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Atmospheric Chemistry and Physics Discussions

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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Specific comments

- Pg. C6789 (first paragraph):

REPLY: Yes, the authors are well aware about the situation emphasized by the referee in this paragraph, and thanks for comment.

- Pg. C6789 (second paragraph):

REPLY: Indeed, we do not have information on the vertical regarding to the phase fronts of the bore because of the mentioned limitation in the airglow imager (have just one filter).

- Pg. C6790 (first paragraph):

REPLY: The paragraph related to the difficult in identify the wave structures (due to the presence of low-altitude haze and the location of the Milk Way) was removed, and the images in Figure 1 were improved by using the Time Difference (TD) image technique and filtering process. We believe that now the Figure 1 is adequate (see Figure 1 attached below). Also, a new animation was posted as supplement material.

- Pg. C6790 (second paragraph):

REPLY: The period of observation (40 min) was associated to the time on which the wave structures were seen very clearly in the images, that is less than the time for the event propagates completely through the field of view of the imager. Indeed, the imager has some limitations, and one of these limitations is exactly a smaller effective area (in km) when compared with regular all-sky imagers, since the used camera was adapted to the all-sky system (see explanations in Bageston et al. (2011)). Briefly, this imager system produces a useful image inside of 312x312 pixels on the CCD, given a projected image in the OH layer (with 1 km/pixel of resolution) with a maximum area of 312x312 km. So, the time of observation associated to the bore event (about 1 hour) is consistent with the observed velocity (92m/s or $\sim$ 331 km/h). The text in the paper was changed to: "The original images (with 1024x1024 pixels) were not binned, but cropped to 512x512 pixels due to limitations of the optical (Bageston et al., 2009 and Bageston et al., 2011}, which produces a useful image inside of 312x312 pixels on the CCD."

Improvements of the text were performed in order to give the reader a better idea of the evolution of the event. In synthesis, the event came from outside of the field of view of the imager, from aproximately west, and was maintaining its propagation to the northeast until exiting the field of view. Also, a new animation, with the processed images, will be added as additional material.

- Pg. C6790 (third and fourth paragraphs):

ACPD

11, C8438–C8445, 2011

REPLY: The sentence “This was not done in several previous bore studies, including that by Nielsen et al. (2006) at Antarctic latitudes, because of the absence of temperature and/or wind data” was removed from the text, and a proper citation was added in the introduction.

- Pg. C6790 (Fifth paragraph):

REPLY: The imaging spectrometer is described in the paper: Bageston, J. V., Gobbi, D., Takahashi, H., and Wrasse, C. M.: Development of Airglow OH Temperature Imager for Mesospheric Study, http://www.scielo.br/, Braz. J. Geophys., 25(2), 27–34, 2007. In the revised version the above reference was included.

- The referee said: “ . . .it is mentioned that the field-of-view is too large to yield any wave information”.

REPLY: Maybe we did not express properly the correct information. In the paper we find the following sentence (see the end of pg. 16191 of the manuscript):

“...the field-of-view over which the spectrometer temperatures were averaged was $\sim$70 km in diameter about the zenith, more than twice the wavelength of the bore. . .”. This sentence was changed to:

“...the field-of-view over which the spectrometer observes the sky as an integrated counting of the OH (6-2) emission is $\sim$70 km in diameter about the zenith (Bageston et al., 2007), more than twice the wavelength of the bore. . .. This means that the field-of-view from which we calculate the temperature is large compared with the horizontal wavelength of the bore. Hence, the spectrometer showed no evidence of the 6-min bore period inferred from the all sky imager data...”

- Pg. C6790 (last paragraph): Referee comment: “The discussion of whether ducting is due to the temperature structure through the static stability or to the wind structure is not always stated well in the text.”

REPLY: The separation of the effects of temperature structure (static stability) and wind

ACPD

11, C8438–C8445, 2011

structure is hard to do, especially given possible vertical phase variations between the temperature and wind observations and those of the bore. The best we could do was the separation through the dispersion relation presented in the Eq 1.

The relative importance of the Doppler shift in comparison with the curvature of the wind field is just the comparison between the first and the second terms on the right side of the Equation 1. The second term of Eq 1 is in the Fig. 5 (d), as shown in black, and its scale is at the bottom. For comparison, the Doppler shift in the curvature term, i.e., (u0-c), for a wind of about 40 m/s (the maximum at $\sim$ 82 km hight) gives (u0-c)= -52 m/s, and the term u0"/(u0-c) $\sim$ 1.5X10-7, then we can infer that u0"$\sim$ 10-6. A simple scale analysis shows that the Doppler shift is much higher than the wind curvature in the second term in the dispersion relation. The relative importance of the full curvature term is discussed with more details, for comparison with the N2 term, in the last paragraph before the conclusions.

- Pg. C6791 (second paragraph): Referee comment: "The caption claims they result from the tidal winds alone, while the text claims they are from tidal winds plus the mean winds. I would guess that the latter may be correct."

REPLY: The referee is right, and the figure caption has been changed as in the text.

- Pg. C6791 (last paragraph – general comments):

REPLY: Indeed, we agree that temperature structures are affected by tidal motions. However, it does not appear that the SABER temperature profile showed in Figure 2 was induced by the same tidal components identified in the winds presented in Figure 3, and associated to the variability observed in the wind profile seen in Fig 2. The tidal components identified from the wavelet analysis (Figure 4) are unlikely to be responsible for the inversion layer identified in the temperature profile shown in Figure 2, mainly because of the two following reasons: first, the average temperature profile (not showed here), within -7/+7 hours centered in the event, did not show similar temperature structure (presence of inversion layer) as the one seen in Fig 2; and second, the

ACPD

11, C8438–C8445, 2011

temperature structure mainly at high latitudes is less affected by tides when compared with the horizontal winds according with the classical theory (Chapman and Lindzen, 1970). Some comments regarding to the situation described above are included in the paper.

Referece:

Chapman, S., and Lindzen, R.S., Atmospheric tides. D. Reidel Publishing Company and Dordrecht-Holland, 1970, 200p.

Technical corrections

- “The term "dual duct" in the title is ambiguous.”

REPLY: The term above was replaced by “wind-temperature” in the title. Also, with the clarifications and improvement of the images we can change the title to (if the ACP allow this changing): “Observation of a mesospheric bore in a Thermal-Doppler duct over King George Island, Antarctica”, following the suggestion of Jonathan Snively (referee 2).

- “I recommend changing the order of Figs. 2a, b, c to agree with the text. “. . . “In addition, the caption of Figs. 2 has two labels "(b)" and no label "(c)" “. REPLY: The above recommendations were applied, as can be verified in the new Figure 2 (also, see Figure 2 bellow).

- Next two items. . . REPLY: The corrections were implemented.

- “Figure 5 is too small to be read easily. "Background" is misspelled in Fig. 5b.”

REPLY: The size of the figure was increased in the final edition. The title in Fig. 5b was corrected.

- “On pg 16196, line 8, there appears to be a qualifier missing (perhaps "did not include the low-frequency IGW motions"?)”.

ACPD

11, C8438–C8445, 2011

REPLY: The suggestion sounds better than the previous text, so the correct sentence is: “The mean wind (V0) defined here does not include the low-frequency IGW motions,. . .”

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/11/C8438/2011/acpd-11-C8438-2011-supplement.zip

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

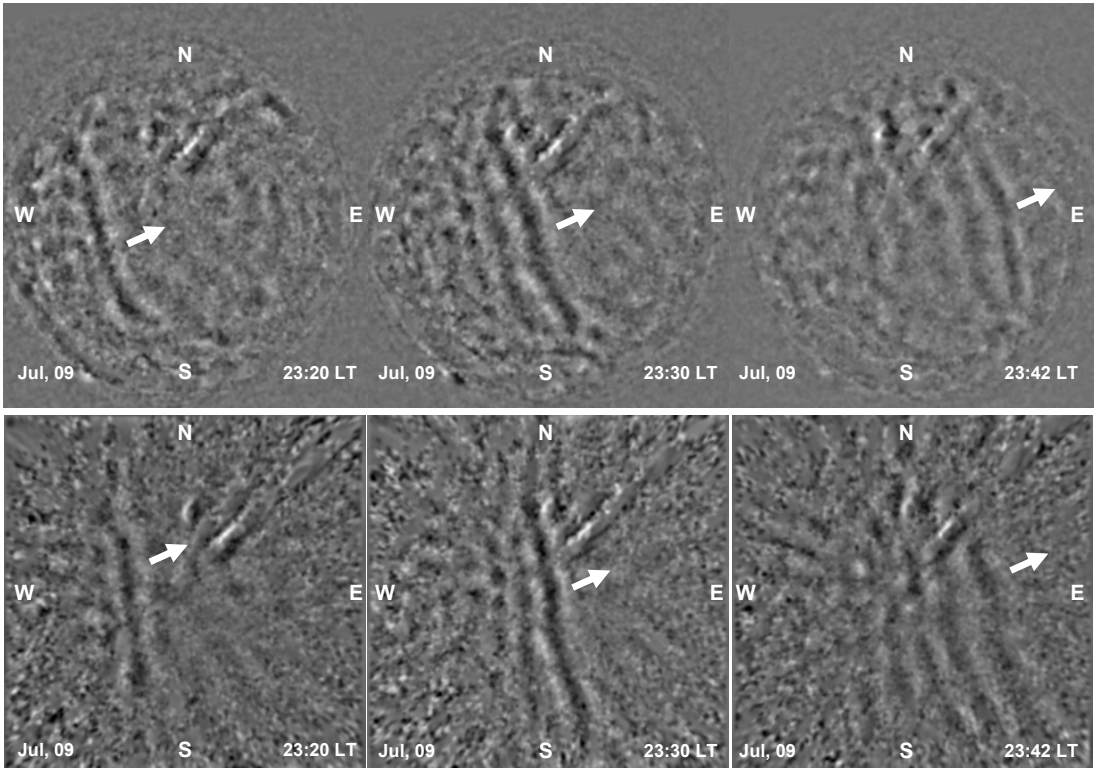

Fig. 1. Processed all-sky OH airglow images at three times spanning about 10 minutes on the night of 09-10 July 2007 showing a mesospheric bore propagating from southwest to northeast.

ACPD
11, C8438–C8445, 2011

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ACPD
11, C8438–C8445, 2011

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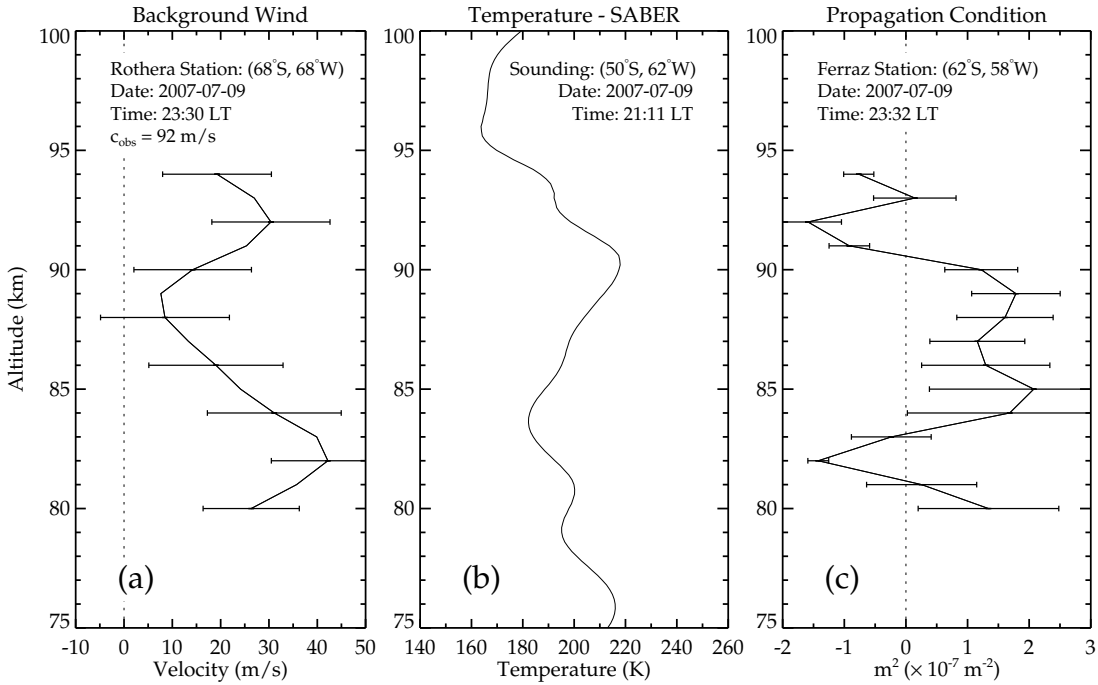

Fig. 2. (a) Wind profile in the bore propagation direction. (b) Temperature profile obtained by SABER on 09 July 2007. (c) Vertical wavenumber squared (mˆ2).

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