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REGIONAL TEMPERATURE VARIABILITY IN THE EUROPEAN ALPS: 1760–1998 FROM HOMOGENIZED INSTRUMENTAL TIME SERIES

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ABSTRACT

This paper investigates temperature variability in the Alps and their surroundings based on 97 instrumental series of monthly mean temperatures. A discussion of the initial homogenizing procedure illustrates its advantages and risks. A comparison of the homogenized series with the original series clearly shows the necessity to homogenize. Each of the original series had breaks (an average of five per series) and the mean of all series was systematically biased by non-climatic noise. This noise has subdued the long-term amplitude of the temperature evolution in the region by 0.5 K. The relatively high spatial resolution of the data enabled a regionalization within the study area of 680000 km^2 into six sub-regions based on principal component analysis of the monthly series. Long-term temperature evolution proved to be highly similar across the region—thus making a mean series (averaged over all 97 single series) representative of the study area. Trend analysis (based on progressive forward and backward Mann–Kendall statistics and on progressive analysis of linear regression coefficients) was performed on seasonal and annual series. The results diverge from those of global datasets. This is mainly due to the extension of the 240-year Alpine dataset by 100 years prior to the mid-19th century, and also due to the advantages of a dense and homogenized regional dataset. The long-term features include an initial decrease of the annual and seasonal series to a minimum followed by a positive trend until 1998. The minima are 1890 for the entire year and winter, 1840 for spring and 1920 for summer and autumn, respectively. The initial decreasing trend is more evident in spring and summer, less in autumn and smallest in winter. The mean annual temperature increase since 1890 in the Alps is 1.1 K, which is twice as much as the 0.55 K in the respective grid boxes of the most frequently used global dataset of the Climatic Research Unit (CRU), University of East Anglia. To enable an easier and more systematic handling of the dataset, these data have been interpolated to a 1° × 1° longitude–latitude grid. The 105 low-elevation and 16 high-elevation grid point series are widely available without restrictions for scientific research and can be obtained from the authors.

KEY WORDS: gridded dataset; homogeneity; instrumental period; regionalization; temperature time series; trends

1. INTRODUCTION

The European Alps constitute a region of high potential in terms of climatological research. They offer different climates ranging from Mediterranean and Atlantic influences in the south and west to continental features in the east, and from low-elevation plains, valleys and basins to high-elevation mountain climate in regions above the tree-line and above the snow-line. They also offer a wealth of climate data not easily obtainable elsewhere. The climatological part of the EC project ALPCLIM (environmental and climate information from ice cores in high elevated Alpine sites; Wagenbach *et al*., 1998) aims to analyse climate-relevant stable isotope information in ice cores from the summit regions of

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