Response to technical corrections: “Protection without poison: why tropical ozone maximizes in the interior of the atmosphere” (egusphere-2024-1552)

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We have made brief technical corrections for the revised version of our paper, and the reviewer response is included below. We again thank the editor and reviewers for their valuable feedback, with our responses noted in blue.

In addition to these technical corrections requested by the reviewer, we have additionally proof-read the paper and made a small number of minor revisions of our own, primarily of a grammatical or stylistic nature. Also, we now cite four textbooks for each textbook paradigm in the Introduction, totaling 8 textbooks, a change that reflects a more strict criterion for inferring whether the textbook supports a particular paradigm.

1 Reviewer comments

I see that this paper has seen a lot of work in response to the first set of reviews; a new Figure (7) was added and the figures and numbers in this paper have been recalculated based on the most recent kinetic information. Congratulations to accomplishing this work. Further, many minor modifications were also made.

I suggest accepting this paper for ACP in its present form.

We thank the reviewer again for their careful review of this work, and their constructive feedback.

I have a very few comments (see below) that the authors might want to consider when producing a revised form of this paper.

* I like the idea of using SWOOSH in place of MERRA-2 (and I agree the changes are minor). But I think the paper is clearer in this way.

We agree that SWOOSH has improved the paper.

* I also like the idea removing the troposphere from the figures.

We agree that removing the troposphere has improved the paper.

* Oy is defined in Brasseur and Solomon (2005). Indeed, it is not uncommon (for certain applications) to have more species contributing to Ox than just O3 and O. However,

I suggest adding the Oy fedinition to this paper, so that people do not have to look up the Oy definition in the book by Brasseur and Solomon (2005).

Per this request, at the location of our first mention of O_y, we have added a footnote that includes its chemical definition from Brasseur and Solomon (2005). The footnote is as follows on page 8: *On their page 414, O_y is defined as $O(^3P) + O(^1D) + O_3 + NO_2 + 2NO_3 + HNO_3 + HO_2NO_2 + 2N_2O_5 + ClO + 2Cl_2O_2 + 2OClO + 2ClONO_2 + BrO + 2BrONO_2$.*

* regarding the Cariolle coefficients, I agree with you that they should nor be published with out his explicit consent. Perhaps there is a chance that D. Cariolle eventually agrees to his values being published.

We agree.

* Regarding Dobson: While he measured total ozone in many locations globally, for some time he estimated the peak of the ozone layer to be above 30 km. These estimates can be found in his old papers. Of course his book was later.

Thanks for pointing out this historical note. We are curious to read about how Dobson's understanding evolved over the years. We now cite Dobson (1963) as an example of a source/sink competition paradigm explanation.

* You mention in your reply that it is not impossible to consider temperature as a function of altitude. Perhaps this point could briefly be mentioned in the paper (rather than making the assumption "isothermal" right away.

Our introduction to the simplifying approximations of the Chapman+2 model now clarifies more explicitly that some of the approximations, namely that of an isothermal atmosphere, can be relaxed in our modeling framework, although we still employ them to support the derivation of the analytical solutions: *Agreement between the Chapman+2 model and observations is imperfect, which is unsurprising given that this work employs many simplifying approximations. Many of these approximations are required to subsequently derive an explicit analytical expression to the Chapman+2 model ozone profile. For example, we will present results for overhead sun impinging on an isothermal atmosphere, although our model can also be run at other solar zenith angles or with vertically-varying temperature. We have also approximated transport and catalytic cycles as a linear damping, used globally-averaged catalytic profiles, and neglected optical scattering. Despite these approximations, the Chapman+2 model produces a reasonable fit to the observed profile, and will be considered to produce a credible interior maximum of ozone. The remainder of the paper seeks to explain why the Chapman+2 model produces an interior maximum.*

References

Dobson, G. M. B., 1963: *Exploring the Atmosphere, by G.M.B. Dobson.* Clarendon Press, Oxford.