

Atmos. Meas. Tech. Discuss., referee comment RC2  
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## Comment on amt-2021-339

Anonymous Referee #2

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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-RC2>, 2021

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The manuscript shows results of the Ny-Ålesund Ozone in the Mesosphere Instrument, NAOMI, at the UK research station in Ny-Ålesund on Spitsbergen during the period August 2017 to March 2020.

The results are seasonally binned and compared to simultaneous observations of the SABER instrument onboard the TIMED satellite.

The differences between NAOMI and SABER are then also compared to the internal differences of the two SABER channels at 9.6 and 1.7  $\mu\text{m}$ .

The paper presents ozone measurements at 11.072 GHz following the instrumental concept of the MOSAIC instruments developed during the last 13 years. This way the paper does not present unique or novel work. It rather builds on and develops previous work by for instance Rogers from 2009 and 2012 in observing ozone in the mesosphere and lower thermosphere, a region hard to explore by ground-based instruments.

However in this paper a more complex data analysis with the help of ARTS is performed instead of Roger's two parameter model. In this respect the paper presents a novel approach.

The goal of the paper is to contribute to a better understanding of the vertical distribution of Ozone in the Northern polar region. Given the already existing network of similar instruments and their low costs this paper might even encourage to set up new instruments at different places in order to increase the network.

### Major comments

The binning of data is sometimes crucial. While SABER has a 60-day period looking North,

the NAOMI data are binned over 90 days. What is the justification for that? And how does this affect the averaged result of the NAOMI data?

The autumn 2019 data are not presented as the NAOMI time series only includes 40 days of data. But if these data have simultaneous co-located data from SABER this would still be interesting to see. A larger error bar due to a poorer SNR is not necessarily a good reason NOT to show the data, unless, the NAOMI data are completely unreasonable.

The choice of the grid points for both WACCM-D and MERRA-2 are chosen such that they are close to the instrument. The tangent point of the measurement at 90 km altitude, however, is roughly 470 km towards North-West. The authors do not expect a significant variation in the results due to changes in the observation conditions over such a large area?

Given the fact that Spitsbergen is an island, the surrounding water might have an effect on at least the tropospheric (observation) conditions with respect to for instance tropospheric water vapor and its high variability? At an elevation angle of  $11^\circ$  I would expect quite some variability in observation conditions and thus in data quality. Has there been any discrimination of data due to 'bad weather' conditions? When the signal of a three-months period adds up to 60 mK I would appreciate some more details on the radiative transfer and how a varying tropospheric water vapour content affects the measurements and the averaging process.

The criteria for 'co-location' and 'overlapping' observations of SABER and NAOMI measurements is not entirely clear to me. Are all SABER measurements under twilight conditions ( $75^\circ < \text{SZA} < 110^\circ$ ) during a 60-day period within the area depicted in Fig. 1 binned together and averaged without considering the location or the time of the day? Could the authors elaborate briefly on their choice of binning and whether this binning is acceptable with respect to the rather strong diurnal variation between midday and midnight ozone concentration. During the twilight period the profiles should vary quite a bit. But probably I missed some important facts here.

Minor comments

Fig 1: The red line depicting the line of sight of NAOMI is hard to see, even harder so are the red triangles. Would a white or black line be more visible?

Fig 6, 7 and 8: in d), h), and l) the uncertainty of the NAOMI O3 number density at lower altitudes is shown as a large area with a completely different shape of the NAOMI profile compared to the SABER profile. A short comment on the different shapes occurring in the plots would be appreciated, especially when this big difference is not reflected in the (binned) column densities for the lower altitudes in Fig. 9.

