

Response to Reviewer 3 Comments

Overall comments:

This paper uses a new approach to monitoring the SSW and uses this new approach to understanding the climatology of SSW. This paper provides a useful tool for future SSW studies. The science of this paper is interesting, and most of the text in this paper is well structured, for example, the introduction and the conclusions. However, the analysis in this paper is very unclear and many places hard to read, and I recommend a major revision before accepting. Most of my comments are only related to how to clarify it and not about the science, so I believe the authors will eventually make it a publishable paper.

Overall response: We thank Reviewer 3 for the valuable comments. We have carefully addressed all comments as stated below and as reflected in the corresponding updates in the Revised Manuscript (RM). The track-changes version of the RM explicitly shows all updates implemented.

General comments:

Point 1: *Many figures in this paper are (a) too complex, and (b) of poor quality. For example, in figure 1, 5, 6, and 9, the annotations overlap with each other so very hard to recognize. Especially in figure 1b-d, with so many large dots, the readers cannot read any information. In figs. 6&7, figure y-axis limits are too low, and some data is cut off. The authors should really find out a way to convey the information in your figures clearly and explicitly. At least, your text in the figures should be easy to recognize.*

Response 1: Thank you, ok, we have basically put a lot of care into the design and making of the figures and have now made a further significant effort to improve in this direction. We added a schematic overview figure on the method (related to a comment of another reviewer), replotted figures 1, 6, 7 and 8, and decomposed Figure 9 into two figures (now Figures 10 and 11) in the RM, to avoid any annotation overlaps and to make the information clearer to readers, including more recognizable texts.

Point 2: *Many paragraphs in section 4 should be rewritten. I recommend using an opening sentence to state the argument of this paragraph, instead of saying 'Figure 3 shows...'. What is important in your paper should be these scientific arguments, not the explanations of your figures. In my opinion, sections 4.1-4.3 are only listed results, and*

section 4.4 should be the scientific conclusions you should emphasize, so efforts are needed to re-organize the paper and extract out useful information.

Response 2: Thanks, we made also a significant improve effort in this direction (though we respectfully disagree somewhat that 4.1-4.3 are “only listed results”). We further improved texts in 4.1-4.3 and, in particular, we also split out from Section 4 a dedicated Section 5, to highlight the climatology and long-term monitoring key results. In this latter section (where we also expanded the results themselves in related figures, based on comments by another reviewer) we as well increased the weight of scientific arguments and interpretation. Sections 4 and 5 in the RM with track changes show these updates.

Specific comments:

Point 1: *Line 90 – why there is a () in reanalysis data?*

Response 1: The () is to indicate that both reanalysis data, and (standard operational) analysis data have been used for the validation of RO data.

Point 2: *Line 150 – name-coining: what does this mean? Also, you need to rewrite this sentence, for example, you should not use (i.e.) after as such*

Response 2: “name-coining” meant that using “sudden stratospheric **warming**” as a term recognizes that it is a temperature anomaly. However, as seen in RM, we dropped the unclear “name-coning” from the sentence now and also rewrote it to be clearer (including that there is no expression with “i.e.” in parentheses any more).

Point 3: *Line 152 – secondly, second after what?*

Response 3: Thanks, we have somewhat rephrased also these follow-on sentences, so that “secondly”, and “thirdly”, do not exist any longer in the RM.

Point 4: *Line 180 – ‘previous published climatologies reach to 2013 only and lack quality over the 1990s decade’ I think it is not true. Also, it should be ‘previously published.’*

Response 4: Thank you, we have revised also this sentence accordingly.

Point 5: *Line 241, line 265– ‘are overall similar’, ‘appear rather similar’: conclusions like ‘similar’ and ‘appear’ are too subjective and should not be in a scientific journal article, please check the rest of the paper to clarify your statements.*

Response 5: We agree that vague interpretations should be avoided as possible and we hence rechecked and changed accordingly at a number of places throughout the text.

Point 6: *Line 267 – ‘leading to somewhat’: delete somewhat*

Response 6: Ok, we can agree and deleted “somewhat” at this place.

Point 7: *Line 296 – ‘same three events’: how to define ‘same’?*

Response 7: Thanks, we avoided to use the phrase “same three events” in this sentence and actually reformulated the whole sentence into a simpler and clearer statement.

Point 8: *Line 339 – this long sentence is too hard to understand*

Response 8: Ok, we agree and have now split the sentence into two sentences in the RM, and reformulated a bit, which clearly eases the understanding of this information.

Point 9: *Line 426 – ‘we detected a number of events’, how many?*

Response 9: Thanks, we included the specific number now in the RM (we detected seven events).