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Comment on amt-2021-339

Anonymous Referee #1

Referee comment on "Ground-based Ku-band microwave observations of ozone in the polar middle atmosphere" by David A. Newnham et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-339-RC1, 2021

The manuscript provides results derived from the NAOMI data analysis finalized to the measurement of the vertical profile of O3 at Ny-Alesund in the microwave region.
Results are provided in terms of seasonal averages and compared to co-located SABER data in the thermal infrared (9.6 um). The degree of consistency between the two datasets in summarized at the seasonal level.
SABER derived O3 concentrations at 9.6 um are also compared to the ones derived at 1.27 um, showing differences comparable to SABER vs. NAOMI data.

Overall the paper presents an interesting dataset, showing information that is incremental with respect of previous studies, towards a better understanding of the vertical distribution of O3 in the Northern polar region. The comparison with the SABER dataset is important to establish eventual biases and effects affecting O3 measurements in the mesosphere at twilight.
At the same time, the manuscript is unclear in some passages, and some ideas related to how NAOMI data products compare to the respective SABER ones could be better explicited.

Major comments:

The manuscript does not sufficiently describe some key retrieval details. While the retrieval setting is fully described in Newnham et al. (2019) the manuscript would be clearer if some of the elements were reported in it: what covariance matrix is used for the O3 profile? Are other parameters fitted? What linelist is used for RT calculations?
The manuscript does not sufficiently explore possible causes for the discrepancy with SABER 9.6 um products. In Smith et al. (2013) that this work references, possible causes for this discrepancy are discussed, and it would be very valuable to do the same in this work to give a perspective on such discrepancies at twilight.

Minor comments:

Line 165: how were SABER products binned?
Line 186-187: the retrieval shown in Fig. 3 is an average over a season, and this should be stated at this point for clarity.
Line 188: noise level is not shown int Fig. 3b, and should be reported. Furthermore, because this is a spectral average, is the noise scaled by, e.g., the square root of the number of measurements?
Line 189: the line in Fig. 3c seems green, not black.
Figure 3: the uncertainty on the retrieved profile could be better shown in Fig. 3c instead of a separate panel (f and g), to be compared to the a-priori one. Also, a scale for MR should be shown (unless it is common to the AVK, in which case the axis caption should say "AVK and MR")
Tables 1 to 3: the caption on top reports (ppmv) as a unit in brackets, however the one in bracket is the uncertainty. I would suggest to use a more traditional notation as the plus or minus sign for uncertainties to not to create confusion. On the same aspect, the uncertainties in the other figures seem very different from the ones reported in this table: it is not clear how are these uncerrtainties calculated, and it should be specified.
Table 4: is it possible to report SABER uncertainties in the same fashion of the previous tables, and the values for the other peak?