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Interactive comment on “Momentum forcing of the QBO by equatorial waves in recent reanalyses” by Y.-H. Kim and H.-Y. Chun

Anonymous Referee #2

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General and major comments

The authors investigated wave momentum forcing relevant to the QBO by analyzing four reanalysis datasets. They compared the wave forcing in standard p-level with that in native model level datasets by ERA-interim data, and indicated that resolved wave forcing obtained from p-level was underestimated. They also mentioned that unresolved gravity wave forcing is smaller than the Kelvin wave forcing in the E-W phase, while gravity wave forcing is dominant in the W-E phase of the QBO. Another interesting point is that the vertical velocity is poorly constrained in the reanalysis, which results in large uncertainty in the vertical advection term. This paper includes interesting and new results that should be useful for both reanalysis and QBO communities, and suitable for the publication in ACP, I believe. However, I have a few major concerns,

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which are written below.

The relative roles of equatorial waves and large, medium, small-scale gravity waves depend on height as well as easterly/westerly shears (e.g. Kawatani et al. 2010). In the introduction and main results in this paper, the authors discussed the wave forcing only at 30 hPa and 10hPa. I believe the author should include more detailed discussion at 50 hPa and/or 70 hPa, which must be very useful information and required for the QBO community, since climate models failed to simulate the realistic amplitude of the QBO in the lower stratosphere.

In addition, I believe that including other reanalysis datasets, such as ERA40 (although data available until August 2002), JRA-25, NCEP-1 and NCEP-2, must make this paper much more interesting and useful, for example, for the S-RIP (SPARC reanalysis Intercomparison project) activity. Another concern is to include the CFSR reanalysis in this paper. The previous CFSR model failed to simulate the QBO, and ERA-40 stratospheric wind profiles were used as bogus observations in CFSR data, at least from 1981 to 1998. I am not sure the latest CFSR model quality, but the authors should check this point.

Other major points are the latitudinal width (5S-5N) the authors discuss about wave forcing relevant to the QBO. As shown in your recent paper (Kim and Chun 2015, JGR), EP-flux divergences of equatorial waves and gravity waves distribute much wider latitudinal width. For example, E-MRG show eastward (small westward) wave forcing around 10 degree (over the equator), and W-MRG show westward (eastward) forcing over (off) the equator. The 5S-5N average is the reason why MRG show westward forcing both in easterly and westerly shear phase of the QBO (Fig. 1). Because the amplitude of the QBO is approximately Gaussian about the equator with a 12 degree half width (Baldwin et al. 2001), 5S-5N average is too narrow, at least for contents of this paper. The author should show results averaged in 10S-10N, for example. Related with this comment, how the authors treat $n=0$ eastward waves (eastward MRG) in this paper? Please clarify in the manuscript.

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