Comments to referee #2

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We thank you for your useful comments, suggestions and constructive criticisms, which have significantly helped us in improving the paper. We have split your comments into several parts (marked in blue), so that all the queries could be answered in a point-wise manner. Responses to your comments are marked in blue in the paper.

This manuscript presents a theoretical study of the two-dimensional "explosive instability" of resonant triads between two surface waves and either a bottom ripple or a vorticity wave on a velocity interface.

In this paper, one 'wave' has to be the bottom ripple. Hence, the resonance is bewteen two surface/interface gravity or vorticity or vorticity–gravity wave along with the bottom ripples.

I believe that this might ultimately be publishable in Nonlinear Processes in Geophysics, but not in its present form. The two principle reasons are listed below.

1. I am concerned that the results from section 2 (two-layered fluid) are not sufficiently novel. The explosive instability in a two-layer fluid using piece-wise linear velocity pro-files (analogous to the present work) was previously investigated by Voronovich and Rybak (Oceanology 1977) and Voronovich et al. (Isvestia 1980). The work of Alam (JFM 2012) on triad resonance between two surface waves and an interfacial wave (without shear, and hence without the explosive instability) should also be recognized. The results in the present manuscript appear to be very similar to these prior studies. The authors need to revise the manuscript to acknowledge this and discuss the differences between the results, or else remove this section if the results are essentially identical.

Most of the theoretical work of our paper is contained in the section 2 itself (i.e. the single–layered fluid). The purpose of the section concerned with two–layered fluid (section 3) is mainly to highlight that in a two–layered flow, the condition of explosive instability is met at considerably lower velocity. We believe that we have adequately explained in the section that why a two–layered flow with small density jump may easily give rise to explosive instability.

Further, we have cited the papers by Voronovich and Alam, as suggested by you, in the revised version of the paper.

2. On page 8, the authors refer to a numerical simulation of the explosive instability for a bottom ripple, but present no results. Instead, an archive pre-print is referenced. I recommend incorporating the numerical simulations into a revised manuscript, as this would make the article much more complete and thorough. Readers would benefit from seeing illustrations of the flow showing how the explosive instability works in practice. As a further suggestion, a numerical simulation of the two-layer case (Sect. 2) would also be a valuable addition, as this could establish the existence of an explosive instability with velocity profiles that are more realistic than the piece-wise linear profiles used here. Such a simulation could be publishable even if the theoretical results are essentially identical to the previous work of Voronovich.

Firstly, we have not explained the numerical method in detail in this paper. The paper concerned with details of numerical method is the arXiv pre-print which is now published in JFM and we have revised the citation. Secondly, we had included the results of one simulation pertaining to single-layered fluid in the first version (Figure 3). The figure illustrates that the amplitude of both of the waves (i.e. the spatial Fourier transform of the waves at different times) grow exponentially. However, we did not include that how the waves and explosive instability look like in the real space. Therefore, thirdly, in the revised version of the paper, we have added three new figures showing that how the explosive instability may look like in the real space (Figure 5). Fourthly, we would like to clarify that the numerical simulation too use a piece-wise linear velocity profile. The numerical simulation is based on the method described in Alam et. al. (2009, Paper II). We have extended the method to include a piecewise linear velocity profile in Raj & Guha (2019). Because the method is based on the potential flow theory, it will not be possible to use a fully non-linear velocity profile (i.e. profile that is continuously differentiable).

We thank you for your suggestion which has helped us in enhancing the novelty of the paper. We hope that now we have been able to clarify your doubts.

References

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