New developments in homogenisation efforts for Austria

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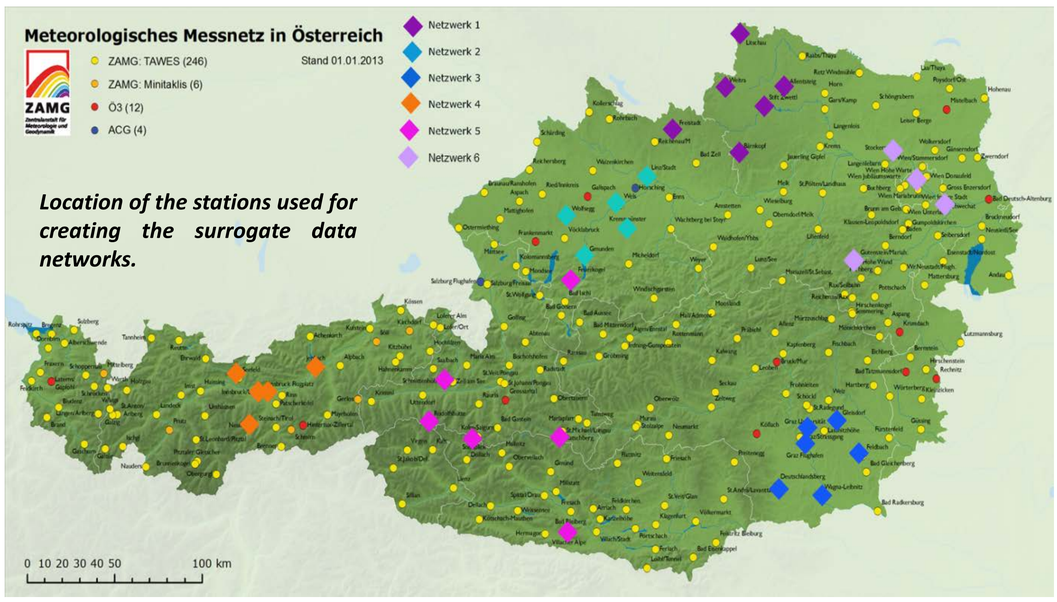
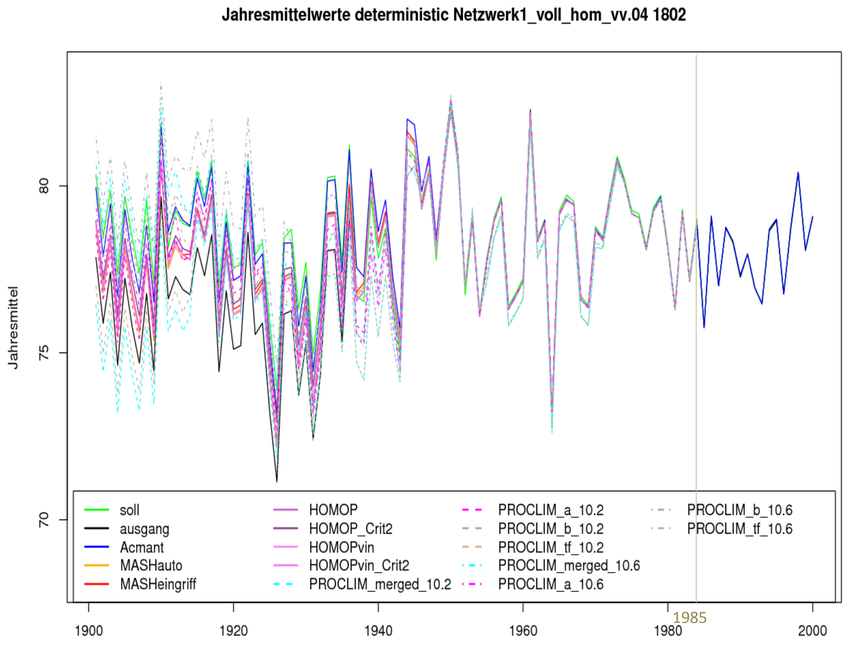
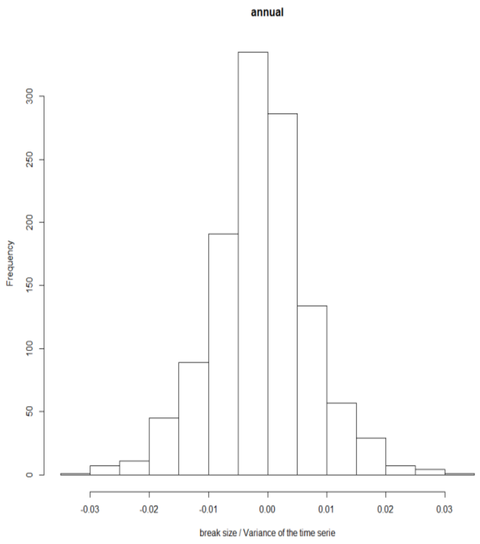
After homogenising daily temperature and precipitation data for a set of about 70 Austrian stations from 1948 onwards, other parameters seemed necessary to be homogenised in order to provide a set of meteorological, homogenised data for further research.
The parameter chosen was the relative humidity, as this parameter is of interest not only in meteorological questions but has influence on materials and plants as well. Nevertheless the parameter has some difficulties not that evident in temperature or precipitation: only a small range of values occurs in nature and the instruments are changed quite regularly, leaving only short periods without interruption.
Four methods have been compared in this study:
ACMANT, MASH, HOMOP, PROCLIM.



Location of the stations used for creating the surrogate data networks.



Example of homogenisation results in a deterministic case
Green: homogeneous searched time series
Black: inhomogeneous time series
All the other lines represent the result of the homogenisation methods



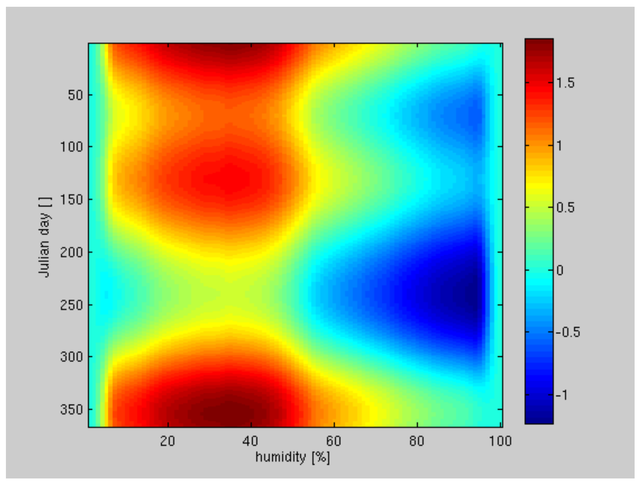
Histogram of the quotient of break size to variability of the time series

1) Creation of a surrogate dataset

Information on frequency of stations relocation and instrumental changes were collected using the station meta data archive of ZAMG.

Typical characteristics of breaks due to relocations were analysed by the use of parallel measurements for different stations in Austria.

Networks of stations that seemed to be quite homogeneous according to the stations meta information, was checked on homogeneity in monthly resolution with HOMER. This station data was used to create surrogate datasets of 100years of length.



Example of a break size (colours) in dependence of the true value (x-axis) and the time of the year (y-axis)

2) Break detection

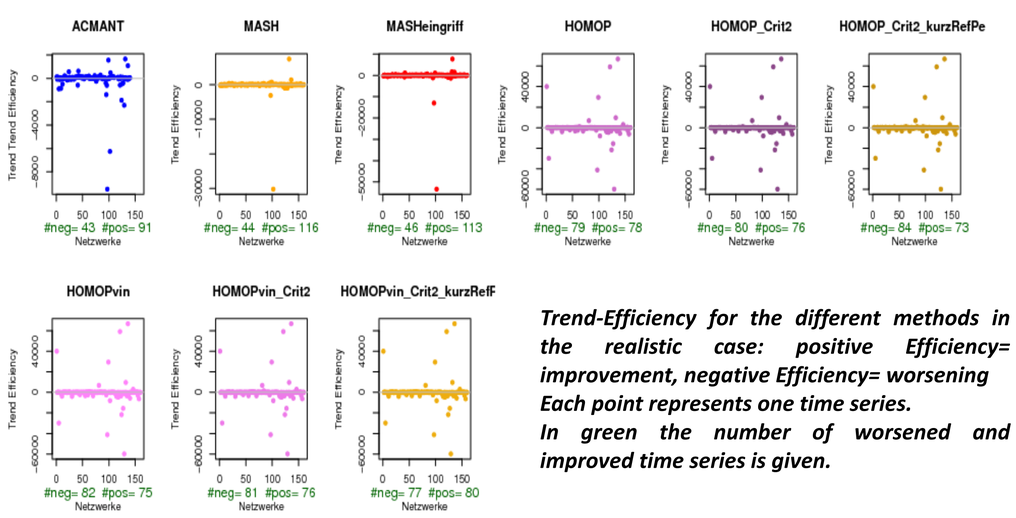
The ability of four different methods, tested during the COST-Action ES0601, was studied using a deterministic (without missing data and white noise) and a realistic (missing data, different start of time series and white noise) dataset. For MASH, HOMOP and PROCLIM different settings were tested.

A break was detected correctly if the year was within the range of ±1 year of the actual break year. All detected breaks within one year counted as one break.

Results

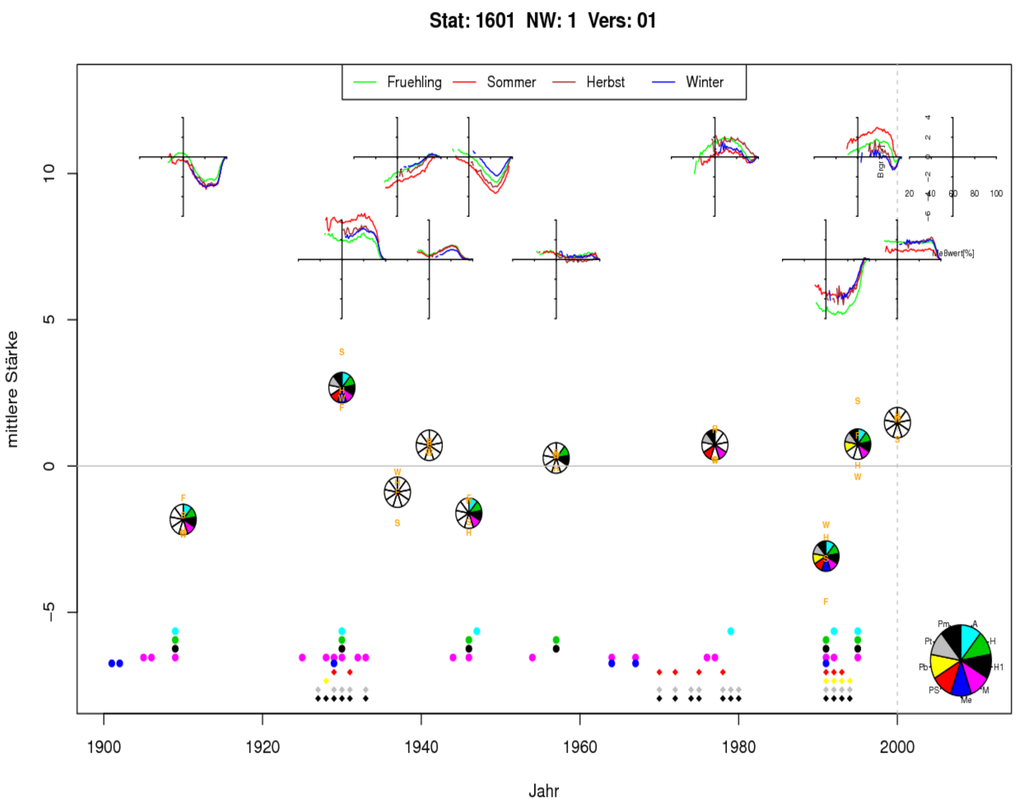
All the breaks of the surrogate dataset are clustered with breaks of the reference time series or are located near the end of the time series. Nearly 3/4 of the breaks are additionally clustered with breaks in the time series itself. More then 1/4 of the breaks was not detected by any of the 4 methods.

The ability to detect the correct breaks is highest for ACMANT and HOMOP. In the case of HOMOP more time series are seen as homogeneous than in ACMANT. Trying to detect breaks in the homogeneous surrogate time series, ACMANT detects more breaks than HOMOP.
For all four methods the ability is lower in the realistic case than in the deterministic.



Trend-Efficiency for the different methods in the realistic case: positive Efficiency= improvement, negative Efficiency= worsening
Each point represents one time series.
In green the number of worsened and improved time series is given.

Result of a break detection for one station in Network1.
Upper row: break signal as a function of measurement for different seasons (Fruehling=spring; Sommer=summer; Herbst=autumn; Winter=winter)
Mean row: Letters mean break signal for 4 seasons and the year. Colours giving the methods with detected this break
Lower row: all detected breaks by the different methods(colours)
X-axis: year of the breaks, Y-axis= mean break signal in mean row.



3) Correction

The ability for break correction in the realistic case was tested for ACMANT, MASH and HOMOP using the according break information. For all but ACMANT different settings have been used.

Results

Only MASH found solutions for each time series, while ACMANT had the most troubles. The networks for which single time series couldnot be solved varied between the methods.

The improvements in RMSE, Variability and Trends were analysed.
While improvements of the RMSE are possible for a part of the time series for all the methods, only ACMANT improves the RMSE in the realistic dataset in about half of the time series.
For the trend all of the methods can improve the trend for about half of the time series. MASH is leading this analyses with about 2/3 of the time series being improved.
The variance is not strongly influenced for ACMANT and MASH in the realistic case.

Interfering with MASH without the knowledge of any metadata, but preferring not to use breaks that extinguish each other within 1 year leads to less homogenisation skill.

4) Change in observing routine

With the start of 1971 the evening observation hour changed from 21°° to 19°°. At the same time a new calculation method for averaging the daily data was implemented. To adjust this break a seasonal multivariate regression using the measurements of this day as well as of the next day and the time of sunrise and sundown can be used. Due to strong local influences only a small part of the stations has enough information before and after the change to calculate the adjustments.

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