Comment on gmd-2021-358
Anonymous Referee #1

Referee comment on "On the application and grid-size sensitivity of the urban dispersion model CAIRDIO for the simulation of a real city and realistic meteorology" by Michael Weger et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-358-RC1, 2021

This work investigated the sensitivity of an LES-based dispersion model to grid size and its impacts on air pollution modeling. The LES model was driven by a mesoscale model, and nested runs were performed at inner domains surrounding ground-based stations. Results were compared against station measurements, which demonstrate clear improvements when using the LES model. This work is generally well-designed, and the manuscript is well-written, although some technical details still need further clarification.

Major comments:

- Lines 49-51: There are also studies on the combined effects of buildings and vegetation, e.g., https://doi.org/10.1016/j.buildenv.2018.09.014 and https://doi.org/10.1016/j.ufug.2016.03.006. Please add some introduction on the impacts of street vegetation on dispersion here.
- Lines 65-67: The authors might also need to mention the potential buoyancy induced by heating between buildings, e.g., https://doi.org/10.1016/j.buildenv.2012.08.029.
- Line 130 and Fig. 1d-f: Some modeling details should be mentioned here.
- Lines 212-218: Please elaborate on the emission datasets used in model simulations. What are the spatial and temporal resolutions of these datasets? How did the authors reconcile the resolution mismatch?
- Lines 225-250: The relationship between M domains and L domains is unclear. Although further details can be found in the authors' previous work, a concise summary of the model is still necessary. For example, how are the buildings "effectively represented as diffuse obstacles"?
- Line 266: I noticed that the authors used different interpolation methods for these 3D variables. Is this based on some sensitivity analysis?
- Equation 2: This equation is unclear. Did the authors use this simple fitting method as a substitute for a land surface model? In addition, what are the forcings of the mesoscale model (domains Ms)?
- Lines 354-379: It is unclear how well the mesoscale model (and the CAIRDIO model) performs during the selected period. I suggest the authors add some model evaluation results (probably in supplementary).
- Lines 406-407: What are the data sources of building geometries (and land use)? Is this “30 m” here the building height averaged across the domain?
- Lines 449-450: The authors attributed the underestimated spikes to observational noises. Could this be due to uncertainties in the forcing data/emission data?
- Figure 13: The authors compared the results of the LES-based dispersion model and mesoscale model in this figure. If my understanding is correct, the CAIRDIO case here is the nested LES, instead of the LES with domain L0. I am curious about the performance of the LES model at L0 level, because this will be critical to demonstrating the necessity of a finer-scale dispersion model. Did the authors check the result of the online coupled LES model?
- Lines 527-530: This comparison is interesting. Is there any possible explanation in terms of the scale-dependence here?

Minor comments:

- Abstract: Please shorten the abstract to make it concise.
- Table 1: “station Central” is not in this table.
- Line 319: $Q_v^S$ is undefined. Not sure if this is a typo ($Q_v^S$).
- Line 604: Please explain “diffuse buildings”.