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The 15th century Arctic warming in coupled model simulations with data assimilation

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Abstract. An ensemble of simulations of the climate of the past millennium conducted with 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 the 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 prominent warm event during the period 1470–1520. This warm period is likely related to the internal variability of the climate system, that is the variability present in the absence of any change in external forcing. We examine the roles of competing mechanisms that could potentially produce this anomaly. This study leads 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 late 15th/early 16th century Arctic warming.

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