

We would like to thank the second referee for his time, valuable feedback, and comments. The authors' comments and response (in red), and the changes will be in the new version of the manuscript (in red).

The authors have addressed some of the issues I raised in my earlier review (I was reviewer #2 last time round). However, I fear there is still more work to be done to make this paper ready for publication. The bulk of the work needed amounts to providing clearer and more complete description of what is being presented. I describe these needs point by point below.

High level comments:

Aside from those more minor issue, I still have some higher level concerns. First it is still somewhat unclear what specifically is new in this paper. The manuscript still frequently interjects references to previous work by the author and others, making it hard to discern the specific new insights being gained here.

Additionally, I remain highly skeptical about details of the presented conceptual model. In terms of vertical profiles of ozone, your own analysis (which only considers altitudes above 22km) shows that the largest impact of these events is in the 22-26km region. How then, does your conceptual model have blue lines showing transport of negative ozone anomalies down to ~800 hPa. You present no evidence for transport to these depths. Such conceptual model would need to be backed up by Lagrangian trajectories or some kind of "tagged ozone" model study. As you've drawn it, how does your model explain what is seen in the SABER data? Your blue lines don't go anywhere near 20 km in at the latitude of your observations. You really need to rethink this model, particularly if, as you say in your response to the earlier reviews" this is the point that is "new" in your study.

Many others have looked such events, which have been termed "ozone mini holes". I suggest you read Millan and Manney, 2017 (doi:10.5194/acp-17-9277-2017) and the many references therein and see how your analysis agrees with theirs, and what your studies add. Also look at more recent papers that cite them or others (it's been a while since I was familiar with the work of those authors).

More specific comments:

Abstract: It feels odd that you don't mention the use of SABER data in the abstract, particularly if (as seems possible), this is the "new" aspect to the work. Please consider working that in.

Okay. The abstract was rewritten.

Line 34: "barrier in" -> "barrier to"

Okay.

Line 35: The first open parenthesis is never closed. I don't think you want it here in any case. Also: "polar region" -> "polar regions" and "medium latitudes" is better as "midlatitudes".

Okay.

Line 62: Insert "from" after "software"

Okay.

Line 65: "validated" -> "valid"

Okay.

Line 75: "Brewers" -> "Brewer"

Okay.

Line 76: Delete "published by"

Okay.

Line 85: "replaced" -> "succeeded"

Okay.

Line 87: "AURA" -> "Aura"

Okay.

Line 88: You've already defined NASA above, no need to define it again., just say NASA.

Okay.

Line 89/90: Similarly, you already defined TOMS above.

Okay.

Line 91: "satellites" -> "satellite instruments"

Okay.

Line 93: Insert "spectral" between "740" and "channels". Perhaps also discuss the number of pixels across the track too.

Okay.

Line 100: "analysis" -> "analyses"

Okay.

Line 103: "varies from ... to ..." -> "switches from ... to ..." or "alternates between ... and ...".

Okay.

Line 107: Delete "of" before "altitudes"

Okay.

Line 114: If you're going to stick to this bizarrely fine grid, please at least note the original SABER resolution in this discussion.

Okay.

Line 121: "regarding" -> "focusing on"

Okay, the sentence has been rewritten.

Line 133/134: Change sentence to: "In particular, they enable identification of the origins of air-masses (Holton, 1995). In the Southern Hemisphere (SH) Absolute Potential Vorticity (APV) is used.". However, I'm going to suggest that you eliminate all discussion of APV and instead simply discuss PV, changing your adjectives from low, to high and vice versa, etc. This is because, in none of your figures do you plot APV, you instead consistently plot PV. Why plot one thing and talk about another. It's not hard for the reader to flip the sign in their heads, but why make them do the unnecessary work.

The sentence was rearranged, removing the explanations about APV. Throughout the text only PV will be used.

Line 136: Insert "the" before "AOH" I'd say

Okay, the paragraph has been rewritten.

Line 138: "preferred" seems an odd choice of word how about "the height at which the largest decreases in ozone mixing ratio occurred, as discerned from SABER profiles"?

Okay, the paragraph has been rewritten.

Line 150: I suggest "... presents values lower than the corresponding multi-year monthly means (TCOm) minus 1.5 times the corresponding standard deviation..."

Okay.

Line 150-153: I'm not clear what is being said here. Does Peres describe an alternative approach that you're contrasting yours with, or does that paper lay the theoretical basis for the approach you're describing above (in which case, cite it in the first sentence in this subsection). In any case, this sentence interrupts the flow where you talk about your definition of a AOH event.

Also, lines 150-155+: You basically define this criteria three times, once in line 150, the second on line 155, then again in the equation immediately below. Surely once (or at most twice) is enough. Please condense this discussion.

The paragraph (150-155+) has been reorganized for better reader understanding.

Line 163 (first line of section 2.2.1): "on 42 years" -> "in 42 years"

Okay.

Line 165: "on the platform" -> "from SABER"

Okay.

Line 166: "the occurrence of an" -> "each"

Okay.

Line 169: insert "multi-year" before "monthly"

Okay.

Line 187: "dynamic" -> "dynamics"

Okay.

Section 3.3.1 title: Insert "of" after "event".

Okay.

Line 215/216: This sentence feels out of place. The one before and one after talk about the 2016 event, the one after does too. Why interrupt with a reference to a different event here?

Okay. Sentence removed.

Line 223: Insert "a" before 23%. Also "into" after "continued"

Okay.

Line 237 (Section title): Shouldn't it be 3.3.2, not 3.2.2?

Okay.

Lines 244: Again, why talk about APV when the plot is PV (so sign flipped). I'd talk about PV decreasing rather than APV increasing. (Or you could make the plot be of APV, but I vastly prefer the former, after all, it's not like you're talking about "Absolute latitude").

Okay.

Lines 249-251: You use terms like "under" and "over" here, but it's not clear whether you mean vertically (as in "high ozone over Brazil") or north/south. Please say "north of", "south of" etc. if that's what you mean. If you really do mean "over", "under" in the vertical sense, how is the reader supposed to deduce that from your maps, which are at a single level. If you're referring to other maps not shown, then say so.

The sentence was re-written and re-arranged.

Lines 252-269: This whole discussion seems to not be about the "case study". I still don't get why it is here. Also, once again, having this here makes it very hard to discern what is "new" in this study. I presume we resume "new" stuff at line 271, but having this long narrative in the middle of the case-study section feels disjoint.

Okay. Paragraph removed.

Line 270, discussion of Figure 6: Nowhere in the discussion or the caption of Figure 6 do you tell us what longitudes this plot corresponds to. Is it a cross section over Santa Maria? An average over some span of latitudes in the Brazil region? A zonal mean. This is a key point in your discussion, but the reader is not able to understand it.

The figure represents a vertical section of the atmosphere over the longitude of Santa Maria (53°W). The triangle shown in the figure represents the latitude, on the x axis, of Santa Maria (29°S). The text will be re-written.

Line 276: "between 200 hPa" and what, do you mean "at 200 hPa" or between 200 and some other level.
Okay. Removed "between"

Line 280: Be specific on "high levels."

Okay.

Line 293-294: This sentence is badly worded, it sounds like the analysis took 42 years to perform, not that your analyzing 42 years' worth of data.

Okay, inserted in the text "of data analyzed".

Lines 313-318: I am confused as to what is being described here and presented in Figure 7. You talk about a histogram of "events" at different levels, but you have not defined what you mean by an "event" for the SABER data. The discussion in section 2.2.1 established your "RD(z)" metric, but you never discussed any kind of "threshold" for it, nor do you refer back to this definition in the discussion here. Are you using the RD metric? If so, what is the threshold for an "event" that appears in the bar chart. If you're not using your RD metric, why did you take the time to define it?

Correct, figure 7 are analyzes of the vertical profiles available for the dates of AOH influence events identified, through the methodology presented in section 2.2, for Santa Maria. Reductions greater than or equal to 15% in relation to the monthly climatology for the period of available SABER data are analyzed. Visually, the 43 event profiles found (SABER data for the same date as the identified event, via table 2) were separated into groups where reductions greater than 15% were considered.

The text in the new version of the manuscript has been rewritten.

Line 334/335: This sentence is very unclear. It sounds like you're saying that the average number of events is reduced more intensely. I think you mean to say something like: "... stand out, with more intense reductions in the ozone mixing ratios averaged over the events compared to the climatology than in other months".

Okay.

Line 349: Suggest "increase in absolute potential vorticity" change to "decrease in potential vorticity"
Okay.

Line 352: Insert "e.g.," before the Bittencourt reference.

Okay.

Line 354/244: "This value has had the monthly climatological ... months of August and November subtracted"

Okay. Sentence removed.

Lines 355-360: Here you've really tied yourself in a knot over the APV thing. You talk about negative PV anomalies standing out, and all the numbers you quote are negative, but you still persist in pretending you're talking about APV. Give up on the "absolute" thing and just talk about PV the way you talk about latitude, there is no shame in negative numbers!

Okay. Decrease.

Line 362: "to understand" -> "for understanding"

Okay.

Line 363: insert "in" after "important"

Okay.

Line 368: Once again, nowhere do you tell us what longitude(s) this plot is for. This is (probably) a critical plot to your argument, but you don't help the reader understand it.

Okay. The sentence was rewritten.

Line 387: "Negative temperature"! Didn't I comment on that last time. Say low temperature or say negative anomalies (but compared to what, if it happens each year it's not an anomaly). Fundamentally, I am still very unhappy about your conceptual model.

Okay. The phrase was removed and reorganized.

Line 415: "... Santa Maria, a midlatitude region, during the..."

Okay.

Line 438/439: Again, give up on APV and just talk about PV

Okay.

Figure 2: As requested before, please artificially stagger the different lines in the x-direction, so we can more readily distinguish the error bars.

Figure 4: Get the fact that this is profiles/averages over your measurement location into the caption (give latitude/longitude range of "box")

Okay.

Figure 6: Again, you do not tell us the longitude (or longitude range or that it is a zonal mean) for this figure. Also, you don't define the feint gray lines with arrows on them.

Okay.

Figure 8: This caption is confusingly worded. "Average of events per month" sounds like a number of events not an ozone mixing ratio should be something like "average ozone mixing ratios for the identified events ... compared to the monthly climatology"

Okay. Thanks for the suggestion.

Figure 9: Similarly, "average the AOH influence events per month" sounds like you're counting events. Say instead something like "Figure 9: Average impacts of AOH-influence events for (a) August, b) September, c) October and d) November from 2002 to 2020, as measured by SABER. Lines show differences between the averages of all profiles influenced by AOH events each month and the corresponding monthly climatology, expressed as percentage of the climatology."

Okay. Thanks for the suggestion.

Figure 12: Again, talk about the longitude (or range or zonal mean) and define the light grey lines.

Okay.

Figure 14: See discussion at the top of this review.

Okay.