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Interactive comment on "Experimental evidence for a universal threshold characterizing wave-induced sea ice break-up" *by* Joey Voermans et al.

Anonymous Referee #1

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This paper presents an analysis of recent field campaigns in which the wave conditions and simultaneous sea ice break up were measured. This data is compared with data from previous observations to determine a threshold for breaking. Such a threshold will be useful provided it is accurate. Even if it is not entirely accurate, I believe it will serve as a valuable benchmark for comparison. I am supportive of the publication.

The fundamental difficulty in this from a theoretical point of view is that the sea state is random with a range of periods. It is therefore difficult to assign to any break-up event a single value for λ unless it is for a wave tank experiment. This point should be discussed.

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Discussion paper

The equations for Young's modulus etc. are essential and summarise literature which is not well known. Multiple authors, mostly those associate with Squire, have used 6GPa for the Youngs modulus, which is an overestimate. However, it should be explained clearly what the units in the formulae are, and the units should be made consistent is possible (e.g. the units of brine volume).

The breaking model, in fact, contains two contradictions/paradoxes. One is that in the limit of small thickness ice is unbreakable, and the other is that short-wavelength waves will break any ice. The second point seems to have been missed by the authors. However, the model assumes that the ice is moving compliantly with the sea surface and the wavelengths are so long that the sea ice can be modelled as a negligible surface. Some discussion of this point and the regime in which it is valid would be useful.

The literature review is mostly complete. However, the first coupled attenuation and breaking model appeared in Kohout AL, Meylan MH. An elastic plate model for wave attenuation and ice floe breaking in the marginal ice zone. *Journal of Geophysical Research: Oceans*. 2008 Sep;113(C9). The authors concluded that their attenuation model was failing because of the overprediction of the break-up.

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