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Interactive comment on “The eigenvalue problem for ice-shelf vibrations: comparison of a full 3-D model with the thin plate approximation” *by* Y. V. Konovalov

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This paper computes the elastic response of an idealized ice shelf overlying a simplified ocean cavity to periodic forcing. The same topic has been addressed in a number of other papers, and the approach taken here mimics that of an older paper by Holdsworth and Glynn (1978). Unfortunately, the novelty in the present case is rather slim: the author opts to resolve stress variations with depth in the shelf rather than depth-integrating the elastic model to obtain a standard Föppl-von Karman elastic thin plate model.

Rather unsurprisingly, the results of the new model agree well with those obtained nearly forty years ago by Holdsworth and Glynn - the discrepancies in the spectra are almost certainly the result of the omission of higher order (and therefore small) terms

in the derivation of the thin plate equations.

The author asserts that a novelty of his work is that he is able to resolve shear stresses, and that this provides insight into probable faulting locations. This is presented in section 3.2, which is so brief as to make me believe there is no real new insight there. In fact, it is not true that the original authors somehow ”excluded” shear stress from their calculation: the computation of shear stresses is a key to the derivation of the Föppl-von Karman model, and these stresses are trivial to compute *a posteriori* once the normal displacement W of Holdsworth and Glynn’s model has been found (even the wikipedia page on the subject provides the relevant information, if you are willing to translate from the notation used there). It is perhaps true that Holdsworth and Glynn did not take that additional step, but that hardly warrants an entire paper.

What the paper unfortunately does not do is address the real questions that need answers. For instance, it is entirely obvious that a linear elastic model for the shelf coupled with a wave model for the ocean cavity will lead to the emergence of resonant frequencies. Real ice sheets do not exhibit resonance in the form of unbounded amplitude growth, even though ocean forcing will have a component at the resonant frequencies. The important question is therefore what dissipative mechanisms dominate, how large actual amplitudes of deformation and therefore of shear stress are likely to get, and how likely the formation of new fractures as the result of plausible forcing amplitudes actually is. Doing so does not require the more elaborate depth-resolving elastic model used here, but more careful thought given to viscoelastic or other dissipative effects.

Another odd inconsistency is that the author has deemed it necessary to resolve the shelf in three dimensions, but not the water circulation in the shelf cavity. This implies that somehow the shelf cavity has a much smaller aspect ratio than the shelf itself, because otherwise the corrections that are included by not using a thin-plate model for the elastic shelf deformation are of the same size as the corrections that are omitted in a depth-integrated irrotational flow model for the shelf cavity. (Note that I assume an irrotational flow model for the shelf cavity is appropriate for the relatively high-frequency wave forcing imposed in this paper, but I confess that I do not deal with ocean wave problems very often.)

Interactive comment on Earth Syst. Dynam. Discuss., 6, 1605, 2015.