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Supplement of

Eurasian autumn snow link to winter North Atlantic Oscillation is strongest for Arctic warming periods

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Supplementary

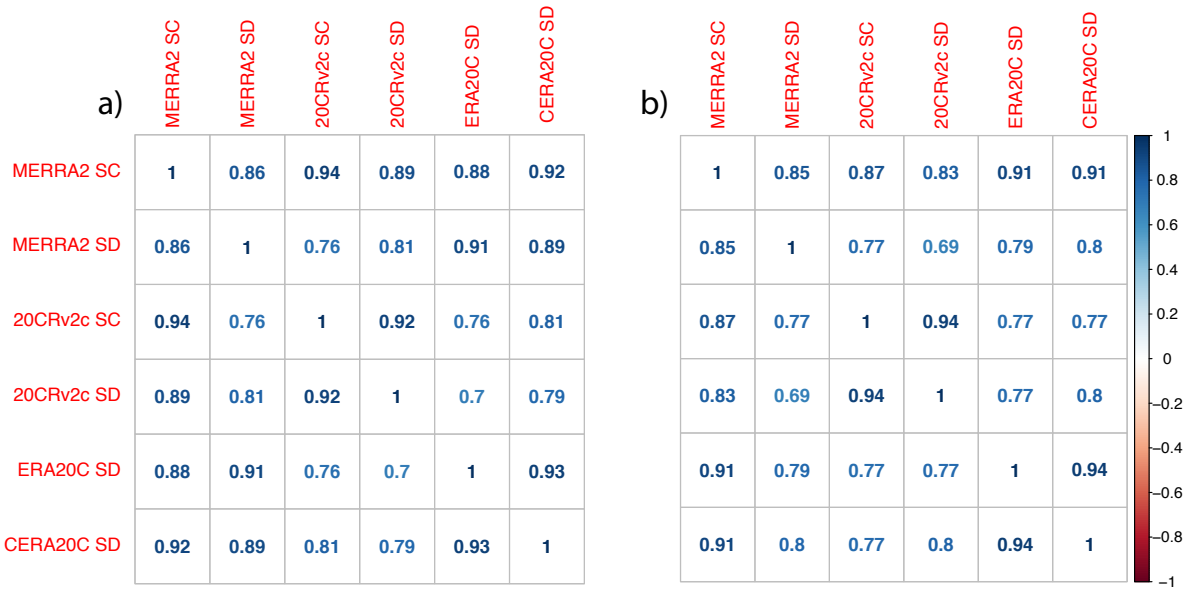


Figure 1: Correlation of snow depth (SD) and snow cover (SC) indices for different reanalyses products for a) October snow indices and b) November snow indices. The correlation coefficient is computed for the respective shared time period among two products (see also Fig. 1).

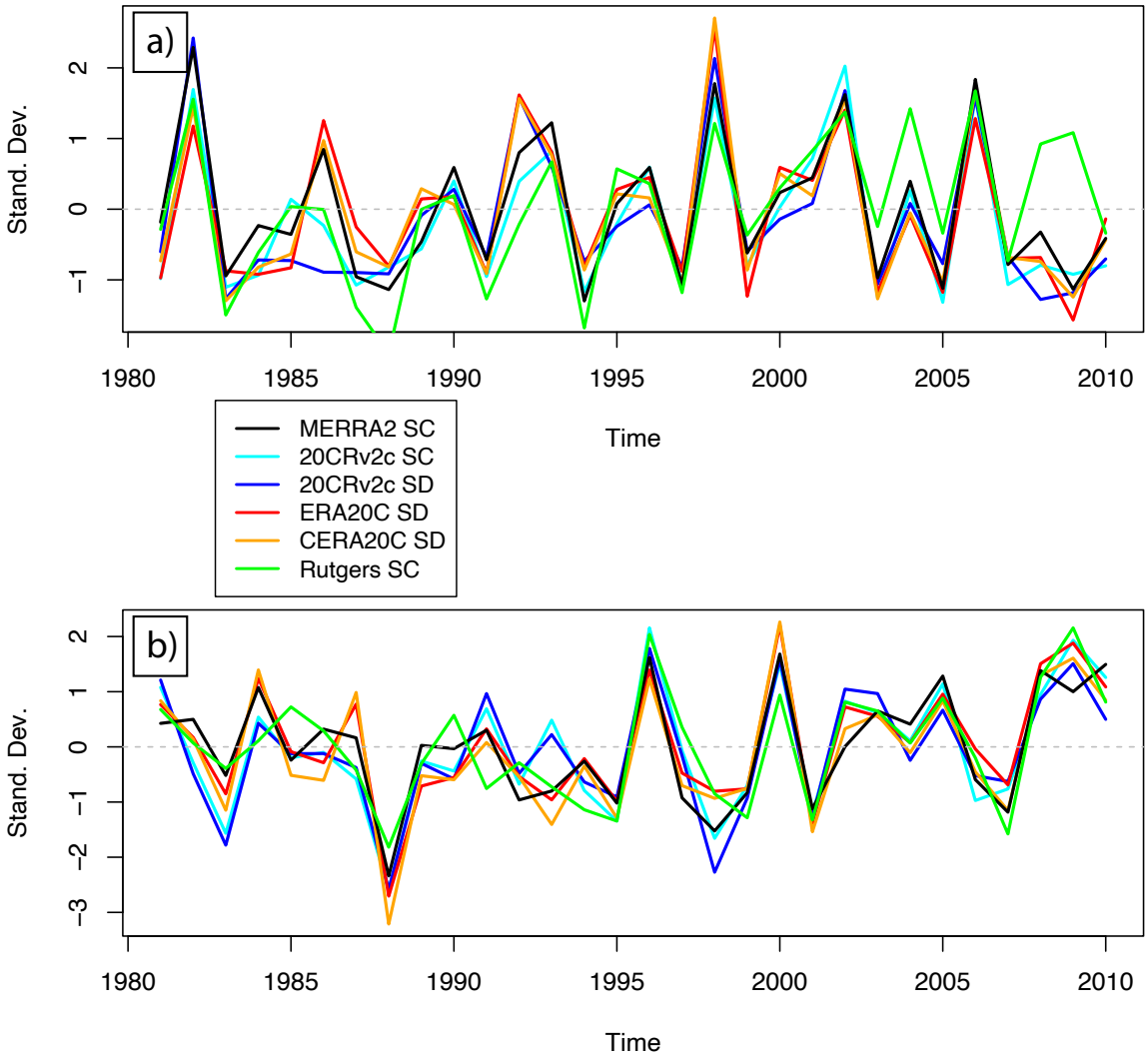


*Figure 1: Comparison of a) October snow indices and b) November snow indices for the period 1981-2010 in multiple reanalysis products as well as the Rutgers snow laboratory satellite–based snow cover product (**Robinson et al. 2012**).*

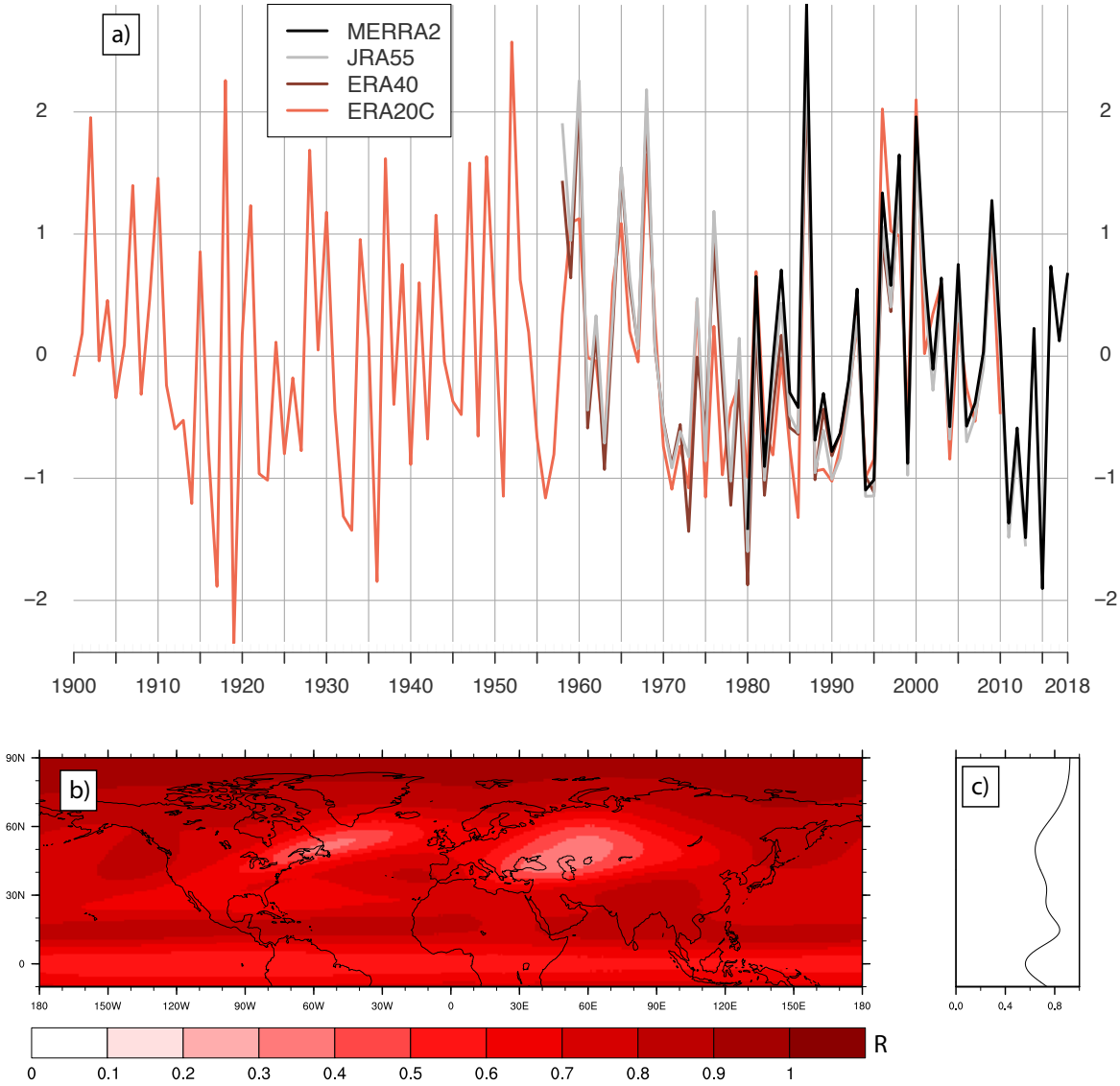
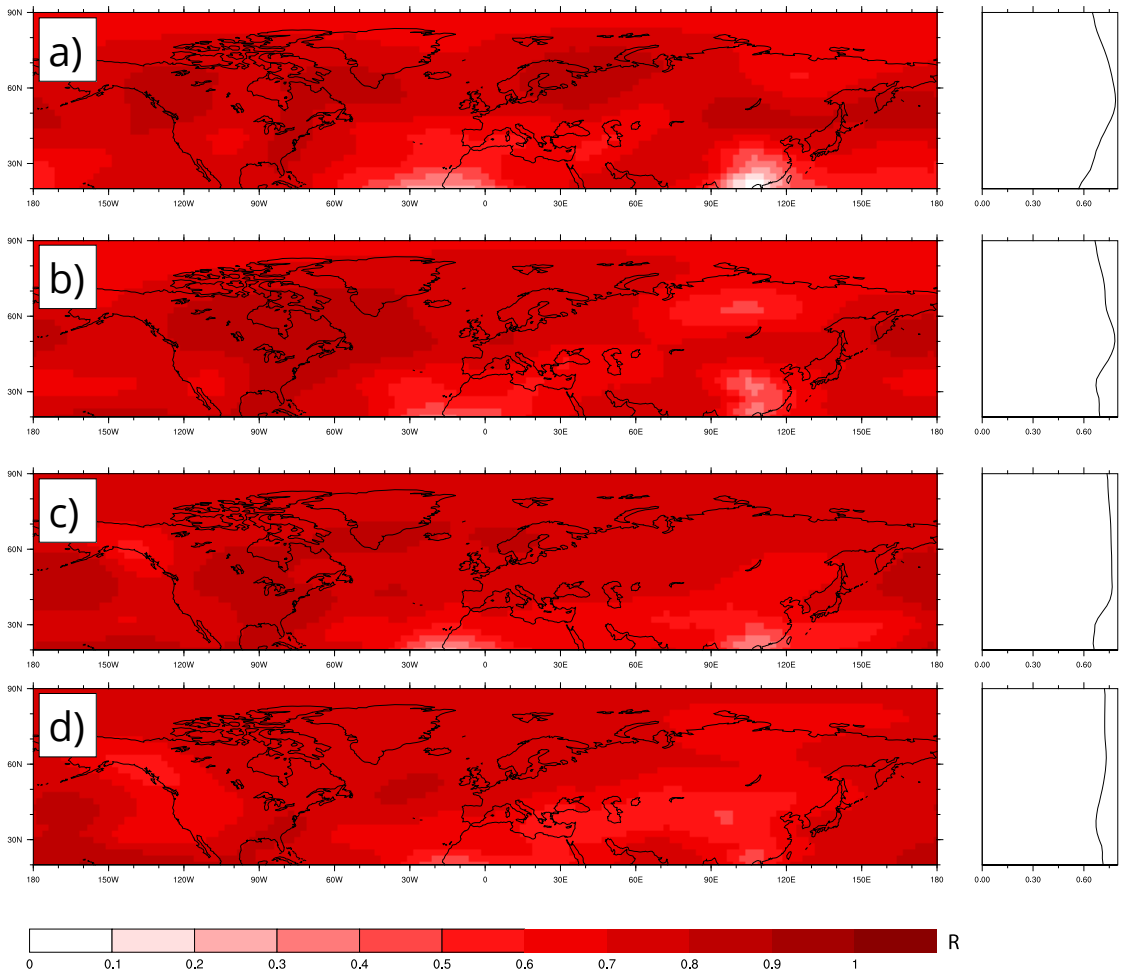


Figure 3: Evaluation of November December mean of polar cap 10 hPa GPH in ERA20C. a) Field mean November December 10 hPa GPH normalized index comparison between MERRA2, JRA55, ERA40 and ERA20C, b) correlation of November December 10 hPa GPH anomalies between MERRA2 and ERA20C with c) the zonal mean of the correlation coefficients.



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19 *Figure 4: Correlation of 100 hPa GPH anomalies between ERA20C and a merged product of JRA55 fields*
20 *(1958–2010) and statistically reconstructed monthly geopotential height fields for the period 1880–1957*
21 *(Griesser et al. 2010) for a) November, b) December, c) January and d) February for 1901–2010*

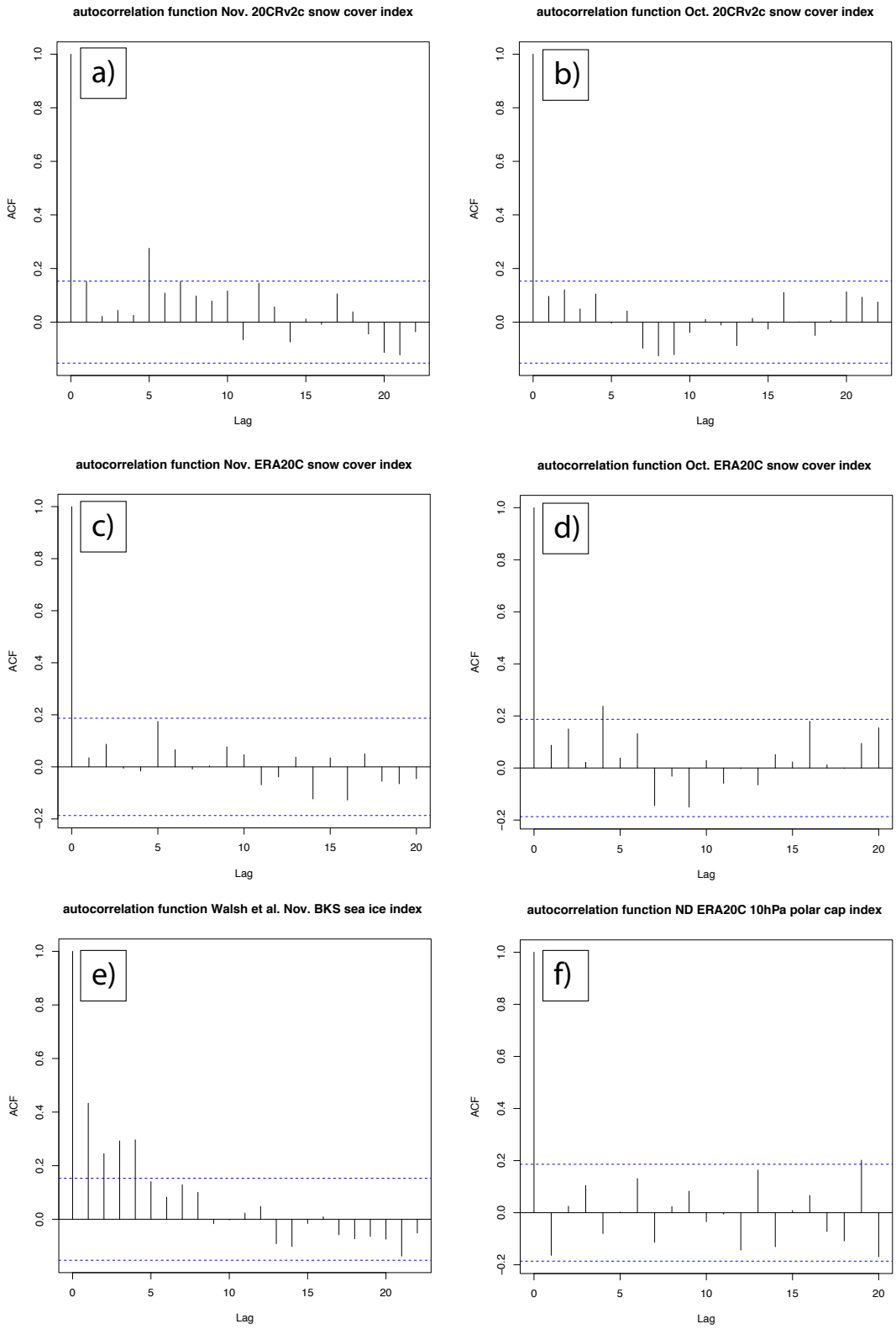

Figure 5: Autocorrelation functions up to lag 20 for a) the 20CRv2c November normalized detrended snow cover index, b) the 20CRv2c October normalized detrended snow cover index, c) the ERA20C November normalized detrended snow cover index, d) the ERA20C October normalized detrended snow cover index, e) the Walsh et al. November normalized detrended BKS sea ice index and f) the ERA20C November December mean normalized detrended 10hPa GPH index.

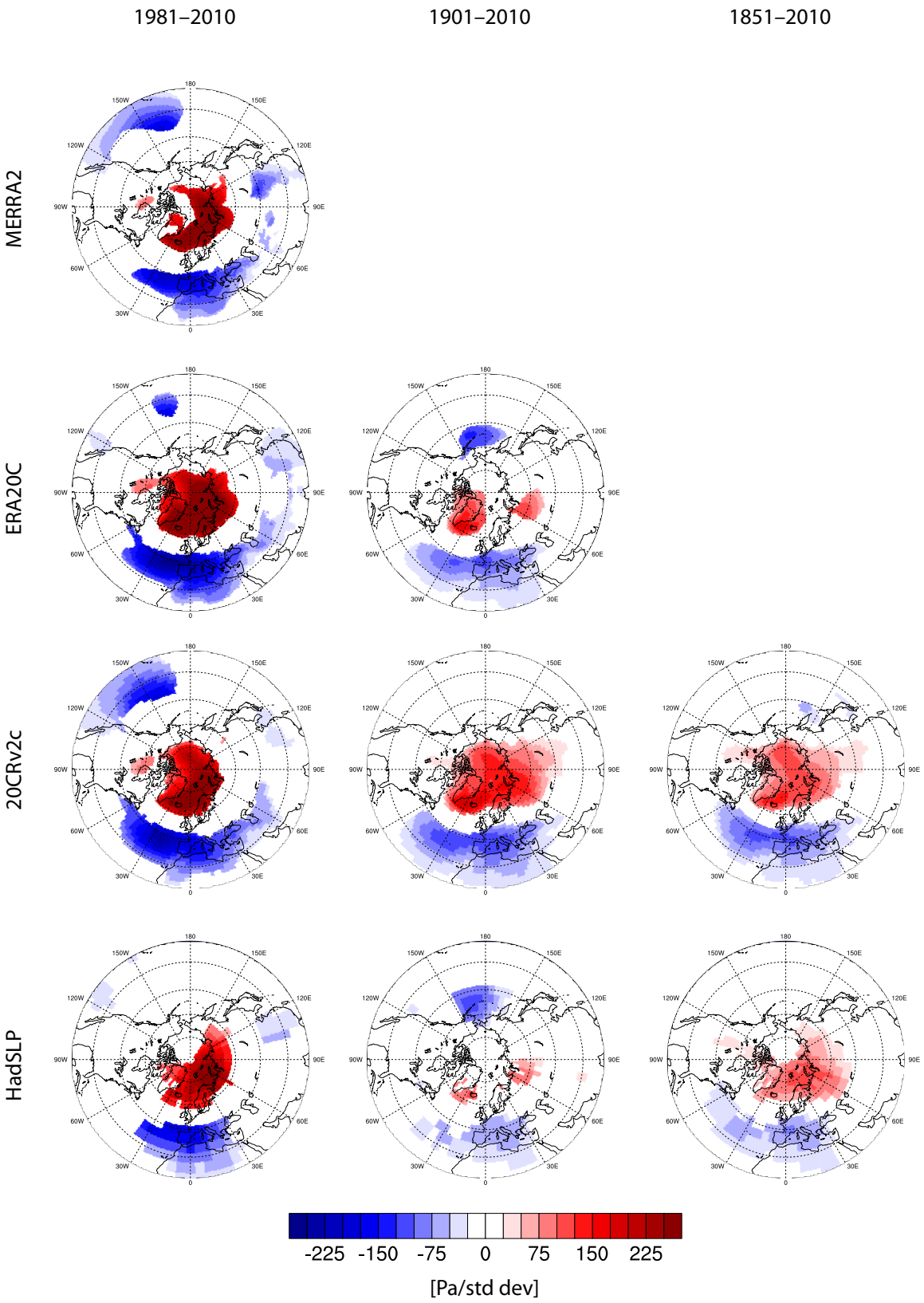

Figure 6: DJF sea level pressure [Pa/std dev] anomalies projected onto snow index in November MERRA2, ERA20C, 20CRv2c and HadSLPr2 covering different time slices.

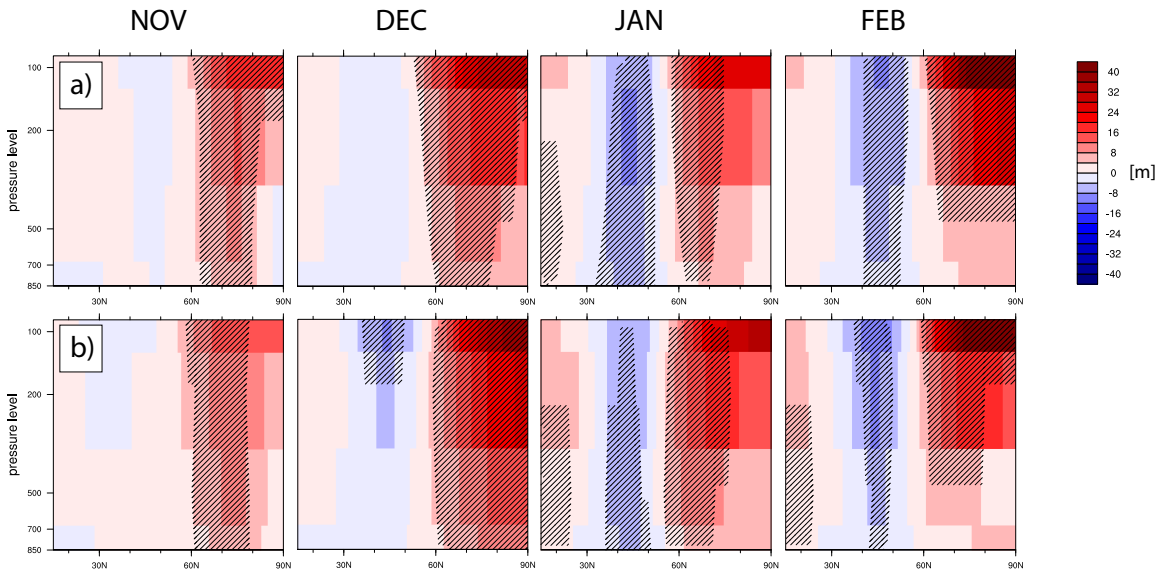

Figure 7: Zonal mean (180°E–180°W, 15°N–90°N) geopotential height anomalies on 100, 200, 500 and 850 hPa projected onto snow indices in November for a) a merged product of JRA55 fields (1958–2010) and statistically reconstructed monthly geopotential height fields for the period 1880–1957 (Griesser et al. 2010) and b) ERA20C covering 1901–2010. Shading indicates 95% significance level.

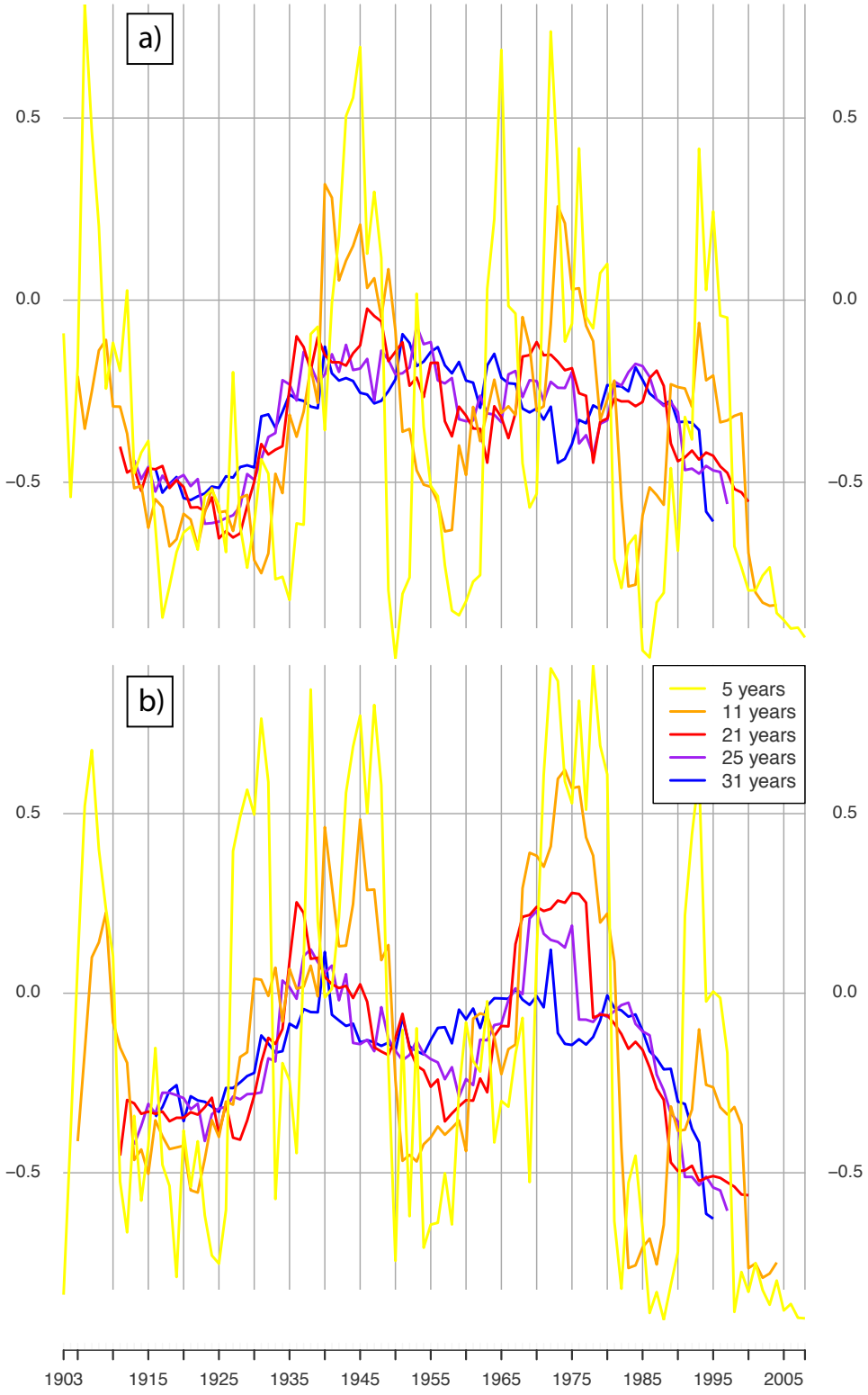

Figure 8: Comparison of different running correlation [R] windows between a) 20CRv2c November snow index and DJF NAO and b) ERA20C November snow index and DJF NAO for the period 1901-2010.

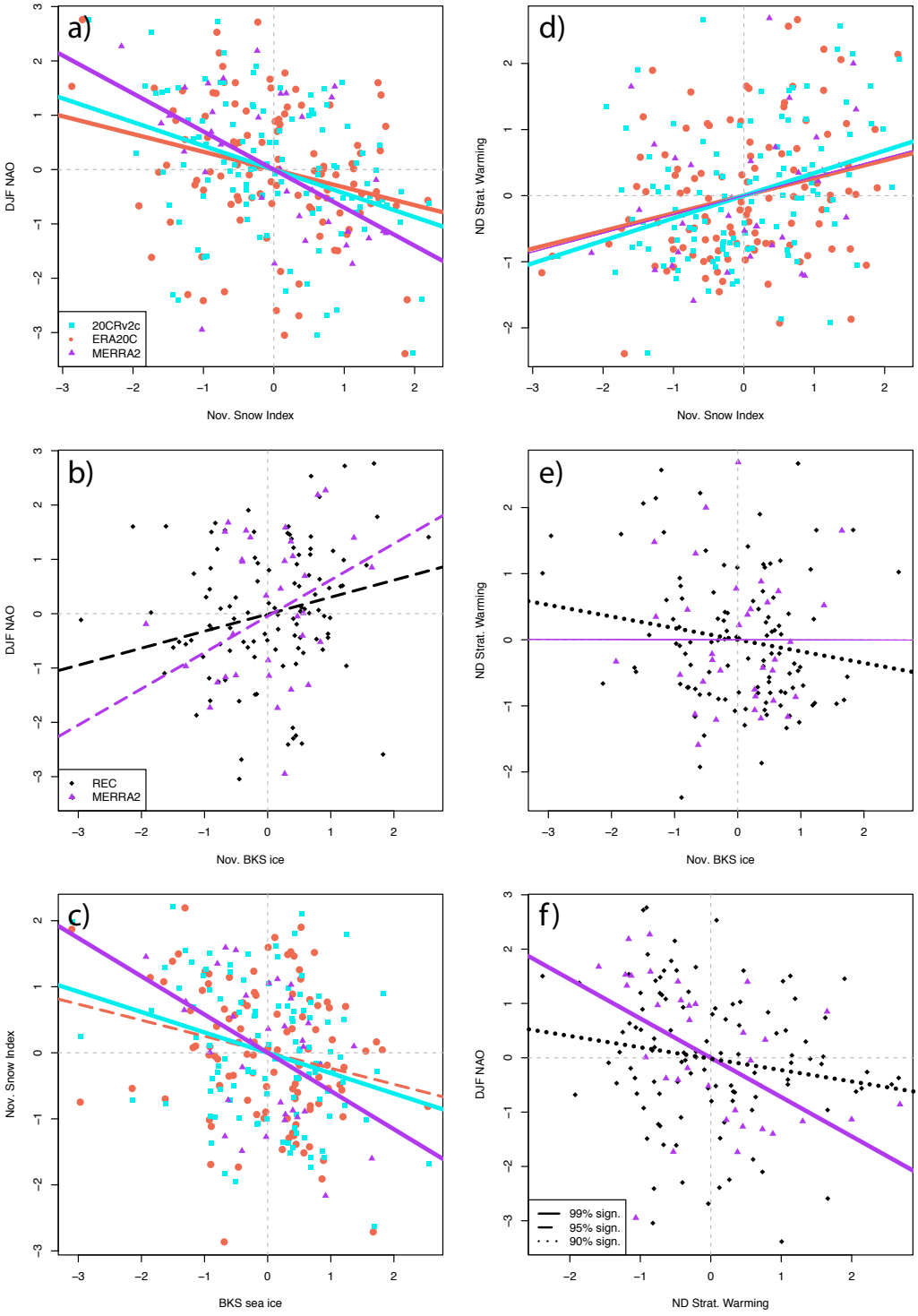

Figure 9: Linear Regression plots for selected variable pairs covering the period 1901–2010 in ERA20C, 20CRv2c as well as Reconstructions and 1981–2015 for MERRA2. a) November snow index versus DJF NAO, b) November BKS ice concentration vs DJF NAO, c) November BKS ice concentration vs November snow index, d) November snow index vs. mean November December polar 10 hPa GPH, e) November BKS ice concentration vs mean November December polar 10 hPa GPH and f) mean November December polar 10 hPa GPH vs DJF NAO

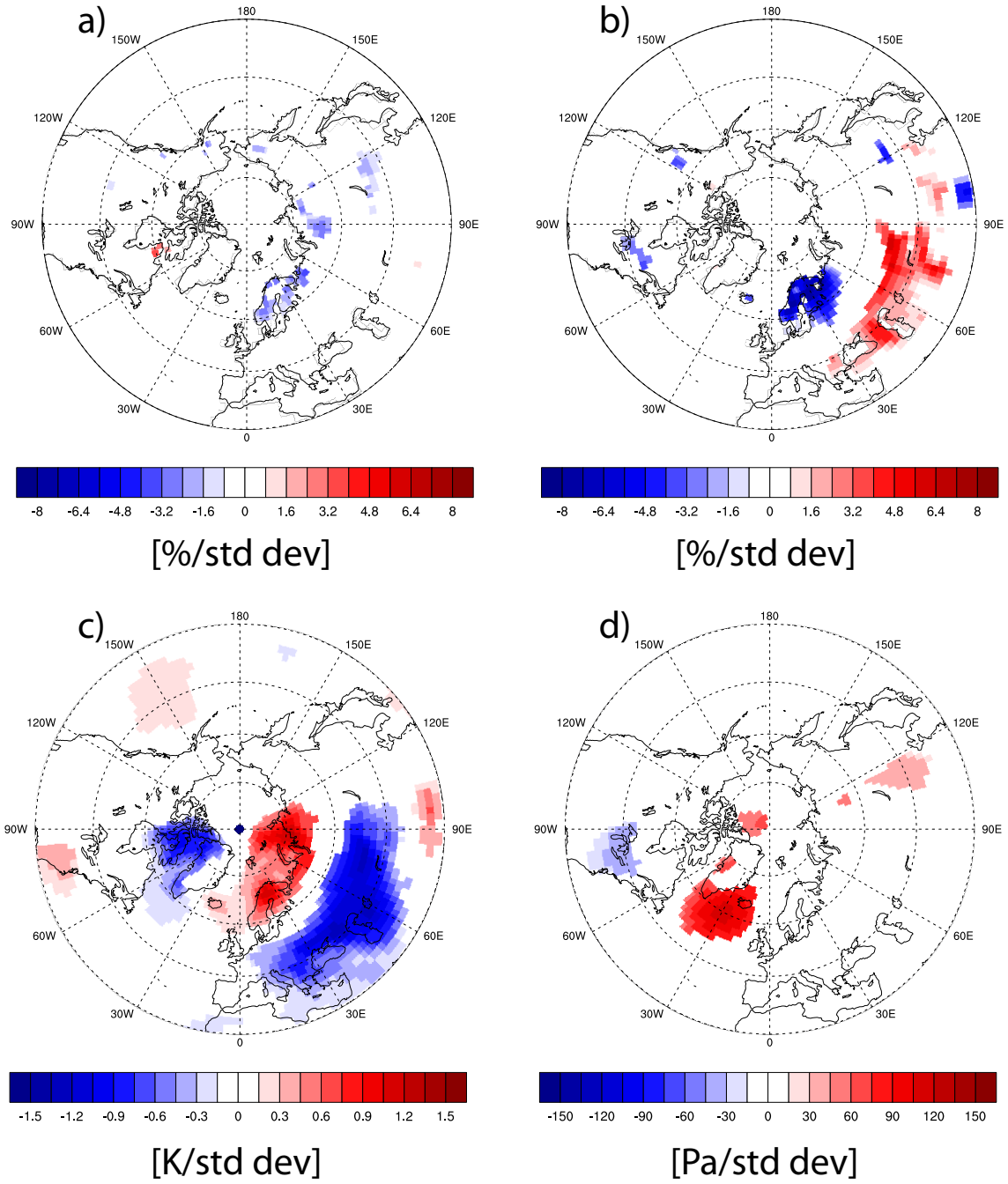

Figure 10: a) October snow cover anomalies [%/std dev] projected onto the field averaged November blocking frequency , b) November snow cover anomalies [%/std dev] projected onto the field averaged November blocking frequency, c) November 2m temperature anomalies [K/std dev] projected onto the field averaged November blocking frequency and d) b) DJF SLP anomalies [Pa/std dev] projected onto the field averaged November blocking frequency. Field averaging was performed for the region, (-10-80°E, 45-80°N) according to Peings 2019.

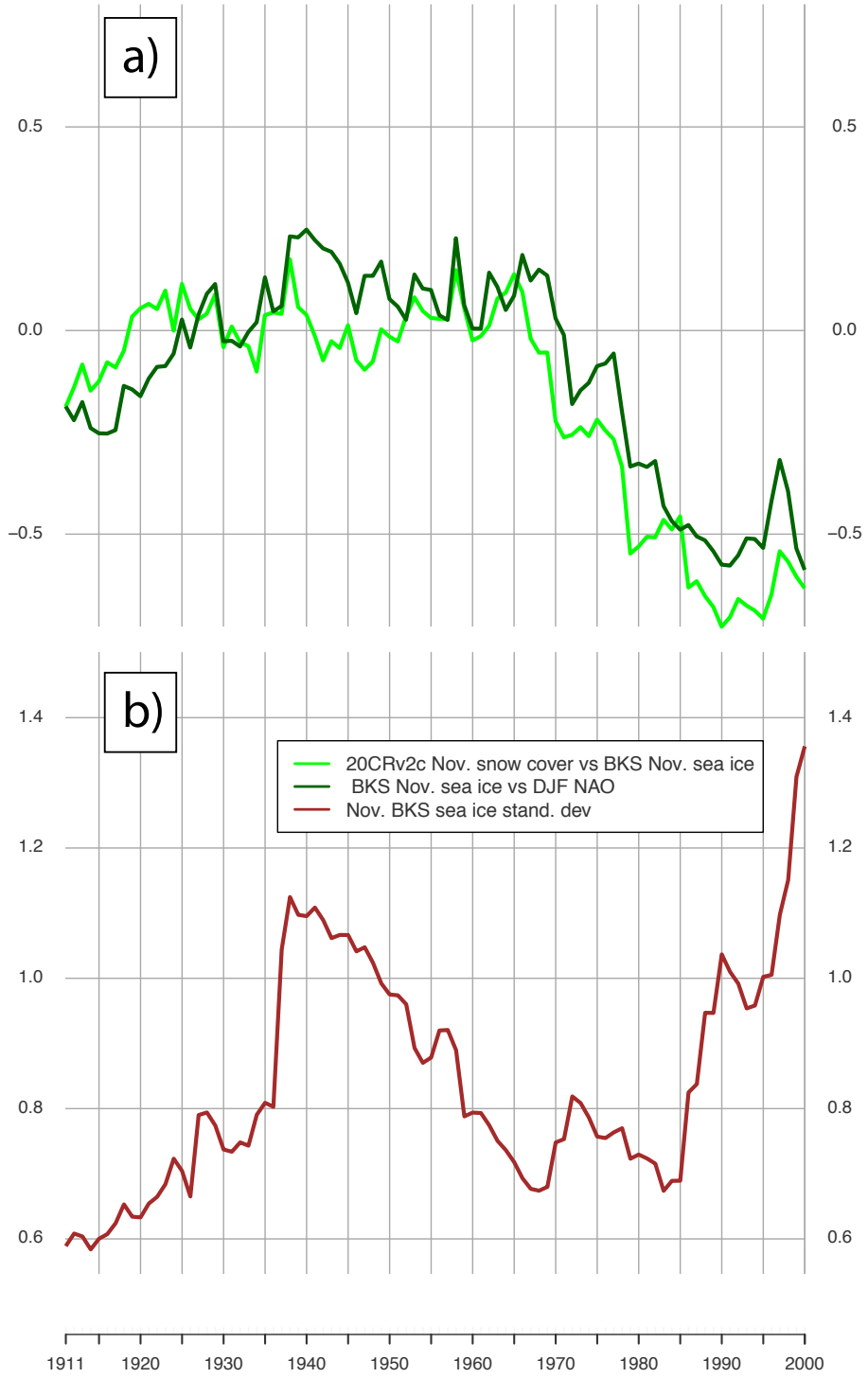

Figure 11: a) 21-year running correlation [R] between 20CRv2c November snow index and November BKS sea ice index as well as 21-year running correlation between November BKS sea ice index and DJF NAO index, b) 21-year running standard deviation for the November BKS sea ice index.

Table 1: Durbin-Watson test statistics examining serial correlation for regression pairs in Figure 7.

	ERA20C	20CRv2c	Reconstruction
DJF NAO vs OCT SNOW (Fig. 7a)	DW = 1.7336, p-value = 0.07846	DW = 1.6661, p-value = 0.03779	
DJF NAO vs NOV SNOW (Fig. 7b)	DW = 1.6869, p-value = 0.04772	DW = 1.6915, p-value = 0.05095	
ND STRAT. WARMING vs NOV SNOW (Fig. 7c)	DW = 2.2592, p-value = 0.9145	DW = 2.2009, p-value = 0.8535	
DJF NAO vs NOV. BKS ice (Fig. 7e)			DW = 1.7831, p-value = 0.1181
ND STRAT. WARMING vs NOV BKS ice			DW = 2.2879, p-value = 0.9318
NOV SNOW vs NOV BKS ice (Fig. 7d)	DW = 1.8652, p-value = 0.2267	DW = 1.7097, p-value = 0.05781	
ND STRAT. WARMING vs NDJF NAO (Fig. 7f)			DW = 1.6319, p-value = 0.02664

Table 2: Partial correlation and multiple regression for sea ice, PV ND and snow

	Estimate	P-Value	Statistic	N	GP	Method
partial correlation between NAO DJF and 20CRv2c November snow index given BKS November sea ice index	-0.296866	0.0017207	-3.215778	110	1	Pearson
partial correlation between NAO DJF and ERA20C November snow index given BKS November sea ice index	-0.211391	0.0273459	-2.237205	110	1	Pearson
partial correlation between NAO DJF and BKS November sea ice index given 20CRv2c November snow index	0.182415	0.0576334	1.919118	110	1	Pearson
partial correlation between NAO DJF and BKS November sea ice index given ERA20C November snow index	0.216711	0.02360975	2.296252	110	1	Pearson
partial correlation between NAO DJF and ERA20C November December mean polar 10 hPa GPH given 20CRv2c November snow index	-0.041280	0.6699642	-0.427376	110	1	Pearson
partial correlation between NAO DJF and 20CRv2c November snow index given ERA20C November	-0.318160	0.00074774	-3.471462	110	1	Pearson

December mean polar 10 hPa GPH						
partial correlation between NAO DJF and 20CRv2c November snow index given BKS November sea ice index and ERA20C November December mean polar 10 hPa GPH	-0.274639	0.00402170	-2.940663	110	2	Pearson

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