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Climatic changes in the Urals over the past millennium – an analysis of geothermal and meteorological data

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Abstract. This investigation is based on a study of two paleoclimatic curves obtained in the Urals (51–59° N, 58–61° E): i) a ground surface temperature history (GSTH) reconstruction since 800 A.D. and ii) meteorological data for the last 170 years. Temperature anomalies measured in 49 boreholes were used for the GSTH reconstruction. It is shown that a traditional averaging of the histories leads to the lowest estimates of amplitude of past temperature fluctuations. The interval estimates method, accounting separately for the rock's thermal diffusivity variations and the influence of a number of non-climatic causes, was used to obtain the average GSTH.

Joint analysis of GSTH and meteorological data bring us to the following conclusions. First, ground surface temperatures in the Medieval maximum during 1100–1200 were 0.4 K higher than the 20th century mean temperature (1900–1960). The Little Ice Age cooling was culminated in 1720 when surface mean temperature was 1.6 K below the 20th century mean temperature. Secondly, contemporary warming began approximately one century prior to the first instrumental measurements in the Urals. The rate of warming was +0.25 K/100 years in the 18th century, +1.15 K/100 years in the 19th and +0.75 K/100 years in the first 80 years of the 20th century. Finally, the mean rate of warming increased in the final decades of 20th century. An analysis of linear regression coefficients in running intervals of 21 and 31 years, shows that there were periods of warming with almost the same rates in the past, including the 19th century.

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