Geophysical Research Abstracts
Vol. 17, EGU2015-7271, 2015
EGU General Assembly 2015

Modeling Wave-Ice Interactions in the Marginal Ice Zone

Mark Orzech (1), Fengyan Shi (2), Sam Bateman (3), Jay Veeramony (4), and Joe Calantoni (3)

(1) Naval Research Lab, Code 7322, Stennis Space Ctr, MS, 39529 USA (mark.orzech@nrlssc.navy.mil), (2) CACR, University of Delaware, Newark, DE 19716 USA, (3) Naval Research Lab, Code 7434, Stennis Space Ctr, MS, 39529 USA, (4) Naval Research Lab, Code 7322, Stennis Space Ctr, MS, 39529 USA

The small-scale (O(m)) interactions between waves and ice floes in the marginal ice zone (MIZ) are investigated with a coupled model system. Waves are simulated with the non-hydrostatic finite-volume model NHWAVE (Ma et al., 2012) and ice floes are represented as bonded collections of smaller particles with the discrete element system LIGGGHTS (Kloss et al., 2012). The physics of fluid and ice are recreated as authentically as possible, to allow the coupled system to supplement and/or substitute for more costly and demanding field experiments. The presentation will first describe the development and validation of the coupled system, then discuss the results of a series of virtual experiments in which ice floe and wave characteristics are varied to examine their effects on energy dissipation, MIZ floe size distribution, and ice pack retreat rates.

Although Wadhams et al. (1986) suggest that only a small portion (roughly 10%) of wave energy entering the MIZ is reflected, dissipation mechanisms for the remaining energy have yet to be delineated or measured. The virtual experiments are designed to focus on specific properties and processes – such as floe size and shape, collision and fracturing events, and variations in wave climate – and measure their relative roles the transfer of energy and momentum from waves to ice. Questions to be examined include: How is energy dissipated by ice floe collisions, fracturing, and drag, and how significant is the wave attenuation associated with each process? Do specific wave/floe length scale ratios cause greater wave attenuation? How does ice material strength affect the rate of wave energy loss? The coupled system will ultimately be used to test and improve upon wave-ice parameterizations for large-scale climate models.

References:

>Kloss, C., C. Goniva, A. Hager, S. Amberger, and S. Pirker (2012). Models, algorithms and validation for opensource DEM and CFD-DEM. Progress in Computational Fluid Dynamics 12(2/3), 140-152.

>Ma, G., F. Shi, and J.T. Kirby (2012). Shock-capturing non-hydrostatic model for fully dispersive surface wave processes. Ocean Modelling 43-44, 22-35.

>Wadhams P., V. Squire, J.A. Ewing, and R.W. Pascal (1986). The effect of the marginal ice zone on the directional wave spectrum of the ocean. J. Phys. Oceanog., 16(2), 358-376.