

## Reply on RC1

Nikolai M. Gavrilov et al.

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Author 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-AC2>, 2021

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**We would like to thank the Reviewer for interesting and valuable comments helping us to improve the paper. Our replies are given below in bold font.**

Replies to the general points.

- **In the middle atmosphere, our model involves the same dissipation mechanisms as at higher altitudes, namely, molecular and turbulent viscosity and heat conduction, also instabilities and nonlinear effects leading to generation of secondary short-wave modes. The rate of AGW dissipation depends on the wavelength. Short-wave components may effectively dissipate in the middle atmosphere. Long-wave modes can propagate up to the upper atmosphere. The model involves all these cases. We add more clarifications to the revised text of the paper.**
- **The model is based on special numerical algorithms accounting for the main conservation laws. Therefore, "numerical viscosity" is very small. Our test simulations showed that in the absence of physical dissipation, wave modes might exist in the model for hundreds of wave periods without substantial decrease in their amplitudes. Therefore, we think that in the present model, viscous dissipation is much smaller than molecular and turbulent viscosity and heat conduction, which are involved in the model at all altitudes. We added respective description to the revised text.**
- **In principle, we have performed some test simulations for localized wave sources. The reviewer is right that locally, for an isolated wave source, the amplitude decay could be faster due to horizontal dispersion of wave packets. However, at low altitudes these wave packets can several times go around the globe and return to the initial point (such behavior was observed, for example, for strong AGWs after big explosions of meteorites and volcanoes). Therefore, globally, wave packets may exist in the atmosphere for the long time. If there are several local wave sources, wave packets from different sources may superpose and produce more horizontally uniform long-lived wave noise. Therefore, the horizontally inhomogeneous model considered in this paper may reflect general global features of AGW decay processes in the atmosphere. Considerations of isolated and multiple local wave sources we are**

planning to make in subsequent papers. We added this discussion to the revised text.

- Such impression is probably true for the residual wave noise, which may exist for long time after the wave source deactivation. However, amplitudes of this residual noise become smaller in time, and near active wave sources, amplitudes of generated primary AGWs may much exceed the wave noise. We added this discussion to the revised text.

More specific comments

l. 210 **"Secondary waves"** is a usual term for smaller-scale wave modes generated by forced **"primary"** waves due to instabilities and nonlinear interactions (e.g. , Healy et al., <https://doi.org/10.1029/2019JD031662>). The term **"residual waves"** we use to indicate wave modes propagating in the atmosphere after deactivations of their sources. We added these definitions to the revised text. The term **"quasi-standing"** is less defined. We changed respective phrases to avoid its usage.

- 180 **Thanks. We made this description more precise.**

1.240. **Yes. The time delay was estimated by Gavrilov and Kshevetskii (<https://doi.org/10.1016/j.asr.2015.01.033> ). We added the citation to the text.**