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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Investigation of Arctic middle-atmospheric dynamics using 3 years of H_2O and O_3 measurements from microwave radiometers at Ny-Ålesund" *by* Franziska Schranz et al.

Anonymous Referee #2

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The paper deals with ground-based measurements of water vapor and ozone with a microwave radiometer operated at Ny-Ålesund. The authors retrieve vertical profiles of water vaper and ozone and assess the results by comparing with satellite instruments and model, such as AURA/MLS, ACE-FTS, and SD-WACCM simulation. Almost continuous dataset with a time resolution of hours are obtained since September 2015. Based on the dataset, the authors study dynamical phenomena in the Arctic middle atmosphere including atmospheric descent in the polar vortex, two major SSW events in 2016 and 2018, airmass exchange between the inside and outside of polar vortex

over wide altitude range from stratosphere to mesosphere, and periodicities related to the planetary waves.

The high-time resolution dataset at Ny-Ålesund (79N) in the Arctic region for 3 years is highly valuable, unique, and important particularly for the researchers of polar science. But the analysis method seems basically same as the previous studies by authors' group, and several important details of analysis are missing in the manuscript. It is not clear enough to me what is the originality of this work and what are new findings. The authors could improve the paper by identifying the characteristics at Ny-Ålesund by comparing with the previous studies in Bern and Sodankyla done by authors' group and by presenting them more clearly.

As a whole, the observational results are very interesting and the dataset is invaluable. I think the paper is to be published, but further revisions are necessary before publication to present the key conclusions more clearly. The issues to be considered are raised below.

Specific comments: P8, L9-11: "In the mesosphere a diurnal cycle . . .. . ." The present description about the diurnal variations is too simplified, though the details were already discussed in the author's previous paper, Schranz et al. 2018. At least, the variation pattern (when the VMR is maximum and minimum), typical variation amplitude, and major causes of the variations, are to be described for spring+autumn and polar day, respectively.

P8, L23: "The balloon borne ozone sonde data were not convolved." Why the sonde data are not convolved with the averaging kernel?

P11, L6: "the black contour lines indicate when the polar vortex edge is right above Ny-Ålesund . . .." There is no explanation how the black lines are drawn. How the authors determine the polar vortex edge? What are the criteria?

P11, L10: "Lagranto" appears for the first time. So, brief explanation about Lagranto is

necessary.

P11, L27-28: “The polar vortex edge was derived from . . .. . . (Scheiben et al. 2012).” I think the polar vortex edge is conventionally defined in terms of potential vorticity and/or equivalent latitude. There must be small discussions about the appropriateness of the definition in this paper, i.e. the polar vortex edge determined by the GPH contours and the maximum wind velocity, though detailed discussion would be described in Scheiben et al. 2012.

P12, L10: eastward ==> westward ??

P12, L28-29: “Ongoing meridional mixing brought again ozone rich air from the midlatitudes on February 25 and the ozone VMR increased again to 8 ppm.” Is this statement concluded by trajectory analysis or speculation? There are no supporting materials for this argument. It is difficult to conclude this only from the series of vortex edge snapshots in Figure 11. On the other hand, the top panel of Figure 12 shows that the temperature is suddenly decreasing around 10 hPa on Feb 25. According to the ozone chemistry, ozone VMR tends to increase if the temperature decreases. Does this temperature-change contribute to the ozone increase or the effect is negligible? Please make more quantitative and more careful discussion by using trajectory analysis and ozone distribution in the mid-latitude obtained by MLS and/or SD-WACCM.

P13, L12: “because midlatitude air is drier than vortex air at that altitude.” Why the mid latitude air is drier? Please explain this more detail by using appropriate references.

P13, L27-28: “5.2 water vapor isopleth” → “5.2 ppm water vapor isopleth”.

Figure 13: On the vertical axis, there is only one tick at 10ˆ0 hPa. At least two ticks and labels are necessary to indicate the span.

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