The Cryosphere Discuss.,
https://doi.org/10.5194/tc-2019-121-RC2, 2019

The Cryosphere Discussions
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Interactive comment on "Wave energy attenuation in fields of colliding ice floes. Part A: Discrete-element modelling of dissipation due to ice–water drag" *by* Agnieszka Herman et al.

Anonymous Referee #2

Received and published: 5 August 2019

This paper deals with theoretical aspects relevant to the dissipation of waves traveling in sea ice. Particular focus is devoted to the role and parameterization of the ice-water drag as relevant dissipation mechanism. A discrete-element model (DEM) was employed in order to simulate the motion and collisions of the ice floes under the wave action, coupled to the wave energy transport with phase-averaged source terms. As the aim of the paper was to explain wave dispersion and attenuation observed in a wave channel, wave energy dissipation due to overwash was also considered for completeness. Indeed, laboratory wave data are the subject of a companion paper (Part B), for which I was also asked to review. Unlike the water-ice drag, a minor role was recognized to the overwash mechanism to account for wave energy dissipation. Wave

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Discussion paper

energy attenuation was analytically analyzed in the case of compact, horizontally confined ice cover. Interestingly, the authors show that a non-exponential wave attenuation law with the distance has to be expected if a quadratic drag law at the ice-water interface is assumed. Current wave field observations do not allow to discriminate between the widely accepted/assumed exponential wave energy decline against other types of wave attenuation as a result of the large data scatter provided by in situ wave measurements. This means that new technologies should be envisaged to overcome this experimental limit. Authors also show that the attenuation rate is frequency-dependent and the dependence is related to the dispersion relation used. To this end, the authors assumed a wave dispersion relationship which blends shortening (mass loading) and lengthening (elasticity) of the open sea wavelength proportionately to the nature and rheology of sea ice. I support this paper. Some specific comments will be reported below, which I would like to read in the final version of the paper: 1) a discussion to explain the choice of the wave dispersion (eq. 6) could be added. The reason is the presence of the mass loading term. The weak point is that it could not adequately represent the ice floes assumed in the paper in terms of horizontal size/ wavelength ratio. In fact, the mass loading term is considered valid for really point-like ice floes (compared to the wavelength). 2) The relevance of papers like this is the possibility to extrapolate to the real world what learned for the in-door environment, also in simulation. So, to what extent do the authors think their model formulation can represent the complexity of our changing Arctic and Antarctic MIZ?

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