

Interactive comment on “Mechanical effect of mélange-induced buttressing on embayment-terminating glacier dynamics” by D. Seneca Lindsey and T. K. Dupont

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We would like to once again thank the editor for his time and also request a reconsideration for acceptance of a revised and resubmitted manuscript with changes enumerated below.

The recent AGU meeting was a lively and informative gathering with discussion of mélange coming up often. At this meeting we presented our work on the topic of mélange and included experimental results motivated by Jason Amundson's comments here in The Cryosphere discussion. Moreover, Twila Moon presented new results correlating glacier dynamic response to percentage sea ice concentration, reinforcing the

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idea that it's the connected nature of winter mélange that leads to dynamic response of glacier terminus. We would like to submit a revised paper with the following significant revisions as well as other revisions outlined in the previously posted response comments of referee reviews:

1. We will include results from experiments we have run based on Jason Amundson's suggested mélange geometry.
2. We readily acknowledge that mélange is most likely substantially weaker than the upper-bound scenario and we propose including results from several experiments designed to simulate a weaker material:
 - (a) Weaken mélange by reducing the Glen hardness parameter B_m with a lower bound being that of temperate ice. These experiments do not substantially alter the results.
 - (b) Reduce the mélange coupling to the embayment wall by lowering the side-shear parameter, B_s . This simulates a reduced ability to generate drag. The current B_s value is appropriate for that of a Jakobshavn Isbræ-like scenario and we reduce it to a value of zero that simulates a decoupled scenario where mélange is simply pushed along.
 - (c) Simulate a more plastic rheology of mélange as suggested by Jason Amundson by increasing the Glen exponent n . This experiment alters the character of the response.
 - (d) Reduce the mélange thickness in the embayment and at the ice front. With thin enough mélange, the buttressing effect becomes negligible.
3. We will emphasize the following:
 - (a) The core experiments are an upper-bound estimate of mélanges mechanical impact on glacier dynamics. We take the connected nature of winter

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mélange to the natural limit; that of a continuous medium treatment. The experiments are heuristic in nature and mélange is, in actuality, a complex material that is most likely substantially weaker than the upper-bound treatment.

- (b) We do not believe there is a mechanism for mélange to mechanically affect glacier dynamics in the absence of sea ice nor is there any evidence that we are aware of to suggest such an effect.
- (c) There are a myriad of other indirect mechanisms through which mélange can impact glacier dynamics that are not explored here and are worthy of further investigation. The seasonal ice-front advance/retreat cycle at Jakobshavn Isbræ is most likely due to a combination of direct and indirect factors with the mechanical, mélange-induced, buttressing of longitudinal strain-rate a small component with upper-bound of 5-10% of observed seasonal advance.

Interactive comment on The Cryosphere Discuss., 6, 4123, 2012.