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Atmospheric pressure variations of the North Atlantic during the last 6000 years seen from Norwegian glaciers

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Whereas a number of records from the marine realm have demonstrated Holocene changes regarded to be related to overturning circulation in the North Atlantic region, independent information of atmospheric variability from the terrestrial realm have proven more elusive to capture in palaeo-records. This is a major concern, as several studies have suggested that wind-forcing may be an important factor to understand the reconstructed variations in ocean circulation trough the Holocene.

A number of studies considering the instrumental period have shown (A) that the atmospheric variability associated with the North Atlantic Oscillation (NAO) and sea-level pressure (SLP) in the North Atlantic is amplified in alpine areas on the western side of the Scandinavian mountain range, and is manifested as variations in the total winter accumulation in these areas. Moreover, it is (B) demonstrated that the spatial distribution of winter precipitation can be seen as a direct response to NAO and SLP variations.

A glacier may be regarded as a simple climatic system, responding to temperature during the ablation-season and winter-precipitation during the accumulation-season. By using an established approach to separate the two mass-balance terms of glaciers, three established Holocene glacier reconstructions are transferred into winter-accumulation signals, allowing the records to be viewed as palaeo-gauges of precipitation in three regions in southern Norway, thereby allowing the spatio-temporal variations in winter-precipitation to be reconstructed.

The vectors of westerly and southerly air-flow over southern Scandinavia are inversely

modeled from the distribution and amount of precipitation, and pressure-field patterns are identified for the last 6000 years with a 100 yr resolution.

By comparing our results with information on North Atlantic Ocean circulation, we can demonstrate a consistent behavior between the ocean and independently reconstructed atmospheric circulation from the terrestrial realm, thereby presenting post priori support to the a priori hypothesis that wind-fields are inter-connected to variations in the North Atlantic Ocean's circulation and behavior during the last 6000 years.

The most notable period of precipitation starvation in southern Norway both east and west of the main watershed is identified between 3.0 and 2.4 kyr BP and is interpreted as a severe slowdown of North Atlantic atmospheric circulation. This period is consistent with indications of the largest negative anomaly both in proxies for Meridional Overturning Circulation and Sea Surface Temperatures in the NA. We suggest that this period as the most promising candidate to investigate causes and effects of post-deglaciation slowdown of circulation in the NA. This period moreover delimits the behavior of the atmospheric system, suggesting that there is a mode-change between the period previous and after the slow-down, falling at the traditional subboreal-subatlantic transition.