Homogenization of Austrian and Alpine time series

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The National Austrian Weather Service (ZAMG) has been active in the area of data homogenisation since 2001 and participated and contributed to the COST Action ES0601 on homogenization. Different methods have been applied during the last years. HISTALP offers freely available data sets (homogenized monthly data of the alpine region) and daily data of extreme temperature and precipitation of Austrian stations. Further work is invested in improving the existing homogenization routine, and investigating the usefulness of available homogenization methods for other parameters than temperature and precipitation on a daily base.

HISTALP

The HISTALP database (www.zamg.ac.at/histalp, Auer et al. 2007) includes homogenised long term climate data in monthly resolution for the Greater Alpine Region (GAR, see Fig.1, Fig.2) for temperature, precipitation, sunshine duration and air pressure.
The homogenised station data can be downloaded via the webpage and different gridded analyses are available for different resolutions.
At the moment a homogenisation rerun (Fig.3) is done using HOMER (developed within the COST Action ES0601, Mestre et al. 2014) . Such a re-homogenisation has to be done regularly due to improved homogenisation methods on one hand and prolonged time series on the other.
Additional breaks, that can't be detected by statistics, e.g. due to changes affecting the whole network (or the bigger part of it) at the same time, like changes in observing hours or rules for instrument instalments have been corrected for temperature by additional corrections terms, derived from data analyses. The early instrumental bias (Böhm et al. 2010) has been corrected using available parallel measurements and metadata.

Daily temperature

Homogenized series of daily temperature extremes have been made available for about 60 stations (Fig.4, Nemec et al. 2013). They are often used in different climate analyses, due to their lengths and completeness.
For homogenising these time series PRODIGE (Caussinus et al. 2004) and SPLIDHOM (Mestre et al. 2011) have been used, but improved by some additional plots for facilitating the decision of the homogeniser and extended with some uncertainty information by using different reference stations as well as bootstrapping methods (HOMOP, Gruber et al 2009).
These time series are used for gridded analyses (Fig. 5, Hiebl J. et al. 2015) for climate monitoring purposes as well as for evaluation & correction of climate models.

Fig. 7: 5-year gliding mean of frequency of extreme events (>40mm/6h) using information of 10 stations in Austria. (Chimani et al. 2013)
Blue bold line: as derived from original data, red bold line: as derived from homogenised data, thin lines: regression

Daily precipitation

Daily precipitation sums have been homogenised (Nemec et al., 2013). using a combination of PRODIGE (Caussinus and Mestre, 2004) and INTERP (Vincent et al., 2002), including some uncertainty measures (HOMOP, Gruber et al 2009, Fig. 6). A conservative approach was chosen, using one adjustment for each season, instead of monthly or even daily adjustments.
This method was also applied to subdaily data. The correction factor found for the daily data was used to adjust the hourly values. These data have been used to investigate heavy precipitation events. (Fig. 7)
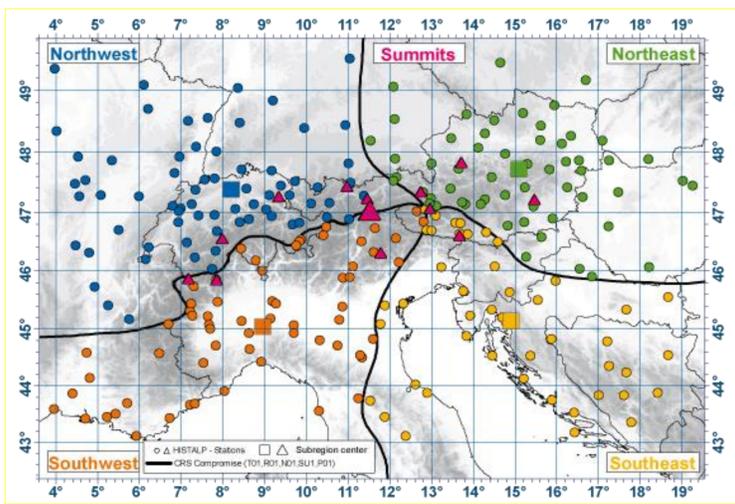

Fig. 1: Greater Alpine Region (GAR) of HISTALP and climate regions as derived by EOFs (Auer et al. 2007)
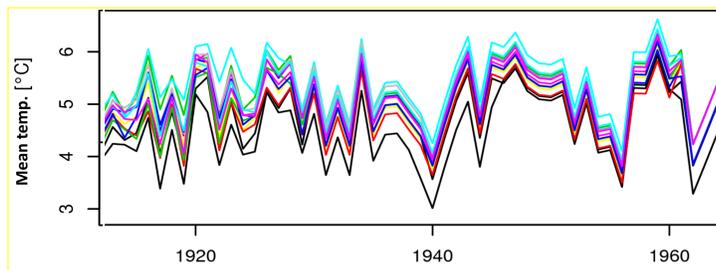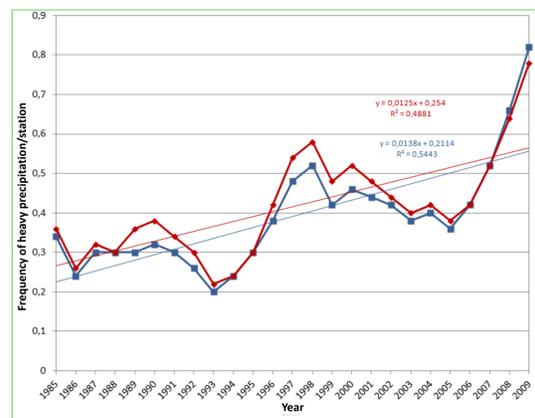

Abb. 3: Comparison between the actual homogenisation (black) and the homogenisation of using different networks in HOMER for the HISTALP-station Rauris
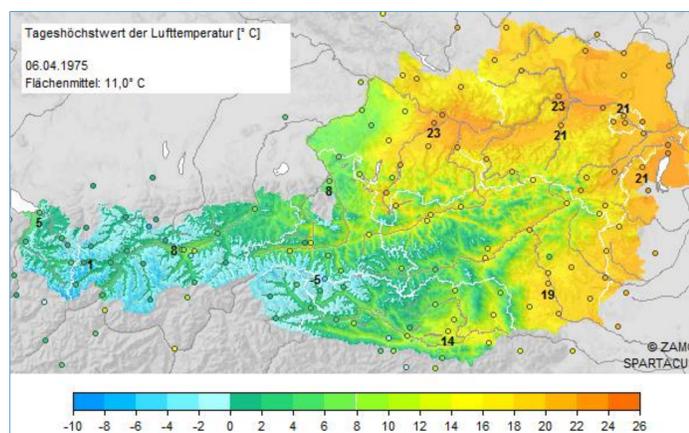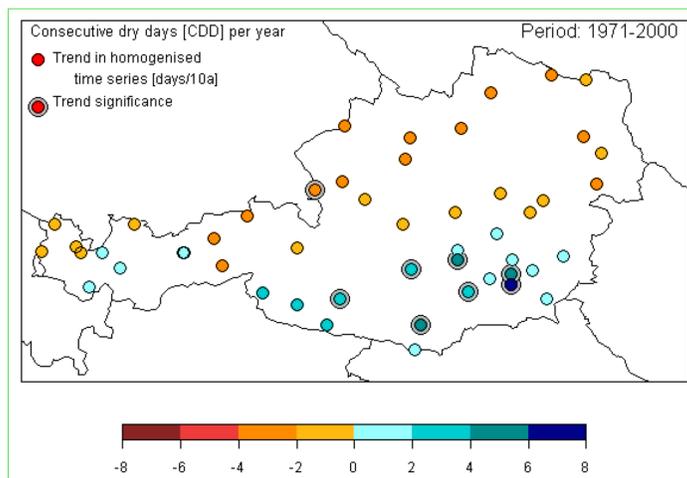

Fig. 6: Results of the homogenisation of precipitation at the example of consecutive dry, showing the trend in homogenised data and significance of the trend (Nemec et al. 2013)

Fig. 5: Example of a gridded analyses (Tmax on the 6.4.1975) using homogenised data where possible (Hiebl et. 2015)
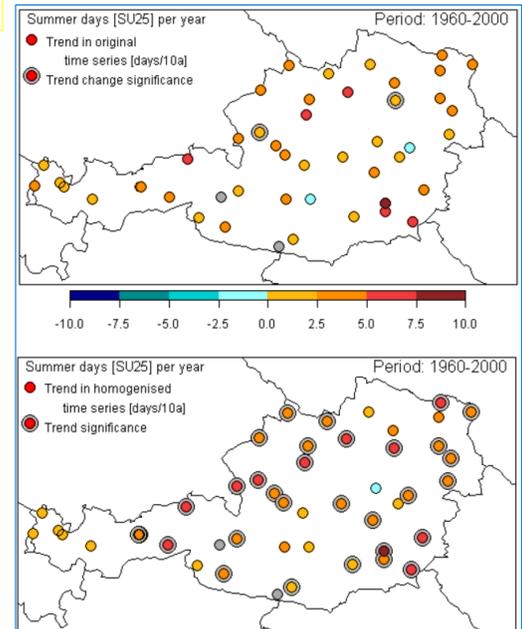

Fig. 4: Results of the homogenisation of temperature at the example of summer days (days with Tmax>25°C), upper panel: Trend in original data and significance of the trend change from original trend to homogenised trend, lower panel: Trend in homogenised data and significance of the trend (Nemec et al. 2013)

Further work

After homogenising daily temperature and precipitation data additional parameters need to be tested for homogeneity before being used in climate impact studies. Therefore available homogenisation methods have to be tested on their ability to work for other parameters in daily resolution as those, they have been designed for (T, RR).
Using a surrogate dataset, different methods (MASH, PROCLIM, ACMANT, PRODIGE, INTERP and SPLIDHOM) are tested on their ability to homogenise relative humidity.

Data Rescue

Knowing about the worth of past climate information the rescue of meteorological data and it's metadata is of high interest. At ZAMG most of the climate sheets which are stored in the archive are already digitised, however some time consuming work of gathering and digitising data from other institutions (e.g. universities, astronomical observatories) is left. In addition a thorough quality control and homogenisation process is necessary. This point is of special intricacy, as the number of stations decreases the older the data are.

Austria is also leading the EUMETNET-DATA RESCUE-Activity (DARE), in which an inventory of available long-term stations for Europe is built up and homogenisation of the data is planned for the future. (www.zamg.ac.at/dare)
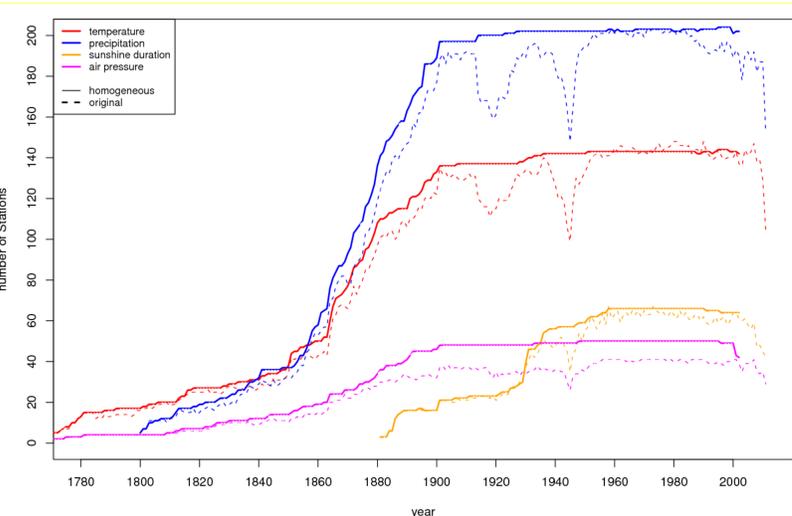

Fig. 2: Number of stations in HISTALP-Database original and homogenised (homogenised lines end in 2002, when the last homogenisation was done. The time series are prolonged with original, quality controlled data)

References

Auer I. et al. 2007: HISTALP – Historical instrumental climatological surface time series of the greater Alpine region 1760-2003, Int. Journal of Climatology, 27,17-46
Böhm R. et al. 2010: The early instrumental warm-bias: a solution for long central European temperature series 1760–2007. Climatic Change 101, 41–67, doi:10.1007/s10584-009-9649-4
Chimani B., Türk K., Krennert T. 2013: Erstellung eines subtäglichen Extremniederschlgsdatensatzes SUBEX, project report, ZAMG
Caussinus H. Mestre O., 2004: Detection and correction of artificial shifts in climate series. Journal of the Royal Statistical Society, Series C,53,405-425
Gruber C., Auer I., Böhm R. 2009: Endberichte HOM-OP Austria - Aufbau und Installierung eines Tools zur operationellen Homogenisierung von Klimadaten mit 3 Annexen
Hiebl J., Frei C. 2015: Daily temperature grids for Austria since 1961 – concept, creation and applicability. Theoretical and Applied Climatology, doi: 10.1007/s00704-015-1411-4
Mestre O. et al. 2013: HOMER: a homogenization software –methods and applications, Quarterly Journal of the Hungarian Meteorological Service, 117, 1, 47-67
Mestre O, Gruber C, Prieur C, Caussinus H, Jourdain S, 2011: SPLIDHOM: A Method for Homogenization of Daily Temperature Observations, J. Appl. Meteor. Climatol, 50, 2343-2358
Nemec J, Gruber C, Chimani B, Auer I,2013: Trends in extreme temperature indices in Austria based on a new homogenised dataset. Int. Journal of Climatology, doi: 10,1002/joc.3532
Nemec J, Chimani B, Auer I, Gruber C., Türk K. 2010: HOM-START Homogenisation of climate series on a daily basis an application to the StartClim dataset. Project report Klima und Energiefond
Vincent LA, Zhang X, Bonsal BR, Hogg WD, 2002: Homogenization of Daily Temperatures over Canada, Journal of Climate, 15, 11,1322-1334