

## Response to RC2: 'Comment on egusphere-2023-1856', Anonymous Referee #2, 03 Oct. 2023

### Major:

*Lines 63 and Section 4.1: It is difficult (for me) to see how the varicose-mode extreme events in Figures 1 and 4 visually resemble a mesospheric bore/ soliton. As mentioned in section 4.1 mesospheric bores are characterized by a sharp wave crest followed by smaller trailing waves. While there are some solitary waves structures for e.g. in Figure 4 in the overall vertical velocity evolution, the varicose events i.e. upwards/downwards velocity (e.g. Figure 4c at 10:10 UT) don't appear to have any resemblance to a mesospheric bore (sharp wave crest/solitary wave).*

- ➔ Thank you for your observation and comment. We understand your point of view, and we have taken your feedback into consideration. In Section 4.1, we have clarified that in the selected, specific cases, the bore-defining feature, which is the presence of trailing waves, is indeed missing. This absence of trailing waves distinguishes the varicose-mode extreme events from typical mesospheric bores or solitons.

*Additionally while the text in Section 4.1 alludes to possible coincident observations to infer background conditions to investigate potential ducting mechanisms, no actual data is presented. I think it would be useful to the reader if the authors could clarify how the extreme varicose events are similar to a mesospheric bore. Perhaps provide more information and/or expand on Lighthill, (1979) [Line 230].*

- ➔ Thank you for your feedback. In response to your point, we plan to present background conditions, including actual data, for some cases in dedicated case studies in a follow-up paper. In the current version of the paper, the use of the theory of bores/solitons serves as an initial attempt to provide a foundation for exploring potential explanations for these previously unknown structures. As discussed in Section 4.1, while the resemblance in structure hints at potential underlying processes such as a guiding mechanism linked to a thermal or Doppler duct, we intend to delve deeper into these aspects in future research.

### Minor:

Your suggestions and the responses have been considered. If you have any more comments or need further assistance, please feel free to ask.

*Figure 4: I am curious as to why in Figure 4c, right column, the decreasing layer thickness after the increase (after blue color at the bottom), is not indicative of upward velocity?*

- ➔ Thank you for your question. The reason for the decreasing layer thickness after the increase (following the blue color at the bottom) in Figure 4c is that, in the data, there was no updraft measured during this time period.