

## ***Interactive comment on “Phenomenology of the highest ozone episodes in NE Spain” by Xavier Querol et al.***

### **Anonymous Referee #1**

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The manuscript submitted by Querol et al. presents a detailed analysis of the generation of ozone episodes in the Catalonia region (North-Eastern Spain), elucidating key mechanisms yielding to acute ozone episodes in the area. The analysis is carried out exploiting a comprehensive dataset of measurements at ground level and on the vertical profile by means of balloons. The authors were able to identify two types of synoptic patterns associated to high ozone episodes and convincingly describe the underlying processes. For the type associated with highest ozone levels, the authors also suggest that emission reduction in the Barcelona metropolitan area during the days preceding the event, might reduce the risk of having the most severe ozone peaks in the valley to the north of the city. Although specific of the area, the analysis may be taken as a useful example also for other similar areas.

This is a well conceived study reported in a well written manuscript. Publication on

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ACP after addressing the minor points listed below is recommended. These are mostly typos and request of clarification at a few points not clear to this reviewer:

1. abstract, l. 24: "vertical measurements". It would be useful to state immediately here that vertical measurements were performed using tethered and non-tethered balloons.
2. abstract, l. 39-40: "At the highest altitudes reached in this study (900-1000 m a.g.l.) ..." this is somewhat in contradiction with the height interval specified above (1500-3000 m a.g.l., see line 29). Please rephrase.
3. abstract, l. 45: "free sounding data". Not immediately clear what does it mean. I suggest to write "non-tethered balloons" in place of "free".
4. abstract, l. 46-48: unclear paragraph. UFP are said to be low in the lower 100-200 m a.g.l., but nucleation events were detected in the PBL: does it mean that the PBL itself is stratified and nucleation only occurred above 100-200 m? Moreover, the paragraph does not seem to contain strictly necessary information for an abstract, I would consider removing it at all. Please clarify.
5. abstract, l. 54-57: This paragraph may be removed, it does not add significant and crucial information, as it is written now. Otherwise, please clarify the importance of the statement.
6. l. 78: "(where no exceedances are recommended)": misleading statement. Perhaps rephrase as "(where no specific number of exceedances is recommended)".
7. l. 86: "... to yield secondary aerosols". I would also add "organic nitrates", which may sequester a significant fraction of NO<sub>x</sub>.
8. l. 108: "In days," replace with "There,".
9. l. 266: "are bivariate polar plots concentrations are ...", add "where" between "plots" and "concentrations"
10. p. 7, subsection "Modelling system for O<sub>3</sub>": from the description apparently a

continuous run for all the period analysed is carried out (it is mentioned a 24-h spin-up period). In that case, probably grid nudging of WRF was used. Please clarify and eventually specify the variables used in nudging, the nudging coefficients, and if nudging were applied also in the PBL.

11. I. 291: "pressures" should be "pressure".

12. I. 292-293: "... changing the direction at nighttime". Misleading statement. Apparently, the meaning is that air masses circulate clockwise during the day and counter-clockwise at night. Please clarify.

13. I. 385: "nitrate ... concentrations increased during the evening". This is not true. In Figure S6 nitrate decrease in the evening, while shows a peak in the morning period. Moreover, the effect is attributed to changed "gas/particle partitioning": is this an effect of temperature? Please correct and clarify.

14. I. 420-421: "O<sub>3</sub> variations at the coastal BEG are opposed to those at the inland MSC". Not clear what the authors mean with "opposed". The two signals are actually qualitatively correlated. Please clarify.

15. I. 472-477: Here, a quantitative estimate of the non-local contribution to the O<sub>3</sub> peak in the Vic Plain is attempted. However, it is not really clear how the authors estimated it. Please clarify, explaining in depth the calculation.

16. I. 488: "... more than 50% of the O<sub>3</sub> hourly ...". Again, the authors attempt quantification of different contribution to O<sub>3</sub> levels, but do not explain in details the calculations. Please clarify.

17. I. 529: "150 ug/m<sup>3</sup>". Probably the authors mean "100 ug/m<sup>3</sup>". Please check.

18. I. 586: " ... more marked in the episode." Probably a "A" is missing at the end of the sentence.

19. I. 586-589: Here the authors refer to previous quantitative estimate of contributions

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to O<sub>3</sub> levels from specific mechanism. This reinforced the need for clarification, as mentioned above.

20. I. 701-703: Here the authors qualitatively suggest that NO<sub>x</sub> reduction in BMA should reduce ozone peaks in Vic Plain during type A episodes. They are thus implicitly assuming a NO<sub>x</sub>-limited ozone regime. Please state this point explicitly, and possibly support the claim referencing previous studies, if any available.

21. One concluding natural question is: are type A and B the only two situations expected to yield high ozone events in the area? May the authors rule out other types of situation from the analysis of this period only? Please add a comment on that point.

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