



Climate Change

The ECA&D and E-OBS datasets for Europe

A focus on uncertainty

Title

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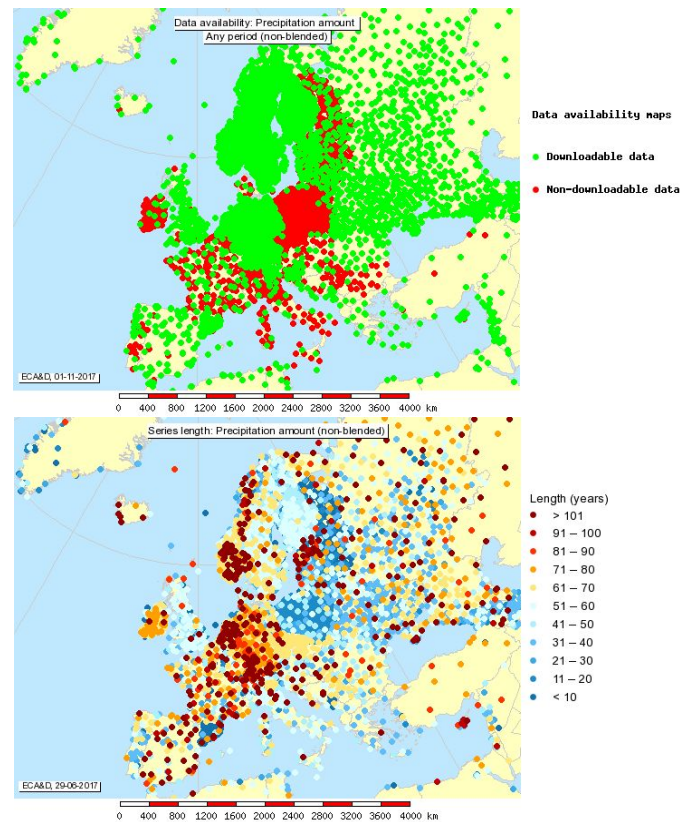
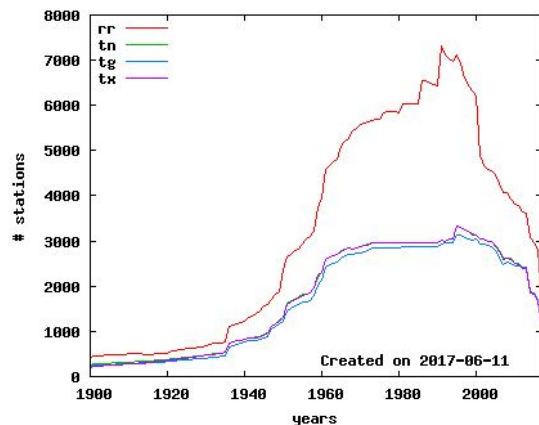




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Introduction: ECA&D

- European Climate Assessment & Dataset (ECA&D)
- Essential Climate Variables
- daily data
- validated data sourced from the NMHSs
- updated monthly



UNCERTAINTY IN DATA: INHOMOGENEITY

Step-like signals in series introduced by:

Gradual changes of the **surrounding** (growing vegetation, expansion of urban area)

Change in the **instrumental** features (new screen, manual to automatic, analog to digital, etc.)

Relocation of stations, often from the city center to the airport (urban heat island effect removed) or with change of altitude.

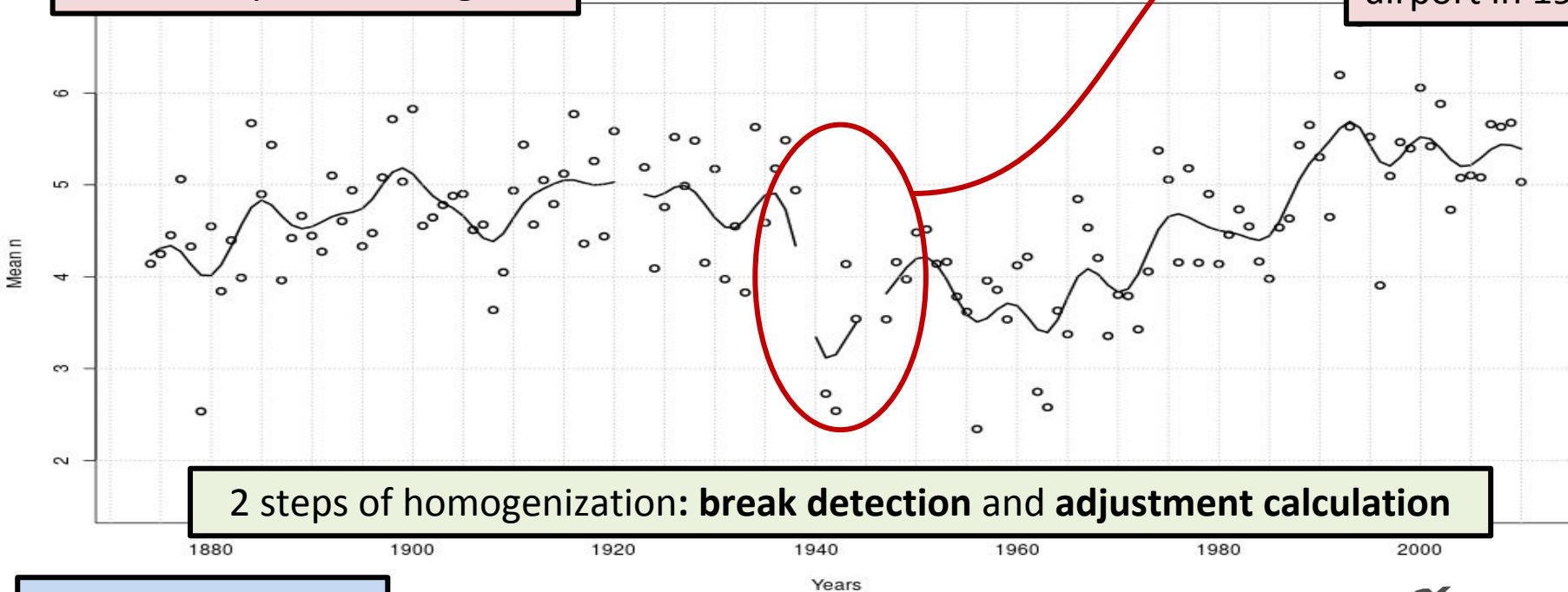


UNCERTAINTY IN DATA: INHOMOGENEITY

Climatological analyses
falsified by **artificial signals**

Mean ann(ori) tn 2150 Salzburg AUSTRIA

Station is
moved to the
airport in 1938



2 steps of homogenization: **break detection** and **adjustment calculation**

Ann, mean of TN Salzburg
with running mean and
detected breaks.

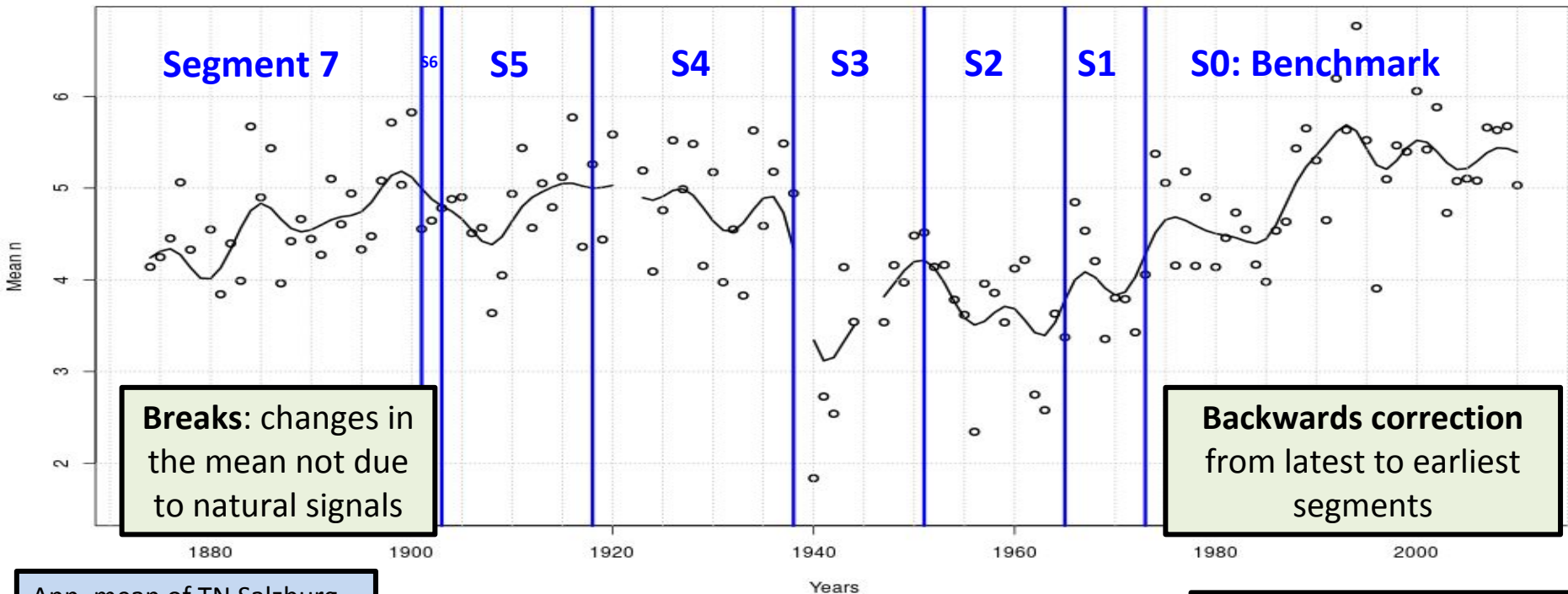
—○— original series

— gaussian weighted running mean

UNCERTAINTY IN DATA: INHOMOGENEITY

Detection of changes in the mean or other statistical features through the comparison of the target series with a set of neighbours.

Mean ann(ori) in 2150 Salzburg AUSTRIA



Breaks: changes in the mean not due to natural signals

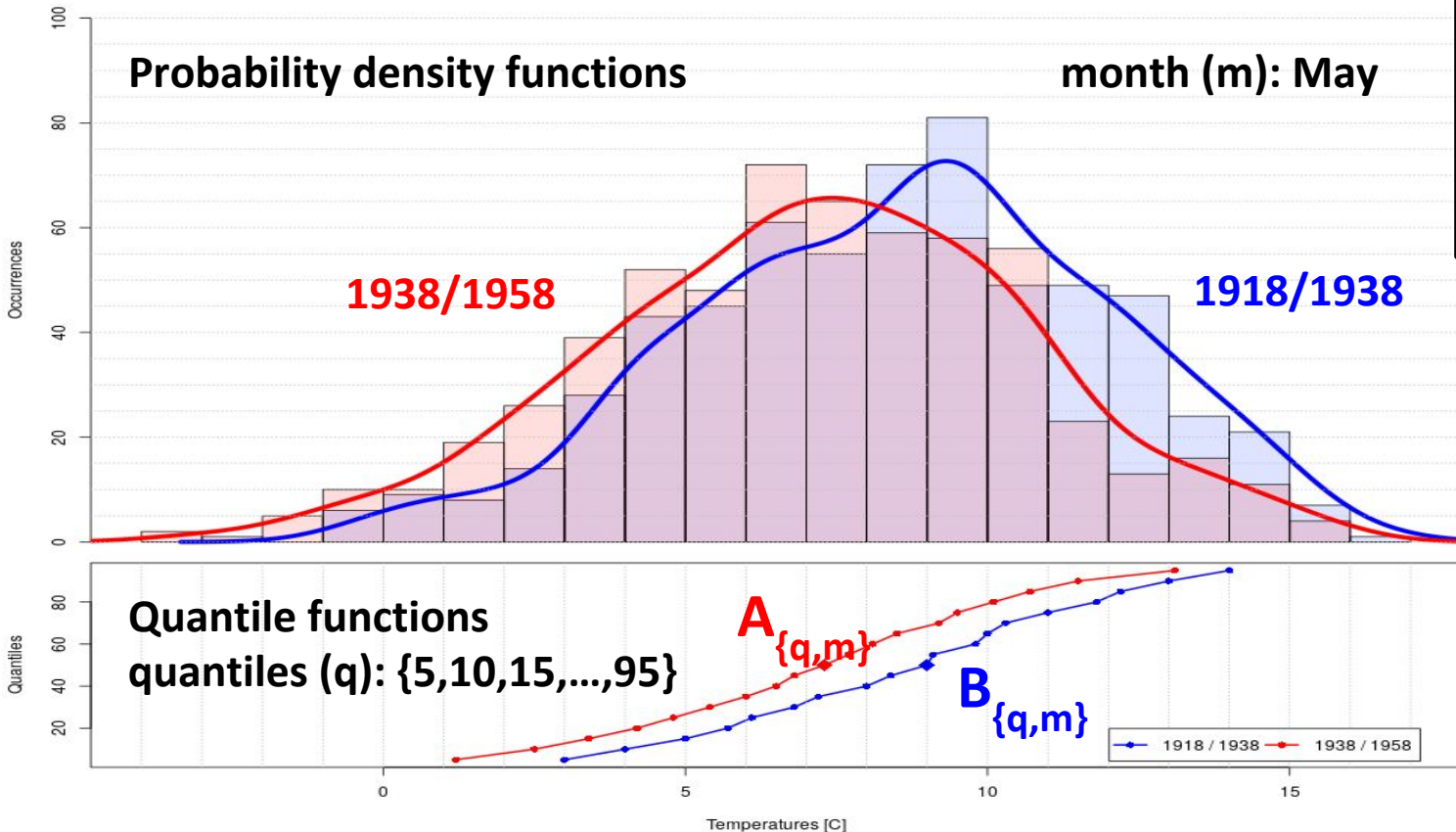
Backwards correction from latest to earliest segments

Ann, mean of TN Salzburg with running mean and detected breaks

Kuglitsch et al. (2012)

UNCERTAINTY IN DATA: ADJUSTMENT

Pdf month 5 tn Salzburg AUSTRIA , split in 1938



Statistical differences in the pdfs due to sum of **artificial** and **climatic signal**.

use homogeneous reference series to calculate the adjustment of each quantile

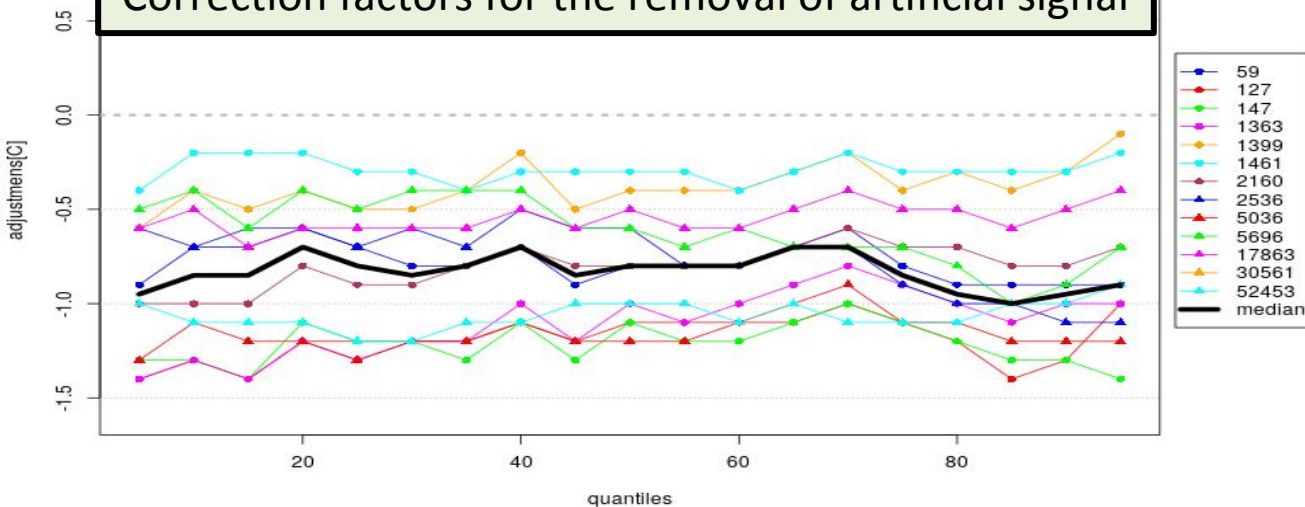
Trewin (2012)

Temp. pdf and quant. of TN Salzburg (May) 10 years before (blue) and after (red) 1938

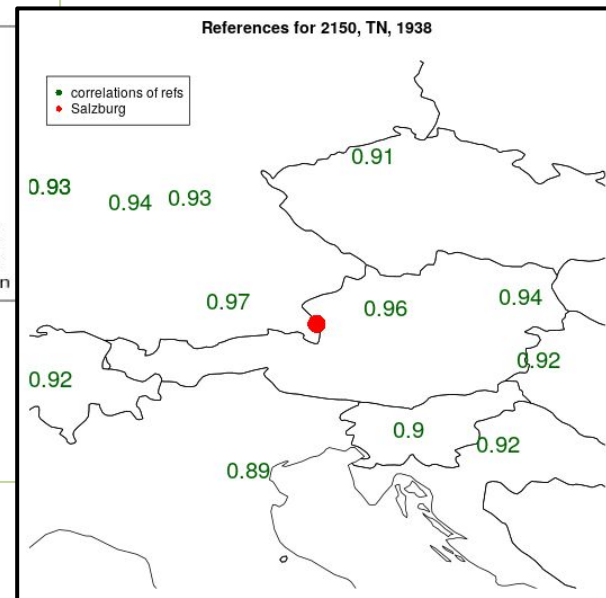
UNCERTAINTY IN DATA: THE ADJUSTMENTS

Adj. estimations for 2150, 1938 , Month 5

Correction factors for the removal of artificial signal



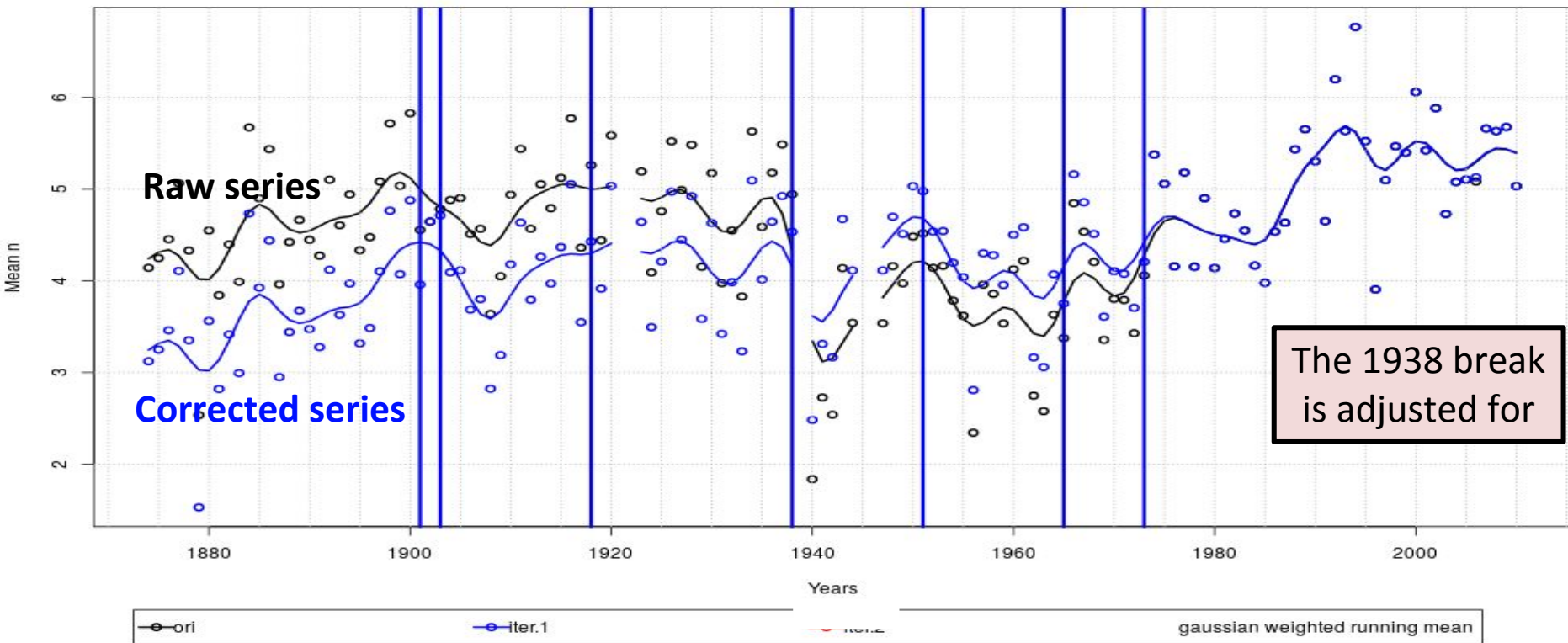
For Salzburg, several references are possible



Of all possible adjustments,
we take the median
and ignore the spread....

UNCERTAINTY IN DATA: ADJUSTED SERIES

Mean ann(2it) tn 2150 Salzburg AUSTRIA



The 1938 break
is adjusted for

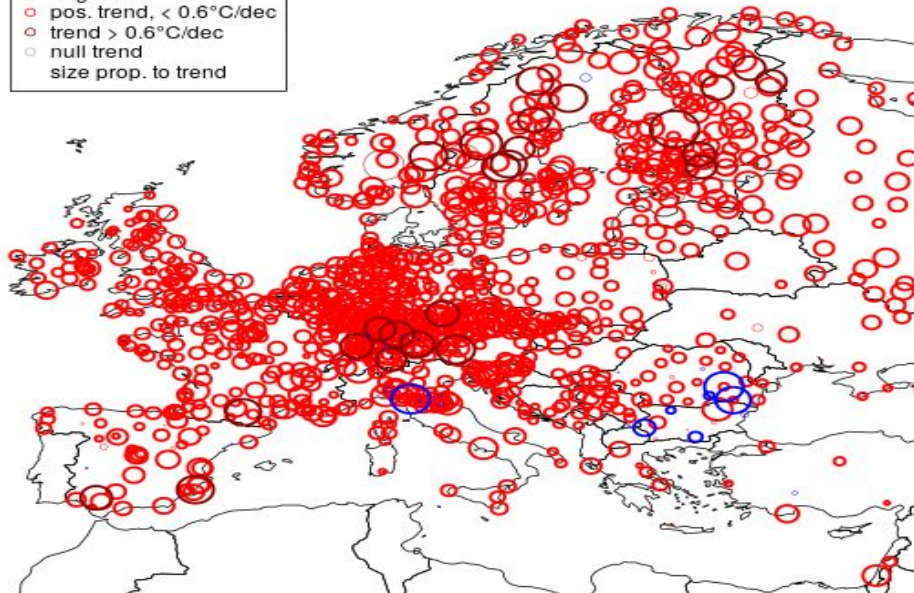
Annual means of TN Salzburg before and after the homogenization with running mean and change points identified during break detection.

EFFECTS ON TRENDS: SPATIAL CONSISTENCY

BEFORE HOM

TN, annmean, trends of ori., period: 6110

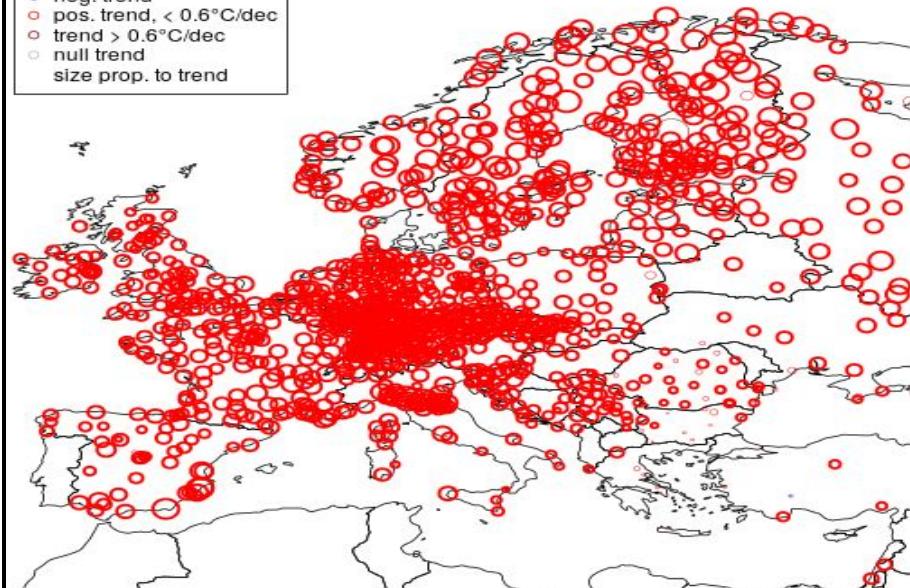
- neg. trend
- pos. trend, < 0.6°C/dec
- trend > 0.6°C/dec
- null trend
- size prop. to trend



AFTER HOM

TN, annmean, trends of 2 it., period: 6110

- neg. trend
- pos. trend, < 0.6°C/dec
- trend > 0.6°C/dec
- null trend
- size prop. to trend

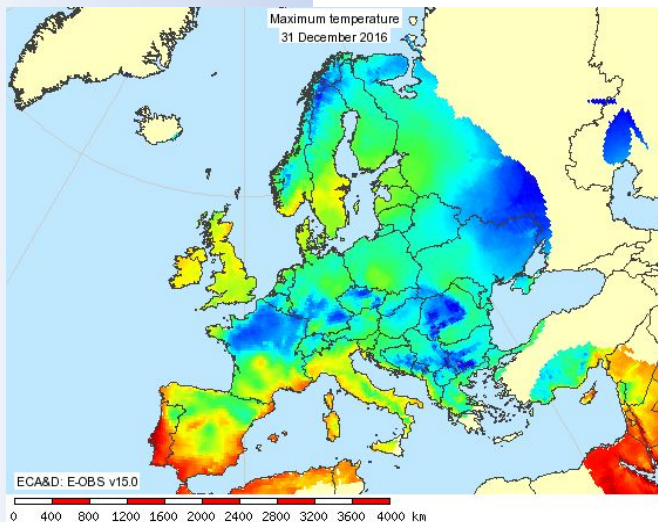


Trends on annual mean of minimum temperatures: blue circle (negative trend), red circle (positive trend, <0.6 C/dec), brown circle (trend over 0.6 C/dec)



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The E-OBS dataset

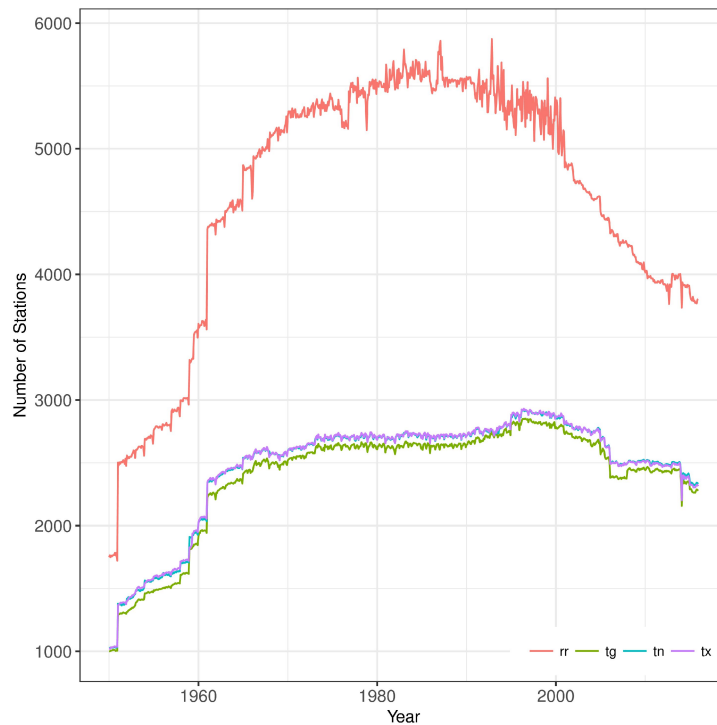
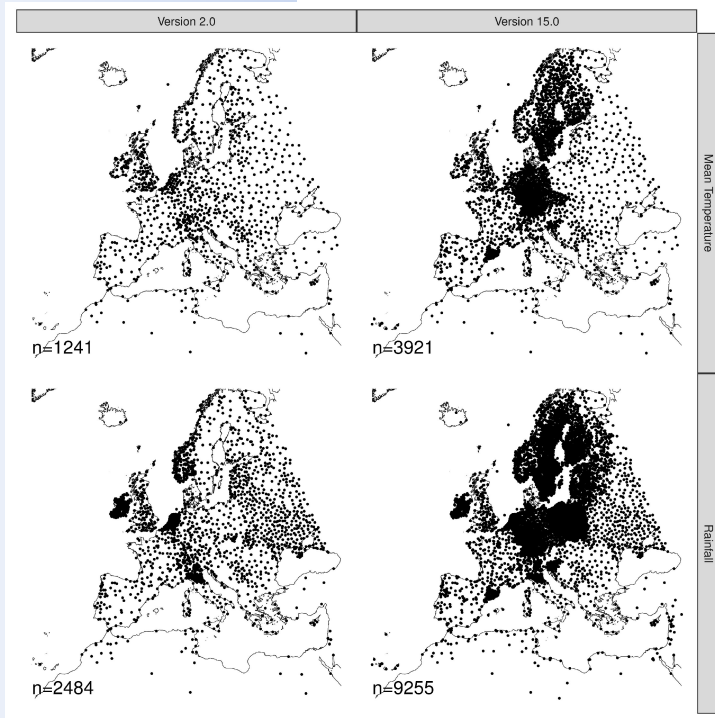


- Covers the **European** domain
- Uses the ECA&D blended station series
- **Daily values** of temperature, rainfall and MSLP
- Produced from 1950 to present
- Produced at a variety of spatial resolutions (~25km)
- **Updated** on a rolling monthly basis



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The Input Station Data

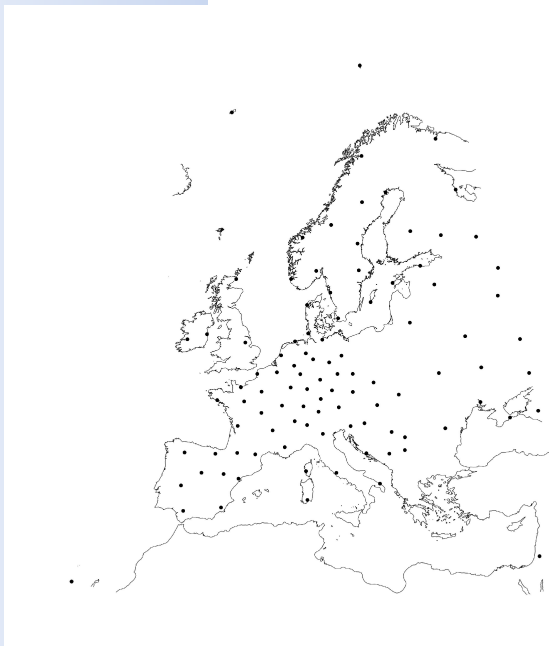




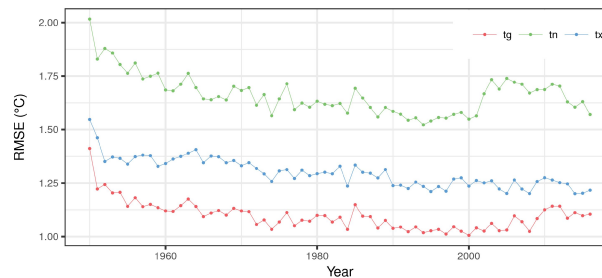
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Evaluating the Daily Interpolation

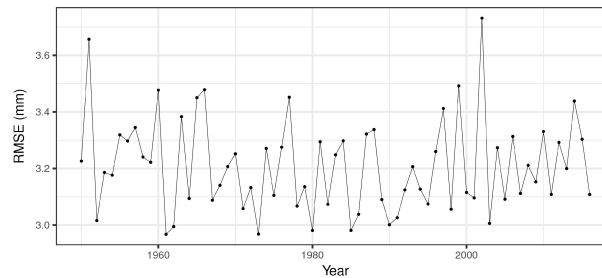
Comparison against station values



a) Temperature Variables



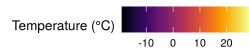
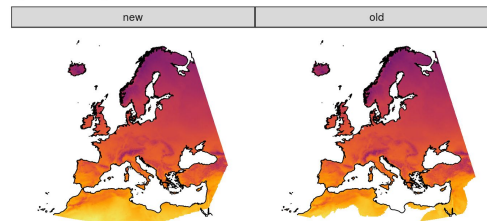
b) Rainfall



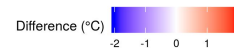
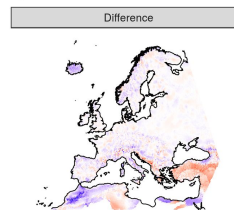


Evaluating the Daily Interpolation Climatology Comparisons

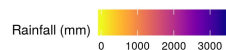
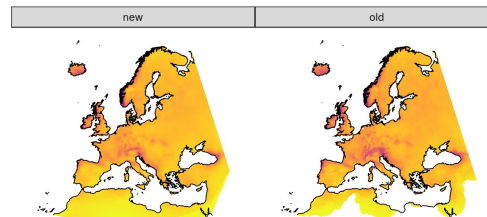
a) Mean Daily Temperature



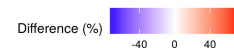
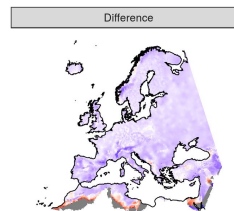
b) Difference



c) Daily Rainfall



d) Difference

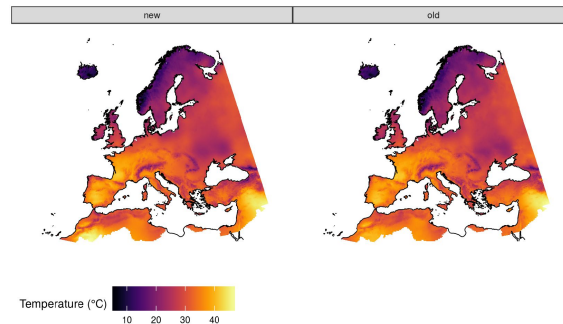




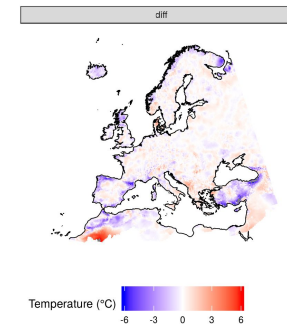
Evaluating the Daily Interpolation

Extreme Events | TX 8th August 2003

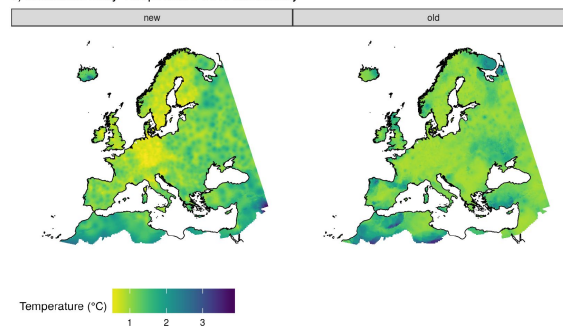
a) Maximum Daily Temperature Interpolation



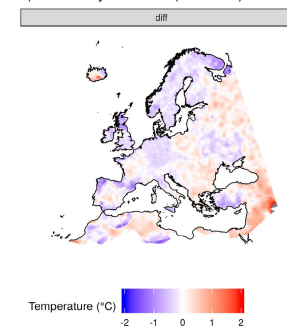
b) Interpolation Difference (New - Old)



c) Maximum Daily Temperature 95% uncertainty



d) Uncertainty Difference (New - Old)





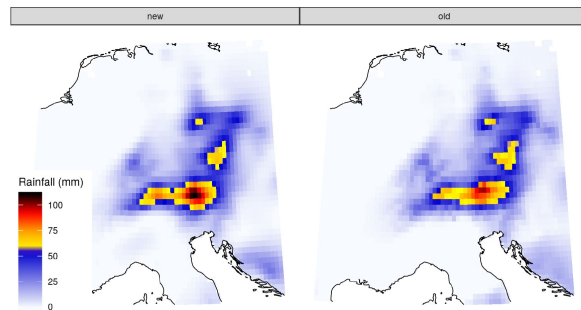
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Evaluating the Daily Interpolation

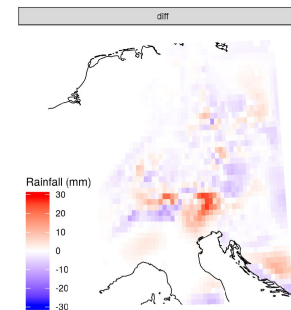
Extreme Events | RR 1st June 2013



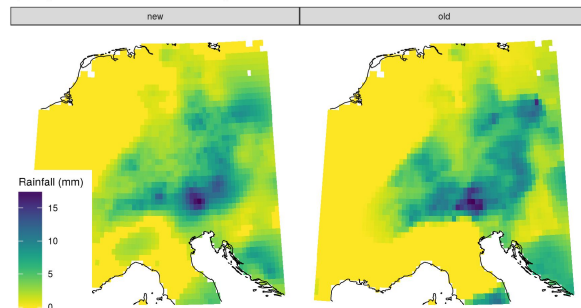
a) Daily Rainfall Total Interpolation



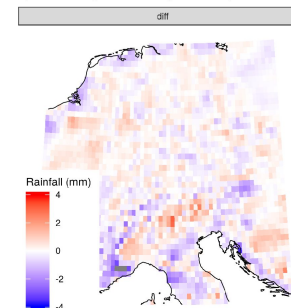
b) Interpolation Difference (New - Old)



c) Daily Rainfall Total 95% uncertainty



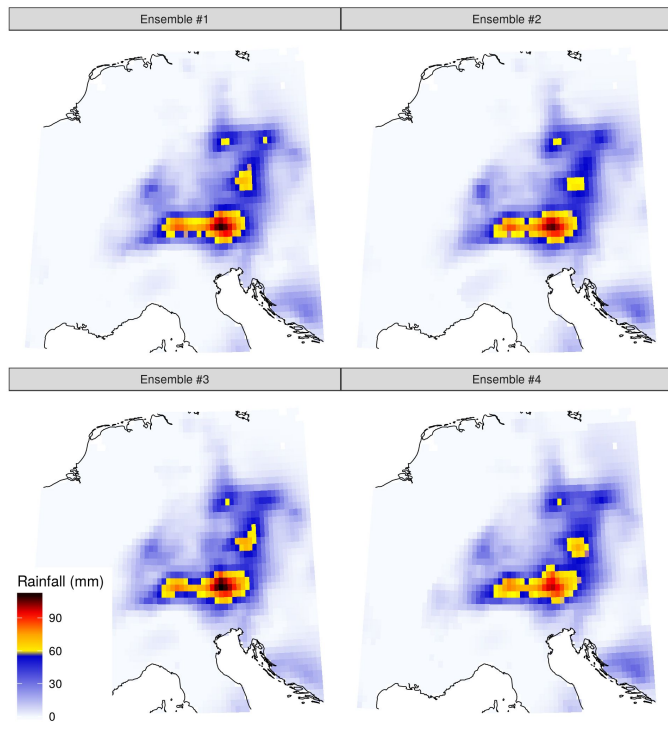
d) Uncertainty Difference (New - Old)



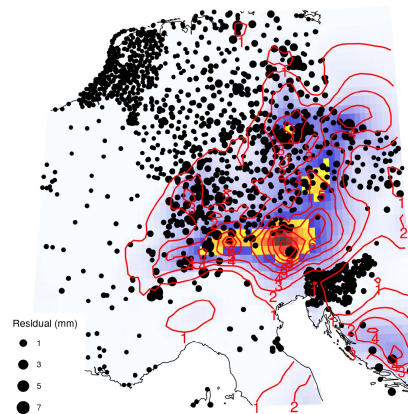


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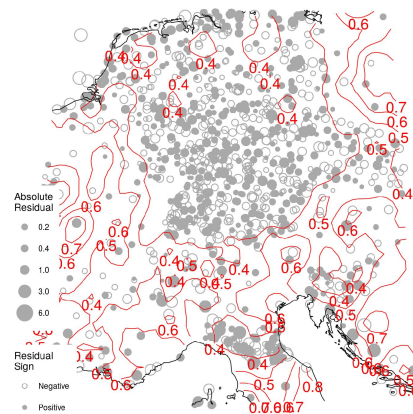
The Nature of the Ensemble



a) Daily Rainfall Total 1st June 2013



b) Maximum Daily Temperature 4th August 2003

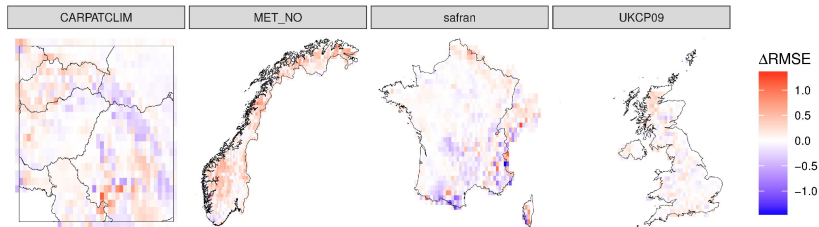




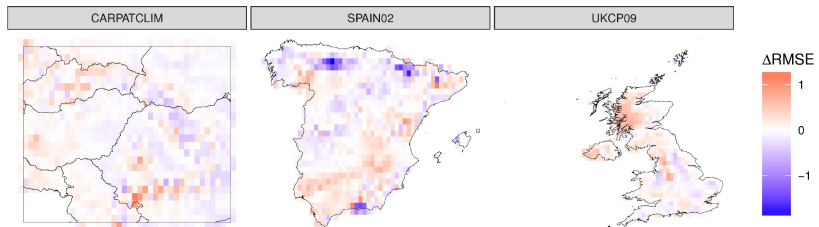
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Comparison against NMS Gridded Data

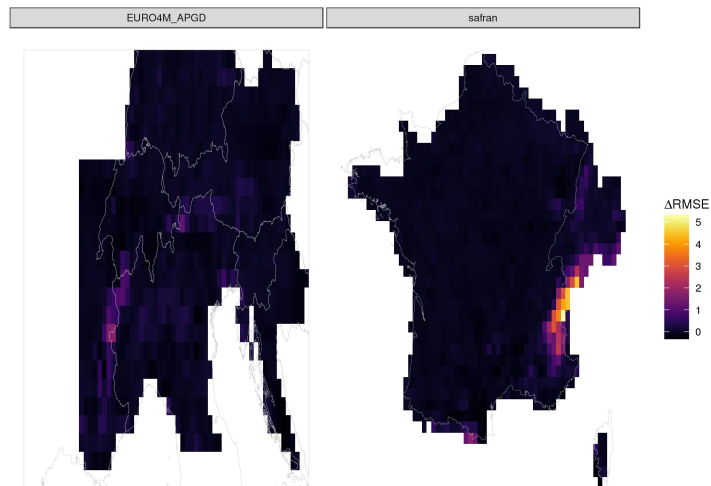
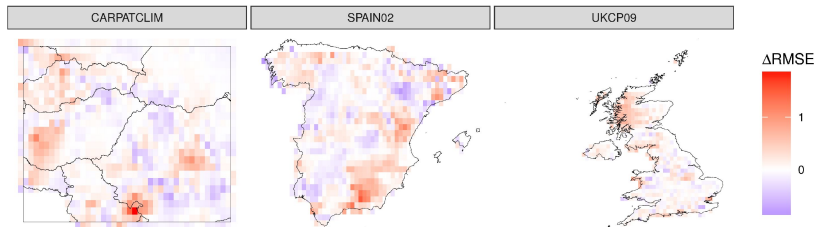
a) Mean Daily Temperature (tg)



b) Maximum Daily Temperature (tx)



c) Minimum Daily Temperature (tn)





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Conclusions

- Uncertainty in station data due to
 - Station relocations
 - Change of measurement equipment and set-up
 - Change in surroundings
- Detection and adjustment of breaks
 - If no metadata is present: the location of the break can be uncertain
 - Adjustments are based on surrounding reference station – the spread is a measure for the uncertainty in the adjustment
- Gridded dataset
 - Gridding adds an additional uncertainty
 - Large in areas where station density is low