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Pressure fields beneath intense surface water wave groups: weakly nonlinear vs strongly nonlinear results

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A weakly-nonlinear potential theory is developed for the description of deep penetrating pressure fields caused by single and colliding wave groups of collinear waves due to the second-order nonlinear interactions [1]. The result is applied to the representative case of groups with the sech-shape of envelope solitons in deep water. When solitary groups experience a head-on collision, the induced due to nonlinearity dynamic pressure may have magnitude comparable with the magnitude of the linear solution. It attenuates with depth with characteristic length of the group, which may greatly exceed the individual wave length. In general the picture of the dynamic pressure beneath intense wave groups looks complicated. The qualitative difference in the structure of the induced pressure field for unidirectional and opposite wave trains is emphasized.
The results of the weakly nonlinear approach are compared with strongly nonlinear numerical simulations of the potential Euler equations, which are performed with the help of the High Order Spectral Method. The focus on extreme events in the pressure field is made.

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[1]. A. Slunyaev, E. Pelinovsky and H.-C. Hsu, The pressure field beneath intense surface water wave groups. Eur. J. Mech. B / Fluids 67, 25-34 (2018).