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Little Ice Age climate and the NAO

T. Kleinen (1,2), T. Osborn (1) and K. Briffa (1)

(1) Climatic Research Unit, School of Environmental Sciences, University of East Anglia, Norwich, UK, (2) Potsdam-Institute for Climate Impact Research, Potsdam, Germany (kleinen@pik-potsdam.de)

We are investigating the climate of the Little Ice Age. While cooling as a simple, direct response to the reduced insolation due to solar minima, as well as high concentrations of volcanic aerosols, may explain part of the changes in climate during the Little Ice Age, it is possible that dynamic changes in the climate system also play an important role. Dynamical changes in the atmosphere or ocean may themselves be part of the response to solar and volcanic forcing, but this is currently unclear because many climate models simulate only a relative weak dynamical response to changes in external forcings.

In order to explore the potential causes of the Little Ice Age climate anomaly, we are conducting sensitivity experiments with the GCM HadCM3 to investigate the consequences of candidate mechanisms for North Atlantic climate. The candidate mechanisms are: (i) changes in North Atlantic atmospheric circulation to negative NAO states, and (ii) reduced radiative forcing due to solar minima and volcanic aerosols. In order to influence the NAO index state in the climate model, we have implemented a data assimilation module based on the Data Assimilation Through Upscaling and Nudging (DATUN) approach. This approach allows us to force the model NAO index to desired states, without suppressing internal model variability.

We will present results from experiments implementing these mechanisms. The climate change resulting from these model experiments will be compared to the existing palaeoclimatic data on Little Ice Age climate in order to determine, if possible, which of these mechanisms were likely to have been important for the climate during the period we call the Little Ice Age. We will highlight the spatial patterns of climate change

resulting from the candidate mechanisms, and investigate whether available data is sufficient to prove or disprove any of the hypotheses.