

Interactive comment on “Enhancements of gravity wave amplitudes at midlatitudes during sudden stratospheric warmings in 2008” by T. Flury et al.

Anonymous Referee #1

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General Comments

Overall, the scientific content of this paper is excellent, but the presentation could be improved. On the scientific side, radiosonde launches are arguably under-used for gravity-wave studies, but they provide valuable observations on scales too short for satellite measurements. Therefore, this paper contains rare measurements and analyses that complement the satellite data and that would be a welcome addition to the literature.

On the presentational side, the paper reads too much like a chapter from a PhD thesis. Distracting technical details and textbook material ought to be cut out and replaced with references. The impact of the paper would be greater if it could be re-structured as a list of hypotheses that were then tested using the data, rather than a simple description

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of the data. In other words, the focus of the paper should be the scientific advance that is achieved from the data, rather than the data itself.

Specific Comments

1) If the typical radiosonde ascent speed is 6.5 m/s and the typical altitude reached is 34 km, then the typical ascent time is 5200 s. This is at least an order of magnitude longer than the typical gravity wave periods of 200-500 s, so the gravity-wave field can categorically *not* be regarded as stationary during the ascent (page 29975, lines 13-14). I think this calculation needs to appear explicitly in the paper. The consequence is that there will be aliasing between the evolving gravity-wave field and the ascending sonde.

Because of the aliasing, the apparent gravity-wave periods will not be equal to the intrinsic gravity-wave periods, but will need to be corrected. The same applies to the apparent wavelengths. This correction is being attempted on page 29978, but these are not the usual Doppler-shifting formulae that I expected to see. Has a limit been taken in which the two frequencies are very different? Please try to be more explicit about all of this in the paper, instead of leaving the reader to guess what has been done.

2) The interaction between the SSW and the gravity waves is potentially two-way. Not only could the circulation associated with the SSW be generating the gravity waves, but the gravity waves could be helping to trigger the SSW. A paper led by Thomas Birner (published in *Journal of the Atmospheric Sciences* in 2008) proposed a noise-induced mechanism for this. The two-way nature of the interaction would be worth discussing in the paper, because the direction of the causation is impossible to determine.

3) It has been suggested from laboratory experiments that the amplitude of spontaneously emitted gravity waves scales linearly with the Rossby number, in apparent contradiction to theoretical expectations of an exponential scaling (Williams, Haine & Read 2008, *Journal of the Atmospheric Sciences*). Could this contradiction be resolved using the methodology of your paper? For example, you could use the radiosonde data

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to obtain the amplitudes and use the re-analysis data to obtain the Rossby number for the larger-scale flow, and hence produce a scatter-plot. This is an interesting prospect. Actually attempting it would probably be beyond the scope of the present paper, but the possibility could at least be discussed and mentioned as an area for future work.

4) There is too much distracting technical information, which should be cut out to improve the readability. For example, most of the information in lines 1-21 on page 29975 could be deleted and replaced with a simple statement that the amplitudes are calculated following the method of Hocke (2009), and most of lines 2-18 on page 29980 is standard textbook material that could be deleted. Also, many of the paragraphs are far too long, and should be either split up into shorter paragraphs or cut down into a single shorter paragraph. An example is the first paragraph of Section 3.1.

Technical Corrections

Page 29972, line 2: insert 'in the Northern Hemisphere'

Page 29972, line 18: 'surprising' is not an objective scientific adjective; change to 'counter-intuitive'

Page 29972, line 25: do you mean 'variable' in height or time?

Page 29973, line 3: as well as Matsuno (1971), you could also cite Holton & Mass (1976, *Journal of the Atmospheric Sciences*)

Page 29973, lines 4-6: this sentence is speculation; either insert a reference to justify it, or delete it

Page 29974, line 18: what is the time resolution (1-3s) when converted into an equivalent vertical resolution in metres?

Page 29976, lines 1 and 16: two different definitions are used for the end dates of the first minor SSW — is it 21 or 22 January?

Page 29977, line 26: I would say that 180 degrees is *very* far away from 90 degrees!

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Page 29988, figure 2: I presume these trajectories are obtained from the GPS measurements? Please state explicitly in the caption.

Page 29989, figure 3: in the PDF I downloaded and printed, the red and gray bars completely obscure the data, so the anti-correlation is impossible to see

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