**Parallel measurements to study inhomogeneities in daily data**

http://tinyurl.com/dailyIMSC2013

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**Motivation: daily data**

- Currents research needs daily data
- Trends and climate variability therein
- Attribution study on extremes
- Trenberth et al. (2007):
  "This [inhomogeneous data] affects, in particular, the understanding of extremes, because changes in extremes are often more sensitive to inhomogeneous climate monitoring practices than changes in the mean."


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**Physical causes of inhomogeneities**

- Instrument
  - Zero drift, shrinking glass initial years
  - Calibration errors
  - Response, integration time
  - Temperature out of range
  - Quicksilver thermometers: $T < -39^\circ$C
- Relocation of station
  - City, airport, suburbs, lower heights
  - Deurbanisation of network
- Change surrounding
  - Urbanization, growing vegetation, irrigation
- Shelter type, exposure
  - Radiation & wetting protection
  - Natural or forced ventilation
  - Snow cover
- Plastic screen: insulation on hot days

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**Parallel measurements**

- WMO recommendation: several years of parallel measurements in case of change in observation
- Experiments with parallel measurements
  - WMO studies for operational instruments
  - Climatological studies with historical instruments
  - Typically analysed for change in mean only
- Two studies on temperature distribution
  - Australia, relocation
  - Austria, north wall and Stevenson screen:
**Australia: Albany airport and town**

![Graph showing differences in temperature between Albany airport and town](image)

*Figure 1. Differences (°C) between percentile points of summer maximum temperature at Albany airport (99731) and Albany town (000500) during the overlap period (2002–2009). The 0th and 100th percentiles indicate the lowest and highest values recorded during the overlap period.*

**Parallel measurements – Kremsmünster**

![Image of Kremsmünster measurements](image)

*Böhm et al. (2010)*

**Kremsmünster – percentiles difference**

![Graph showing percentile differences](image)

*Böhm et al. (2010)*

**Spain: Montsouri screen, Stevenson observations, Stevenson automatic**

![Image of Montsouri screen and Stevenson automatic station](image)

**Montsouri vs. Stevenson: difference as function of Diurnal Temperature Range and Tmax**

*Murcia: South East Spain, Mediterranean, La Corunia, Corunna: North West Spain, Atlantic.*

**Daily correction methods**

- No correction
  - Determine trends on homogeneous subperiods
- Correct the mean
  - Monthly adjustments smoothed to daily, Vincent (1998)
- Correct the distribution
  - HOM, SPUD/HOM, HOMAD, QM, PM, WHM (wavelet)
  - One break after another (error accumulation)
  - One station as reference (except PM, Trewin, 2012)
- Weather-dependent correction
  - Using co-variates
  - Wild → Stevenson screen: Auchmann & Brönnimann (2012)


Quality of correction

- Percentile Matching (PM; Trewin, 2012)
  - Improvements if cross correlations ($\rho$) > 0.6
- Higher order moments method (HOM; Della-Marta and Wanner, 2006), rule of the thumb:
  - $\rho$ > 0.9: Mean, standard deviation, skewness useful
  - $\rho$ < 0.9: Better use adjustment of means
- Mainly depends on amount of data, likely similar for other methods
- No information: other moments & indices

Not homogenized datasets

- European Climate Assessment & Dataset
  - Homogenized assessed (useful, doubtful, suspect)
- Global Historical Climatology Network – Daily

Northeastern Spain – mean temperature homogenised

- Detection
  - SNHT, TPR, Vincent (1998)
- Correction
  - Monthly mean corrections are smoothed to daily corrections
    - Vincent (1998)
    - Much applied method

Austria – Distribution homogenised

- Austria: 1948-2009, 57 Tmin & 54 Tmax stations
- Detection: PRODIGE, metadata
  - Annual, winter and summer means
- Correction: SPLIDHOM (trust the skewness)
  - Significance testing by bootstrapping

Conclusion

- Inhomogeneities change the distribution
  - Physical reasoning and parallel measurements
    - Strong inhomogeneities in tail
  - Biases in the trends of extremes/variability are expected
- First correction methods for distribution
  - Need dense network
  - Are labour intensive
- Many widely-used dataset are not homogenised
Outlook

- Urgently need to study non-climatic changes in distribution for severe weather studies
- Lack in understanding
  - Physical and statistical properties of daily breaks
- Correction
  - Multiple breakpoint methods missing
  - Weather dependent corrections
  - Stochastic corrections
  - Analysis on HSP requires new statistical tools
- Close collaboration between climatologists and homogenization specialists

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
  - Develop daily correction methods
    - Weather dependent (Auchmann & Brönnimann, 2012)
    - Stochastic
  - Generate benchmark data with realistic inhomogeneities
    - For example, second cycle of ISTI
  - Validate detected inhomogeneities

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

E-mail list on homogenisation of climate data

- Goal
  - Strengthen communication and co-operation
- Suggested uses of the list are
  - Conferences, workshops, etc.
  - Important papers
  - Discussions
  - Job opportunities
  - New projects started
  - Requests for data, information, and cooperation partners
- Subscribing
  - You can join the mailing list by sending an e-mail to Victor.Venema@uni-bonn.de
  - For more information: http://tinyurl.com/HomList

Questions?

These slides can be found under http://tinyurl.com/dailyIMSC2013
Parallel data initiative http://tinyurl.com/paralleldata
Homogenization distribution list http://tinyurl.com/HomList