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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Observations of the mesospheric semi-annual oscillation (MSAO) in water vapour by Odin/SMR" *by* S. Lossow et al.

Anonymous Referee #1

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The paper is coherently written and well organized. The results presented are important in understanding the variation of the chemical key constituent water vapour. The most important finding may be the phase change of the semi-annual variation of the water vapour mixing ratio between 75 and 80 km (Fig. 4). It helps in understanding some disagreements in calculations and observations. For this reason I recommend the paper for publication in ACP. Some historical remarks and minor comments could additionally be included in the paper.

Already in 1991 Smith and Brasseur (JGR, 96, 7553-7563) found a semi-annual variation of mesospheric water vapour in 2D-calculations for small Prandtl numbers. An indication of a semi-annual oscillation obtained by ground-based microwave observations was first given by Nedoluha et al. in 1996 (JGR, 101, 21,183-21,193). Chandra

et al. (Geophys. Res. Lett., 24, 639-642, 1997) showed clear semi-annual variations at 80 km at 5 N and smaller peaks in middle latitudes using HALOE data. The maxima occurred around the solstices (see their Fig.3) with the exception of one intermediate maximum in the northern spring in 1993. They compared the observations with 2D-calculations and found good agreement concerning the occurrence of the maxima.

In 2001 Körner and Sonnemann (JGR, 106, 9639-9651) showed a semi-annual oscillation at 89 km altitude in low latitudes calculated by means of a 3D-model. However, in contrast to the results presented in this paper, the maxima occurred during the equinoxes. Apparently, the model did not reproduce this phase step.

10159, line 28: Perhaps the term " the rather precise solar occultation technique" is a somewhat too optimistic view of the accuracy of this method, particularly at the upper domain, because the local density will be derived from an integral signal. Fig.1 displays differences in the water vapour profiles derived with two different instruments, which indicates that the precision of all measurements is limited.

10168, lines 10-15: The result that the amplitude of the semi-annual and annual variation above 90 km does not depend on latitude is surprising. One would expect that the annual amplitude increases with increasing latitude. Perhaps the relative amplitude is more important than the absolute one as the absolute water vapour mixing ratios are already very small. The QBO is a stratospheric phenomenon with an average period of longer than two years. Is the QBO found linked to that in the stratosphere?

10169, line7: "As noted before the summer maximum is stronger in the Northern hemisphere **than its counterpart in the Southern hemisphere**, while the winter maximum is stronger in the Southern Hemisphere." Looking at Fig. 9 upper panel, evidently the annual amplitude is larger in the Northern Hemisphere than in its southern counterpart, whereas the semi-annual amplitude is larger in the Southern hemisphere as is also displayed in Fig. 7, upper panel.

10172, lines 1-14: The discussion in the last paragraph is somewhat misleading. The

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function of Rossby waves for the formation of the hemispheric differences could be discussed and also the influence of the eccentricity of the Earth orbit (see e.g. the paper of Berger 2008, JASTP, 70, 1170-1200). A stronger circulation from the Northern to the Southern Hemisphere should entail smaller water vapour mixing ratios in, at least, middle to high latitudes of the wintry Southern Hemisphere than in its northern counterpart because the downward flux of dry air is also stronger. The behaviour in the subtropics cannot simply be explained with only a gravity wave driven meridional circulation.

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