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Interactive Comment

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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Review of "Observation of a mesospheric front in a dual duct over King George Island, Antarctica," by Bageston et al.

General comments:

This manuscript describes a single wintertime observation of a mesospheric bore from Ferraz Station, Antarctica with an all-sky airglow imager on 9-10 July 2007. Evidence of the presence of a wave duct was obtained from MF radar wind observations at Rothera Station and a satellite temperature profile from a near-coincident TIMED/SABER limb scan 12 degrees to the N. The evidence for the bore and its supporting duct is presented, and their properties are determined. It is argued that both the temperature and the wind structure contribute to duct formation. While the data set is not optimum and the evidence for the duct and bore behavior is, therefore, less than ideal, the observations are sufficiently unique and compelling to warrant publication.

Specific comments:

This observation is interesting in that it adds to the very small number of observations of bore and other front-like mesospheric disturbances in the Antarctic. Since bores are ducted nonlinear waves, it is important to determine that a duct exists and that the bore characteristics are consistent with the properties of that duct. This is difficult to do convincingly without correlative data to the airglow images, and many, if not most, mesospheric front observations in the past have lacked correlative data. Fortunately, in this case correlative wind and temperature data are available. However, the separation in space and time between the images and the correlative observations is greater than desirable, with the Rothera observations approximately 900 km to the SE and the SABER observations 1300 km N and over 2 h earlier. Despite this, the authors argue that the horizontal structure is sufficiently large scale spatially and slowly enough varying in time that the assumption of near-coincidence measurements is valid. Moreover, it is true that structures in wind and temperature fields, such as wind-curvature regions and temperature-inversion layers, can extend over large spatial areas, with the result that inertial-gravity-wave and tidal amplitudes and phases will change only slowly in space and time. The authors seem well aware of this shortcoming of their data set and may have done the best that is possible in this case to characterize the duct and the bore.

In addition, the imager had only one spectral filter and only observed a single airglow layer (OH). This means that the tilt of the phase fronts in a vertical cross section containing the horizontal wave vector cannot be ascertained. Since there should be no tilt in the case of a ducted wave such as a bore, another powerful means to ascertain the presence of ducted waves and bores is not available.

A further issue with the data is the very low contrast of the wave structures. The authors attribute this to the presence of a low-altitude haze and to the location of the Milky Way in the center of the field-of-view. I could not see the bore at all in Fig. 1, and the bore is not easy to study in the animation, provided as a supplement. The animation seems to also show clouds or haze structures being advected southwestward. Perhaps the authors could attempt to enhance the weak wave structures through image-processing techniques. Failing that, it is probably best to remove Fig. 1, since it shows nothing except how cluttered the field-of-view is.

The period of observation of the bore is only about 40 min. This is shorter than the time for the bore to cross the field-of-view, which is approximately 90 to 140 min depending on the imager resolution. Some discussion of what happened to the disturbance and what the imagery reveals before and after the 40-min "observation" period would be useful.

To be up-to-date, the authors should reference the new Stockwell et al. paper on the 2001 Antarctic bore observation. It is available in "Papers in Press" on the JGR-Atmospheres web site. Reference: Stockwell, R., M. Taylor, K. Nielsen, and M. Jarvis (2011), The Evolution of a Breaking Mesospheric Bore Wave Packet, J. Geophys. Res., doi:10.1029/2010JD015321, in press (accepted 30 June 2011).

It is no longer true that vertical profiles of the vertical wavenumber squared were not calculated for the earlier Antarctic bore, as claimed on pg 16192, line 12. See the above-referenced paper by Stockwell et al.

The specifications of the imaging spectrometer at Ferraz are not given, and it is mentioned that the field-of-view is too large to yield any wave information. However, have the authors considered whether an estimate of the background temperature could be obtained from these spectra, perhaps after binning pixels? This would be very useful.

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. The best

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considered statement is in the last four lines of Sec. 3, where it is stated that the temperature and wind fields together produce ducting and that both are necessary in this case. Also, since the wind can affect the ducting in two ways, through the Doppler shift of the observed wave and through the curvature of the wind field, it would be interesting to show how important each of these roles is.

There is an important discrepancy between the descriptions of the red curves of Fig. 5a,b,c in the text and in the figure caption. 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.

Remember that the tides will affect the temperature structure as well as the wind structure, and the broad temperature-inversion layer seen in the SABER data of Fig. 2 in the OH emission region might be tidally induced. It does not appear that the temperature and wind structure seen in Fig. 2 have a component that is induced by a common tidal modulation, and there is probably good reason why this should be true, given the varying conditions of observation (location, field-of-view, observation time, ...). Nevertheless, since the tidal wind structure seems to be so important to duct formation, some comment about the effect of tidal temperature modulation would be interesting.

Technical corrections:

- The term "dual duct" in the title is ambiguous. It could be misinterpreted to indicate the presence of more than one spatial duct region, as has been suggested for some other bore observations. Some other term should be substituted indicating the importance of both wind and stability effects, for example "wind-temperature duct".

- The reference to Fig. 2a in line 7 of pg 16191 should be a reference to Fig. 2b. There are additional discrepancies in references to Fig. 2b in line 24 and to Fig. 2c in pg 16193, line 7. I recommend changing the order of Figs. 2a,b,c to agree with the text; that is, change b to a, c to b, and a to c. In addition, the caption of Figs. 2 has two labels "(b)" and no label "(c)".

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- Spelling: "consistency" on pg 16193, line 9.

- Phrasing: "from 4 to 33 h" on pg 16195, line 7.

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

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

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