

Interactive comment on “Improving the deterministic skill of air quality ensembles” by Ioannis Kioutsioukis et al.

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General comments

The manuscript entitled "Improving the deterministic skill of air quality ensembles" reports about the properties and the scores of different ensembles applied on the model outputs of the two phases of AQMEII (2006 and 2010) over Europe. The presentation of the manuscript and of figures is good. To my view, the study has several merits and the results that are presented are original enough to be published. However, the manuscript should be improved along the following recommendations in order to go over the Discussion step.

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1. There is a lack of focus of the manuscript on the main relevant original ideas that are demonstrated. Many interesting results are presented, and the manuscript needs to be focussed on one or two main new scientific questions that the manuscript addresses. These lines should be followed from the abstract to the conclusion. To make my argument more understandable, I would like to point out the following:

- the results that are reported in the first paragraph of the abstract - from lines 6 to 10 - are not new as they were demonstrated in past research articles. These lines mislead the reader on the purpose of the article;

- many times (page2-line12, page4-line4, page7-line12), "two ensembles" appear in the text, but it is not clear whether it refers to two different ensemble methods (and actually, the article compares more than two methods) or to the two AQMEII phases.

A suggestion would be to present the article as a comparison of different ensemble methods (mmW, mmS, KZ, ...), applied on two different datasets (both phases of AQMEII). Actually, the manuscript does not present new methods, but it compares the performance of existing ensemble methods on different pollutants and on different periods. What I consider also to be original are the diagnostics (such as Figure 5) that have been developed and that are used to analyse the ensemble properties. The objectives written page 4 (lines 20-23) may also be the relevant lines to follow, which is not fully obvious in the present manuscript.

2. In the same line of thoughts, the title of the manuscript is too general and it should be more specific. A general title such as the one that appears now could apply to many papers that have already been published.

3. Comparing the ensemble performance between the two AQMEII phases does not bring much to the study and can be misleading, since:

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- the observation dataset changes (no PM10 observations available from UK nor France in Phase II, page8-lines7-8),
- the period (meteorological regimes, types of pollution, etc) change,
- the individual models change in depth.

The differences in ensemble performances between phases I and II (page9 for instance) are subject to all these differences. The attribution of differences of ensemble performances between the two phases should be done cautiously, making only one variable change at each time for any interpretation. If it is not possible, I suggest then to remove the discussions about the differences between Phase I and Phase II of AQMEII.

4. There is a lack of description of the experimental setup of the two phases of AQMEII, that would help the reader to understand some of the conclusions that are drawn, such as the arguments at page9-line19, page16-line, among others. The manuscript as it is written now is not self-consistent. To improve this, I would suggest to add in section 3.2 the key facts of both AQMEII phases: general experimental setup (domain, periods, common input data and setup for all models) and the different models that participate (name, chemical and aerosol schemes, resolution, meteorological model, etc). At least the key facts that are needed to understand the discussions should appear in the manuscript. For the rest, the manuscript should cite some AQMEII reference articles.

Minor comments

- page 3, if the "Recent results" (line 7) refer to the citation (Eskes, 2002) (line 9), then the word "Recent" does not apply; if they refer to an actual recent other work, please cite it,
- the manuscript would gain in clarity if the KZ methods (page6) were described more in depth; for instance the page12-lines(7-10) sentence is somehow enigmatic.

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- Is the quarter (September-October-November) chosen for NO₂ the most relevant one? Do not the December-January-February quarters show higher NO₂ concentration levels?
- The sentence page7-line22 would better fit in section 3.1.
- page8-lines5-8: the sentence "the decline ... due to .. sampling stations." should be proven by some diagnoses or adequate citation.
- page10-line 2: the sentence "the benefits of ensemble ... members)." is not fully clear and maybe not true: what happens if we take the 6 "worse performing" models?
- page10-line17: reference to the relevant figure is needed.
- page17-line28: remove '*'

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