

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

Anonymous Referee #3

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General comments

This is a focused, concise and well-written study that makes useful estimates of the forcing of the QBO by different types of equatorial waves. The use of four different modern reanalyses allows an estimate of the uncertainty of the results, which is very valuable. These results should be quite useful to QBO modellers. I strongly recommend publication, pending a few minor suggestions for corrections that are given below.

Specific comments

End of Sec 2: In Fig 1 you calculate EP fluxes for ERA-I at model-levels resolution. As I understand it, based on C1606

http://old.ecmwf.int/products/data/technical/model_levels/model_def_60.html, the ERA-I model levels are equivalent to pressure levels from 73 hPa upward. This would correspond to 18.3 km altitude for a log-pressure scale height of 7 km, just below the 19 km lower cutoff of your Fig 1. Based on this, it should be ok to apply the TEM equations for pressure coordinates to the ERA-I data on model levels, and I presume this is what you've done. But, please add a sentence or two here to clarify for the reader that this is the case. Or, if I've got it wrong, please explain what has been done.

Temporal resolution of the data: if I recall correctly, MERRA data is available at 3-hourly frequency and the other reanalyses at 6-hourly frequency. I'm not sure about that, but at any rate, please state in Sec 2 what is the temporal resolution of the data. If it differs between reanalyses, did you use the same frequency for all of them when doing the spectral analysis? If not, does it affect the results?

MRG wave phase speeds: in Fig 1, I was surprised to see westward forcing by MRG waves occurring in both westerly shear (E-W transition phase) and easterly shear (W-E transition phase). E.g. in mid-2007, westward forcing is occurring simultaneously in the lower (18-21 km) easterly shear zone and the upper (28-35 km) westerly shear zone. Is this due to there being MRG waves of both westward and eastward phase speeds included in the MRG group? From Fig 9b,c of KC15 I see that both westward and eastward propagating MRG waves give westward forcing at the equator (at least, in HadGEM2), within the 5S-5N band that your Fig 1 covers. In that case, I presume the westward forcing in easterly shear would be due to westward propagating MRG waves, and the westward forcing in westerly shear would be due to eastward propagating MRG waves. Is this the correct interpretation? It would be helpful to add a brief comment to clarify this (or whatever is the explanation, if I've got it wrong) in the discussion of Fig 1, perhaps at line 21 on p 6.

Technical corrections, going by page & line number

p 2 (5176 using ACP's page numbering)

2: suggest: "momentum forcing by equatorial waves to the QBO" → "momentum forcing of the QBO by equatorial waves"

5: suggest move "(3– 11 m s⁻¹ month⁻¹)" to right after "all equatorial wave modes", so as to be clear that this is the net forcing by all equatorial wave modes during the 30 hPa E-to-W transition.

12: "easterly-to-westerly phase" → "easterly-to-westerly transition phase"

p 3

5: convections → convection

p 6

26: suggest add "at altitudes below 30 km" following "phases of the QBO". Strong Rossby wave forcing in Fig 1 does coincide with easterly onsets at very high altitudes.

p 12

18-19: "The increase in forcing from other waves at 10 hPa is not large (see also Fig. 1).": I find this sentence a little unclear, suggest rephrase as: "For other waves, the forcing at 10 hPa not much larger than that at 30 hPa (see also Fig. 1)."

24-25: "due to the less constraints on" → "due to fewer constraints acting on"

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 5175, 2015.