Review of Annales Geophysicae Article “Global analysis for periodic variations of gravity wave squared amplitudes and momentum fluxes in the middle atmosphere” by D. Chen, C. Strube, M. Ern, P. Preusse, and M. Riese.

In this study SABER satellite data are used to investigate the global distribution of spectral variability of monthly zonal mean gravity wave (GW) square temperature amplitudes (GWSTA) and absolute GW momentum flux (GWMF), i.e. no direction information. The knowledge about the global distribution of the temporal variations of GWMF and their sources is very valuable for models of all kinds. It cannot only help validate existing models but has great potential in improving GW-schemes and parametrizations.
The authors focus here on four dominant frequencies: the annual, semiannual, terannual and on the QBO. The annual variation has two maxima in high and subtropical latitudes in each hemisphere resulting from filtering of GWs due to the strong winds in the polar vortex and from convective excitation of GWs in the subtropics. The semiannual variation has also 2 maxima at higher latitudes forming a crescent-shaped region with decreasing amplitudes towards the equator and also caused by convective GWs from the subtropical summer hemisphere propagating upward and poleward. However, since the GWMF has no direction information the semiannual variation is actually an annual variation which was proven by the authors applying the ray-tracer GROGRAT to a mixture of ERA-Interim and SABER data. The terannual variation has a peak around mid- to high latitudes in both hemispheres resulting from a combination of 4 consecutive month of a high occurrence rate of tropical convective systems followed by 8 consecutive “calm” months. The QBO variation has three maxima: The first one occurs in the equatorial stratosphere related to the well-known QBO winds. The second one appears at 50°N/S in the stratosphere resulting from the modulation of GW filtering by the QBO modulated polar vortex and SSWs. The third one occurs in the equatorial mesosphere and results from the modulation of GWs by mesospheric QBO winds and may show that the mesospheric QBO is coupled to the stratospheric QBO. These four variations explain up to 80% of the total variance in most regions. Additionally a possible solar cycle effect on the GWSTA and GWMF temporal variations is discussed.

General comments:

This paper is very well written, the analyses methods are up to date and have been carried out with the utmost care. Only two aspects on why data are treated a special way should be clarified. Even though it would be nice to have a global GW momentum flux including propagation direction, the analysis method used here is the best we have at the moment as far as I know. The authors give also a very good and extensive discussion missing only a few points (see below) and summarize their results in clear schemes. Therefore I strongly recommend to publish this study after a *minor revision.*

Specific comments:

SABER data are available from January 2002 until today. Why do the authors use data only between 2002 and 2015 and do not include at least also 2016 and 2017?

Monthly averaged GWSTA and GWMF have a grid resolution of 10° in longitude and 5° in latitude. To obtain values at each grid point the data are averaged in grid boxes of 30° in longitude and 20° in latitude. This means that the averaged grid boxes are three or four times larger than in the initial calculation. Is this really necessary, especially in the latitude direction?

Figure 1a shows the FFT spectrum of the GWMF at 45°N. Besides the peaks discussed here (AV, SAV, TAV and QBO) there is also a peak at around 6 - 7 years which is even higher than that one of the QBO. I assume that this peak results from ENSO (El Nino southern oscillation). Please shortly discuss this peak even though you will not go into much detail in your further analyses.

Even though the Southern Hemisphere experienced only one SSW in the last decades namely in 2002, does make it a difference for the spectral analysis including or excluding this year? I am convinced of your results but I am also curious about the difference.

The described variance by the four variations in mid-latitude upper stratosphere is higher in the southern hemisphere than in the northern hemisphere. An additional cause for this effect might be a general much higher Rossby wave activity in the northern than in the southern hemisphere resulting in a much more variable polar vortex in the northern hemisphere and therefore in a much more variable GW filtering.

Figure 10 shows the GW variation related to the 11-year solar cycle. The authors calculated the median value of the time series and defined the beginning and ending of this solar cycle by the occurrence of "valleys". However, the dependency of the GW variation on the solar cycle is more pronounced in the GWMF than in the GWSTA since there is a third "valley" around 2009 even though it was still above the median. The solar minimum in 2009 was the lowest solar minimum of the last decades. Please discuss this the different behavior between GWMF and GWSTA around this solar minimum.

Technical corrections:

P2L24: …other sources are accounted ~~for~~ in a so-called …

P3L26: Li et al. (2016) further found an indication … (*tense for consistency*)

P11L20: … structures in Fig. 4a with Fig. 3c especially above 60km and Fig. … (*similar structures are more obvious above 60km*)

P12L21: … four month period (i.e. May/September/January) in the Southern Hemisphere… (*for consistency with Fig. 5b*)

P13L17: … use the number index 1 to 26 for the colorbar. -> *Does month 1 presents January? Please clarify that in the text.*

P14L20: One possible reason could be that the study of Krebsbach and Preusse (2017) …

Figure 1: Example of a~~n~~ FFT …