

Detailed response to Anonymous Referee #2

Note: reviewer comments are given in bold and our response is given in normal type.

page 1, line 12 (Abstract) "short period variability in time" - please quantify what time range you mean here.

Text added: '(i.e. intra-seasonal)'

p.1, l.24 Re. GrlS recent significant mass loss, please add the following two highly relevant, more recent references to Shepherd et al. 2012:

Hanna, Edward and Navarro, Francisco J. and Pattyn, Frank and Domingues, Catia M. and Fettweis, Xavier and Ivins, Erik R. and Nicholls, Robert J. and Ritz, Catherine and Smith, Ben and Tulaczyk, Slawek and Whitehouse, Pippa L. and Jay Zwally, H. (2013) Ice-sheet mass balance and climate change. Nature, 498 (7452). pp. 51-59.

van den Broeke, M. R., Enderlin, E. M., Howat, I. M., Kuipers Munneke, P., Noël, B. P. Y., van de Berg, W. J., van Meijgaard, E., and Wouters, B.: On the recent contribution of the Greenland ice sheet to sea level change, The Cryosphere, 10, 1933-1946, <https://doi.org/10.5194/tc-10-1933-2016>, 2016.

Both citations added alongside Shepherd et al., 2012 and Hanna et al., added into reference list.

p.1, l.27 Re. recent episodes of rare and extreme surface melt (2012), please add the following two highly relevant references to Nghiem et al. (2012):

Tedesco, M., Fettweis, X., Mote, T., Wahr, J., Alexander, P., Box, J. E., and Wouters, B.: Evidence and analysis of 2012 Greenland records from spaceborne observations, a regional climate model and reanalysis data, The Cryosphere, 7, 615-630, <https://doi.org/10.5194/tc-7-615-2013>, 2013.

Hanna, Edward and Fettweis, X. and Mernild, S. H. and Cappelen, J. and Ribergaard, M. H. and Shuman, C. A. and Steffen, K. and Wood, L. and Mote, T. L. (2014) Atmospheric and oceanic climate forcing of the exceptional Greenland ice sheet surface melt in summer 2012. International Journal of Climatology, 34 (4). pp. 1022-1037.

Both citations added alongside Nghiem et al., and added into reference list.

page 2, line 39: after Noel et al., 2016 reference, suggest inert new sentence: "Alternative statistical downscaling techniques fulfill a similar purpose and give broadly comparable results (Wilton et al. 2017, Vernon et al. 2013), and add the following two relevant references. However, RCMs can also make...":

Wilton, D. J. and Jowett, A. and Hanna, E. and Bigg, G. R. and Van Den Broeke, M. R. and Fettweis, X. and Huybrechts, P. (2017) High resolution (1 km) positive degree-day modelling of Greenland ice sheet surface mass balance, 1870-2012 using reanalysis data. Journal of Glaciology, 63 (237). pp. 176-193.

Vernon, C. L., Bamber, J. L., Box, J. E., van den Broeke, M. R., Fettweis, X., Hanna, E., and Huybrechts, P.: Surface mass balance model intercomparison for the Greenland ice sheet, The Cryosphere, 7, 599-614, <https://doi.org/10.5194/tc-7-599-2013>, 2013.

Text edited as suggested including citations. Both papers added to reference list.

p.2, I.45 change to "fidelity at the regional OR SEASONAL scales does not...".

Edited as requested

p.2, I.53: GC-Net also needs Steffen et al. reference here.

Citation added.

p.3, I.69 change "max" to "maximum".

Edited as requested

p.3, II.74/75 slightly reword to "The MAR version 3.5 used here has been EXTENSIVELY evaluated in...".

Edited as requested

p.3, I.87 "MAR-Era data ARE available...".

Edited as requested

p.4, II.97 & 99: "data set" -> "dataset".

Edited as requested.

p.4, I.101 "below the threshold for three consecutive days"- based on daily mean temperature (and, if so, how is the latter calculated?) or what exactly? Needs a bit more detail/explanation since how this is defined can affect the results.

We use the maximum daily temperature time series to identify extreme events. We choose to use the maximum, rather than the mean, temperatures in order to capture high temperature events that may last for < 1 day.

Text edited on line 99 to read: 'type-specific threshold applied to the maximum daily temperature time series' and on line 100 to read: 'start once the maximum daily temperature'

p.5, I.127: Why is event frequency *positively* correlated with elevation in North Greenland/the dry snow zone?

We have yet to identify a satisfactory explanation for this which is why we decline to comment in the manuscript. We wonder if perhaps it is to do with increased exposure with elevation but further investigation is required to ascertain whether this is in fact the case.

p.5, I.154: change "~decadal scale" to "decadal scale".

Edited as requested

p.6, I.158: change ">1.5°C" to "≥1.5°C" since MAR_Era = 1.50°C.

Edited as requested.

p.7, ll.216-218: "extreme melt years on Greenland have been attributed to an increase in the frequency and duration of high pressure conditions...Greenland Blocking Index" -please add the two highly relevant citations and add them in the reference list:

Hanna, Edward and Cropper, Thomas E. and Hall, Richard J. and Cappelen, John (2016) Greenland Blocking Index 1851-2015: a regional climate change signal. International Journal of Climatology, 36 (15). pp. 4847-4861.

Hanna, E. and Jones, J. M. and Cappelen, J. and Mernild, S. H. and Wood, L. and Steffen, K. and Huybrechts, P. (2013) The influence of North Atlantic atmospheric and oceanic forcing effects on 1900-2010 Greenland summer climate and ice melt/runoff. International Journal of Climatology, 33 (4). pp. 862-880.

Citations added as requested, both in text and to reference list.

p.8, l.247 needs punctuation correction to "...given its assimilation of observations; however, we note that...".

Edited as requested.

p.9, l.259: "strongly controlled by geography" sounds a bit vague. Can you be more specific, e.g. say topography, elevation and ice/snow facies etc.?

ok, edited to read: '...geography (e.g. topography, elevation, latitude etc), though...'

p.18/Table 3: add units (e.g. °C/yr?) for "rate of change of mean daily temperature".

Edited as requested.