

Response to the reviewer:

General comments:

The paper is improved regarding the basis for the study and a description of the results. However, the English in the text still needs improving – in many places, it is clumsy, with vague statements made. As a result, it is difficult for the reader to follow the arguments made by the authors. In my view, until the authors address this key point for a scientific publication, the paper should not be accepted for publication in ACP.

A: As we mentioned last time, the paper was read by native speaker (scientist but not physicist). However, we have tried to improve English anyway (only British English is used); wording is modified here and there (not only in response to your specific comments).

Below please find examples of what the authors need to address.

L. 11: Important for what aspect of ozone? The distribution?

A: Important for ozone dynamics. It is added to the text.

L. 14: search for -> study.

A: Search for was changed to study.

L. 21: Would “central areas” be better than “peak areas”?

A: It was changed to central areas.

L. 22: Remove “quite”.

A: Removed.

L. 25: Do you need “well-pronounced”?

A: Well-pronounced was deleted.

L. 28: on -> at. Make this change elsewhere in the paper, so it should read: “...significant at the...level...”.

A: It was changed everywhere in the paper.

L. 40: transportation -> transport.

A: Changed to the transport.

L. 45: Perhaps provide here a reference to Manney et al. (2011) describing the unprecedented ozone loss in the Arctic for 2011.

A: The reference was added to the text and reference list.

L. 50: Introduce the acronym for BDC. Acronyms should be introduced when first used, both in the abstract and in the main text.

A: The acronym was introduced.

L. 53: Provide a reference for the concept of age of air, e.g., Waugh and Hall (2002).

A: The reference was added to the text and detailed information with new reference was included.

L. 70: “Many studies have been working with...”. This is clumsy - reword.

A: The sentence was reworded.

L. 75: Introduce the Dobson Units (DU).

A: The acronym was introduced.

L. 77: "...some effects...". This is vague – describe what they are.

A: The details were added to the text.

L. 79: What are these reasons?

A: This part was reformulated to express reasons more clearly.

L. 83: What do you mean by a substantial distribution?

A: The "prevailing" was used.

L. 93: Changed its trend from what to what?

A: From negative to positive. Now in the text

L. 94: I suggest: "...main contributor to heating of the...".

A: The sentence was changed

L. 95: "...more or less...". This is vague – describe the effects on the behaviour.

A: It was described more in details.

L. 110: Results of what?

A: The results of the meridional wind analysis. Now in the text.

L. 127: Do you mean direct wind measurements from satellites? If so, specify.

A: Direct satellite measurements. It is specified in the text.

L. 130: reanalyzes -> reanalyses. The plural of the noun "reanalysis" is "reanalyses". Change this elsewhere in the paper. You can use "reanalyze" as the US spelling of the verb.

A: The spelling was corrected everywhere in the paper. Now we use only British spelling.

L. 138: Specify the lower level of the model, presumably the ground. For example: "...28 levels from the ground to the top of the model at...". Do the same for L. 142 and L. 145.

A: The low level is 1000 hPa. It is now in the text.

L. 139: Do you need "efficiently"?

A: The efficiently was removed.

L. 151: Quantify the "very close"?

A: The sentence was reworded (do not differ in the main features).

L. 153: I presume sufficient to use any of the three reanalyses for the period from 1970 to 2012.

A: Sufficient was changed to possible.

L. 160: in -> at.

A: Corrected in the text-

L. 167: Make sure the two-core structure has been introduced before in the text.

A: The two-core structure is now first mentioned on lines 164-165.

L. 169: "...at 10 hPa...".

A: It was corrected.

L. 177-178: Clumsy sentence – reword.

A: The sentence was reworded.

L. 186-188: Clumsy sentence – reword.

A: The sentence was reworded.

L. 189: The comparison using different time periods is (a priori) not consistent. Please justify.

A: We know that using the different time periods is not consistent, but here we would like to show just the similar (or the same) main features for comparison – their robustness through independence on the length of period used. That is why we used the whole possible period for each reanalysis.

L. 202: What do you mean by “...distribution is much less compact”?

A: It was changed to “has no regular structure”

L. 216-217: The frontside and backside of something depend on the way one is facing. In the absence of a definition of what is the front and what is the back, this usage is ambiguous. By contrast, the concepts “westward” and “eastward” are well defined for the Earth, and are not ambiguous.

A: The frontside and backside is well defined in standard meteorology terminology (western for frontside, eastern for backside). But anyway, we use now both possibilities.

L. 226: “...and not the eastern. ”

A: It was corrected in the text.

L. 238: columnar → column.

A: It was corrected in the text.

L. 239: Remove “evident”.

A: Evident was removed

L. 242: factor → factors.

A: It was corrected in the text.

L. 245: Why do you use the NCEP/NCAR reanalysis?

A: We can use longer period 1970-2012 with this reanalysis.

L. 256: “...as well as the meridional...”

A: It was corrected in the text.

L. 261, 262: “...of the QBO...”; “...on the QBO...”; a bit → slightly.

A: It was changed in the text.

L. 286: predominately → predominantly.

A: It was corrected in the text.

L. 292: Is using different time periods consistent? Justify this.

A: We know that using the different time periods is not consistent, but here we would like to show just the similar (or the same) main features for comparison – their robustness through independence on the length of period used. That is why we used the whole possible period for each reanalysis.

L. 289-324: Very long paragraph – consider splitting into 2 or 3 paragraphs.

A: The paragraph was split into 3 parts.

L. 296-299: This sentence is not clear to me – reword.

A: The sentence was reworded.

L. 321: “...found an impact from that longitudinal...”.

A: It was corrected in the text

L. 322: Provide details of the impact.

A: Changes in maximum and minimum of O₃ and H₂O and their distributions, their Figs. 7 and 8. Now it is in the text.

L. 323: “...with the model...”.

A: It was corrected in the text

L. 324: This is vague – provide details of how this asymmetry is demonstrated.

A: Miller’s Fig. 6) demonstrates the very longitudinally asymmetric mean state of winter stratospheric zonal winds in HAMMONIA. Moreover, the winds do not only evolve differently during the SSWs, the wind speeds were found to differ by more than 20 m/s between the four locations at stratospheric altitudes between 100 and 1 hPa. Now in the text.

L. 333: What do you mean by “sector not affected...structure”? In the context of the main sentence, what you mean is not clear to me.

A: Sector not affected by the two-core structure, 160°E-140°W, 80°W-100°E.

L. 336: Provide details of how this is confirmed.

A: Change of the wind trends from positive to negative during mid-1990s. Now in the text.

L. 338: from -> is.

A: It was corrected in the text

L. 339: Provide details of this changed dynamical behaviour.

A: The details are now in the text.

L. 347: “...for years with major SSWs than...”.

A: It was corrected in the text

L. 348: I suggest “abnormal” -> “unusual”.

A: It was corrected in the text

L. 349: “...during a SSW...”.

A: It was corrected in the text

L. 350: Have you introduced the concepts of split and displacement SSWs? If not, do so, and provide a reference, e.g., Charlton and Polvani (2007).

A: This sentence was deleted from the manuscript.

L. 358: Provide examples/references of these other authors.

A: We added references to the text.

L. 360: “...larger at higher...”.

A: It was corrected in the text

L. 361: Provide references for these previous studies.

We added references to the text: Labitzke and Kunze, 2009, Labitzke and van Loon, 1988

L. 368: "...a well pronounced...".

A: It was corrected in the text

L. 370: "...one in each...".

A: It was corrected in the text

L. 376: What do you mean by the ozone content?

A: Total ozone column.

L. 378-379: How do your results illustrate the limitations of the zonal mean approach?

A: I.e. zonal mean of meridional component in middle latitudes could hide the two-core structure and probably the significant trend)

L. 383: "...in the cores...".

A: It was corrected in the text.

L. 384-385: "...it recovers.".

A: It was corrected in the text.

L. 385: What is the influence of the solar cycle?

A: The influence of solar cycle is now described on lines 278-281 and in Table 3. Wording of the final part of Conclusions, now lines 400-405, is modified.

References

Charlton, A. J., and L. M. Polvani, 2007: A new look at stratospheric sudden warmings. Part I: Climatology and Modeling Benchmarks. *J. Atmos. Sci.*, 20, 449-469.

Manney, G. L., et al., 2011: Unprecedented Arctic loss in 2011. *Nature*, 478, 469–475, doi: 10.1038/nature10556.

Waugh, D.W., and T.M. Hall, 2002: Age of stratospheric air: Theory, observations, and models. *Rev. Geophys.*, 40, no. 4, 1010, doi: 10.1029/2000RG000101.

Response to editor's comments

Dear authors,

Please find enclosed the report from referee one. Unfortunately, there are still some (minor) revisions necessary before publication in ACP.

The major point of the referee is that you really need to improve the language in your paper to get the message through. It is not enough to just correct the English grammar to get a correct sentence; you also have to check if your message is still the same after the sentence is corrected.

A: As we pointed last time the paper was read by native speaker (scientist but not physicist). However, we have tried to improve English anyway (only British English is used); wording is modified here and there (not only in response to your specific comments).

Additionally to the referee's suggestions for improvement I would like you to consider the following:

L23: "reanalysis" or "reanalyzes": Singular and plural should be used correctly and you should decide on either using British English or American English (and use it consequent throughout the manuscript).

"analysis" = singular, "analyses" = plural (same for BE and AE), but "to analyze"=AE and "to analyse"=BE

A: Only British English is used and the paper should be more consistent.

L29: What is meant with "ozone depletion development"? Do you mean during polar winter when the ozone hole forms? What is meant with "ozone trend turnaround"?

A: You are right. It is period when the ozone was depleted. And ozone turnaround is change of trend from negative to positive. To use the term turnaround instead of reversal in relation to change of ozone trends in the mid-1990s was recommended to us by reviewers of the paper Krizan and Lastovicka about trends in ozone laminae (JGR, 2005), because this change was not of predominantly chemical origin and they related the term reversal to effect of change of EESC.

L126: It should read "SMILES" (and not "SMILE")

A: It was corrected in the text.

L126: The instrument name stands for Superconducting Submillimetre-wave Limb-emission Sounder. Please correct this.

A: It was corrected in the text.

L130: See comment above (L23).

L188: see comment above (L23).

L215: Which height? Do you mean geopotential height or do you mean the Aleutian high pressure?

A: We mean Aleutian high pressure. It is corrected in the text.