Answers on the comments of Reviewer 2 of the paper

The Lagrange form of the nonlinear Schrodinger equation for low vorticity waves in deep water: rogue wave aspect

by

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Reviewer 2:

First, it suffers a lack of illustration. Indeed, a single figure appears, and intends to show the full geometry of the problem. For instance, from the figure, I cannot understand what is this “average current” (average in time, in ‘a’ coordinate? In ‘b’ coordinate?) Neither can I see a weak vorticity. Thus, the definition of vorticity is confusing. Another way to say the same thing is that the Euler to Lagrange coordinate transform is not clear. Is a background vertical flow included? Or do we only consider the vertical flow induced by the waves?

Authors:

We highly appreciate this comment. We shall add the required information in the figure. The horizontal current ψ_{1t_1} depends on slow coordinates only. So we name it “average current” as it is average in fast variables a_0, t_0 (see Eq.13). A weak vorticity is set as an arbitrary function of the Lagrange coordinates in some region. For example, the vorticity may differ from zero within the restricted region. This case corresponds to the interaction of the wave with the localized vortex. We plan to illustrate this distribution of the vorticity in the figure. We concentrate on studying horizontal current because it is a term of the NLS equation. But in the quadratic approximation there exists the vertical flow as well. This one is described by the function f_2 depending on the wave amplitude and the horizontal current (see Eq.21). In the Eulerian coordinates the background flow has two components of the velocity depending on the variables x, y, t.

Reviewer 2:

Presentation of the results is a little bit confusing.

For instance, it is shown that the absence of vorticity and current, the Akhmediev soliton solution in Lagrange coordinates does correspond to the Akhmediev soliton in Euler coordinates, up to the second order in epsilon. But then, for quadratic and cubic terms, it is claimed the solutions differ. Here could be an interesting result. Could be the authors consider obtaining these solutions and present differences?

Authors:

That is a good idea, but there are two serious problems. First, it is necessary to get a solution up to the third order in the Euler coordinates. As far as we know nobody was able to do that. Second, it is necessary to transform our solution to the Eulerian form, i.e. to solve equations for the functions $\psi_1, \psi_2, \psi_3, f_2, f_3$ and then to express the obtained solutions in the Euler variables. This program requires very unwieldy calculations. So we consider the reviewer’s idea worth being realized in a new paper.

Reviewer 2:

When considering the Gerstner wave, where does the vorticity profile comes from? Thus, the following sentence is disturbing: “From the physical point of view, this is due to the fact that the average current induced by the vorticity compensates the stokes drift”. Is it only true when integrated? The result associated is very interesting (finding Gerstner waves not affected by modulational instability), but its explanation is not straightforward and should be developed. Still, these waves are a very specific case, and this is not clear from the text.

Authors:

We agree that a more detailed explanation is necessary. The vorticity profile of the Gerstner wave is found by substitution of the solution (Eq. 42) into Eq. 6. This will be mentioned in the revised paper. Besides, special attention will be paid to the fact that the first term in Eq. 40 coincides with the Stokes drift. It is a remarkable fact. In the quadratic approximation the vorticity of the Gerstner wave equals modulo and opposite in sign to the vorticity of Stokes drift. So these terms mutually neglect each other without integration (see Eq. 22). The Gerstner wave is really a very specific case and we shall mention this fact in the revised paper.

Reviewer 2:

Results of the following part, entitled "Rogue waves", describe the evolution of the coefficients of the NLS equation with the structure of vorticity. In each one of the three cases studied, the eventuality of a breather soliton to exist is analyzed. Maybe, the characteristics of these new Peregrine breather could be described, by comparison with classical one. This analysis would provide an idea of whether or not a vertical flow is amenable to increase the probability of occurrence of rogue waves.

Authors: The vorticity leads to variation of the wavelength of the carrier wave but doesn't affect its amplitude. The vertical flow is described by the function f_2 (see Eq. 21). It affects the amplitude in the next approximation relatively to the solutions of the NLS equation.

The authors would like to express their sincere thanks to Reviewer 2 for all of the valuable comments and helpful suggestions.