Ensemble approach to the homogenisation of monthly climate records in Slovenia

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Outline

- Project Climate variability in Slovenia
- Homogenisation
- HOMER
- Ensemble approach
- Subjectivity factor study
- Dataset factor study
- Results for the Slovenian network
- Conclusions
Project Climate variability in Slovenia

- Increasing need for accurate, useful climate (change) data
- In 2008 Slovenian Environment Agency launched a project about climate change & variability detection
- Manual observations mostly
- Time period 1961-2011

Climate station Lesce-Hlebce

Maximum liquid-in-glass thermometer
• Spatial & logical quality control of air temperature, precipitation, snow depth and wind data
• Metadata collection
• Homogenisation of monthly values
• Analysis of homogenised series
• Results probably published in 2014

A monthly weather report

An example of spatial quality control of daily precipitation
Homogenisation

• Correction of biased, inhomogenous data series (station moves, change of instrumentation, urbanisation etc.)

• Homogenised series approximation of series having only natural weather and climate variability

• Relative comparison of tested and reference series, statistics of difference series

• Most homogenisation methods assume more or less the same climate signal in a tested and reference series

• Strong correlation between the series needed!
Tested series is compared with a reference series (constructed from neighbouring stations data) or more reference (neighbouring) series.

Correction based on difference before and after break.

(Usually) no a priori homogenous series! (all tested series serves as a reference and vice versa)
HOMER

- Product of COST action HOME, 2007-2011
- R-based interactive, semi-automatic tool for homogenisation of monthly data series (Mestre et al., 2013)
- Several detection methods included
- Corrections made by ANOVA
- Iteration of detection-correction rounds
Ensemble approach

- Manual methods (e.g. Craddock method) may perform very well if user is an expert (Venema et. al., 2012)
- Manual methods time consuming, automatic can not fully exploit all the available metadata
- Semi-automatic approach in HOMER, expert accepting/rejecting proposed breaks
- What is the expert’s influence on the outcome?
- Subjectivity & dataset factor study
Subjectivity factor study

• Monthly temperature series (mean, daily maximum, daily minimum)
• Three experts (A-C)
• Different parameter values (e.g. reference stations)
• 49 (36) Slovenian stations + 11 stations in Austria and Croatia for mean temperature

Map of stations: mean (red dots), maximum (red dots, Slovenian stations only), minimum temperature (blue dots)
Dataset factor study

- **Mean** monthly temperature
- Subset of data series (44 out of 60 stations)
- Three experts (D-F)
- Homogenous station distribution
- 12 stations in all subsets, other 32 randomly in 2 of 3 subsets
<table>
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<th>expert</th>
<th>No. of SLO stations</th>
<th>No. of breaks</th>
<th>confirmed by metadata (%)</th>
<th>frequency (/year/station) (%)</th>
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Results for the Slovenian network

Mean annual air temperature anomaly (network average) – six experts & original interpolated data
- More or less the same variability
- No significant bias
• Narrower distribution after homogenisation
• Some differences between experts
• Only a small change of the median value
Mean air temperature, mean of A, B, C

Period: 1961-2011

Deviation (°C/century):
- < -0.5
- -0.5 - -0.1
- -0.1 - 0.1
- 0.1 - 0.5
- 0.5 - 1
- > 1

Map showing the difference in trend after homogenization.
Map of trend in **maximum air temperature**, 1961-2011, original, experts A-C

For Kredarica mountain station lacks suitable reference stations → hard to decide if the series is homogenous or not → different results
Is there an important spatial gradient in trend of mean temperature across Slovenia?

95% confidence interval for a single station trend IS LARGE compared to the spatial variability

Positive trend statistically significant only for a period ~25 years or more (on a state level)
Conclusions

• Some significant differences in derived climate features between different experts and datasets
• A need for high-quality and continuous climate measurements
• Dense network grid necessary (e.g. mountain area for maximum temperature!)
• Temperature trend for the period of 51 years positive, however quite uncertain in magnitude due to interannual variability (2-5 °C/100 yr at 95 % confidence level)
• Warming signal in Slovenia stronger than on global scale
Thank you very much for your attention!
References


- [http://www.homogenisation.org/v_02_15/](http://www.homogenisation.org/v_02_15/)