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Comment on acp-2021-824

Anonymous Referee #2

Referee comment on "Decay times of atmospheric acoustic–gravity waves after deactivation of wave forcing" by Nikolai M. Gavrilov et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-824-RC2, 2021

This paper is a numerical study that investigates the effects that happen after a source of acoustic-gravity waves (AGWs) is deactivated. One of the main findings is that after source deactivation there is a significant amount of "wave noise" that slowly decays quasi-exponentially. The wave noise is attributed to quasi-standing and secondary AGW spectral components. This effect should contribute to the background level of AGW activity in the real atmosphere and is so far neglected in parameterizations of AGWs.

The paper provides several interesting results and is of relevance for the readership of ACP. The paper is well written and recommended for publication in ACP after minor revisions.

Minor comments:

(1) l.23: The paper by Fritts and Alexander (2003) starts with a general dispersion relation, but does not explicitly treat acoustic GWs (AGWs).
Therefore it should not be used as an evidence for the statement that AGWs "exist almost permanently in the atmosphere".
I would suggest to replace this reference with other examples of observations and modeling. Some suggestions:

Lay, E. H. (2018). Ionospheric irregularities and acoustic/gravity wave activity above low-latitude thunderstorms. Geophysical Research Letters, 45, 90-97. https://doi.org/10.1002/2017GL076058.

Meng, X., Vergados, P., Komjathy, A., & Verkhoglyadova, O. (2019). Upper atmospheric responses to surface disturbances: An observational perspective. Radio Science, 54, 1076-1098. https://doi.org/10.1029/ 2019RS006858

Siefring, C. L., J. S. Morrill, D. D. Sentman, and M. J. Heavner (2010), Simultaneous near-infrared and visible observations of sprites and acoustic-gravity waves during the EXL98 campaign, J. Geophys. Res., 115, A00E57, doi:10.1029/2009JA014862.

Snively, J. B. (2013), Mesospheric hydroxyl airglow signatures of acoustic and gravity waves generated by transient tropospheric forcing, Geophys. Res. Lett., 40, 4533-4537, doi:10.1002/grl.50886.

Trinh, Q. T., Ern, M., Doornbos, E., Preusse, P., and Riese, M.: Satellite observations of middle atmosphere-thermosphere vertical coupling by gravity waves, Ann. Geophys., 36, 425-444, https://doi.org/10.5194/angeo-36-425-2018, 2018.

Wei, C., Buehler, O., and Tabak, E. G.: Evolution of Tsunami-Induced Internal Acoustic-Gravity Waves, J. Atmos. Sci., 72, 2303-2317, doi:10.1175/JAS-D-14-0179.1, 2015.

(2) In Fig.2 it is noteworthy that there seems to be a cascade of amplitude decay before the exponential decrease sets in.
Particularly at 10km and 30km, there is a fast decrease after wave source deactivation to an intermediate level (between 125 h and 175 h), followed by another fast decrease to a level from where the quasi-exponential decay starts.
Do you have any idea what causes this cascade?

(3) About wave launch amplitudes and phase speed:
are the values assumed for your simulations realistic for known source processes?

(4) l.254: about "generation of wave-induced jet streams..."
Do you think that this can be an important effect in the real atmosphere?
Do you think that launch amplitudes are realistic, or could they be too strong and cause this effect?

(5) Could there be reflections at the tropopause level in the model and in the real atmosphere?
Is the sharp feature of the real-atmosphere tropopause captured in the assumed background atmosphere? Could you show the temperature profile that you use? What

would happen if the background wind changes rapidly with height?

Technical comments:

l.26: AGWs are permanently existed -> AGWs permanently exist

l.26/27 reference Yigit et al. (2012) is missing in the references

Yigit, E., Ridley, A.J., Moldwin, M.B.:
Importance of capturing heliospheric variability for studies of
thermospheric vertical winds,
J. Geophys. Res. 117, A07306. https://doi.org/10.1029/2012JA017596, 2012.

l.29: Gossard and Hook -> Gossard and Hooke

l.36: 1916 -> 2016

l.40: there analysis. -> their analysis ??

l.43: (RAMS) -> (RAMS)

l.48: propagations -> propagation

l.54: of numerical model, -> of the numerical model,

l.83: accompanied AGW propagation. -> that accompany AGW propagation.

l.85: deviations (2) -> deviations as defined in Eq. (2)

l.87: (Picone et al., 2001). -> (Picone et al., 2002).

l.91: maxima about -> maxima of about

l.92: minimum up -> minimum of up

l.98:
conditions at the upper boundary (4)
->
conditions at the upper boundary as defined in Eq. (4)

l.99: conditions (4) -> conditions (Eq. (4))

l.102: ??
have sense of the amplitude and frequency,
->
are the amplitude and frequency of wave excitation,

l.104: in (5) -> in Eq. (5)

l.112: the wave excitation (5) -> the wave excitation in Eq. (5)

l.113: of wave source (5), -> of the wave source in Eq. (5),

l.118: the wave source (5) -> the wave source in Eq. (5)

l.119: activating surface wave -> activating of the surface wave

l.120: (5) -> (Eq. (5))

l.121: in (5) -> in Eq. (5)

general comment: please check how equations should be referenced in the text according to ACP style!

l.127: 2001 -> 2002

l.129: and use horizontal -> and assume the horizontal

l.131: conditions (6). -> conditions according to Eq. (6).

l.133: (5) -> (Eq. (5))

l.135:
This corresponds the horizontal wavelength
->
This corresponds to the horizontal wavelength of

l.136: periods -> periods of

l.142: of smoothing factor -> of the smoothing factor

l.174: Hook -> Hooke

l.178: made applying (7) -> performed by applying Eq. (7)

l.191:
making vertically quasi-standing AGW modes
->
resulting in vertically quasi-standing AGW modes

l.192: of wave source spectrum -> of the wave source spectrum

l.216:
wave noise at the sharp wave source triggering
->
wave noise for the case of sharp wave source triggering

l.263: Hook -> Hooke

l.291: XOZ region
Please clarify! Do you mean an XZ cross section at y=0?

l.304: produces -> produced

l.310: Hook -> Hooke

l.420: paper number or page range missing in the reference Dalin et al. (2016)

l.423: paper number or page range missing in the reference De Angelis et al.

l.426: reference Djuth et al. (2004): journal should be GRL, not JGR.

l.448: reference Godin: Earth Planets Space, 67, 47, ...??

l.466: L"uhr, -> L\"uhr,

l.460: Yigit,

l.475: reference Rapoport: please delete ", Elsevier, 2004,"

l.487: last excess -> last access

l.493: volume number and pages are missing in the reference Yigit and Medvedev

l.494: reference Yigit and Medvedev is from 2015, not from 2014