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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modelling surface ozone during the 2003 heat wave in the UK" *by* M. Vieno et al.

Anonymous Referee #1

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General comments

This paper describes a model study about the heat-wave period in summer 2003 in the UK. Surface ozone levels were simulated and several sensitivity runs were performed to evaluate the effects of some meteorological and chemical variables. Modeled O3, NO2 and isoprene levels were compared with measurements provided by a field campaign. The heat-wave period in 2003 can be considered as a prototype of future summer weather in Europe and it is therefore a very special episode for model studies. I think the topic of this paper is suitable for ACP. Although the heat-wave period in 2003 has been extensively studied by several other groups in Europe, this study might add some more regional information to the topic. The comparison of modeled isoprene concentrations with measurements can be useful for modeling community because of

the large uncertainties in emission inventories. However, there are some weak points in this study:

-VOC/NOx limitation is not discussed sufficiently. Vigorous changes (50%) in NOx and VOC emissions might lead to shifts from one regime to the other.

-The wind patterns are not shown and not discussed adequately although they are very important for the discussion.

-The meteorological and chemical variables were changed only in the inner domain for the sensitivity runs (boundary conditions were kept the same). This would need more discussion.

I believe the paper can be improved by considering the following issues.

Specific Comments:

Introduction: Other studies related to this topic were not sufficiently addressed and cited. There are several model studies performed in various parts of Europe during the heat wave period (e.g. Ordonez et al. ACP 2005, Chaxel and Chollet Atmos. Environ. 2009, Andreani et al. JGR 2008, Tressol et al. ACP 2008 and others).

Model description and setup Although meteorological model has 3 domains (50x50, 10x10, 5x5 km2) no intermediate domain was used for the CTM (50x50 and 5x5 km2). Is there any reason for skipping the intermediate domain? Some information about nesting procedure in both models should be given (one-way or two-way nesting?) The vertical structure is described only for the EMEP model. Is it the same for WRF?

19513, 16-20: Biogenic emissions include isoprene, DMS, NOx from lightning. Monoterpene emissions were not mentioned at all. Were they not included? Is there any particular reason to ignore them? Their emissions are temperature dependent and they might have a significant effect on O3 concentrations as well (Pinto et al. 2007). At high temperatures as in summer 2003, monoterpene emissions are expected to increase.

Methods 19514, line 10-12: In sensitivity experiments variables were changed only in the inner domain (5x5 km2). Changing NOx and VOC emissions by such a large amount (50%) would lead to significant changes in the NOx/VOC ratios in the inner domain. Emissions in the low-resolution domain however were kept constant. This affects the boundary conditions. The same applies to other variables too (temperature affects the chemical reactions as well as biogenic emissions).

Results

4.1. Information about the wind fields is missing. Wind direction and speed during the studied period are crucial for the discussion about the transport (especially for explaining the reasons for the discrepancy between model and measurements at Writtle (Fig. 3c).

4.2. Results of the sensitivity runs are discussed here. However, they are discussed again in section 5 (discussion). It is confusing and difficult to follow. It would be much better to combine the two sections (4.2 and 5) and discuss various sensitivity parameters under different subsections (temperature sensitivity, NMVOC sensitivity, etc..).

19517, line 6-13: Why is the effect of NMVOC emissions different on certain days (Fig. 8)? It is not explained in the manuscript.

19517, line 14-23: It would be good to give some uncertainty for isoprene measurements in this section.

19517, line 18-19 "...that UK biogenic isoprene emissions contribute up to 10 ppb ozone on SOME DAYS in the base run case". The strongest effect of isoprene is seen actually on hottest days, 6th, 9th and 10th August, due to higher emissions.

19518, line 1; Authors say that 50% decrease in NOx emissions affects a few days with high ozone concentrations, particularly 2nd and 9th of August. However, 6th of August has even higher ozone levels but the effect is less, why? It needs an explanation.

19518, line 13. For the first time, transport by winds is mentioned here. It is absolutely

necessary to show the wind patterns at the beginning in order to understand the base case better.

Page 19518, line 16-19. There is a slight negative impact on ozone on 2nd of August, in the afternoon (fig. 11b) when deposition is switched off. This fact needs an explanation.

Page 19523, line 24: "even using a coarse grid (50x50 km2) for UK emissions of isoprene.." Is the resolution for isoprene emissions 50x50 km2, not 5x5 km2? Some information about the resolution of emissions is needed.

Table 1: Description of sensitivity runs in Table 1 and in Section 3 should be the same (e.g. either -50% or $\frac{1}{2}$, not both).

References: 19526, line 23: Shar must be Shär (in the Introduction too)

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 19509, 2009.