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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Planetary wave activity in the Arctic and Antarctic lower stratospheres during 2007 and 2008" *by* S. P. Alexander and M. G. Shepherd

Anonymous Referee #1

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This paper is devoted to analysis of planetary waves using the COSMIC GPS-RO data. Temperature data derived from the COSMIC GPS-RO satellite constellation provide us with a new good possibility to study global-scale dynamical processes in the stratosphere. Especially this data set is useful to investigate the processes in the Southern Hemisphere where the data assimilated in the models are not very reliable due to sparse measurements. This is a very good paper at the forefront of the study of large-scale waves in the middle atmosphere. I think that it has to be accepted for publication in Atmospheric Chemistry and Physics after some revision.

Major comments:

Figure 10 shows the behavior of the temperature perturbation from zonal mean during 2006/2007 and 2007/2008 winters. One can see in Fig. 10a and Fig. 10d that quasi-periodic changes of the amplitude of stationary (standing) wave, the so-called stratospheric vacillations, are dominant. These oscillations can be presented as a superposition of the westward and eastward traveling waves with equal amplitudes (see Fig 10b,c and Fig. 10e,f). To describe irregular character of the stratospheric vacillations, we need a set of such traveling waves with different periods and amplitudes. However, this fact do not means that these waves really exist in the stratosphere. Fig. 10b,c and Fig. 10e,f demonstrate that there are quasi-periodic westward and eastward traveling disturbances, which amplitudes (and periods) changes during time interval considered. To these wave-like disturbances, the spectral analysis based on the least-squares approach is not a god choice. Equation (8) can be used to approximate the observations and to restore the time series for westward and eastward traveling waves. However, the information on the variability of the amplitude of individual harmonic wave in equation (8) is practically usefulness. The realistic wave-like disturbances, which we observe in the stratosphere, can be described only by a superposition of all these harmonics. In this case the wavelet analysis is much more useful. I think that it would be more useful instead of Fig. 11-13 to show the wavelet amplitude spectra for westward and eastward propagating waves. Moreover, these spectra can be recalculated using a very simple rule (if Awi > Aei, then As = 2Aei, Aw = Awi-Aei, Ae = 0, and if Awi < Awei, then As = 2Awi, Aw = 0, Ae = Ae-Aw, where Awi, Aei are the initial amplitudes of wavelet spectra for westward and eastward propagating waves, As is the resulting amplitude of the standing wave, and Aw, Ae are the resulting amplitudes of the westward and eastward traveling waves). Such approach allows us to consider not only behavior of traveling waves, but also to obtain the quasi-periodic variability of the amplitudes of stationary (standing) waves.

Minor comments:

Page 14608, lines 19-23: It is not clear what data and time interval were used for initial wavelet analysis to estimate the main periods existing in the observations.

Page 14609, lines 1-2: The long-period harmonics with the close periods (10, 12, 16, and 23 days) can not be resolved using the time interval 46 days. I presume that least-squares problem is ill-conditioned and the solution in this case is unstable. To resolve this problem, some method of regularization, for instance, the SVD (singular value decomposition) technique has to be used. Unfortunately, there is no any discussion of this problem in the paper.

Page 14622, lines 2-3: All results are presented only at one height level (30 km). There is a short discussion of the results obtained on 100 hPa and 10 hPa using UKMO data, however, I think that the sentence on the vertical structure of individual planetary waves has to be removed from the Conclusion.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 14601, 2009.