

## ***Interactive comment on “Tuning of a convective gravity wave source scheme based on HIRDLS observations” by Q. T. Trinh et al.***

### **Anonymous Referee #1**

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General comments: This work is clearly structured with detailed descriptions of presented figures. Abstract, Introduction and Discussion are of appropriate length and nicely put the topic of this work into the broad context of gravity wave parameterizations and their problems with appropriate references where needed. The paper presents a systematic tuning of the Yonsei Convective Gravity Wave Scheme using observational data. Due to the limitations of observational data such a comparison is not a straightforward undertaking, but the authors manage to produce new, interesting and useful results by using a unique and ambitious modeling and analysis strategy. Limitations of this approach are discussed as well. Certain aspects of the work need clarification and the language and phrasing should be improved in several paragraphs.

Specific comments:

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Page 34326, Lines 7-8: At first it was not clear to me what "applying a comprehensive observational filter on simulated GWs" entails. Maybe rephrase and say something along the lines of: "The instrument can only see a limited portion of the gravity wave spectrum due to visibility effects, ...ect. ...To allow for a fair comparison of simulated GWs to observations a comprehensive filter is applied to the simulated waves that mimics the instrument limitations."

Page 34326, Line 9: "effects". Can you specify effects on what? It would be helpful to let the reader know right away what effects you will be looking at, i.e. the zonal mean forcing at a certain altitude range.

Page 34329, Lines following line 5: The introduction has been very clear to this point. Here things become difficult to understand. - Why does tuning based on observations help with producing results that are representative of other years? Is this even what you intend to say? I find this sentence confusing. - "adjusting the amplitudes of individual waves while keeping the overall flux the same". Now you are talking about the intermittency factor. But when I read this for the first time, I had no idea what you are referring to or what the idea behind this was. Later on you very nicely introduce the intermittency factor and explain its meaning and consequences. I suggest call it "intermittency factor" here, and say this is an additional tuning parameter that controls the wave amplitude and therefore determines breaking levels. Then it will also be clear why you are mentioning vertical cross sections next. You can leave the detailed explanation for later. - You mention this observational filter but still haven't told us what it is. Please mention briefly what it does. The reader can guess but it's better to just say it explicitly.

Page 34330, Line 21: Are  $\rho_0$  and  $T_0$  the density and temperature at the cloud top?

Page 34330, Line 16: Do you mean filtering by the background wind when you refer to the vertical propagation condition? No all readers may know what this is. Maybe add a few words for clarification.

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Page 34330, Line 20: What is the shape of  $\theta(c)$  as a function of  $c$ ? I'm curious what equation 2 looks like when you plot  $\theta$  versus  $c$ . Secondly, in the Beres parameterization, for example, there are also assumptions about the shape of the heating in space and time. But in addition to that a sine-shape is assumed for the distribution in the vertical. Does your parameterization assume some kind of vertical shape? If so, what is it?

Page 34331, Line 1: How do you determine  $q_0$ ? How do you determine  $cq$ ?

Page 34331, Line 6: Can you give a description of the physical meaning of  $\Delta x$  and  $\Delta y$ ? Some of the values for your  $\Delta x$  and  $\Delta y$  are so large that they cannot describe convective cells. Convective systems of such scales consist of many smaller convective cells.  $\Delta x=4$  would be representative of a single convective cell. What scale is it that  $\Delta x$  and  $\Delta t$  describe? Gravity waves are triggered by the individual cells inside such large systems. Therefore, could you better motivate your approach of using these numbers in a parameterization that was intended for individual cells? This really is one of the most central points of your paper and one that I am not quite comfortable with at this point.

Page 34331, Line 7: You are talking about the intermittency factor further down in this paragraph. But selectively sampling the phase speed spectrum also affects the total GWMF. If you didn't use 10, but 20 samples, or 5, - how would you correct for this different number of waves? You somehow have to be sure they are giving you the flux of the whole phase speed spectrum. Can you please comment on this?

Page 34331, Line 12: Where does the heating depth come from? It appears to be a free parameter just like  $\Delta x$  and  $\Delta t$ . How does the heating depth enter the parameterization?

Page 34331, Line 20: What information exactly are you getting from the MERRA latent heat input data? You are assuming  $\Delta x$  and  $\Delta t$ , which wouldn't be resolved anyway because the MERRA grid is too coarse. MERRA can neither resolve the heating

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depth of individual convective systems. This is a key point that needs clarification.

Page 34334, Line 4: How can a certain step width optimize computational efficiency? Isn't it more like minimizing the number of different scales that improves computational efficiency?

Page 34335, Lines 22 ff: Yes, different combinations are needed, but how do you know that this has something to do with the hemisphere? If you looked at just one hemisphere but at different years, can you be sure that the best combinations would differ less from year to year for the same hemisphere than they differ between hemispheres? We do not know the uncertainty of these spectra. Is there any way to give an estimate of error bars?

Page 34335, Line 25 ff: Would a new paragraph starting at "These scales" be good here? It seems you are now discussing uncertainties in your approach. Maybe also state this explicitly, i.e. new paragraph: then "there are limitations to our approach:" - You say the scales are determined by the regions of deep convection? How is this? For each panel (or simulation) you set them to constant values. I do not understand what you mean here. - I also do not know what "adopted for convective sources" means. My guess is you want to point out the following: You are talking about the observations and how you compare to observations above deep convection. I think what you are trying to say is that there could be other wave sources. But in minimizing the eta function you are using these observations. I would suggest you work on the language of this paragraph and rewrite it because it is not straightforward to understand.

And following this, Page 34336 Lines 1-3: I thought you were only looking at deep convection and not considering shallow convection. So what exactly is the concern when applying your parameterization to the whole hemisphere? That you would include shallow convection? Please clarify.

Page 34337, Line 11: In the previous section (page 34334, line 20) you restrict the HIRDLS data to regions that were previously identified as regions of deep convection.

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You haven't stated what is shown in Figs 3 and 4, all HIRDLS data or HIRDLS data for regions of deep convection only? Please add this information. If you are comparing to all HIRDLS data: is this necessary? Or could you only look at regions of deep convection as before? If you are comparing to convective regions only: Why would you be so concerned about sources other than convection?

Page 34337, Line 20-21: The description of the features in Figures 3 and 4 is careful and good. However, I am not convinced that the differences are solely due to other sources. Your intermittency factor, for example, changes the wave amplitude, the breaking level and could impact the height of the maximum GWMF. And my guess is that GROGRAT introduces some uncertainties as well that could impact the width. Could you comment on this?

Page 34339, Lines 13-14: Why does the wind maximum affect Q this strongly? When you discuss the observational filter, there was no mentioning of wind effects. Could you add a sentence saying how the wind affects Q?

Technical corrections: Page 34326, Lines 13&14: "flux" is singular, "are" is plural. Page 34327, Line 22: Suggest MF1 -> "MF1" for this first time. Page 34328, Line 29: ", which" -> "that" Page 34329, Line 3: "which fit best to the" -> "which best fit the" Page 34329, Line 6: I don't think "grounded" is a good word. Suggest "based on" or "informed by". Page 34329, Line 8: you are in fact showing meridional, not zonal cross sections. Page 34330, Line 20: shaped -> shape Page 34334, Line 7: by -> for Page 34335, Line 22: "northern" and "Southern". Choose a consistent capitalization.

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