Atmospheric Chemistry and Physics Discussions

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Comment on acp-2022-382

Anonymous Referee #1

Referee comment on "Stratospheric water vapour and ozone response to the quasi-biennial oscillation disruptions in 2016 and 2020" by Mohamadou A. Diallo et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-382-RC1, 2022

Diallo et al. investigate the impact of the two QBO disruption events in 2016 and 2020 on water vapour and ozone using ERA-5 reanalyses and satellite observations from MLS. They find differences in the impact these disruption events had on atmospheric circulation and thus on the trace gas distribution of water vapour and ozone. This is a quite interesting study with interesting results. However, the writing could have been generally done a bit better and I have several suggestions for major revision before publication in ACP.

Generally, the whole study and writing is a bit too descriptive and though you state in the abstract that you "quantify" the impact it is done throughout the study in just a "qualitatively" manner. Don't understand me wrong, I do not need for everything numbers, but if there are too many phrases using terms like "weakly", "small", "large" it is quite difficult to get a feeling for how strong actually the impact is. I will provide more detailed feedback on this in the specific comments.

General Comments:

- Usage of the term "2016" and "2020" and "2015-2016" and "2019-2020". In some occasions the whole period is used and in other only the second year of the period is used. I could not really see if there is a concept when you use which term, thus I would suggest to change to one way of writing consistently throughout the manuscript or explain when you use what.

- In all figures the font size should be increased. In the supplement this should be done for Figures 1-5.

- Use the Copernicus style: Units (km, hPa,…….) are written in upright font.

- Your results are based on the measurements from one satellite, namely MLS. I remember that there are significant differences in the QBO imprint on the trace gases between different satellites. How does that affect your results? Have you done a similar analysis using another satellite instrument? What where the differences?

- Some figures of the supplement as e.g Figure S5 should be moved to the manuscript since they are discussed in detail and seem thus to be not that unimportant. There are also some other figures in the supplement that also could be moved to the manuscript.

Specific Comments:

P1, L6: "weakly decrease". Be more precise. Decrease by what? What exactly causes the decrease? The BDC transport?

P1, L7: Here you talk about "circulation anomalies", but before you talked about changes in the trace gas distributions (their abundance). I would prefer a clear separation in the language between dynamical processes and their consecutive imprint on the trace gas distributions.

P1, L17: Here a 1-2 sentence description what the BDC is should be added.

P2, L21: "Ozone is mainly produced in the middle stratosphere and is a good proxy for tropical upwelling". This is generally correct, but a too simple and not correctly understandable sentence for non-experts. I would suggest to rephrase this sentence and clearly state when and where is ozone produced, how is it transported and why can it be used as proxy for transport.

P2, L27: Introduce the abbreviation "QBO" and add a sentence describing what it is. You actually do that in the next paragraph. This paragraph should be moved higher up.

P2, L29: Explain also shortly what dehydration is.

P2, L32: Shouldn't it read "e.g. water vapour and ozone". Doesn't this hold also for other trace gases?

P2, L31-36: As stated in my comment on P2, L27 this entire paragraph should be incorporated in the previous paragraph.

P2, L52: ….affect the radiative forcing it the Earth's climate system…" What does that mean? Are we (the society) affected by these disruptions? What are the changes or consequences we experience based on this disruptions? Or are these just interesting for scientists to better understand atmospheric circulation?

P3, L68-69: "….high precision and lower systematic uncertainty…." Add some numbers. How high is the precision? Lower uncertainties than what? The former MLS version?

P4, L112: Rephrase this sentence that either the references are incorporated in the text or so that these can be added in parentheses. As it is done know it is not correct

P4, L116: Differences in the disruptions. Are here references missing? Are you referring to previous studies or is this done in this study? Please clarify and revise text accordingly.

P5, Figure 1 caption: How has the onset/offset be defined? When exactly did this happen. Can you provide year/month of the respective onsets and offsets?

P6, L148: What is the "tape recorder". A short explanation should be added.

P7, Figure 2 description: I really have trouble follow your descriptions/explanations. This is really difficult to see from the figures. Could add some guidance for the eye in the figures, like arrows or boxes or any other shape or sign that marks the respective areas?

P7, L181: I would suggest to rephrase this sentence. Dehydration refers only to H2O not to both H2O and O3. This sentence can be easily misunderstood.

P7-8: This is all bit too qualitative and difficult to see in the figures. Is there a possibility to quantify the changes?

P8, L197: How do you exactly derive the "zonal mean impact"? What has been done/considered here? The difference of the zonal means?

P8, L198: Which AOD data has been used?

P8, L198: How do you derive the impact? This becomes not clear.

P8, L216: "Also note the large variability…." Is this visible in the figures? Or do you mean these have been shown in other studies? If the latter is the case references should be added. If the former is the cause the text should be rephrased.

P9, L226: "large" should be quantified or give more information on the differences than just "large".

P10, Figure 3 caption, 3rd line: The monthly mean mixing ratios you are referring here to; are these for the entire time period 2005-2020?

P10, Figure 3 caption: The sentence "The impact of the QBO ……." should be incorporated into the main text rather than in the figure caption.

P10, Figure 10: The wind lines are difficult to see in detail. Thus, I would suggest to add a figure panel showing only the wind.

P11, L231ff: Can you quantify these differences?

P11, L254: about 10% weaker? How do you derive this number?

P11, L259: Fig S4 and maybe some other figures should be rather moved to the main text. It is quite inconvenient to swap back and forth between the manuscript and the supplement.

P13, L280: Add a marker/box in the figure to better visualize this?

P16, L348: "large" and "small". Please quantify this.

P17, L354: “smaller” and “shallower”. Same here as for P16, L348.

P17, L358 and L360: This is really hard to see from the figures shown.

Supplement, Figure 3: Although you can only show here a specific altitude range, these figures is much more helpful to see the difference. I would suggest to put this figure into the manuscript rather than in the supplement.

Supplement, Figure 5: Since this figure is discussed in detail in the manuscript it also should rather appear there than in the supplement.

Technical Comments and Corrections:

P1, L1-2: I would suggest to move “in the tropical stratosphere” to the first part of the sentence so that it reads: “The Quasi-biennial Oscillation (QBO) is a major mode of climate variability in the tropical stratosphere, with ……”.

P1, L4: Writing it like this is rather misleading. I would suggest to rewrite the sentence as follows:…..on the Brewer-Dobson circulation and respective distributions of water vapour and ozone, using…...”.

P1, L14: The line “Copyright statement: TEXT” is obsolete and can be deleted.

P1, L29: in the air parcels □ of the air parcels

P3, L70: Add “e.g”. There are also other studies that document the quality of the MLS H2O data than the ones by Hegglin et al.

P3, L71: Here a capital “U” is used. Later to the wind with a small ”u” is referred. This should be done consequently throughout the manuscript in one or the other way.

P3, L81: Rephrase sentence as follows: “In the figures only the 2013-2020 period is shown to highlight the two QBO disruptions.

P4, L92: Introduce abbreviation “ENSO”.

P4, L95: Introduce abbreviation “AOD”

P4, L99: In In ☐ In

P4, L105: are ☐ were

P5, Figure 1 caption: “U” or “u”?

P7, L158: 3_3 ☐ O_3

P7, L159: I am not entirely sure, but I would add “a”, so that it reads “we performed a regression analyses”

P7, L163: \citet instead of \citep

P8, L186: disrution ☐ disruption

P9, L221 and L225: JAS ☐ July-August-September (or July-to-September)

P11, L227: add “phase” or “winds” after “easterly”

P11, L229: JAS ☐ July-August-September (or July-to-September)

P12, Figure 4 caption: “Tropical averaged of the deseasonalized mean” should be either changed to “Tropical averaged deseasonalized mean residual velocity” or to “Tropical averages of the deseasonalized mean residual velocity”.

P13, L284: move “in the following” before “we finally” so that it reads “in the following we

finally investigate……."

P14, Figure 5 caption: space between "(NetF)" and "(a,b)" and between "(contours)" and "easterly" missing.

Supplement: Check the figure captions. The units should be in upright font (same holds for the manuscript) and in several occasions the O in H2O is in italic instead of an upright font.

Supplement, Figure 3 caption: Add which line is the blue one and which is the red one.