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Interactive comment on "Dynamic evaluation of a multi-year model simulation of particulate matter concentrations over Europe" *by* È. Lecœur and C. Seigneur

Anonymous Referee #2

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GENERAL COMMENTS

The paper presents the results of the operational, diagnostic and dynamic evaluation of the Polyphemus/Polair3D chemical-transport model from the year 2000 to 2008 over Europe. The Polyphemus/Polair3D (0.5° x 0.5° horizontal resolution) is compared against ground-based concentration from the EMEP monitoring network with a special focus on PM2.5 and its components and other European chemical-transport models. The operational/diagnostic evaluation shows that O3 meets the model performance criteria established by Russell and Dennis (2000) and that PM2.5, PM10 and SO42- meet the performance goal of Boylan and Russell (2006). NH4+ meets the perfor-

mance criteria, but NO3- does not. The dynamic evaluation shows that the evolution of PM2.5 as a function of changes in meteorology is well represented for precipitation and wind speed overall, although model tends to overestimate the PM2.5 response to wind speed.

The paper deals with a relevant application of chemical transport modelling on a regional scale to investigate the effects of climate change on PM concentration. As the authors stated, "It is primordial to ensure that our current understanding of the relationships between meteorology and PM concentrations is correct". The methodology used to apply the dynamic evaluation is relatively new and hence provided a lot of quantitative and new results. The paper is well written and structured.

The present work could be of interest to the readers of ACP. I think it should be suitable to be published on ACP. However, I think the paper would be improved if some parts would be discussed and presented more in detail.

SPECIFIC COMMENTS

The points to be considered by the authors:

1. Emission. (Pg 480, lines 14-18): I guess that you do not perform any horizontal disaggregation from the EMEP inventory because your model run at 0.5° x 0.5°. But, how do you perform vertical and temporal disaggregation from the emission inventory?

You used MEGAN model from biogenic emission, do these emissions include NOx from soils? If it is true, how do you considered NOx from SNAP 10?

Have you considered emission from forest fires?

2. Boundary condition (Pg 480 line 19). You use MOZART-4 model to gas-phase and aerosol species at the boundaries.

How many species (gas and aerosol) from MOZART-4 model do you considered in the boundaries?

How have you matched the MOZART-4 VOCs to the CB05? Specifically, how have you managed the lumped species called BIGALK, BIGENE and TOLUENE from MOZART in your CB05 mechanism?

How have you matched the aerosol species of MOZART to Polair3D species?

3. Aerosol module (Pg 481 line 9). Do you considered aerosol dynamic? Do you considered nitrate aerosol in the coarse fraction?

4. Section 2.2. PM2.5 spatial distribution and chemical composition over Europe. This section is very descriptive and it does not explain the reason of such patterns. I am surprise about the high contribution of organic matter in Scandinavia in Figure 3. Do you have any reason for that? It seems like organic matter contribution in this area came from boundary condition. Could it be unrealistic?

5. Section 3. Operational evaluation and section 4. Dynamic evaluation. Why don't you evaluate NO2 concentration? Do you have any idea about this performance in your model system?

Overall, the merit of the paper would significantly increase if the authors could more clearly identify current model deficiencies, point to specific chemical/dynamical processes in Polyphemus/Polair3D responsible for the underestimations, and suggest ways to improve those.

Do you have any idea about the overestimation of PM10 and PM2.5 daily concentration? It is really surprising, since most models in Europe underestimate PM10.

You also indicate that Polyphemus/Polair3D overestimate nitrate. Do you have any idea about this behaviour? Could it be related to ISORROPIA thermodynamic equilibrium?

In the comparison to other model evaluation I recommend you to clarify that the models use different configurations (emission disaggregation, boundary condition, and meteorology, among others), are run for different year, with different horizontal resolution, and different set of air quality stations for the evaluation, etc. I recommend you to complete the tables A1, B1, B2, B3 and B4 with the year of the simulation, the name of the chemical-transport model, and the number of stations include in the evaluation when possible.

TECHNICAL CORRECTIONS

- Be consistent using PM2.5 or PM2.5 with subscript (especially in figures 2, 4,5,7,8 and 9).

- Be consistent using ozone of O3 along the test. The same for SO42- or sulfate, NO3- or nitrate, etc.

- Pg 484, line 2: "sites are remote rural background stations"

- Pg 486, line 5: remove "Daily PM10 is well estimated" by "Daily PM10 is overestimated"

- Pag 487, line 3-4: remove "see Appendix B" by "Table B1".

- Pag 490, line 18: replace "data" by "measurements".

- In Pag 492 line29, Pag 493 line 1 you talk about soil dust. How do you include this? Include some comments in section 2.1

- Pag 495, line 9: ". . . over Poland in winter than in summer"

- Pag 498, line 14: remove "data" by "measurements"

- Table 1. Caption: talk about correlation coefficient. Include the temporal base of the statistics, hourly or daily? Adjust significant digits in Table 1.

- Table 2. Caption: include units "(%)". Used ozone as O3, to be consistent. Adjust significant digits in Table 1.

- Table 4. Describe the meaning of DJF and JJA.

- Table A1. Insert the reference of the data, I think Sartelet et al. (2012)

- Table B1. Indicate that the data corresponding to “This study” represent the average (2000-2008)

- Figure 2. Caption: include the year (2000-2008)

- Figure 3. Caption: include the year (2000-2008) and the units “(%)”

- Does Figure 6 show SO_2 emission or concentration? Please correct it accordingly with the units.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 475, 2013.