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Interactive Comment

Interactive comment on "Characteristics of gravity waves resolved by ECMWF" *by* P. Preusse et al.

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We thank the reviewer very much for the favorable review and the constructive and helpful comments.

The reviewer has two major points:

A) The reviewer points out that a figure which has a large number of caveats should be omitted from the discussion, in particular, if this figure does provide only limited additional information.

We will follow the reviewers request and delete this figure and remove / modify the according parts of the manuscript.

B) The reviewer inquires whether we can show simulated HIRDLS measure-

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Interactive Discussion

Discussion Paper

ments, in particular, in case that this effort would not be too high.

Unfortunately the effort for a full end-to-end simulation of HIRDLS would be indeed to high. However, we have developed a comprehensive observational filter for application on a data set which fully characterizes the waves. We originally intended the filter to be used on ray-tracing results, but it can be applied to the S3D method as well. The observational filter takes into account: The visibility filter in the direction of the line-of-sight due to radiative transfer and retrieval in linear approximation (cf. Preusse et al. (2002)), some filtering mimicking the MEM/HA analysis, the projection of the horizontal wavelength on the tangent point track and aliasing. These effects are introduced by e.g. Preusse et al. (2009b) (cf. Figure 3 in Preusse et al. (2009b)).

This observational filter was applied to the S3D results shown in Figure 9 of the current manuscript. In Figure 1 of this reply we compare the data for period 1, 25km and show spectra as analyzed from ECMWF and after application of the observational filter. The effects are as anticipated before in the paper. The total intensity is reduced by about a factor of 2. The spectral shape is only slightly modified. Gravity waves with short vertical and short horizontal wavelengths are more strongly reduced than GWs on average. Because of the projection of the horizontal wavelength on the tangent-point track, GWMF appears at longer horizontal wavelengths. Due to the combined effects, the observational filter enhances the bias of the ECMWF distribution showing too long horizontal wavelengths: Even in the original data, the peak of GWMF from ECMWF is at much longer horizontal wavelengths than for the HIRDLS observations. After application of the observational filter, i.e. generating a distribution as HIRDLS would observe if ECMWF data were real, the peak of GWMF in ECMWF data is shifted to even longer horizontal wavelengths.

The tendency of slightly less GWs at long vertical wavelengths (i.e. high phase speeds) is not affected.

The comprehensive observational filter will be described in a dedicated paper (Trinh

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et al., manuscript in preparation for AMT) and is too complex to be introduced here in detail. Since we have no description in the literature so far, we will not give these results in the main body of the paper, but add an appendix reproducing the discussion given here.

Minor comments:

P11971, L12-17: noise, turbulence and trapped waves

The data investigated here are not a full instrument simulation, but just a sampling to the measurement location. The S3D method is applied to a cube consisting of 12 points across-track, 7 points along-track and 15 points in the vertical, in total 1260 points. By fitting over a total of more than 1000 points in the 3D fit volume noise/turbulence in the ECMWF model is largely reduced. Reflection of waves may occur also in the stratosphere (e.g. Kim et al., 2011). However, in this case we expect an upward propagating and a much weaker downward propagating wave, and not waves trapped in a waveguide as below the tropopause or in the vicinity of the mesopause. In addition, it should be noted that for mid-frequency wave-reflection would be partial reflection, which reduces the likelihood for wave trapping. We will add these arguments to the discussion.

P1978, L25: Unstable atmosphere in convection

This is an interesting suggestion we will test before resubmission. On a first guess, however, this seems unlikely. We have used ECMWF fields (like those used here for backward trajectories) also for forward calculations (Preusse et al., 2009a) and did not find major problems due to instability.

pp11982, 1st paragraph: Rule out mid troposphere?

Probably not completely, but the ray-paths are very oblique. It therefore seems unlikely that the waves are really reaching the mid-troposphere in the first cloud they match on their backward trajectory. Both points will be mentioned in the discussion and we will consider whether further testing is possible.

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pp11985, L20: It is very abrupt here to make the statement about the "altitude of strongest wind shear"

This seems also to have confused reviewer 1. We will try to clarify the text.

pp11990, 1st paragraph: So you don't suggest any remedy here anyway?

There are two pathways to remedy this problem. First, other convective schemes have proven their ability to generate more realistic GWs in mesoscale models. We here just want to point out that introducing a new convection scheme is a big issue in a NWP model. The second way to remedy is introduction of a parameterization for convective GWs. However, in this way one loses the self consistency to describe the resolvable part only by resolved waves. A few lines of discussion will be added.

A complete reply to all points will be given together with the resubmission of the paper.

References

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Interactive comment on Atmos. Chem. Phys. Discuss., 14, 11961, 2014.

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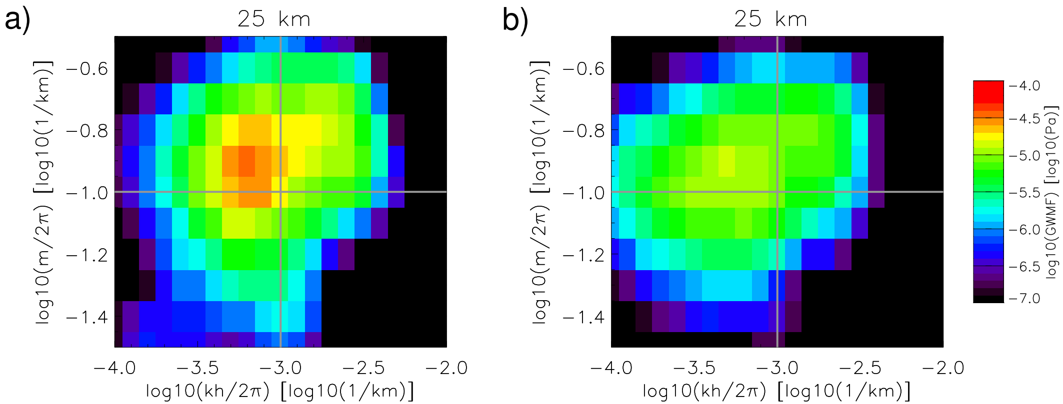

Fig. 1. GW spectrum for period 1, 25km altitude. Panel a shows the spectrum as given in Figure 9e of the manuscript, the right panel shows the spectrum after application of the observational filter.