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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Middle atmospheric water vapour and dynamics in the vicinity of the polar vortex during the Hygrosonde-2 campaign" *by* S. Lossow et al.

Anonymous Referee #2

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The paper presents results from the Hygrosonde-2 campaign. The main goal consisted in the investigation of small scale distributions of water vapour at the border of the Arctic polar vortex and the exchange of air between inside and outside of the polar vortex using the water vapour mixing ratio as tracer for dynamical processes. Some accompany measurements complete the campaign. It is true, high resolution water vapour measurements in the middle atmosphere and particularly in the mesosphere are rather rare. Accurate measurements are a precondition to infer assertions about small scale processes. Although the possible error, particularly of the water vapour measurements, is not quantified the results are worth to be published. I recommend the paper for publication in ACP after some minor changes listed below.

The paper discusses the hygrosonde and possible errors of the measurements by contamination of rocket out-gassing and desorption from the payload but it do not estimate an error so that it is difficult to decide between real small scale variations and errors.

Quenching of excited OH is the main loss process and depends on density and temperature. How is this influence considered?

Sonnemann et al. 2008 (Sonnemann,G. R., P. Hartogh, M. Grygalashvyly, Song Li, and U. Berger, The quasi 5-day signal in the mesospheric water vapor concentration in high latitudes in 2003 - a comparison between observations in ALOMAR and calculations, J. Geophys. Res., 113, D04101, doi: 10.1029/2007JD008875, 2008.) also used the water vapour mixing ratio as tracer for planetary wave activity in ALOMAR. They discussed in this context the role of meridional advection along a certain gradient of the water vapour mixing ratio.

In the paper by Lossow et al. the role of gravity waves to explain the origin of different air masses was pointed out. But which influences have tidal or planetary waves on the exchange of air masses between the vortex and extra-vortex?

The geographic coordinates should be supplied for the Esrange/Sweden.

In introduction:

The seasonal variation of water vapour is not only governed by the temperature of the tropopause but also by the velocity of the upward flow in the tropical tropopause. The Brewer-Dobson circulation decreased since 2001 reducing the (lower) stratospheric humidity (see e.g. Randel et al., 2006, Decrease in stratospheric water vapour after 2001: Links to changes. . . , JGR, 111, D12312 or Scherer et al., 2008, Trends and variability of midlatitude stratospheric water vapour. . . , ACP, 8, 1391-1402.).

ECMWF should occur in the reference list.

3.2 Polar vortex situation:

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Interactive Comment

A major stratospheric warming on 20 December is early but not very early (this would be if it occurred during end of November - beginning of December).

Page 11: “Current model results show a wide spread in the water vapour distribution in the polar vortex region.” Please provide citations.

An increase of the water vapour mixing ratio above 70 km shown in Fig. 1 seems to be unrealistic. What is the reason of this increase? Contamination, uncertainty of the hygrosonde measurements at this altitude or can you explain the increase in terms of geophysics? The temperature (Fig. 3) does not show any anomaly there. Unfortunately, Fig. 2 and Fig. 4 have, at least in the version which I received, only cryptographic symbols for the designations of the axes so that I cannot assess whether the meridional wind blew toward the pole conveying more humid air from the extra-vortex.

The caption of figures could provide more information (where and when) so that the reader must not read the text before.

Fig. 3: It is certainly difficult to define the tropopause (11 km) from the temperature measurements shown in this figure as the absolute minimum occurs around 25 km and in the domain of the normal tropopause the temperature varies around a general decrease with height.

The dashed line in Fig. 5 for water vapour outside of the polar vortex seems to show too large values (6 ppmv) in the upper domain (at 70 km). How certain are the peaks (particularly the maxima) of the water vapour mixing ratio of the Hygrosonde-1 measurements which seem to determine the dashed line? The very strong oscillations ($>$3 ppmv variation, meaning more than a doubling of the water vapour mixing ratio) would indicate a long-range transport but not a transport induced by gravity waves.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 12227, 2008.