

Interactive comment on “The response of super pressure balloons to gravity wave motions” by R. A. Vincent and A. Hertzog

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General comments

1. Regarding the derivations of Equations (2) and (3), we agree with the referee that some assumptions were implicitly made in the article. We now explicitly mention the fact that we consider spherical SPBs and small vertical displacements. On the other hand, we did not make any use of the Boussinesq approximation, and have removed any references to it. Furthermore, as Equations (2) and (3) deal with the vertical equilibrium of the balloon, no specific assumption on the horizontal wind needs to be made to derive these equations.

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As suggested by the Reviewer, we have now included a short discussion in the article to convince the readers that $\omega_B > N$ for realistic vertical temperature gradients in the lower stratosphere.

2. First, we agree with the Reviewer that our derivation of \underline{z} only applies in the gravity wave frequency range, i.e. when $N > \hat{\omega} > |f|$. This is now clearly stated in the article.

We also agree that we did not consider in this study the specific case of gravity waves with very long vertical wavelengths, for which the relation that links the wave-induced density disturbances and vertical displacements (our Equation (9)) has to be modified. Eckermann et al. (1998) showed that this equation is indeed accurate to within a few percent in amplitude and phase for waves with vertical wavelengths shorter than 20 km. We retain our approximation since most gravity waves in the lower stratosphere fall within this vertical wavelength range. Nevertheless, we now explicitly stress our use of this approximation in the study.

3. The Reviewer is right that we only dealt with timeseries containing a single wave packet in our analysis. We have now followed his/her suggestion, and included a short discussion on how our results might be changed when multiple wave packets occur at the same time. In this revision we refer to Bocarra et al. (2008), who showed a slight degradation of the retrievals in the case of multiple wave packets. Yet, we are not aware of any observational constraint on the mean number of gravity-wave packets at a given position and time in the atmosphere, and it is therefore impossible to precisely quantify such effect on our retrievals.

Minor Comments

- p10798 L17: the first paragraph of the Introduction has been rephrased to render the meaning of “quasi-Lagrangian” more explicit: SPBs closely follow the horizon-

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tal motions of air parcels but not their vertical motions, as SPBs are constrained to drift on isopycnic surfaces.

- p10803 L12-17: Agreed.
- P10806 L1-3 and Fig. 3: It is now clearly stated in the caption of Figure 3 that $\tau_B = 2\pi/\omega_B$ and $\tau_N = 2\pi/N$. We furthermore stress in the text that our results only apply for $\hat{\omega} > N$.
- P10809 L12: This expression has been rephrased: we now use "position in terms of longitude and latitude".
- P10810 L2: Agreed.
- P10810 L4: Agreed.

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