Statistical properties of directional surface gravity waves: A laboratory experiment with mechanically generated waves

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A wave basin experiment has been performed at MARINTEK, in one of the largest existing three-dimensional wave tanks in the world. The goal of the experiment has been to investigate the effects of directional energy distribution of the waves on the statistical properties of surface gravity waves. Different degrees of directionality have been considered, starting from long-crested waves up to waves with a directional distribution of about $30°$. Particular attention is given to the tails of the distribution function of the surface elevation, wave heights and wave crests. Comparison with second order theory is reported. The results show that for long crested, steep and narrow-banded waves, the second order theory underestimates the probability of appearance of large waves. As directional effects are included, the departure from second order theory becomes less accentuated and the surface elevation is characterized by weak deviations from Gaussian statistics. A complete picture of the role of the modulational instability for deep water, unimodal random spectra is finally achieved and here discussed.