The thermal regime at the base of West-Antarctic Ice stream tributaries – is the Holocene decay of the West-Antarctic Ice-Sheet coming to an end?

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The West Antarctic Ice Sheet is a marine based ice sheet. Melting of its ice would cause a sea level rise of 5 m. Documented history of repeated advances and retreats and the fact that most of its base is grounded well below sea level raises concern about its future disintegration. Over the past decades major advances have been made in understanding the behavior of the WAIS. Ice draining from the WAIS toward the Ross Ice Shelf converges into 6 up to 600 m/yr fast flowing ice streams, which are fed by moderately fast flowing (~ 50 m/yr) ice stream tributaries. Boreholes drilled through the ice sheet revealed high basal water pressures in the ice streams and a highly porous water saturated till layer (shear strength ~1 to 5 kPa) suitable to accommodate the fast motion of ice.
As subglacial melting is the only source for the subglacial water, the spatial and temporal distribution of melting and freezing has to be incorporated into models simulating the past and future behavior of the West Antarctic Ice Sheet. So far it is unclear if the lubrication of the ice stream bed is caused by local melting/freezing only, or by subglacial/basal water advection/flow. A 12-to-25-m-thick layer of frozen-on basal ice has been found at the Sticky Spot location of Ice Stream C (Engelhardt, 2001; Kamb, 2001). It represents a freeze-on history of at least several thousand years and the question arises whether ice stream tributaries are a source or sink of subglacial water.
Initial results of our thermo-dynamical flow-line model indicate that the 12 to 25 m thick basal ice layer could have formed over the last 7000 years while the ice found today at UpC was flowing through the northern tributary of Ice Stream C. This suggests that basal freezing dominated in this tributary in the recent past. Results of time-dependent model-runs further suggest that basal melting was highest in the early Holocene, after a thickening of the ice in the WAIS interior, possibly initiating the rapid decay of the ice sheet. Further work and the acquisition of field data have to be done to determine if (and if yes to what extent?) the suggested basal freezing could reduce basal lubrication beneath ice streams and tributaries thereby leading to deceleration of ice flow rates (as observed on the Whillans Ice Stream and Ice Stream C).