

Interactive comment on “The major stratospheric final warming in 2016: Dispersal of vortex air and termination of Arctic chemical ozone loss” by Gloria L. Manney and Zachary D. Lawrence

Anonymous Referee #3

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This paper is certainly comprehensive, appropriate for ACP and most probably, correct. It was, however, also difficult to read and review. It comes across, at least to this reviewer, as a so-called “core dump” of information. As a consequence, I readily admit that this review is probably incomplete and that I probably missed pieces of information that to the authors, at least, they would deem critical. My comments are therefore (with one exception) more editorial than scientific.

General 1. One general science question that I think could use a greater exposition is the question of the MFW. The authors imply that this hybrid event in 2016 is unusual. Some context as to its occurrence frequency would be helpful. Is this the first to occur in the AURA record?

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2. As far as presentation, Section 3 is a case in point as exemplifying my concerns. Figures 1-3 are introduced in rather random order, with lots of information, which, while not technically wrong, may well be irrelevant. The authors present a whole bunch of figures (14 panels in all for Figures 1-3) and then jump back and forth in a scatter shot discussion. This is very taxing to read. The first three paragraphs do not even discuss the 2015-16 season, but rather present a literature review of 3 three previous winters. Line 27 on page 7 is a good example. The statement is simple- temperatures in a particular year (a year which was not the subject of the present paper) were cold enough to activate chlorine for a prolonged period of time. So why do we need to refer to four separate figure panels (Figure 1a and b Figure 2d and e?) to make this simple point (which again is irrelevant to the subject of this paper that is nominally about 2016)? In fact, I don't understand why Figure 2 is referred to here. Is it because CIO was going up? That is not explained.

3. Adding up all the panels in 15 figures, the paper contains 128 separate graphs. I confess that I found it difficult to subject each and every one to the scrutiny they probably deserve; I do nonetheless strongly suspect that they are not all necessary. As an example, I did examine one specific panel- that of Figure 1b. All references to Figure 1b occur with a simultaneous reference to Figure 1a. I therefore conclude that Figure 1b can't be necessary since it never is referred to independently of Figure 1a. So it should be deleted. Especially since they never describe it (what is V_{nat}/V_{vort} ?- they briefly mention it on page 9, but not in the context of Figure 1).

4. I also think Figure 3 is unnecessary. Not that it's technically incorrect, but it adds no new information that is not conveyed in Figures 1 and 2. Indeed, their concluding sentence on lines 19-20 of page 9 can easily be gleaned from Figures 1-2.

Minor

1. Figures 5-14 (with the exception of Figure 8) are essentially 3 sets of three figures for 850, 490, and 550 potential temperature surfaces. It would be useful to have a few

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introductory few sentences at the beginning of Section 4 explaining why they chose these three levels. Even if it was empirically determined that they were good representative levels, they should at least say that. As it reads, it just says (for example) Figures 5-7 without telling the reader where you are going with this. You have to read almost 2 pages of the draft before you find out that these 3 figures are for three separate altitudes.

2. Figure 6 vs Figure 7. If I understand correctly, the text on page 11 suggests (line 25, compared with line 7) that one difference is that N₂O and O₃ do not show mixing out of the vortex at 550K but they do at 490 K. Looking at Figures 6c and 7c, I see no difference. Am I supposed to?

3. Figure 1c: what is Max PVG? Those three letters do not appear anywhere else in the text or figure captions.

4. Figure 15: What do the colors mean? There is a label that says "first", "second" etc, but doesn't explain what those terms mean other than "bulk". Are they related to the colors of various fragments in Figure 14. If so, it should say so.

5. Abstract: Line 20. Where do they show chlorine in the offspring vortices? Figure 15 does not show chlorine. There are cryptic references to chlorine activation and deactivation scattered throughout the text, but I could not find where it pointed to a figure saying "this shows the deactivation of chlorine etc. etc."

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