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Atmospheric Measurement Techniques Discussions

Interactive comment on "Intercomparisons of HIRDLS, COSMIC and SABER for the detection of stratospheric gravity waves" *by* C. J. Wright et al.

Anonymous Referee #1

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General comment:

This is an interesting study that provides significant information about the ability of three satellite observing systems to measure temperature wave structures in the stratosphere. There are however some severe limitations in the analysis technique that have to be discussed in much more detail (see the Major Comments below)! In particular, good agreement in correlations, standard deviations and vertical wavelengths will be biased towards long horizontal wavelength gravity waves or even planetary scale waves. Of course, not all questions raised below can be answered completely in this study. However, a much more detailed discussion of the drawbacks and cautions of the methods used, as well as the interpretation of the results obtained must be given!

Publication of the current work in AMT cannot be recommended before all points raised

below have been addressed adequately!

Major comments:

(A) The reasoning for the choice of the colocation criterion contains some errors and does not seem to be sound. It is not even clear, which criterion is applied (180 or 1800km horizontally).

If the criterion is 1800km horizontally, this is much too loose for comparison of single altitude profiles! (You would assume that large part of the observed waves would have a wave train of about 10 wavelengths horizontally with constant amplitude!) In this case the whole study should be repeated with a more reasonable colocation criterion.

If the criterion used is (900s, 180km) this still makes sense, since waves observed should have horizontal wavelengths longer than about 200km and the horizontal group velocity should be sufficiently small to avoid that waves propagate out of this region. In this case it is sufficient to simply rewrite the reasoning for the selected colocation criterion. However, even in this case large phase shifts can occur in colocations and high correlation of altitude profiles will be found especially for long horizontal wavelength waves which will bias the observed distributions.

(B) Application of vertical high-pass filtering to extract temperature perturbations of gravity waves is very problematic because also global scale waves can have short vertical wavelengths. Therefore especially in the tropics (latitudes lower than 20deg) the current study will be subject to larger errors! Amplitudes and correlations will be high-biased because larger scale waves (in particular Kelvin waves) will be present in both altitude profiles of a valid colocation considered and often dominate over temperature perturbations due to smaller scale gravity waves. This issue should also be discussed in the manuscript!

(C) The altitude range used in this study is 16-34km. This range usually crosses the tropopause in the tropics and will therefore introduce some artifacts in the analysis.

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This effect has been studied before in detail by, for example, Schmidt et al., GRL, 2008, using GPS temperature data. Due to this effect both standard deviations and correlations might be further high-biased in the tropics. Please clarify: Is the altitude range entering the analysis not even larger by applying a 7km cosine half-bell high-pass filter?

(D) More detailed error discussion should be provided in Sect. 4: In particular, it should be discussed that low correlations are not necessarily indicative of measurement noise. (1) It should be pointed out more clearly already in Sect. 4 that small vertical shifts of wave patterns in the two altitude profiles considered will yield zero correlation even though the same wave might be observed. This is especially important for short horizontal wavelength gravity waves. For example, if you assume a wave having 400 km horizontal wavelength, there can be phase shifts of 180deg if the two measurement locations are apart 180km! (2) It should at least be mentioned that the different instruments view an observed wave at different angles which will introduce differences in observed wave amplitudes due to the observational filter of the instruments, as well as different vertical phase shifts of the observed wave.

(E) It is striking that high numbers of high-amplitude coincidences are obtained all over the tropics (Fig. 6). Little spatial correspondence is found with regions that are known for high-amplitude gravity wave activity, in particular the monsoon regions in the tropics and gravity waves at high latitudes in the winter hemispheres (these are completely missing!). This again could indicate a strong bias of high correlations and amplitudes towards long horizontal wavelength waves. This issue should be discussed in more detail!

Specific comments:

p.739, l.6: in the listing of important advances in the interpretation of gravity waves observed from space the reference Ern et al., 2004 should be added.

p.741, last line, as well as Table 1: the precision (random error) of SABER temperatures

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is somewhat better than 1K in the stratosphere (see Remsberg et al., 2008: Table 1 and Fig. 6). The estimate given in Fig. 6 in Remsberg et al., 2008 probably still contains some non-random fluctuations of atmospheric origin.

p.742, l.17+18: Cgh is about 32m/s and Cgz about 1.6m/s, looks like factor 2pi has been forgotten when calculating kh and m from horizontal and vertical wavelengths

p.743, l.3: ten times the horizontal travelling distance of 180km (p.742, l.22) would be 1800km, instead of the 180km mentioned as spatial colocation criterion in this study (p.743, l.3). Which is the value taken, 180 or 1800km? Please clarify!

p.743, l.10: please check vertical propagation range

p.743: Subsection 3.2 contains only little additional information, please delete subsection and merge contents with previous subsection! Title of Sect. 3 should also be changed!

p.743, l.9: The height range of about 16-34km crosses the tropical tropopause which might introduce some artifacts in the analysis. A lower boundary at 20km would make more sense!

p.744, l.13: Why are so many altitude profiles lost in the HIRDLS-SABER and COSMIC-SABER comparison? Is this due to clouds at high altitudes in the tropics? Again, would a lower limit at 20km make more sense?

p.754, l.4: Saber data are available since 2002, not 2001.

pp.761, 763, 764: Axis labels in Figs. 3, 5, and 6 are way too small, please select bigger fonts!

Technical comments:

p.738, l.4 and p.741, l.12: acronym SABER stands for "... using broadband ..."

p.739 bottom - p.740 top: "obtained" used three times in a row, please avoid

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p.749, l.20: "Figure 5 shows..."

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 737, 2011.