PreCICE in the case study will be summarized in another table in the revised manuscript, including the schemes for data mapping and temporal interpolation.

Further, showing that the OpenFOAM simulation can run for 120 seconds (Figs 6-8) at a qualitative level is far adequate. For instance, Chan and Butler (2021) and Piroozmand et al (2020) devised coupling frameworks for OpenFOAM, both capable of operating for at least a 24 hour period.

For the study of Chan and Butler (2021), the simulation is conducted with an idealized street canyon, whose geometry is simple enough to reduces the size of the mesh. More importantly, the boundary conditions, or the free stream velocity in their study, are specified as constant. Consequently, they are the "snapshot" simulations corresponding to a few specified moments, in which the temporal variations in the meteorological wind field is entirely neglected. In other words, the results from their OpenFOAM simulation do not contain the large scale variations but only shows the detailed dynamic patterns of the flow inside a street canyon under the influence of steady meteorology forcing. Such a methodology could be helpful in assessing the flow pattern and pollution dispersion mechanism around an idealized urban morphology, but is not applicable to forecast the detailed wind field within a urban block as in the present study.

For the study of Piroozmand et al (2020), it is much like the simulation reported in the present study expect that the regional meteorology model of COSMO is used instead of the meso-scale model of WRF. The main difference between the two studies are,

a. The domain sizes of the regional meteorology simulation for COSMO and WRF are different, while the COSMO simulation shows the domain size of 25km, the WRF simulation reported in the present study gives the domain in the length of 100km. In other words, the COSMO simulation requires the initial and boundary conditions from another large scale simulation but the WRF could take the data from a global model to initialize and to bound its simulation.

b. The mesh corresponding to the CFD simulation of Piroozmand et al (2020) is relatively coarse comparing to the mesh reported in the present study. More specifically, the number of grids for a dense area of Zurich is in the order of 4 million, while the number of grids for a residential quarter is above 5 million in the present study. Therefore, the detailed flow structures around the building corner, which could be absented from the simulation of Piroozmand et al (2020) are reported in the present study.

c. The coupling scheme is already implemented within the framework of PreCICE in the present study while the coupling between OpenFOAM simulation and the COSMO simulation requires expert experiences and hence involves manual twisting. In other words, the development and publish of WOCSS enable the scholars who is interested in running the coupled simulation could download the source code of WOCCS and do it themselves following the instructions available on the website running the case study reported in the present study.

While reading Section 3.1 I have understood that the Authors used PreCICE to create a 3D field from the WRF model data, which is then prescribed into the OpenFOAM domain. This approach is incorrect, as this will cause spurious solution fields in the urban canopy region, in addition of not being mass or energy conservative. An acceptable approach is to map the WRF variable fields as lateral boundary conditions for the OpenFOAM domain, which allows the solution field inside the OpenFOAM domain to develop in its own accord. Of course, this is technically much more challenging.

The original text could be misleading for running the coupled simulation. The WOCSS actually maps the results from the WRF simulation at the lateral and top boundaries to pose the large-scale forcing on the micro-scale simulation. In other words, the WOCSS actually coincides with the suggestions from this reviewer and agrees with the study of Jeanjean et al (2015). The creation of various 3D fields based on the meso-scale simulation is only used to initialize the simulation at the micro-scale side to shorten the spin-up time of the coupled simulation. In fact, the end-user has the option to enable this feature to initialize the OepnFOAM simulation or simply have the zero wind velocity as the initial conditions of the OpenFOAM simulation.