Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., referee comment RC2
https://doi.org/10.5194/acp-2022-173-RC2, 2022

Comment on acp-2022-173

Anonymous Referee #2

Referee comment on "Sources of surface O_3 in the UK: tagging O_3 within WRF-Chem" by Johana Romero-Alvarez et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-173-RC2, 2022

This paper describes the application of a regional chemical transport model using an ozone tagging scheme to quantify source contributions to surface tropospheric ozone in the UK during May-Aug 2015. The application of such a scheme in this context is novel, and the paper provides useful insight into the local, wider European, and extra-European contributions to ozone, broken down by local region within the UK. The paper explores differences in source contributions during episodes of higher surface ozone concentrations, and explores contributions using air quality and vegetation-relevant metrics, which provide some policy-relevant context. The paper is well written, and the methods applied appear robust and well described. There are some aspects of the model information and evaluation, and well as improvements in the discussion of results that would improve the manuscript. I recommend that once these issues (described below) are addressed, that the paper be published in ACP where it will be a valuable addition to the literature on European ozone air quality.

General comments

- For high ozone episodes in summer, biogenic emissions may be an important driver of ozone formation (e.g. see point made in Introduction on Page 7). Even if it is not possible to evaluate the model-simulated isoprene with observations, it might be informative to include a supplementary plot of isoprene during high ozone and more average conditions. The authors could also refer to previous studies evaluating MEGAN isoprene emissions in WRF-Chem, if relevant.
- Is it possible to calculate population-weighted MDA8 ozone contributions using population data and the model output? This would really strengthen the relevance of the results to air quality and human health. At the moment the discussion does not differentiate based on population distributions among the different regions, so it is difficult to interpret the relevance of the results to air quality.
- During ozone episodes (presented as when MDA8 O3 exceeds 50 or 60 ppbv), it would

be informative to provide more in-depth discussion of meteorological conditions alongside the source region contributions. Are these periods dominated by anticyclonic conditions? What are the atmospheric transport pathways that dominate the France-sourced O3 influence on UK ozone? Are there any specific features that characterise the MDA8 > 60 ppbv episodes from the more moderate 50 ppbv exceedances?

Specific Comments

- Introduction - be more explicit about describing ozone production dependencies in NOx and VOC-limited conditions, and importance of NO+O3 in high NOx environment. This effect is variously referred to as 'titration' and 'scavenging'. It would help the reader to point out the reaction specifically.
- Line 79: Not clear what is meant by "the second warmest year in a row in Europe".
- Line 80: "EU information threshold of 1 hour (h) average mixing ratio of 180 µg m-3": the value of 180 µg m-3 is a concentration not a mixing ratio. Is the threshold defined as the 90 ppbv mixing ratio, or the 180 µg m-3 concentration? These are not necessarily equivalent (dependent on local meteorological conditions).
- Line 97-99: Please clarify how the IC concentrations are applied. The phrase implies that they are used to initialise the model simulation at the outset, however the text implies that they are applied every 3 hours. Does this mean that the model fields are essentially overwritten with MOZART fields every 3 hours? Please clarify.
- Line 103: Presumably aerosol are also simulated in the model? Please provide information on the aerosol scheme used in the simulations.
- Line 169: Mean bias in µg m-3, ppb, or %? Please clarify.
- Figure S1 - Do you have an explanation for the lack of diurnal cycle in the model surface temperature at coastal sites? Does this imply issues regarding diurnal variation in mixing height / boundary layer? Is there any potential link to biases in the NOx and ozone shown? It would be helpful to expand more on some of these evaluations and comparisons in the main text.
- Fig. 3, 4, 6 captions: the plots depict mixing ratio, not concentration. Please change wording to reflect this.

Typographical errors:

Line 35: "Concentration of …" -> "The concentration of..'

Line 94: Erroneous "G. a."?

Line 100: "shipping lines' -> "shipping lanes"?