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Atmospheric Chemistry and Physics Discussions

Interactive comment on "European atmosphere in 2050, a regional air quality and climate perspective under CMIP5 scenarios" *by* A. Colette et al.

Anonymous Referee #3

Received and published: 4 May 2013

General comments

Thank you to the authors for presenting an interesting study of changes to future in 10-year ozone and PM2.5 metrics and especially in the quantification of contributions of climate and emissions as displayed in Figures 5-6, where the main contribution to new science lies. It is also good that the manuscript contains investigation of climate change.

However, besides the minor issues descried below, a few main issues need to be sorted before publication in ACP. The main issues are described further below, but consist of:

- The manuscript is lacking evaluation against measurements for present climate. It is not good enough to refer to previous studies with different model set ups, nor is it

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enough to compare to a simulation using reanalysis meteorology, without evaluating that or the present hindcast to measurements of ozone and PM2.5.

- The modeling of particles included are not well described, nor is the change in individual components well described, nor is the possible impacts of simplifications in PM2.5 model representation in terms of climate change impacts discussed.

- It seems that for regional downscaling 10-year time slicing were used for climate. This is, in my experience, not a common practice. (on the other hand it is commonly done for CTMs, but not for the underlying climate data, even if it is downscaled). If this was used in the manuscript then it should also be followed by convincing argumentation for the validity of such a method.

All in all, given that these issues are resolved the manuscript can be published in ACP.

Specific comments and questions

2 Emissions

Please revisit Table 1 regarding units. Are you sure about the kt/year-unit? Comparing to the EMEP emission data base, NOx emissions in EU27 is on the order of 10 Tg year-1, whereas kt year-1 is10e9, i.e. Gg year-1. Please also consider changing units in the manuscript to SI everywhere.

3.2 Regional climate model

You state that the main difference compared to Vautard et al 2012 include using 11 years' time slice instead of transient simulations. Did you conduct the regional climate downscaling for time slices? In my experience this is not a common nor recommended practice in downscaling of climate. It is ok to use time slices in CTM calculations, but not in dynamical downscaling of climate. Please argue why it is ok to do so here, or clarify the modeling set up if you only apply the time slicing for the CTM calculations (the second being a more common practice).

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3.4 Regional CTM

While you present many references for where CHIMERE has been used and validated in other settings, you fail to evaluate the model for this model set up. You must provide an evaluation for the metrics presented in the paper, or refer to a paper where such evaluation is presented, based on the exact same model set up. It is not sufficient to present the bias in results compared to model results using ERA-Interrim as input meteorology, especially since you do not show or recapture any evaluation results for such a set up either.

4.1.1 General circulation

Why is it meaningless to compare future climate projections to past reanalysis? 4.1.2 Temperature and precipitations (and general on present climate vs reanalysis) It is really alarming that the bias in the current climate is much larger than the changes to the future. Is it at all possible to believe in the results? Please improve the arguing why the description of the impact of climate change is robust enough to be published.

4.1.3 Summary

In the last section of 4.1.3 your statement could be interpreted that it is not robust enough to be published (or at least the statement is too complex to be understood clearly). So – is the results robust enough to be published? Refers to: "before concluding this section... it is important to keep in mind that it is not because the climate model exhibits a bias... that its projections are not robust".

4.2.1 ozone

The third paragraph starting "A closer look..." is difficult to read and understand. Please improve the language. The fourth paragraph. How do you know that the isoprene emissions are underestimated in the climate simulation and not overestimated in the reanalysis? The biogenic emissions are not well known and you do not compare to any measurements.

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General: Population weighing

You fail to present from where you extract population data, what the scale of the data is and what projections you use for future population distribution in Europe and possible simplifications and errors introduced.

General PM, and section 4.2.2

You do not describe what is included in PM2.5. You must include such a description. Secondary organic aerosol? How do you calculate these? Terpene emissions – is it coupled to climate and SOA formation? Or not included at all? Is sea salt included in the global model? Please include description on how you model particles, what particle components are included. Do you include any particle dynamics? How is the wet deposition represented? By particle activation in clouds? Please include a discussion on how your (if any) simplifications may affect the results and the coupling to/effect of climate change. The average PM2.5 is the same in historical and reanalysis (12 ug m-3). See general technical comment below on number of valid digits used.

If the difference between precipitation in current climate and reanalysis is so different, how can the difference (in the updated manuscript) be so small for particles for the same? Precipitation should affect particle concentration largely. It would be nice if you included the same analyses for the individual components of PM and discuss this more, but it is understandable if you decide not to due to the increase in length of paper.

Table 2 and section 4.3.1.

The R and M scenarios. It is difficult to understand these, especially from the table directly (which it should be). Could be clarified, perhaps with help from the following suggestions:

i/ It is very difficult to grasp the difference between the R1 and R5 and R2 and R4 scenarios (the same for the corresponding Mx).

ii/ It would be good if you indicated what you change by e.g. boldening (compared to

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the H scenario, which I assume is the baseline).

iii/ it is confusing that you refer to the righthand-column in the explaining text in the methodology section. Perhaps you should divide into two tables: one explaining the scenario runs and one explaining what you show in the figures (taking differences between the scenario runs etc)? It would be much easier to understand the scenarios and differences if you do this!

Technical details:

Please make sure to improve the language of the manuscript. The beginning of the paper is more well-written than the second half. Some examples:

- exchange precipitations to precipitation.

- please consider whether to exchange “long-range transport” by something else, it can be confused with long-range transport within Europe.

- Use “row” instead of “line” e.g. in section 4.1.2.

- Section 4.1.3: exhibited? significant or large (last paragraph)

Please review the chosen number of valid digits in quantifications in the text. For example, you choose to say that the NH4+ decreases from 4.05 to 1.43 um m-3. Why three digits? You should remove at least one, at least for the sake of readability. When you present an interval within brackets, then please also include the unit for these as well. E.g. section 4.3.2 ozone.

You write long-range transport in multiple places. This can be confused with long-range transport within Europe, which probably is not intended. Please consider changing the wording to something more appropriate, such as hemispheric external contribution.

Please revisit the figure legends.

i/ In my view you should not (generally and especially for figures 4 and 6) write figure

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legends as “same as figure X, for PM2.5” but rather state what the figures do show. It is not necessarily so that the figures end up close enough together for the legend to be read and the figure to be seen at the same page. If they are not it is very arduous for the reader.

ii/ In Figure 4 you refer to the figure 3 legend, but figure three is composed of two columns. The same for Figures 5 and 6 (but here you have also switched the column for a row in figure 6). You could consider condensing these figures instead to one for figs 3-4 and another for figs 5-6.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 6455, 2013.