Thank you for your thorough replies. I appreciate you taking the time to clarify the issues raised.

There are only couple of small items that should be clarified/revised:

Line 489-490.
"Equation (14) is similar to equation (27) derived by Anderson and Anderson (2018) but with the important difference that we have allowed variable velocity in this derivation, rather than assuming a constant velocity along the entire glacier."

Equation (27) in A and A, 2018 does not assume uniform velocity for any part of the glacier, rather it only assumes that englacial debris emergence is negligible. It is derived directly from the continuity equation for debris and is independent from the analytical model presented in that paper (A and A, 2018). Please revise the text above to reflect the fact that variable surface velocities are not assumed in the derivation of equation (27) from A and A, 2018.

The text from A and A, 2018 is below for completeness:

4.3. Concave up debris patterns: velocity controlled

Debris emergence is negligible if there is no debris within the glacier or if sub-debris melt rates are small. In such cases Eq. (9) reduces to

$$\frac{\partial h_{debris}}{\partial t} = \frac{\partial (h_{debris} U_s)}{\partial x} \tag{26}$$

Solving for h_{debris} by taking the integral of Eq. (10) with respect to x leads to

$$h_{debris}(x) = \frac{q_e}{U_s} \tag{27}$$

where q_e is the surface parallel flux of debris at the down-glacier end of the emergence zone (where the emergence rate declines to zero; see Glazyrin, 1975). Here q_e is constant with respect to x and is the integral of emergence rate. Hence

$$q_e = \int_{x_e}^{x_{e_{end}}} \frac{Cb'}{(1-\phi)\rho_r} dx \tag{28}$$

And equation 9 from A and A, 2018:

In the ablation zone, the rate of change of surface debris thickness in one-dimension may be written

$$\frac{\partial h_{debris}}{\partial t} = \frac{Cb'}{(1-\phi)\rho_r} - \frac{\partial (U_s h_{debris})}{\partial x} \quad (9)$$

where b' is the sub-debris ice melt rate, U_s is the down-glacier surface speed, and ρ_r is the density of rocks comprising the debris cover (e.g., Nakawo et al., 1986; Naito et al., 2000). The first term on the right-hand side is a local debris emergence rate ε_{debris} (in units of m y^{-1}), and the second represents the thickening or thinning rate of debris caused by down-valley gradients in the surface debris discharge $U_s h_{debris}$. For the analytical model, we assume a uniform U_s field in the debris-covered portion of the glacier so the right-hand term in Eq. (9) is neglected.

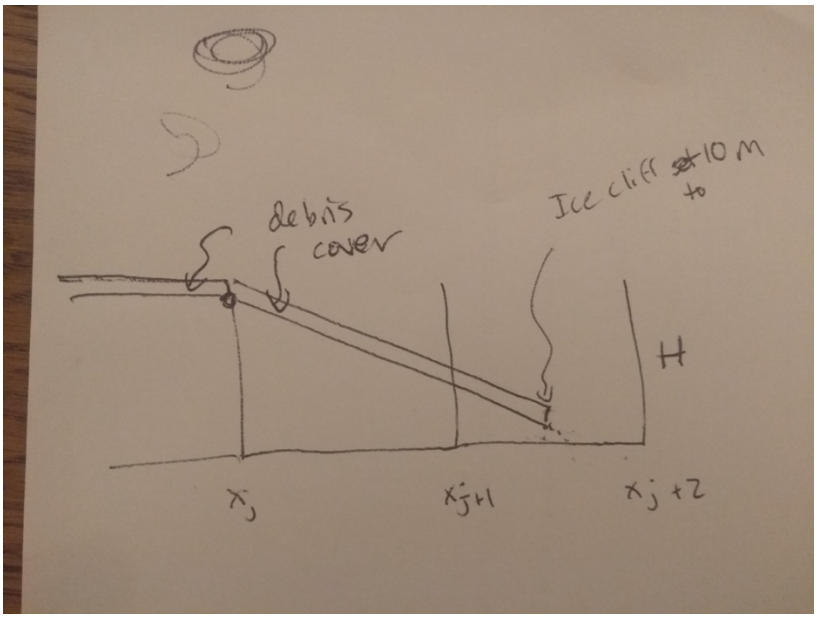
Line 602.

"A second difference is the fact that the size of the terminal ice cliff —and hence the size of the region over which the terminal debris flux condition is applied —depends directly on the grid spacing, resulting in a smaller ice cliff as the grid size is reduced. The implications of this for model convergence are not clear."

Ice cliffs are defined quite differently in the two papers/terminal parameterizations.

The terminal wedge parameterization in A and A, 2016 prevents the issue outlined by the authors above for the grid sizes explored there (100 and 200m). The ice cliff height is set to 10 m, is vertical, and is applied within the terminal wedge.

Here is the ice cliff parameterization as done in A and A, 2016:



The ice cliff height does not change in A and A, 2016 because it is defined as a parameter in the code and the ice cliff height is always much smaller than the ice thickness at the start of the terminal wedge. The code from A and A, 2016 is not yet available (it should be and I would like to make it so) so this is not clear to the authors here.

I would simply appreciate if the text quoted above was at least edited to reflect that the ice cliff is defined differently between the papers and as it is defined in A and A, 2016 the ice cliff height is not grid size dependent.

It is accurate though to say that the height of the start the terminal wedge is grid sized dependent. But because the terminal wedge is debris covered in A and A, 2016 it does not introduce ice cliff height dependence issues as described by the authors.

Best wishes for finalizing the manuscript!

Leif