Supplementary figures for Christian et al.: Differences in the transient responses of individual glaciers: a case study the Cascade Mountains of Washington State, USA

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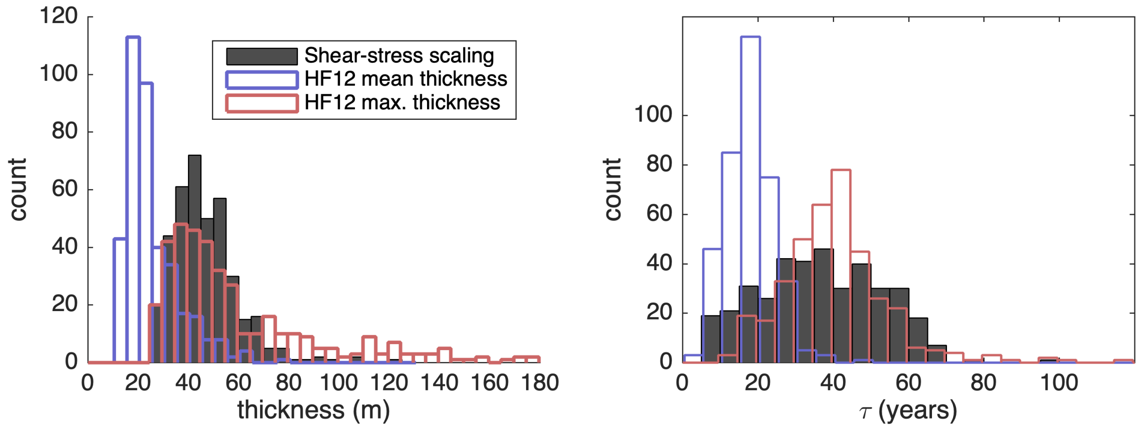

Fig. S1. a) Distributions of characteristic thickness estimates from shear-stress scaling (gray) vs. estimates from Huss and Farinotti (2012) (HF12, data published in Farinotti and others, 2019, model 1) for Cascades glaciers. For HF12 estimates, distributions of mean (blue) and maximum (red) are shown. b) Resulting estimates of τ, where b_t is estimated as in the main text. Using HF12 maximum thicknesses would yield a similar range of response times to estimates based on shear stress scaling, but as described in the main text, may underestimate thickness on low-slope glaciers. Note that the mean thickness is taken over the entire glacier outline, which includes thin marginal ice for some glaciers, and may not be equivalent to the mean flowline thickness sometimes used to estimate τ.

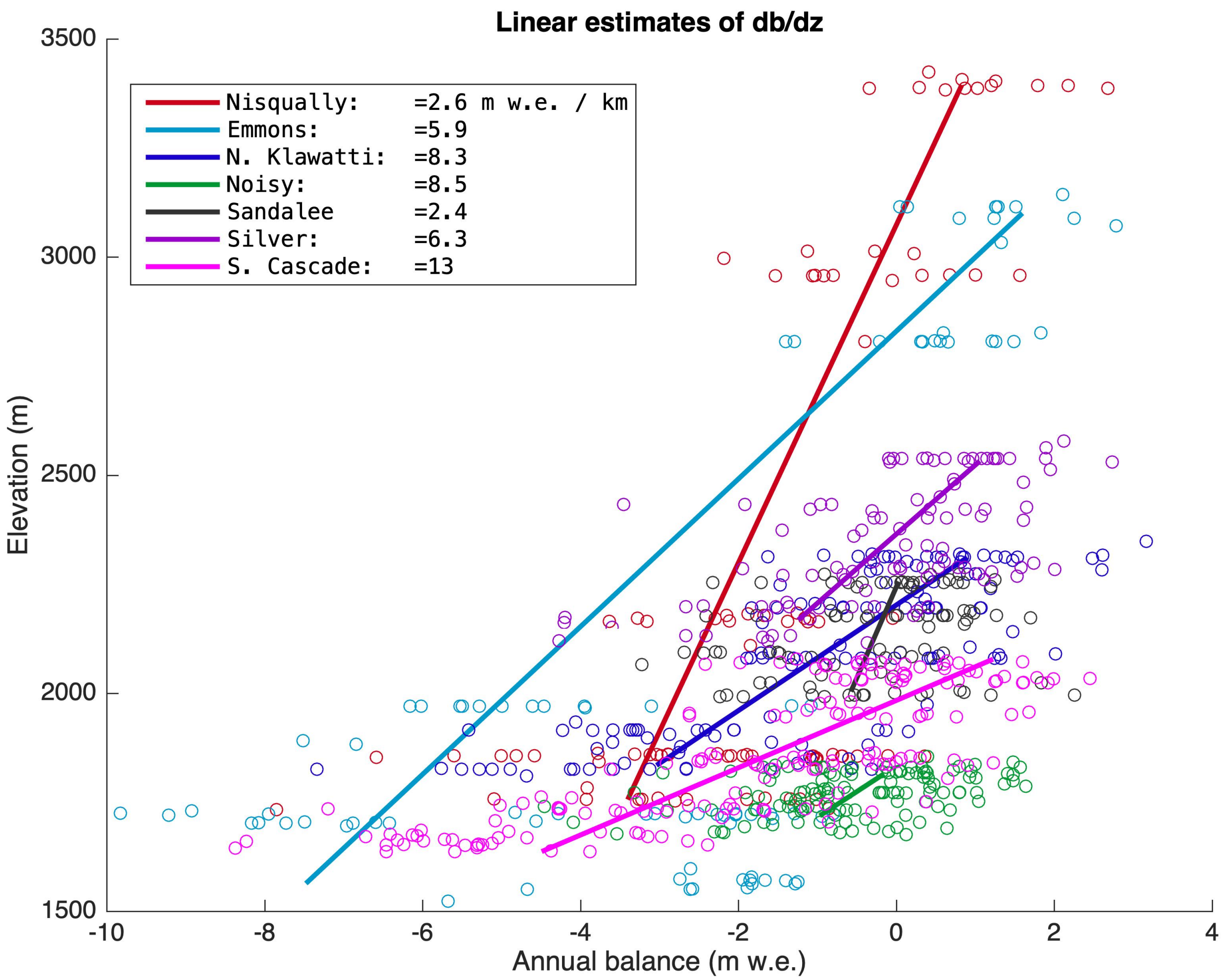

Fig. S2. Mass balance measurements from individual stakes (circles) and linear estimates of vertical gradients (lines). For each glacier, gradients are estimated by taking a linear fit to the stake measurements each year, and then the time average of these yearly gradients. For Emmons and Nisqually, we excluded stakes that were indicated to be positioned in heavy debris cover. Mass balance on South Cascade glacier is reported by the US Geological survey (Baker and others, 2019), and on the other glaciers by the National Park Service (Riedel and Larrabee, 2015, 2016, 2018, NPS provisional data, 2020)

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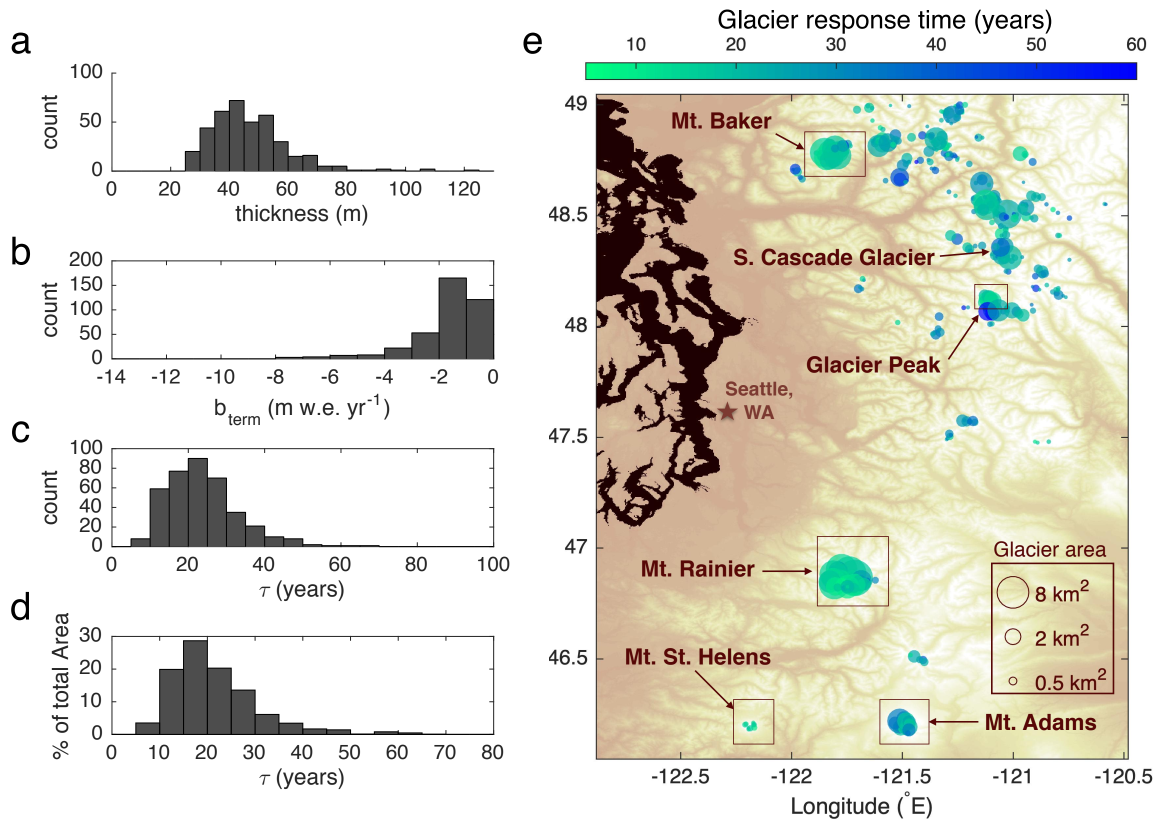

Fig. S3. Estimated glacier parameters and response times, as in main text except using a vertical mass balance gradient ($db/dz = 6$ m w.e. a^{-1} km^{-1}). (a) Distribution of characteristic thickness using shear-stress scaling, same as in main text. (b) Estimated b_t, using $db/dz = 6$ m w.e. a^{-1} km^{-1}. (c) Estimated response times according to Eq. 1 (main text). (d) As for (c), but weighted by glacier area reported by RGI. (e) Map of each glacier in our sample. Dot size corresponds to area and color indicates τ. Basemap is topography from the Shuttle Radar Topography Mission (Jarvis and others, 2008).

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