

Referee report for amt-2021-340 (Remsberg et al., Variations of Arctic winter ozone from the LIMS Level 3 dataset)

General Comments:

I found myself somewhat torn regarding the value of this manuscript, which describes a few features of LIMS Level 3 maps and profiles in the context of the Arctic winter of 1978/1979. The motivation seems to be to generate more visibility for this data set for anyone interested in placing those historical ozone fields (or other fields obtained by LIMS) in “context”, given the longer-term changes in and the importance of ozone, in particular. Most of the usefulness of this nice early data set may well have been “milked”, by now, and in large part thanks to the work of the authors of this manuscript. Adding this manuscript at this late stage is not of the highest value, scientifically, or even as a brief data description or as a partial demonstration of validation using Level 3 data. Nevertheless, it is not technically incorrect or flawed, and there may not be enough published research of mesospheric variations, which are reported on to some extent here. I also found that the flow and focus of the manuscript were not that easy to follow. Finally, there are also some data limitations in the case of LIMS (non-LTE effects mentioned in the manuscript) for parts of the upper atmosphere, as mentioned by the authors.

I do (somewhat marginally) recommend publication in AMT (or a data-type Journal, possibly, if not in AMT), mainly for “historical” reasons. A few minor comments for details and clarity should be addressed (see below); there is nothing major, except for that somewhat “agonizing” part over the worthiness of this publication at this time, since it does not add much to the science and there are clearly more recent studies using many more years of data from other instruments (as referenced in this manuscript), even without the use of synoptic-type maps. It is also not so much of a “measurement technique” type of paper, but this may still be the best option.

Mostly minor/editorial-type comments:

- P2, L32, “heights” rather than “height”, since this is a sequence of heights.
- P3, L53, too many “report on” in these last few sentences of this paragraph. Try using “describe”, for example, here, instead.
- P3, L56-57, these two sentences use the past tense, and it would be best to use either present or past for the whole paragraph (e.g., use present in these two sentences also).
- P3, L61, I think you really just mean “(Level 2)”, since there is also a V6 Level 3 data set.
- P4, L102, delete “all” in front of “latitudes”.
- P4, L104, I would delete “, or 33.5 deg counterclockwise...vector” as this is the same sort of statement as the first part of the sentence (but just turned around).
- P5, L107, I would use “well registered” rather than “registered well”.
- P5, L110, it would seem that the latitudinal spacing represented by the samples in Fig. 4 is coarser than 1.6 degrees; is this just the mapping algorithm (coarser) grid [maybe I missed this part]? If this is described well enough in the manuscript, no need to change anything.
- P6, L136, no need to redefine SPARC Data Initiative as SPARC-DI (was done earlier), just use one or the other...

- P6, L158, The sentence should be reworded better, e.g. "To first-order, the stratospheric T(p) retrievals account for the effects of horizontal temperature gradients" [+ I would have liked to see a reference regarding the methodology here, even if it might be much more obvious to the authors themselves]. It is hard for the reader to understand this otherwise, and this is either stretching the long-term memories of some or asking too much (literature search) from an interested younger reader.
- P6, L159 (and in general), what do "errors" reflect in this manuscript? Are they estimated 1-sigma-type errors, or double this? Please specify this somewhere (assuming that all error bars represent, say, 1-sigma).
- P6, L161, I suggest a slight rewording: "...bias error for ozone, and these errors grow to about 16% in the middle mesosphere..."
- P7, L173/174: how exactly is it known that the larger SD values are caused by planetary wave activity? Because of their magnitude and extent? Please specify what is known (with a reference, possibly).
- P7, L175/176, this statement would also be better with at least one reference regarding the upward propagation part (and there are certainly references for this).
- P7, L183, "The estimated total error for CHEM..."
- P8, 205: Here, the sonde data are referred to as "Datasonde" rather than chemiluminescent sonde, or just CHEM (as done for Fig. 4 and associated discussions). Either call all the sonde data "CHEM" (short for chemiluminescent sonde), or make it clear when "Datasonde" is introduced that this is the same as "CHEM"... but in my view, one consistent notation (either CHEM or Datasonde) would be better, unless you have a good reason to keep changing notations. I should note that the Hilsenrath (1980) paper never mentions "CHEM", but they do mention chemiluminescent sonde and (one occurrence of) "Datasonde".
- P8, L211, "are well determined along..." [might be better]
- P9, L239, "and relatively low temperatures" [or "and is relatively cold"]
- P9, L244, "at 0.46 hPa or above in the Alaskan anticyclone"?
- P10, L257, "from studies of GPH..."
- P10, L258, "They determine the extent..."
- P10, L260, delete the comma before "vertical resolution"
- P11, L263, the vertical resolution has already been defined (3.7 km)
- P11, L286/287, what about downward transport from higher altitudes, is that not also possible / part of the equation?
- P11, L288, NO<sub>x</sub> includes NO<sub>2</sub>...so you could delete "(and NO<sub>2</sub>)"
- P11, L294, "some chemical loss of ozone..."
- P11, L295, "indicates that there were significant variations..."
- P12, L318, "temperatures are" much higher in the Canadian sector..."
- P13, L344, delete ", too"
- P14, L371, I would think that with less than one year of data, a baseline is somewhat difficult to establish (given seasonal and QBO effects), but the statement is sort of alright.
- P14, L388/389, it is way too late to reconsider validation efforts for LIMS, in my view, or to add much to past work from such an effort.

- P14, L393/394, this sentence is too nebulous (what does one may find mean?), in large part because this is probably too difficult to accurately assess, given the short period of data from LIMS, in my view. Of course there are changes, but accurately determining an underlying trend requires a good amount of nearly continuous data between “recent decades” and 1979. Also, the community knows that SAGE data have been used for this purpose.
- P15, L396, “surface maps” means what (why not just “maps”)?
- Figure 4, one should be able to know which two satellite profiles are immediately adjacent to the CHEM profile. Please specify in the caption.
- P33, L626, please provide all author names for this reference.