

This version typeset on August 17, 2021

Note: We use *italics* for direct quotes from the reviewers.

Reviewer 1

Reviewer 1 required no further corrections.

Reviewer 2

Reviewer 2 gives the following introduction to his specific comments:

I have reviewed the resubmission of the manuscript “Stratospheric pollution from Canadian forest fires” (now “MLS observations of biomass-burning products in the stratosphere from Canadian forest fires in August 2017”) by Hugh C. Pumphrey et al., after the first stage of review and the subsequent Authors’ modifications of the previous version. During my first review stage, I pointed at a number of issues, including two major comments. The main point was (and is) the fact that the paper looks, at least to my eyes, as very confusing and superficial in places and, I suppose, rushed. For what I see, even if some critical points have been solved (e.g. now the title is much less generic, the trajectory analyses are clearer, the “Authors contributions” section is more complete) many of my comments have been rejected by the Authors and/or unsuccessfully tackled. Thus, from my point of view, the two major issues have only been partially solved and so, unfortunately, I cannot recommend the manuscript for publication in its present shape. As I am a bit puzzled by the fact that the Authors decided to dismiss many of my comments, I leave it to the Editor to judge if a Major Revision or another decision is the best choice (I suggest Major Revisions). As a guide for solving the mentioned issues — in case the Editor thinks it useful — please find some elements in the following. Please consider that this is not supposed to be a complete list of the modifications needed, this is just a set of examples of unclear/unprecise bits of text. Besides these points, I strongly suggest the Authors to thoroughly revise the text to improve clarity, preciseness and completeness.

We find it difficult to address the reviewer's desire to have us revise the entire text for clarity. The corresponding author has revised the text many times now, and the other authors have read it and provided extensive corrections which have been incorporated into the text. We have addressed the reviewer's specific comments as we note below, and have made a number of small corrections to the text. While we are fairly sure that these would not be regarded as sufficient by the reviewer, it is hard to know what he would consider to be sufficient.

- 1) *My comment during the first stage of the review process: “The originality of the manuscript must be clarified and openly discussed, in particular with respect to the previous work of Yu et al., 2019. What's new and what's complementary with respect to Yu et al., 2019? This is not clear at all in the present manuscript version, at least to me.” The Authors decided that this is not necessary because “Given that our paper references Yu et al. (2019) and notes which species are described in that paper it did not seem necessary to us to go into more detail” I disagree on this point but might accept the small modification at L39–40, that implicitly mention the difference and complementarity of the two papers. It could (and should) be expanded a bit, so to be clearer: please consider this possibility. The paper by Yu et al. is about*

almost entirely different aspects of the event than those covered by our paper. We have added a sentence which spells this out in more detail than before.

- 2) *I pointed at this, also: “The paper is unfortunately very confusing and certainly not very well crafted. The Abstract, Introduction and Conclusions are very short, incomplete, probably rushed. Many statements are not justified but just “written down”. Many discussions and argumentations are just lacking. All the analyses with trajectories (Sect. 4.2) are very obscure and must be extensively clarified/rewritten. Many crucial references are missing. The Authors should put a much larger effort in the writing of the text, the production of intelligible figures and the discussion of their results in the context of previous literature.” I commend the change in the title, the efforts in extending the Abstract, the Introduction and Conclusions and the new organization with a very welcome ‘Results’ unitary section. Nevertheless, this is not yet satisfactory, in my opinion, and many of my specific comments have been either superficially dealt with or even just dismissed. I don’t think that a Reviewer should need to insist on this aspect: writing a clear, accessible, unambiguous and complete manuscript is one of the main tasks of the Authors. By the way, a selection of most urgent specific comments, as examples of possible improvement of the text, is in the following (please revise the manuscript beyond these comments)* This is the kind of comment which is difficult to satisfy, and impossible to know whether you have done so. We have attended to the specific comments given below. But this general comment is so open-ended it is not possible for us to know whether we have improved the paper to the reviewer’s satisfaction.
- a. *Abstract*
 - i. “Events such as this are rare”: “such as this” in which sense? We felt that the wording used followed naturally from the previous sentence and was not particularly ambiguous. The reviewer is clearly an adherent of lucidity in scientific writing as set out by Michael McIntyre¹, and he is right to be so. We have attempted to re-word the offending sentence to remove ambiguous pronouns.
 - ii. “third of four”, “preceding two events...like the most recent” this is obscure at best. Please mention the specific events you’re comparing to. We have added a sentence noting that all of the other events occurred in Australia and have given the dates.
 - iii. “Unlike the preceding two events (sic), but like the most recent event (sic), the polluted airmass described here had an unusually high water vapour content”: how much? Why not putting specific results in an Abstract? The main text gives a value of 14 ppmv where the background values are 3.5–5 ppmv. In other words, the plume values are 2.5–5 times the background value. We have altered the abstract to state this explicitly.
 - iv. “these are in roughly the ratios to CO reported elsewhere”: what does this means? Elsewhere where? Please use more words to express your ideas. We have changed “elsewhere” to “in the literature”. We are not sure what the reviewer wants here. The relevant references are in the main text and it is not usual to put references into an abstract.

¹See <http://www.damtp.cam.ac.uk/user/mem/lucidity-in-brief/>

- *v. “We use back-trajectories...”*: in Sect. 3.1, you have much more precise origin identification than just “originated in British Columbia fires” (also mentioned in the Conclusions): why a sentence so generic and superficial in the Abstract? We have added a specific location to the abstract and stated it as part of the results in the relevant section of the paper. A few numerical typos were corrected in the process.

- *b. Introduction:*

- *i. “an important natural component”*: what do you mean with “component”? Please use a less generic word. Sentence changed to use “process”.
- *ii. What do you mean with “nature” of fires?* Again, too generic. A typical example is that forestry practices can, by suppressing the natural fires, allow combustible material to build up on the forest floor. When a fire does occur, it then may be larger and more intense than the fires which would have occurred in a less managed forest. We have replaced “nature” with “intensity” — it is the only fix we could think of without adding a large digression.
- *iii. By the way, the full sentence is unclear to me. What do you mean with “even when...the fires”?* We have had a go at making the sentence more specific.
- *iv. “more damaging”*: this is another generic statement I don’t understand. You mean in terms of burned area? Of environmental/atmospheric impacts? Other? The sentence deliberately does not spell that out because it is speculating about the future rather than describing the past.
- *v. Please use reference in chronological order (e.g. Torres et al./Kloss et al.)* Done, both here and wherever more than one paper are cited together.
- *vi. Kloss et al. is cited in a ACPD version and not the final ACP version. I did not check in the whole text but please double check if there are other occurrences of this.* We have corrected this and apologise to the reviewer and his co-authors on that paper for the error. We have checked the BibTeX database used for “Discussion” papers and have, we think, updated any that are cited in the current paper.
- *vii. “most detailed description” in terms of what?* In terms of “the evolution in time and space of the polluted airmass”, as the remainder of the sentence spells out.

- *c. Others:*

- *i. Specific comment 13 of first stage: “L34–37: Please justify these statements.”, reply: “We regard the reference to the MLS data quality document to be sufficient for this purpose.” It would be very easy to briefly mention the reasons why the use of lower levels are not recommended; a paper should be as self-sufficient as possible on these aspects, especially when referencing a technical document. Please expand.* We have attempted to give the reasons briefly without being led into a long digression from the topic of the paper.
- *ii. Specific comment 14: “L40–41: “this is about ... value”: Where are these values (zonal mean; daily maximum) taken from?”, reply “From the MLS data*

at times outside of the event. We have made the wording of this sentence even more explicit.” If I understand well, the “more explicit wording” is the following: “for this latitude band, for times immediately before the PNE”. This is not explicit at all, in my opinion. Please specify this reference period, please. We have re-done the analysis, being more specific about the reference period and latitude band. The values change slightly, the essence does not.

- *iii. L130: “some results are shown in Khaykin et al., 2020”: I don’t see how a sentence of this type, “some results” can be part of a scientific paper. Which results? During the first review stage I pointed at, and I still do at the second stage, the superficial writing style in this manuscript, which is well represented by this example. I strongly suggest the Authors to look through the manuscript for the many points where this kind of lack of precision and details occurs. A detailed revision of this point is surely well beyond the scopes of a Referee.* Because Khaykin et al. (2020) is about a different event from the current paper, we did not want to distract the reader by going into any detail of their results. However, we felt that it was necessary to mention those results briefly to show that there is no fundamental reason why the method we describe for CO could not be used for other species, if the amount of that species injected by an event was large enough. It was clear to us that the second part of the sentence under discussion follows on from the first part. We have added three words to make this more explicit, but we do not think it necessary to expand the sentence any further.
With regard to the referee’s broader point we note that the corresponding author has already had the paper read and corrected in detail by the co-authors.
- *Specific comment 22: it is acceptable to cite open-source softwares these days but this is a scientific paper so, besides citing the nlm() function and R, please briefly explain how the errors are calculated.* We have added a couple of sentences in an attempt to explain how the errors are calculated.

Other changes

A reference was added to a paper by one of the co-authors (M. D. Fromm) which was published while the second round of corrections to this paper were ongoing. A sentence was added to note that although the first obviously-enhanced CO values were observed on 14 August, Fromm et al (2021) report values at the high end of the normal range on 13 August at a location where CALIOP shows aerosol from the PNE. A further sentence was added in order to reference a paper by Das et al., which was also published while the current paper was being revised.