

Review of “Laboratory study of frazil ice accumulation under wave conditions” by De la Rosa and Maus, submitted to the Cryosphere Discussions.

The authors describe the results of four experimental runs that studied the properties of frazil ice generated by waves done at the Hamburg cold wave tank facility, in 2007- 2008 under the acronym RECARO (Reduced Ice Cover in the Arctic Ocean). This is new work that according to the authors, was “described briefly by Wilkinson et al. (2009).” Some of the data from these experiments has been published by Wang and Shen (2010a) on wave attenuation, (by De la Rosa et al. (2011) on frazil ice properties, and in a submitted paper by Maus and De la Rosa (2011), so that the present authors are working on ground that has been heavily ploughed.

The current paper studies the change in bulk frazil ice properties during the transition from open water to pancake formation under wave conditions, where bulk refers to averages over the entire tank. This is useful information, but presented in a way that is not easily understandable. There is only one figure that shows the variation in ice properties with distance down the tank, the rest refer to bulk properties. Given the change of frazil ice properties that occur with distance due to wave attenuation both in the lab and in the field, I find their bulk averages approach bewildering. I also don't have a very good feel for the experiment; the addition of some photographs of the apparatus and ice layers would help.

Because the size of the font in Table 1 and the size of many of the figures are too small, a major problem with the paper is that it difficult is to read. This means that my review was done using a combination of a printout for the text, and the pdf enlarged by 2 to 4 times for the figures. Specifically, the Table is written in what I estimate to be a 4-point font (a 4 point font), which I find really hard to read. This use of such a small font would not be permitted at JGR. I suggest that the authors break the table into two parts, and redo it with the 10-pt font used in the rest of the paper. A similar problem occurs with some of the figures; these are also difficult to understand because of their small size; when they are enlarged by 200-400% so that I can read them, the symbols and labels lose their resolution.

There are also problems with the experiments: The authors carried out four experiments (E1-E4) but only two of them started with “completely ice-free conditions.” According to Section 3.3 in the paper, Experiments E2 and E4 began with a 3-4 cm ice thickness, where this ice was left over from melting the ice of previous experiments (E1, E3). The authors do not provide an explanation as to why they began the so-called open water experiments with a layer of old ice crystals, and do not explain why data from these runs is included in the analysis. Regarding old ice crystals, as Peter Hobbs discusses in his

book Ice Physics, this aging ice has different properties than young frazil, because its crystal shapes tend more to the spherical than the flat young frazil crystals. Given the problems with E2 and E4, and the confusion on the graphs described below, I strongly suggest that they drop E2 and E4 from the discussion, and focus their discussion on E1 and E3.

Discussion of the figures and related text:

Figure 2. I'd like to see some discussion of the long period oscillations in (b).

Figure 3. The closed and open circles are not identified, and data taken at a number of different times are identified by the same open circles. Because of the scatter in the data, this reviewer cannot associate the open circles at each distance with a specific time. The inability to distinguish among different times, plus the small size of these sub-figures, makes them near worthless.

Figure 4. Needs lots more discussion; let's look at the blue dashed line; this is the mean of an exponential fit at three different times with the observed data; why does it fall off so dramatically with time? Why is such a confusing figure important? And, why don't you discuss the anomalous behavior described in this figure?

Figure 5. You state that experiments E2, E4 "present less clarity due to the reasons (of starting with an ice cover made up of old ice)." Given that the old ice is not representative of new frazil, why include it in the figure? These points only serve to muddle the good data.

Figure 6. Since E2 and E4 are your worst experiments, why break them out separately? Why not break out your "good" experiments, E1 and E3?

Figure 7. Your experiment E2 (thin green line) in panel b is really strange, with the unexplained and undiscussed fall-off at the end, another reason for eliminating E2 and E4.

Figure 8 is okay

Figure 9. I've spent a fair bit of time staring at these three sub-figures, and I don't understand them. Your definition of an e-folding length based on the length of the tank seems completely arbitrary. I'd be very happy if you would drop this figure.

Figure 10. Again, I find these figures of ice thickness averaged over the length of the tank not to be very valuable. Also, how do you handle the cases where you change the paddle

wave amplitude or turn it off? How does this figure help me in understanding frazil ice? And, you refer in the text to “histogram distributions grouped in time (not shown)”, that show the ice thickness is still increasing and had not reached a limiting value in the times covered by the figure. If this is the case, why show the figure?

Figure 11. Again, much too small to read, I need to use a 400% enlargement to see the figures. This is one of the critical figures in the manuscript, since it shows (I think) the maximum packing that occurs before pancake ice formation. There is also a great deal of scatter in this figure. If this figure is critical, and I think it is, why not display it in a way that the casual reader can understand it?

In summary, the authors need to resize the Table and Figures so that they can be read from the printout, and seriously consider dropping Experiments E2 and E4 from the discussion, because of their contamination by old ice. The resizing has to be done, otherwise no one is going to read the paper.