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The Cryosphere
Discussions

Interactive comment on "Wave-induced stress and breaking of sea ice in a coupled hydrodynamic–discrete-element wave–ice model" *by* Agnieszka Herman

Anonymous Referee #2

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1 General comments

This is generally a good paper, with some interesting conclusions. In addition, the tool developed by the author has a lot of potential for further investigations when all the effects available in the Design model (collisions) and NHwave (eg. turbulence) are included in this coupled code.

2 Specific comments

1. p2: *'For example, the functional form describing the rate of change of wave height with distance from the ice edge is far from established. . . '* Meylan et al (2014) found exponential decay from this dataset when the individual frequencies are considered instead of the significant wave height. Li et al (2015) were able to qualitatively produce the linear decay of the significant wave height with Wave-watch 3 — proposing that the nonlinear source term S_{nl} was the reason, as it moves energy to lower frequencies which are attenuated more slowly.

2. p8: please give the equations for the free-slip boundary conditions.

3. equation (7): Ma et al (2012) has the total derivative of w in the bottom condition ($\mathrm{d}w/\mathrm{d}t$). Maybe this is a typo? Similarly, perhaps the pressure condition at the lower surface of the ice (21) should be checked?

4. p6: How are the waves generated?

5. *§3.1 Stress variability in continuous ice*

   (i) The locations of $\sigma_{t,max}$ seem to occur about 10 m away from the ice edge, which seems very small — eg. Squire et al (1995): *'Anecdotally it appears that incoming waves and swell cause a fracture line to develop a few tens of meters back from the ice margin and parallel to it'*. Was there any attempt to tune the wave number in the ice to a realistic value, eg. for a thin elastic plate? Perhaps these numbers would increase if such tuning were done.

   (ii) Presumably the damping of the waves is due to some damping in the bonds, although this is not mentioned anywhere. Perhaps if this was removed it could be useful to see how much of the attenuation is numerical and how much is physical. The reflection and transmission coefficients could also be compared to linear models for a semi-infinite elastic plate. It would also be interesting to see if this affects the conclusions about the location of $\sigma_{t,max}$ being independant of wavelength or not.

6. *§3.2 Breaking of uniform ice by regular waves*

   (i) It would be interesting to see fig 8 without damping in the bonds and also the time evolution of the wave amplitude to see if there is more or less attenuation after breaking — on one hand the floes produced are small compared to the wavelength but on the other hand there are many of them and perhaps multiple scattering could do something.

References

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