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Atmospheric Measurement Techniques Discussions

Interactive comment on "Recovery and validation of Odin/SMR long term measurements ofmesospheric carbon monoxide" *by* Francesco Grieco et al.

Anonymous Referee #1

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This manuscript outlines the approaches taken to correct previously unusable data from the Sub-Millimeter Radiometer (SMR) on board the Odin satellite, presents results for the altitude range 50-100 km over the period from 2004-2017. It then compares the results, which range over more than 2 orders of magnitude in volume mixing ratio, with data from MIPAS, ACE-FTS and MLS satellite instruments, and the OSO ground station in Sweden. The data show expected seasonal and latitudinal variations. Global mean differences with the other instruments is shown to be in the range +20% to -30%, higher than the comparisons at the lower altitudes and lower at the higher altitudes, especially around 85 km, but with no attempt at an explanation. However, differences in some seasons and latitude regions can show much larger differences, especially

compared to MIPAS, again with no discussion, or comments on how to resolve who is right. The paper would be more complete if it indicated how, with these large seasonal and latitudinal uncertainties, the data can be scientifically used.

Specific Comments:

More information is needed on SMR in Section 2, for instance Are the 2 side bands folded over on each other, or are they separate? (Could be part of more detailed explanation of Fig. 3). Is the scan continuous, or a step scan? Section 3.1: The method looks conceptually straightforward. Is there a reason the this has not been done before? It looks as though the method described will work from 40 to 70 km, but what is done above that? Is the monthly a priori also divided into latitude bins? What is the "measurement response"? Is this the same as the Degrees of Freedom of the Signal (DFS)? Section 3.2: Does the retrieval depend on temperature? If so, what temperature is used? What are its Biases? P. 7, Line 12 (regarding Fig. 5)- isn't it more that the concentrations above 90 km are influenced by the signals there? P. 9, l. 25: Please relate the vertical motions associated with the SAO with these signals l. 28: clarify which is "this latitude band". P. 10, l. 1: Isn't it more accurate to say SSW's occur almost entirely in the N.H. P. 12: l.2: What was the criterion for sufficient coincidences? l. 11: If this is absolute difference, please denote with abs. value brackets. Why use absolute values- aren't you interested in whether the difference is positive or negative? If not, why? ll. 17-18: Wording is unclear- is the average difference being calculated, or the median, or some combination? Is ïĄĎ(z) the mean of ïĄď'abs,i (z)? Where does the median come in? The SEM expression is the standard for calculating the standard deviation of the mean. P. 13, l. 12: Why were the 2 different periods with different MIPAS spectral resolution lumped together? Does the MIPAS spectral resolution not make a difference? The difference plots in Fig. 9a stop at $\sim$ 70 km. What is plotted in the right panel above that- is it all a priori? P. 14, Fig. 9: What is the explanation, or theory for, the negative peak in the comparisons $\sim$ 85 km? Since this occurs for all global comparisons, it would seem that it is a feature of the SMR measurements

and/or analysis. On the same subject, there are very large and fluctuating differences as functions of season and latitude. Do the authors have any explanation for these variations?

Note that the large number of comparisons make the SEM's very small and perhaps not useful.

P. 16, l 3 MLS: Since MLS is another microwave instrument, it is surprising that its data are more different that that from MIPAS or ACE-FTS. The authors should comment on why this might be the case. Is it instrumental, or arising from the data analysis?

P. 17, ll. 4-5: Again, what is measurement response? Why a criterion of 0.75? Were OSO data only available for 2002-2007? The description seems to indicate an instrument improvement, especially after 2014. P. 19, Fig. 14: The difference of the comparisons between MLS and the other instruments is striking, as noted above. Also, the consistent decrease from higher to lower than the comparisons with altitude.

Appendix: Latitudinal and seasonal differences in the biases at high altitudes- who is right?

Looking at Figs. A2 and A3, it strikes this reviewer that the strong differences with MIPAS occur at the summer mesopause, the coldest region of the atmosphere. However, this difference does not show up in the ACE-FTS comparisons. This suggests that the MIPAS CO mixing ratios might be too high, which could result from their temperatures being too low. At this level MIPAS temperatures must take non-LTE effects into account. These are notoriously difficult, and a negative error could lead to CO amounts too high.

Technical Comments:

Page 1,Line 7: Much of the level 1. . . (The not needed) l. 8: front end l. 17: comparison instruments P2,l. 19,20- Suggest wording- ". . .obtsined overall agreement over a two order of magnitude agreement" l.22: front end P3, l. 19 downward) scans P4, l. 7 front

end P. 10, Fig. 7- tick marks on abscissa can't be seen, also Fig. 8. P. 15, l. 13: Does SCISAT-1 need to be explained and capitalized? l.24: monotonically, not monotonously P. 16, l. 17: better English would be . . .the MLS bias described is. . .

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