Review of egusphere-2022-1162 by Mark Loewen

Uncertainty analysis of single- and multiple-size-class frazil ice models

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I am referring to line numbers below.

Figure: In all figures with multiple plots you should label the plots (a), (b) etc. to avoid confusion.

74: Change “supposed to be” to “assumed to be”.

191-193: Explain the reasoning for fixing the number of initial particles at zero for classes exceeding a radius threshold.

262: Define UQ.

Sec. 3.3: I recommend this be moved to an appendix.

384: I agree the uncertainty in the initial volume fraction is very large.

500: In Fig. 5 time is plotted in seconds so referring to minutes in the text is inconsistent. Also please check the value of 0.1 C I think it is inaccurate.

511: Are you referring to the median value of the time of maximum supercooling here?

514: I think for experiments this argument is valid but I am not convinced this is true in rivers. There are very few reliable measurements of dissipation in rivers available and the uncertainty could easily be an order of magnitude or larger.

518: Here you refer to “the initial distribution parameter” and it would be helpful to state also that these are C_0 and r_0.

520: In Table 1 C_0 and r_0 are categorized as "Initial conditions" and here they are referred to as initial distribution. I find this confusing.

521: You write “At the recovery” and later refer to a “recovery time” and these are both too vague. You define the “recovery phase” previously but this includes all time after steady state is reached. So clear terminology and clear definitions are required. In the same line you write “the parameters of secondary nucleation and flocculation processes”. Please list all of these parameters here.

523: How did you observe interactions between parameters?

Figure 8: Supercooling of -0.2 C is quite extreme so some comments on these values are required. In the right plot please also comment on the fact that for P95 the maximum supercooling is not reached even after 3000 s.

546: List the parameters please.

552; Replace “coherent” with consistent?

554-555: Excellent point I agree.

559: Spelling changed to predicted.

560-562: This is a very limited discussion of Figure 10. Seems too brief - presumably there is more to discuss.

571-573: Awkward wording, please rewrite this sentence.

Figure 11; Add info to the caption to explain the symbols i.e., dots, error bars etc.

582: I think you mean quantitative here not qualitative.

591-599: Excellent discussion here.

599: Define API.

632: Replace relevant with suitable or promising?

640: I found it very interesting that you found that the turbulent dissipation rate plays a major role. Laboratory studies have found that the mean particle size varied with dissipation rate but the results are inconsistent. Can you use your model to examine this?

640-641: I do not agree that the dissipation rate is often appropriately quantified. Reliable measurements of dissipation rates in rivers are virtually non-existent and even in the lab it has not been accurately measured very often.

645-646: You write “The long-term evolution of the system also showed increasing interactions between parameters, which can be explained by the balance in the physical processes involved in class interactions”. This was not clear to me since I do not think you explained this well in the paper.

652-653: Your conclusion regarding the rise velocity is a very significant result – well done!