Atmos. Meas. Tech. Discuss., 4, C1618–C1620, 2011
www.atmos-meas-tech-discuss.net/4/C1618/2011/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Modeling the ascent of sounding balloons: derivation of the vertical air motion" *by* A. Gallice et al.

A. Gallice et al.

aurelien.gallice@gmail.com

Received and published: 15 September 2011

We would like to thank Marvin Geller for taking the time to examine our manuscript, and for his helpful comments. Below we give our detailed responses to the points raised.

The reviewer states that we "don't consider the drag arising from the rise rate fluctuations as well as the mean rise rate." We apologize for not discussing this point more clearly in the manuscript. As shown in Eq. (2), the drag force is actually proportional to the ascent rate squared. Moreover, the drag coefficient implicitly depends on the ascent rate, since it is a function of the Reynolds number (see Eq. (6)), itself being a function of the ascent rate through the relation: $\mathrm{Re} = \rho_\mathrm{a} R v_z / \mu$ (P3974, L15). In our model, the drag coefficient is calculated at every point during the balloon's ascent,

using the velocity at that point. Therefore fluctuations in ascent rate are taken into account in our drag calculation. We have modified the text to make this clearer.

The reviewer kindly pointed out that "turbulent layers arising through gravity wave breaking [...] imply fluctuations in the turbulence contributions to the drag." This process may have a significant impact on the calculated value of the ascent rate. We nevertheless chose not to account for it, as it is far too complex to be properly taken into account in the model. Among the major issues preventing the parametrization of this effect, we wish to point out that there is little knowledge regarding the effect of the turbulence intensity on the drag coefficient of non-spherical objects at very high Reynolds numbers.

We are afraid we did not state the point of Sect. 4.2 clearly enough. We did not intend to discuss "on whether it is better to use temperature fluctuations to derive gravity wave vertical velocities rather than the rise rate fluctuations." The aim of Sect. 4.2 was to present an example of the derivation of the air vertical velocity using the model. We also tried to validate the derived air motion by comparing it with other data. As air vertical velocity had not been measured coincidently by other methods during the LUAMI campaign, comparison of the vertical air motion could only be performed with the other variables measured by the radiosonde during the ascent. Temperature appeared to be the most relevant one of these variables, since "the temperature perturbations are partly caused by vertical movements" (Gong and Geller, 2010) and therefore a correlation between air vertical motion and temperature was expected. However this procedure is strongly limited, as pointed out by the reviewer. Temperature fluctuations can be sensitive to both low- and high-frequency gravity waves, whereas vertical velocity fluctuations are more affected by higher-frequency gravity waves (Lane et al., 2003; Geller and Gong, 2010). Gong and Geller (2010) also state that "the gravity wave spectrum in the T' [(temperature fluctuations)] field at least partly overlaps with that in the w' [(vertical velocity fluctuations)] field." We have now emphasized further the limitations of our work in Sect. 4.2.

References

Geller, M. A., and J. Gong (2010), Gravity wave kinetic, potential and vertical fluctuation energies as indicators of different frequency gravity waves, J. Geophys. Res., 115, D11111, doi:10.1029/2009JD012266.

Gong, J., and M. A. Geller (2010), Vertical fluctuation energy in United States high vertical resolution radiosonde data as an indicator of convective gravity wave sources, J. Geophys. Res., 115, D11110, doi:10.1029/2009JD012265.

Lane, T. P., M. J. Reeder, and F. M. Guest (2003), Convectively generated gravity waves observed from radiosonde data taken during MCTEX, Q. J. R. Meteorol. Soc., 129, 1731–1740, doi:10.1256/qj.02.196.

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 3965, 2011.