Geophysical Research Abstracts,
Vol. 11, EGU2009-7035, 2009
EGU General Assembly 2009

Potential causes of 15th century Arctic warming using coupled model simulations with data assimilation

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An ensemble of simulations of the climate of the past millennium using a three-dimensional climate model of intermediate complexity are constrained to follow temperature histories obtained from a recent compilation of well-calibrated surface temperature proxies using a simple data assimilation technique. Those simulations provide a reconstruction of the climate of the Arctic that is compatible with model physics, the forcing applied and the proxy records. Available observational data, proxy-based reconstructions and our model results suggest that the Arctic climate is characterized by substantial variations in surface temperature over the past millennium. Though the most recent decades are likely to be the warmest of the past millennium, we find evidence for substantial past warming episodes in the Arctic. In particular, our model reconstructions show a particularly warm period at the end of the 15th century. This warm event is likely related to the internal variability of the climate system. We examine the roles of competing mechanisms that could potentially produce this anomaly. These examinations lead us to conclude that changes in atmospheric circulation, through enhanced southwesterly winds towards northern Europe, Siberia and Canada, are likely the main cause of the Arctic warming during the late 15th century.