



Improved 3-D model for periodic waves based on initial equation

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The improved method of modelling of three-dimensional surface waves is described. Contrary to approximate HOS approach, where the vertical velocity on the surface is calculated with Taylor expansion, the given method allows to calculate the exact surface vertical velocity with estimated accuracy. The advantages of new method are discussed by comparison with HOS method.

Method is based on dynamic and kinematic surface boundary conditions and elliptic equation for velocity potential written in surface-fitted coordinate system. A direct iterational solution of equation for potential usually needs a high vertical resolution what significantly slows down the speed of calculations. The separation of velocity potential into linear and nonlinear modes allows to reduce the problem to the same equations but written for nonlinear correction for linear solution. Since the correction is typically smaller by 2 decimal order than a linear constituent, the solution needs less accuracy and smaller number of vertical levels. Such improvement makes the 3-D model well suitable for performing the multi-mode and long-term calculations. Such calculations allows to investigate the nonlinear properties of 3-D wave field, mechanics and statistics of extreme waves, formation of angular spreading of waves. Being supplied by well developed algorithms of wind input and breaking dissipation model allows the simulation of long-term development of waves initially assigned as a monochromatic train of initially small waves.

The details of numerical scheme as well as the results of model validation and the examples of long-term simulations of 3-D wave field are given.