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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evaluation and Error Apportionment of an Ensemble of Atmospheric Chemistry Transport Modelling Systems: Multi-variable Temporal and Spatial Breakdown" *by* Efisio Solazzo et al.

Anonymous Referee #2

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Solazzo et al. (S2016) present an interesting model-observation analysis, making use of a range of model data from the third phase of the Air Quality Model Evaluation International Initiative (AQMEII), of primary and secondary air pollutants important for our understanding of the chemistry of the atmosphere and how well models simulate it. This sort of study is vital as more and more model evidence is used to link exposure to air pollution and impacts.

The model and observed time series were broken down using spectral decomposition - breaking the time series into it's spectral components - and further analysis

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Discussion paper

focused on separating the mean square error between the model and observations to better characterise the sources of error with the aim of attributing them to specific sources/processes. This technique was recently published by the same authors Solazzo and Galmirini, 2016) and the work here greatly extends previous analysis.

In general I think this paper should be published following several minor revisions. In my opinion, more emphasis needs to be spent on evaluating models at the process level and this paper raises a promising avenue for others. As the authors say, this method has not completely determined the causes of model error - but I think that modifications to and expansions of the method will lead to improved insight in the future.

Major comments: My main criticism of this paper comes about in the presentation of the results. There are multiple figures at such poor resolution that I almost had to give up looking at them. Many of the graphics look like they are plotted in R and I would encourage the authors to save the graphics in a high resolution output (pdf, eps etc). I also think that the reader would benefit from a consistent set of axes limits for plots in EU and NA and the ordering of the models should follow those used in Figures 23 and 26 (i.e. clustering the WRF-Chem variants together and the WRF-CMAQ variants together). When I did this "by hand" I found that the intra model variability was large - no doubt reflecting different model options (chemistry schemes etc).

My other minor criticism is the choice of the domains. I just wonder if country specific (or State specific in the USA) boundaries were used could we learn more about emission estimate biases? I would imagine that the averaging over states and countries in the current classification will smear out these effects to some extent depending on their heterogeneity.

Minor comments: line 138: Delete the first "known".

line 162/Section 2.2 opening paragraph: There are other spectral filtering methods (e.g. Bowdalo et al., 2016 ACP). A comment on these would be useful and why the kz approach has been selected.

line 191: re-phrase the sentence starting "A clear-cut...".

line 197: add "do" after "they".

line 336: add "wave" for radiation.

line 458: what is the source of the meteorological data that you compare against?

line 647: It's not clear what you mean by timescale here? Do you mean the e-folding lifetime? Should that not depend on the concentration of NO?

line 699: remove duplicate round bracket.

line 726: insert "is" after "bias".

line 728, 826, 823, ...: add space between mixing ration and units (e.g. 11.5ppb -> 11.5 ppb). This is a common error so please search the document for this.

line 766: insert space "Figure17and".

line 824: Do the authors really believe that vertical mixing can be analysed through something as complex as ozone? I would suggest that vertical mixing needs sources with no chemistry to be understood (e.g. Rn or Pb).

lines 841: Is this really good?

line 858: "sulphates" should be "sulfates".

line 881: What about oxidants? Could the corr(biasO3, biasSO2) be useful?

line 928: What about temperature effects? Could corr(biasTemp, biasPM) be useful?

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