Atmospheric Chemistry and Physics Discussions

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# Comment on acp-2022-267

Anonymous Referee #2

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Referee comment on "Sources of concentric gravity waves generated by a moving mesoscale convective system in southern Brazil" by Prosper K. Nyassor et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-267-RC1, 2022

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The paper presents a thorough analysis of concentric GW patterns in the middle atmosphere and deep convection as a potential source. The investigation methods are sound and the figures of generally high quality. Much emphasis is given to the development of the convection in the potential match time and how large an emission erea and match error might be. This distinguishes the current work from previous studies and I recommend to publish the current study for ACP. However, I think that the structure of the paper needs to be improved. In particular, the MCS tracking analysis is never shown together with actual brightness temperatures, which would elucidate which structures are actually tracked. Some real zooms would be helpful, so the details close to the source can be distinguished. There are quite a number of repitions (please remove), but sometimes a motivation why the next step in the analysis chain is performed whould be helpful.

**Major comments:**

The presentation logic needs to be improved. The tracking data are shown on several figures, but never become really clear. My suggestion would be:

Introduction: Please skecth your multi-step approach: a) back-traces, b) coparision with instantaneous map c) area region + tracking => likelihood for a specific convective event / MCS in short. Do so without providing results but refer to (sub)sections. Then one gets a plan of what you are going to do

Figs 3-6
a) remove the inlay showing the tracking
b) add a new panel showing a real zoom of the core circle with the RT and the symbols,

use red and blue for the respective tropopause crossing of the ray

Do a new combined Figure where you show for one fixed time the BT -90 -> -50 °C, the tracking position at this time with a larger symbol and the tracks for the other time with smaller symbols. For a second panel of each wave-event: Combine this with tracks overalyed on winds as in F11. For the tracks the area of the circle / zoom region is sufficient and this would allow to resolve the movements. The large area including the observation side is not required, on the other hand.

For the tracking run from C #1 to C # 9, don't repeat C #1 - #4 for the second / third event. Then it becomes immediately clear that these are not the same!

Summary: Please provide a more generic summary. Describe the new points of your method (combing RT and tracking, error estimates) first. Briefly summarize what you found.

More to the details of the writing: You quite often present a result in something like two sentences where you don't have the details. One or two paragraphs later you then explain this. That is unhelpful, becuase one gets sidetracked. Rather than having preliminary results a motivation at the head of the section where you are in the general plan would be helpful.

Section 3.5:
There are several problems with this section:

A) The observational filter of GPS-RO allows only to see GWs with wavelengths larger than 100~km, actually even longer than 200-300km for the fast waves discussed here (cf. comments to LL170 below). That is for along-LOS wavelength, still one would need a very favourable viewing geometry to see the waves. As every MCC also emits longer horizontal scales it is much more likey you sound these (cf. horizontal wavelengths of GWs determined from AIRS). This makes the approach faulty from the beginning.

B) Which vertical wavelengths did you determine? They are not shown! Are they compatible with the extremly high phase speeds you gain directly from the OH observations. At least at the OH layer they must be long (lz>15km) or you couldn't observe the waves from an OH layer. In the stratosphere refraction by the background wind is negligible (your own argument), thus they the GWs have long lz their, too. In that case you need to spedify how you sepeareted between GWs and background.

C) A lot is missing in the descrition. What did you take for the propagation direction?

Radial from a center would be my approach ...

This section does not contribute much to the overall results. Thus I suggest to simply remove section 3.5 from the paper rather than trying to fix the points.

**Specific comments:**

L257 Please omit or reformulate the statement: "It is worth ... " Convective GWs can have a wide range of phase speeds. Considering previous works by Hye-Yeong Chun and Joan Alexander you would assume the spectrum to peak at phase speeds of 20-30 m/s. Actually, such lower phase speed CGWs drive the QBO. Therefore, the statement must not be made in such generality. I would rather say, the waves observed here have phase speed sufficiently large that the winds below do not introduce major disturbances in the wave fronts and that they hence can be still recognized as concentric wave structures.

In all maps: You show circles in lon/lat. Shouldn't it be circles in terms of (km)? So close to the tropics the difference is only 15%, still ...

Fig 10 and description. This repeats a lot between legend and text, but it does never become really clear to me what you are after. Please try to reformulate. In particular, it is not the tropopause diameter, but the diameter of something at the tropopause and it remains unclear to me whwther you try to estimate backward from the observed rings or forward from the source or both.

**Minor comments and technical corrections:**

L23 of the GWs -> omit the

L24 if you consider it from the view point of the mesosphere - otherwise mountain waves are probably more important and spontaneous imbalance for higher latitude of similar importance

L27 has -> have

Since you give a quite comprehensive overview, perhaps add something of the following: There are also some studies linking satellite observations with OLR. That includes work by

McLandress et al., JGR, 2000, Jiang et al., JGR, 2004 for MLS, Choi et al 2009 (introducing a CGW source model), Preusse et al. 2001 (IR limb sounding). Also, a typhoon may act as a source to quasi-circular waves of much larger scales -> Kim, Chun and Wu, JGR, 2009)

L74,L75 repeats 1024 pixels

L105 this is horizontal and time? Please say so

Eq1 / 2. This would be more meaningful if you also provide the dispersion realtion

L144 Omit the sentence The backgrounds ... That's coming in the next paragraph comprehensively

What does happen, if you have a bias? A potential bias could induce a locally enhanced / reduced buoyancy frequency. Would it be worth correcting for that first?

L155 Since you use this as stopping condition: What is your actual conserved quantity? In GROGRAT it would be wave action flux.

L158 module -> sounds a bit strange, simply omit?

L164 I am missing the point of the "Therefore". You mean unusual cold so you want to see whether both lead to the same deviation?

L167 / 169 repeats

LL170 With that you very likely see different horizontal wavelengths than the ones you find in the airglow. The observational filter of GPS is given in

@Article{lange_2003,
  Author = "M. Lange and Ch. Jacobi",
  Title = "Analysis of gravity waves from radio occultation measurements",
  Journal = "Springer Berlin",
  Pages = "479-484",

Year = 2003
}

They actually come to the same values as found by the analytical approach in Preusse et al. JGR 2002. With that you need very favourable viewing conditions (angle between LOS and wave fronts) to see the same wave. More likely you are observing longer parts of the wave spectrum emitted from the same event.

How did you remove the large-scale background in the GPS profile?

L177 That sentence is a bit ambigious. Do you mean: A large overshoot results in a particular cold tropopause? Or do you mean: If the tropopause is already particularly cold you need more energy to create an overshooting? Please insert one more sentence making this more specific.

L203 Why T_{core}/2 and not \Delta T_{core}/2 ?

L220 regions have been

L237 Suggestion: The blocking diagram hence visualizes where the background winds induces a zero vanishing intrinsic frequency of the GWs.

LL243 I like the 3D blocking diagram as it shows the altitude structure, but swap introduction of 6b and discussion of phase speed: the quantitative argument is much better seen from 2D. (Or reading further, just omit the in-advance statement L244).

L265 There is Taylor and Hapgood (1988) as well (please include, it's the first) - and then I think you have the full list. Maybe "Numerous" is a bit strong. Anyway, you here repeat from the introduction.

L277 That sentence is too long and too warped.

Fig10 diameter of the tropopause: what do you mean?
diameter of circular wave fronts at tropoapuse altitude?
diameter of overshooting?

Fig11 You don't need three grey-scale bars, only information is time

L353 Take your own values! You should be able to just take them out of e.g. F7

Literature:
For backward raytracing: Some work by Pramitha?