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Comment on acp-2022-22

Anonymous Referee #2

Referee comment on "Influence of emission size distribution and nucleation on number concentrations over Greater Paris" by Karine Sartelet et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-22-RC2, 2022

Sartelet and co-authors present a comparison of modelled and measured aerosol number concentrations and size distributions at three sites in the greater Paris region. Modelled aerosol concentrations are performed without a nucleation scheme and using three nucleation schemes: binary, ternary, and heteromolecuar (including organic components). The paper is clearly written and the analysis of data is mainly about comparing correlation model results and measurements. My expertise is not in aerosol modelling, so I cannot comment on the validity of the modelling framework, however I have a few comments pertaining to the treatment of aerosol emissions that are shown below. In summary, I believe that there is a large number of processes that can influence the aerosol number concentrations (especially the nucleation mode) that are not addressed nor discussed in this study.

It is not clear to me how representative these modelling simulations are compared to measurements given that there are significant uncertainties regarding emissions of gas-phase precursors, especially organic SOA precursors. Have the authors investigated the impacts of changing precursor source emission concentrations and evaluating the impacts on number concentrations and size distributions? How would that affect model results?

Do the authors consider the emissions of low- and extremely-low organic volatile compounds? if so, how are these treated? if not, I would assume that thLVOCs and ELVOCs ese can significantly impact modelled nucleation rate, concentrations, and size distributions, hence a discussion of potential impacts would be needed in the manuscript.

How are organics partitioned to the aerosol phase? Different treatments can affect the evaporation of the nucleation mode (and hence concentrations and size distribution), especially when using the heteromolecular nucleation scheme which consider condensation of organic components. For instance, have the authors explored the impact of absorptive partitioning versus non-adsorptive partitioning? I am bringing this issue since it will likely

affect nucleation mode number concentrations, which is the main focus of this study.

Can the author add a temporal comparison of modelled and measured $N_{<10}$, $N_{<100}$ and $N_{>100}$ for the duration of the measurements? It would be informative to understand the temporal evolution of particle concentrations and chech if biases occur on given days or are consistent throughout the measurement period.