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Interactive comment on "Intercomparison of AIRS and HIRDLS stratospheric gravity wave observations" *by* Catrin I. Meyer et al.

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This is an excellent paper. The authors have used both AIRS and HIRDLS observations to study atmospheric gravity waves. AIRS is a nadir-viewing instrument, and hence has relatively poor altitude resolution, but AIRS, having cross-track scanning capability, has excellent horizontal resolution. HIRDLS is a limb-viewing instrument that has better vertical resolution, but due to a malfunction has fixed azimuth viewing. Although the two spacecraft on which these instruments are flying, Aqua in the case of AIRS and Aura in the case of HIRDLS have overpasses separated by only a few minutes. The time separation between observations at the same point is actually about 100 minutes, a time separation over which gravity waves can vary considerably, so cases investigated in this paper have been chosen to hopefully minimize the influence of this.

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Discussion paper

Another point made in these papers is that the high-resolution AIRS retrievals are superior to the operational retrievals for measuring gravity wave variances. The operational retrieval uses 3 x 3 observational points. This is done to improve retrievals in the presence of clouds, but this is mainly important for the troposphere. The authors show that their high-resolution AIRS retrievals, which use each individual viewing point give superior stratospheric gravity wave information relative to the operational retrievals.

The measure of gravity wave activity used in this paper is gravity wave variance, but to obtain this, the variances due to larger scale atmospheric variability plus the variance due to instrumental noise must be subtracted from the measured variance. This is discussed in considerable detail in the early portions of the paper.

Now, the lower altitude resolution and higher horizontal resolution of AIRS relative to HIRDLS means that higher frequency gravity waves will preferentially be seen by AIRS relative to HIRDLS. A point made both early and later in the paper is that these higher frequency waves, with shorter horizontal and longer vertical wavelengths, will carry more momentum than the lower frequency waves seen by HIRDLS, even if the variances seen by the two are similar.

The gravity wave variances seen by AIRS and HIRDLS are compared for two cases. The first is for a mountain wave event, and the second is a storm event with active moist convection. For both cases, it is illustrated that the high-resolution AIRS product is superior for sensing gravity wave variances relative to its operational counterpart, and also that the general distribution of gravity wave variances, in both the horizontal and vertical, from the high-resolution AIRS data closely resembles those of HRDLS, when one takes into account the different frequencies and wavelength sensitivities of AIRS and HRDLS. This certainly suggests the broad-spectrum source nature for gravity waves for both events.

Gravity wave variances at 2.5 hPa (about 42 km) show a large correlation with zonal winds at that level for both AIRS and HRDLS. It is interesting that evidence of a similar correlation between winds at 200 hPa and lower stratospheric gravity wave activity was noted by Wang and Geller (2003).

One important conclusion of this paper is that given the superior altitude and vertical scanning capability of HRDLS, which allows estimates of gravity wave momentum fluxes to be made, along with the superior horizontal information from AIRS that results from its horizontal scanning capability, use of the two data sets in a complementary manner should allow gravity wave propagation direction to be inferred by AIRS, and using this information would allow for more certain gravity wave momentum flux information to be derived from HRDLS. Of course, this relies on the broad-spectrum nature of the gravity wave fields emanating from significant gravity wave sources. Since short horizontal and long vertical wavelength gravity waves carry large momentum fluxes, perhaps clever combination of the two data sets can also be used to place more certain bounds on gravity wave momentum fluxes from various sources.

This is a very well written paper, with one exception, and that is the somewhat awkward use of English in a few instances. Of course, this is understandable given that only one of the authors is a native English speaker. One example of this is on line 12 on page 1, where the verbal use is “are conform.” The term “are similar” would be preferable in my mind. This terminology is seen again on line 22 on the same page. A similarly awkward terminology is on line 18 of page 12, where the wording “are diverse” is used instead of the more preferable (to me) “are different.”

I also have a couple of relatively minor points that I would like to see dealt with in this paper. One is a greater emphasis on the implication of broad-spectrum sources of atmospheric gravity waves. Another is on lines 15 and 16 of page 2, where they point out that satellite observations are only sensitive to a certain portion of the gravity wave spectrum. Of course, this is true for all observational techniques, a point made in Alexander et al. (2010). I also think the authors might spend a little time pointing out the different vertical phase tilts in the high-resolution AIRS and HRDLS variances in figure 5. This is likely due to the different propagation characteristics of the portion of the gravity wave spectrum seen by the two instruments.

All in all, this is an excellent paper that will be a valuable addition to the literature on atmospheric gravity waves. It would be fine as is, but I think it could be improved a bit by their considering my suggestions.

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