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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Top-down quantification of NO_x emissions from traffic in an urban area using a high resolution regional atmospheric chemistry model" *by* Friderike Kuik et al.

Anonymous Referee #2

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The paper analyses the general problem of simulating NOx concentrations in urban areas using high resolution chemical transport models, as in this case WRF-Chem. Via top-down quantification of NOx emissions from traffic the authors claim the need for a correction factor for traffic NOx and highlight the general model problems in simulating meaningful mixing in the urban boundary layer – which they state being a main source of error in modelling near surface concentrations of air pollutants. A detailed model evaluation is provided which is underpinned by a comprehensive statistical analysis. The paper is well written and structured in an understandable way.

In its current form, it shows a case study for the city of Berlin which maybe should

be included in the title. It would be nice if the authors could add a section or a short passage, discussing the questions What do we learn from this study? or, Are the results transferrable to other urban areas? In the following you can find comments line by line:

Page 1: Line 11: It is unclear at this point you have treated the discrepancy between model resolution and resolution of the emission data. What is the purpose of the emission downscaling to 1km and what was the initial resolution of the inventory. These points should be discussed more details in the methodology section, also explaining the downscaling method.

P2: 9ff: better EEA 10: What is the reason for the downward trend? 16: specify 'real world driving condition' 21: better WHO

P3: 3,7: Fallmann et al. 2016 presents a modelling study for the city of Stuttgart following similar procedures and gets similar findings 21: unclear: 'basing'

P4: 1: what is meant by 'activity data' 5: where does the large error range come from and how did you consider this in your study? 14: better 'model setup' 16: see comment above about the purpose of downscaling 21: State, whether the sensitivity simulations are taken from the output of the 1 year run or whether they are independent experiments. General: specify the source and the characteristics of the urban canopy parameters

P5: 20ff: how is second part of the simulation initialized, how does it refer to the first model period? 28: Discuss briefly if you can estimate an error from using 2011 emission data for a 2014 simulation?

P6: 2: specify chosen categories and reason for the selection 23: Can you give an estimate of the error in mean values when only considering weekdays?

P7: 25: Procedure of NO2 retrieval at Air Base station unclear. How do you get the final NO2 concentrations from converted NO?

P8: 20,21: Specify more details about ‘using the model setup for [. . .] policy relevant’. Do you mean operational forecast here?

P10: 25: state briefly why you changed the model setup compared to Kuik et al (2016) with regard to re-initialization etc. Can you discuss the impact of the modifications on NO, NO2, NOx, O3? 30: reference height for wind speed and temperature? Model height 30m?

P11: 5-21: Indicate briefly the reason for different model performance for different seasons/daytime → does that relate to general problems with tour model setup (boundary layer scheme, chemical mechanism etc.)

5.1/5.2: how do the biases in meteorology relate to biases in chemical species? Is there a seasonal dependence?

P13: 24: How is the link between population density and emission achieved/applied in the model?

30/31: earlier it was mentioned that only weekday profiles were applied in the model setup. Please clarify this aspect here.

P14: 5ff: Does a change of the urban canopy model make a change in boundary layer mixing close to the surface? How was the change in model code achieved? What is the model height for the NOx evaluation? How do model and observation height compare?

Some boundary layer schemes have been modified recently in order to take into account the mixing of chemical compounds inside the boundary layer. Can you comment on this? What impact might this have to your study?

14: better ‘too strong’ instead of ‘too efficient’ 15: Did you find a sensitivity to UCM selection? 25: Is the emission at urban background station generally too low? Maybe you are missing an advection term here?

P15: 16: what are the dominant non-traffic emission sources in the area of Berlin in

summer time?

P16: 18: Are the ‘newer’ diesel cars already implemented in the inventory used here?

P17: 6: From your experience: Which part of the model/configuration has to be changed for improving the representation of mixing processes? 11: Can the difference between secondary and primary NOx be attributed to wrong NO titration processes? Or other chemical processes?

P18: 11: The fact that a higher resolution emission inventory does not improve the model results is an important finding here and has to be explained more detailed. Did you run model experiment with a high-resolution emission inventory as well? What is the resolution here?

15-20: What kind of models do you suggest in terms of higher resolution? Chemical transport models, LES, CFD, dispersion models. . .? 25: meaning: HBEFA

P20: 27: Urban processes in WRF-Chem are linked via meteorology only. Do you have a suggestion, how UCMs have to be changed in order to improve AQ simulations?

P21: Some open questions should be briefly discussed her as mentioned in the beginning: âĂć Why is the study important for the field of research? âĂć What were the novel findings? âĂć What can we learn? âĂć Are the results transferrable to other urban areas?

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