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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modeling of photolysis rates over Europe: impact on chemical gaseous species and aerosols" *by* E. Real and K. Sartelet

Anonymous Referee #1

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General comments: This manuscript compares different models to simulate gas and aerosol concentrations over Europe. The authors first assess the impact of a new photolysis scheme which uses updated cross-sections (the main source of change from previous photolysis schemes). They then assess the effect of changing the way clouds are represented in the model, and then the addition of aerosols to the model (which act as attenuators of solar radiation and so alter photolysis rates and gas / aerosol concentrations), using Polair3D. Results are presented in terms of monthly averages for July and November, across Europe. After comparing the different model outputs, the results are compared with measurements. The differences between models are generally small – smaller than the differences between any model and the measurements, and provide the expected outcomes i.e. including aerosols attenuates solar radiation (especially at the ground) and reduces photolysis rates. How this affects gas concen-

trations depends on the time of day, the existing concentrations and the competing photolysis rates that may influence a given gas. This is all explained in great detail for all gases and aerosols considered, and all model comparisons. It makes the paper rather longwinded and I suggest the authors try to find more concise ways to present their arguments and results. It would be helpful to have some more detail about the models and measurements (e.g. uncertainties).

Specific comments: Abstract – the manuscript does not evaluate the effect of photolysis rates on air quality monitoring. The monitoring is used to assess the models. This work shows that the model with aerosols would reduce the number of predictions of air quality alerts, or prior warnings, it would not affect the actual, measured air quality (which may or may not agree with the prediction).

P16698 The FastJX scheme. How are the 18 wavelength bins defined. For example, is there enough resolution to distinguish between UVA and UVB – ie to separate the effects on J(O3) and J(NO2). Please give more detail.

P16699 line 26 sensitivity, not sensibility

P16704 + the authors describe the (small) changes in photolysis rates with on line cloud treatment, but do not explain why the changes occur (what is the physical mechanism captured by the more complex treatment?). Are changes of this magnitude important? Are they within the general uncertainties of any measurement, or model? Are they "correct"? Similarly with the inclusion of aerosol. Figure 1 shows that R-ATT is most often closest to R-AERO (except at the ground when the two cloud-only models agree) – is the addition of two complexities in the modelling warranted by the modest differences observed between the most complex and the simplest treatment of cloud / aerosol? The authors are correct to illustrate the magnitude of the cloud and aerosol influences, but having done so, are the differences in photolysis rates significant?

Aerosols not only influences photolysis rates through changing the actinic flux, but can also form part of the following chemical reactions and so have a dual effect on gas con-

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centrations and aerosols. This is most pronounced where aerosols are high, as some of the figures show, although changes are large for a limited number of species. The tables comparing models and measurements show that the three models are always in better agreement with each other than with the measurements, implying that there is still something missing from the models (but see comment above about uncertainties). For the daily ozone peaks (important for air quality alerts) the model R-AERO is least representative of the measurements, implying that it would incorrectly reduce the number of alert warnings. Perhaps hourly peaks would be represented differently (R-AERO is best for average hourly ozone) – could the authors provide this information.

P16717 Please say how many EMEP (and AERONET) stations were included in the comparison with measurements)

Table 4 caption – clarify that this is the average hourly O3 for the month, and also for ? stations

Table 5 – similarly, the average daily peak O3 for the month and ? stations. In the case of table 5 the average daily peak ozone, averaged over a month and several stations, is not very instructive. Would it not be better to show how many daily peaks (for all stations in the month) exceeded limits – for measurements and for each model.

Figure 12 – what is the unit on the coloured scale, is it really difference in number of exceedances, or is it percent difference? The difference in number is hard to interpret without knowing the absolute number of exceedances from one of the models.

Technical corrections: The use of English could be improved. There are many minor grammatical errors. These are not sufficient to prevent understanding of the text, but they are annoying and detract from the general impression of the manuscript. The errors are too numerous to list here, but pay attention to plurals, and use, or not, of the definite article (the).

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 16691, 2010.