Geophysical Research Abstracts
Vol. 12, EGU2010-9179-2, 2010
EGU General Assembly 2010

The Medieval Climate Anomaly and the Little Ice Age: testing the NAO hypothesis

James Scourse (1), Valerie Trouet (2), and Christoph Raible (3)

(1) University of Wales (Bangor), Ocean Sciences, Menai Bridge, United Kingdom (j.scourse@bangor.ac.uk), (2) Swiss Federal Institute for Forest, Snow, and Landscape Research (WSL), Zürcherstrasse 111, CH-8903 Birmensdorf, Switzerland, (3) Climate and Environmental Physics, Physics Institute, University of Bern, Sidlerstrasse 5, CH-3012 Bern, Switzerland and Oeschger Centre for Climate Change Research, Bern, Switzerland

Medieval Climate Anomaly (MCA) terrestrial proxy records (speleothem, NW Scotland; tree rings, Morocco) from close to the centres of action of the winter North Atlantic Oscillation (NAO) indicate that the MCA was characterized by a pervasive positive phase of the NAO(1). Spatial gradients across Europe in this MCA synoptic climatological interpretation were analyzed using the Proxy Surrogate Reconstruction approach based on general circulation model simulations. Changes in pervasive NAO phase result in synoptic shifts in surface pressure, wind fields and precipitation. It is hypothesized that these NAO changes are associated with oceanic responses/feedbacks including upwelling intensity and heat transport via the Atlantic Meridional Overturning Circulation (AMOC). Positive (negative) phases of the NAO are associated with enhanced (reduced) AMOC.

We review high quality palaeoceanographic data from the North Atlantic covering the last 1000 years to test this hypothesis. These data include proxies for sea surface temperature, bottom water temperature, sea ice cover, upwelling intensity and reconstructions of ocean hydrographic variability, including Gulf Stream outflow, North Atlantic Deep Water return flow and the position of the oceanic Polar Front. Palaeoceanographic data are consistent with the hypothesis that the MCA (Little Ice Age, LIA) was characterized by more (less) intense AMOC. However, there are multiple datasets, including the Na ion ice core proxy from the Greenland Ice Sheet(2), that indicate enhanced storminess across the North Atlantic during the LIA. These data conflict with the hypothesis in that enhanced winter storminess (cyclone frequency) should correspond to the NAO positive rather than negative phase. A possible explanation of this problem has been provided by ensemble simulations of the cyclone-resolving Climate Community System Model (CCSM) coupled ocean-atmosphere general circulation model for the Maunder Minimum (LIA)(3). These indicate major mid-latitude blocking anticyclones and reduced cyclone frequency constructions for the LIA consistent with NAO negative phase. But the intensity of cyclones during the LIA is found to be increased when anticyclones break down. The enhanced storminess during the LIA indicated by the ice core and coastal proxies and archival data may therefore be a product of more intense, rather than more frequent, storms during the LIA.

(1)Trouet, V.et al. 2009. Persistent positive North Atlantic Oscillation mode dominated the Medieval Climate Anomaly. Science 324, 78-80.

(2)Meeker, L.D. & Mayewski, P.A. 2002. A 1400-year high-resolution record of atmospheric circulation over the North Atlantic and Asia. The Holocene 12, 257-266.

(3)Raible, C.C. et al. 2007. Extreme midlatitide cyclones and their implications for precipitation and wind speed extremes in simulations of the Maunder Minimum versus present day conditions. Climate Dynamics 28, 409-423.