Nonlinear Processes in Geophysics Discussions

Nonlin. Processes Geophys. Discuss., referee comment RC1
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Comment on npg-2021-16

Anonymous Referee #1

Referee comment on "The effect of strong shear on internal solitary-like waves" by Marek Stastna et al., Nonlin. Processes Geophys. Discuss., https://doi.org/10.5194/npg-2021-16-RC1, 2021

The refereed paper is devoted to the description of the series of numerical experiments performed with high resolution on simulations of wavefield adjustment in a stratified basin with strong shear flows. It is demonstrated that strongly nonlinear large-amplitude solitary-like waves of bell-shaped forms can stably propagate in the counter-current direction. In the meantime, co-current propagating perturbations have recirculating vortex cores completely different shapes from the classical theory of internal solitary waves. Moreover, behind the leading waves, a turbulent wake is generated and gradually separates from the frontal waves. Both co-current and counter-current waves are spontaneously generated from general initial conditions demonstrating further very asymmetric behaviour. The cases associated with critical layers were also observed. The authors discuss the application of the numerical experiments to the real observations in situ and to existing theories; the results obtained provide a partial reconciliation between observations and theory.

The paper is clearly written in good English, contains new, important, and interesting results. I am recommending the paper for publication in the journal with only minor remarks and suggestions.

1) I would suggest citing papers in the same references in chronological order. In particular, on page 1, line 15, it would be logical to refer to the papers in the reverse order (Talipova et al. (1999); Helfrich and Melville (2006)) rather than (Helfrich and Melville (2006); Talipova et al. (1999)).

2) On the same page 1, line 15 it would be reasonable to add the reference on the review: Ostrovsky et al., Chaos, 2015, DOI: 10.1063/1.4927448

3) On page 3, line 79 extra ‘the’ must be removed.

4) On page 4, line 100 I am suggesting replacing the term ‘shear’ viscosity with the term ‘molecular kinematic’ viscosity.

5) I was going to remark that the use of the molecular kinematic viscosity is doubtful in the context of water waves in such a rather big basin, but the authors have anticipated my remark and mentioned the importance of the eddy viscosity on lines 287–288. This is indeed an important issue that can be studied separately.

6) It would be good to clarify in a bit more details the physics of such a big difference and asymmetry in the ISW behaviour when they propagate co-current and counter-current. It is amazing that despite the wave amplitudes in the latter case are notably higher, they stably propagate, whereas in the former case, the instability occurs producing a turbulent wake.