

***Interactive comment on* “Observation of a mesospheric front in a dual duct over King George Island, Antarctica” by J. V. Bageston et al.**

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General comments

Pg. C6847 and beginning of pg. C6848

REPLY: The authors thank the referee for the kind acknowledgement on the paper's writing. Also, the authors thank for the recognition of the contribution of this paper and his recommendation for publication.

Minor comments

Pg. C6848 1) General questions

a) About the description of the evolution of the bore.

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REPLY: The Figure 1 was replaced (see the Figure 1 attached in the answers to R. Picard - AC C8438) and it was added more comments on the bore evolution (description of Figure 1).

b) Does the event propagate into the imagers FOV or does it form inside the FOV?

REPLY: We recognize that the text was confused, and in the first view of the animation it was thought that the bore was originated inside the FOV, but with a latter analysis we observed that the bore front seems to come from outside the FOV. It is difficult to identify this situation, since the event appeared near the border of the FOV. However, we could observe the trailing wave formation inside the FOV and the growth rate were estimated to be around 4 crests per hour. More detailed description of the trailing wave is in the updated version of the paper.

c) Is there any variation in the observed wave parameters or intensity?

REPLY: We did not calculate the wave parameters at distinct time intervals, but just for a set of six images, within the 6 minutes when the wave crests behind the main front was well developed. The average power spectrum obtained from these 6 images did not show significant spread, what means that the wave parameters during this interval did not change significantly. For other different time intervals it was not possible to access the wave parameters, since in the beginning the wave crests were not developed and in the final part of the wave propagation inside the FOV the wave was close to the border of the image. In these and in other tested situations it was not possible to fit more than 2 crests inside of a fixed box on each image (the same box and in the same position for all analyzed images) in order to prevent the final spectrum of having contamination from the Milk Way. It was not observed significant changes in the relative intensities obtained from cross sections in the analyzed images (sub-image - part inside the box used in the event). See details of this methodology in our previous paper (Bageston et al., 2011).

The variations in the observed wave parameters (mainly the horizontal wavelength) and

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intensity probably would be verified (quantified) if we could calculate these variables at least for three distinct time intervals. Indeed, we can verify qualitatively in Figure 1 (and in the animations added as additional material - see this animation in the answers to the Referee Richard Picard) that the horizontal wavelength increases while the wave progressed (see the unwarped images) and the intensities of the main front and its successive peaks also have changed as the wave packet propagates to the border of the images. The maximum in the main front is not a requirement for a bore (see Figure 12 of Laughman et al. 2011), since the KdV theory is generally not valid in the atmosphere.

Reference: Laughman, B., Fritts, D. C., and Werne, J.: Comparisons of predicted bore evolutions by the Benjamin-Davis-Ono and Navier-Stokes equations for idealized mesopause thermal ducts, *J. Geophys. Res.*, 116, D02120, 405 doi:10.29/2010JD014409, 2011.

d) Does the front steepen as it progress across the FOV?

REPLY: Yes, please see the new Figure 1, and from the images sequence you can have this idea.

e) However, does it truly last 40 min or does it just propagate outside the FOV? This is a rare event; therefore I think a more detailed description would be in order.

REPLY: No, the bore propagates outside the FOV. From more careful analysis, it was verified that the bore propagates inside the FOV for about 1 hour. More detailed description was addressed in the updated version of the paper.

2) Since the vertical wavenumber is estimated, could the author also estimate the vertical wavelength? For a bore to fit inside the duct, I would imagine the vertical wavelength of the trapped signature should match the depth of the duct.

REPLY: Yes, the vertical wavelength can be easily be estimated by using the relation $m=2\pi/\lambda_z$ and the result presented in Figure 2 (c). For example, for an observed

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value of $m_2 \sim 1.5 \times 10^{-7}$ (at ~ 87 km high) it is obtained $\lambda_z \sim 16$ km. On the other hand, by looking the relation above when $m_2 \rightarrow 0$ implies $\lambda_z \rightarrow$ infinite in Figure 2 (c) (see Figure 2 attached in the answers to the Referee Richard Picard). These results are typical for ducted waves like bore events.

The above result of 16 km for the vertical wavelength inside the duct is consistent with the identification of bore event in OH airglow layer (thickness of ~ 8 km), which would be possible only for vertical wavelength somewhat greater than the airglow layer thickness, i.e., $\lambda_z > 8$ km (Taylor et al., 2007).

Regarding the vertical wavelength, we do not think that the vertical wavelength would match the deep of the duct (its thickness). Maybe the referee want to say that the vertical structure (amplitude) associated to the observed wave (horizontal structure) should fit inside the duct, which makes sense, but we do not have this information.

Reference: Michael J. Taylor, William R. Pendleton Jr., Pierre-Dominique Pautet, Yucheng Zhao, Chris Olsen, Hema Karnam Surendra Babu, Amauri F. Medeiros, and Hisao Takahashi. Recent progress in mesospheric gravity wave studies using night-glow imaging systems. *Braz. J. Geophys.*, 25(2), 27–34, 2007.

3) Use same font size on all figures (or at least make font size on Fig 5 larger).

REPLY: The font size in Figure 5 was increase, and the final version of this figure can now fit with the width of the page.

4) It is difficult to see the event in the first image in Fig1.

REPLY: It was improved the images quality and the Figure 1 was replaced (see Figure 1 attached in the answers to the referee R. Picard).

5) Check references to Figure 2.

REPLY: The Figure 2 was changed according to Picard's suggestions and the text is in agreement with the figure.

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6)” There is a paper by Stockwell et al regarding the Nielsen et al. bore event, which is currently in press (JGR), where the vertical wavenumber squared is being calculated.....”

REPLY: The appropriate citation and discussion regarding the paper of Stockwell et al. (2011) were done (see the new version of the paper).

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 16185, 2011.

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