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Ocean Science Discussions

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

Anonymous Referee #1

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General:

This discussion paper reports on oceanographic field data obtained from a fast ice platform, near the tip Erebus Glacier Tongue (EGT), Ross Island, Antarctica. From acoustic Doppler current profiler data, microstructure, salinity and temperature profiles the authors attempt to characterize the flow and regime and discuss the effects of the flow on local mixing and supercooling.

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 not up-to-date on the field of iceberg-ocean interactions, and it is possible that there are publications discussing observations from near icebergs over the Antarctic continental shelf; such publications might be relevant. Does anyone else know of any? I'm quite sure that there are none describing mi-

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crostructure data though – measurements are most likely confined to observations of T and S profiles.

I believe the paper to be publishable in Ocean Science, although I would recommend some editorial work and presentational changes (see below). My general comment is that 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. 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? Either way, the authors' purpose appears to be to demonstrate some of the effects that occur in the vicinity of such a feature, and I believe they succeed in that aim.

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 phase-locked (even if the lock is a bit loose!).

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. Line 10 gives a weak south-easterly flow at low tide, whereas Fig. 2c suggests south-westerly. 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 recircula-

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tion", 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. Line 21 In fact, Fig. 3a (and 8a) shows the upper edge of the pulse shoaling, rather than the pulse deepening. Line 24-25. With one measurement site I can't see how we know the direction of motion of the pattern of water speed. 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).

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.

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.

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

Details: I'm afraid that the text needs quite a lot of detailed revision to ease the reader's job. I can't give a full list, but here's a start. P 1440 L10 vertical diffusivities -> ... deduced from microstructure measurements L11 that -> than L11 parameterization -> existing parameterizations (?) L12 and elsewhere: can we use "glacier topography" rather than "cryotopography"? And "glacial" rather than "cryogenic"? L24 tens <of> kilometers P1441 L3 flows<,> with L4 ...of course with a glacier... -> ...of course that

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for a glacier... L20-21 ... or forms frazil/platelets... I thought they did that only if nucleation sites exist? Otherwise the water has to become very supercooled indeed before spontaneously crystallizing. L24 delete "thus" L26 what's meant here by "cryomechanics". Is this the same as "glacier dynamics"? P1442 L1-2 Either "estimates of mixing rates" of "evidence of mixing". Not "evidence of mixing rates" P1443 L4 delete "quite" L5 ...where we have <in the past> had far... (?) L7 "included"? Was it dialed into the instrument, or done in post-processing? L10 "Turbulence properties were resolved with a..." -> "Turbulence properties were deduced using data from a..." or similar. L12 ...key <derived> property... L13 Thirty<->eight... L15 Needs a re-write. L16 ...were resolved... -> ...estimated using data from... or similar L16 delete "profiler" L17 delete "the data" and "in terms of e" L18 delete "In addition"

I need to stop here, but there are a lot of other revisions and typos. Perhaps one or two other authors need to have a careful look through the text. A citation for Osborn's method is required around P1450 L 21.

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