***Final Author Comments to Anonymous Referee #2 comments on* “Reconstruction of internal gravity wave parameters from radio occultation retrievals of vertical temperature profiles in the Earth atmosphere” *by* V. N. Gubenko et al.**

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Page	Line	mark No. (from left to right)	Comment
1398	2		OK
1398	3		OK
1398	14	1	OK
1398	14	2	OK
1398	15		over France
1398	16-17		radiosonde temperature data
1398	17	2	the wave parameters determined by Cot and Barat (1986)
1398	24		OK
1398	25		OK
1399	8		OK
1399	10		OK
1399	11		was
1399	23		rely
1399	27		the
1400	12		temperature amplitude of the wave field
1400	16		Other part of signal may be associated with the stable layers or turbulence
1400	19		OK
1400	25		OK
1400	28		OK
1401	1		OK
1401	9	1	OK
1401	9	2	OK
1401	12		OK
1401	17		OK
1402	3		We will discuss these assumptions in more details in a re-worked paper
1402	10		OK
1402	12		OK
1403	20		OK
1404	2		OK
1404	11		relative to the horizontal plane
1405	2		OK
1405	3		a_e is experimental analog of a (see p.1404, line 1)
1405	6-8		We will add a comment in a re-worked paper
1405	9		RO data
1405	11		We will introduce the termin RO in a re-worked paper

1405	13		OK
1405	15		vertical
1405	19	1	from RO
1405	19	2	OK
1405	24		This statement follows from the GPS/MET RO analysis and simulations by Marquardt and Healy (2005)
1406	4		absolute value of…
1406	9	1	Because such parameters as vertical wavelength (and vertical wavenumber), Brunt-Vaisala frequency squared, normalized amplitudes of temperature and density fluctuations can be determined from the vertical RO temperature or density profiles, so Eq. (11) or Eq. (12) enables to find experimentally the relative amplitude threshold a_e
1406	9	2	OK
1406	10		$\|m\|=2\pi/\lambda_z$
1406	13		OK
1406	15		Our sign convention here assumes that an intrinsic frequency is positive definite (see Fritts and Alexander, 2003)
1406	16		OK
1408	3	1	Essence of this method is in following: such parameters as vertical wavelength (and vertical wavenumber), Brunt-Vaisala frequency squared, normalized amplitudes of temperature fluctuations can be determined from the vertical temperature profile; this enables to find experimentally a magnitude of the hypothetical relative amplitude threshold a_e; if this magnitude a_e satisfies to the IGW identification criterion then temperature fluctuations can be considered as wave-induced, and a_e is the real amplitude of the wave field correspondent to the amplitude threshold for shear instability; additional knowledge of this important parameter gives a possibility to find IGW characteristics from the vertical temperature profile with the aid of basic dispersion and polarization relations
1408	3	2	OK
1408	11		This is standard form of the WKB approximation in the case of the small wave-induced harmonic perturbations (see Holton, 1992; Fritts and Alexander, 2003)
1408	16		$\|m\|=2\pi/\lambda_z$; we consider only situations when wave amplitude, vertical wavelength and background Brunt-Vaisala frequency are approximately constant on short vertical intervals of wave observations. Our approach is invalid when approaching a critical level
1409	11		OK
1410	7	1	OK
1410	7	2	We omit “verified”
1410	8		with
1410	18		OK
1411	8	1	OK
1411	8	2	Indeed, we calculate a magnitude of the hypothetical relative amplitude threshold a_e from the experimental temperature data. In the case when a_e satisfies to the IGW identification criterion then temperature fluctuations can be considered as wave-induced, and the IGW characteristics may be found from the vertical temperature profile.
1411	12		The simultaneous temperature and wind velocity measurements obtained in a high-resolution balloon experiment (Cot and Barat, 1986) were used by us for the experimental verification and validation of our IGW

			parameters reconstruction technique. Cot and Barat (1986) identified an inertia-gravity wave propagating upwards using a wind velocity hodograph analysis. For the determination of IGW parameters from the basic dispersion and polarization relations they utilized not only the wind velocity data but temperature data also. Using the temperature data only, we independently identified the same wave and reconstructed the IGW parameters determined by Cot and Barat (1986) with relative deviations not larger than 31%
1411	15		OK
1411	16		You are quite right thinking that we used the values of λ_z, |T'|, T_bar and N (left hand side of Table 1) to derive the IGW parameters from temperature data (right hand side of Table 1). Indeed, the values of λ_z and |T'| (indicated by Cot and Barat (1986) on their p.2752) can be obtained from the **vertical temperature profile** shown in Figure 1c on their p.2750. The background values of T_bar and N (don't indicated by Cot and Barat (1986)) can be estimated from the same **vertical temperature profile** also. You are quite right assuming that our method just follows directly from the relations of the IGW linear theory. However, the new relationship (Eq.12), followed from the basic relations of the linear theory, was first obtained by us (Gubenko et al., 2008), and this relationship gives the possibility: 1) to calculate the values of a_e from a single vertical temperature profile measurement; 2) to test the analyzed temperature variations with the aid of IGW identification criterion for the calculated value of a_e; we obtained that the magnitude $a_e=0.67<1$ satisfies the IGW identification criterion (see Table 1), and concluded that the wavelike temperature variations in the data of Cot and Barat (1986) can be considered as wave-induced; 3) to reconstruct the magnitudes of the key IGW parameters such as intrinsic frequency, etc. (see Table 1). For the comparison, let us consider a hodograph analysis method of the IGW parameters reconstruction which was used by Cot and Barat (1986). According to the IGW linear theory the tip of the wave wind velocity vector describes an ellipse. The direction of its major axis indicates that of wave number vector with an 180° ambiguity. The lengths of the major and minor semi-axes of the hodograph ellipse correspond to amplitudes of IGW wind velocity components parallel to (|u'|) and perpendicular to (|v'|) the wave number vector. The ratio f/ω and intrinsic frequency ω can be determined from the polarization relation (2), where f is the inertial frequency at the observation site. Horizontal wave number $k_h=(k^2+l^2)^{1/2}$ and horizontal wavelength $\lambda_h=2\pi/ k_h$ are calculated using the dispersion relation (1) and the background value of N, estimated on the basis of radiosonde **temperature data** from Eq.(22)**!** Thus, we see that if our IGW reconstruction technique is based on the temperature data only, then a hodograph analysis method use both the **wind velocity and temperature data** for the determination of wave parameters. This feature of our IGW parameters reconstruction technique is especially important for RO observations, which can furnish vertical temperature profiles with the global spatial coverage, high vertical resolution and under all weather conditions. But before it was supposed that because in RO measurements the observed quantities are only temperature and atmospheric density, it is impossible to estimate IGW parameters such as the intrinsic frequency and phase velocities that are necessary to quantify the IGW effects.
1411	18		OK

1411	19		Although Cot and Barat (1986) indicated the high accuracy and high vertical resolution of their radiosonde data but, unfortunately, they did not indicate uncertainties of the results of IGW parameters reconstruction. Therefore, we do not know why are some results better than others and the all we have is the mutual comparison of our IGW parameters reconstruction results and that of Cot and Barat (1986) and relative deviations between compared parameters.
1412	1	1	see answer for 1411/19
1412	1	2	OK
1412	3		see answer for 1411/19
1412	6		OK
1412	7		will be deleted “validated”
1412	9		will be specified in a re-worked paper
1412	10		will be specified in a re-worked paper
1412	13		will be specified in a re-worked paper
1412	17		we used similar assumptions as earlier in deriving this expression
1412	20	1	Yes
1412	20	2	amplitude threshold a_e of the temperature wave field
1413	6		in the atmospheric region over territory with pointed coordinates
1413	8		Yes
1413	12		original profiles = profiles with perturbations
1413	24		“confirms” will be replaced for “it is seen from Fig.1”
1413	27		OK
1414	3	1	OK
1414	3	2	reference will be made in a re-worked paper
1414	5		OK
1414	8		the discussion of the results in this table will be made in a re-worked paper
1414	21	1	when uncertainties are less than 100%
1414	21	2	1) Radiosonde soundings consist of point measurements while RO soundings represent averages over finite volumes of the atmosphere and hence there are significant interpretation difficulties when the two types of soundings are compared. Moreover, the validation studies (Kitchen, 1989; Sofieva et al., 2008) indicate that separations of less than a few tens of kilometers and 1 or 2 hours are necessary for useful comparisons between point measurement instruments. This implies that profiles should be almost exactly collocated in time and space for validation of high-resolution profiles. It is quite hardly to get from the CDAAC website the radiosonde data collocated in time and space with RO data where an IGW is clearly visible. We suppose that the simultaneous high-resolution radiosonde wind velocity and temperature data are most appropriate for the further examinations of the technique’s validity. Wave parameters and their uncertainties are listed in Table 2. Description of the uncertainties calculation method can be found in the paper of Gubenko et al. (2008). 2) see answer for 1411/16
1415	1		OK
1420			namely, $\omega*10^4$
1421			when they are less than 100%; rel. un. – relative units
1422			OK

P.S. In accordance with the referee #1 remark the Sections 2 and 3 will be combined. In a re-worked section the needed key equations will be summarized in a couple of paragraphs, and the new equations will be kept.

References

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