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Atmospheric Chemistry and Physics Discussions

Interactive comment on "On the spectrum of vertically propagating gravity waves generated by a transient heat source" *by* M. J. Alexander and J. R. Holton

Anonymous Referee #2

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General Comments The paper begins by noting that many analytical studies of the waves generated by deep convection have a dominant stratospheric vertical wavelength about equal to the depth of the troposphere heating. Observations and cloud resolving models, however, suggest that longer vertical wavelength modes are also produced by convection. Using a linear model, the authors are able to generate vertically propagating waves with longer wavelengths from a transient heat source. They were able to show that the response to the transient convective-like heating profile produces a complex spectrum of wavelengths, including longer vertical wavelength waves that have high vertical group velocities.

One of the strengths of the paper is its use of the spectral analysis to examine how observations of the wave spectra by profilers might vary according to the location of the profiler. They showed that an observer close to the heat source would observe a short burst of longer-vertical wavelength waves soon after the convection, while a profiler further from the source would see a shorter vertical wavelength pulse, arriving later and lasting longer.

Overall, the paper does a nice job in using a linear model to explain how a transient heat source can generate a spectrum of gravity waves, including longer vertical wavelength waves. Although the discussion of the appropriateness of a linear model is short, it is enough to establish the credibility of the approach. The analysis of the waves is thorough. The discussions of the model, the analysis techniques, and the results were clear. Finally, the examination of what these results imply for different observers was comprehensible and useful.

The paper is well written and very readable. It lays out a potential discrepancy between observations, analytical and numerical models, proposes a solution and tests that solution with a simple, well-explained numerical model. The results of that model are clearly analyzed, and appropriate graphs are used to show that result.

Specific Comments One small thing that might've improved the paper might have been a general discussion of the role of these waves in the stratospheric/mesospheric circulation, and the potential impact of the longer vertical wavelength modes in particular.

One thing that could be more clearly explained was the reason for switching the domain of analysis in between the simple zonal wavenumber analysis presented in section 3 to the Fourier and Morlet analyses presented later.

What is going on at very long horizontal wavelengths at hour 1 in Fig. 4? Why the almost delta-like function? The text suggests that there isn't much power in these low horizontal wavenumbers, but doesn't explain the peak at about k = 0.003. Is it a physical thing, or a numerical artifact?

ACPD

4, S421–S423, 2004

Interactive Comment

In the discussion of Figure 10, there is the comment that "at a given horizontal location, m increases linearly with time." This is a bit hard to see at x=25km in Fig 10. Presumably this is also related to the fact that this relationship is only strictly true for hydrostatic (Lx$>>$Lz) waves. The waves close to the heat source at early times are less likely to be hydrostatic - is this the reason that the m increasing with time relationship is less clearly visible here?

Technical Comments The graphs are labeled in wavenumber, but the discussions in the text are often in terms of wavelengths. It would be helpful to the reader to label the axes both in terms of wavelength and wavenumber.

Figures 5-7 weren't really discussed in the text. Are they necessary?

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 1063, 2004.

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4, S421–S423, 2004

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