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Effect of water vorticity on wind-generated gravity waves in finite depth. (English)

Zbl 07443735

Water Waves 3, No. 2, 355-369 (2021)

Summary: The generation of wind waves at the surface of an established underlying vertically sheared water flow, of constant vorticity, is considered. A particular attention is paid to the role of the vorticity in water on wind-wave generation in finite depth. The present theoretical results are compared with experimental data obtained by Young and Verhagen (Coast Eng 29:47-78, 1996), in the shallow Lake George (Australia), and the least squares fit of these data by Young (Coast Eng 32:181-195, 1997). It is shown that without vorticity in water, there is a deviation between theory and experimental data. However, a good agreement between the theory and the fit of experimental data is obtained when negative vorticity is taken into account. Furthermore, it is shown that the amplitude growth rate increases with vorticity and depth. A limit to the wave energy growth, corresponding to the vanishing of the growth rate, is obtained. The corresponding limiting wave age is derived in a closed form showing its explicit dependence on vorticity and depth. The limiting wave age is found to increase with both vorticity and depth.

MSC:

76E20 Stability and instability of geophysical and astrophysical flows

76M25 Other numerical methods (fluid mechanics) (MSC2010)

76B15 Water waves, gravity waves; dispersion and scattering, nonlinear interaction

76E17 Interfacial stability and instability in hydrodynamic stability

86A05 Hydrology, hydrography, oceanography

Keywords:

shear instability; Rayleigh equation; wind-wave generation; vorticity

Full Text: [DOI](#)

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