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Joint analysis of soil temperature and meteorological data: a contribution for climate change analysis using southern Portugal borehole data

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Understanding the climate change processes requires the application of special methodologies for revealing the history of climatic elements, one of the most important being air temperature. Regional climate warming over the past hundred years is studied using borehole temperature logs in southern Portugal. They are used to estimate the timing of recent warming and its magnitude; to explain any discrepancy between observed air temperature rise and estimates from global climate models; to examine temperature trends century by century during the last few centuries; and to establish a baseline temperature to compare to the observed 20th century warming. However, borehole inversion methodology estimates surface ground temperature in the past and not air temperature. In order to reconstruct past climate, a strong coupling between temperature variations in the atmosphere and those in the ground must be identified in order to provide rationale for interpreting surface ground temperature histories in terms of atmospheric warming and for coupling low-frequency surface ground temperature histories with proxy records of climate change. So, in the present work, we look for an eventual correlation between secular surface air temperature recorded in southern Portugal and ground temperature in order to detect if both are or not responding to similar forcing. This analysis is essential for assessing if borehole temperature profiles contain a valuable signal for measuring the magnitude and timing of global warming since pre-industrial time and provide a low-frequency complement to proxy reconstructions.