

## ***Interactive comment on “Sensitivity of spatial aerosol particle distributions to the boundary conditions in the PALM model system 6.0” by Mona Kurppa et al.***

### **Anonymous Referee #1**

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Review of gmd-2020-163

Sensitivity of spatial aerosol particle distributions to the boundary conditions in the PALM model system 6.0

The study applies the LES model PALM in an urban setup in order to model air quality parameters in a street canyon of a major road and its surrounding in Helsinki. The model is evaluated against stationary and mobile observations. Furthermore, the authors examine different ways of providing boundary conditions for their LES simulations. The evaluation of the different simulations is conducted by applying a number of different statistical measures. This detailed evaluation is scientifically sound. However,

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the complexity of several different statistical measures in addition to the different simulations makes it difficult to write the analysis in an understandable way, which would make it easy for the reader to follow the analysis and results. I highly recommend to revise sections 4.2 and 4.3 in terms of writing. In these sections, the authors often jump between one measure or simulation and the other. For some of the paragraphs and sentences it was not clear to which simulation or time period they were referring to. Overall, I don't have concerns about the scientific relevance and the quality of the applied analysis. Therefore, the manuscript can be accepted for publication after minor revision.

Specific comments p.3, l.8-9: What do the authors mean with “but not necessarily stable performance”? If you apply boundary conditions from other model runs, you often use a (mostly coarser) larger scale model run. Such a continuous run would usually enable continuous boundary data. The statement also seems to be in contrast to p.6, l.28-29 (“which allows realistic [...] boundary conditions”).

p.6., l.29: Do the authors mean that the forcing mesoscale flow does not provide enough turbulence, which would take time and distance to be generated on the higher resolution LES domain? I suggest to explain this with one or two more sentences to the benefit of the readers.

p.8, l.2-4: Are only the mast observations used as observation-based driving data? I think, the description of how observational data serve as boundary conditions could be extended.

p.8, l.31-32: Can the authors provide the size distribution parameters of the Hietikko et al. (2018) size distribution in the manuscript?

p.9, l.9: There is no number given for EFPM in the manuscript. Can it be included in the manuscript? Furthermore, do EFPM and EFPM2.5 refer to the same quantity? In case not, I think it would help the reader to follow the calculation if numbers for both are given.

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p.10, l.14-15: Would it be possible to run including variable roughness length, e.g. derived from the building structure or density? If so, would you expect a strong impact on the air flow? If it can be expected that a variable roughness length may affect the results substantially, I suggest to include this consideration in the discussion section.

p.11, l.14-15: In the figures the observations above 200m show lower temperature and higher dew point temperature than the model.

p.11, l.28-30: For 21:00-24:00, there are two ADCHEM peaks, whereas the smaller one is at ~50nm(?) and the second at 100nm, which is matching the observations.

Figures S5, S10: Related to comment above. If this isn't a huge effort, I think it would be helpful to summarize the modelled PNSDs matching the investigation periods, i.e. 7:00-10:00 and 20:00-22:00, instead of the currently given time windows. Same is for winter period shown in Fig. S10.

p.12, l.3-4, Figure S10: The observed peak seems to be clearly at smaller sizes than the modelled one during 9:00-12:00. Again, providing the PNSD comparison for 7:00-10:00 would be helpful. Perhaps the authors could put these in the paper, and leave the diurnal evolution as it is in the supplement?

p.13, l.1-2: Can the authors please explain in little more detail the meaning of these acceptance criteria and why they have chosen these thresholds? That is, what error / deviation is accepted if the criteria is fulfilled. This is done exemplarily later in the text for NMBF and NMAEF, however, I think it would be helpful already here in a more general manner.

p.16, l.4: In Table S3, I find NMBF for the side street in the summer morning first hour of -2.45 and -4.58 for EEPS and ELPI, respectively, which is different from the numbers reported in the text. Can the authors check again if the numbers in the text are correct and if so, please explain how these were calculated based on NMBF?

p.16, l.11: Related to the comment above, the numbers 3.68-4.36 differ from NMBF in

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the tables S8 and S9.

p.18, l.1: Overestimated by MMETMPSD or OMETOPSD? Are the numbers 2.7 and 4.2 supposed to be found in Table 6 or not shown?

p.18, l.1-2: What do the authors mean with the last sentence of this section? I think this thought needs more explanation in the text.

p.21., l.8: Slower than what? It is not clear to what other observation or model result the wind speed of OMETOPSD is compared to.

p. 24, l.24-26: Can the authors please explain this thought and its conclusion?

Other comments p.1, l.10: I suggest to change "factor of two" to "fraction of data within a factor of two", or similar.

p.1, l.12-13: One "and" too much in the enumeration.

p.2, l.7: What do the authors mean with "being at the same level"? I assume the authors refer to the height, i.e. in ~1.5m above ground? However, the pollutants are not only in this height, as the sentence might suggest.

p.2, l.34 – p.3, l.1: Does this sentence refer to the study by Kuurpa et al. 2019? If so, the link to the sentence before is not clear.

p.3, l.16-17: I think, better English would be "can model boundary conditions cause" -> "can be / is caused by model boundary conditions".

p.3., l.21-23: Perhaps try to split this rather long sentence holding so much information into two or more sentences to improve readability.

p.7, Table 2: I did not do the maths, but just see that two numbers deviate. Below the table it says "591 m", however Lz is given as 606 m in the table. Which is the correct one?

p.8, l.28 & 29: Should it be "total mass emission factors" and "number emission factors",

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at least this is what EF usually stands for. Emission factor is also used in the following.

p.8, l.30: "sensitivity" -> "sensitive".

p.12, Figure 2; Figure S6; Figure S8: Missing ")" after "m s-1".

p.14, Figure 3: Is the tick mark in the yellow color at  $2 \times 10^5$  cm-3?

Figure 4, 7 and 8: I suggest to change in the caption "The grey ..." to "The grey area ...", or similar.

p.16, l.2: Is "overperform" the right word? To my non-native speaker knowledge it means something like "better than expected"? In a quick search, I only find it in a financial context.

p.17, l.3 & 4: The abbreviations ACSM and MAAP should be given with their long name here.

p.17, l.9: The statement refers to Figures S12 and S13, not "S11-12".

p.17, l.11: Nitrate has a typo superscript "1".

p.17, l.12: NH<sub>4</sub><sup>+</sup>, as named in Table 6 is ammonium not ammonia. Furthermore, similar to the other substances the chemical formula for ammonium should be given in brackets in the text.

p.17, l.12-13: Again, I don't understand the meaning of "overperform" here. Do the authors mean something like "performs better than OMETOPSD"?

p.17, Figure 6: Really unimportant detail... Nevertheless, the color for "Stationary" changed compared to Figure 5? I think it is easier for the reader if it would not.

p.18, l.7: I suggest to add "see Fig. 4" somewhere in this brackets.

p.21, Table 6: Can the authors color code the numbers as done for Table S12 and S13?

p.21, Table 6; Table S12, Table S13: I suggest to change "Performance in the mod-

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elling" to "Performance of the modelled" or "Model performance for" in the table captions.

p.22, l.1: It should be mentioned in the beginning of this paragraph that you now focus on the performance for LDSA.

p.22, l.2: I suggest to add "of the summer morning" after "during the first hour".

p.22, l.6: I think instead of "Where" it should be "Whereas".

p.22, l.6: Does "lower" refer to "lower than MMETMPSD"? If so, it should be mentioned here.

p.23, Figure 11: It should be OWD,mastOPSD and OWD,SMEAROPSD in the legend.

p.23, l.2-3: It should be mentioned that it is now referred to the difference to MMETMPSD and not the observations.

Supplement p.1: There seems to be something wrong with the section counting. S1 is missing, also S3.2 and S3.3.

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