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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evaluation of the performance of four chemical transport models in predicting the aerosol chemical composition in Europe in 2005" *by* M. Prank et al.

Anonymous Referee #2

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The manuscript by Prank et al. presents a new intercomparison among four regional models at the European scale for year 2005. The intercomparison focuses on particulate matter and results are presented in comparison to available measurements of the PM10-PM2.5 mass and several PM chemical components carried out at 12 EMEP stations. In this reviewer opinion, the manuscript contains a useful update on the operational validation of the models involved in the study, and indicates major uncertainties and main directions for further models improvement.

The presentation of result is clear and the manuscript generally well written, but a little effort in order to make it more concise is recommended. Before publication, I encourage the authors implementing the following comments/suggestions:

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Discussion paper

- please double check the reference list: I checked the first three citations, and they are all missing in the list at the end of the manuscript.

- I find too much overlap and redundancy in the introductory part on model-to-obs uncertainties (page 2-4) and the discussion (section 4). My impression is that a quite long list of possible reasons for model-to-obs disagreement is presented in both parts, but never really demonstrate them for the specific simulations presented here. I thus suggest to shorten both the introduction and the discussion, and possibly move all the model-to-obs issue directly into the discussion section.

- page 4, lines 7-10: I do not completely agree with this final statement. From my understanding, the "main reasons behind model-measurements" are not clearly identified in the study. I would better state that the model error regarding the PM simulation is characterized against available measurments.

- Figure S4: please define PPMr in the caption.

- page 8, lines 9-13: there seems to be some inconsistency between the major components illustrated in figures S5-S8 and values given in Table 6. In particular, from Table 6 one would say that carbonaceous aerosol are the major fraction of PM, not secondary organic aerosol. Please clarify.

- page 8, line 31: could a poor correlation coefficient for NO3- be related to a pulsed behaviour of the aerosol nitrate production in the PBL, as recently described in this paper:

Curci, G., Ferrero, L., Tuccella, P., Barnaba, F., Angelini, F., Bolzacchini, E., Carbone, C., Denier van der Gon, H. A. C., Facchini, M. C., Gobbi, G. P., Kuenen, J. P. P., Landi, T. C., Perrino, C., Perrone, M. G., Sangiorgi, G., and Stocchi, P.: How much is particulate matter near the ground influenced by upper-level processes within and above the PBL? A summertime case study in Milan (Italy) evidences the distinctive role of nitrate, Atmos. Chem. Phys., 15, 2629-2649, doi:10.5194/acp-15-2629-2015, 2015.

- page 9, lines 7-8: the discussion on HNO3 bias is made difficult by the fact that HNO3 is not shown alone in the figure. Could this be shown, or the results commented on the NO3+HNO3 concentration that the reader may actually directly see in the plots?

- page 9, line 10: it is not completely true that the seasonal cycle is not reproduced by all SIA, e.g. NO3 and NH4 are reproduced quite well.

- page 9, line 16: "... overestimate the temperature dependence ..." suggest to rephrase with "... have an exaggerated temperature dependece ..." to avoid confusion with overestimated/underestimated resulting PM values.

- page 9: in general, natural PM seems to be a major factor contributing to the spring PM maximum: may you confirm that (or not)?

- page 10, lines 16-17: perhaps could be useful the discussion on EC lifetimes presented in this paper:

Wang, X., Heald, C. L., Ridley, D. A., Schwarz, J. P., Spackman, J. R., Perring, A. E., Coe, H., Liu, D., and Clarke, A. D.: Exploiting simultaneous observational constraints on mass and absorption to estimate the global direct radiative forcing of black carbon and brown carbon, Atmos. Chem. Phys., 14, 10989-11010, doi:10.5194/acp-14-10989-2014, 2014.

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