

**CAPACITY OF ACMANTv4 FOR
HOMOGENIZING CLIMATIC
DATASETS OF NATIONAL
METEOROLOGICAL
SERVICES**

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- Note: This file includes a written response (at the end of the slides) on the comment of Tamás Szentimrey about the credibility of the MULTITEST benchmarking experiment results. ---- I could not provide my response online for the insufficient quality of informatical connections.

ACMANT: General properties

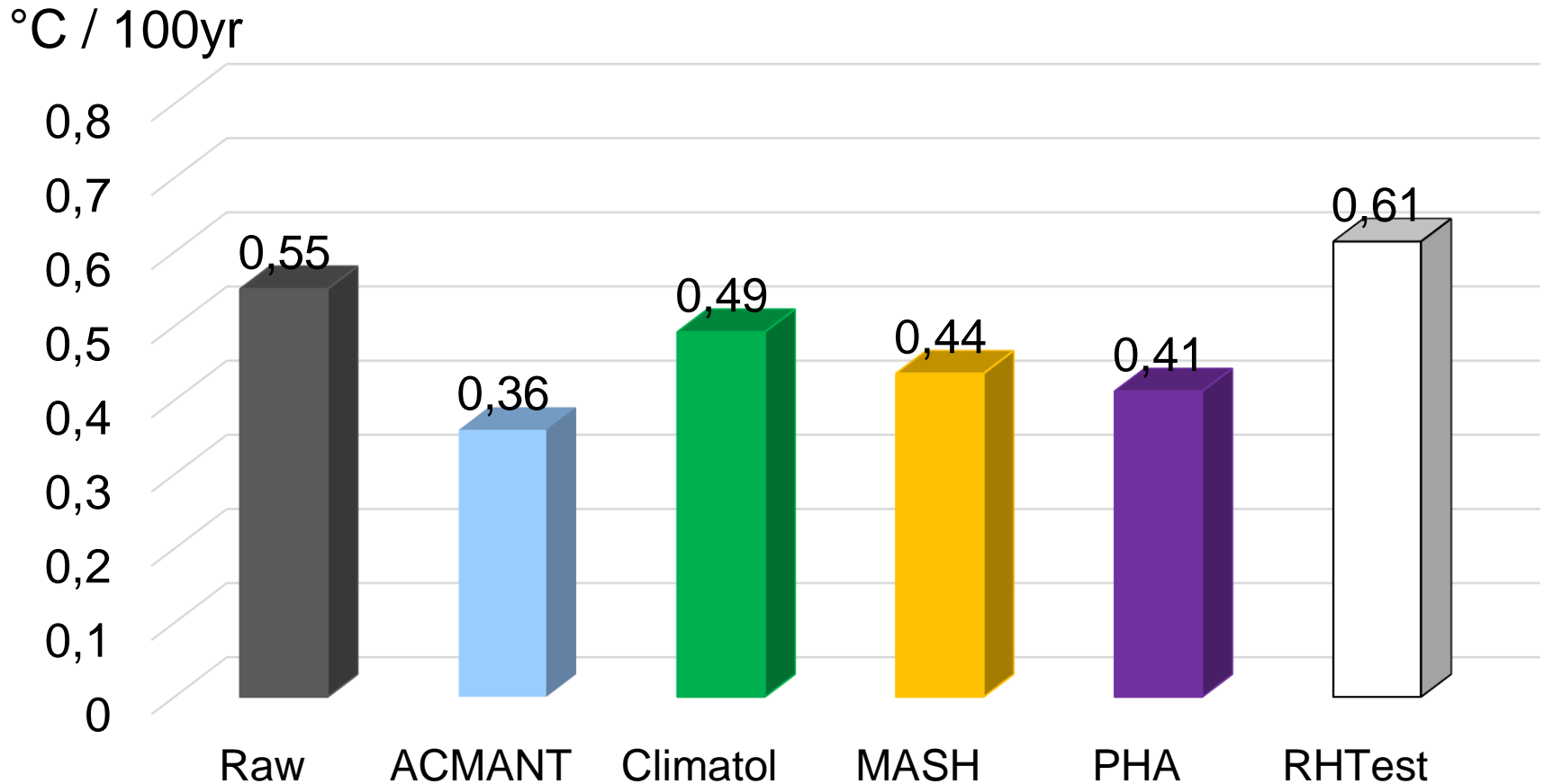
- Automatic method for the homogenization of climatic datasets in daily or monthly resolution
- Developed in the last 10 years. Sources: earlier knowledge (PRODIGE); own ideas; tests with benchmark datasets
- Input time series may cover varied periods
- Tolerance of high missing data ratio
- Several output options (e.g. completion of time series with spatial interpolation for data gaps)
- Excluded: metadata use and subjective interventions
- Free: <https://github.com/dpeterfree/ACMANT>

ACMANTv4: Novelties

- For more climatic variables: **temperature, precipitation, air humidity, wind speed, sunshine duration, radiation, atmospheric pressure**
- Fully automatic treatment for datasets of **up to 5000 time series**
- Elimination of physical outliers
- **Improved accuracy**
- Easier input data preparation
- Software, its Manual and Scientific description are available: **<https://github.com/dpeterfree/ACMANT>**

Mean results for 1900 networks (MULTITEST project)

Network mean temperature trend bias

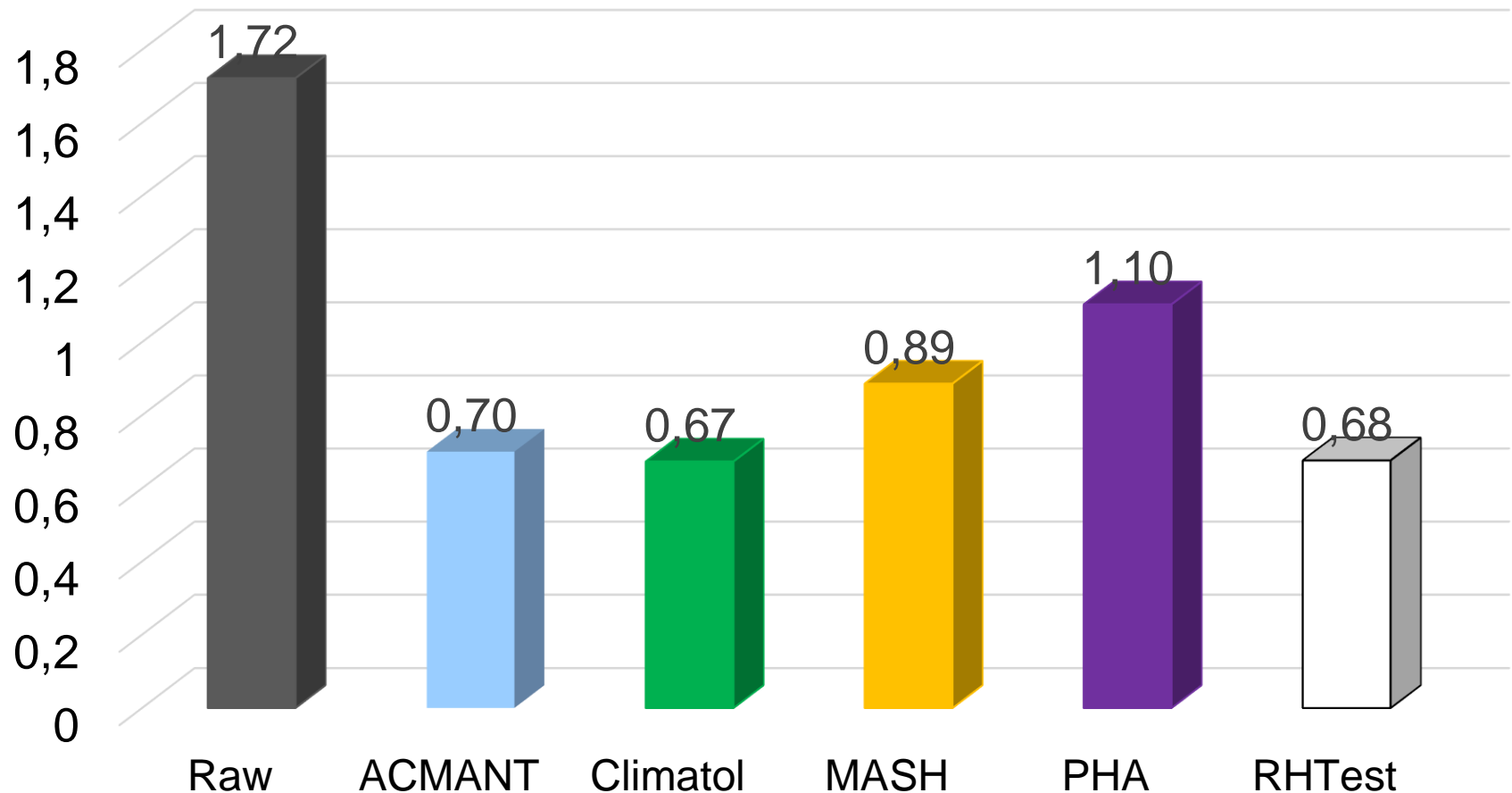


<https://github.com/dpeterfree/ACMANT>

Residual errors for low SNR data

Mean temperature trend bias for individual time series

°C / 100yr



<https://github.com/dpeterfree/ACMANT>

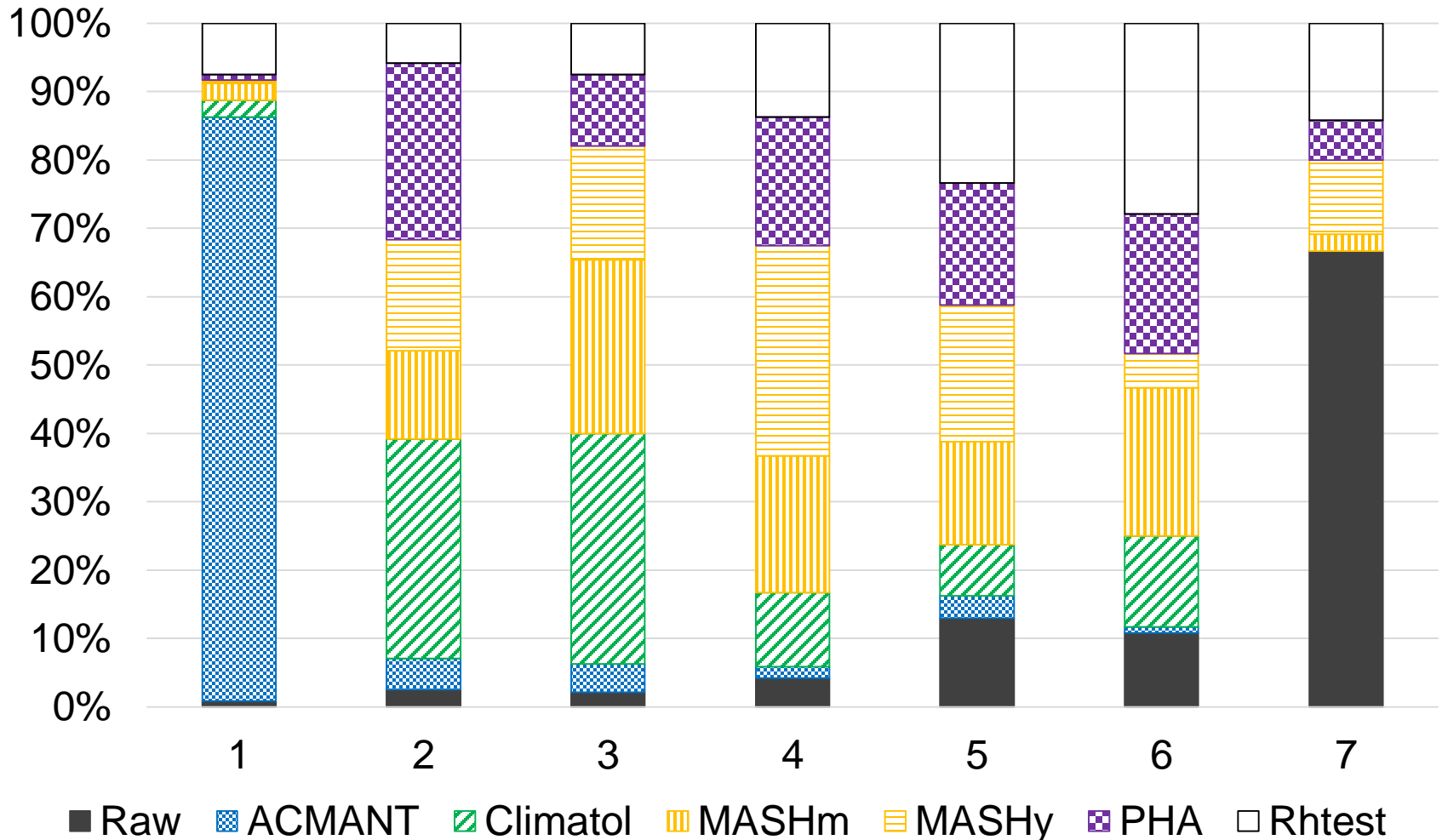
Purpose of ACMANT development

- Creating an automatic method which gives good results for any kind of time series (considering the frequency, magnitude and shape of inhomogeneities, as well as the other properties datasets (number and lengths of time series, spatial correlations, etc.))
- “Good” for any efficiency measure characterises directly the accuracy of climate variability estimated from the homogenized time series (RMSE, trend bias, for individual time series and for network means)

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Rank order frequencies

120 characteristics (12 test datasets and 10 efficiency measures, MULTITEST project)

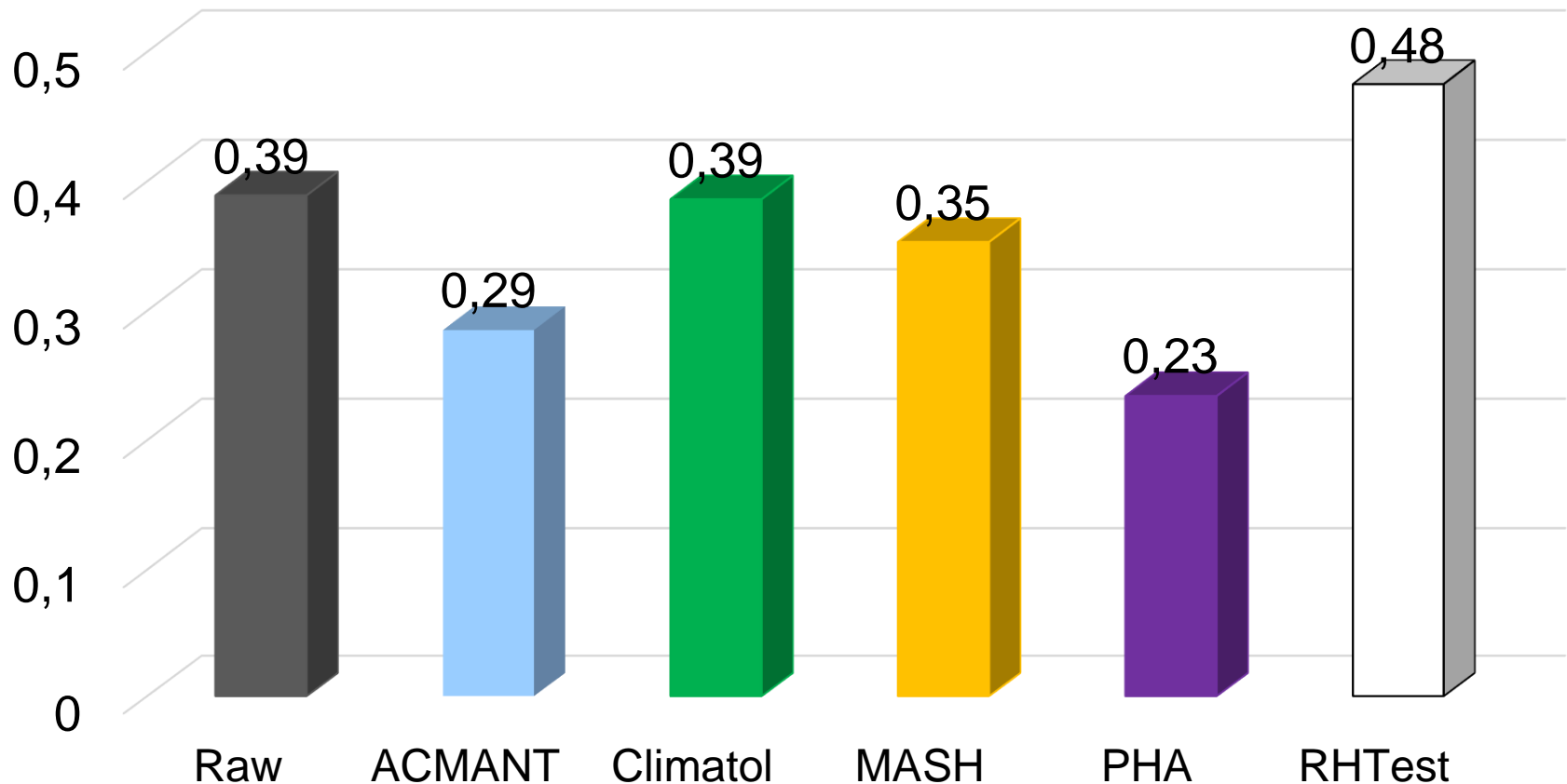


Important exception

Concerted breaks within a short period

Mean network mean trend bias

°C / 100yr



<https://github.com/dpeterfree/ACMANT>

Knowledge of method efficiencies

Project name	Project type	Period	Variables	Thompson-R Publications (2011-2020)
HOME	EU	2007-2011	monthly TT, RR	1
Killick, R.	PhD program	2014-2016	daily TT	0
MULTITEST	Spanish	2015-2017	monthly TT, RR	0
ACRP	Austrian	?	daily RH	1
INDECIS	EU	2017-2020	daily, 8 variables	0

- Network mean trends are evaluated only in MULTITEST
- More benchmark datasets and more tests are needed
- **More peer reviewed publications are needed**

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Factors affecting the spread of using ACMANT

Objective	Semi-objective	Subjective
New method	exclusion of meta-data use exclusion of human intervention lack of graphical output suboptimal for concerted breaks

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ACMANT and the new WMO Homogenization Guidance

- The newly published WMO guidance does not contain efficiency test results
- In the guidance ACMANT appears as one good homogenization method among a selection of 7-8 good methods

Development of ACMANT: Tasks for the future

- Improving the treatment of concerted breaks
- Including the option of metadata use
- Improving the treatment of inhomogeneities with irregular annual cycle
- Improving the treatment of non-linear inhomogeneities
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- **ACMANTv5 (?)**

ACMANTv4: <https://github.com/dpeterfree/ACMANT>

Conclusions

- ACMANT is one of the most accurate and most user friendly homogenization method available for climatologists. The method is still rarely used in practice.
- According to present knowledge, ACMANT is the best method for the homogenization of large datasets of national meteorological services
- The dissemination of the related knowledge needs further effort.

<https://github.com/dpeterfree/ACMANT>

Response on Szentimrey's comments on the credibility of MULTITEST benchmarking results

- Tamás Szentimrey claimed his scepticism about any validation by benchmarking experiments with the following arguments: The results depend on A) Homogenization methods, B) Benchmark dataset, C) efficiency measures involved, D) tester
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- Response:
- I start my response at the end, with issues C) and D)
- C-D) We applied efficiency measures which commonly characterise the usability of homogenized data to climate variability assessments: RMSE and trend bias for individual time series and for network means. The involved methods were fully automatic and the evaluation was with software without any subjective intervention. --- In case of any doubt concerning these aspects, one may consult with the clean and homogenized datasets, and perform additional calculations if he/she thinks them necessary:
- https://zenodo.org/record/3934835#.XwTjF-dS_IU
-
- A) (tested methods) Freely applicable automatic method were tested following the relevant method guides. We intended keeping in contact with method creators, which was solved for ACMANT, Climatol and also for MASH (although in the latter case perhaps it has not functioned optimally), while we could not achieve collaborating contact with Matthew Menne and Xiolan Wang. Generally we used the methods in the same way as any user downloading the methods from Internet would use. I do not believe that any important bias could have occurred for the way of running the methods.
- B) And finally, the most difficult point. We used very large test datasets, with diverse statistical properties (length of time series, spatial correlations, number of time series per network, ratio of data gaps, etc.), and also the frequency and magnitude of inhomogeneities are widely varied in these datasets. In some test datasets the set of inhomogeneities generated systematic trend bias. In any case, we examined problems