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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aura MLS observations of the westward-propagating s=1, 16-day planetary wave in the middle atmosphere: climatology and cross-equatorial propagation" *by* K. A. Day et al.

Anonymous Referee #1

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Referee report on ACP manuscript #601, 2010 "Aura MLS observations of the westward-propagating s=1, 16-day planetary wave in the middle atmosphere: climatology and cross-equatorial propagation" by Day et al.

The report present results from the analysis of almost 6 years of Aura MLS temperature observations. The intent is to determine the global climatology of westward propagating 16-day planetary wave. The report is well written and some of the results obtained are described and presented in 9 figures of good quality. The size of Figure 8 need be increased to allow for better resolution and to make it more easily readable. The topic of the study is not very novel in view of earlier work both in the stratosphere and in the

mesosphere/lower thermosphere region.

The study of the climatology of the west-ward propagating 16-day wave presented by Day et al. is part of a series of studies already done and published on the subject, employing both satellite and ground-based observations of temperature and winds. In the current publication the temperature data are from the MLS-Aura experiment, which have not been used in this context (at least there are no publications on such results). However, the results obtained are well within the already established knowledge. This concerns, for example, the year-to-year, seasonal and inter-hemispheric variability as seen in the 6 years of the Aura/MLS temperature observations.

There are a few points concerning the reported year-to-year variability, which should have been considered and addressed in the discussion.

The spectral analysis applied to the data is a least mean square fit. There have been discussions in the literature on the merits of reliable spectral decomposition employing either Fourier Analysis of the Hayashi type (Hayashi , J. Met. Soc. Japan, 49, 125–128, 1971) (Pogoreltsev et al.,2002) or least-mean square fit to the data (Pancheva et al., 2008). However, in both cases it is emphasized that the spectral decomposition need be done simultaneously on the entire spectrum of wave numbers and frequencies, in order to avoid a possible distortion of the usually weaker traveling waves by the much stronger stationary planetary waves. This issue need be addressed by the authors while discussing their approach to the analysis.

The authors reported a decrease in the amplitude of the 16-day wave, particularly in January 2009, but were satisfied to say that this illustrated the year to year variability. The MLS time series encompass the period from 2004 to 2010, which was characterized among other things by three very strong major stratospheric warmings, in January 2004, 2006 and 2009. However there has not been any discussion on the effect of these events on the state of the middle atmosphere and the coupling between the stratosphere, mesosphere and the MLT region. Alexander and Shepherd (ACP, 2010)

employing COSMIC/Formosat-3 temperature observations for the period 2007-2009, have shown for example that the amplitude of the wave 1 westward propagating planetary waves (including 16-d wave) was greatly decreased in the 10-40km altitude range. The decrease in the wave amplitude at high latitudes, where the SSW manifestation is the greatest would have been felt well into the MLT region (there are a number of publication on the effect of the SSW in 2004, 2006 and 2009 on the MLT region).

The SSWs have had an effect also on the height of the stratopause at high latitudes, which also makes the choice of the 35-55 km altitude range as representative of the stratosphere incorrect, as observations show that the stratopause has been lifted higher up well into the climatological mesosphere. The authors could see this in their data should they plot the temperature profiles for January versus day number. Accounting for this change in the peak altitude of the stratopause might explain the so called 'stratopause-level minimum' in wave amplitude during winter they have reported. The same argument applies to the designation of the 65-95 km altitude range as representative of the mesosphere. Thus before discussing the climatology all these issues need to be carefully considered.

The usage of the URAS monthly-mean zonal winds in understanding the MLS observations in my opinion cannot provide information the authors need to interpret their results. The reason being, as already mentioned, the three major SSW from the MLS period. Again, the report by Alexander and Shepherd (2010) gives information on the wind field in the stratosphere for at least three of the seasons included in the current study and could enhance the information provided by the URAS. (I am only mentioning this reference since it provided analysis which included satellite data, spectral decomposition and climatology of planetary wave over a period overlapping with the one discussed in the current study).

Summarizing the results from the climatology, the authors have stated that in the autumn the largest amplitudes occur first in the mesosphere (conclusion 9), but no explanation is provided as to what might be the reason for this.

With regard to the analysis of the QBO modulation on the summer MLT region, the results presented on the correlation between the amplitude of the QBO mesospheric 16-day wave and the stratospheric QBO winds need further development and interpretation. The mesospheric temperature QBO is out of phase with regard to the stratospheric QBO. How does this relate to the stratospheric winds and in term to the established correlation?

With all these comments in mind this Referee feels that the report in its present form does not carry sufficient new information to grant publication in the ACP journal. The Introduction could be shortened to address just the knowledge on 16-day wave, rather than planetary wave perturbation in the MLT region, since they are not necessary in the present context. The analytical method and the results as reported are confined to establishing already known behavior. The Referee realizes that with so few new experimental data available it is challenging to provide a new look when there are so many other researchers using the same data, but for the climatology of the 16-day planetary wave to be meaningful the above suggestions need to be addressed.

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