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Response to reviewer #1

I am grateful to Bo Vinther for his insightful comments. He is correct that the relationship between blocking, NAO and Greenland temperature should be discussed . Bellow is our attempt to clarify this relationship as well as the response to the other comments/suggestions.

This is an interesting paper that presents an investigation into the relationship between SW Greenland climatic conditions and atmospheric circulation in the North Atlantic region. Specifically atmospheric blocking in the North Atlantic region is found to be related to both observed temperatures and an ice core temperature proxy for Southern Greenland.

The paper does, however, lack an investigation/discussion of the similarity between the blocking index presented in the paper and the North Atlantic Oscillation (NAO) index. Furthermore the paper will benefit from a more consequent use of correlation analysis in the discussions and presentation of the major findings. I will elaborate on these and other points of criticism in the major comments section below.

We added new figures (Figs 5 and 7), a new section (section 3.2) and new comments to clarify the relationship between blocking, NAO and Greenland temperature.

MAJOR COMMENTS:

Chapter 2:

The Tibaldi-Molteni index is used to describe blocking. A statement on why this index is chosen needs to be included. Other definitions of blocking are common in the literature (see e.g. Scherrer et al. 2006 for two alternative definitions)

As suggested we presented several other indicators of blocking, principally the blocking index based on the latitudinal position of the storm track (Pelly and Hoskins, 2003) as well as based on vertically averaged potential vorticity (Scherrel et al. 2006). We used the TM index (Tibaldi and Molteni 1990) as well as its 2D-extension (Scherrer et al. 2006) because they are based on 500 mb daily geopotential height, a field that is available over the last 100 years from the 20th Reanalysis Project (Compo et al., 2009) and Reanalysis project (Kalnay et al. 1996). These indices are largely used in the literature which makes a comparison of our results with those published in the literature possible.

Chapter 3:

Two blocking indices are defined (one based on 500mb data and one based on SLP data) and both are found to be significantly correlated to SW Greenland temperatures. This is interesting, but a discussion of how the blocking index is related to the NAO needs to be included. Specifically the annual and decadal correlation coefficients between Dec-Feb averages of an NAO index (e.g. Jones et al. 1997, http://www.cru.uea.ac.uk/cru/data/nao.htm) and the blocking indices should be presented.

Based on the results presented by Scherrer et al. 2006, it must be expected that the two winter blocking indices are highly correlated to the Dec-Feb NAO index. To put the findings of this paper into a broader context (i.e. with earlier publications on the relationship between Greenland temperatures and the NAO) it is important to find out and discuss if this is in fact the case.

The blocking index for winter was defined based on the difference between blocking frequency during warm and the cold years in SW Greenland. Therefore it is not identical with blocking indices defined for the entire Atlantic sector. However, the blocking activity in the sector we defined should be strongly related to the NAO. We addressed this question both in the introduction as well as in 3.2. Over the period 1908-2005 our blocking index is correlated with NAO both at interannual (r=-0.69) and decadal (r=-0.73) scales. We argue that the remaining blocking variance is related to the variability of the other two identified patterns. Therefore, our blocking index, which is defined based on temperature variability in SW Greenland contains more information related to blocking variability, which is connected to SW Greenland temperature variability than NAO index.

The similarity between the blocking patterns given in Fig. 6a/6b and the NAO related blocking patterns presented in Scherrer et al. 2006 fig. 3a/3b also needs to be discussed in the context of the discussion of Fig. 6 on page 2418.

The 2D blocking patterns derived in our study are based on the same algorithm of Scherrer et al. (2006) but for a different data set and different period. However, our patterns are similar with to those of Scherrer 's et al (2006). We discuss these aspects in this revised version of our paper.

On page 2419 lines 1-2, the similarity between decadal variations in the ice core proxy and in the SLP-based blocking index is discussed. The decadal scale correlation between the two should also be presented here.

We removed the SLP blocking index because in this version we have used only 500 mb geopotential height to calculate the blocking indices. The correlations between SW Greenland temperature and blocking indices for winter are r=+0.42 (interannual time scales) and r=+0.60 (decadal time scales.

Chapter 4:
On page 2420 lines 16-18, the out of phase variability between variations in the SW Greenland summer temperatures and the SLP-based blocking index is discussed. The annual and decadal scale correlations between the two should also be presented here. A discussion of the relationship (if any?) between the summertime NAO and the observed atmospheric blocking could also be interesting.

For summer r=-0.40 (interannual) and r=-0.62 (decadal). We mentioned that practically there is no relationship between summer NAO index and our summer blocking index.

Chapter 5:
The power spectrum of the ice core PC1 is discussed in this chapter; hence it is appropriate to include a figure showing the power spectra of the PC1, the NAO and the

SLP-based blocking index. Then the discussion of the proposed 20-year cycle will be more informed.

We did not add a new figure because we already have enough. However we mentioned that other authors identified this cycle in Greenland ice cores.

2421line 18-20: For the 1865s and 1930s the statement is contradicted by the data presented in Fig. 14 (i.e. blocking activity is low and for the 1930s temperature is high). This statement needs to be rewritten or deleted.

We have deleted this sentence.

MINOR COMMENTS/CORRECTIONS:
2412 line 4: I think you need a comma after ?winter?
2412 line 8: ?during past? should be ?during the past?
2413 line 8: Is ?Cruger et al. 2004? the correct reference here?
2413 line 12: ?during observational? should be ?during the observational?
2413 lines 12-13: ?during pre-instrumental? should be ?during the pre-instrumental?
2416 line 13: ?Details of? should be ?Details concerning?
2417 line 2: ?Figure 2 shows boreal? should be ?Figure 2 shows SW Greenland boreal?
2417 line 17: ?(1984/85)? should be ?(1983/84)?
2418 line 29: ?with temperature? should be ?with the ice core based temperature?
2419 line 1: ?similar with? should be ?similar to?
2419 line 21 ?during 1972? should be ?during the 1972?
2419 line 22 ?during 2000? should be ?during the 2000?
2419 line 23 ?in Fig. 11? should be ?(in Fig. 11)?
2420 line 8: ?over Scandinavian? should be ?over the Scandinavian?
2420 line 8: ?summers frequency? should be ?summers the frequency?.
2421 lines 1-2: ?during 1890s-1920s? should be ?during the 1890s-1920s?
2421 line 10: ?Similar? should be ?A similar?
2421 line 19: I do not think the terms ?1865s? and ?1885s? are correct English.
2421 line 23: Would be nice if you elaborate a bit on which ?extreme phenomena?
2426 figure 3: The lines between the black circles are confusing.
2430 figure 7: A suitable Gaussian or triangular filter will make the smoothed curve
2433 figure 10: The lines between the black circles are confusing .
2437 figure 17: A suitable Gaussian or triangular filter will make the smoothed curve

We modified the text according to the suggestions.

REFERENCE:
Jones, P.D., J?nsson, T. and Wheeler, D., 1997: Extension to the North Atlantic Oscil lation using early instrumental pressure observations from Gibraltar and South-West Iceland. Int. J. Climatol. 17, 1433-1450