

Interactive comment on “Link between the Surface Mass Balance of the Greenland Ice Sheet and the North Atlantic Oscillation under preindustrial and last interglacial climates: a study with a Coupled Global Circulation Model” by Silvana Ramos Buarque and David Salas y Melia

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Interactive comment on: “Link between the Surface Mass Balance of the Greenland Ice Sheet and the North Atlantic Oscillation under preindustrial and last interglacial climates: a study with a Coupled Global Circulation Model” by S. Ramos Buarque and D. Salas y Melia Anonymous Referee #1 Received and published: 2 May 2018

This paper shows that the link between NAO and SMB over Greenland has been

changed through the centuries by using the CNRM-CM5.2 global model. The paper is interesting to read and deserves to be published in CP. However, some (major) improvements are still needed before publication.

Major: 1. In Fettweis (2007), seasonal 2D correlations with NAO was shown (see Fig 15 and Fig16). Such similar figures should be shown with the MAR data used here and the CNRM based present climate reconstruction to check if CNRM is able to simulate the current pattern of NAO impacts on SMB. The validation by using the R value (correlation) shown in Fig 5 and Fig 6 is not enough for me. A 2D validation is needed here as the paper discusses 2D changes in the correlation with NAO.

In the new version of the paper, Fig 5 and Fig 6 have been removed. We agree that the added-value of these plots was low and decided to provide the correlation coefficients only in the text of the paper. Instead, we have inserted figures showing the seasonal spatial correlation of accumulation, ablation and surface mass balance with the NAO index. By contrast with the paper by Fettweis (2007), we chose not to display correlations for the intermediate seasons (MAM and SON), in order to focus on DJF and JJA, like in the rest of the paper. In this answer, you will find hereafter (FYI) the correlation between precipitation and the NAO index for all seasons.

2. The ERA forced 1979-2012 period is used here as validation for pre-industrial climate but since the end of the 1990's, we have observed a switch of NAO toward negative value in summer as remembered in this manuscript. This issue should be discussed or the period 1980-1999 should be used as validation. This reference period 1980-1999 was selected in Fettweis et al (2013b) for this reason because surface melt GrIS records were observed over the 2007-2012 period (included in the reference period used here) which is not representative of the present or pre-industrial climate.

In the new version of the paper, we now systematically use the 1980-1999 time-span for validation, instead of 1979-2012 previously, to be more consistent with preindustrial conditions. Among other results, this change in validation period affects the correlation

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we provide between SMB and NAO indices for MAR.

Minor: 1. Fig1: What is the interest of showing the whole globe while only the North Atlantic area is discussed here ? A zoom over the area of interest will be more useful. We wanted to show the whole globe for a general, view of model biases. Following the reviewer's recommendation, we changed the domain of Fig. 1 to represent only the Arctic and the North Atlantic. However, since our model is a global one, we chose not to restrict the figure to Greenland, in order to place the biases over the GrIS in a wider, still not global context.

2. Fig2: as only positive values are shown, the legend could be adapted. We adapted the legend to follow this recommendation.

3. As said earlier, what is the interest of showing Fig 5, fig 6 and Fig 11. Only the statistics listed here are useful for me and can be put in a table. We agree with these comments, and removed Fig. 5, 6 and 11. The table hereafter shows correlations between the NAO index and the GrIS-averaged accumulation, melting and SMB for MAR and NPS under all climates. However, we have chosen not to integrate it into the paper since we now focus more on the 2D-correlations.

Are there any trends in the CNRM based time series? The trends are very small in the time series provided by CNRM-CM. However, we removed the trend for plotting the time series and computing the correlations, just as we did for MAR due to the large SMB trend over 1979-2012. Over 1979-2012, the MAR based SMB should significantly decrease as well as the JJA NAO index. The MAR based SMB and NAO time series were detrended, in order to correlate just interannual variations, not the trends over 1979-2012.

4. Why Fig 12 and Fig 13 are black and white and not in colour? New figures were plotted with color shading. Why only the correlation with accumulation is show over summer in Fig 12? We added the correlation of winter accumulation with NAO+ and NAO- (new Fig 11). Note that for DJF, significant parts of the GrIS show negative

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correlations (unlike for JJA). Hence we adapted the range of plotted values accordingly for Figs. 11, 12 and 13. We adapted the text accordingly (see Sec. 4.2 and 4.3) Over these figures, it is difficult to distinguish which is significant or not. The dashed areas corresponding to significant correlations are now easier to see thanks to the colored background.

5. Section 4.3 : Fig 11 and Fig 12 are referenced in the text instead of Fig 12 and Fig 13 (ex: line 284). Thanks for this comment, done.

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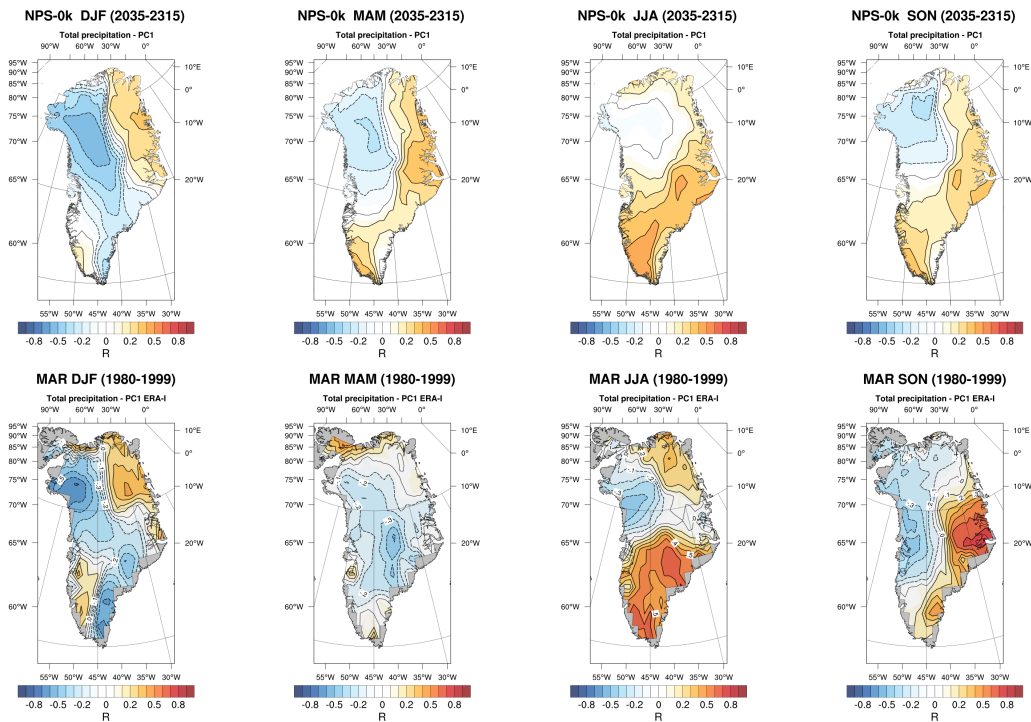


Fig. 1.

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	Accumulation		Melting		SMB	
	DJF	JJA	DJF	JJA	DJF	JJA
MAR	-0.21	0.54	-	0.37	-0.21	0.40
NPS-0k	-0.22	0.48	-	0.51	-0.22	0.62
NPS-115k	-0.11	0.43	-	0.56	-0.11	0.62
NPS-130k	-0.04	0.48	-	0.43	-0.04	0.56

Seasonal (DJF and JJA) correlations between accumulation, melting and SMB averaged on GRIS and the NAO index.

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Fig. 2.

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