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Interactive comment on "Fluctuations of a Greenlandic tidewater glacier driven by changes in atmospheric forcing: observations and modelling of Kangiata Nunaata Sermia, 1859–present" *by* J. M. Lea et al.

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Lea et al (2014) provide a detailed presentation of the results of a simple flow-band numerical model for reconstructing glacier dynamics and the terminus behavior of Kangiata Sermia. They further compare the resulting terminus history to sea surface temperature and air temperature finding this glacier more sensitive to the latter. This model provides useful insights and the results here will be of considerable importance, in part because the glacier has a sill preventing sea water at depth from entering the fjord. The paper needs more attention to the fjord width variable to better quantify the importance and limitations of this parameters impact on terminus behavior.

Specific Comments:

2009-25: List a couple of example glaciers, where warm water incursion is important.

2010-3: Other glaciers with shallow sills in their fjords? Should have a better Figure 1 that illustrates the larger region and points out the sill location and other key features, this is a long and complicated fjord. This could replace Figure 3. The figure could be similar to Figure 1 from Lea and others (2014a) but showing the sill location too. Any bathymetry that can be added could be in this figure also.

2011-25: Example here from Lea et al (2014b) in the difference maybe Jakobshavn or Narssap Sermia.

2013-14: Explain crucial nature of the crevasse water depth variable.

2014-5: The model is not focused on the seasonal cycles as noted, but as a follow up to the runoff cycle, the velocity cycle should be mentioned in the next sentence. Ahlstrøm et al (2013) in their Figure 4 indicate the peak in velocity as the melt season begins and a decline and minimum in velocity as the melt season progresses.

2016-10: What is the upstream limit where rapid ice flow begins, identified by Joughin et al (2010) and modeled by Lea et al (2014a)? Does this agree with the velocity and depth profile in Thomas (2009)?

2019-26: Fjord width and pinning point importance. Given the nature of the model and lack of bathymetry it is not expected that this be fully quantified here, since pinning points can be width or depth based. Fjord orientation may also be involved, less so for Kangiata. However, it should be emphasized more. In Figure 1 and 3 it would appear that natural pinning points exist at the LIA maximum, the 1921-1936 terminus location and the 1979-1997 terminus position. It makes sense to have an along track fjord width figure, which would show how much control this factor play in short term slowing or accelerating the retreat. This could be one slice of Figure 4a, which would

TCD

8, C595–C598, 2014

Interactive Comment

show fjord width as a function of time not distance. Carr et al (2013 and 2014) provide a good description of the concept first outlined by John Mercer (1961). From Carr et al (2014).

"However, our data suggest that along-flow variations in fjord width are an important control, and we demonstrate a statistical relationship between fjord width variability and glacier retreat across the study region. We suggest that along-flow width variations may influence retreat rates via two mechanisms: (1) owing to the principle of mass conservation, widening of the fjord would mean that the glacier needs to thin and the surface slope needs to reduce in order to maintain the same ice flux, which would make the ice more vulnerable to thinning and eventually to flotation, thus increasing calving rates and promoting retreat; and (2) lateral resistive stresses tend to decrease with increasing width, which would reduce resistance to flow and promote further dynamics thinning and retreat."

2021-25: Need to provide an example Mbase value that the reader can better relate to, mean thickness of melt. What is the areal extent where submarine melting occurs, what is its variability in the model?

2023-8: This is the natural location to discuss fjord width role in changing retreat rates, if the model indicates it is a key factor at such points. If not that is key to point out to.

2025-7: Specify the centennial behavior referred to here.

2025-21: The fjord width as noted cannot be verified above the 2012 position, however, it can be stated whether your work suggests it increases and how far behind the current terminus there is a significant change. Is there an inflection in surface slope at some distance above the terminus suggesting a depth pinning point?

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8, C595–C598, 2014

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