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The Cryosphere Discussions

Interactive comment on "Glacier dynamics over the last quarter of a century at Helheim, Kangerdlugssuaq and 14 other major Greenland outlet glaciers" *by* S. L. Bevan et al.

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General comments: This paper provides a good dataset, for speed and glacier front position of 16 outlet glaciers located in all different geographical regions around the Greenland Ice sheet. Their data includes the periods before the warming and the rapid changes started (from the mid 1980s). Deriving records of air and sea surface temperature, they investigate the response of the outlet glaciers to warmer climate. It is a valuable paper but it needs somehow stronger argument for some of their discussion points and conclusions.

A better explanation of each glacier geometry and fjord geometry is needed while dis-

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cussing the differences in behaviour of the glaciers in each section.

Specific comments: Page 1642, line 24: Is sea temperature the same as sea surface temperature or is it ocean temperature? Needs better argument why they use sea surface temperature instead of deep ocean temperature. That may make a big difference for glacier with long floating tongue.

Page 1642, line 26: A high number of coincident retrievals of speed and ice-front position also allows us to determine the strength of the relationship between retreat and acceleration by calculating for each glacier the statistical correlation between the two parameters. What is this statistical correlation between two parameters? Explain better.

Page 1644, line 28: For the position of the glacier front: why not averaged front position, instead of one point on the centerline? I reckon the mean front position is more reliable indicator.

Page 1645, line 9: For some of these outlet glaciers there are much higher resolution thickness data (bed topography) available (CReSIS data). Those data should be included.

Page 1646, section 3.2: Is the flow speed, averaged summer speed or maximum speed?

Page 1651, line 5: Major calving event of Petermann was in summer 2010 not 2011.

For each sector add a plot, showing air temperature and sea surface temperature evolution in time.

For some of their selected glaciers, they mention how many percentage of the Greenland discharge occurs through each glacier (e.g.Daugaard Jensen Glacier). Why not showing this for all of these 16 glaciers?

It is better to include data from other studies for the part they are missing, e.g. front

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position of Petermann Glacier (Falkner et al., 2011) or velocity measurements of the recent years (Joughin et al., 2010 and Moon et al, 2012)

Discussion: Page 1652, line 14: It is true that bed topography is unknown but there are other available data, which may help to understand the difference in behaviour of these glaciers, e.g. shape of the fjord (wide or narrow), existence of the sea ice or ice mélange, glacier front surface elevation (whether the front is close to flotation or not)!

Page 1652, line 21: "By 2002 the front retreated to a well defined, presumably grounded, linear ice-front, and calved much narrower icebergs. The lack of acceleration was presumably because the loss did not affect the stress balance as the ice removed was not bounded by fjord walls" First, figure 7 doesn't really show the velocity changes of the glacier after 2002, there is only one point! There might be an increase in glacier flow between 2002 and 2006! Can Joughin et al 2010 or Moon et al., 2012 show some additional velocity measurements to this? Second, if in 2002 it was grounded, then it should show changes in the stress balance (loss of basal resistance) even if the fjord walls were not supporting the front.

Page 1652, line 27: "The first two both experience major calving events on timescales of decades" When were the major calving events of Nioghalvfjerdsbrae? It should be marked on figure 7. Again, it would be much more helpful, if they include front position change or velocity from previous studies for the parts they are missing.

Page 1653, line 5: some explanation why it is stable. Move the first few sentences from page 1654 to here.

Page 1654, line19: Explain the geometry of the Gyldenlove and Kong Oscar, how long and wide is their floating tongue?

Conclusions: Page 1655, line 11: Velocity data shown in figure 7, except for D.G., is not enough to make such a conclusion about any changes seasonality of these glaciers.

Page 1655, line 16: "The data presented here support the concept that under con-

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ditions of increasing atmospheric and/or oceanic temperatures, the loss of floating tongues or retreat of grounded ice-fronts changes the balance of forces at the termini of tidewater glaciers resulting in rapid glacier acceleration and thinning." Not for at least four of these glaciers!?

References: Very long list of references. I suggest checking again whether they have been used for the right reason. Page 1639, line 26: Nick et al. 2009 doesn't discuss hydrofracturing of crevasses! That is discussed in Nick et al., 2010. And line 29, again Nick et al., 2012 investigate the importance of submarine melt for Petermann Glacier not 2009.

Table1. Better to include the front thickness and width, ice discharge and geometry of the front, whether or not they have a floating tongue. Kong Oscar and 79fjordsbrae are missing Location and CC.

Figure 4 to 7, It helps a lot if they include a graph showing sea-surface temperature and air temperature changes in time.

Page 1642, line 27: change "allows" to "allow" Page 1651, line 9: delete "in" Page 1655, line 27: remove "highly likely"

Interactive comment on The Cryosphere Discuss., 6, 1637, 2012.