Overall, I think this paper and modeling effort is an important advancement in the modeling meltwater movement through firn in that it addresses the more complex physics of energy and fluid flow beyond the bucket tipping methods. It also combines compaction and fluid flow. It addresses a modeling need that is timely and relevant and the methods and conclusions are valid.

The paper, particularly the introduction and results, are vague and needs significant editing. In general, the paper would be much improved with specific definitions, for instance, near-surface (>10 m). The Introduction should be rewritten completely and there are suggestion in specific comments. Additionally, the results need to be rewritten with values given. The text just mentions the figures and words such as large, small, intermediate. These need to be defined with numbers and ranges. This paper and work is significant and worthy of publication after major editing for clarity, adding column headers to all chart, making all figures a simple as possible for the reader to understand, grammar corrections, and defining all acronyms and model variables. Additionally there are incorrect or vague statements about firn properties and the interaction of meltwater with the subglacial hydrologic system and ice dynamics that should either be removed or clarified.

Specific Comments:

p1, l 2 meltwater can also percolate and store (See work on Greenland firn aquifers) and should be added to this sentence.

p1, l 10 Largest and intermediate are vague. Please clarify with numbers.

The first two paragraphs in the introduction need major change. They are vague and contain misstatements. For instance, while percolated meltwater does affect near-surface firn temperatures (~ 1 m depth), the surface temperature of a glacier is mainly atmospherically driving by conduction (top 10’s of cm). Be clear and precise in wording. Also it the first paragraph makes the assumption that all meltwater that reaches the bed causes a dynamical response in the ice which is incorrect. Define the depth for mean firn temperature, near-surface and relatively cold. The paragraphs should also include citations including work by Fountain, Harper, Humphreys, Koenig with specific numbers on the buffering potential of the firn and how much of the buffering potential is likely filled already.

p2, l 3 IMAU-FDM is not defined.

p2, l 8: The SNOWPACK model now includes Richards equations to describe fluid flow in variably saturated media. How does this model compare to that? See Wever, N., et al. "Solving Richards Equation for snow improves snowpack meltwater runoff estimations in detailed multi-layer snowpack model." *The Cryosphere* 8.1 (2014): 257-274. Also SNOWPACK should be cited.

The last 4 paragraphs in the Introduction should not be included in an introduction. They include topics of methods, discussion, etc. The introduction should just discuss what is need to set up your scientific questions. More the rest to the proper sections. It is OK to have 3-4 sentences outlining your paper at the end of the introduction but this is too much and is confusing for the reader.

There are some variables not defined in equations:
eq (1) - u
eq. (12) cp, K

p 3, l 23, can they explain why they selected the Carman-Kozeny relationship?

P3, l25 Generally a table is introduced in a scientific paper with a sentence similar to Table 1 provides the ….. Please change to this format. See table 1 for the parameter values we use later is vague. Also Table 1 should have column headers such as parameter and value.

p 4, figure 1 caption: maybe change "squeezed out" to "replaced by water" . The final sentence "Ice grains make contact in the third dimension and similarly many of the air and water pockets are connected in the third dimension." is unclear. How is this picture showing a third dimension?

p 5, l 6: they assume that compaction is unaltered by metlwater. Can they justify that assumption or at least describe how compaction actually is affected by meltwater and what that might do to their results.

P 5, l 9 State why Herron and Langway was chosen over the other compaction equations, especially since it was developed for dry snow where Morris and Wingham had more variety in location.

p 8, l 19: change "understand" to "understood"

P 9 figure 2, While this appears correct it could benefit if you replaces some variables with terms like rain (R), Saturation (s). Also the lines and colors do not appear to be explained.

P10 figure 3 Similar comments to figure 2. If you can label the y axis with rate of refreeze it would be helpful. The figures are difficult to understand.

P13 l 4 define small surface layer and full firn column with approximate depths.

P 13, l 30 only the Forster citation is appropriate here. The others are studies from the West Coast of Greenland where water may persist late into the season but has not been confirmed to be perennial except in buried lakes.

p 13, l 32: I think they mean percolation instead of accumulation? The explanation of this scenario doesn't make sense to me (e.g., that the meltwater fills in the pore space more effectively and that prevents water from moving deeper (p 15, l 1). Are there field observations to justify this? Increased water saturation (more effective pore space filling) results in higher hydraulic conductivity, which would allow more water to move through the column. Why doesn't the water move deeper? Is it running off at the surface? If so, that should be clarified. This may also be a result of this being a 1D model - in 2D the water would be able to flow laterally and you might not get this result.

Could they detail more about the relative sensitivity to accumulation vs surface energy balance?

P 15, l 3 Cite here that your model is consistent with others, Kuipers Munneke for instance.

P15 Throughout this entire page it is unclear what values are being refered to. For instance they mention the critical Q value, Q being large enough. Specify with numbers. Also there are methods in the results for instance "We also calculate the total quantity of surface melt and the partitioning of the melt between runoff, liquid storage in the ice, and refreezing in the firn. Runoff and melt are calculated from the model output, liquid storage is taken to be the total water flux out of the bottom of the domain and the amount of refreezing is computed as the residual" Move this to the methods section and just report results here.

p 15, l 14: why is storage equal to the flux out? Shouldn't storage be what doesn't leave the system?

P16 l 17 Glacier surface should be Glacier facies, Make sure this is consistent throughout.

p 16, l 27: can they define what surface slope they are referring to that controls "lateral percolation"? Also, I would say lateral flow.