

Interactive comment on “The European aerosol budget in 2006” by J. M. J. Aan de Brugh et al.

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The European aerosol budget in 2006, J. M. J. Aan de Brugh, M. Schaap, E. Vignati, F. Dentener, M. Kahnert, M. Sofiev, V. Huijnen, and M. C. Krol.

This manuscript describes the European aerosol budget in 2006 using the TM5 model. AEROCOM emissions and ECMWF meteorology input data are used in order to calculate the budgets for the different aerosol species. An overview is given regarding the mechanisms which determine the aerosol lifetime and formation, together with a description of the emissions, aerosol optical properties calculations and in-situ measurements. The model performance in calculated aerosol concentrations, aerosol optical depth values and the budget analysis are presented. The goals are: (i) Coupling M7 with TM5 and evaluate the model results with observations, (ii) analyse the European aerosol budget, import/export terms in the BL and free troposphere and (iii)

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highlight the uncertainties in aerosol modelling, i.e. wet removal parameterization and improvement of biomass burning emissions.

The paper is well written and gives a good overview of the aerosol budget over Europe. I suggest publishing the paper in ACP after addressing/correcting the following points given below.

General comments: The manuscript describes to some extent the uncertainties related to calculated aerosol concentrations. However, there are some points in the text that requires a better description and some issues which need to be added.

One should not draw strong conclusions on the model performance by evaluating annual means. This does not give any information how good the model calculates gas and aerosol concentrations during specific episodes (e.g. dust events in spring, summer) or during cold periods (low PBL heights and the sensitivity of NO₃ aerosol formation). I suggest including a comparison of calculated aerosol concentrations with observations for a winter month. This allows the author to compare the implementation of M7 in TM5 with an earlier study by De Meij et al. (2006).

The manuscript shows the budgets of the inorganic components, natural dust, BC and POM. However, the model performance regarding BC and POM is not evaluated. I believe that adding the evaluation of calculated POM and BC concentrations would improve the quality of the model evaluation.

Specific comments: Page 21393, Line 5, add reference Kaufman (2002): Kaufman, Y.J., Tanré, D., and Boucher, O., 12 September 2002. A satellite view of aerosols in the climate system, Nature, Vol. 419.

Page 21394, line 14, also water uptake on aerosols, chemical formation of aerosols, model resolution dependency on aerosol calculations, horizontal and vertical distribution of the emissions and meteorology.

Page 21396, line 9, wet and dry deposition. Later you deal with wet deposition and the

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related uncertainties in the calculated AODs. How is the cloud formation done in TM5? Perhaps you can write a few lines about this.

Page 21396, line 13. Please explain the abbreviation SVN.

Page 21397, line 1, 5 and 11. Median radius, instead of median size. In the same section: you should say that the aerosols in M7 are internally mixed for the water soluble components, which is later important for interpreting the calculated AODs. I assume that your optical properties are based on externally mixed aerosols?

Page 21397, 2.2.2. Ammonium and nitrate, what are the uncertainties in EQSAM at high relative humidities (>95%)? Do you use a cut-off value for the RH? Which version of EQSAM are you using, Version 2?

Page 21400, a description of NH₃ emissions is missing.

Page 21401, 2.2.6. Maybe you can add the real and imaginary refractive indices in a table. What is the reason to compare the AODs at 440nm? Common practice is 550nm (many optical instruments deliver products around this wavelength). No need to change to 550nm of course.

Page 21402. In Table 5 you describe the method how you compare modeled AOD with observations. I think that you should move that description to section 2.3. Secondly, say a few words on how the sun photometers of AERONET operate.

Page 21403, section 3.1, line 13: SO_x (SO₂, H₂SO₄), do the same for NO_y (NO₂, NO, PAN, NO₃, HNO₄, N₂O₅).

Page 21404, line 1, The calculated annual mean AOD

Page 21406, line 24 you mention that the numbers in the Tables 3 and 4 are raw model results. Could you please explain the difference of 45 Gg/year for dust sinks and sources in Table 3? All the other numbers are within 2 -3 Gg/yr difference.

Page 21409, line 28: Part of the underestimation. . . the model. The study of De Meij et al. (2006) shows that calculated AODs at low RHs ranges are underestimated, indicating that the AEROCOM emissions are too low. Another reason for the underestimation of the AODs is that vertical distribution is not well represented, as mentioned earlier

Page 21411, section 3.5: for how long remains BC and POM insoluble before it can be washed out?

Page 21412, section 3.5.2; you mention that in spring 2006 smoke was transported from Russia because of easterly winds. Analyzing ECMWF monthly mean winds over the western part of Russia (at 850 hPa, 700hPa and 500hPa) for March – June 2005 and 2006, I find a dominant westerly monthly mean wind direction. However, for some days in e.g. 14 – 15 June 2006 the dominant wind direction is easterly. Analyzing back trajectories for the period you mention in the figure caption, I find that for the Lille station (70km from Dunkerque) the air mass originates only from the east between 9th May – 14th May. Therefore I think you should specify the dates when the easterly winds are occurring, as you did in the figure caption of Fig. 6.

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