

## ***Interactive comment on “Tropospheric ozone and its precursors from the urban to the global scale from air quality to short-lived climate forcer” by P. S. Monks et al.***

**Anonymous Referee #2**

Received and published: 5 February 2015

This is a very interesting review paper. At first I was slightly daunted by its length, but it actually was a very easy and enjoyable read. It provides a very nice up-to-date review of what is a complex topic, simultaneously providing a good introduction to the subject, whilst exploring some of the latest research findings. I expect to use it as a recommended paper for my students (UGs and PGs).

I think the paper should be published subject to minor revisions.

I thought the title of the paper was rather cumbersome and not quick to understand. I would suggest something more concise.

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Throughout the paper, but particularly towards the front, ensure that all acronyms and chemical formula are defined.

P. 32712, lines 26-30. I believe that the reference to Bloss et al (2005) refers to the high OH concentrations in the tropical lower troposphere rather than the greater ozone production from long-lived HCs there. As it stands, this is not clear. Whilst it is expected that there will be greater oxidation of the long-lived HCs in tropical lower troposphere, the production of ozone does rather depend on the amount of NO<sub>x</sub> present. Fig. 2 relates to this. Whilst the plots indicate high ozone production in the tropical lower troposphere, the non-linear scale for the legends tends to hide some of the variation at the higher rates. Note axes labels are missing from the upper panels.

P. 32716, lines 21-23. “Considering . . .”. This is not a sentence.

P. 32717, lines 5-6. I suggest including a reference to Reaction R3, for example, for the regeneration of OH.

P. 32717, lines 6-8. This says that production of O<sub>3</sub> is shown schematically in Fig. 3. Although Fig. 3 was not what I had expected which was a figure that would show schematically the reactions involved in the formation of ozone. I think this would be a useful additional figure.

P. 32717 discusses Fig 3 including the transition from point A to B and from point C to B. I also think it is useful to discuss moving from point A towards the origin and from point C towards the origin.

P. 32718, line 12, suggest “which can be readily”.

P. 32718 discusses the impact of deposition in rural areas in such a way that it seems to suggest that deposition is not important in urban areas. Of course in urban areas there is the added impact of the NO<sub>x</sub> titration effect, but that doesn't mean that deposition isn't still an important ozone sink.

P. 32729, line 9. I didn't fully understand what was meant by “by treating the vegetation

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to fully close stomata". Please clarify.

Structure of section 2.1.2. This seemed a bit odd, with the end of section b introducing sections c, d and e, which all seemed to be sub-sections of b. Consider restructuring the headings.

P. 32722, line 14, suggest "deposition rates to water"

Structure of section 2.1.3. I suggest giving the sub-headings letters a, b, etc. I also suggest perhaps separating stratospheric-tropospheric exchange and summer monsoons. I don't see the need for them to be together.

P. 32733, lines 14-18. "this behaviour", which I take to be the decreasing trend in high percentiles is said to be in part due to increasing hemispheric ozone levels, but this would lead to reduced ozone. Please clarify.

P. 32734, line 6, "non-significance of the trends". Urban or rural background?

Section 2.3.2 relates to "evolution" of emissions and yet, quite a lot of the text at the end of this section is on uncertainties, which might fit better in the following section 2.3.3. in uncertainties.

P. 32738, line 5, suggest "among these inventories".

P. 32738, line 7, suggest "lowest and highest".

End of section 2.3.2.a is about shipping emissions. These do not seem to specifically relate to Europe or N. America, so I suggest some restructuring.

P. 32739 lines 21-22, suggest "For India, the range of values proposed by the different groups is even larger,..."

P. 32739 line 26, suggest "Figures 7 and 10"

P. 32740 line 13. When you say "deterioration" of emissions, do you actually mean "varying deterioration"?

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P. 32740 line 21. "most countries".

P. 32741 line 1. "on a few".

P. 32741 line 6. "information on".

P. 32741 line 8. "uncertainties in".

P. 32741 line 20, says that Figure 14 also highlights the "growing" importance of emissions from Africa. It doesn't actually highlight this as it only shows 2005 data. It does however show that in 2005, African emissions are comparable to emissions from other regions.

P. 32742 line 24-26. This is confusing as it says an example of "variability" is .....the "constant" high fire episodes.

P. 32743 line 9. I would also suggest that Fig. 17 shows large differences for broad regions as well.

P. 32743 line 12. "limit in".

P. 32743 line 29. "remain in".

P. 32744 line 6. "taken as constant".

P. 32744 lines 18-19. "fire plumes".

P. 32744 line 23. "fire emissions".

P. 32746, line 11, suggest "lowest and highest".

P. 32747, line 16, should refer to Fig 21b not 22b.

P. 32750, lines 8-9, suggest "during a 2 year period".

P. 32750, lines 13-15, I am not sure of the relevance of this within this section.

P. 32751, line 13, suggest "than would be".

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P. 32752, line 1, refers to Figure 26. As well as ozone, this figure includes PM10, which is not discussed in the text and is actually not relevant.

P. 32752, line 10, suggest "coupling at the".

P. 32752, line 20, "emission".

P. 32753, lines 22-24. It is not clear why there is an interim target and the "High Level" maximum daily mean (one being 40 ppb than the other). Please clarify.

P. 32756, line 18. It would be helpful to provide the definition of SOMO here. It is given later on page 32801.

P. 32756, line 22. Surely this should be "calculated" increases in health effects?

P. 32757, lines 1-13. Again the comments here seem to refer to actual increases in ozone impacts depending on the choice of SOMO. Surely these should be calculated impacts.

P. 32758, lines 12-13. This could be defined as AOT40 as again this used later in the paper.

Section 4 Topics. It is not clear to me why the various topics are ordered in the way they are. I would suggest ordering the topics something along the lines of emission sources, chemistry, specific regions, general topics (such as modelling and nitrogen cycle).

P. 32763, lines 23, suggest "concentrations have been observed".

P. 32765, Up until now ozone levels have been given as mixing ratios. I realise that here they are given as mass densities because of the units of the thresholds, but I think it would be helpful to be consistent with the earlier text to give the values in mixing ratios (even if this means giving the values in both units).

P. 32765, line 20. The 3 needs to be a subscript.

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P. 32765, line 22, suggest "avoided by such policies".

P. 32765, line 24. What is meant by "small but substantial"?

P. 32768, lines 3-4, "Tropical biomass burning dominates ...". It would be good to give the percentage contribution from this biomass to burning emissions to compare to boreal fires.

P. 32768, line 17. "boreal".

P. 32768, line 21. "BORTAS was to".

P. 32769, line 4. "drivers of the OPE".

P. 32769, line 26. "algorithms"

P. 32769, line 29 – p. 32770, lines 1-3. I am confused by the comment that boreal fires emit products up to 10 km, and then the subsequent comments which limit emission to below 4 km. Please clarify.

P. 32770, line 16. "have a strong impact on meeting air ...".

P. 32770, line 17. "Figure 30".

P. 32770, line 18. "July 2012 in the frame"

P. 32770, lines 23-24. "and given plume age .....pathway apparently)." I really don't understand the point being made here. In fact I am really not very sure what message is trying to be conveyed with respect to Figure 30.

P. 32772, line 20. "of its key". Section 4.4 Halogens, first paragraph. I would prefer to see the reactions given on separate lines rather than integrated within the text.

P. 32777, line 20. "to O3".

P. 32777, line 28. "Bromine is twice as important as chlorine as an ozone sink".

P. 32782, lines 8 and 9. "reported for the tropics".

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P. 32785, line 1. "At the continental".

P. 32786, line 8. "can be a significant".

P. 32787, lines 22-23. If the power is given for over the land, why not for over the ocean? Having said that, the rest of the paragraph suggest that other parameterisations may be better, so perhaps there is no need to give any values (i.e. remove the bit in brackets).

P. 32798, line 16. What is the Advanced Light Source?

P. 32799, line 23. "in its excited".

P. 32802, line 2. "100s".

P. 32805, lines 2-5. "even if . . . . penalty". This is confusing. Please clarify.

P. 32805, line 16. "deaths".

P. 32806, first paragraph. Comments relate to 20% emission changes. The emissions of exactly which chemical species were changed?

Section 5.4. Most of the material on page 32807 is about the science of the impact of climate change on ozone and it is not until the next page that this section really deals with the policy context, which is what section 5 is about.

P. 32808, line 9. "impacts".

P. 32812, last paragraph. I think it would be good to mention personal exposure monitors here.

P. 32813, lines 3-6. It seems a bit odd to add this bit about the whitefly in the conclusions when it hasn't been mentioned before.

Throughout the paper, but particularly towards the front, ensure that all acronyms and chemical formula are defined.

Be consistent with the use of upper case letters, particularly when referring the specific

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regions, e.g. polar regions, boreal regions, tropics. Also stratosphere-troposphere exchange, chlorophyll, dissolved organic matter, background ozone

The text on a number of figures was rather small. Please make sure it is legible in the final paper.

Fig. 4. Although the RC terms are defined in the text, none of the other terms are. They should either explained in the text or figure caption.

Fig. 7. According to the figure headings some of these emissions are for the USA and others for N. America. The caption should reflect this.

Fig. 8. "data for Canada".

Fig. 17. "see Fig. 17-1b" makes no sense.

Fig. 18. "of the mass"., "from Sofiev et al. (2013)."

Fig. 21. In the caption please indicate for the fight hand panel whether "This study" is a bottom up or top down study.

Fig. 27. The two panels would be more comparable if they were both either daily maxima or annual means.

Fig. 29. Define MMM and T which are used in the title.

Fig. 32. States that the values plotted are losses. However as the values are negative, they are actually negative production terms. The x-axes labels are rather unclear.

Fig. 35 need more explanation.

Fig. 37. "emission increases", "leakage rates".

I didn't see Figure 39 referred to in the text.

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Interactive comment on Atmos. Chem. Phys. Discuss., 14, 32709, 2014.

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