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Atmospheric Measurement Techniques Discussions
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Interactive comment on “Advanced hodograph-based analysis technique to derive gravity waves parameters from Lidar observations” *by* Irina Strelnikova et al.

Anonymous Referee #4

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This is an interesting study introducing a new evaluation method for data which continuously record both winds and temperatures - currently the case only for very specialized lidar systems. The method is demonstrated for a period recorded 9-12 January by the IAP ALOMAR lidar system. The results are novel and merrit publication in AMT. However, GW momentum flux is the more interesting and conclusive quantity and some more information with regard to the altitude development should be given, see comments below.

Major comments:

You produce most of your diagrams for "number of waves". However, from the dynam-

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Discussion paper

ics point of view GW pseudomomentum flux is most relevant. It would be very helpful if you add a second row to Figure 12 where you plot the total absolute momentum flux of the waves in a wavelength bin. (You could normalize that in a way that the total GWMF of all waves (up + down) is normalized to 1. and keep that same normalization also for up and down separately). Same for F14 and F15.

The vertical wavelengths you observe are rather small. Starting from the very first work on saturated spectra (Smith, Fritts VanZandt, 1987) we have indication that the wavelength of the maximum in the distribution shifts to longer wavelengths at higher altitudes. Follow-up work by e.g. Gardener et al. and the general concept of the Warner & McIntyre scheme infer a power law for this. You can put in several observations by e.g. radio sondes, rockets ... to calibrate this. Then you would expect something like 2km in the lower stratosphere, 10-15km in the mesopause region and accordingly $\sim$5km around the stratopause. The satellite data certainly have a long-bias, but they confirm the increase of typical wavelengths with altitude. Compared to this you have 2km which one would expect for the low stratosphere in a data set which goes up to the mesopause. One reason may be that you give your histograms for number of waves only. Still it would be good to see some vertical profile of avereage vertical wavelengths, normal average as well as GWMF weighted, up + down searately, so for profiles in total.

Phase speed is approx proportional to vertical wavelength. The observational filter for airglow is totally different (lz>10km), so no wonder that phase speeds are much higher. There is a wealth of literature on phase speeds from different sources (convection, spontaneous imbalance, ...). Maybe it is more worthwhile to compare to that. The phase speed diagram kind of seems to exclude convection as dominant source here. Still there is the general issue about the short vertical wavelengths.

Minor comments and technical suggestions:

P2L1 Suggest to omit colloquial phrase: The problem is that

P2L4 these models need to rely on various parametrizations.

P2L18 information about GWs (), but they base solely on temperature observations.

P2L20 Did the Shigaraki radar not provide some winds? If so: provide high-resolution wind

P2L27 legacy -> established ?

P2L31 Would be nice, if we were sure about this. In our analysis technique we aim solely at such fluctuations which are generated by GW.

P2L35 aimed -> aim

P3L20 and afterwards smoothed

P4L8 Please check and reformulate the sentence

P4L26 For an hodograph you need a certain altitude range, so it is not 'in the center'. As you specify the altitude range below: 'around the'

P4L30 several oscillation periods

P5L3 remove

P5L6 Coriolis

P6L2 procedure plays a key ... and may even lead ...

P6L12 which supposedly are produced

P6L13 Please describe all panels: The upper panels show the measured data, the middle ...

P6L16 made -> performed

P6L23 as the one most

P6L25 dissipation ; refraction may also change the amplitude, conserving wave action flux Under the assumptions of conservative propagation and a constant background,

P6L29 Sorry, I don't understand this: You cannot analyze small-scale structures at low altitudes in the atmosphere? Please explain or reformulate.

P7L17 So you don't do that? Why not?

P7L20 or 3) the wave source process generates waves with a frequency changing in time Just a remark, no request to discuss this

P7L26 Which step 4.2 are you talking about? There is nothing here to indicate which steps form the whole algorithm

P8L2 which cover an altitude range of approx. 50km and thus much longer than a wavelength and the expected scale of amplitude variations.

P13L9 Please include a sentence that when the average energy is about the same but you have less downward waves also the total energy of downward waves is less.

F13 I like that figure, but it would be great if you could add two more panels: Vertical wavelengths and GWMF.

P14L1 And this is really puzzling! You have most of the waves and the momentum flux propagating against the wind and the wind velocity increases at higher altitudes, so no critical level filtering. Vertical wavelengths then should increase which leads to lower amplitudes at same GWMF, so no saturation expected either. Reflection? It would be good to know at least which parameter changes most (wavelengths, amplitudes ...) as to produce this result. Or do you have an edge effect in your retrieval or your method?

P14L16 Corwin Wright does something similar for his AIRS analyses

P15L8 I do not think that this is true! It would needed to be shown, anyway. There should be places where temperature and wind amplitudes overlap and I would expect phase shifts of $\sim 90^\circ$ between winds and temperatures. Just watch one of the tidal movies. Here, you have likely removed the tides by the 15km vertical cut-off, though.

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