

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

### **Anonymous Referee #2**

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This study, that is based on a comprehensive set of both ground level and balloon borne measurements of air pollutants as well as model simulations, gives a detailed description of the characteristics of two high ozone episodes observed during the month of July 2015 in the North Eastern part of Spain, where the highest ozone concentrations in the country typically are found. The authors show that the episode with the highest ozone concentrations is characterized by what they call ‘closed circulation’ with a high degree of recirculation of air masses due to the sea and land breezes, while during the other episode no major recirculation takes place and horizontal advection over a larger scale plays a more important role. The manuscript builds on a long series of previous studies, mainly carried out by the group of Millan Millan, that have highlighted the influence of the particular orographic and meteorological conditions on air pollution at the Iberian Mediterranean coast and in the western part of the Mediterranean Basin

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in general.

The manuscript presents an interesting set of observations and what seems to be a scientifically sound analysis of these; it is well written and generally clear, apart from a few points mentioned in the following. I think that the manuscript would only need minor corrections and recommend that it be published after the authors have addressed the comments and suggestions given below.

As a general comment, I find that while the qualitative description of the contribution of different processes to the episodes is clear, in the cases where a more quantitative evaluation of these contributions to the ozone or Ox-levels is given a more explicit description of the calculations that were performed is needed, as mentioned below.

There seems to be a discrepancy between what is written about the altitude up to which ozone rich layers may influence surface ozone concentrations in different parts of the paper. In the abstract it is stated that surface fumigation takes place “from high O<sub>3</sub> reservoir layers located at 1500-3000 m a.g.l. ...”, in accordance with what is written in lines 477-478 and 556-560 but in apparent disagreement with the text in lines 119-120, where the ozone rich layers descending to the surface are said to be located at 1000-1500 m.a.s.l. I realize that there is a difference between ‘a.g.l.’ and ‘a.s.l.’ but as the layers are descending over the sea it seems that this cannot explain the difference.

In the following I will go through the paper and comment on specific points:

Line 106, ‘Seco et al., 2011’: The paper by Seco et al. from 2011 is not in the list of references. There is another paper by Seco et al. from 2013, but probably not the one that the authors have in mind because it deals with emissions during wintertime.

Line 135-136, ‘..which combined with BVOCs emissions, very often cause severe O<sub>3</sub> episodes...’: Is there any study showing that BVOC emissions are dominating VOC reactivity in the Barcelona area? I understand from the paper by Valverde et al. (2016) that VOC emissions from traffic and from the harbour are relatively large in this area.

Lines 145-146, 'SPECIFY SIZE RANGES...': This seems to be a comment left from the internal reviewing process among the authors. I agree with the comment!

Line 336: 'Figure S5' should probably be 'Figure S7'.

Line 414, 'This is due to...': It is possible that the higher ozone levels at the coastal sites may be related to a higher proportion of primary NO<sub>2</sub> (due to ship traffic, I suppose), but it remains a hypothesis that this is the main reason for the differences so I think it is mandatory to write 'this may be due to..'

Line 469: The meaning of the term 'meteorologically influenced patterns' is not completely clear here. I guess that it refers to the impact of long range transport (in contrast to the transport within the region mentioned afterwards), but please change the wording in the text.

Lines 476-481: It is not clear how the 150 micrograms/m<sup>3</sup> were calculated. Please give the necessary details.

Lines 493-495: I do not understand the reasoning here: In my understanding not only the inland stations in the Vic plain but also the coastal sites should be subject to fumigation by recirculated strata.

Lines 583-586: The occurrence of layers where ozone and BC are uncorrelated is attributed to recirculation of aged air masses, possibly coming from "local-to-regional sources and more distant over the W-Mediterranean". However in the abstract it is suggested that these layers are "possibly due to a prevailing regional/hemispheric contribution of O<sub>3</sub> at those altitudes", i.e. transport at a much larger scale. As this is an important issue and as the abstract should reflect the contents of the paper, I think it would be relevant to discuss this possibility of an impact of long range transport.

Line 591, 'ordered by importance': It is not clear to me how the relative importance of the three processes has been determined.

Technical comments:

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The basis for dividing the figures between the main paper and the supplementi is not completely clear to me. I would suggest to put the figures that are most important for the discussion in the main paper. For instance, the maps of the synoptic meteorological situations that lead to the two episodes (type A and type B) are essential for following the discussion in the paper. I would thus suggest to move Figure S5 from the supplement into the main paper and also to replace the present figure with German text by a figure with English text. Also Figure S7 is important for the discussion and thus I find it more natural to have it in the main paper.

Line 180, ‘The area is surrounded...’: The sentence needs to be rephrased.

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