Review of A fast and simplified subglacial hydrological model for the Antarctic ice sheet and outlet glaciers, Kazmierczak et al.

Thanks to the authors for their work restructuring and clarifying the paper, which is a very nice and interesting read. Most of my comments below are quite minor. However, I am still a little unhappy that there are two (rather different) assumptions lumped under 'key point 3' in their new section 2.2.1, where the only justification provided in the text is that the assumption 'follows from [their] modelling approach', which seems circular to me.

I do appreciate that for practical purposes one must prescribe a single value of N for a given grid cell, to then use in the sliding law. My point was that it is usually the case (per high resolution models) that the effective pressure in a channel [as calculated with something like (5b)] is somewhat higher compared to the average effective pressure in the area surrounding it [which would be more like the N controlling sliding for the whole grid cell]. Admittedly, this effect is likely small, but it would be better to acknowledge and dismiss than to ignore.

The assumption that the drainage density is uniform is rather separate. I appreciate the sensitivity tests showing that using different uniform values results in only limited sensitivity of the model, but I was questioning more about whether l_c should change with q, and therefore would feed more impactfully into the way that N changed with flux. The authors include quite a detailed description around l.235 about the change in morphology of the patchy film with H, which is exactly why I question that l_c, effectively the distance between separating clasts in this regime, is not also somehow a function of film thickness. Similarly one might consider that the distance between linked cavities is likely quite a bit smaller than the distance between subglacial channels (recorded by eskers). I would really appreciate if the authors spent more time with this assumption, either in section 2.2.1, around equation (4), or when discussing film geometry ($\sim$l. 235). If nothing else, there is a lot of great discussion in this paper highlighting the need for future investigation, so it would be helpful to highlight that future work could be performed here.

Specific comments

- Abstract: it could be nice to focus more on the fast aspect of the model.

- l.2 Perhaps just 'switch' rather than 'dynamic switch' since the hydrology is quasi-steady?

- l.9 Comma missing after 'itself'

- l.17 What is meant by 'plasticity' here? In the sense of variability, not in the sense of sediment having a plastic rheology? Perhaps rephrase.

- l.41 There are no processes listed in the previous sentence? Unless by distribution you mean the flow, rather than the final spatial distribution? Also, please add an example reference for this sentence.

- l.43 A[nother] limiting factor, rather?

- l.50 'allows [us?] to dynamically link' word missing.

- l.51 Perhaps state that the hydrology is quasi-static but temporally varying.

- l.92 Inefficient hydrological systems can still transport large fluxes of water if they need to, they just induce larger pressure gradients to do so. Maybe add 'with low gradients in ϕ' to the end of the sentence.

- l.123 As noted above, split this point into two parts. Also, drainage density has not yet been defined in the paper at this point.

- l.131 You have your own synthetic and real geometries to estimate $\nabla\phi_0$ from, so it could be good to use those values.

- l.159 Suggest for clarity 'we choose not to do so as this allows us to decouple the water routing solver from the effective pressure calculation.'

- l.197 Not sure the sentence beginning 'Note that' belongs here.

- l.200 Clarify - drainage rate from where to what aquifer?

- l.212 Can commit to this analysis having been discussed already in 2.2.1 and skip straight to using $\nabla\phi_0$.

- l.222 Weaken to 'and we suggest the effective pressure is approximated over the whole domain by', since the functional form does not formally come from the boundary layer analysis.

- l.306 How are the fluctuations in meltwater forced, since there is (as I understand it) no direct meltwater input in the model?

- l.448 is split $\rightarrow$ can be split

- l.460 Confusingly worded - seems more like the second sentence is restating the first, rather than being implied by it.

- l.464 I don't understand how low $\tilde{\tau}_b$ causes a low N - via ice sheet loss? Or is the implication the other way round and just via (12b)? Please clarify logical flow with a more explicit description of the mechanism.

- l.465 that $\rightarrow$ which

- l.481 Probably should use something less strong than 'On the contrary', such as 'However' or even 'Similarly' since the logic is the same. Then have a paragraph break or contrasting start to the next sentence to introduce the new logic of a spatially variable C.