

Response to Reviewers

We would like to thank the reviewers for their time and effort to review our manuscript. Detailed responses (in *cursive*) to the reviewer's comments and suggestions are below.

Reviewer 1:

The revisions satisfy my original concerns and I think have greatly improved the paper, and it is acceptable for publication as it is.

However, I think the authors should consider revising the last sentence of the abstract. This could be read to say the the timing of the FSW determines the level of ozone depletion (as "anomalies" is vague), whereas it is the other way around.

Comments: We are glad that we have satisfied the reviewer's concerns. We have re-written the last line of the abstract as follows. "In the Southern Hemisphere, the timing of the FSW is strongly linked to both total column ozone before the event and the tropospheric circulation after the event."

Reviewer 2:

I am happy with the changes made to the manuscript in response to my comments and those of the previous reviewer/commenter. The paper is interesting and I think can be useful for dynamicists and forecasters. Aside from a couple of very minor points below, my suggestion is to publish as is.

Comments: We thank the reviewer for their comments and we are glad they are happy with the revision. We address the remaining minor comments below.

Figure 2: It may make more sense to include this in section 4 where the independent ozone dataset is introduced.

We appreciate the suggestion and considered moving this figure, but it seems important to be able to explain the differences in the SH 50 hPa and 10 hPa dates, and the differences in NH and SH processes, in Section 2. We do cite the dataset in the Figure 2 caption, and have added "see Section 4" to the caption as well.

Figure 5; I think performing a 2-sided t-test on the difference between the individual pairs of panels would be more useful given that you compare in the text, early vs late FSWs and wave-1 vs wave-2

dates (e.g., lines 190-201, 207-211). Currently you only show stippling for significantly different values from zero, but actually it is the comparison between panels that is important. I guess the 10hPa vs 50hPa differences are less important, but the wave-1 vs wave-2 differences are important for the main objective of the paper (to classify and document differences between such FSW types).

We appreciate this comment. One of the goals of Figure 5 in particular was to determine where the response was robust across events for different types of classifications (i.e., do wave-2 events always or often occur in the same way spatially?). We think Figure 5 gives an indication of the commonality across events of certain features of a wave-1/2 event in particular. Therefore we think for this figure it makes sense to use a statistical test to test the significance from zero. However, we agree that later on we are particularly interested in comparing the differences in the impacts of FSW geometry and timing. So, for Figures 7 and 8 (and corresponding Appendix figures) we have changed the stippling (except in panels a,f which show the composite for all events) to the significance between, e.g., wave-1 and wave-2 or early vs late. We agree that this helps the reader visualize where the differences may be most important. Small changes to the text in reference to statistically significant differences have been added.

Line 271-272; Although it is worth mentioning that this is not robust and currently up for debate. I have seen two papers in the last month on this issue, both in JGR atmospheres; Hall et al. (2021) and White et al. (2021). The former examined observations and the latter used an idealized model. Both found that differences between displacements and splits (wave-1 and wave-2 events) were only present at lags close to the onset. At longer lags, differences are not apparent.

We thank the reviewer for pointing this out. We do bring up some of these issues in the conclusions, but we have also changed this line to the following and included the suggested references: “There are observed differences in the NH surface impacts following displacement and split-type SSW events (Mitchell et al. 2013), though the robustness of these impacts are debated (Maycock and Hitchcock 2015, White et al. 2021, Hall et al. 2021).”