

Atmos. Chem. Phys. Discuss., referee comment RC2  
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## **Comment on acp-2022-267**

Anonymous Referee #1

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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-RC2>, 2022

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In their manuscript "Sources of Concentric Gravity Waves Generated by a Moving Mesoscale Convective System in Southern Brazil", the authors combine measurements from multiple instruments at multiple altitudes with ray tracing models to connect gravity wave observations in the OH layer with their sources at the tropopause. Single cores of a moving mesoscale convective system are identified as most likely sources of the concentric gravity waves observed in the OH layer.

This work is quite impressive from the amount of data used and the analysis performed. However, I would suggest to better explain the reasoning behind all the measurements taken and the analysis performed. Both the introduction and the summary/conclusion section are missing clear scientific research questions motivating the work. At the moment the paper seems a bit like a data dump without a clear motivation behind. This impression could possibly be overcome by refining the introduction and conclusion. Additionally, I would suggest to revise all the sections / figures for their necessity to support the findings and possibly remove some of them.

A detailed list of minor comments is given below.

L24: Better: „in the tropical troposphere“, as otherwise one might start arguing about the importance of orographic versus convective gravity waves.

L27: Maybe better: ... mechanism is known to generate concentric gravity waves ... (or remove at least “natural”, you probably do not want to start a discussion about non-natural GW sources)

L27: Most [...] cases [...] have [...]

L38: ... images ... have been used ...

L42: ray tracing models

Introduction: You are nicely describing what was done before and what you are doing, but you are missing to describe the difference and provide a reasoning for your study. Why do we need this paper? What does it bring new to the world?

L101-103: This is a hypothesis which will be confirmed later. Maybe rephrase: According to previous studies (...), the appearance of concentric structures in the airglow hints to: 1) point-like convective overshooting of the tropopause and 2) weak intervening background wind.

Table 1: What is the exact definition of the propagation direction? Degree measured clockwise from North? And how do you define the propagation direction of a concentric outward propagating wave? Is only the value of the centre fit shown for the propagation direction?

L105: One parenthesis too much.

Figure 2 (+ description): Maybe do this as an example on top of one of the plots from Figure 1, so one can better understand what you are doing. Maybe explain the crest/trough part already at point 1. Makes it easier to follow. In 2: The 3 circles have to have the same radius, no? In 5: Why so complicated? Why not directly measure from P to where one of the lines from 3 crosses the black circle? Are all these steps done manually for each case or is there an automated software?

Chapter 2.1 – raytracing part: How is the vertical wavelength / wave number determined, which is necessary for the raytracing? All 4 stopping criteria seem a bit arbitrary. Can you explain in more detail why you chose these four stopping criteria? What is the physical reasoning behind each of them?

The advantage of this ray-tracing method (variable background wind over this large altitude range) should be made clear somewhere in the text.

L186ff: Please reorder for better readability:

Adapting Equation 3 from Griffin et al. (2016), the overshooting top height ( $OT_{\text{Height}}$ ) is estimated using the brightness temperature (BT) and the lapse rate (LR) of the overshooting top (OT), the tropopause height and temperature:

Eq. (3)

Here  $H_{\text{Trop}}$  is the tropopause height,  $OT_{\text{BT}}$  is the brightness temperature of the OT,  $T_{\text{Trop}}$  is the tropopause temperature and  $OT_{\text{LR}}$  is the OT lapse rate.

The cloud top brightness temperature was obtained from the Advanced Baseline Imager (ABI), which is an imaging radiometer of GOES-R satellite. The ABI has 16 different spectral bands, including two visible channels, four near-infrared channels, and 10 infrared channels with a spatial resolution of 0.5-2 km. Among the weather and climate products of these channels, the CTBT product is derived from the 11, 12 and 13.3  $\mu\text{m}$  infrared observations.

The OT lapse rate was estimated using the radiosonde profile and the CTBT. The OT lapse rate for the days considered in the determination of the tropopause temperature and altitude were averaged and was found to be  $-7.35 \text{ Kkm}^{-1}$ .

L160: Why do you state this here, as you are not tracing any waves forward to the thermosphere?

L220: [...] regions have been used to identify [...]

L221 & 222: I am confused by the use of references in this sentence. Why are you referencing other papers for things you have done here in your paper?

L231: Maybe better "deployed"

Figure 6: The description of the different colours and vectors belongs to the caption, not the text.

L258f: If this criterion is not applicable to the cases you show, why do you introduce it?

L284: Maybe use "shown" instead of "demonstrated"?

L284: How is the CAPE calculated?

L290ff: Is this an observation from your data or from Kim et al.? I would suggest to rephrase: It was observed in previous studies that the presence of deep convection with colder cloud tops brightness temperatures further decreases the tropopause temperature (Kim et al., 2018). In our data this also happens between 12:00 UT on September 30, 2019, and 12:00 UT on October 3, 2019, when the cloud top temperature ranges between  $-40^{\circ}\text{C}$  to  $-90^{\circ}\text{C}$ .

Reorder Figures 10 & 11 according to their first mentioning in the text.

L315ff: Please rephrase. The first and second sentence seem to be in contrast to each other. Were all four cores there or only core 3 & 4?

L344 - 355: Please explain better where you get the diameter of the plume at the tropopause from (31 km you state, but not where you extracted this value from).

Chapter 3.4: This chapter seems a bit like unnecessary information to me. Please either remove or explain why it is necessary for your findings (e.g. mention it in the summary section).

L441: Is signifies the correct word here?

L482f: spectra (plural) -> were

Figure 15: Please use a more intuitive colour scale for a continuous (not around 0 centred) range. See also Crameri, Shephard, Heron (2020) for hints on good colour scale usage.

L524: \*Rossby\*

Figure A1: For better comparability, the colour scale (extend) for the upper plots should be kept constant. Additionally, please add an x-axis. Otherwise the points in the lower panels are really hard to interpret. Is the tropopause here defined by thy laps rate?

Please check citation formatting throughout the whole manuscript.

Crameri, F., Shephard, G.E. & Heron, P.J. The misuse of colour in science communication. *Nat Commun* **11**, <https://doi.org/10.1038/s41467-020-19160-7>, 2020.