Supporting Information for

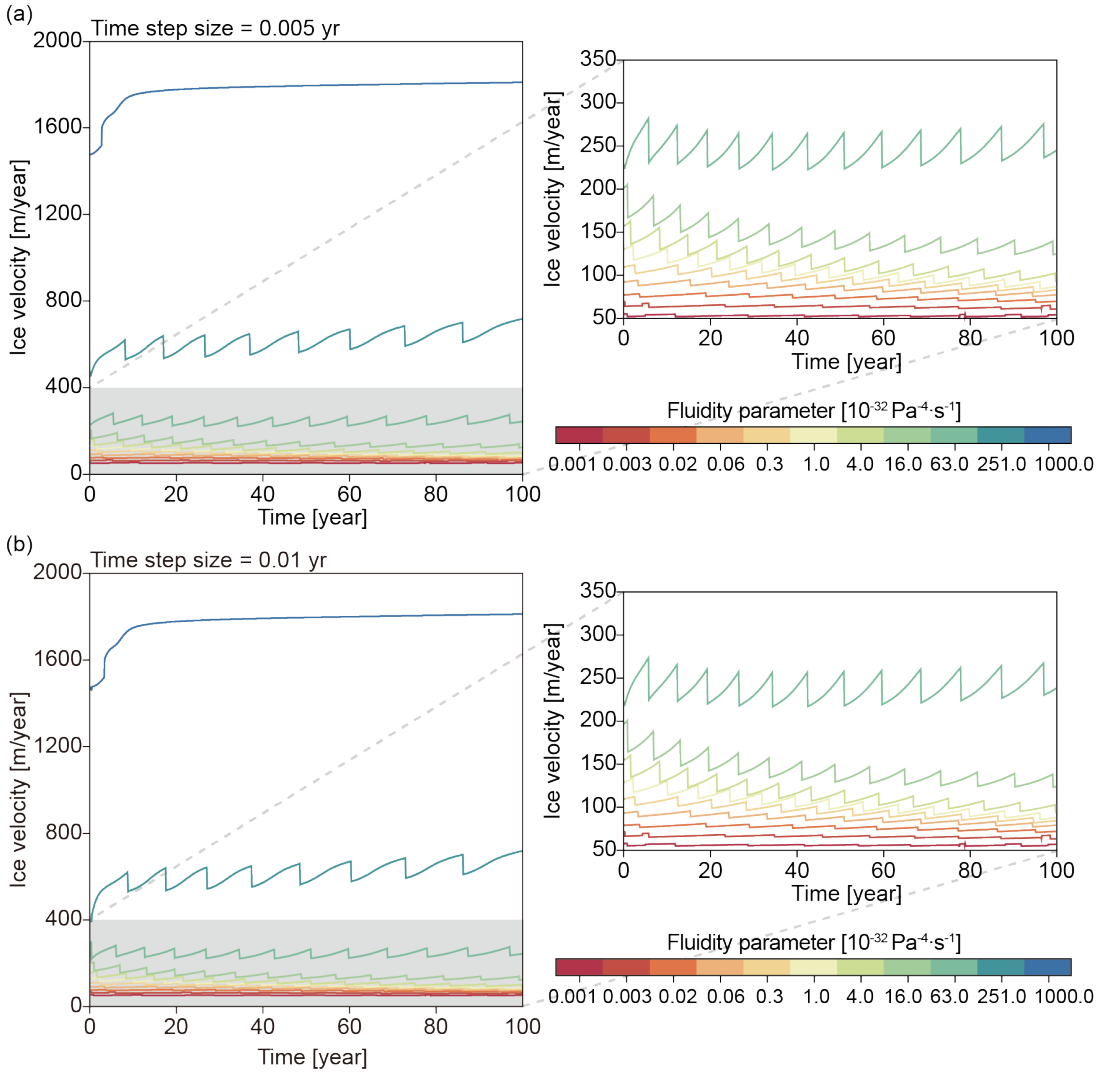
Refinement of the fluidity parameter range with a stress exponent of four in Glen's law: insights from Antarctic bed topography model

Su-Jeong Lim[1], Yi-Jeong Baek[1], Byung-Dal So[1*]

[1]Department of Geophysics, Kangwon National University, Chuncheon, Republic of Korea

Corresponding author: Byung-Dal So (bdso@kangwon.ac.kr)

Contents of this file



15 **Figure S1.** Time-dependent ice velocity changes of the simplified slope model as a function of time step size. The time-dependent ice velocity was compared for a time step size of (a) 0.005 years and (b) 0.01 years. Both time step sizes result in a consistent pattern of ice velocity evolution.

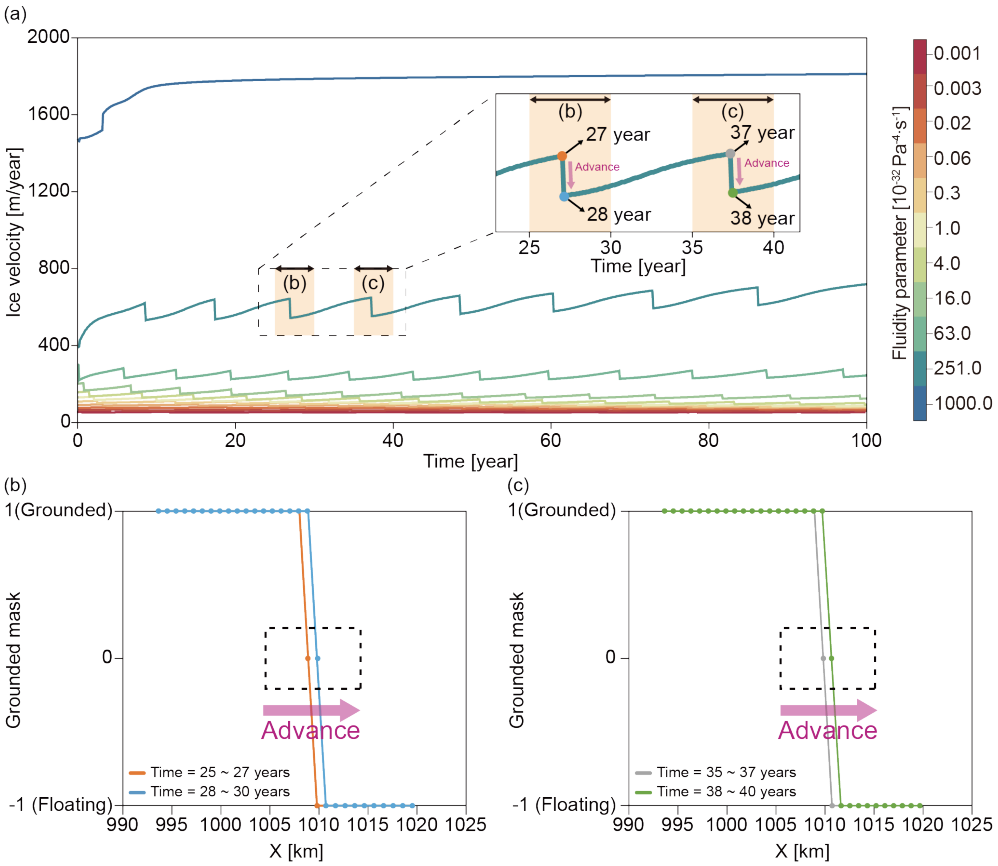
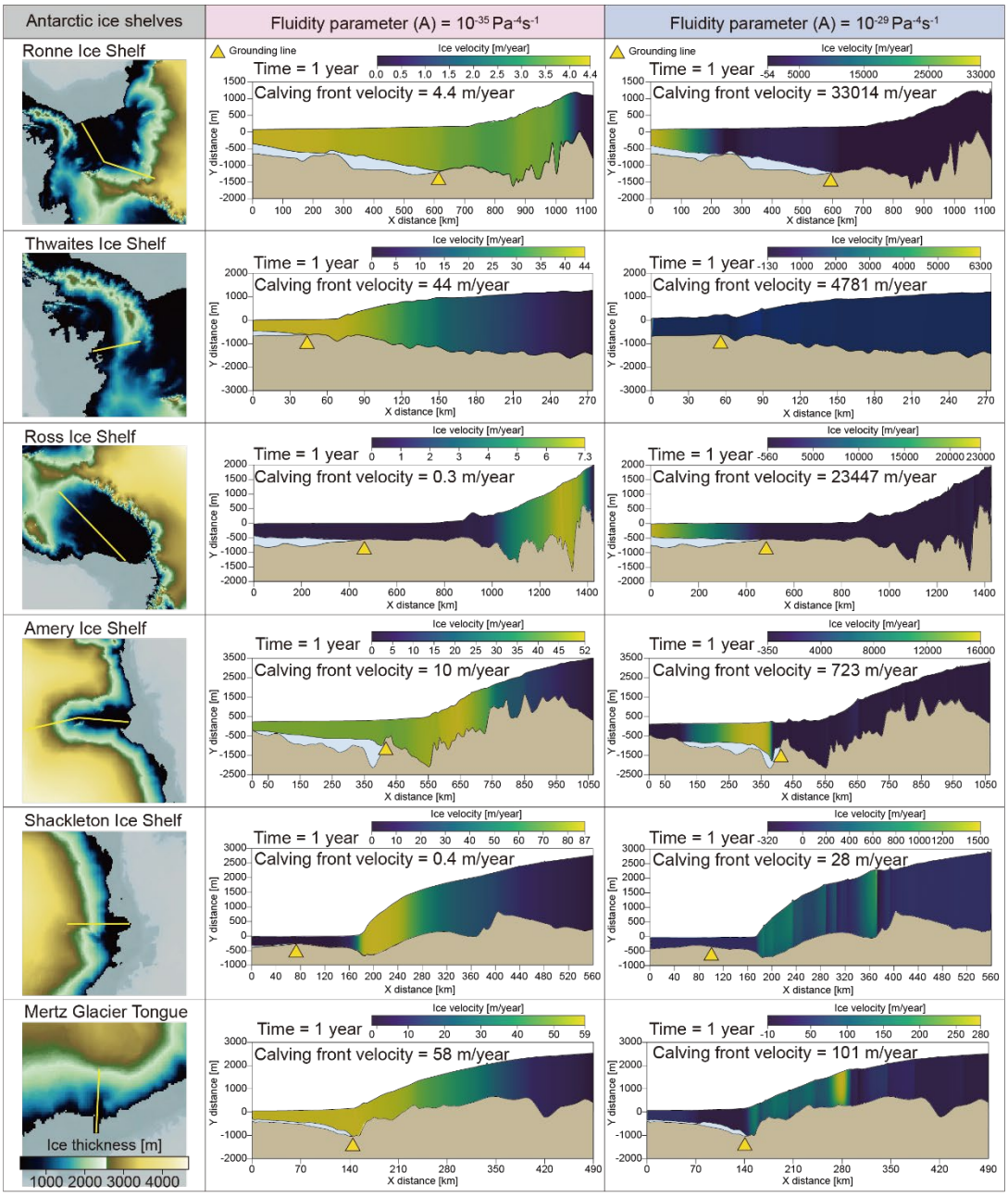


Figure S2. Comparison of ice velocity oscillations with grounding line migration periods in the simplified model. For a total time of 100 years and an A value of 251×10^{-32} $Pa^{-4}s^{-1}$ (dotted box in a), (b) the grounding line migration from 25 to 30 years, (c) the grounding line movement from computation time of 35 to 40 years. The observed oscillations in the time-dependent ice velocity coincided with periods of rapid ice velocity deceleration and grounding line advance. The dots in (b) and (c) indicate the numerical node along the basal ice surface



25 **Figure S3.** Ice velocity after one year for the models with the smallest (A = 10^{-35} $Pa^{-4}s^{-1}$; left column) and the largest (A = 10^{-29} $Pa^{-4}s^{-1}$; right column) values. The yellow lines in the ice thickness maps indicates the cross-section for extracting the bed topography and ice thickness. Ice velocity at the calving front produces ice velocities that are significantly slower or faster than the observed Antarctic velocity. The pink box denotes the calving front of each model. The yellow triangles indicate the calculated grounding lines.

30

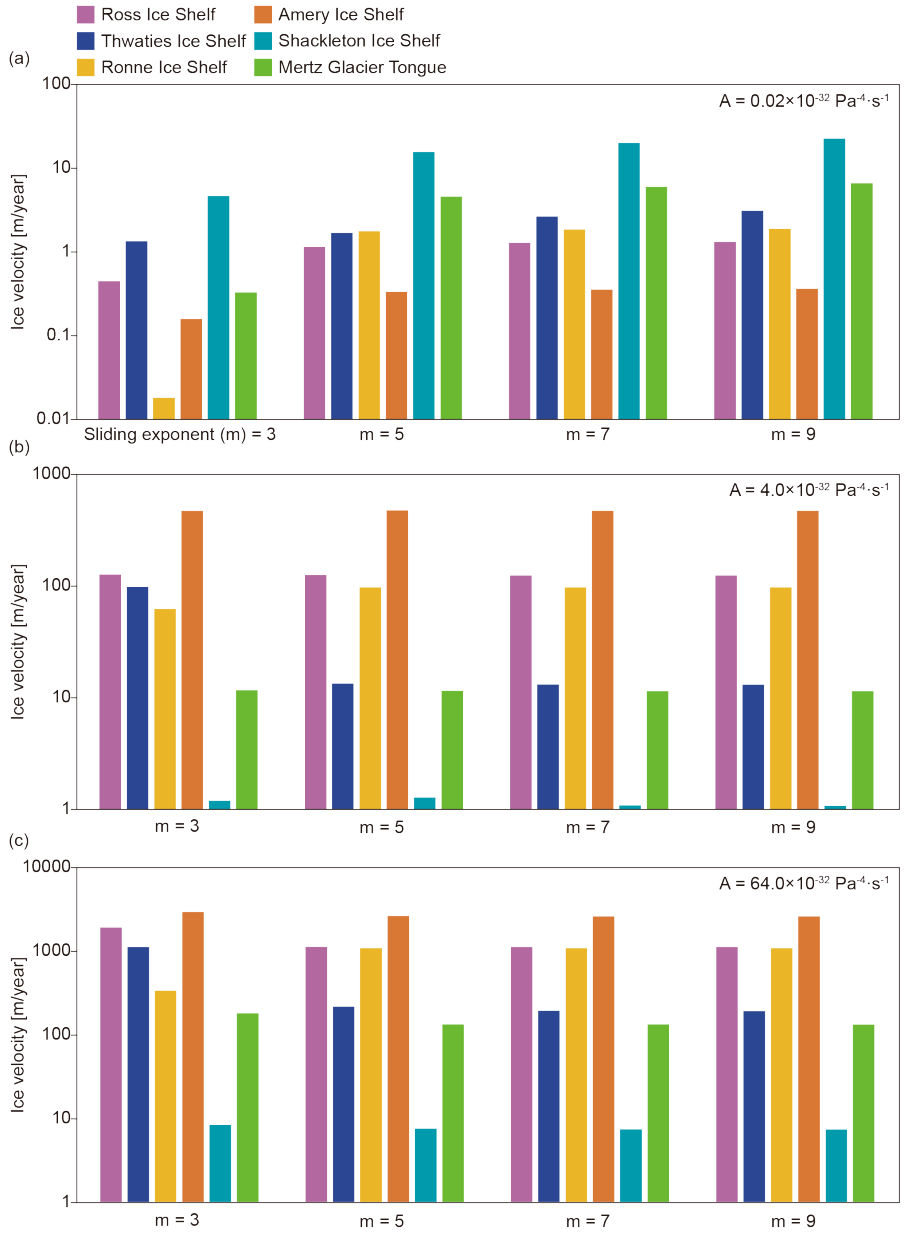


Figure S4. The variation of ice velocity in the Antarctic ice shelves with the value of the sliding exponent (m), a parameter of the Weertman friction law. Typically, the sliding exponent in modeling ice sheet dynamics is selected the value of 3. We compared the ice velocity change for four values of m = 3, 5, 7, and 9. Compared to the variation of ice velocity with the value of the fluidity parameter (A) of Glen's law, the variation with the value of m was relatively small (less than 10%). (a), (b), and (c) correspond to the models with $A = 0.02$, 4.0, and $64.0 \times 10^{-32}\ \mathrm{Pa}^{-4}\ \mathrm{s}^{-1}$, respectively. Note that $A = 4.0 \times 10^{-32}\ \mathrm{Pa}^{-4}\ \mathrm{s}^{-1}$ was included in the range, which fits the observed ice velocity, derived from the Antarctic bed topography models (see Fig.5 and 6).