A NEW HIGH-RESOLUTION BI-CENTENNIAL (1800–2003) PRECIPITATION DATASET FOR THE GREATER ALPINE REGION

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Abstract: A new precipitation dataset for the Greater Alpine Region (GAR; 4°E–19°E, 43°N–49°N) has been developed. It provides monthly precipitation totals for the 1800–2003 period on a 10-min resolution grid. The new 'HISTALP 10-min-grid' dataset is based on long-term homogenized precipitation series from meteorological stations across the study domain and a high-resolution precipitation climatology dataset for the 1971–1990 period. The effective coverage of the dataset depends on the observations available in the station network which progressively decline back to the early 19th Century (from 192 to 5 stations). To aid the use of these data in other studies, an accompanying dataset has also been developed, which provides a measure of quality of each monthly precipitation estimate over the grid: the explained variance, relative to the 1931–2000 (maximum data availability) period. The computed quality score illustrates the comparatively poorer accuracy of the dataset for regions and months with less coherent precipitation fields (i.e., over the Alps and in summer) and when the number of stations is reduced, particularly before 1840. The derived gridded field has been compared with other independently-developed datasets and is found to provide a similar description of the precipitation in the GAR for places and periods of common coverage.

Keywords – *precipitation, spatial interpolation, European Alps*

1. INTRODUCTION

A general climatic database for the realm of the European Alps has been in development since the early 1990s. It is named "HISTALP" and comprises instrumental monthly climate time series. Precipitation is one of the key parameters in HISTALP and is composed of data from 192 stations. The station time series of monthly precipitation totals have been homogenized (Auer et al., 2005). A few of them extend back to 1800 (5 stations), whereas most of them start within the 19th Century. Complete data coverage is provided from 1927 to 2003 (192 stations, see Fig. 1). Based on the 'HISTALP station-mode' precipitation dataset a new gridded precipitation dataset has been developed, which comprises time series of monthly totals, on a regular 10-min grid over the Greater Alpine Region (GAR; 4°E–19°E, 43°N–49°N), spanning the period 1800 to 2003. The construction of 'HISTALP 10-min-grid' dataset was intended to facilitate grid-based multi-parameter studies of Alpine climate, to validate numerical models, and to calibrate climatic proxies which are not always located nearby meteorological sites.

2. DATASET DEVELOPMENT

The gridding scheme follows the "anomaly approach" (e.g., Jones et al., 1982; Jones and Hulme, 1996) which is based on the characteristics of the two components of the field: the long-term time-mean component (the "climatology") and the temporal deviations from this (the "anomalies"). The climatology, being characterized by small-scale spatial patterns, has been calculated, at high resolution, for the period 1971–1990, when the station network is dense (Schwarb, 2000; Schwarb et al., 2001). It was geographically augmented, using additional station data, to cover the eastern parts of the GAR. The anomaly field consists of comparatively large-scale patterns. The grid-based anomaly field was estimated

by interpolating the station-based anomaly data (expressed as per cent deviations from the 1971–1990 mean field). An angular-distance-weighted (ADW) interpolation is applied using the data for the three nearest stations to each grid-point. These data are based either on observations or reconstructed values (by means of local EOFs) based on nearby station observations. Finally, the (full) gridded field in mm units was derived by merging the gridded climatology and the gridded anomaly field.

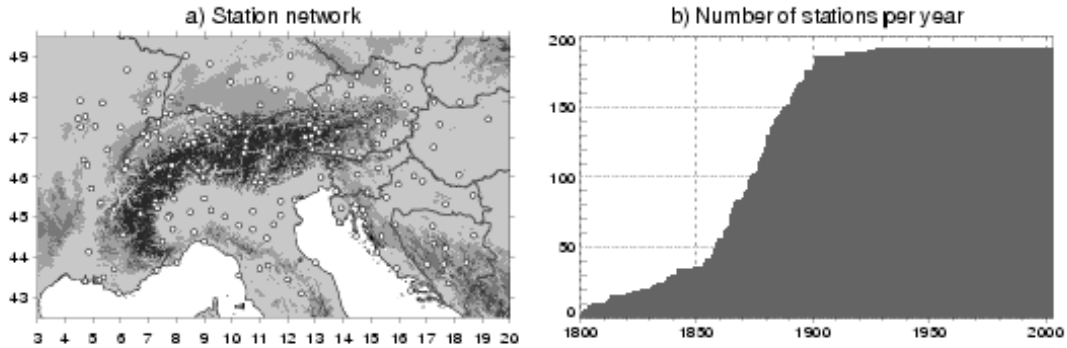

Figure 1. a) The HISTALP station network for precipitation, and b) the evolution of the station network as expressed by the number of stations per year during the 1800–2003 period

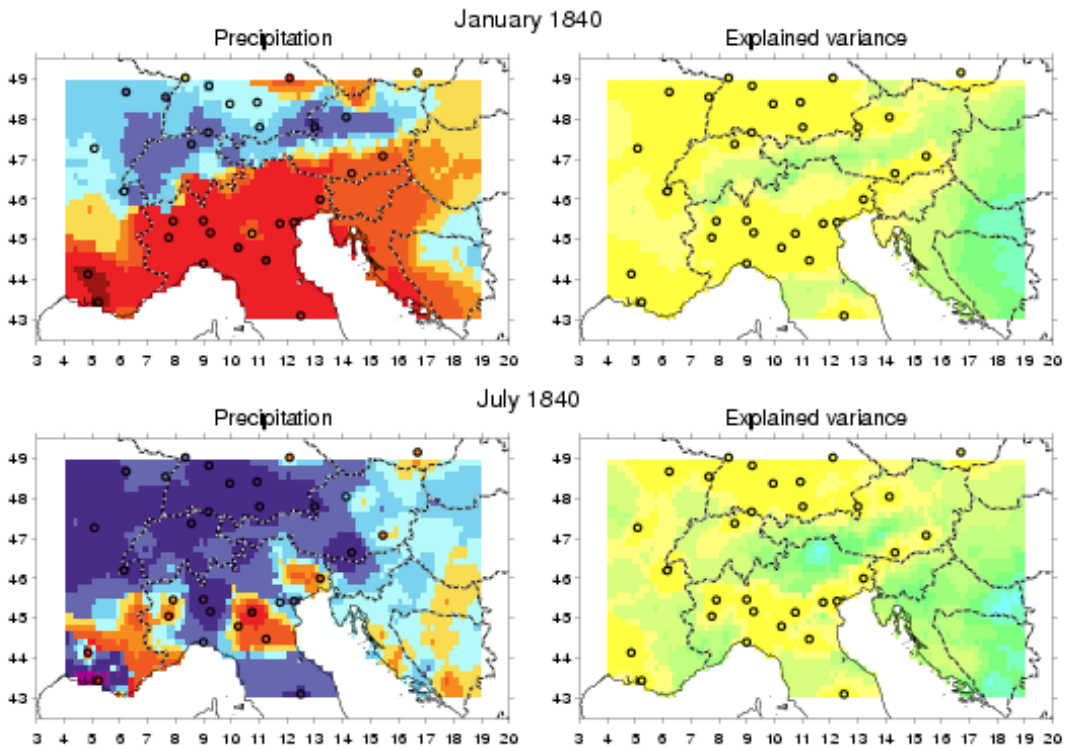

Figure 2. HISTALP 10-min-grid precipitation (overlain with HISTALP station-mode precipitation, in circles), and the associated explained variance for January (upper panel) and July (lower panel) of 1840.

3. DATASET ACCURACY

Since the station network declines progressively back to the early 19th Century, the accuracy of the interpolated field diminishes. To quantify the effect of sparse network, the accuracy relative to the 1931–2000 (maximum data availability) period was calculated. The explained variance was selected as the quality score, expressed on a per cent scale (with 100% assigned to the 1931–2000 period). For the relative explained variance calculation, weights, used for interpolation in each month and year, were also applied to the 1931–2000 data and the resultant interpolated series were compared with the original 1931–2000 series. Higher scores are found in winter months, whereas the lowest scores characterize the June and July time series (Figure 2). In particular regions the scores are locally low: in mountains (where the precipitation field has low spatial coherence) and southeast GAR (where the observational data are unavailable for most of the decades of the 19th Century).

The HISTALP 10-min-grid dataset has been preliminary evaluated through comparisons with other, independently-developed, datasets. Correlation of interranual variability, multidecadal trends, and extreme precipitation cases were examined within the 20th Century. A general consistency was found across the GAR, but less over the Alpine mountain chain. Some local discrepancies were also identified where the station networks used for developing the various datasets differed substantially.

4. CONCLUSION

The construction of the new HISTALP 10-min-grid dataset aims to represent the precipitation variability over the Greater Alpine Region on a regular geographical grid with monthly time resolution. Its principal contribution to Alpine climate studies stems from its bi-centennial length. However, its accuracy declines back in time as the station network becomes sparse, particularly in the inner-Alpine region during the 19th Century. The accuracy also varies throughout the calendar year, with comparatively lower scores during the summer, due to the reduced spatial coherence of rainfall patterns at that time. Thus further improvement may be achieved by incorporating additional observational data and/or achieving more advanced homogenization of the station data used.

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