



EGUsphere, referee comment RC1
<https://doi.org/10.5194/egusphere-2022-381-RC1>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Referee Comment on egusphere-2022-381

Anonymous Referee #1

Referee comment on "Equatorial waves resolved by balloon-borne Global Navigation Satellite System radio occultation in the Strateole-2 campaign" by Bing Cao et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-381-RC1>, 2022

To my knowledge the paper by Cao et al. is the first time that balloon borne GNSS radio occultations are used to investigate equatorial waves.

Although the paper contains a major technical part it is well suited for ACP and its readership, given the novelty of the presented results and its potential impact on our understanding of atmospheric dynamics in the tropics.

The paper is well written. Some technical parts were already moved into the appendix, and the technical parts remaining in the main text are needed for understanding the methodology.

The authors extract the properties of equatorial Kelvin waves in a Lagrangian frame, and the importance of a better determination of Kelvin wave momentum fluxes is discussed for a better estimation of the wave driving of the quasi-biennial oscillation. Therefore the paper is of broad interest for the readership of ACP.

Overall, the paper is recommended for publication in ACP after addressing my mainly minor comments.

My main comments are that the importance of observations in a Lagrangian frame is overemphasized, and in the introduction the credit to previous work is a bit thin.

Specific Comments:

I.12:

With a vertical resolution of 200-500m you should be able to identify Kelvin waves and gravity waves of vertical wavelengths shorter than 2-3 km.

Identification of 2-3km waves should be possible already by space-borne GNSS RO and space-borne infrared limb sounders that can have vertical resolution as good as 1km, see Wright et al. (2011).

Wright, C. J., Rivas, M. B., and Gille, J. C.:
Intercomparisons of HIRDLS, COSMIC and SABER for the detection of stratospheric gravity waves,
Atmos. Meas. Tech., 4, 1581-1591, 2011.

I.42: You should cite some of the few existing examples as detailed below:

Antonita, T. M., Ramkumar, G., Kishore Kumar, K., and Sunil Kumar, S. V.:
Quantification of gravity wave forcing in driving the stratospheric Quasi-Biennial Oscillation,
Geophys. Res. Lett., 35, L09805, doi:10.1029/2008GL033960, 2008.

Ern, M., and Preusse P.:
Quantification of the contribution of equatorial Kelvin waves to the QBO wind reversal in the stratosphere,
Geophys. Res. Lett., 36, L21801, doi:10.1029/2009GL040493, 2009.

Alexander, M. J., and Ortland, D. A.:
Equatorial waves in High Resolution Dynamics Limb Sounder (HIRDLS) data,
J. Geophys. Res., 115, D24111, doi:10.1029/2010JD014782, 2010.

Ern, M., Ploeger, F., Preusse, P., Gille, J. C., Gray, L. J., Kalisch, S., Mlynchak, M. G., Russell III, J. M., and Riese, M.:
Interaction of gravity waves with the QBO: A satellite perspective,
J. Geophys. Res. Atmos., 119, 2329-2355, doi:10.1002/2013JD020731, 2014.

I.53: This is not entirely correct!

The understanding of equatorial wave properties was advanced by limb sounding observations from satellite in general.

This includes not only GNSS RO, but also several other kinds of limb observations from satellite.

In particular, infrared limb observations from satellite can achieve vertical resolutions similar to GNSS RO from satellite (see Wright et al., 2011)!

To put your results better into context, you should modify this statement and add the

following references:

Salby, M. L., Hartmann, D. L., Bailey, P. L., and Gille, J. C.:
Evidence for equatorial Kelvin modes in Nimbus-7 LIMS,
J. Atmos. Sci., 41, 220-235, 1984.

Shiotani, M., Gille, J. C., and Roche, A. E.:
Kelvin waves in the equatorial lower stratosphere as revealed by cryogenic limb array
etalon spectrometer temperature data,
J. Geophys. Res., 102, 26131-26140, 1997.

Srikanth, R., and Ortland, D. A.:
Analysis of Kelvin waves in High-Resolution Doppler Imager and Microwave Limb Sounder
stratosphere measurements using a constrained least squares method,
J. Geophys. Res., 103, 23131-23151, 1998.

Ern, M., Preusse, P., Krebsbach, M., Mlynczak, M. G., and Russell III, J. M.:
Equatorial wave analysis from SABER and ECMWF temperatures,
Atmos. Chem. Phys., 8, 845-869, 2008.

Alexander, M. J., and Ortland, D. A.:
Equatorial waves in High Resolution Dynamics Limb Sounder (HIRDLS) data,
J. Geophys. Res., 115, D24111, doi:10.1029/2010JD014782, 2010.

I.76-78: please give a reference for this statement, give reasoning, or delete it

I.253: this describes only the situation of setting occultations, but not for rising ones

caption of Fig.5: To which altitude do the SRO locations (yellow circles) refer to?

I.354: What dropsonde products? The sondes are mentioned only here without any further
explanation.
Please give some more information!

I.519-537: You are making too strong statements here! This part of the discussion should therefore be carefully revised and toned down!

Indeed, the wave dispersion relations / dispersion curves are valid for intrinsic frequencies. However, usually the background wind is known relatively well, so that calculation of intrinsic frequencies from ground based frequencies should be possible with good accuracy.

Displaying dispersion curves for zero wind conditions makes also some sense because most of the tropical waves are excited in the troposphere where winds are relatively weak. Therefore I agree with the authors that the Lagrangian perspective offers a different view that may help to better understand details of the wave physics, but I do not see the major benefit of observing in a Lagrangian frame.

I.555: To me, it looks like several corrections and iterations are needed to arrive at a final product release that is trustworthy enough for operational data assimilation.

Can you comment on this issue? Do you think that providing near real time data for operational data assimilation is really feasible? How long would it take from an observation to a final data product?

Technical Corrections:

I.370: Figures 6(d) -> Figure 6(d)

I.430-431: "including Kelvin waves through shorter period gravity waves"
Please reword this phrase for clarity!

I.452: with the wavenumber -> with the zonal wavenumber

I.724: mars -> Mars

I.760: "Hoeg, P., H., A., K., G., S., S., Belloul, B.," ???
reference looks strange!

I.774: "Kirchengast, G., J., H., and W, P.:"
reference looks strange!

l.838: "H., Harijono, W. B., , and Kato, S.: "
reference looks strange!

l.841: reveald -> revealed

l.842: occultationi -> occultation