

## ***Interactive comment on “The wintertime two-day wave in the Polar Stratosphere, Mesosphere and lower Thermosphere” by D. J. Sandford et al.***

**Anonymous Referee #2**

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The 2-day wave is the most prominent atmospheric planetary wave. Since the first detection by Doyle and later on by Muller a large body of publications have dealt with the characteristics of this wave. However, most of these observations stem from mid and low latitudes, while measurements in high latitudes were rare. The paper presented continues and deepens investigations by Nozawa et al. 2003a/b and Manson et al. 2004. These groups found first that, in contrast to findings in mid-latitude, the quasi two-day wave (Q2DW) also possesses pronounced amplitudes in wintry high latitudes, higher than in summer. Unlike the behaviour of the Q2DW in summer, it was supposed that the winter Q2DW moves eastward. On the basis of MLS data from an instrument aboard the EOS Aura satellite in connection with the meteor radar measurements at Esrange, the latter supposition could be confirmed and it was shown that the Q2DW

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starts in the stratosphere already at 30 km. The amplitude maximizes at 60-70 km. The results are worth publishing. Thus, I recommend the paper for publication in ACP after some minor changes.

It is less surprising that the variance of the wind minimizes during the periods of wind reverse during the equinoxes. The authors use a band-pass filter to reveal oscillations with periods between 1.5 and 3.4 days, but they did not describe its characteristics. This is a relatively broad filter (36 to 81.6 h). The period of the two-day wave varies between 42 and 56 h. E.g. Manson et al. 2004 employed a 24 day window to achieve this resolution for the 2-day period. According to the signal theory, the filter here corresponds to a window in the order of only 5 days.

The first paragraph of 3. Results belongs in 2. Data analysis and should be moved.

In the mesopause region one important diabatic heat source is chemical heat. Particularly in the domain above 90 km the heating rate is determined by transport of latent chemical heat from the lower thermosphere triggered by planetary waves. During sudden stratospheric warmings (SSW) and in their aftermath, drastic changes of this rate occur (see e.g. Sonnemann et al. 2006, JASTP 68, 2012-2025, Figure 5d). These changes feed back to the dynamics. Ward et al. 1997, Geophys. Res. Lett. 24, 1127-1130, observed a Q2DW in the green line of atomic oxygen in a height where the concentration variation can only be explained by the transport of atomic oxygen by winds. Kulikov, 2007, J. Geophys. Res. 112, D02305, doi:10.1029/2005JD006845 investigated the influence of a Q2DW on nonlinear photochemical oscillations. He found a periodic transport of minor constituents by vertical wind associated with the wave and he stated this mechanism may lead to a phase locking of the photochemical oscillation to the wind oscillation. The paper cannot give an answer to the question, how the behaviour of the Q2DW influences the feedback between dynamics and chemistry, but the problem could be mentioned in the chapter "Discussion"; Fig. 5 seems to indicate that SSWs prevent a Q2DW in accordance with the Charney-Drazin theorem because the mean zonal wind speed decreases during this time or even re-

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verses for major SSWs. Looking at the SSW statistics, one will find that in 2005 a major warming occurred in the beginning of March and no SSW occurred in the winter 2006/7. However, in the winter 2005/6 a minor warming occurred in the beginning of January 2006, succeeded by a major SSW on January 20, 2006. The figure exactly reflects this behaviour. Dickinson 1968, Month. Weath. Rev., 96(7), 405-415, recalculated the Charney-Drazin theorem using spherical coordinates. His values differ somewhat (they are larger for wave number 2) from those of Charney-Drazin and should be employed in the paper. The lines in Fig.5 are not dashed. It would also be better to use 12 ticks instead of 10 for the time axis to conform to the number of months. (On the web-page <http://www.cpc.ncep.noaa.gov/products/stratosphere/strat-trop/> one can find a zonal and latitudinal average of data for  $u$ ,  $T$ , and for the zonal wave numbers 1-3 up to 0.4 hPa (>50 km) for each year.)

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