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Natural Hazards and Earth System Sciences
Discussions

# *Interactive comment on* "Hydroelastic analysis of ice shelves under long wave excitation" *by* T. K. Papathanasiou et al.

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The authors would like to thank Prof. Pelinovsky for his instructive comments and suggestions. Moreover, the authors share the opinion that the presented model must be enhanced and extended in order to constitute a simulation tool for more complicated domains and physical phenomena. The present analysis aims to provide some simple means for the estimation of long wave impact on floating, slender formations and their response. Thus, it is a first step towards the hydroelastic modelling of ice shelves. The present results appear to produce, at least qualitatively, a response compatible with physical intuition and observations. Phenomena, such as wave reflection, hydroelastic dispersion, bending moment variation etc., are reproduced. Bending moment distribu-



tions are studied in particular, as they are directly linked to maximum normal stress values. Note that for notched or pre-cracked specimens it is usually those normal stresses that mostly influence crack initiation and propagation. The latter phenomena are crucial when a preexisting crack happens to be inside a tensile zone of large magnitude. The above reasoning justifies the calculation of bending moment profiles and their extreme values, as an indicator of possible areas with increased normal stresses. The determination of specific cases when an ice shelf would collapse is a far more complex and interesting task. One needs to determine the location of stress raisers such as cracks, voids, notches and the constitutive behavior of sea ice. The present model serves as a stepping stone towards this direction. The pressure distribution, as correctly indicated, might constitute another crucial factor for the triggering of damage mechanisms. Water inundation inside notches or cracks might also lead to crack opening and propagation. In addition, phenomena induced by locally increased pressure values can cause surface damage initiation, local yielding etc., depending on the structure status and the material properties. Let us mention that this pressure distribution can be computed by means of the presented numerical model and will constitute another indicator of possible critical points for the structural integrity. This task is to be performed in future studies with more sophisticated simulation models. Some specific remarks:

1. The problem of tsunami-ice interaction in coastal zones, during the runup stage, appears to be very interesting and of great practical significance. These phenomena constitute another possible application area and could provide benchmark tests for the numerical method presented by the authors. Suggested references are included in the final version of the paper.

2. For the employed bathymetric profile, the authors have used some mean values calculated using data from the literature. For example, it is mentioned in Brunt et al (2011) that the water column depth in front of the ice-shelf is ~150m, while it increases to 800m within 100km form the ice shelf front. In the present study, a linear variation be-

tween the values 150 and 800 m ranging over 100km is assumed, intending to employ a smoothed, mean approximation. If the bottom slope variation is localized near the ice shelf front, the wave amplification characteristics will indeed be altered as the present referee correctly indicates. The bottom profile used is viewed as a ‘mean value’ approximation. It is within the capabilities of the employed Finite Element scheme however, to solve for different bathymetry scenarios (see also Le Brocq et al 2010).

3. The typo in Fig. 1 will be corrected in the final version of the manuscript.

References

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