

Interactive comment on “Understanding Drivers of Glacier Length Variability Over the Last Millennium” by Alan Huston et al.

Anonymous Referee #2

Received and published: 7 November 2020

This study attempts to quantify the relative roles of internal climate variability vs. external forcing on length fluctuations in glaciers over the last millennium. I believe this to be an excellent and important study, which I would recommend for publication after revisions.

Comments: L25–29, 40–41: As far as I can tell from this discussion, these studies do not directly address glacier length variability, rather temperature variability. Please clarify this. L47–53: Since the results of the paper rely on the fact that the ensemble spread can be used as a proxy for internal climate variability, I would like to see some more discussion of this. Have other studies used the LME for this purpose? How realistic is the magnitude of variability in LME? It would be good to cite some other papers that have similarly used ensembles of climate models for the purpose of disentangling

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forced and unforced variability. Eq. 6: Please make clearer exactly how you compute this. The numerator is clear enough, but L90 "total variance across all ensemble members" is not totally clear. L140–144: There are a few studies that have looked at the dependence of response time on size on a global scale; see Raper and Braithwaite (2009), Bach et al. (2018). L142: The reference Barth et al., 2017 is missing from the bibliography. L161–163: Why was the SNR computed for the industrial era for the mass balance but not for the length fluctuations? L169–171: There appears to be a negative trend in L' for South Cascade at $\tau=30$ as well. More generally, however, it seems too strong to claim an "absence of 20th-century retreat in the Northern Hemisphere" based on the sample of three glaciers. Do you find this also when you look at the larger sample of 76 glaciers? L242: Are the ratios similar when you choose a larger τ ?

References: – Bach, E., Radić, V., & Schoof, C. (2018). How sensitive are mountain glaciers to climate change? Insights from a block model. *Journal of Glaciology*, 64(244), 247–258. <https://doi.org/10.1017/jog.2018.15> – Raper, S. C. B., & Braithwaite, R. J. (2009). Glacier volume response time and its links to climate and topography based on a conceptual model of glacier hypsometry. *The Cryosphere*, 3(2), 183–194. <https://doi.org/10.5194/tc-3-183-2009>

Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2020-230>, 2020.

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