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Atmospheric Chemistry and Physics Discussions

Interactive comment on "On the long term impact of emissions from central European cities on regional air-quality" *by* P. Huszar et al.

Anonymous Referee #1

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This study uses the online regional modeling system RegCM4.2-CAMx to investigate the impact of emissions on air quality over central Europe. Four key-pollutants are investigated, namely O3, NO2, SO2 and PM2.5.

The paper address relevant scientific questions within the scope of ACP and its novelty is the use of an on-line modeling system taking into consideration 2 way climate-chemistry interactions, to investigate the long-term impact of emissions on air quality over central Europe in high resolution.

The work is well written –although parts could be better organized in sections (see below technical comments) -and contains an appropriate amount of work, worth to be published in ACP.

The scientific methods used and assumptions are generally valid, despite the fact that certain modules of the current modeling system need to be improved, to deliver more accurate air quality products (see below).

According to authors "The main goals of this study is to 1) evaluate the present day contribution of city emissions to the regional air pollution over central Europe 2) estimate the impact of mitigation strategies by testing the regional fingerprint of urban emission reductions".

My impression is that is too much work for one paper. I am convinced about findings concerning goal 2 (the sensitivities part), but several questions remain on goal 1 (the evaluation part, which I would primarily see as an evaluation of the modeling system per se, followed by the estimation of the contribution of the impact of emissions on air quality).

Ideally, I would first expect to see a pure evaluation paper, investigating thoroughly the basic weaknesses of the modelling system (e.g. poor temporal correlation and large biases) by looking into emissions and the way they are disaggregated, the impact of Boundary Conditions and the biases of key-meteorological variables on chemistry. If this work, which is forced by reanalysis meteorological fields produces average (occasionally below average) metrics, it cannot be expected to perform better, when coupled to a regional climate model to study for example the impact of future emissions/climate on air quality.

The importance of this works lies in using an on-line modeling system as a tool for the investigation of the impact of emissions controls on air quality. The online regional meteorology-chemistry models are an emerging community, which establishes fast in the field of air quality modeling studies. Before replacing the widely used offline meteorology-air quality models, it is important to evaluate the performance of the new-generation online models, and gain some valuable insight into the nature of the complex and not so well understood interactions of meteorology and chemistry.

This work, includes a considerable amount of work on the impact of emissions on central European air quality and the some impact metrics (e.g. AOT40), however I missed some information on the added value of this work, compared to similar previous literature using offline models.

What is the incentive to use an online model in this specific study instead of an offline? What will be the added value for having a computational expensive system to investigate emission/air quality issues? And more importantly: Is this model capable to reproduce accurately the state of the atmosphere? Or we simply use a more sophisticated but less understood modeling system, undermining the quality of final results? Can you compare the evaluation performance of this modeling system with the offline system and support the use of the online?

Technical comments:

Introduction is rather lengthy, could be shortened to reflect a literature overview on issues relevant to European emission/air quality.

Sections 4.1.1 to 4.1.4: These sections are very short and there is no attempt to explain the current findings. On the other hand, Section 5 “Discussion and conclusions” is a very lengthy one. My suggestion is to move parts of the S5 discussion into S4.1.1-S4.1.4 and try to provide some connections, between the findings that can be related (e.g. O3 biases with NOx biases).

My major concern is the poor O3 correlation. Eventually the invariant boundaries could be the problem? Authors can refer to literature and cite previous work reporting improvement of temporal correlations with the use of space/time variant BCs, and also explain, to which extent they believe that improving the BCs in their mother domain, could improve results in the nested central European domain. I think it should also be a priority for the modeling group to update the BCs in future versions.

Also in the evaluation plan of the modeling system I think authors could include some

key meteorological parameters like temperature, radiation which strongly affect chemistry and emissions. May be it will be too much too add for the current manuscript that is already very lengthy, but I think is an important action, which need to be considered as a future action.

Discussion and conclusions could be separated. Conclusions could be a short paragraph summarizing the most basic findings of this work and eventually future steps to improve the methodology followed.

Page 32102. Line 9: Introduce NMVOC I don’t agree with the expression “satisfactory reproduction” (line 11), “reasonable values” (line 13). I would suggest referring to the metrics simply. Line 17: Replace “EC” with European? Line 26- Please rephrase the sentence “ Further, for the case of Prague...”

Page 32103. Line 1: Please rephrase the sentence: “The emission perturbation experiments showed.. “ Line 5: You could delete “remote from cities” since the label rural implies that. Line 25. Asia is also a source of NOx.

Page 32110. Line 18: correct to: “ a coupled system was designed...”

Page 32112 Line 20: where > were (twice) Line 20-21. To which extent do we expect differences in the simulations, when radiative feedbacks are not considered?

Page 32119 Line 18: therefor>therefore

All figure legends, colorbars, could become larger.

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