Studies for the Reconstruction of the NAO Index from Greenland Ice Cores

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Introduction
Reconstructions of the NAO index based on proxies (e.g. ice cores, tree rings) have not yet been able to establish an unequivocal estimation of the state of the NAO. It is already known that the climate variability of Greenland is considerably inhomogeneous on the regional scale. Therefore, we investigate the time series of the NAO index with respect to the climate variability in the Greenland area in order to extract regions with high reconstruction potential.

Since isotopic concentration proxies ($\delta^18O$, $\delta^13C$) reflect both local temperatures as well as remote climatic conditions, we investigate the influence of the NAO on the distribution of air parcel trajectories. Systematic changes in the distribution between the high and low NAO phases might imply that different source regions for the precipitation of Greenland exist. Thus, additional climatic signals have to be taken into account for the assessment of the reconstruction potential of the NAO index.

Questions of Interest
1) Which regions yield the highest reconstruction potential?
2) Are annually averaged proxies still sufficient for reconstructions or do we have to restrict our retrieval to winter season proxies?
3) Do systematic changes in moisture advection towards Greenland accompany the NAO?

Datasets
NCEP/NCAR reanalyses on a $2.5^\circ\times 2.5^\circ$ grid for the period 1948-1998 with a temporal resolution of a) monthly mean values for correlation analyses, and b) 6 hours for the cyclone tracks and trajectory calculations.

Conclusions
1) The highest potential for reconstructions of the NAO index has been identified in the area of western Greenland.
2) Seasonal mean ice core proxies are necessary for accurate reconstructions of the winter NAO index.
3) Systematic differences in cyclone tracks and air parcel trajectories exist between the high and low phases of the NAO.
A possible consequence is that both source regions and trajectories of precipitating air masses also vary during the different periods of the NAO.

Outlook
1) It is planned to perform a multi-proxy-reconstruction of the NAO index using ice cores, tree rings and corals from sites, which are highly correlated with the NAO index.
2) We want to investigate to what extent the variations in the location of the steering Iceland Low disturb the assumption of statistical stationarity in the reconstruction.

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Isentropic Backward Trajectories: Spatial Distribution of Trajectory Points

Cyclone Motion

Figure 1: a) the western slope of the Greenland ice cap with the locations of 13 of the 19 selected ice caps for the period 1948-1998. b) the map of the selected ice caps for the period 1948-1998 with the locations of 13 of the 19 selected ice caps. Each ice cap is represented by a symbol, and the ice caps are numbered from 1 to 19. c) the western slope of the Greenland ice cap with the locations of 13 of the 19 selected ice caps for the period 1948-1998. d) the map of the selected ice caps for the period 1948-1998 with the locations of 13 of the 19 selected ice caps. Each ice cap is represented by a symbol, and the ice caps are numbered from 1 to 19.