Geophysical Research Abstracts,
Vol. 10, EGU2008-A-12181, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-12181
EGU General Assembly 2008

Strongly nonlinear simulation of wave packet dynamics and verification versus laboratory experiment

A. Slunyaev (1), L. Shemer (2) and B. Dorfman (2)

(1) Institute of Applied Physics, Nizhny Novgorod, Russia, (2) School of Mechanical Engineering, Tel Aviv University, Tel Aviv, Israel (Slunyaev@hydro.appl.sci-nnov.ru)

The numerical simulations of evolution of a narrow-band steep wave packet over deep water are performed using numerical models of different levels of nonlinearity: the Dysthe equation, the strongly nonlinear Dommermuth and Yue's code, and the fully nonlinear conformal mapping approach by Dyachenko and Zakharov. The third-order finite deep water nonlinear bound wave correction is employed to link the envelope approximate equations and the solvers of the Euler equations. The significant wave nonlinearity (initial steepness is 0.18, and it grows further) makes the nonlinear Schrodinger equation inappropriate to describe the envelope dynamics, and the results of simulations of the Dysthe and of the Dommermuth & Yue codes become doubtful from the formal point of view. It is shown however that the Dysthe model describes very well the wave packet dynamics for about 25 wave periods (this limitation is imposed by the size of the wave flume). The strongly nonlinear models predict steeper waves than the Dysthe approach and the experiment measurements. This discrepancy may be due to the dissipation or ambiguity in the definition of the initial conditions for the simulations, and will be analyzed further.

The results of the simulations have been verified by measurements in a wave tank. The measurements included classical retrieving of time-series at different distances of the wave group propagation, as well as the results of an elaborated method of digital processing of sequences of video images. This approach provides immediate comparison of the laboratory experiments with the time-evolution water waves' models.