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Interactive comment

Interactive comment on "Reanalysis intercomparisons of stratospheric polar processing diagnostics" *by* Zachary D. Lawrence et al.

Anonymous Referee #2

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Reanalysis intercomparisons of stratospheric polar processing diagnostics Z. D. Lawrence, G. L. Manney, and K. Wargan

This manuscript provides an extensive intercomparison of diagnostics relevant for polar stratospheric ozone processing in five recent 'full-input' reanalyses, MERRA, MERRA2, CFSR, ERA Interim, and JRA55, as part of the S-RIP intercomparison project. The study is thorough, well thought out and generally clearly presented, and the intercomparison should provide a valuable reference point for studies of polar processing that are based on reanalysis data, as well as a reference point for comparisons of these quantities in future reanalyses. To me the more interesting results are the almost ubiq-

uitous improvement seen in the agreement between reanalyses following the advent of improved satellite observations around 1998-2000, as well as the increased sensitivity to threshold definitions seen in the NH relative to the SH. The results are not earth shattering, but are of value and as such I would recommend publication after some minor revisions.

My main concern is that the paper is very long, and that its impact would be greater if it were significantly shorter. As a potential reference for future studies, there is some value in being rather complete in the intercomparisons, but 21 figures is a lot more than most readers will want to go through. It's not clear to me that Figs. 1-3 are really necessary, nor what is the additional gain from including Figs 18-19 over the content of Figs. 16-17.

Specific comments

p2 l1 There is a spurious 'data' here.

p2 l32: 'Best' is highly debatable here. They are a good tool, certainly, but they are not appropriate for all tasks.

p7 l6: The role of radiosondes should not be understated here – although it is not considered here, JRA55C, which assimilates only 'conventional' (non-satellite-based) observations does a remarkably good job of capturing much of the details of NH stratospheric variability.

p10 l4-19: The choice of a 5 day geometric mean here needs to be justified here. The key question is the decorrelation timescale of fluctuations in the differences between reanalyses. these could arise from a variety of processes with rather different timescales so it's not at all obvious to me what timescale is appropriate, but given that fluctuations in the physical quantities themselves (temperatures, PV) can have decorrelation timescales of far greater than 5 days this choice could be rendering the derived CIs rather meaningless. This can be checked directly by looking at the autocorrelation

functions of some sample quantities.

There is also a question of just what it means for two reanalyses to be 'statistically' indistinguishable. There is an important distinction to be drawn as to whether a difference seen between two temporal averages is indicative of a systematic, steady bias between the two systems as opposed to a result of the residual over temporal fluctuations. But given that these systems are meant to capture the same atmospheric fluctuations, time-dependent differences between reanalyses are still meaningful and potentially quite relevant to know about. Just because this measure indicates that the fluctuations are of larger amplitude than the mean bias (in some statistically meaningful sense) doesn't mean the reanalysis products are indistinguishable.

p10 l22-24: Are these averages and standard deviations taken over time (from the 12Z snapshots) within the year? Or are they taken over spatial degrees of freedom? Is the data synthetic? If not, what is actually shown?

A more general thought on this section - while I appreciate the effort to make the plots clear I wonder if it would be more efficient to simply explain this plot in the first case rather than present an example; the paper is quite long and omitting Figures 2 and 3 would go some ways towards shortening it without omitting relevant details.

Fig. 4: What is the relevance of the black lines 70 hPa and 30 hPa?

Fig. 5: Four digits of precision are not needed on the pressure axis labels

p13 l3: Earlier in the text A_PSC has been used - this to my mind is more standard than A_NAT. Was the switch intentional?

p15 l34: Up to 600K or so there is a significant improvement in the agreement between MERRA and MERRA 2 (in means and standard deviations) after 2000 - it's just in the upper stratosphere (particularly 660 and 700K) that the disagreement becomes if anything larger.

p16 l2: Is this a result of a more or less constant PV offset across the polar regions or

differences in the locations of the maximum gradient?

p16 l23: 'Total days' is a strange unit here since it's regularly far in excess of the total number of days in a year. The appropriate unit should be pressure-level days, I suppose.

p18 l26: I can't find an explicit definition of A_vort, though there are some relevant details in section 2.2.2

p22 l34: Given the statement two lines earlier about the similar timing of changes in the observations being assimilated by different reanalyses, the consistency of trends across multiple reanalyses should not be seen as any kind of definitive indication of the reliability of trends.