Review of "Balance between driving stress and basal drag results in linearity between driving stress and basal yield stress in Antarctica's Siple Coast Ice Streams"
By: J. Wohland et al.
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The authors investigate the relationship between ice stream geometry and basal stress. The primary contribution of this work is a simplified flowline model, which the authors use with observed flow velocities and ice stream geometry to infer stresses at the bed and along the flowline within the ice column (sometimes called 'longitudinal stress' and herein called 'membrane stress'). The results indicate, as the title suggests, that membrane stresses are negligible and, consequently, that driving stress is a linear function of basal yield stress.

I like several things about the paper but have some major concerns. These concerns would need to be addressed before I would recommend the paper for publication.

Starting with the positives:

- Overall the manuscript is very clear and well written.
- The treatment of the model and underlying assumptions is concise and well organized, although it misses the most consequential assumption (see my main concern below). In particular, the authors go out of their way to qualify their results in light of the assumptions that they mention.
- The authors do a worthwhile error analysis for driving stress based on the errors available for the observations.
- The figures are neat and do a good job of communicating the main findings.

My main concerns are that the simplified model the authors use does not seem valid for this study and that the main conclusion drawn from this model are at odds with previous studies that the authors do not cite. In deriving the model, the authors neglect shearing in the margins in the SSA momentum equation (Eq. 1) without justification. Shearing in the margins can be a major component of the stress balance, particularly in Siple Coast ice streams. For example, Echelmeyer et al. (1994) found that shearing in the margins balances half of the driving stress in parts of Whillans Ice Stream while basal shear stress accounts for the other half of driving stress. There are flowline models that parameterize shear stress in the margins (e.g. Dupont and Alley 2006) and these seem more appropriate to this study than the model that is used. At the very least, the authors need to do more to convince the reader that their main conclusion makes sense in light of Echelmeyer et al. (1994), Tulaczyk *et al*. (2000a,b), and other studies on Siple Coast ice streams that point to drag in the margins as being a major factor in the stress balance.

Other major comments:

1. There is a lot of literature on basal shear stress and basal conditions in Siple Coast ice streams that is relevant to this study and that the authors do not mention. Certainly Tulaczyk *et al*. 2000a,b warrants some discussion. Many others have used ice geometry and flow velocities to constrain ice flow models and to infer basal conditions in the Siple Coast. This work should be taken into account. Examples include classic papers like MacAyeal (1989,1992) and Joughin *et al*. (2004), as well as more recent work by Morlighem *et al*. (2013) and Arthern *et al*. (2015).

2. Even though longitudinal stresses are unlikely to be important, smoothing the surface topography and ice thickness over 50 km (i.e. roughly 50 ice thicknesses) seems extreme

(see lines 144-155). Given the sensitivity of the results to ice geometry, this choice warrants a more thorough evaluation than is currently given. Kamb and Echelmeyer (1986a) provide a detailed, physically based discussion of how filtering can influence ice flow calculations. They argue that a rectangular window (like that used by the authors here) is a "poor approximation," preferring a triangular filter window. The length scale used by the authors here exceeds the length scales recommended by Kamb and Echelmeyer by a factor of 5 or more. Furthermore, other approaches that are more sophisticated and almost certainly better than the low-pass filtering applied by the authors are available to extract realistic gradients from noisy data (e.g. polynomial fitting, spline fitting, Savitzky-Golay filtering, etc.). Any of these approaches seem more appropriate for this work and all are available in most scientific programming packages (Matlab, Scipy, etc.), making them relatively straightforward to implement. At the very least, the authors should show how sensitive their conclusions are to their choice of smoothing window size.

Grammatical and minor comments:

Line 36: 'summary' is misspelled

Line 41: 'inverse' should be 'invert'

Line 62: 'hint to' should be 'hint at'

Line 82: 'theses' should be 'these'

Eq. 4: v_x should be u_x

Line 120: The assumption of spatially constant A is discussed earlier (Line 91) and does not necessarily need to be repeated here.

Figures 1b and 2: On my printer, it is difficult to tell the difference between some of the line colors. I suggest using a different color scheme for the lines and/or using different line types or markers to distinguish between the different ice streams.