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Atmospheric Chemistry and Physics Discussions

Interactive comment on "European summer surface ozone 1990–2100" *by* J. Langner et al.

Anonymous Referee #2

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General comment:

The paper describes a modeling study which goal is to diagnose the relative contribution of climate change and changing emission precursors on future European summer surface ozone. This is a relevant topic as ozone is a key compound for air quality and climate. The paper is relatively well written and interesting but additional and more detailed discussions about the model results and the limitations of the study are missing in the current version of the paper (as further detailed in the following), which prevents publication at that stage in my opinion. The Authors should also provide more detailed information about the extent to which the results presented in this paper are different from existing work dealing with a similar topic.

Specific comments:

Abstract: Please define what is a "sufficiently long period". Indicate the main limitations

of the study (see also details below), and also what is really new in the paper.

Section 2.1, page 7708, lines 6-7: The Authors report that the evaluation of both current and future climate simulations were discussed in two papers. Could they briefly summarize the findings of these papers and in particular the known deficiencies (if any) of the model? They should also provide a short but quantitative description of how future climate look like in their simulations.

Section 2.1, page 7708, line 8. The GCM simulations were performed with an emission scenario that differs from the emission scenario used for air pollutants in the regional chemistry transport model. There are good reasons for this, however the Authors should provide more details about these different scenarios and actually discuss to what extent those different scenarios are consistent (or not) in terms of world development. In particular, what are the assumptions about air quality regulations that are used in these scenarios? Otherwise this section just looks a bit like "a scenario acronym soup".

Section 2.3, page 7710, lines 1-2: Are emissions changing homogeneously throughout Europe?

Section 2.4, page 7710, lines 15-16: Could a reference be provided for the statement regarding the stabilization of the increase in ozone background? This point should be discussed in a more quantitative manner to provide justifications for the values chosen afterwards for the increasing ozone background in the simulations.

Section 2.4: I assume that the Authors mean "lateral boundary conditions" by boundary conditions? What are the assumptions made at the model top?

Section 2.4, page 7710, lines 22-25: Is this consistent to consider a steady increase in ozone background at the border of the domain throughout the entire period and at the same time to consider an increase followed by a decrease in methane concentrations? Part of the change in background ozone could be due to a changing methane

concentration.

Section 2.5, page 7711, lines 11-22: Please be quantitative when you say “Evaluation of MATCH driven by meteorology data constrained by observations shows better correlation”. What “better” means here? How do the results differ between the simulations driven by the different GCMs? The Authors say “Emission data also impacts the results”. That is certainly true but not particularly insightful. Could they provide any quantitative statement with respect to the validity of the emission inventory they used in that study in comparison to some emissions they have used previously? Also about lines 19-22: I would think that a too cold and wet climate could induce a bias in the simulated ozone but maybe not such a low correlation. Again, how does that look like in the HadCM3-driven simulation (assuming that this model does not suffer from such bias)?

Section 3, page 77121, lines 18-19: Which quantities exactly are changing in the climate change cases? How are BVOC (isoprene) emissions changing? How are cloud cover changing and what are the implications on the photolysis rates for example (if any)? How are dry deposition velocities changing throughout the domain? In my opinion, addition analyses of the simulations are really needed so that the paper includes a substantial added value upon previous papers addressing a similar topic.

Section 3, page 7712, line 18 until page 7713, line 10: Why does a changing climate result in decreasing surface ozone in Northern Europe and an increase in Southern Europe?

Section 3, page 7714, lines 6-14: Do the distributions change in the climate-only changing simulations?

Section 3, page 7715, lines 12-29: What do the Authors mean by “Under a SRES A2 scenario surface O3 concentrations in 2030 could increase by 4–6 ppbv around Europe, in line with our Increasing boundary case, and would then continue to increase until 2100 (Prather et al., 2003).” How does the SRES scenario compare with the sce-

nario used in this study? It is not too interesting to compare changes in future surface summer ozone if the assumptions underlying the emission scenario are different.

Conclusion: The authors say “A drawback with this model setup is that assumptions have to be made about trends in the concentrations of chemical components on the model boundaries.” In my opinion, there are many additional drawbacks that are not discussed. For example, to what extent future changes in the stratosphere-troposphere exchange may affect future surface ozone? In general in the conclusion, the Authors should clearly state:

- what is new/original in their paper in terms of future summer surface ozone and the respective role of changing climate versus changing emissions?

- what are the main limitations of their study? Are there any missing processes/feedbacks in their model that would affect their results?

In addition, I think it is not correct to state that "the MATCH CTM simulations using climate model output are able to capture major features of the observed distribution of surface ozone over Europe" when the correlation is below 0.1 in at least one case. Please rephrase.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 7705, 2012.