Supporting Information for "Ambiguous stability of glaciers at bed peaks"

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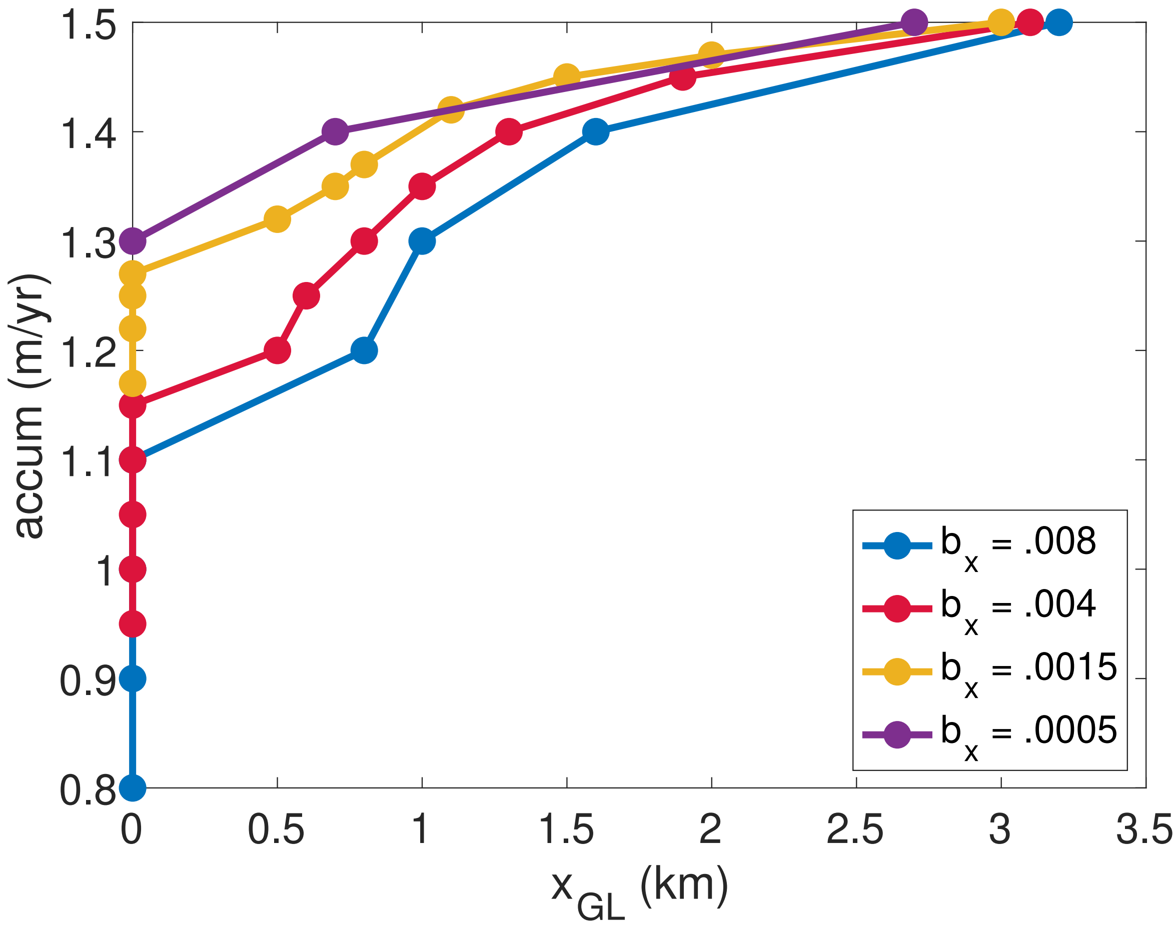

Figure S1. Stable grounding line positions in Elmer/Ice Full Stokes simulations (along a flowline) of grounding line retreat over sharp bed peaks located at $x = 0$ on the x-axis. Bed topographies are identical to those use in simulations plotted in Figure 3. Horizontal resolution is 100 meters throughout domain. Simulations are variants on the the Elmer/Ice MISMIP benchmark simulations.

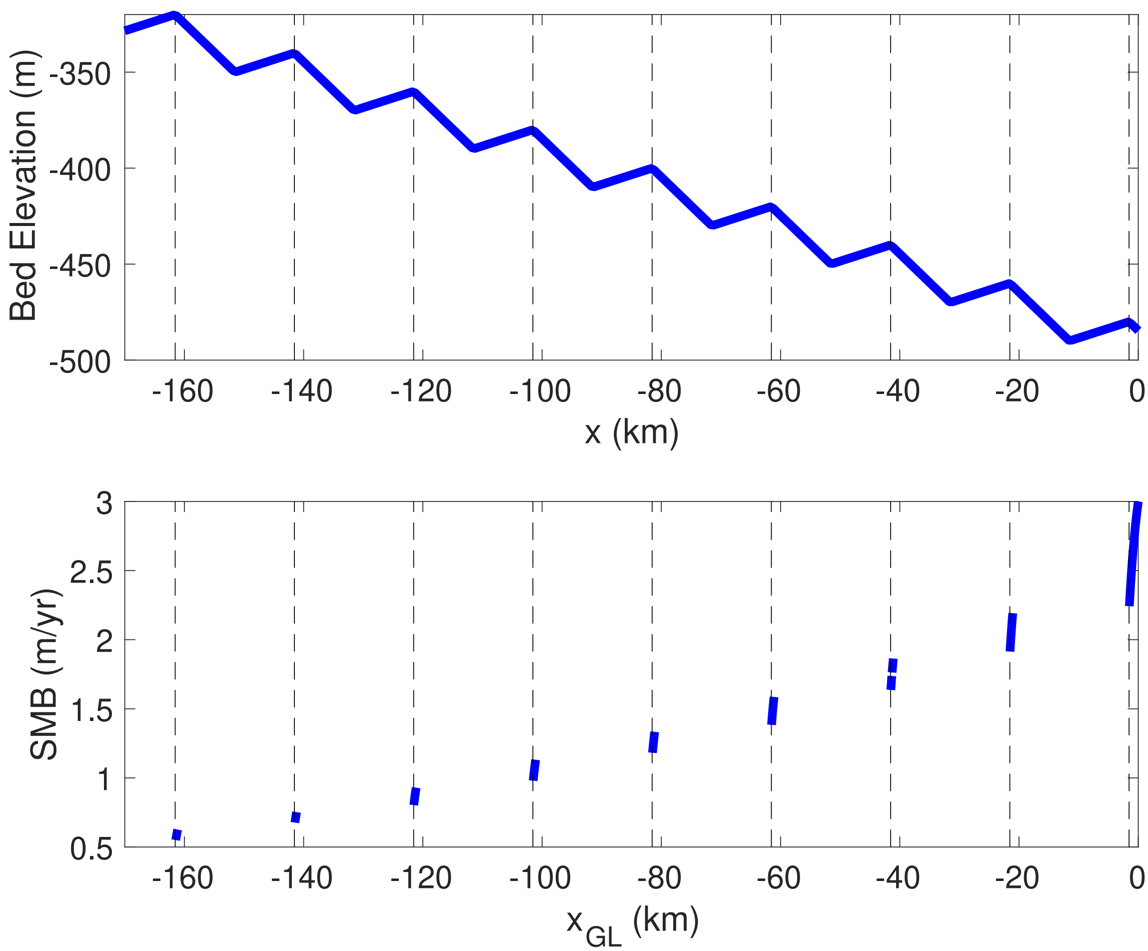

Figure S2. Steady-state grounding line positions over a range of surface mass balance (panel b) on a corrugated bed with many bed peaks (panel a). Bed peaks are indicated with black dashed lines.

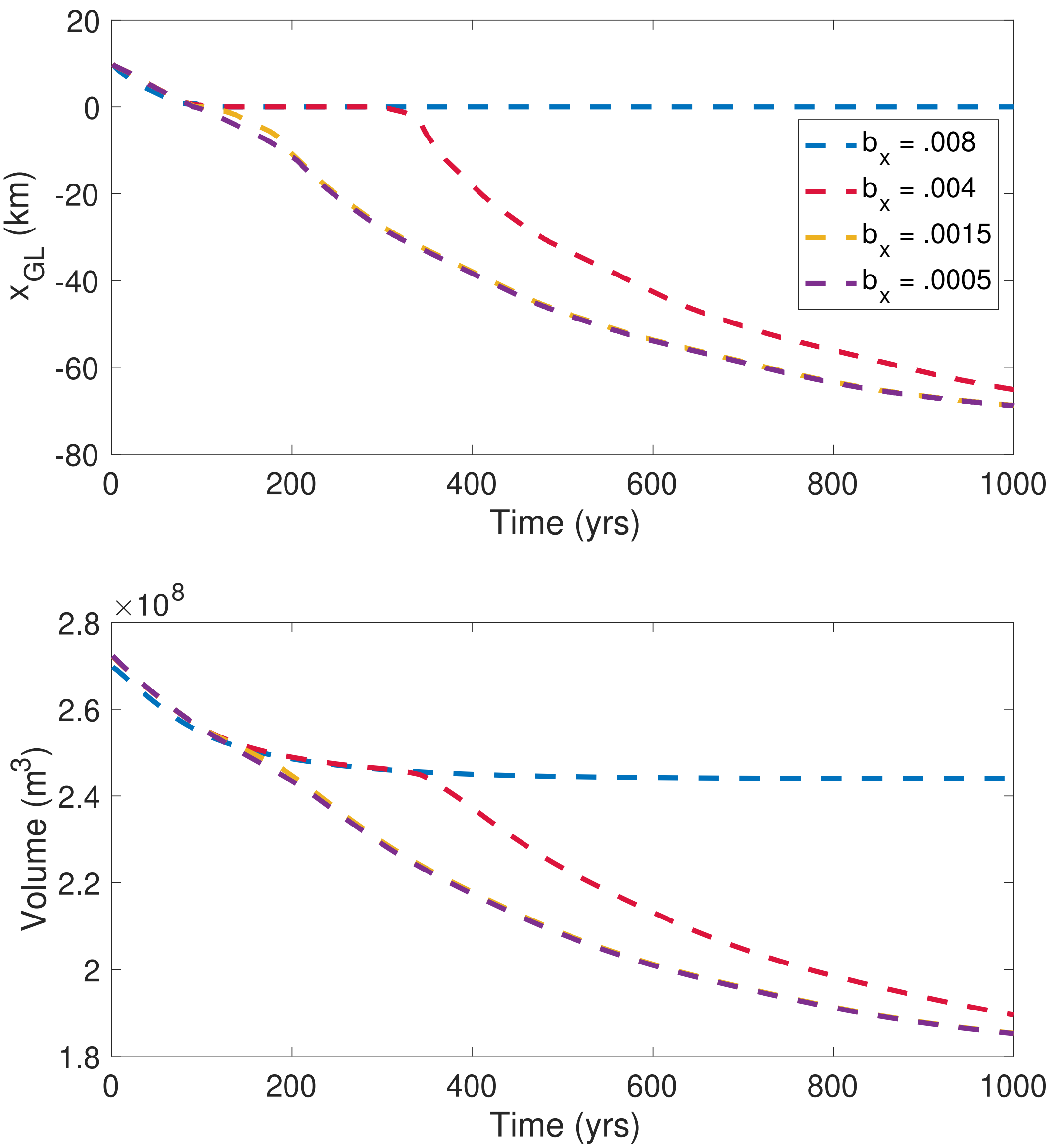

Figure S3. Transient grounding line (top panel) and glacier volume (bottom panel) evolution in Elmer/Ice Full Stokes simulations of retreat over sharp bed peaks (simulated along a flowline). Bed topographies are identical to those use in simulations plotted in Figure 4. Due to small quantitative differences in steady-state grounding line positions in full stokes simulations, initial SMB is set to 1.5 m/yr (compared to 1.1 m/yr in SSA simulations) and then reduced by 40% at beginning of simulation, as in the SSA simulations). Horizontal resolution is 100 meters throughout domain.

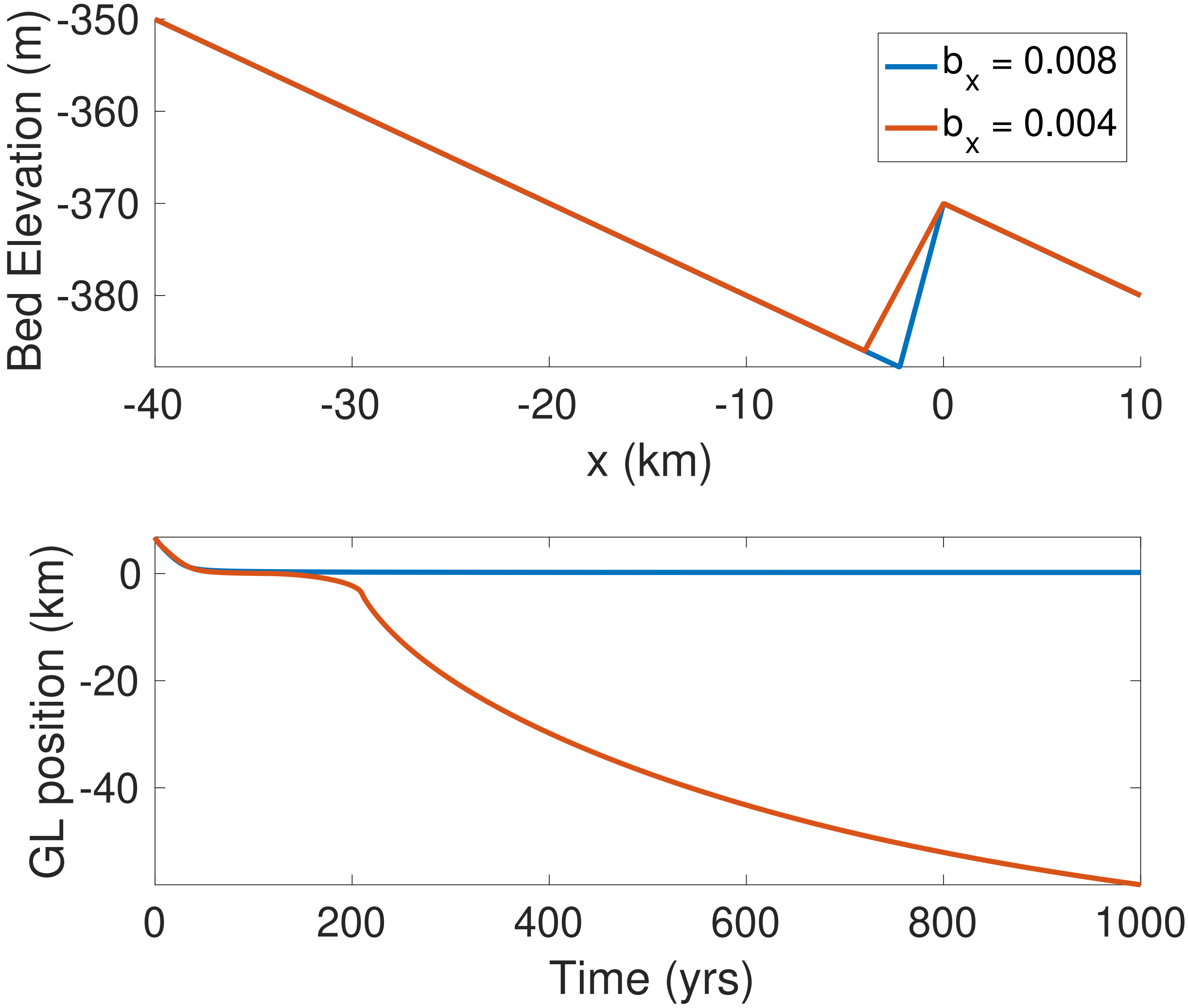

Figure S4. Comparison between simulated transient persistence and retreat over bed peaks with different upstream bed slope under changing ocean forcing. Simulations are the transient response to a step change from zero ocean melting to 50 m/yr basal melt rate at the terminus. Submarine ocean melt is imposed as a basal melt rate at the node corresponding to the grounding line. The idealized bed topographies here correspond to the two steepest bed peaks plotted in Figures 3 and 4.

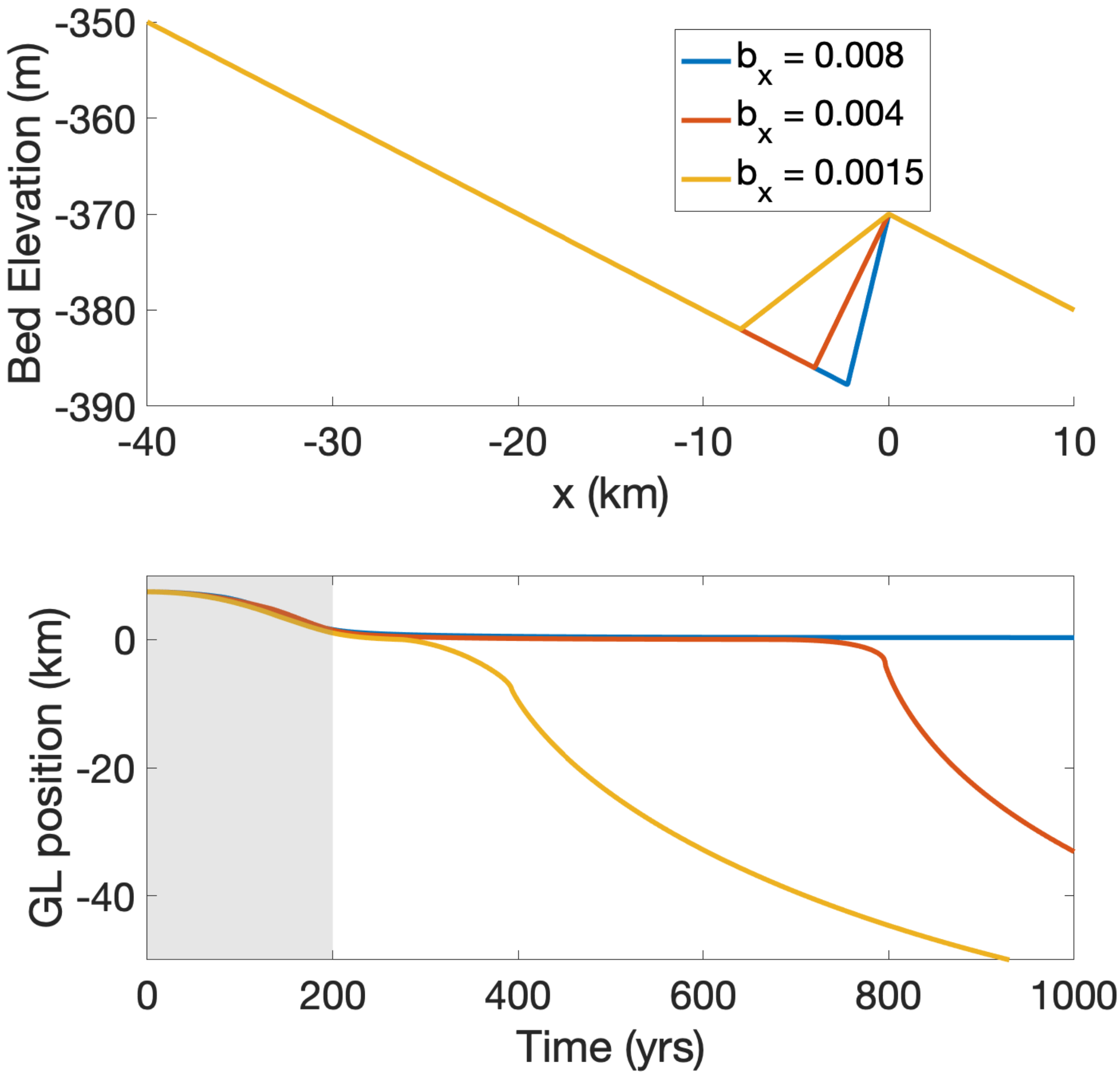

Figure S5. Comparison between simulated transient persistence and retreat over bed peaks with different upstream bed slope. Simulations are the transient response to a trend in SMB over the first 200 years of the simulation. The total change in SMB is the same as in the simulations plotted in Figure 4. The idealized bed topographies here correspond to the three steepest bed peaks plotted in Fig. 2a. It can be noted that though the timing of retreat onset is slightly delay (presumably due to the slower forcing), the qualitative behavior of the transient persistence at bed peaks is unchanged.

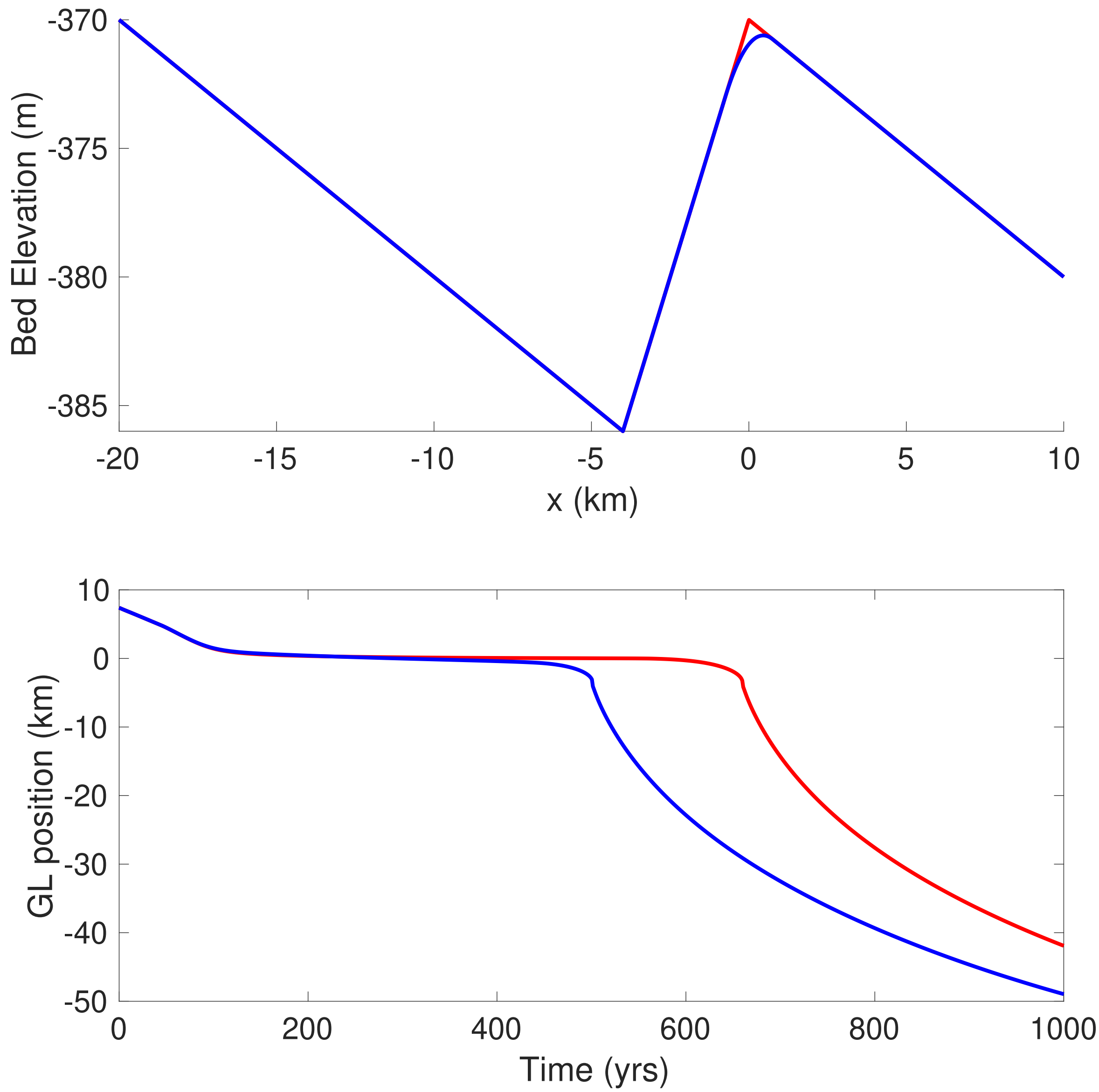

Figure S6. Comparison between simulated transient persistence and retreat over bed peaks. Red line is the same simulation as the red line in Figure 4 in main text. Blue line is with bed peak smoothed over 1 km moving window. Multi-centennial persistence still occurs, though onset of rapid retreat is slightly early due to lower bed peak.

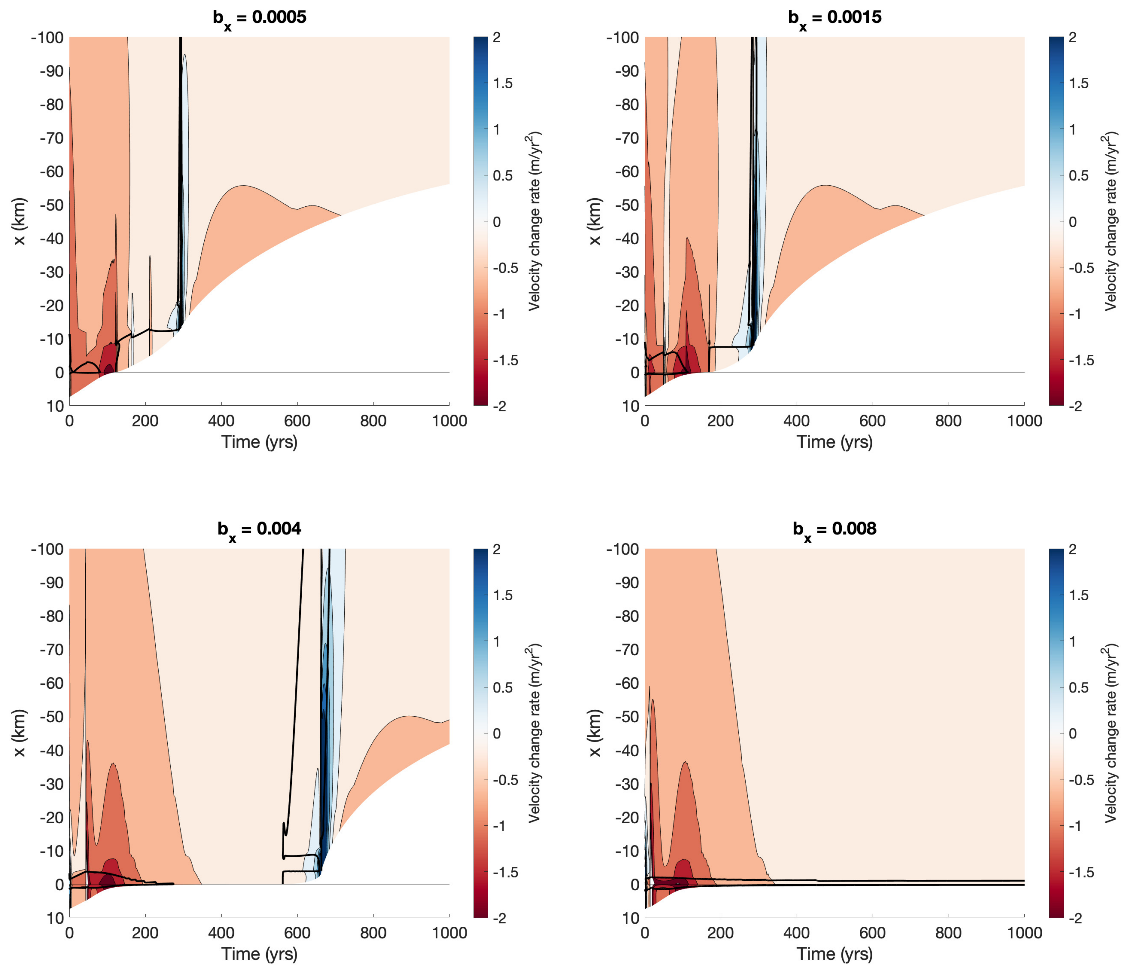

Figure S7. Rate of change of ice velocity in transient simulations plotted in Fig. 2 in main text. x-axis is time and y-axis is the along-stream distance relative to the terminus, where negative values are upstream.

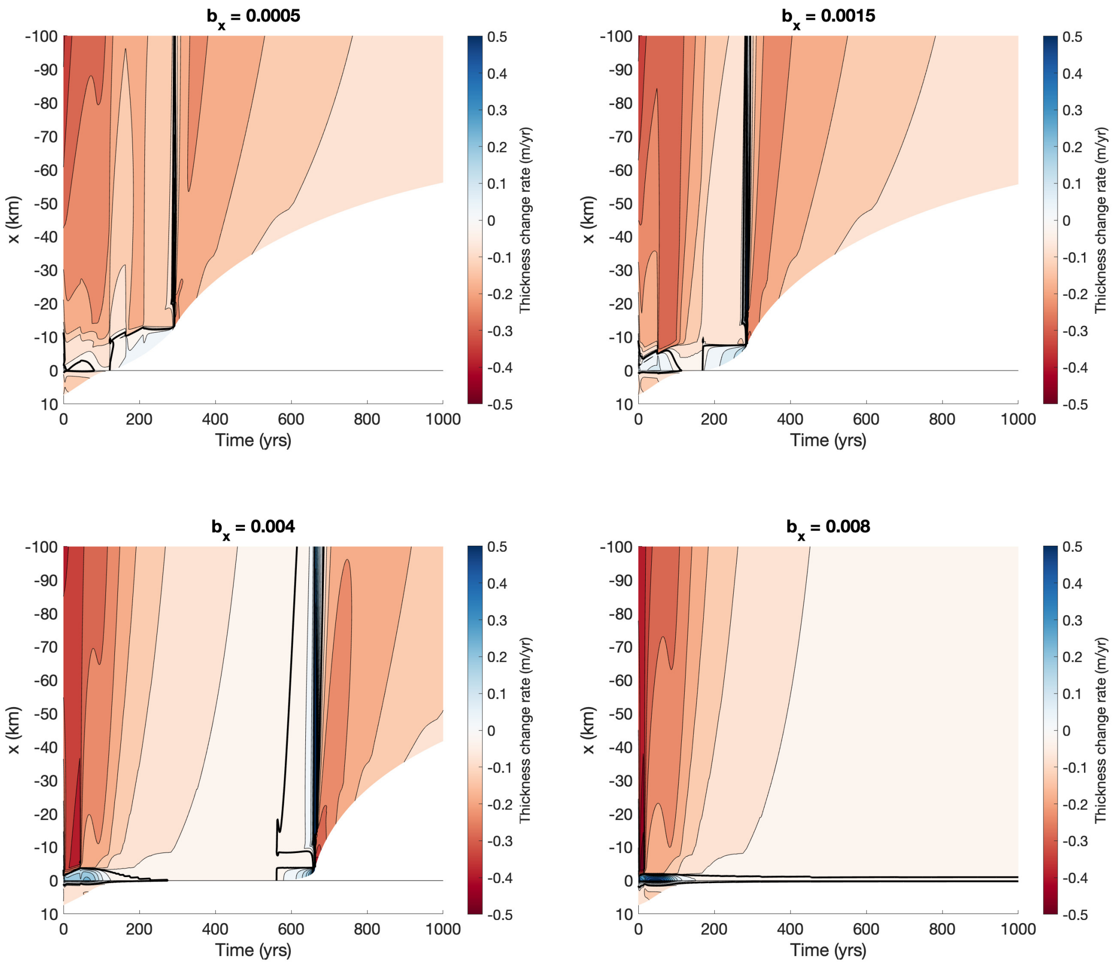

Figure S8. Rate of change of thickness in transient simulations plotted in Figure 4 in main text. x-axis is time and y-axis is the along-stream distance relative to the terminus, where negative values are upstream.