Author response to RC1, Cathleen Geiger:

The paper is ready for publication, but I invite the authors to please include more quantitative information in the abstract beyond the simple percentages. In checklist item #3 above, I can only rate the significance as Fair per the definition given where the paper stands now- simply because there are few new practical applications of broad relevance given how the outcome is communicated. Therefore as my final recommendation, please consider a significant upgrade to the Abstract- which is the key to this paper being read. And if you do, then I can say that it elevates my ranking in #3 from Fair to Excellent.

Keyword missing in the abstract is Process. It's in the introduction and all over the paper, but not in the Abstract. A field experiment like this is looking at singular events to gain insight into geophysical Processes. Please include this word in the Abstract somewhere near the reference to the words "one instance". It is incredibly important in a field paper such as this to explain why this paper is relevant in the larger context. The word "Process" is used as a keyword search by modelers to find papers on this subject- especially process modelers. Contrary to this, the words "one instance" makes it sound anecdotal- which takes away from the significant merits of the paper. You want the chance to reproduce such activities again- say in 2032 IPY- yes?.

For field people to continue going to the field, it is crucially important to clearly spell out WHY IS THIS STUDY IMPORTANT IN THE LARGER CONTEXT- in the Abstract. Clarifying this as a "Process study of the formation of fate of freshwater on ice floes"- in the Abstract- brings such a context. The jump in the abstract from single "instance" to CESM2 climate model currently reads as too big to grasp in the Abstract. The hook is missing in the abstract to make people want to read the paper.

As example, percentages are a fuzzy thing to compare to a model, but a rate of freshwater production or rate of drainage can be inferred and included in the Abstract? Rates can be computed in process models as a next step before jumping into the big climate models. I couldn't find any mention of the encouragement of process models to help scale these results up toward climate models. But maybe I missed that. If it's in the main body, it helps to bring that to light in the abstract.

I am essentially challenging you to include something tangible AND TESTABLE directly in the abstract- something that modelers can sink their codes into to see if they are on track. As example, in the last paragraph- "dramatically underestimated"- please put a number with "the drama" so that we can also see how big that underestimate really is and what model-derived term is responsible- like freshwater production rates as wonderfully highlighted in Figure 7. That

is a notable result that can be tested first against a process model and then upscaled to a climate model.

As example, what is that rate- on average- in terms of Meters Per Summer? Granted, this is not SI units, but it is understandable in terms of impact. A freshwater production rate of 0.01 to 0.02 m/day (10-20 cm/day) times two months (~60 days), the ballpark is 0.5-1.0 meter per summer in freshwater production which is a seasonal average (that matches up with 7a and 7b). The rate of 0.5-1.0 meter / summer season is a climate rate that can be tested in a climate or process model that includes melt pond fraction and in turn be directly compared to this "one instance" field experiment. A number like this essentially provides a bulk term to compare with winter ice growth rates as climatological inventory numbers. In a model, this can be used to explain why a climate model may be underpredicting ("dramatically") the rate at which ice is being lost due to summer freshwater melt in excess of winter growth.

A quantitative statement like this let's you leverage modeling results the next 5 years to get you out there again in 2032 for IPY.

> *We really appreciate this external perspective on how the abstract can best hook readers and motivate the work. As you can see from the track changes version, we have made heavy changes to the abstract in response to the comments. Notably, we have made a more concrete suggestion that the evaluated terms (such as cumulative summer freshwater) might be used as model diagnostics. The word "process" has been incorporated at multiple points throughout the abstract. We hope that these changes capture the intent of the reviewer's comment and provide more tangible results and relevance for future work to build on.*