

Interactive comment on “Continuous in situ measurements of anchor ice formation, growth and release” by Tadros R. Ghobrial and Mark R. Loewen

Anonymous Referee #3

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General Comments:

The authors have conducted a novel field study of anchor ice formation, growth and release that clearly addresses a knowledge gap in the literature. They have provided a thorough review of the current state of knowledge of anchor ice processes and have complemented this very well with their new field measurements. The paper is well written and will be of interest to many people in the river ice engineering field.

The authors note that several previous investigators have discussed correlations between anchor ice characteristics and the flow Froude or Reynolds number. Perhaps it would be useful to report these two values for each of the events summarized in Table

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2.

There is discussion on the uncertainty of measured parameters (ie. crystal growth rate, thickness). Perhaps this could be added. I suspect that while the camera resolution (ie. pixel size) might suggest a high degree of accuracy, the problems associated with the depth of field when measuring the anchor ice thickness might be more significant.

I am unfamiliar with the local hydraulics, so I am unable to differentiate between the normal diurnal water level variations because of upstream hydropeaking versus staging during anchor ice formation and de-staging during anchor ice release. Were the impacts of anchor ice of sufficient magnitude to be observable in the water level measurements?

Specific Comments:

Line 2 of the abstract – even though line 1 notes both turbulence and supercooling, line 2 starts over and says that supercooled water generates frazil ice and does not mention the concurrent requirement of sufficient fluid turbulence.

Stage 4 is listed as the release phase (Pg 10, line 25) however, on Figure 11 Stage 4 is shown to have a very rapid increase in thickness, as opposed to a drop in thickness down to zero.

Page 12, line 25 – Did Kempema and Ettema report observed water temperature measurements at the wedge wire screens? If the water was more supercooled this could also explain the higher growth rate.

Page 14, line 1 – The substrate thermometer looked to be covered in anchor ice in the photo, which may prevent it from providing an accurate measure of the water temperature. Did you compare with the thermometer mounted higher up on the frame?

Page 16, line 6: is the first sentence too general? You've listed a few field measurements of anchor ice growth in your lit review section.

Page 16, line 9: the mode name 'rapid' could be more descriptive in my opinion.

Technical Corrections:

Pg. 1, Line 14 – rewording is required: '... have been reported to study'; 'but'

Pg. 1, Line 26 – repetitive 'defined'

Pg. 3, Line 23 – increase with increasing Froude number; lines 24 – 26 – changing from present to past tense a couple of times. This also occurs at other locations within the manuscript.

Pg. 3, line28 – 'have been reported' rather than 'has been reported'.

Pg. 4, line 2 – reword '...provided many valuable information'.

Pg. 4, line 34 – reword '...crystals showed grew preferentially...'

Pg. 14, line 33 - ... release of event C anchor ice

Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2020-161>, 2020.

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