AT-HOM

a homogenized daily temperature and precipitation data set for climate impact studies in Austria

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Overview

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• Method and Results
  – Temperature
  – Precipitation
• Summary
Introduction

Homogenity – „St. Paul im Lavanttal“

- Replacement of stations
- Changes in the instrumentation
- Changes in surrounding
- Changes of observer
- Automatisation
- ...

Should be documented, but a lot of events not known!

Statistics + metadata

Benedictine Abbey St. Paul:
Station location 1: 28.5.1946 bis 31.5.1949,
Station location 2: ab 1.7. 1949
Current location: St. Andrä im Lavanttal
Dataset

Daily temperature extremes (tx, tn)
24h-precipitation sum

Longterm measurements 1948-2009, high quality and good spatial distribution
Comparion between different methods: (Gruber et al., 2008)
*) accuracy
*) practability

**PRODIGE** (detection; Caussinus, Mestre 2004) and **SPLIDHOM** (adjustment, Mestre et al. 2011) – **non-automatic method**

Software HOMOP allows execution of Detection and Correction (Projectdescription Gruber et al., 2009)

**Requirements:**
- Sufficiently high correlation of reference stations (>0,8)
- Sufficiently high station density (<100km horizontal, 200m vertical)
Method: Break detection

• Log-likelyhood-approach

\[ C_k(Y) = \ln \left( 1 - \frac{1}{n} \sum_{j=1}^{k+1} n_j (\bar{Y}_j - \bar{Y})^2 \right) + \frac{2k}{(n-1)} \ln(n) \]

\[ \text{Penalty term} \]

k..number of breaks
n..length of complete time serie
\[ \bar{Y} \]..mean of the whole time serie
\[ \bar{Y}_j, \bar{Y}_i \]..mean of time serie between break points

• 3 different penalty terms used:
  o Caussianus & Lyazrhi, 1997
  o Jong, 2003
  o Lebarbier, 2005
Definition of break:
Has to be visible  ▪ in at least 2 seasons
  ▪ in at least 2 criterias

At least 50% of the reference stations detect break
More then 2 series detect break
More than 1 series detect break
1 detect break
Method: Break adjustment

Correlation test - reference stations >0.9

Non-linear regression functions:

\[ m_{YXbef} \leftrightarrow m_{XYbef} \]
\[ m_{YXaft} \]

Regressions calculated by using splines

\[ m_{cor} = m_{YXaft} - m_{YXbef} \]

Different adjustments for different seasons

\[ Y_{hom} = m_{cor}(m_{xybef}(Y)) \]

Mestre et al. 2011
Method: uncertainties of correction

Bootstrapping method
- Calculation of adjustments done 50 times
- Sampling with replacing

SPLIDHOM adjustment bootstrapping distribution
Method: uncertainties of correction

Calculation of adjustments for 3 high correlated reference stations

SPLIDHOM adjustment for ref. station 1
SPLIDHOM adjustment for ref. station 2 & 3
bootstrapping distribution
Results Temperature

Gray stations not been homogenised
Due to high uncertainties in adjustment

Daily temperature minimum

<table>
<thead>
<tr>
<th>Metadata event</th>
<th>Number</th>
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<tbody>
<tr>
<td>Station Relocation</td>
<td>50</td>
</tr>
<tr>
<td>Instrumentation change</td>
<td>23</td>
</tr>
<tr>
<td>Screen shelter change</td>
<td>16</td>
</tr>
<tr>
<td>Observer change</td>
<td>8</td>
</tr>
<tr>
<td>other information</td>
<td>6</td>
</tr>
<tr>
<td>break without metadata</td>
<td>36</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>139</strong></td>
</tr>
</tbody>
</table>

Daily temperature maximum
• Most corrections between -0.5°C and +0.5°C

• Adjustments ($T_{\text{max}}$) in Summer > Winter

• Mean adjustments neg -> stronger trends
Number of summer days ($T_{\text{max}}>25^\circ\text{C}$) (1961-2000)

Trend in homogenised data & trend significance

- Trends increase in homogenised data
- Change of trend direction by homogenisation

Trend in original data & Significance of trend changes
Cold nights [TN10P] per year

Period: 1960-2000

- Trend in homogenised time series [days/10a]
- Trend significance

Cold nights
(number of days $T_{min} < 10$ percentil)
Method Precipitation

- Break detection
  - number of days RR>5mm
  - Monthly precipitation sum (ratio)
  - Correlation: >0.6
  - Additional stations of Austrian hydrological service

- Adjustment: Adapted INTERP (Vincent, 2002)
  - Seasonal adjustments

\[ adj = \frac{\text{median}(\frac{\text{test after}}{\text{ref after}})}{\text{median}(\frac{\text{test before}}{\text{ref before}})} \]

- Corr >0.7 (adjustment)
- No interpolation
to daily adjustments

Adjustment of ref. Station
5th and 95th percentil of bootstrapping adjustment
### Results Precipitation

<table>
<thead>
<tr>
<th></th>
<th>number</th>
<th>percentage</th>
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<tbody>
<tr>
<td>homogeneous</td>
<td>49</td>
<td>69%</td>
</tr>
<tr>
<td>homogenisation not possible</td>
<td>11</td>
<td>15.5%</td>
</tr>
<tr>
<td>homogenised</td>
<td>11</td>
<td>15.5%</td>
</tr>
<tr>
<td></td>
<td>71</td>
<td>100%</td>
</tr>
</tbody>
</table>

#### Maximal number of days with RR≥1mm gap

#### Maximal number of days with RR<1mm gap
Summary

- Homogeniesed daily temperature extremes and precipitation dataset for Austria
- Not all stations have been homogenisable

- Temperature: temperature depending adjustment
- Precipitation: season depending adjustment
- Estimation of uncertainties

- All climate change indices warming
- For precipitation only local statements possible
Dataset and more information

http://www.zamg.ac.at/forschung/klimatologie/klimawandel/homstart/