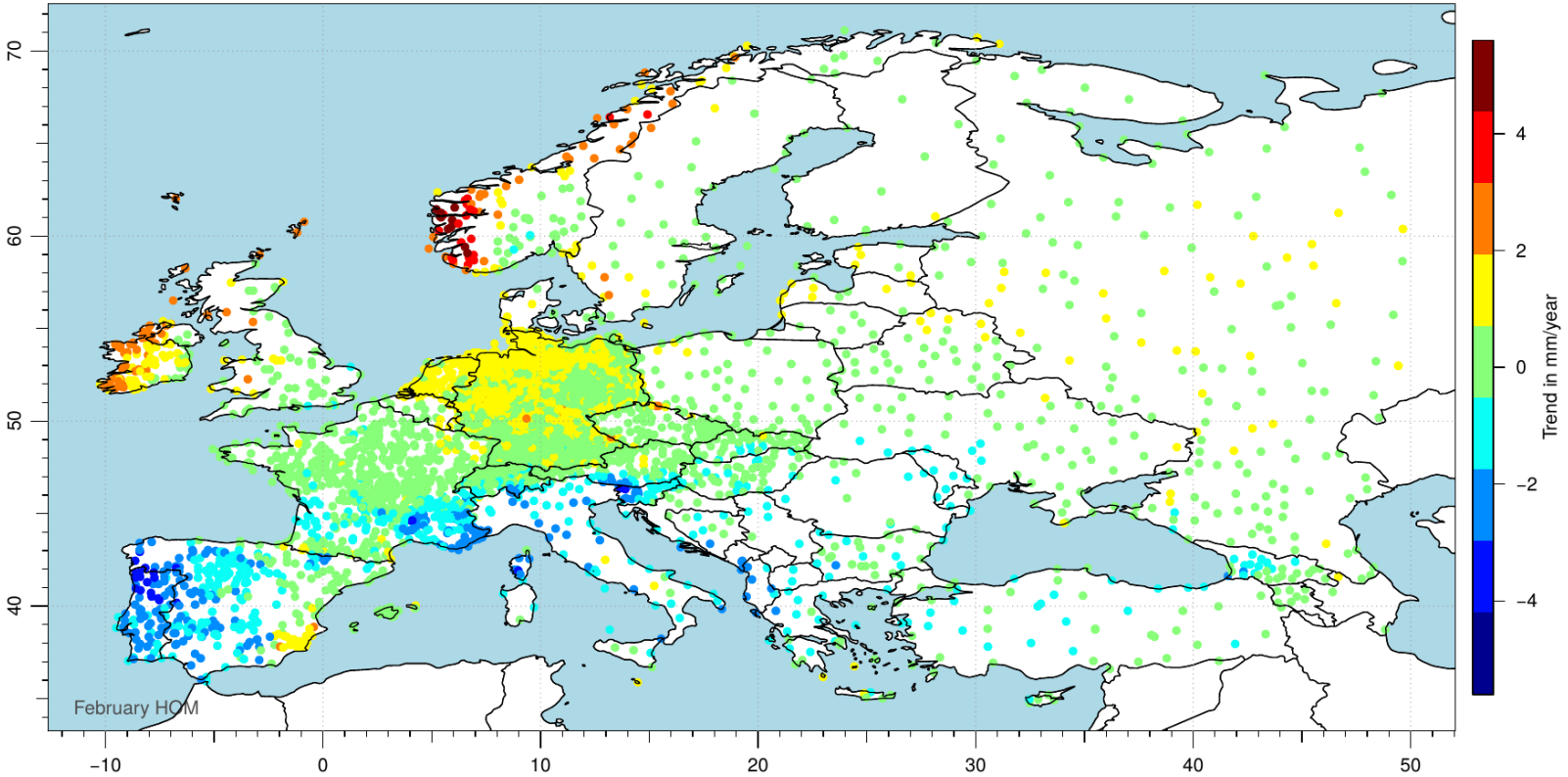
HOMPRA Europe – A gridded precipitation data set from European homogenized time series



Homogenized February trend [mm/yr]

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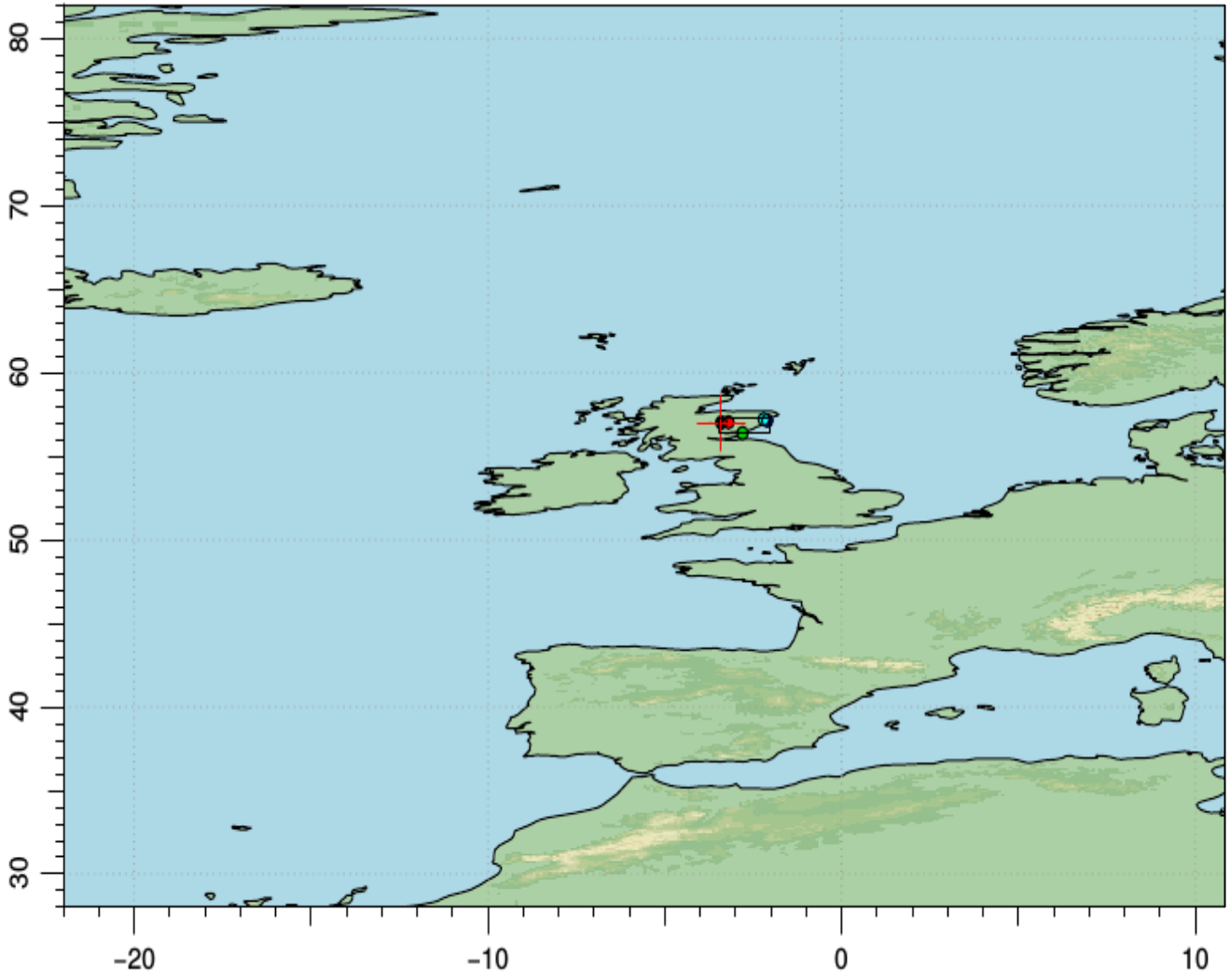
[2]Meteorological Institute, University of Bonn, Bonn, Germany

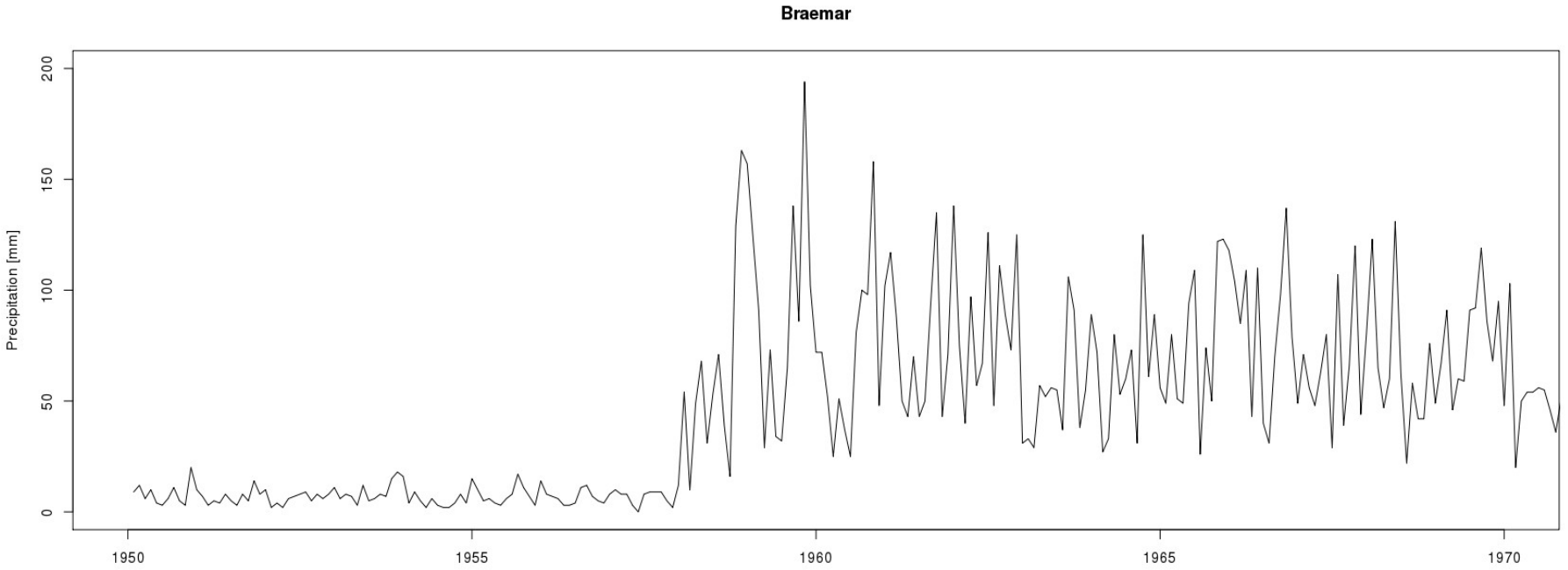
Braemar

Example:

Braemar in Scotland



Monthly homogenization aims for a correct trend



Example: Breamar in Scotland

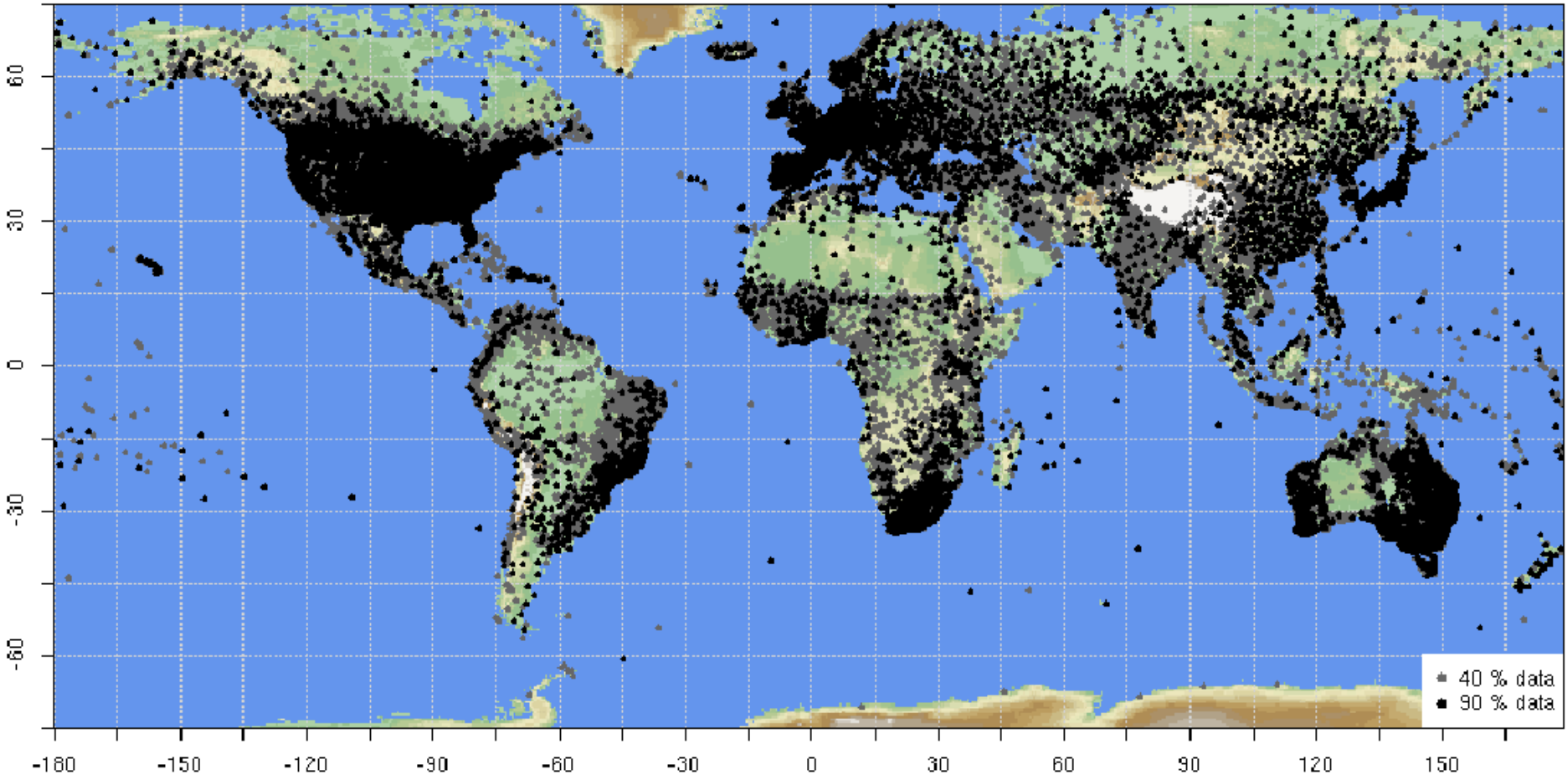
- A trend calculated from the raw data would obviously lead to wrong conclusions.

- Factor 10 error at the beginning of the time series
- Met Office and GPCC (DWD) corrected the data and hold raw and corrected data in their data bases

Overview

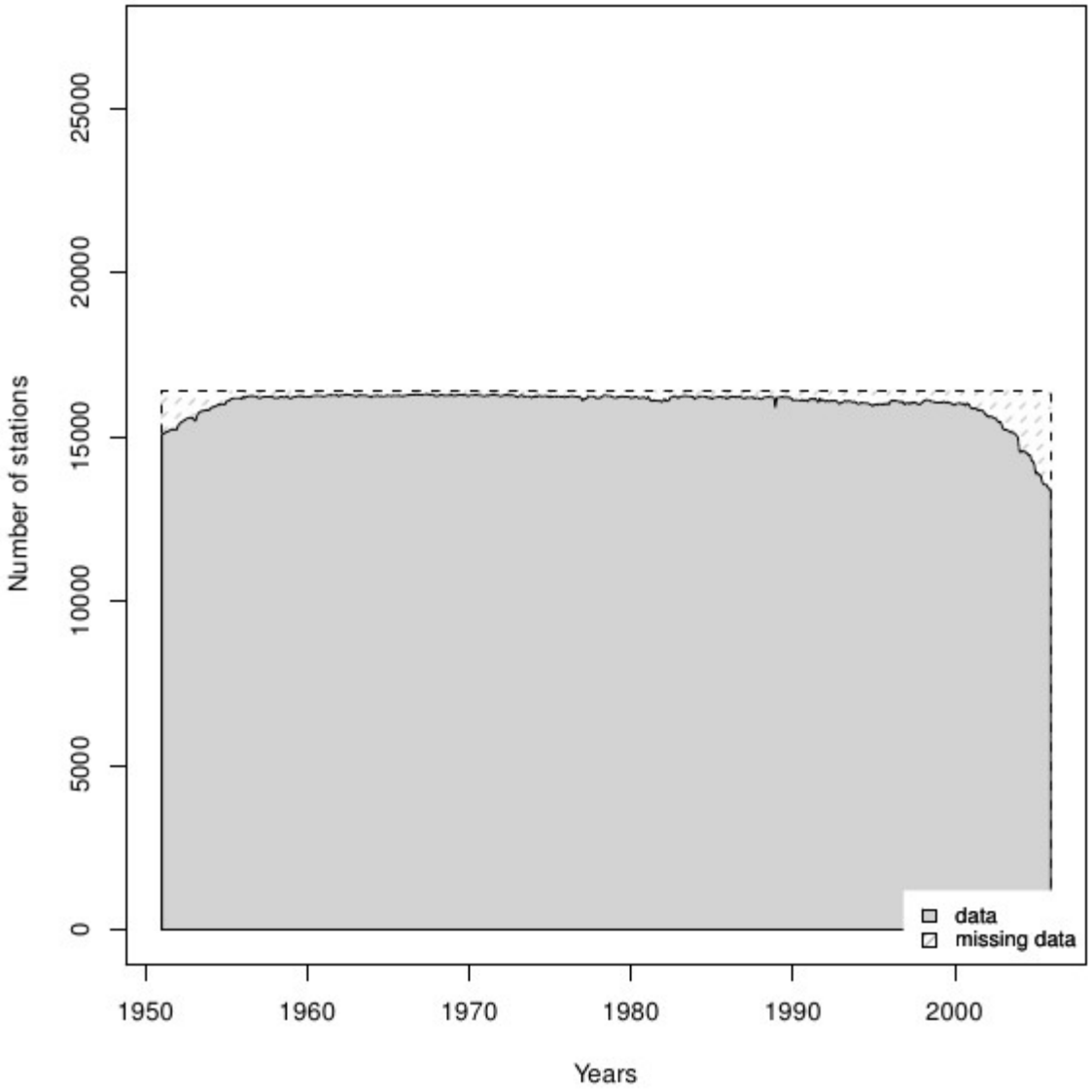
- Data base
- Actual homogenization
  - Networks of similar time series
  - Detection of break-points
  - Correction of breaks
- Interpolation

Data base



Data base

- **1951 – 2005**
- At most 10 % of missing values
- Quality controlled

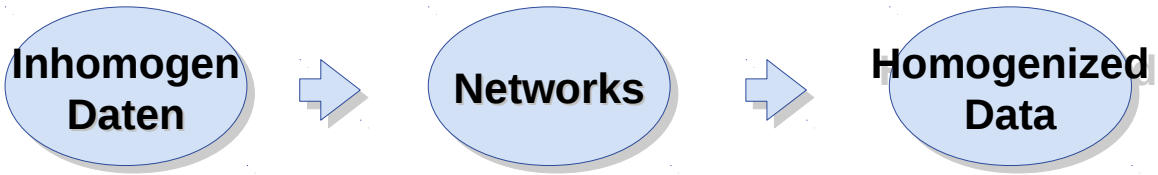


Homogenization of similar time series

- **Homogenization software can not handle more than 300 series at once (of more than 16000 series).**

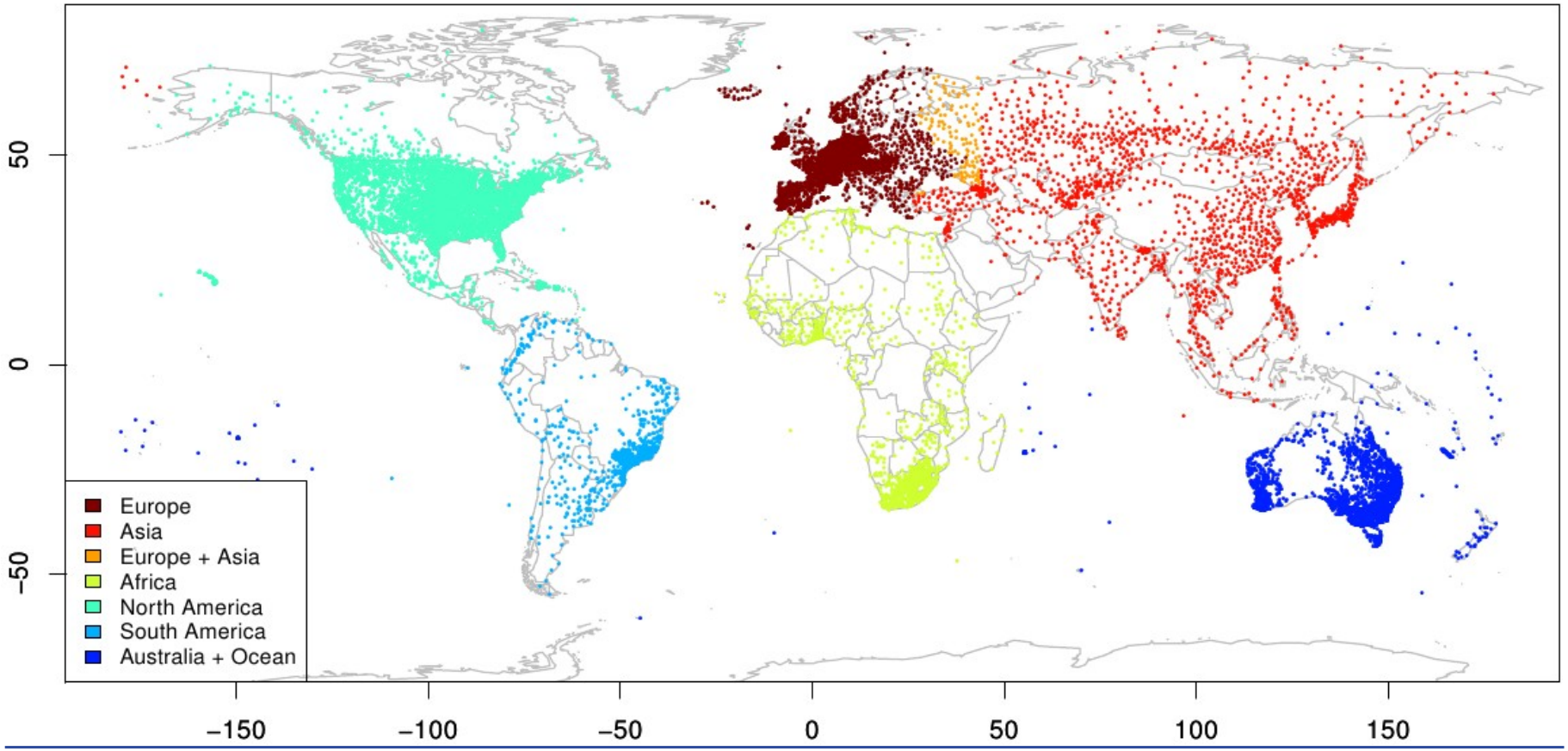
- Series have to be organized in networks of at most **300 series.**
- **Overlapping**

  since the homogenization algorithm depends on comparison with high correlated series.

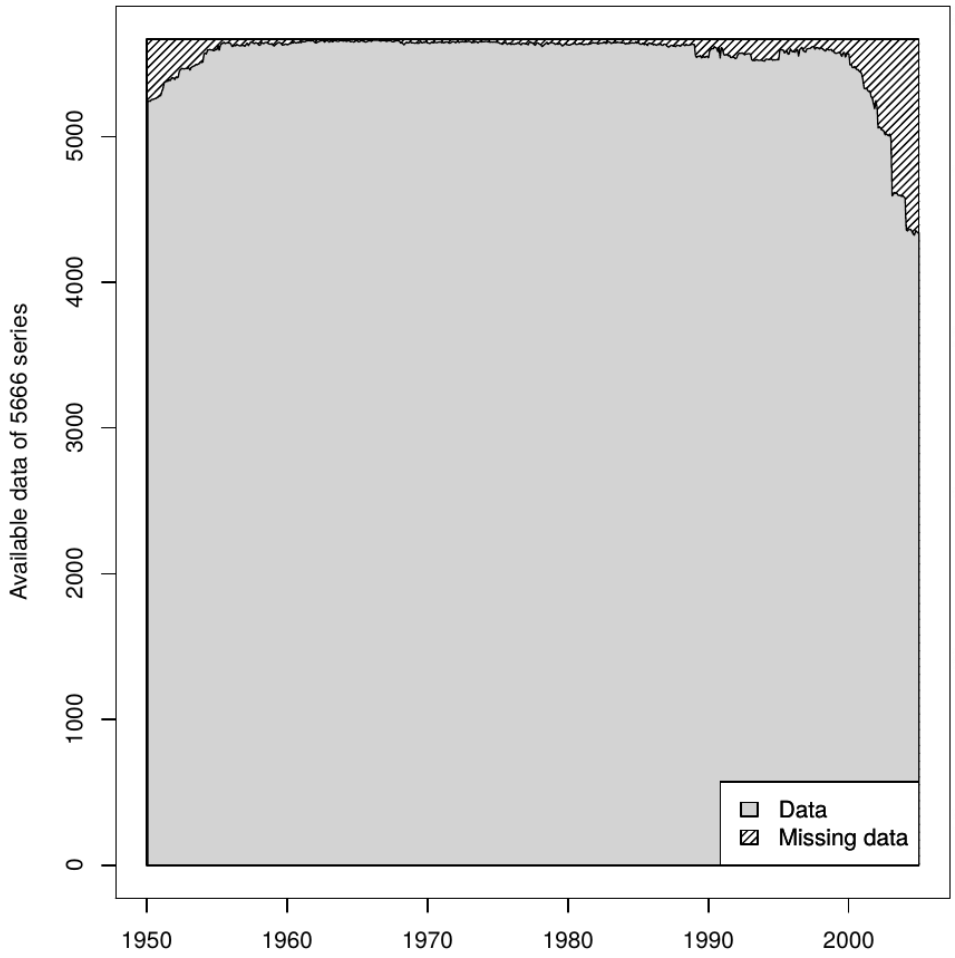


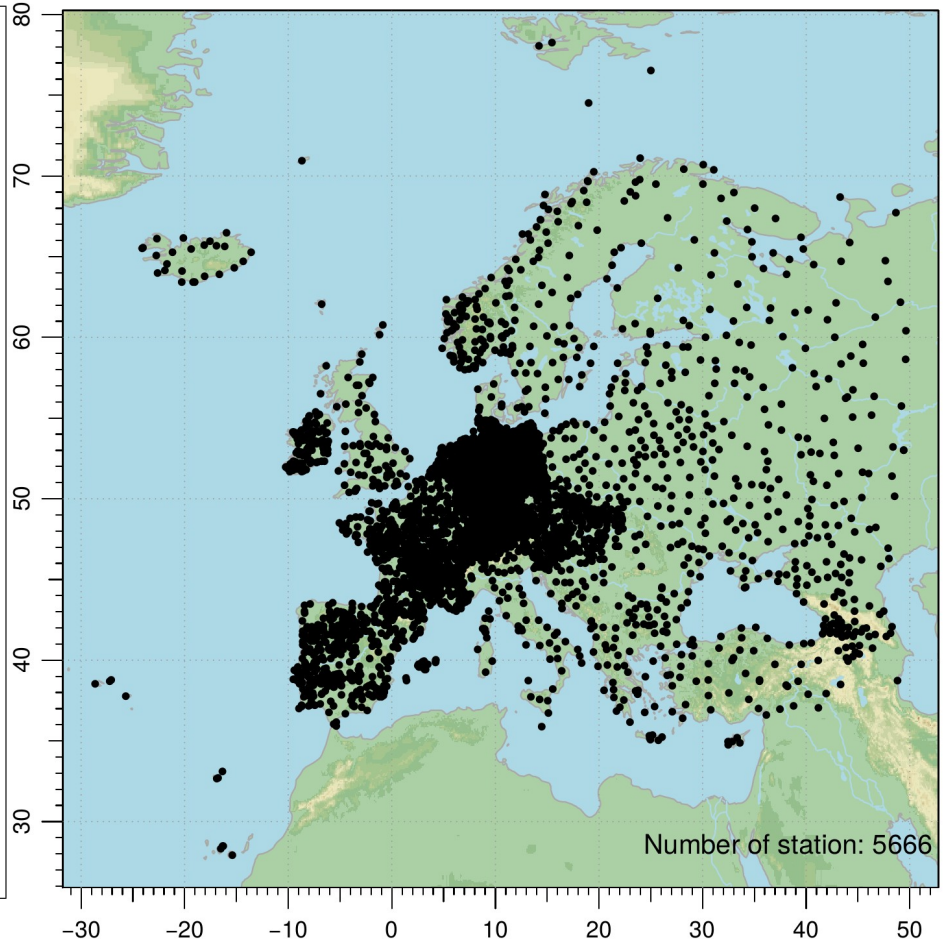
Networks of similar time series: Continents

- First subdevision: Continents
- Spatial distance to the closest continent



Networks of similar time series: Continents





Networks of similar time series

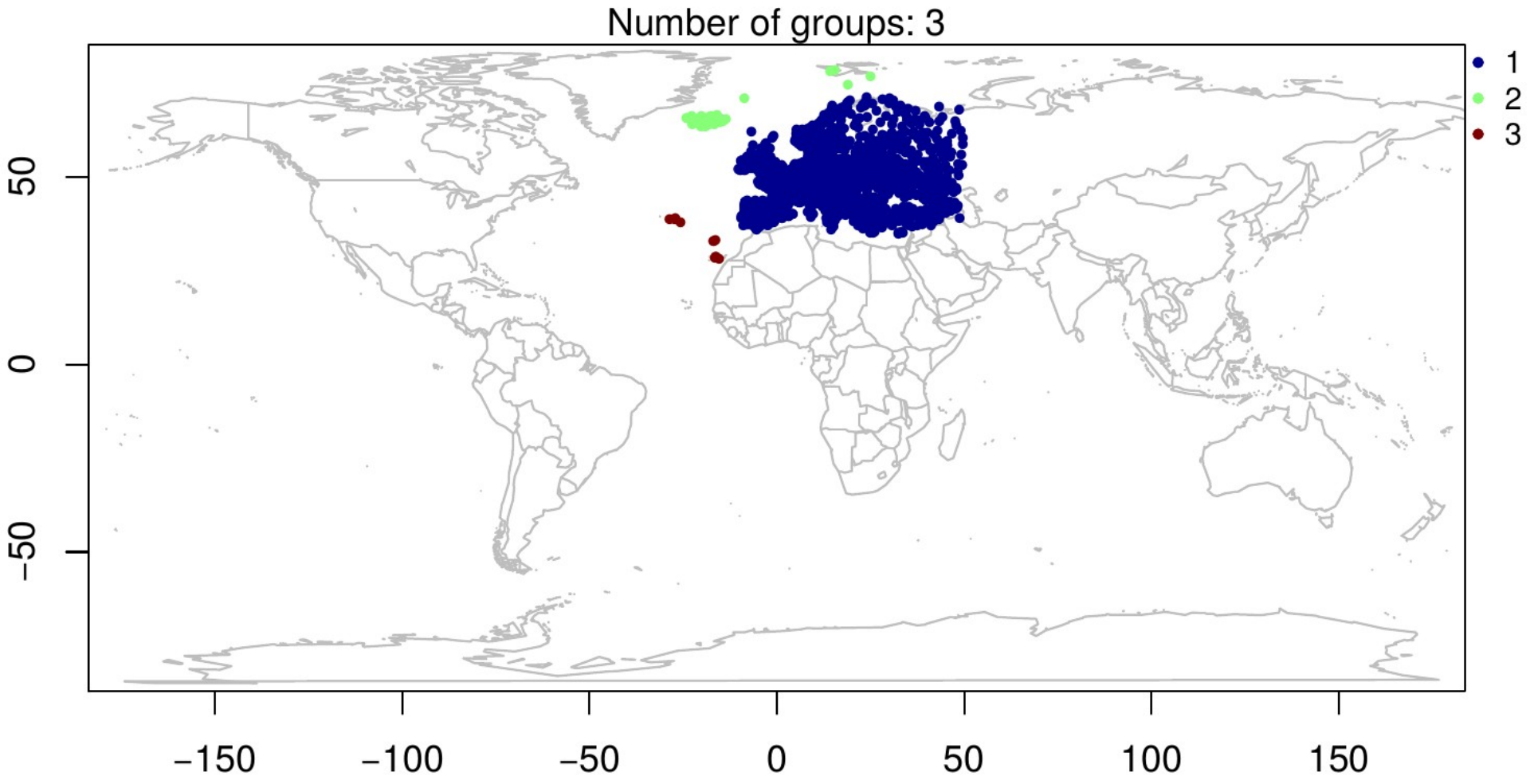
➔ **Second step within continents**

➔ Calculate **great circle distance** between the stations

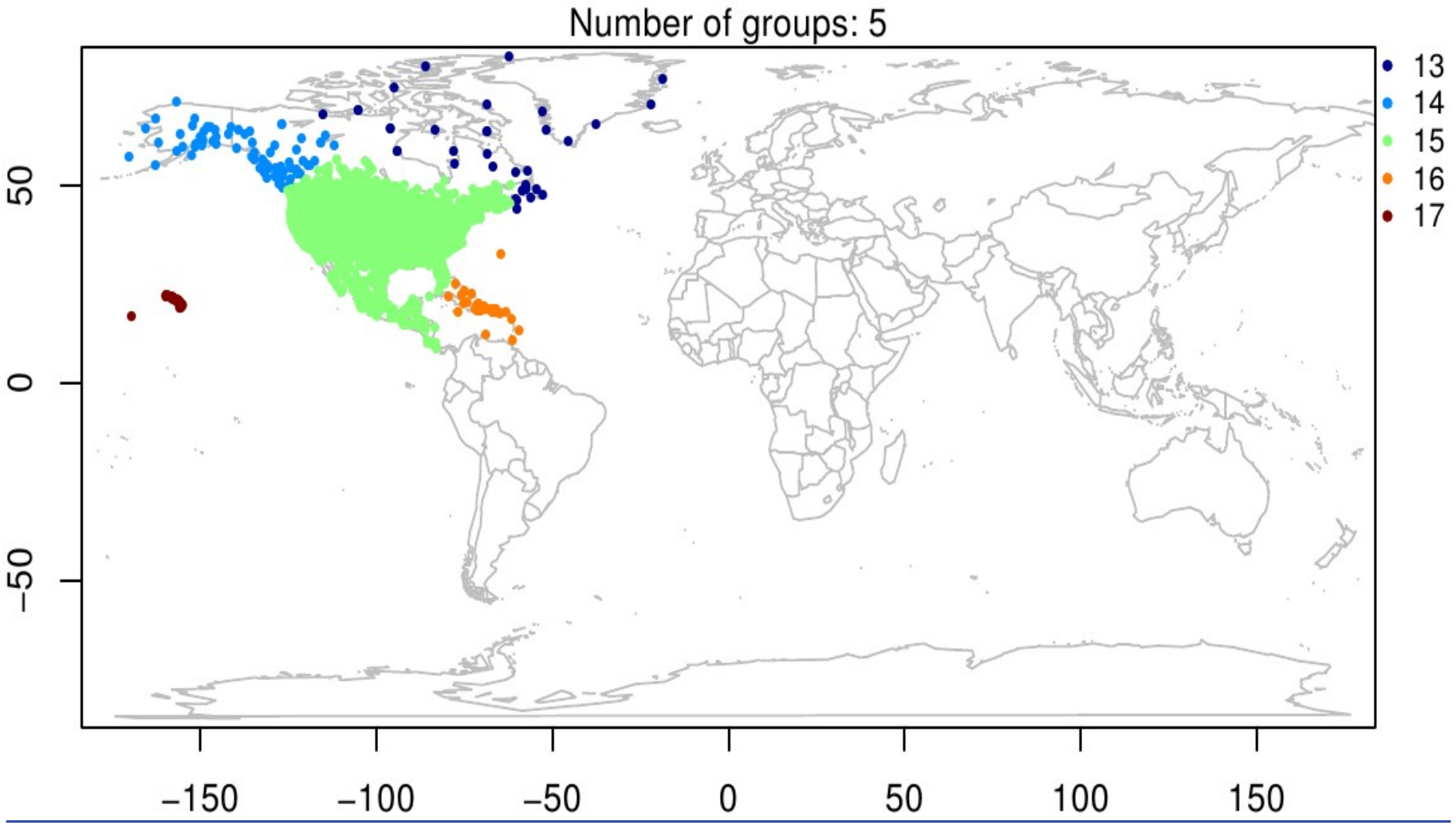
➔ **WARD CLUSTER**

- Hierarchial cluster analysis
- Minimum variance method
- Tends to produce clusters of equal size

Networks of similar time series



Networks of similar time series



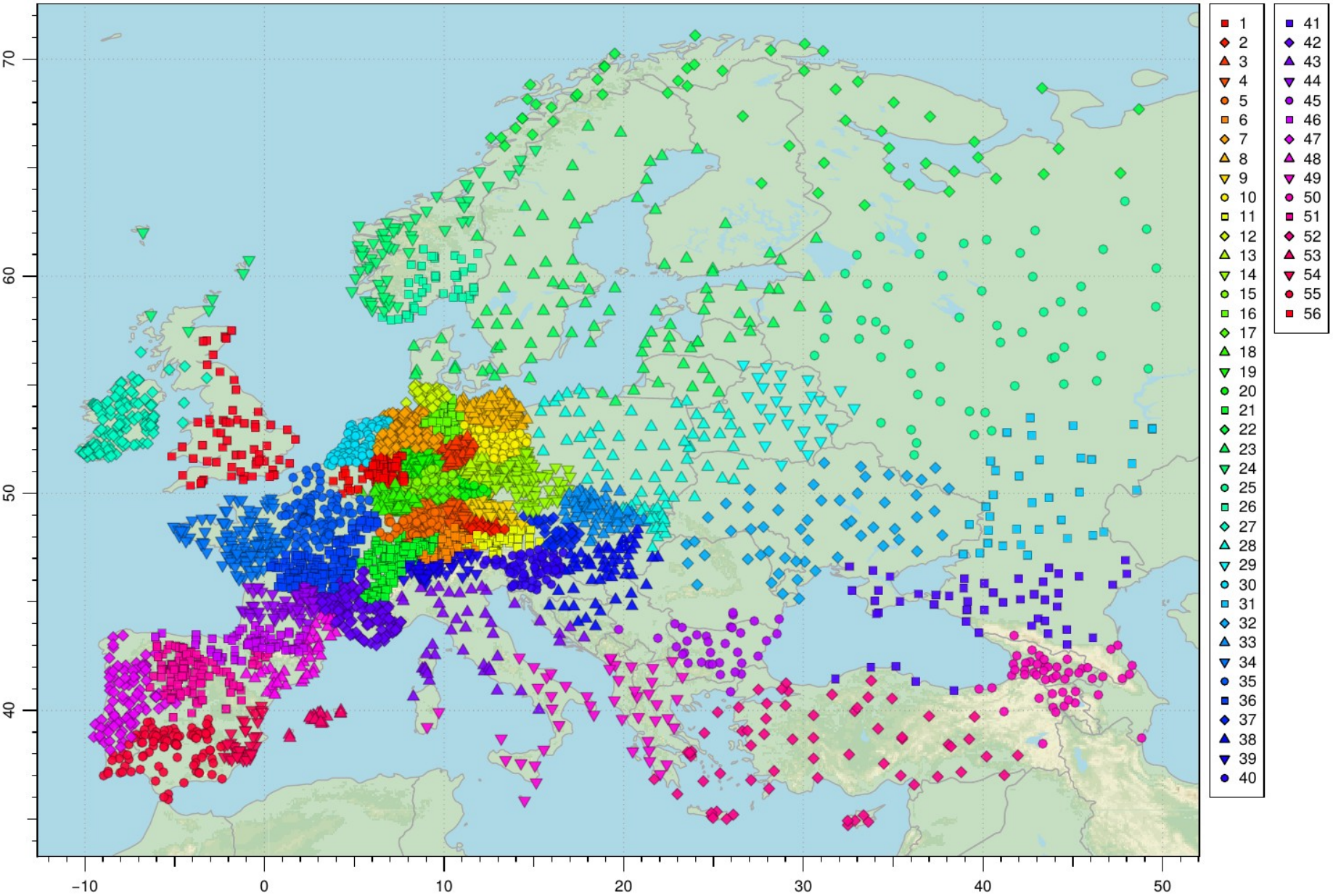
Networks of similar time series

➔ **Third step**

➔ Calculate **partial correlation** between the series

- Consecutive differences
- Removal of the annual cycle
- Calculation of the ranks

➔ **WARD CLUSTER**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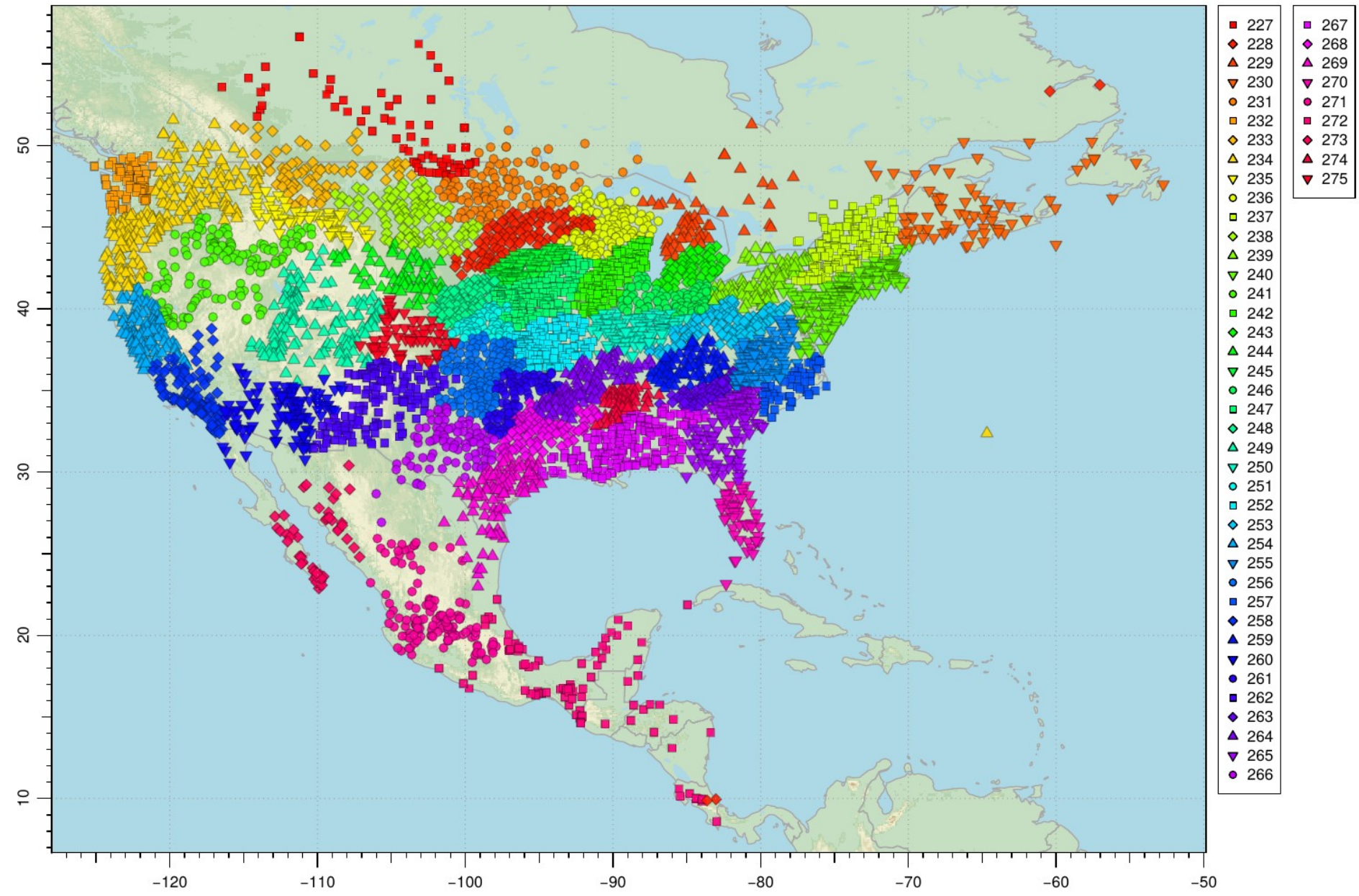
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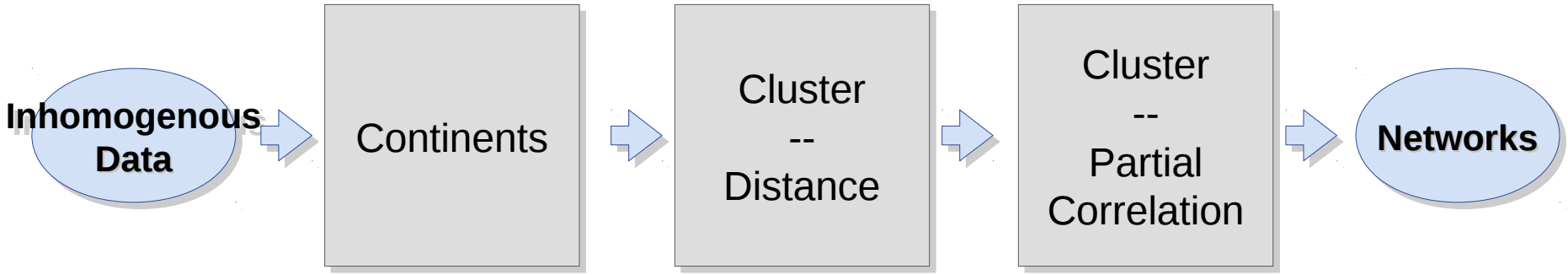
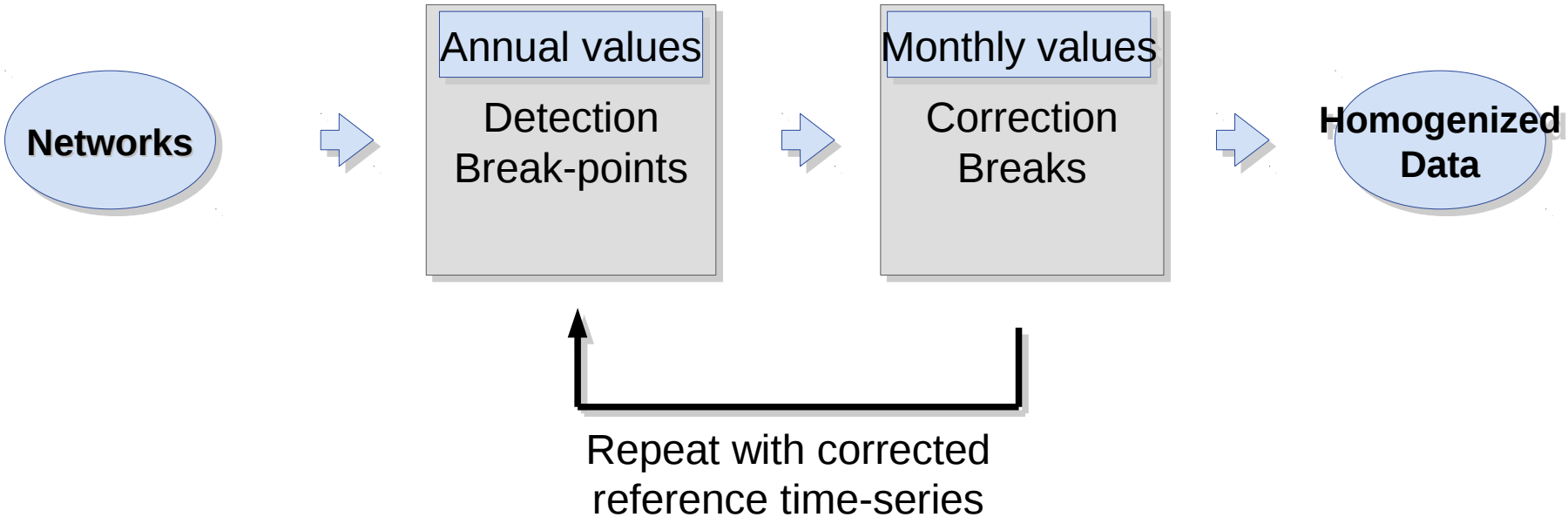
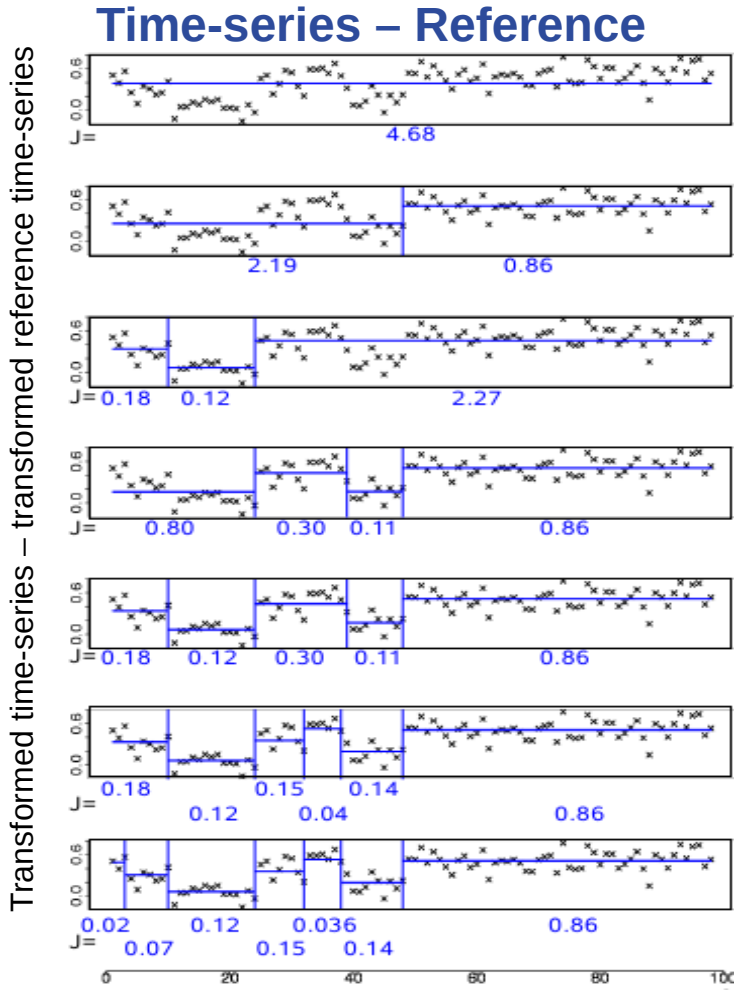
Networks of similar time series: Summary



Homogenization course



Homogenization course: Break-point detection



Difference time-series

➔ Transformed time series – transformed reference time-series

Log-likelihood

➔ Best break-point position for each number of breaks

Penalty term

➔ Number of breaks

CAUSINUS-MESTRE

Homogenization course: Correction

➔ Box-Cox Transformation

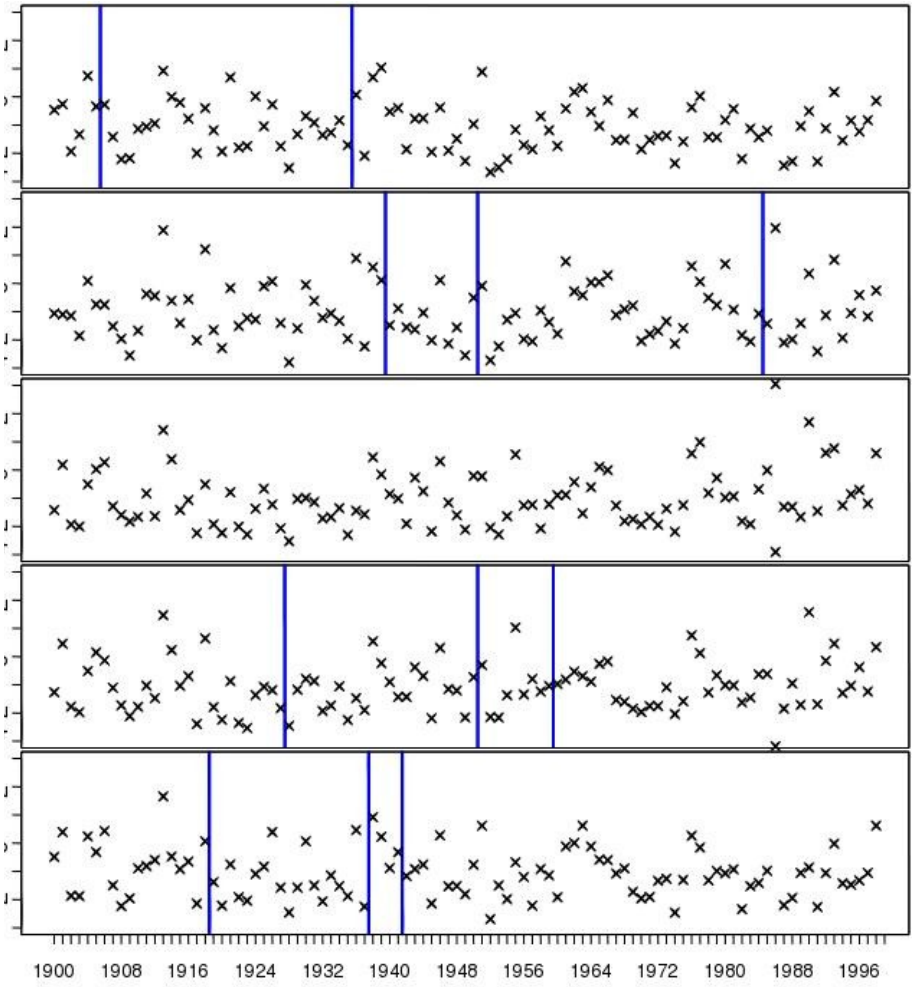
(Software requires normal distribution)

$$Y_{new} = \begin{cases} ((Y_t)^k - 1) / k & \text{for } k \neq 0.000 \\ \ln(Y_t) & \text{for } k = 0.000 \end{cases}$$

➔ Reference series

- High correlated time series

Homogenization course: Break correction



1) Binary coding of the series

2) **Multiple linear regression** over homogeneous segments

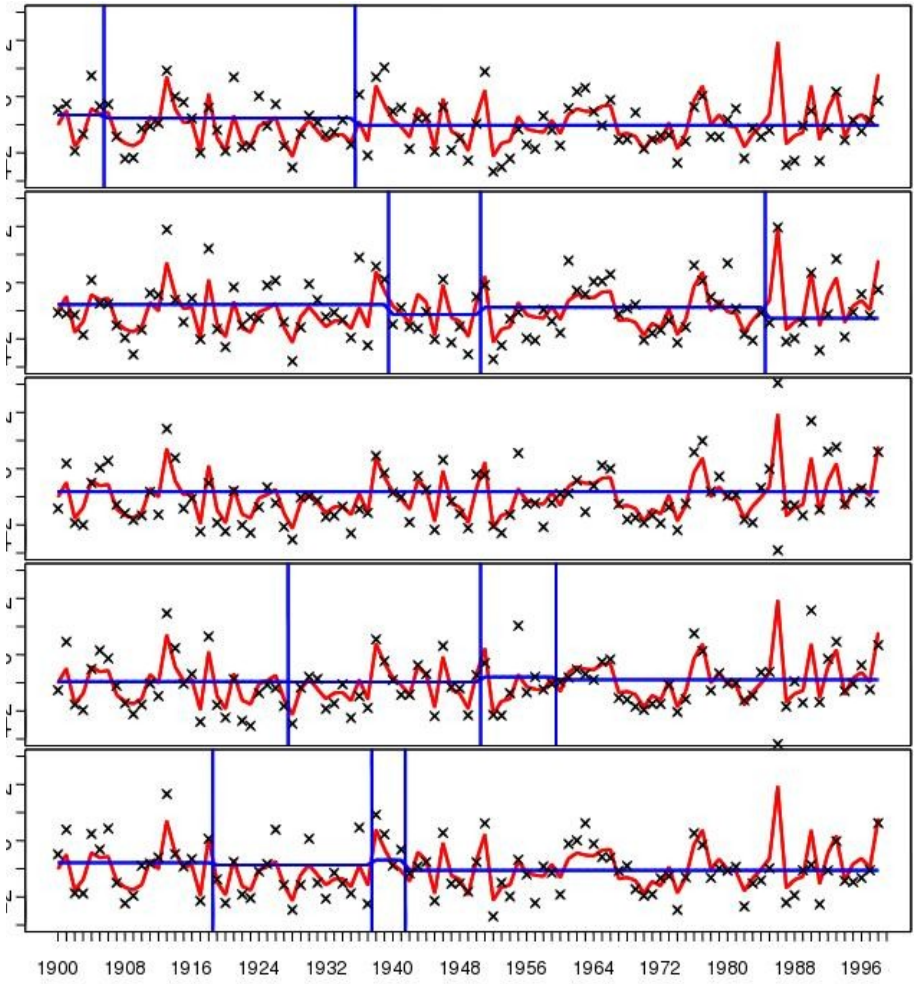
3) **Regression coefficients** indicate **break amplitude**

ANOVA

x Power transformed monthly time-series

| Detected breaks

Homogenization course: Break correction



1) Binary coding of the series

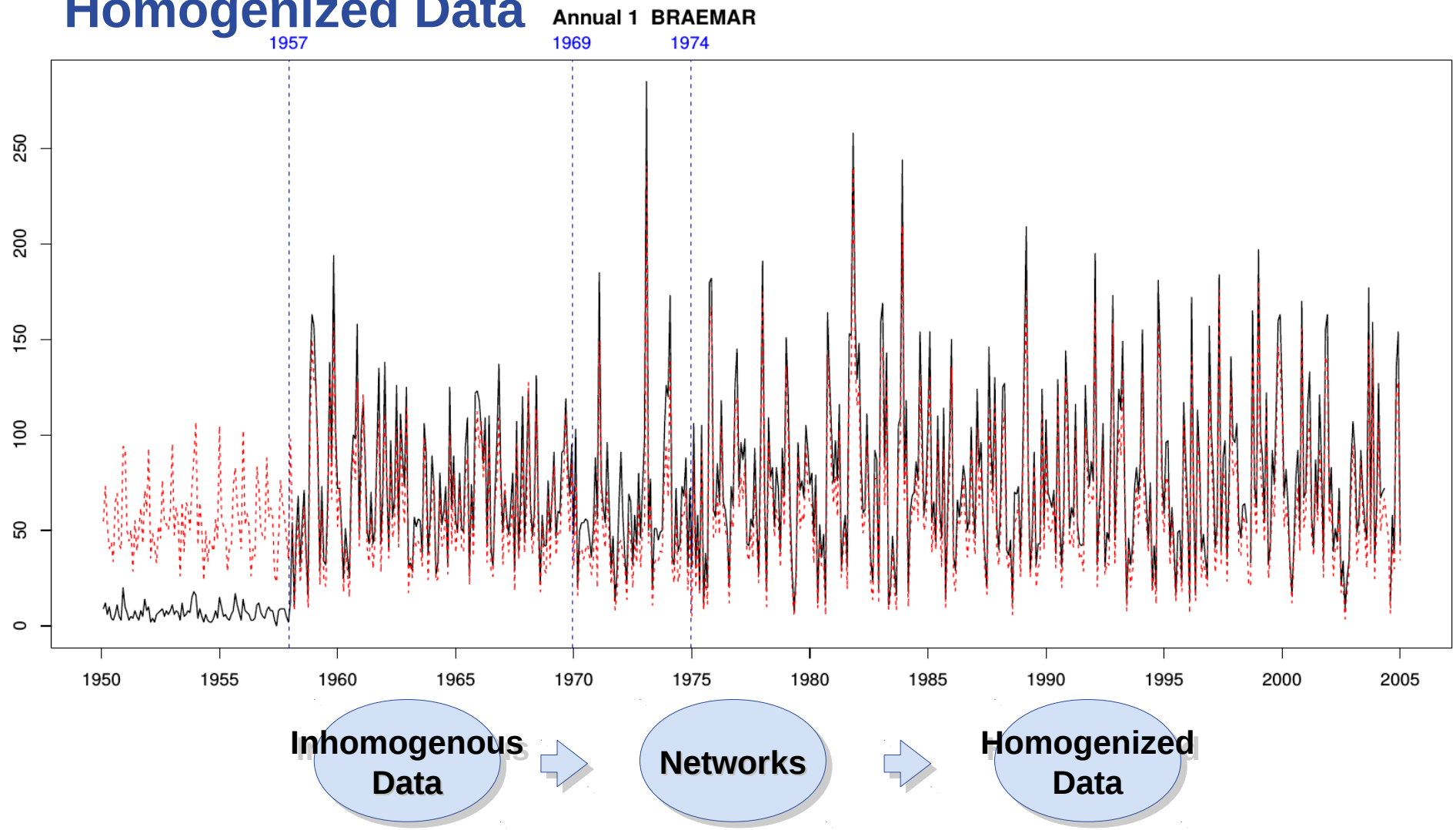
2) **Multiple linear regression** over homogeneous segments

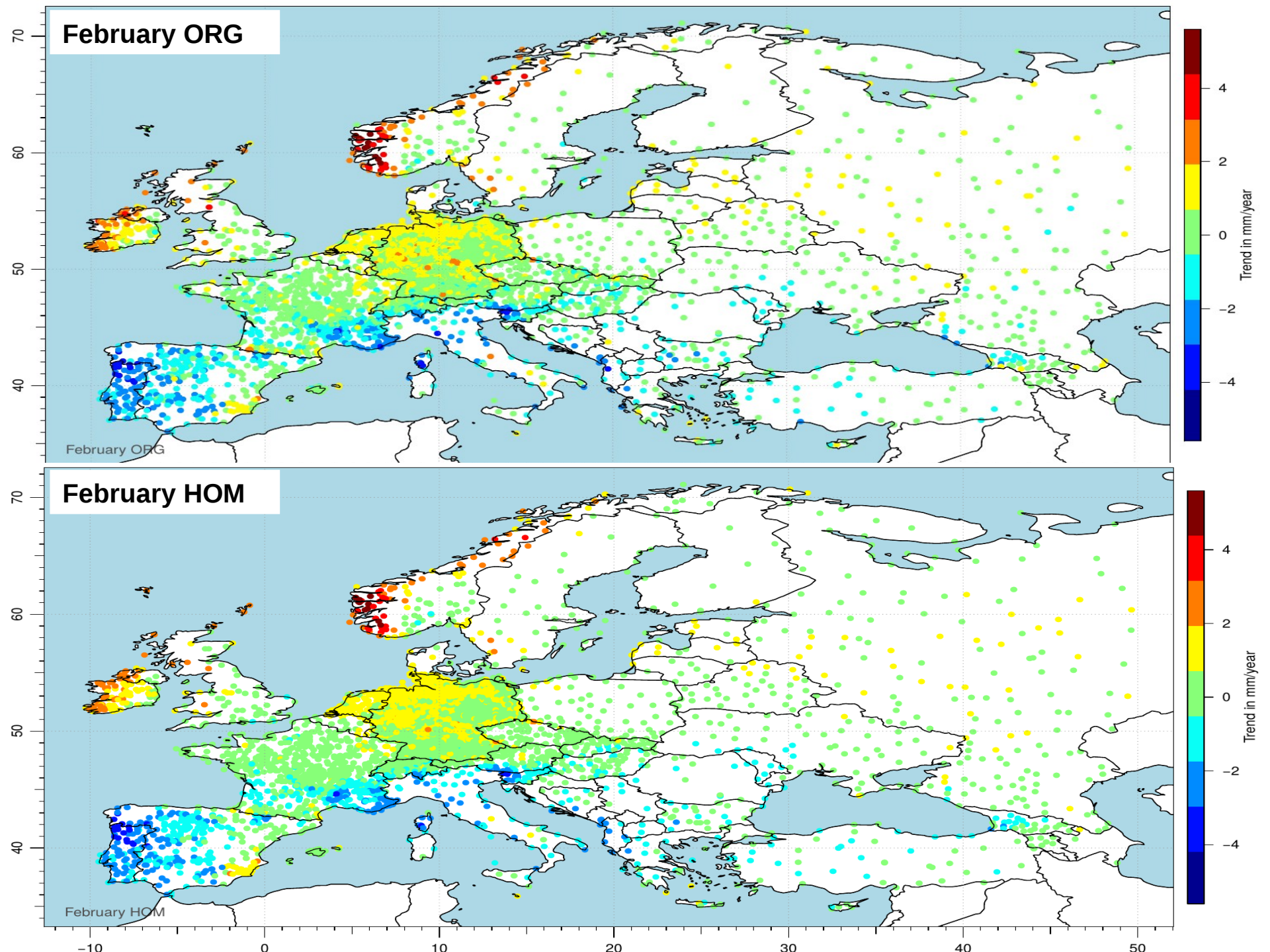
3) **Regression coefficients** indicate **break amplitude**

ANOVA

- Monthly regression parameter
- **Segment regression parameter**

Homogenized Data




February ORG
February HOM
Trend in mm/year
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−2
−4
70
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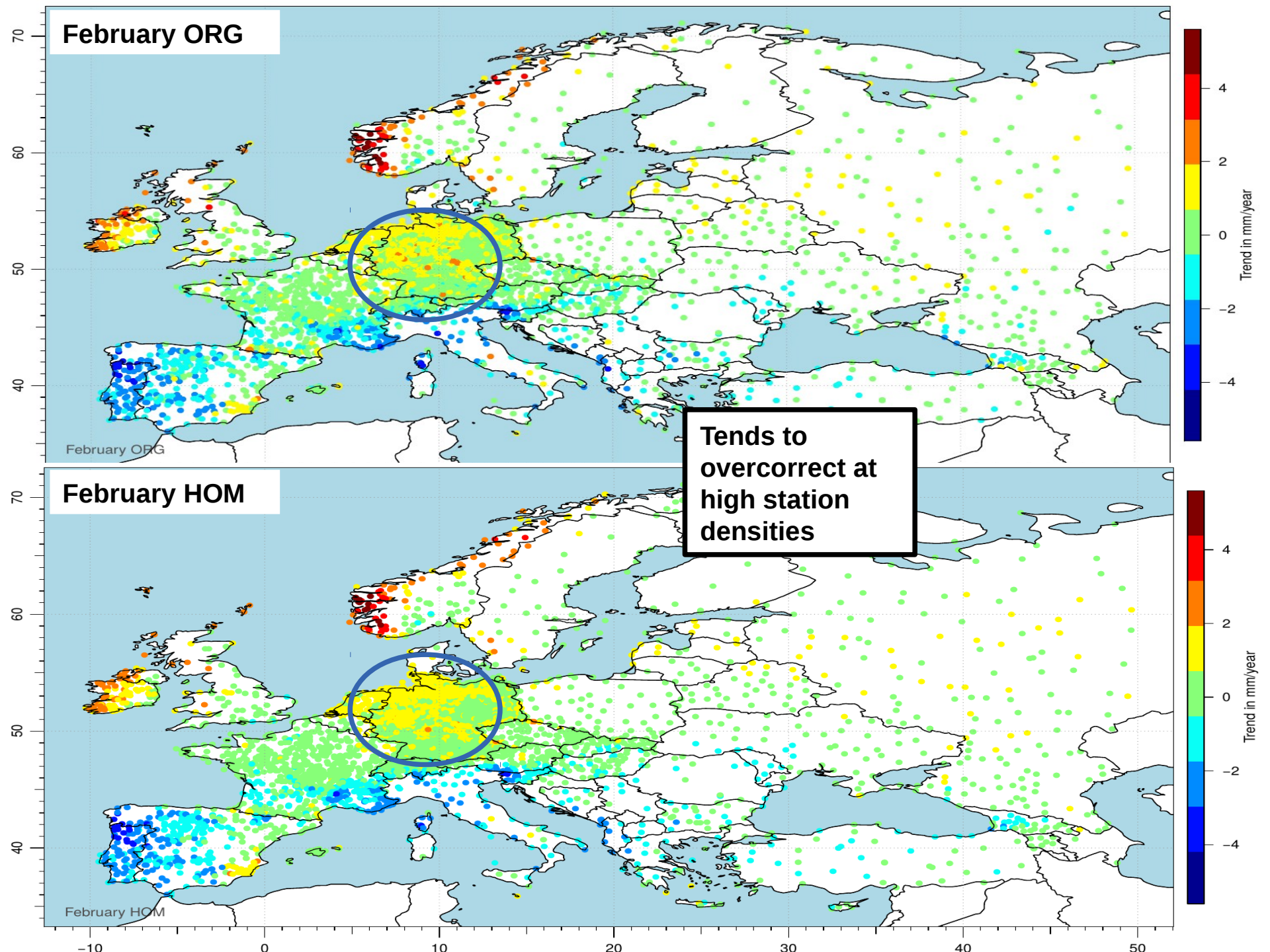

February ORG
February HOM
Tends to overcorrect at high station densities
Trend in mm/year
4
2
0
−2
−4
70
60
50
40
−10
0
10
20
30
40
50

Reporting back to quality control

- **Correlation** between series **too high**
  - Duplicate stations
- **High correction factor**
  - May be factor 10 error
- **Too many zeros** compared to neighbor series

3.) Verification

➔ **Especially important due to automation**

➔ Usually testing on independent data

- **Artificial data**

➔ Sensitivity study

- **Variation of reference series**

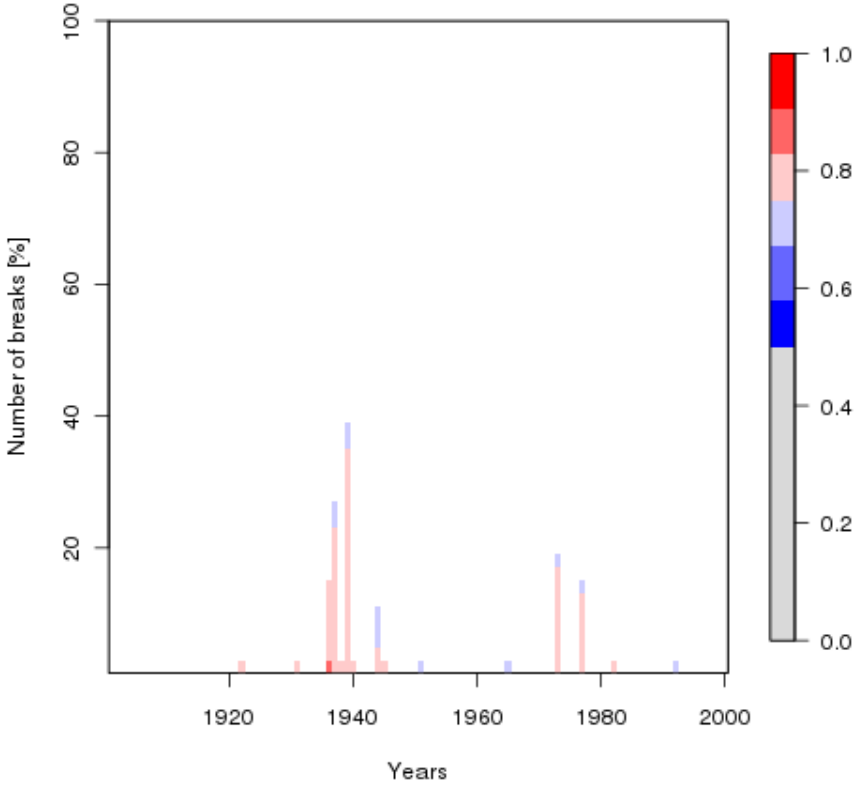
  (Has to be repeated for actual data set, because of changes in the software)

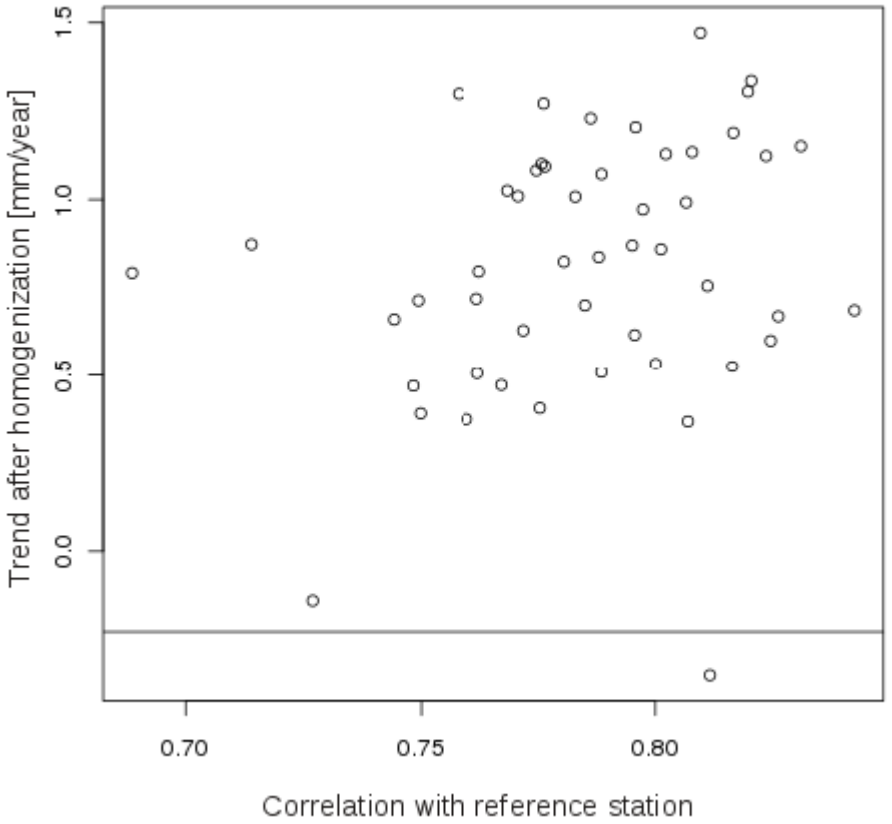
➔ **Comparison with digitized meta data**

(Has to be repeated for actual data set, because of changes in the software)

➔ Suspicious series are controlled **manually**

Sensitivity study (different data base)





Suspicious series are controlled manually

Output for every time series

- **CRADDOCK test** on original and homogenized data

  Including neighbor series and detected breaks
- **Annual cycle** (including neighbor series)
- **Absolute** raw and corrected series
- **Relative** raw and corrected series

Blacklisting before interpolation

- Manually blacklisted series if necessary
  - **High correction factor**
  - Series without high **correlated** neighbors
  - Strong differences in the **annual cycle** between target and neighbor time series

Interpolation

➔ **Modified SPHEREMAP**

(Becker et al., 2013 and Schamm et al.,2014)

- Distance and angle weighted, weighted average method
- Applied on anomalies
- One of the interpolation schemes that run operationally at the GPCC

➔ Kira Rehfeldt will present more information about the interpolation methods used at the GPCC in her talk

Summary and next steps

- Development of an **automatic algorithm**
  - Allows homogenization of large data sets
  - Over correction at dense station networks

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- Development of an **automatic algorithm**
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- Run **validation algorithm**
  - Meta data
  - Sensitivity study
- Interpolation
- Publish HOMPRA Europe (**gpcc.dwd.de**)
- Probably end of April

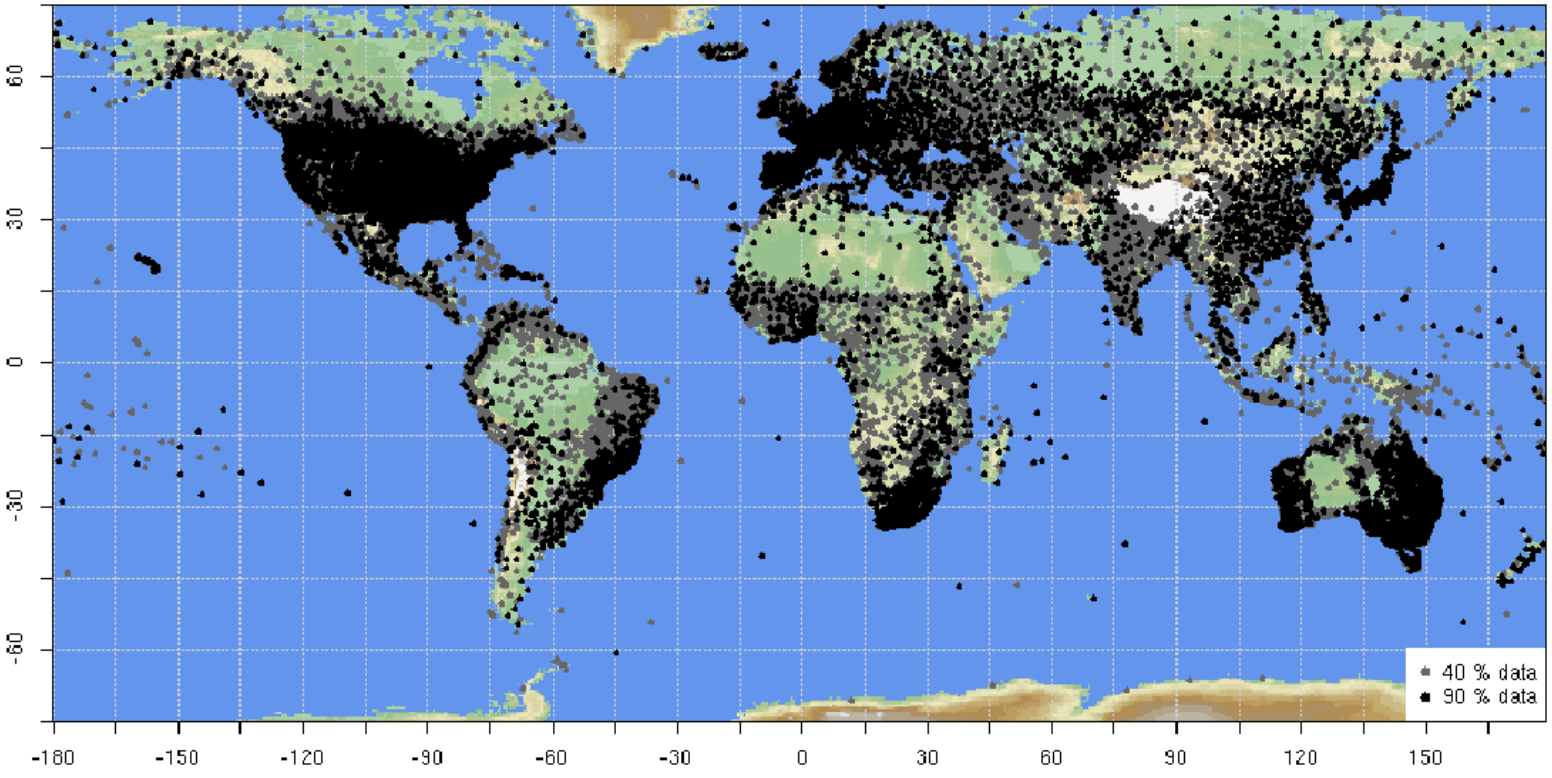
Summary and next steps

- Development of an **automatic algorithm**
  - Allows homogenization of large data sets
  - Over correction at dense station networks
- Run **validation algorithm**
  - Meta data
  - Sensitivity study
- Interpolation
- Publish HOMPRA Europe (**gpcc.dwd.de**)
- Probably end of April
- Comparison with **other homogenized data sets**

  (eg. Irland cooperation with John Coll, Mary Curley and Peter Domonkos)

Still remaining global issues (selection)

- **Include time series with many missing values as reference series**
- Correction (Needs validation)
- Detection (Not startet yet)



Still remaining global issues (selection)

- **Precipitation distribution is assumed to be constant over time (in comparison to neighbor series)**
- Changes in the distribution are detected as breaks

- In Australia the border between tropics and subtropics is not constant
- El Niño/ La Niña years in South America
- Hurricans in the United States
- ...

Thank you for your attention!