

## ***Interactive comment on “Flow and mixing around a glacier tongue” by C. L. Stevens et al.***

**C. L. Stevens et al.**

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Author’s Response to Anonymous Referee 1

*We are very pleased with the interest the Reviewer has taken in our work and note their comments relating to the novelty of the work and that it should be published in Ocean Science. Having said that, they also identified some shortcomings in the manuscript. Here we address all their comments. This response paraphrases their substantive comments in normal font and our response follows in italics. A separate document highlights the changes in the manuscript using track-changes. Furthermore the manuscript was given some serious editorial attention.*

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General This is the first time this reviewer has seen an attempt to characterize the impact of a floating ice tongue on local oceanographic properties, and the work therefore represents a 'first', which is always nice. I'm quite sure that there are none describing microstructure data though – measurements are most likely confined to observations of T and S profiles. *We believe these to be the first such data to be published. We are aware of colleagues who have collected microstructure or CTD data in similar situations but do not believe have resulted to this date.*

The authors have undertaken a difficult task: they have observations from a single site near the tip of the EGT, and also near complex bathymetry, with which they are trying to describe the three-dimensional water circulation. For this purpose, a single site half-way along the tongue might have been easier for a first experiment, as the flow response might have been nearer to two-dimensional. *It would have only been an easier experiment from the perspective of data interpretation as moving much further east along the EGT at the time of the work resulted in encountering multiyear ice between 4-8 m thick. Furthermore, as one moves east they come closer to the influence of Razorback Island so I'm not sure it's a balance one can win!*

Having said that, although the authors describe their study in terms of flow around a glacier tongue, their site is 1 km shorewards of the tip, and only 30 m from the side wall. So is this truly flow around the tip, or principally flow beneath the tongue? *This is a good point and we believe we captured elements of both and so we have modified the text (Section 4.1) to make this clear.*

Technicalities/structure: Abstract – L4-5 and Observations – L8-9. The abstract indicates that the pulses are tidally-induced. Yet the authors state in the observations that they are not phase-locked to the tides. I recognize that the pulses don't appear at exactly the same time in the cycle, presumably being perturbed by other effects, but I they must surely be phaselocked (even if the lock is a bit loose!). *It's not clear that they should be phase-locked. It is relatively well understood that tidally-driven velocity structure can be quite complex as flow separation is influenced by preceding events*

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*(Signell and Geyer 1991 – now included in reference list). However, in keeping with this comment and those of the other reviewers we have removed this connection from the abstract.*

Section 3, first two paragraphs. I had some problems reconciling figures 2 and 3 with the description of the currents. Part of the problem is with the feather plot. It would be nice to see time series of  $u$  and  $v$  as well. Also, it would have been really nice to see the full ADCP record from day 320 to 325, plotted out like the extract in Figs 3a-e. *As Dr. Padman also called for a revision of the graphical presentation of these data we have re-drawn Fig. 2 as the new Fig. 4 where we have  $u$  and  $v$  components plus a new fig. 5 where we show the data as a progressive vector diagram.*

Line 10 gives a weak south-easterly flow at low tide, whereas Fig. 2c suggests south-westerly. *We have re-worked this text in keeping with the new version of the figure as requested above.*

Line 20 the "shallower flows towards the EGT" were actually very weak, although it's hard to say from the color scale. It still might well be interpreted as a "wake recirculation", but it would be better if we had a better idea of the size of the return current. This is a general problem with the figures: nice to have the color plots, but some vertical  $u$  and  $v$ , or direction and magnitude, profiles as line plots at selected times (such as during the recirculation, during the pulse etc) would give a more quantitative feel for the velocity structure. *We have now provided the line plots the Reviewer seeks in the new Figure 4. We have not added in profile figures as we felt this was captured in the expanded ADCP colour panels.*

Line 21 In fact, Fig. 3a (and 8a) shows the upper edge of the pulse shoaling, rather than the pulse deepening. *We have re-worded this text.*

Line 24-25. With one measurement site I can't see how we know the direction of motion of the pattern of water speed. *We have re-worded this text.*

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Line 25-26. But low tide just preceded the pulse, when we think the flow was weak and to the south-west (if I got that right – Line 10 above). *We have re-worked this text in keeping with the new version of the figure as requested above.*

Section 4.1 – last paragraph discussing double diffusive effects. I think this could be reduced to a simple statement saying that the absence of the expected DD effects was presumably a result of their being swept away by the pulse. *We have modified the text somewhat. However, we couldn't reasonably simplify it to the extent suggested by the Reviewer as then the reader would be wondering why we'd even mentioned it in the first place. Yet it is important because the Jacobs et al. paper represents the present paradigm for stratification next to the glacier tongue.*

Section 4.2 – from p.1450, Line 24 to end of section. I didn't quite get this argument. It strikes me that this is quite important: unless I've misunderstood this, it points to the need for better mixing parameterizations in the region of glacier tongues etc. It needs to be expanded. *This text has been expanded in line with both this and comments by other Reviewers.*

Section 4.4 – discussion generalizing to other glacier tongues. I'd be interested to see other people's views, but I would be inclined to replace this with a simple summary of the main effects as seen around EGT. The comparison between EGT and other larger tongues could be moved to the Introduction. *We don't see how this move would work as we are not simply discussing the scale of the EGT relative to other glaciers but also the relevance of our results. Consequently we need to present the results first.*

Fig. 11 and the third paragraph didn't really work for me. It could have been dropped in at the end of Section 3. *We have removed Fig. 11 and its associated text.*

Details: P 1440 L10 vertical diffusivities -> ... deduced from microstructure measurements - *amended* .

L11 that -> than - *corrected*.

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L11 parameterization -> existing parameterizations (?) - *ok changed*.

L12 and elsewhere: can we use "glacier topography" rather than "cryotopography"? And "glacial" rather than "cryogenic"? *We have changed the term to glacier here however in many subsequent appearances we refer also to the presence of first year ice, multiyear fast ice and platelets.*

L24 tens <of> kilometers - *corrected*.

P1441 L3 flows<, > with L4 ...of course with a glacier... -> ...of course that for a glacier... *modified although slightly differently to the request.*

L20-21 ... or forms frazil/platelets... I thought they did that only if nucleation sites exist? *Our text was confused here and has been clarified with thanks.*

L24 delete "thus" - *amended*.

L26 what's meant here by "cryomechanics". Is this the same as "glacier dynamics"? *We use this term to refer to the influence of first year ice, multiyear fast ice, platelets as well as the glacier.*

P1442 L1-2 Either "estimates of mixing rates" of "evidence of mixing". Not "evidence of mixing rates" *ok we have amend to identify that what we have observed can be regarded as "elevated"*.

P1443 L4 delete "quite" *amended*.

L5 ...where we have <in the past> had far... (?) *OK amended*.

L7 "included"? Was it dialled into the instrument, or done in post-processing? *We added the offset in post-processing but do not believe the level of detail is of interest to the reader.*

L10 "Turbulence properties were resolved with a..." -> "Turbulence properties were deduced using data from a..." or similar. *Suitably amended*.

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L12 ...key <derived> property... *Suitably amended.*

L13 Thirty<->eight... *really? We've left it as two words for now and will seek the Copy Editor's advice if it is accepted.*

L15 Needs a re-write. *Rewritten to now say. . . While the profiles penetrated to around 300 m depth, only the upper 120 m are considered here in order to focus on the influence of the glacier.*

L16 ...were resolved... -> ...estimated using data from... or similar *This paragraph has been modified substantially in accordance with comments from Dr. Padman.*

L16 delete "profiler" - *done.*

L17 delete "the data" and "in terms of e" – *the noise floor manifests itself differently in different stages of the data analysis so we have not made this change.*

L18 delete "In addition" *amended.*

A citation for Osborn's method is required around P1450 L 21. *amended in conjunction with a comment by other Reviewers.*

Please also note the supplement to this comment:

<http://www.ocean-sci-discuss.net/7/C544/2010/osd-7-C544-2010-supplement.pdf>

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Interactive comment on Ocean Sci. Discuss., 7, 1439, 2010.

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