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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Advanced methods for uncertainty assessment and global sensitivity analysis of a Eulerian atmospheric chemistry transport model" *by* K. Aleksankina et al.

Anonymous Referee #2

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Review of "Advanced methods for uncertainty assessment and global sensitivity analysis of a Eulerian atmospheric chemistry transport model" by Ksenia Aleksankina, Stefan Reis, Massimo Vieno, and Mathew R. Heal

This discussion paper by Aleksankina et al. documents a global sensitivity and uncertainty analyses for the regional chemical transport model EMEP4UK, with the objective of quantifying the uncertainty in surface concentrations of air pollutants (ozone, nitrogen dioxide, and particulate matter below 2.5 um in diameter) and the contribution to that uncertainty from uncertainties in UK-only emissions. No uncertainties associated with model transport and/or chemical processes, or the lateral boundary conditions or

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Discussion paper

driving meteorology were considered.

I found the paper to be well organised, well written, and a really nice example of applying powerful statistical approaches to understanding model behaviour and uncertainties. The discussion on the sensitivity analysis itself was very interesting and shows how insightful this technique is. The paper will add to the growing literature base on the use of Gaussian emulation in quantifying uncertainties in geophysical models. I wholeheartedly recommend that the paper is accepted and published in Atmos. Chem. Phys. However, I have a few comments which I hope the authors will consider when submitting a revised manuscript:

1. Intro: For the non-specialist, I think it would be worthwhile to include some basic introductory material on what you mean by sensitivity analysis versus uncertainty analysis.

2. Can you include some discussion on structural uncertainty?

3. Intro: Note that aerosols affect climate through aerosol-cloud interactions and not only aerosol-radiation interactions

4. Intro: Meta models have also been used in exploring climate sensitivity/climate response e.g. Murphy et al. (2004)

5. Section 2.1: Full names for SO2, NH3 etc..

6. Section 2.1: Can you include details of bvoc emissions scheme, and parameterisations for sea salt and dust emissions?

7. Table 2: Slight error with SNAP sectors for NH3_O (i.e. 10 should not be included!)

8. Results Section 3.1: You say that there is a “substantial contribution of hemispheric background O3 to UK ambient concentrations”? Can you be more quantitative here?

9. Results Section 3.1: You refer to the ‘compensation of errors’ as one explanation why the surface response is weak given the input uncertainties. Can you point to the

literature for evidence of this statement? I've only seen "compensation of errors" only referred to in the context of process representation in models.

10. Results Section 3.3: One potential explanation for the seasonal change in sensitivity at Harwell to shipping emissions is the seasonal change in the wind direction which results in more NOx from shipping emissions being transported to the site. Can this be verified from the WRF meteorology used to drive the model?

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