

## ***Interactive comment on “Morphological dynamics of an englacial channel” by G. Vatne and T. D. L. Irvine-Fynn***

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### **Review Comment- Morphological dynamics of an englacial channel**

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#### **GENERAL COMMENTS**

This paper reflects an impressive body of survey work and literature review for which the authors should be commended. It generally contains very salient discussion of key englacial channel observations and highlights their implications for the broader field of glacial hydrology. However, these findings are buried within a verbose and sometimes poorly organized text that often presents unnecessary detail. The discussion section in particular tends towards being speculative. More quantitative treatment of the processes described would strengthen the arguments presented, particularly in section 5.2. The paper would benefit from a re-focusing of ideas and removal of unnecessary detail in order to bolster and clarify conclusions.

That being said, this paper presents an important bridge between the fluvial geomorphology and englacial hydrology research communities, a relationship often overlooked by other englacial hydrology papers. I urge the authors to simplify and clarify their message such that their results will be more widely impactful in both communities.

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## SPECIFIC COMMENTS

### Title:

Suggested change to "Morphological evolution of an englacial channel on Austre Broggerbreen, Svalbard"

### Abstract:

Move sentence starting on L10 to first sentence

L8: Delete 'albeit... channel counterparts.'

L15-22: Clarify that channel system is in rapid transition towards an equilibrium morphology that is reached within the survey timeframe

L22: Delete 'in light of this'

L24: Delete 'and role'

### Introduction:

P7618 L2 Streams 'with respect to' meandering

P7618 L8,11 Repeated use of 'given way to'

P7619 L17 In lieu of either direct measurements of knickpoint face erosion rates or extensive erosion model parameter testing, I do not understand how this question will be quantitatively addressed.

P7619 L18-20 Since this article does not present a complete conceptual model of channel formation and evolution to equilibrium state, this sentence over-reaches the presented conclusions

### Theoretical context:

P7619 L23 Specify that the following discussion will be about terrestrial streams flowing over rock, not glacial streams

P7620 L25 Suggested re-wording: define as a critical slope segment preceded and followed by a shallow slope segment

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P7621 L8-12 Delete sentence, unnecessary for logic flow

P7624 L28 Delete last sentence

### Field Site:

P7625 L10 Unusual use of 'reduced dynamics'

P7626 L4 What was surface air temperature during that time? Is it surprising that liquid water was being stored?

P7626 L13 What was error associated with difficulty using a magnetic compass at such a high latitude, or what measures were taken to accurately measure bearing? This has been a consideration in other englacial mapping projects on Svalbard.

P7626 L16 Was inclination not measured from station to station? If not, how were channel slopes measured?

P7626 L16-19 Delete sentence

P7626 L23 i.e. Steps were defined as slopes greater than 45 degrees? Clarify.

### Results and data analysis:

P7627 L1 How were submerged step heights measured if the pool was frozen? Why should pool depth be greater for smaller steps and smaller for larger steps? Either clarify for delete this sentence.

P7627 L5 Why exclude 'channel rapids' from analysis?

Knickpoints likely grow from small perturbations, rapids may reflect some intermediate stage of knickpoint development... P7627 L7-14 Content in this paragraph belongs elsewhere in paper: cusate forms in 'wall groove' section, conduit height measurement difficulty in survey technique section

P7629 L10 The 'taller' the steps (ie not higher elevation in glacier)

P7629-30 and figures: watch consistency with terminology for wall grooves vs. grooves vs. cusate forms vs. cusate morphology throughout the manuscript (in text and figure captions)

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P7630 L26 Do you have data that shows that all knickpoints incise and migrate? You are careful to say that you cannot see individual knickpoint migration in Fig3 longitudinal profiles, yet here make interpretations on the individual knickpoint scale.  
P7631 L7 Sinuosity units of mm-1?  
P7631 L12 No entrance B marked on map in figure 2  
P7631 L8 How do parallel channel walls indicate primarily vertical incision? Clarify.  
P7631 L14 Figure 6 shows quite dramatic changes in meander location and size, and seems to suggest that significant lateral channel meandering does occur. The conclusion to not interpret these results seems poorly-founded, particularly given the current scientific interest in meander formation and evolution (a la Karlstrom et al., 2013). The argument that knickpoint migration masks this signal needs to be clarified. A schematic figure may be useful here. If differences between the 2000 and 2008 profiles in Figure 6 are not going to be commented upon, the figure holds little value.

Discussion:

P7632 L6 "This challenges the prevailing. . ." this is a key finding! Highlight it explicitly in the abstract and introduction.  
P7632 L10-26 This paragraph should be moved to the channel survey results section.  
P7632 L20 "Therefore the flow regime through the conduit is likely to be moderately stable." Has this been studied? If so, please cite. In absence of a study, further explanation is needed that the hydrograph of supraglacial streams is more stable than terrestrial counterparts is somewhat counter-intuitive.  
P7633 L24 Were channel adjustment rates measured? This should be detailed and results presented.  
P73634 L25 This suggests 'that' LG channel reaches 'are' stable..  
P7636 L20 "The direct effect is that step risers migrate. . . at several times the vertical incision" Is this based on measurements of only one knickpoint? More quantitative support of this argument would make it more robust.  
P7639 L18 How was the submerged hydraulic jump observed and measured?

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Conclusions:

P7641 L16 delete 'Vatne, unpublished data'  
P7641 L19-23 Awkward/unclear phrasing, clarify  
P7641 L25 AB not marked on map  
P7641 L17 Separate sentences: We provide the basis for a conceptual model 'for the formation and stability' of step-riser geometry

Figures:

Figure 2: missing map elements AB, B?  
Table 2: Vertical lines between year/LG, LG/MG, and MG/KZ would ease interpretation. Clarify description of H and V in table caption.  
Figure 3 Expand Y axis to the left so initial knickpoint is more easily visible.  
Figure 4b Scale? 4d photo from below showing drops may be more insightful, if available  
Figure 5 Scale?  
Figure 6 What is flow direction? For section that loops under itself, make lower section dotted  
Figure 7 Scale?  
Figure 8 Scale? Could be combined with Figure 4.

TECHNICAL CORRECTIONS

(typos and grammatical corrections only—see Specific Comments for suggested language and clarification changes) p7626 L27: precluded  
p7627 L5: delete 'the' both the step  
p7628 L28: add just upstream 'of' the meander  
p7629 L5: add arguably 'the' definition  
P7629 L29 we suggest 'that knickpoint morphology be divided'

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p7631 L1 add comma In all surveys,  
p7635 L3 delete next, 'the next,' albeit  
p7635 L15 add subsequently receded  
p7635 L21 delete s in leads  
p7639 L14 delete 'the controls' the degree  
p7639 L27 add 'retains' an equilibrium  
p7640 L3 delete has 'for' long  
p7641 L11 delete fluvial erosion 'erosion'  
p7641 L8 add evidence 'suggests' the persistence  
Figure 3 'Thalweg'

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