Current Monthly Homogenization Approaches – Benchmarking their Strengths and Weaknesses

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Content

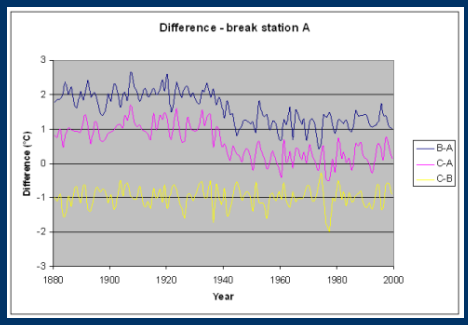
- Global Historical Climate Network (NOAA-GHCNv3)
  - Trend: 0.8°C per century since 1880
  - Raw data: 0.6°C
- Need independent lines of research
  1. Statistical homogenization
  2. Physical understanding (parallel measurements)
  3. Modelling (UHI, radiation screens)

Homogenisation: WHY? Example of PAU-UZEIN temperature

- 1912 PAU-LESCAR (EN)
- 2005 PAU-UZEIN (AERO)

Slide: Olivier Mestre

Pairwise homogenization

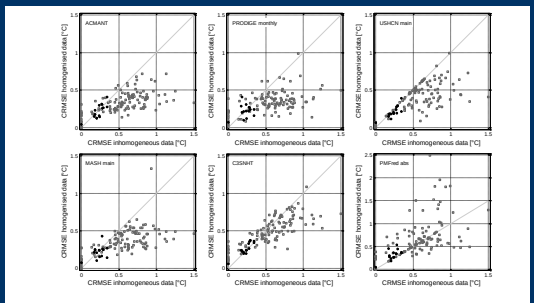


http://variable-variability.blogspot.de/2012/08/statistical-homogenisation-for-dummies.html

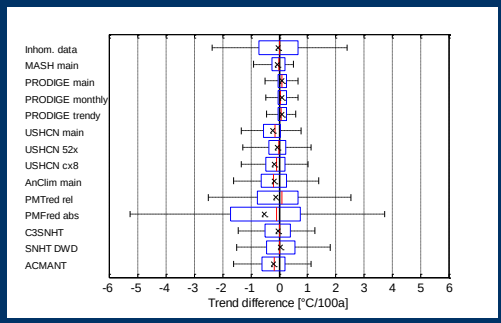
HOME validation study

- Compare full homogenisation algorithms
- Benchmark dataset
  - Monthly temperature and precipitation networks
  - Most realistic to date
- Configuration
  - Typical for Europe
  - Number of stations: 5, 9, 15

Scatterplots monthly CRMSE



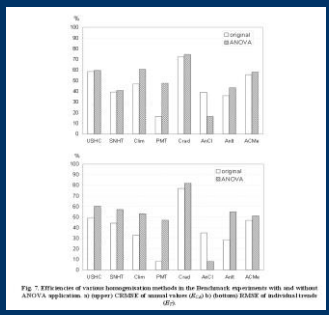
Errors in trends



Lessons

- Modern methods a factor 2 more accurate
  - Multiple breakpoint methods
  - Methods that are designed to work with inhomogeneous reference series
- Training is important
- Automatic methods as good as manual methods
  - No metadata in validation dataset
- SNHT is not recommended
- Absolute homogenization is method of last resort

Decomposition method on Benchmark



CRMSE Annual data

RMSE station trends

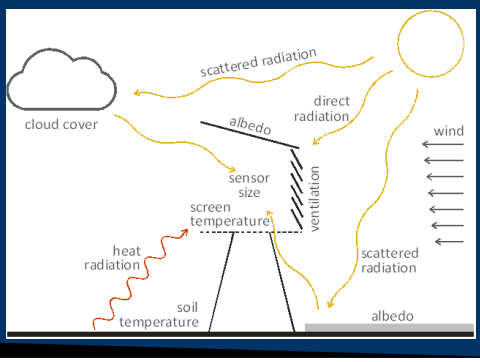
Domonkos, P., V. Venema, O. Mestre. Efficiencies of homogenisation methods: our present knowledge and its limitation. Proceedings of the Seventh seminar for homogenization and quality control in climatological databases, Budapest, Hungary, 24 – 28 October 2011, WMO report, Climate data and monitoring, WCDMP-No. 78, pp. 11-24, 2013.

Caveats HOME: ISTI

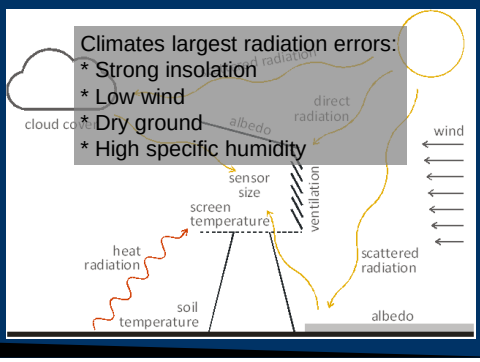
1. Missing homogenization methods
   - Two- or multi-phase regression method
2. Size breaks (random walk or noise)
   - Ralf Lindau and Victor Venema. The joint influence of break and noise variance on the break detection capability in time series homogenization.
3. Signal to noise ratio varies regionally
4. Regional trends (absolute homogenization)
5. Length of the series
   - Ralf Lindau and Victor Venema. On the multiple breakpoint problem and the number of significant breaks in homogenisation of climate records. Idojaras, 117, no. 1, pp. 1-34, 2013.
6. Non-climatic trend bias

- International Surface Temperature Initiative
  - Kate Willett et al. A framework for benchmarking of homogenisation algorithm performance on the global scale. Geosci. Instrum. Method. Data Syst., 3, pp. 187-200, 2014.

Radiation error



Radiation error



Parallel measurements Transition to Stevenson screens

- North-West Europe: < 0.2°C (Various, Parker)
- Basel, Switzerland: 0°C (Wild screen)

- Kremsmünster, Austria: 0.2°C (North-wall)
- Adelaide, South Australia: 0.2°C (Glaisher stand)

- Spain: 0.35°C (French screen)
- Sri Lanka: 0.37°C (Tropical screen)
- India: 0.42° (Tropical screen)

Sources of global temperature trend bias

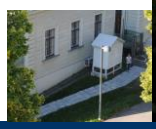
- Transition to Stevenson screens
- Transition to Automatic Weather Stations

- Urbanization
- Siting

- Irrigation
- Relocations to airports

Research on parallel data

- Large database with parallel measurements needed to study daily inhomogeneities
  - Study statistical and physical properties of (daily) inhomogeneities
    - Dependence on local weather and regional climate
    - Most studies are currently about mid-latitudes
  - Validate detected inhomogeneities
    - Independent evidence for trend bias



Parallel Data Initiative

- Produce an open database
- Initially data is restricted to contributors
  - Incentive to contribute
  - Until first joint paper(s) by contributors are written
- First action: Inventory of parallel datasets
  - https://ourproject.org/moin/projects/parallel
  - Dozens of datasets available
- More information
  - http://tinyurl.com/paralleldata
  - Victor.Venema@uni-bonn.de

Conclusions & outlook

- Statistical homogenization improves temperature trend estimates
  - Only best method improve precipitation trends
- Modern homogenization methods more accurate

1. Statistical homogenization
   - Global validation study missing
   - Better mathematical understanding methods
2. Better physical understanding of causes
   - http://tinyurl.com/paralleldata
3. More modelling to improve understanding