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Atmospheric Chemistry and Physics Discussions

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

Anonymous Referee #3

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This paper provides the readers with new observational results on the eastward-propagating quasi-two-day wave (QTDW) arising under unstable conditions in the wintertime stratosphere. This is a very good paper at the forefront of the study of planetary-scale waves in the middle atmosphere by ground- and satellite-based measurements. The analysis of the global data obtained with the Aura MLS instrument shows that in polar winter the eastward-propagating QTDW with zonal wavenumber two (E2) dominates. I believe that this paper will be accepted for publication in ACP after minor changes. I would like to propose a revision of the paper in the part devoted to the interpretation of the results obtained. I recommend that the authors consider the following comments when revising the manuscript.

The authors note (page 14754) that "the wintertime occurrence of the E2 wave can be

explained in terms of the Charney and Drazin theorem (1961)", i.e., "that the E2 two-day wave should only be able to propagate in the regions where the zonal wind speed lies between ~ 52 and 80.6 m/s". On the other hand they suggested that this wave is one of a series of waves generated by instabilities in the winter polar jet. However, to be generated by instabilities, the mode has to be trapped in the source region. Fig. 5 shows that the E2 two-day wave has the strongest amplitudes at the altitude ~ 60 km and decrease in the amplitude above this level. This means that the E2 two-day wave is not propagating. However, it is capable of penetrating from the source region (the stratosphere) up to the heights of the mesosphere and lower thermosphere. Correspondence between the strongest polar stratospheric jet and the maxima of the E2 two-day wave amplitude indicates simply that the strongest jet is more unstable. To identify the source regions of the E2 two-day wave, it should be helpful to show the latitude-time cross section of the background wind in the stratosphere (for instance, at the higher level of the UK Met Office data). If the instabilities in the winter polar jet are responsible for the E2 two-day wave generation, this wave has to be strongly suppressed during stratospheric warming events.

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Interactive Comment