

Interactive comment on “Laboratory observations on meltwater meandering rivulets on ice” by Roberto Fernández and Gary Parker

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Response to Reviewer No. 2 Prepared by Roberto Fernández on behalf of both authors
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Thanks for your thought-provoking review, respectful criticism, and your comments on the manuscript. We really appreciate your time. Please see below a preliminary response to your comments, which we hope to address fully in the coming days.

Indeed, we come to the topic with a fluvial morphology interest and, overall, a motivation to understand the mechanisms that create such similar meandering planforms in spite of the broad range of scales and types of media. Our intent was first to see if we could create such channels in the laboratory and after achieving this we decided to do

C1

multiple runs and compare the results with meandering channels in other media.

As you rightfully recognize, we come to the problem with a fluvial motivation. However, the incidental mm-scale channels are likely better analogs (not scaled models) of supraglacial channels than the cm-scale ones for reasons we acknowledge and that you point out (e.g. large temperature differences, laminar flow regime).

In answer to your questions in paragraph 2, page C2: We did not choose the water temperature but simply used tap water. In one of the experiments, we added ice to control the temperature but this proved impractical without a cold room (a facility we did not have). Water temperature does have an effect on the morphology. The cm-scale channels show preferential downstream skewness and smaller sinuosity values. Natural supraglacial settings must indeed be colder and temperature differences smaller than those observed in the cm-scale channels. The mm-scale channels however must have had temperatures closer to freezing. We did not look into heat fluxes at the ice-water interface. We believe this is certainly something that needs further experimentation in a better controlled environment. We see this manuscript as a very small but significant step towards linking the fluvial aspects that brought us to the topic with the glacial aspects that would broaden the applicability of this work to the glaciology community. We might not be able to offer in-depth analysis of the aspects most relevant to glaciologists now but your criticism is very valid and is something we have thought off for ongoing work on the topic. Be assured that current work does involve glaciologists and we hope to strengthen this link to provide better insights for both the fluvial and glaciology communities.

â€” In response to the minor points: 1) The picture of the Peterman ice island fragment was what triggered this effort. We only intend to acknowledge the fact that it was our main motivation and it led to our first trial runs. We will include a bit more motivation for the manuscript addressing the challenges facing the glaciology community and emphasizing the need for experimental work.

C2

2) We did not consider this definition necessary because we wrote the manuscript with the fluvial perspective. We will include it to make sure readers from other communities have the definition at hand. For the time being:

Channelized flows can be subcritical, critical or supercritical depending on the value of the ratio between inertial forces and gravitational forces. This ratio is expressed with the Froude number $Fr = u / (g \cdot H)$, where u is the flow velocity, g is the acceleration of gravity, and H is the flow depth. If the ratio is smaller than one ($Fr < 1$) the flow is subcritical; if the ratio is larger than one ($Fr > 1$) the flow is supercritical; and if the ratio is equal to one ($Fr = 1$), the flow is critical.

3) A periodontal probe is a tool used by dentists to measure the depth of the pockets between patients' gums and their teeth (My father is a dentist). Its tip is marked (every mm) and is narrow enough (< 1 mm) that we could use it for the experiments without affecting the flow conditions too much.

4) The text is not wrong but we will modify it to make it clearer. 'Direction spatial series' is probably meandering river community jargon.

5) Those lines refer to the potential links between supraglacial and englacial channels mentioned in the previous sentence. We believe that increased meltwater production will lead to increased/altered links between such features and is something we hope to address in future experimental work (in a properly temperature controlled environment).

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