



Isotopic variation in Greenland precipitation in relation to changes in atmospheric moisture transport

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Isotopic parameters Greenland firn and ice cores are known to vary with changes in the North Atlantic Oscillation (NAO) pattern. One hypothesised mechanism responsible for these changes is the variation in sea surface temperature at the source regions of moisture transported to Greenland. However, the meteorological development also impacts directly upon other factors important for isotopic fractionation, such as the location of moisture uptake, transport pathways, and condensation temperatures. Therefore, a better understanding of these influences on isotopic fractionation acting on the synoptic time-scale and between different NAO phases is of great relevance for the interpretation of stable isotope records from Greenland ice cores.

Here we examine the source regions, transport patterns, condensation regions, and precipitation conditions for moisture transport to Greenland for 30 selected winter months from different NAO phases between 1959 and 2000. A sophisticated back-trajectory analysis is applied to determine moisture uptake, transport, and precipitation formation. The isotopic ratios of oxygen 18, deuterium, and deuterium excess are calculated from the identified moisture transport parameters by means of a state-of-the-art isotopic box model.

Precipitation estimates are in good agreement with climatological data, confirming the validity of the trajectory study. Opposing NAO phases show significant differences in moisture sources, condensation areas, transport duration, and precipitation temperatures that are reflected in the modeled isotopic parameters. A detailed analysis of the meteorological processes acting upon the transported moisture during different NAO phases highlights the benefit of detailed trajectory calculations and synoptic consider-

ations for an improved understanding of isotopic signals in Greenland ice cores.