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Numerical simulation of three-dimensional gravity-capillary waves

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Understanding the dynamics of gravity-capillary waves is important for remote sensing and for studying long waves generation mechanisms. A common approach to modeling surface waves is to assume the motion to be potential and then solve the equations of motion for a potential flow with a free surface using boundary integral equation methods. These methods impose high computational costs, especially when solving a 3d problem.
Here we perform numerical simulation of gravity-capillary waves within the framework of fully nonlinear equations of motion (Euler equations) for potential waves using parameterizations for wind forcing and viscous decay. To take an account of three-dimensional effects we employ a quasi-three-dimensional model put forward by Ruban. It is based on the method of conformal transformations and allows an efficient implementation using a Fast Fourier Transform. The model assumes narrow directional distribution of waves while not imposing any limitations on their steepness. The aim of our work is to model the dynamics of transversely modulated wavetrains and to explore the limits of applicability of the Ruban model in the gravity-capillary range.
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