Geophysical Research Abstracts
Vol. 15, EGU2013-13978, 2013
EGU General Assembly 2013

Prediction of Ship Response Statistics in Extreme Seas Using Model Tests Data and Numerical Simulations

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Earlier investigations have indicated that proper prediction of nonlinear loads and responses due to nonlinear waves is important for ship safety in extreme seas. However, the nonlinear loads and responses in extreme seas have not been sufficiently investigated yet, particularly when rogue waves are considered. A question remains whether the existing linear codes can predict nonlinear loads and responses with a satisfactory accuracy and how large the deviations from linear predictions are. To indicate it response statistics have been studied based on the model tests carried out with a LNG tanker in the towing tank of the Technical University of Berlin (TUB), and compared with the statistics derived from numerical simulations using the DNV code WASIM. It is a potential code for wave-ship interaction based on 3D Panel method, which can perform both linear and nonlinear simulation. The numerical simulations with WASIM and the model tests in extreme and rogue waves have been performed. The analysis of ship motions (heave and pitch) and bending moments, in both regular and irregular waves, is performed. The results from the linear and nonlinear simulations are compared with experimental data to indicate the impact of wave non-linearity on loads and response calculations when the code based on the Rankine Panel Method is used. The study shows that nonlinearities may have significant effect on extreme motions and bending moment generated by strongly nonlinear waves. The effect of water depth on ship responses is also demonstrated using numerical simulations. Uncertainties related to the results are discussed, giving particular attention to sampling variability.