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Spatial variability of δ^{18}O during the past 1000 years in Northern Greenland

Motivation

To reconstruct climate changes it is neccessary to have regionally representative data set. Stable water isotope records from the NGT cores are used to better understand the spatial variability of the climate in Northern Greenland.

Questions:
• How representative is a single record?
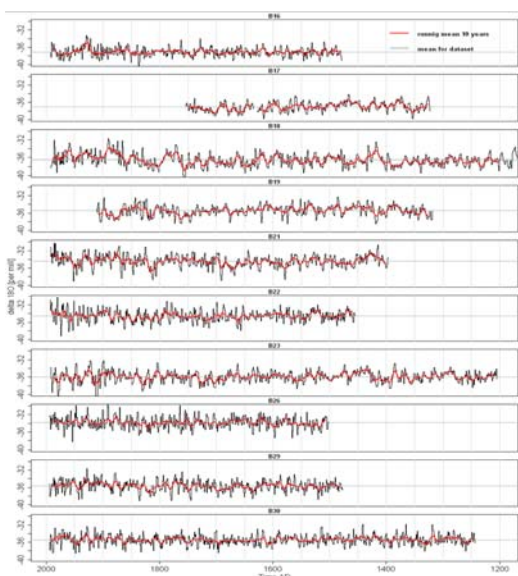• What ist the correlation between the sites in Northern Greenland?

Fig.1 Correlation map between the cores of NGT
Solid lines: r>0.2, p=0.05, dashed lines: r<0.2, p=0.1,
blue line: negative correlation, r>0.2, p=0.05

Data

• AWI traverse in Northern Greenland (NGT) between 1993-1995
• 100-150 m long firn cores
• δ^{18}O measured in 2-3 cm depth resolution
• annual dated by layer counting after back diffusion

B16	B18	B19	B21	B22	B26	B29	B30
Accumulation rates (mm w. e. a^{-1})							
144	106	102	108	159	161	152	177
Hight (m WGS 84)							
3040	2508	2234	2185	2242	2598	2874	2947

Time series

• NGT cores do not show the same δ^{18}O-variability
• isotope records from low accumulation sites are more smoothed by diffusion (B19)
• core sites have different sources of moisture
• influence of volcanic and global climate events is evident
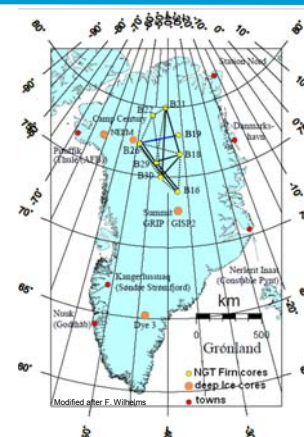• for some time slots cores are highly correlated, for others not

Fig. 2 Time series of δ^{18}O in the NGT cores

Conclusion

• the quality of correlation is independent on distance between the core sites
• the isotope records reflect high spatial variability in the Northern Greenland's climate
• it is difficult to find a representative record for climate in Greenland

Outlook

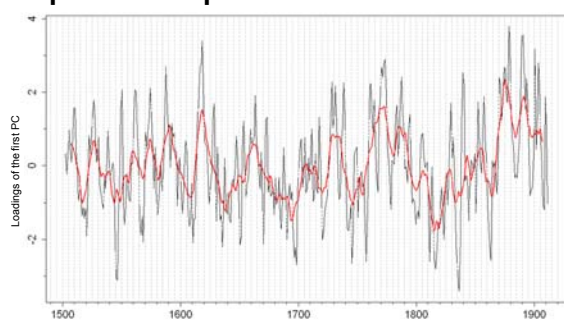• to analyze spatio-temporal variability

Principal components

Fig.3 First principal component (PC) from NGT cores

• PCA-analysis shows that there is no dominant signal for the cores
• each core has other main influencing factor
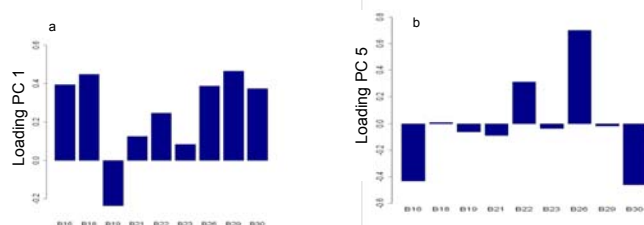• climatic meaning of the principal components is unclear

Fig. 4 Loadings for the NGT cores of the first principal component (a) and fifth component (b)
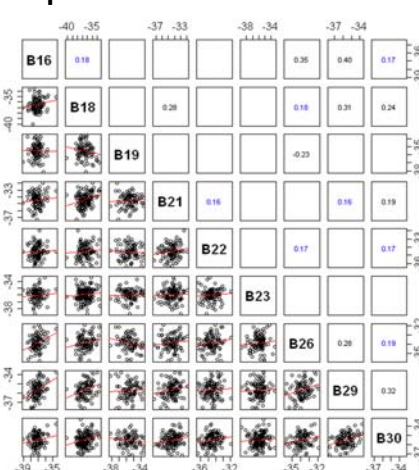
Spatial correlations

Fig. 5

Lower pannel:
The scatter matrix of the 5 years box average of the annual δ^{18}O values. The red lines in the scatter plots show the linear regression line.

Upper pannel:
Significant pearson correlation coefficients as used in fig. 1.
5 years box averaged data usded, because correlation increases increases with averaging. Black numbers are significant on 95% level, blue numbers on 90%.

• relatively low correlation coefficients
• negative correlation with B19
• differences in accumulation rates are not the reason for differences in load of trace elements (Mieding 2005)

References
B. Mieding (2005) Rconstuction of millennial aerosol-chemical ice core records from the northeast Greenland: Quantification of temporal changes in atmospheric circulation, emission and deposition, PhD-theses