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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Gravity wave variances and propagation derived from AIRS radiances" *by* J. Gong et al.

Anonymous Referee #2

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The authors studied gravity wave variances and propagation at 2-100 hPa using AIRS data. They indicated that the zonal component of GW propagation could be inferred by differencing the variances derived between the westmost and the eastmost viewing angles. Using this technique, the authors showed that gravity waves prefer to propagate westward above mountain ranges, and eastward above deep convection. Gravity wave variations associated with the QBO were also discussed. Finally, the authors found that AIRS could observe gravity waves with vertical wavelength smaller than the thickness of the waiting functions.

This study provides very useful new information to satellite observation of gravity waves and meets the level of the ACP. I recommend the publication of this study after revising several points listed below.

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General comments:

(1) Gravity wave observational satellite instruments are categorized into limb, sub-limb and nadir sounders. The authors sometimes compare AIRS results with other instruments. However, the explanation about "observational filter" is insufficient. Gravity wave distributions observed by AIRS are not necessarily corresponding to those observed by other instruments. I understand the authors know this point, but more careful explanation and discussion about "observational filter" are needed. For example, observable spectral ranges for each instrument are explained and/or some references are added.

(2) In section 3.2, the authors showed monthly mean geographical maps of gravity wave variances and discuss two major gravity wave sources of mountains and convections. However, there are other gravity wave sources, which the authors did not mention.

Line 8 of page 11702: "They are highly variable along the longitudes, and not necessarily related with jet"

I partially agree with this opinion, but I think variances of gravity waves generated by the jet are also included in Figs. 5 and 6. But, it seems that the authors decided prematurely that these variances are due to mountain induced gravity waves. More careful explanation is needed here.

Line 12-18 of page 11702: "In the subtropics and tropics, large GW activities are found in the upper stratosphere over the deep convective regions. The deep convective regions are identified from the ice water content (IWC) from Aura MLS (Wu and Eckermann, 2008). In particular, they are Western Pcific warm pool region, Amazon rainforest region, and Central Africa rainforest region for NH winters, and Southeastern US monsoon region and India-South China monsoon region for SH winters".

I agree that gravity waves in the NH winters are generated by deep convections,

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but I am wondering whether gravity waves over monsoon region are generated by deep convection. Property of convection would be different between tropics and mid-latitudes. Monsoon includes several small-scale disturbances, and jets vary associated with monsoon activity. Do 2.5 hPa gravity wave variances over the Southeastern US monsoon and India-South China monsoon certainly correspond to distribution of "deep convection"?

(3) In section 4.3, the authors discussed gravity wave variation associated with the QBO. The authors found that AIRS could observe gravity waves with vertical wavelength smaller than the thickness of the waiting functions. However AIRS generally observes high-speed internal gravity waves with vertical wavelength larger than 12 km.

The maximum speeds of the easterly and westerly associated with the QBO are -35 m/s and 20 m/s. Pure internal gravity waves with zonal phase velocity Cx=20 and Cx=35 m/s have vertical wavelength of $\sim$5.6 km and $\sim$10km under square of buoyancy frequency Nˆ2 of 5.0E-4 sˆ-2. Most gravity waves observable by AIRS are not affected much by the QBO.

Thus, it is not surprising for me that there are some discrepancies between AIRS gravity wave variances and the QBO phase seen in Fig. 9, and the sentence below is not adequate, I think.

Line 27-29 of page 11709: "It suggests that the GWs observed by AIRS may play a more important role for the descent of QBO westerly phase than that of the easterly phase as more AIRS GWs are removed and hence deposit their momentum fluxes in the QBO westerly phase"

On the other hand, the authors mentioned from line 2 of page 11710 as follows: "the GW variance is only slightly modified by the QBO rather than playing a dominant role on the formation/propagation of QBO phases. This is expected since GWs seen by AIRS are mostly high frequency waves that 5 are usually with fast vertical group velocity"

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I recommend the story written in section 4.2 should be revised majorly.

Minor comments

(1) Costal lines in Figs. 5, 6, 8 should be denser.

(2) line 27 of page 11710: Wakatani should be changed to Kawatani

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Interactive Comment