HISTALP-
precipitation homogenisation

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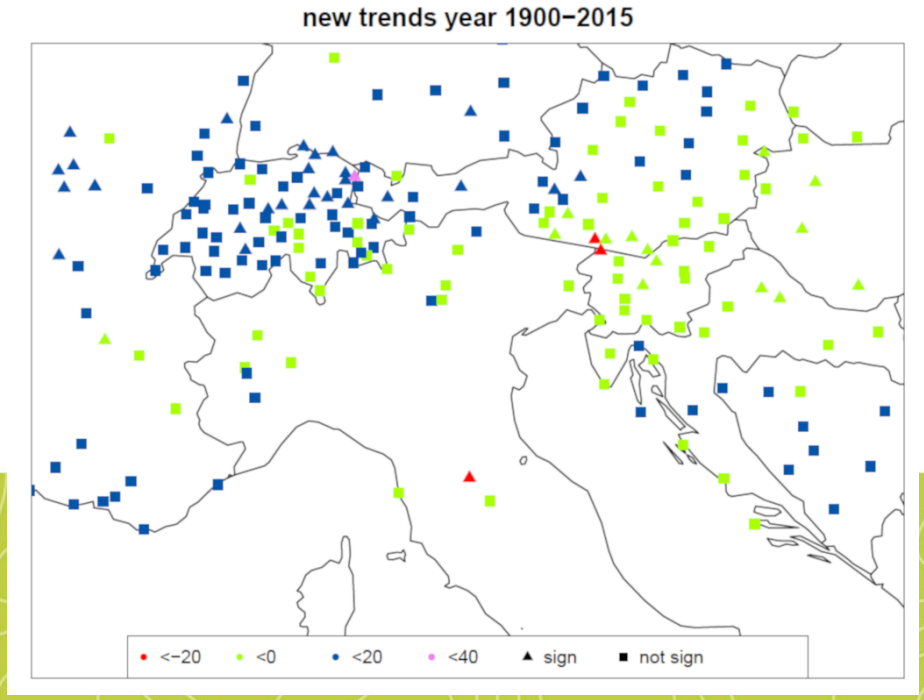
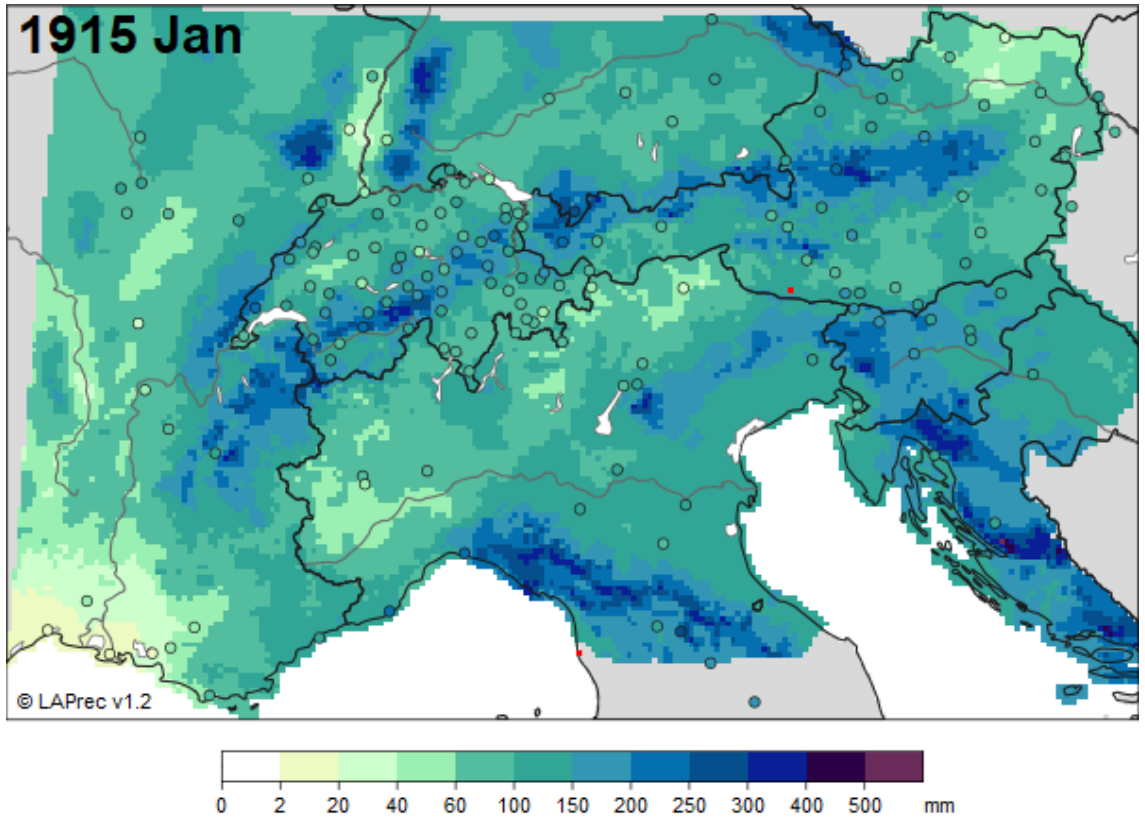


9.5.2023

Changes in station network

For creation of LAPrec-Dataset (gridded RR dataset based on HISTALP station data and highly resolved gridded APGD dataset of MeteoSwiss, distributed via C3S DataStore, https://surfobs.climate.copernicus.eu/dataaccess/access_laprec.php) => Necessity to get agreement of data providers, as gridded dataset might be used commercially



During this activity exchange with Data providers on data in HISTALP-database =>

- Changes in climate network of country (Switzerland changed station set)
- Countries detected differences between their original data and the ori-data in HISTALP => correction of HISTALP ori data
- Countries provided additional stations.

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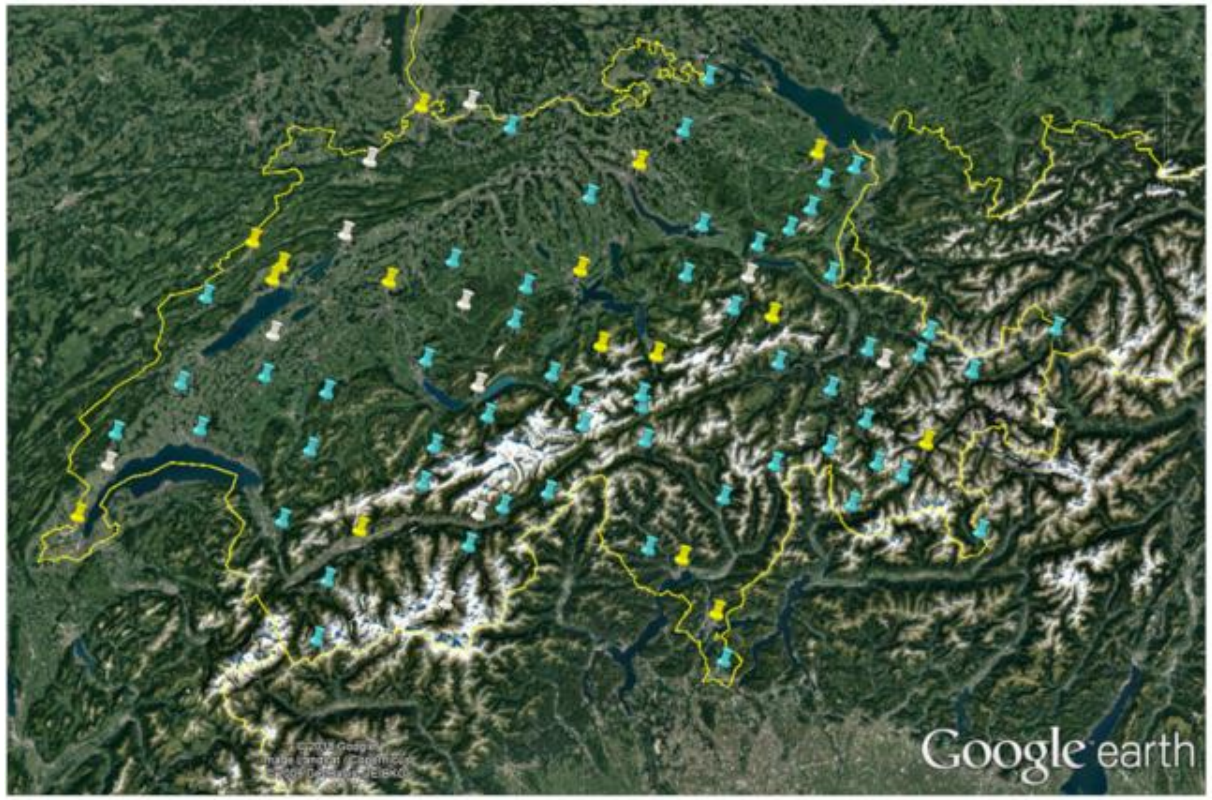
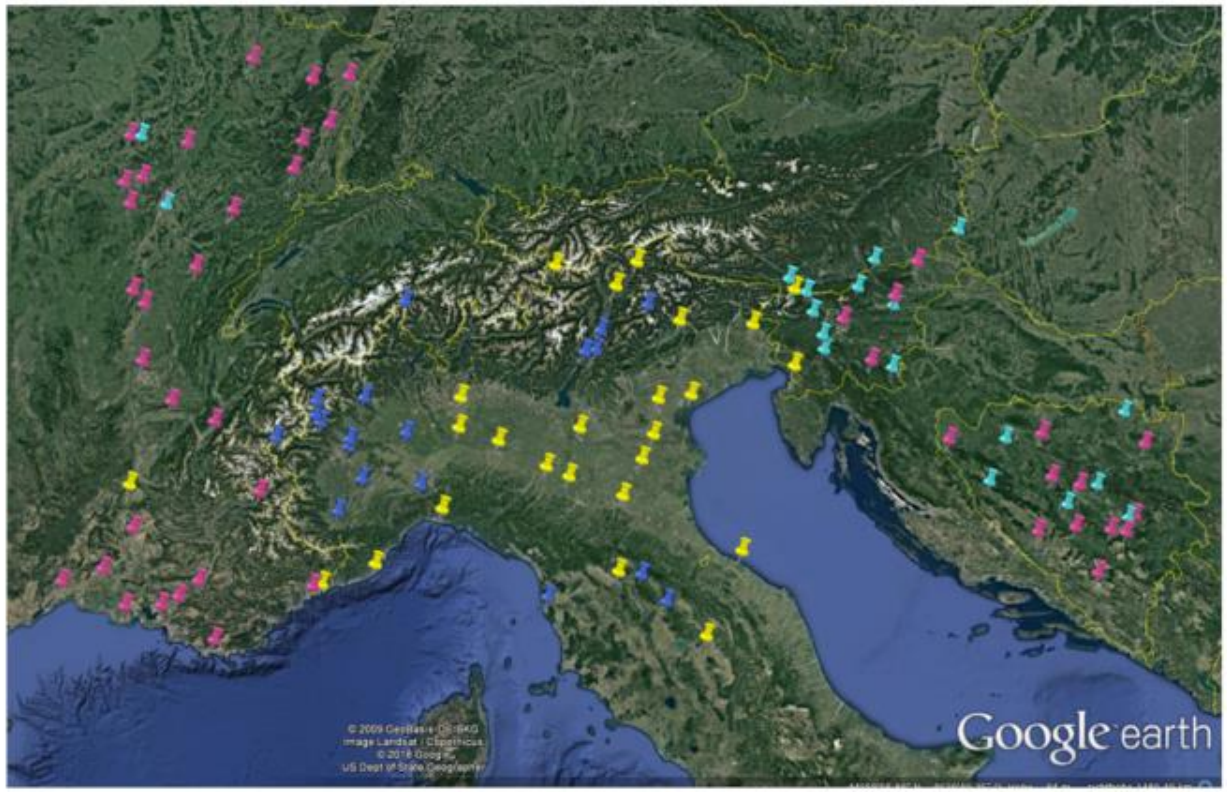
Changes in station network



unchanged
not included in the dataset anymore
additional stations



unchanged
changes in original data or data source
additional stations

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Homogenisation method

HOMER:

- Developed during COST-Action COST-ES0601: Advances in homogenisation methods of climate series: an integrated approach (HOME), 2007-2011)

- Homogenisation of monthly data
- Interactive method

Break detection :

PRODIGE: pairwise-detection based on Maximum Likelyhood Methode with Penalty Term:
break used if detected in more then 50% of the comparisons

Joint detection additionally applied in some cases

correction: ANOVA-approach

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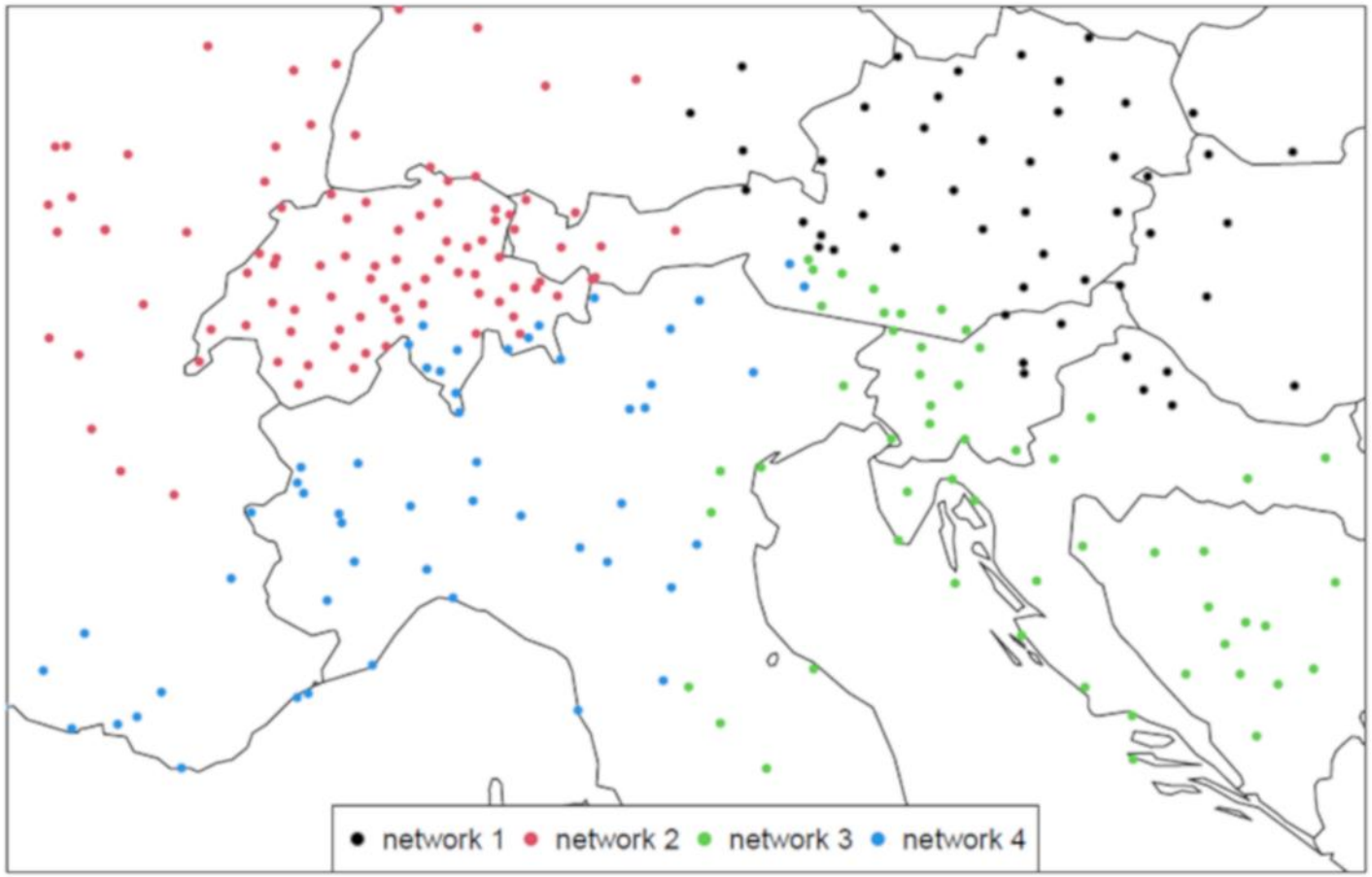
Homogenisation method



reference stations: in network and correlated along the first order differences time series“>0.6
At least 5 reference stations used, usually depending on network 11-33 reference stations (exceptions Bologna and Hvar)

For some stations
Special networks as standard reference stations didn‘t cover whole period

During homogenisation some of the additional Stations where removed:
*) too short
*) no homogenisation possible

Swiss stations not homogenised but homogenised Swiss stations used as reference stations.

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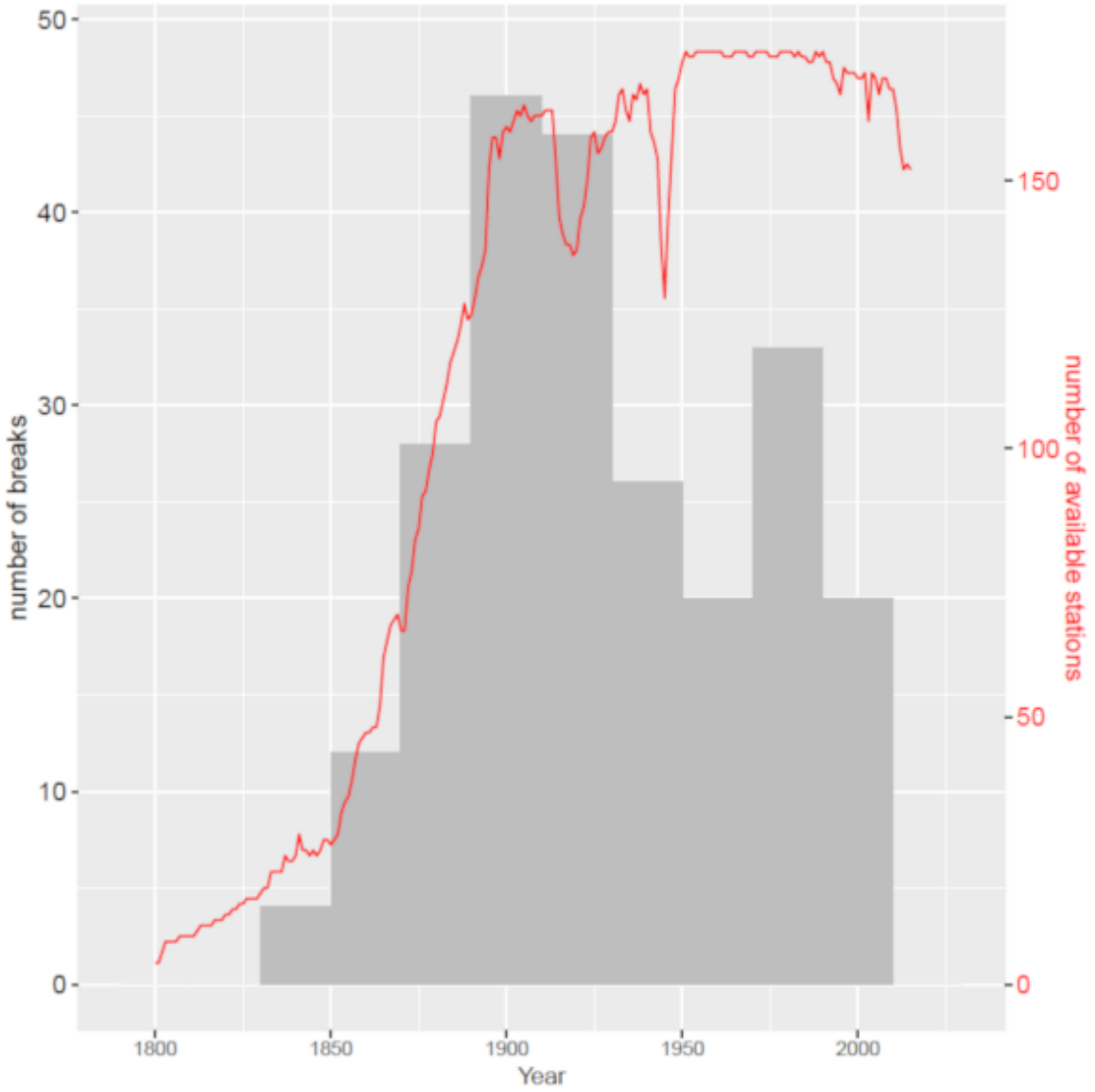
Results of homogenisation

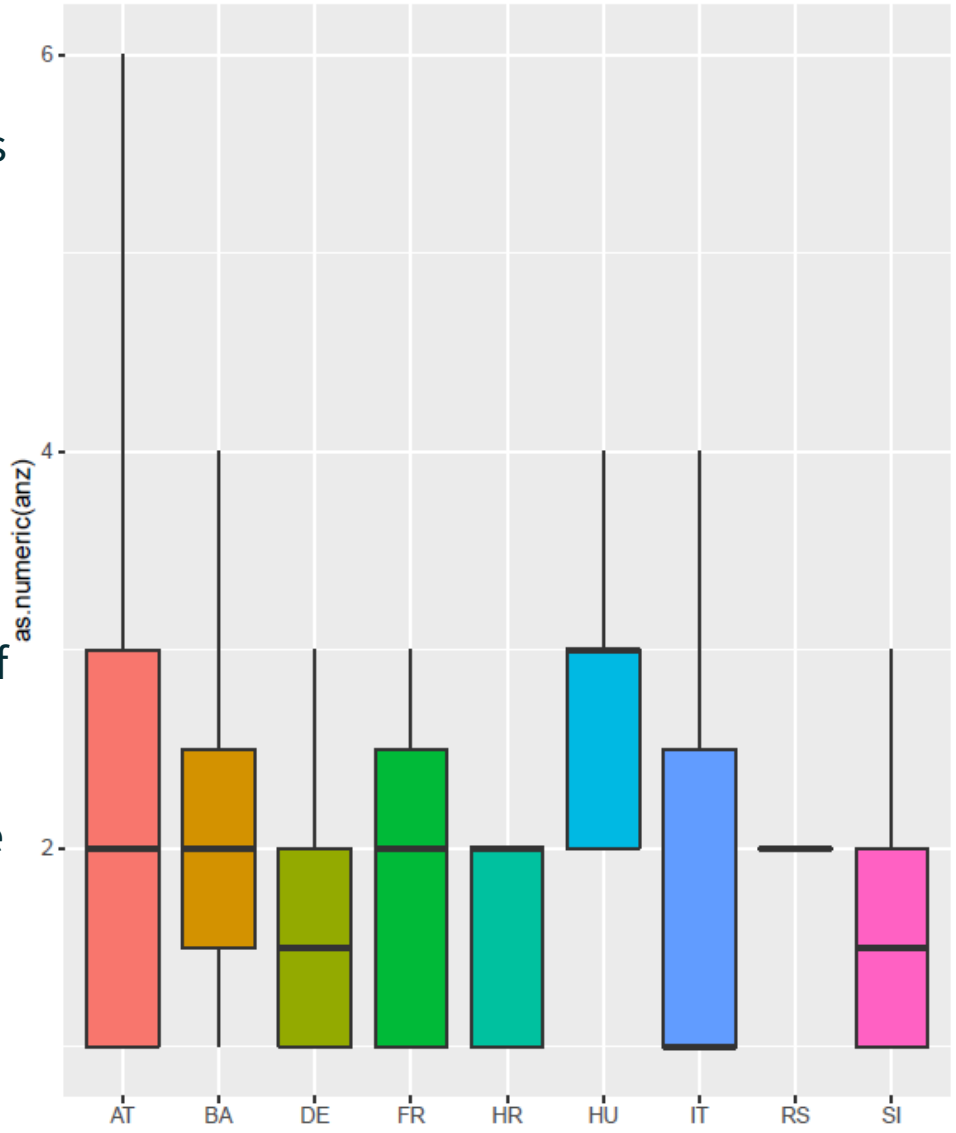


Finally 175 stations checked:
118 inhomogeneous

bigger part: 1-2 breaks
(47/43)

Maximal number of breaks=6

Metadata available for 1/3 of breaks



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Results of homogenisation

Trend after homogenisation mostly not significant

In 1900-2015 more positive (significant) trends as negative (significant) trends. In 1961-2015 this is more even.

In both periods spring shows more negative trends.

Negative trends of annual time series rather in the southeast, slightly positive in the north.

Comparison with other homogenised data sets

	Original homogenisation	Austrian homogenised dataset	Croatian homogenised dataset	Hungarian and Slovakian homogenised datasets	Italian homogenised dataset
methode	HOCLIS	ACMANT	Climatol-Package (R)	MASHv3.03	CRADDOCK
Break detektion	mainly CRADDOCK-Test (visual decision on the basis of cumulative difference time series)	Similar to HOMER but for daily data and automatic method	SNHT	Hypotheses testing, iterative method	CRADDOCK
Referenz station	Up to 10 reference stations (correlation >0,5 and no Break near break of candidate station)	Weighted mean of reference stations (Depending on network and correlation)	3 most nearby located stations from the same region as reference station		10 reference stations,

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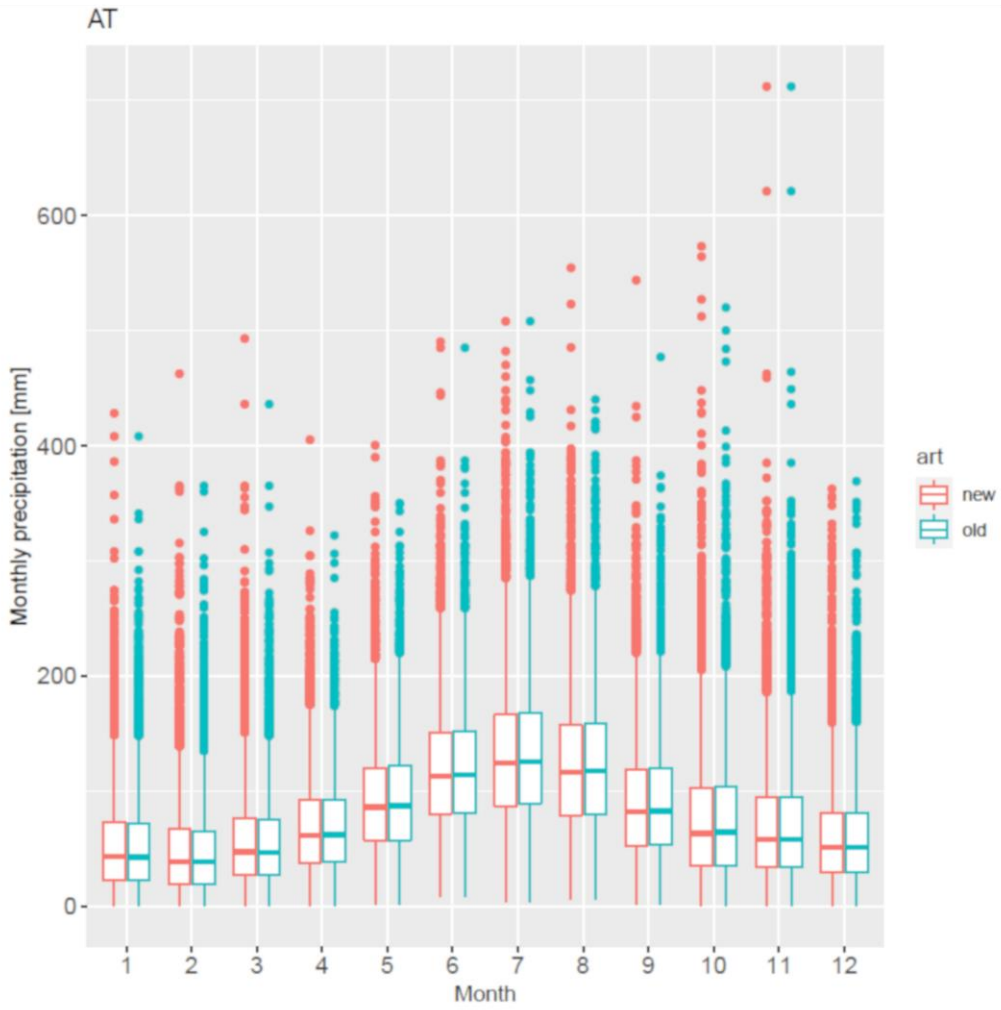
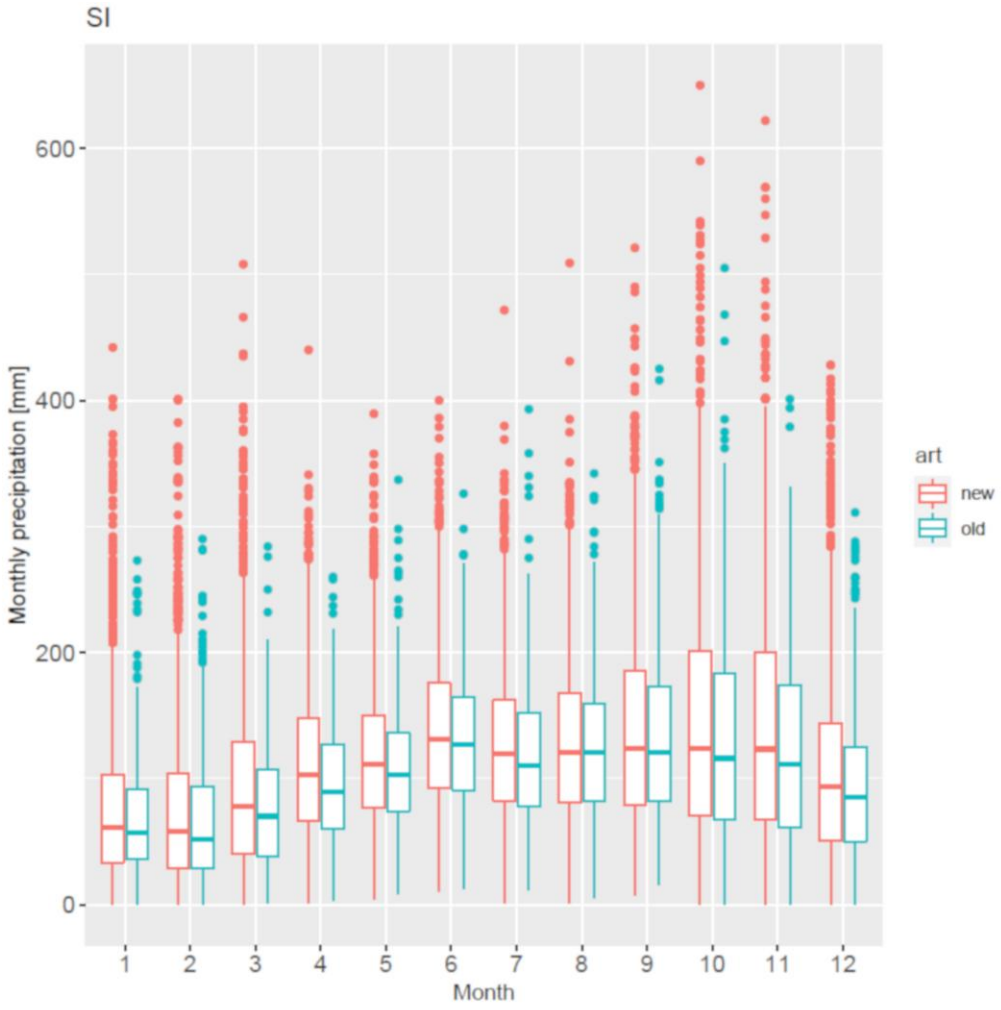
Comparison with other homogenised data sets





Values area between new and original HISTALP homogenisation similar (difference by changed stations)

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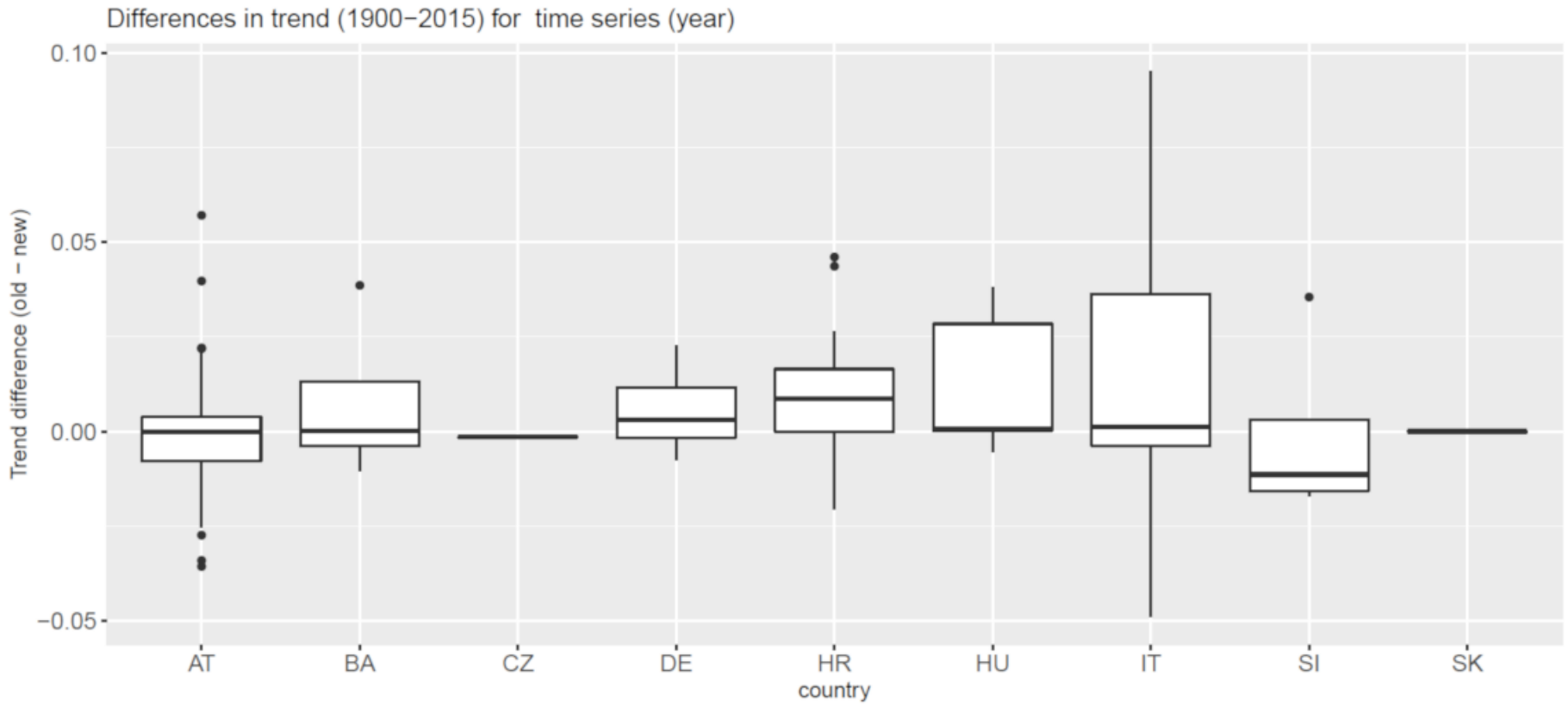
Comparison with other homogenised data sets

Trend comparison between HISTALP versions
trend[mm/year]

Spatial distribution similar but values different.



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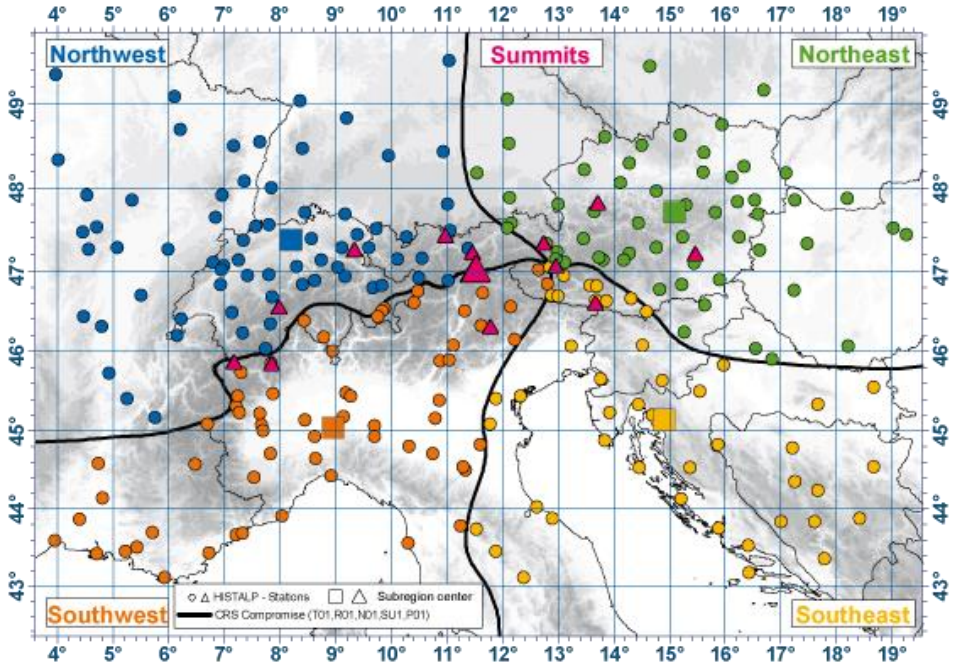
Comparison with other homogenised data sets

Comparison with Austrian Daily homogenisation in connection to climate normal period 1991-2020

41 stations, in 6 of them differences in the original data
HISTALP homogenisation detects less inhomogeneous stations than national one.



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Comparison with other homogenised data sets

6 stations selected for more detailed comparison

Selection criteria:
Longer period after break (long part of time series where differences can occur) and from those best and worst stations for different criteria

Mean and standard deviation
Calculated from homogenised data directly (missing data of one homogenisation excluded in both datasets)

RMSE & MSESS
calculated from normed time series (normed to HISTALP-mean)

$$RR_{Ntr} = \frac{RR_N}{\overline{RR_N}}\overline{RR_H}$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n}\left(RR_{H_i} - RR_{Ntr_i}\right)^2}{n}}$$

$$MSESS = 1 - \left(\frac{\mathrm{RMSE}}{sd}\right)^2$$

trend=mm/year

station + period	season	mean (HISTALP)	mean (national dataset)	standard deviation (HISTALP)	standard deviation (national dataset)	RMSE	MSESS	Trend slope (HISTALP)	p-value (HISTALP)	trend slope (national dataset)	p-value (national dataset)
Bad Gastein (1961-2015)	spring	262,2	278,8	65,6	70,1	12,2	1,0	-0,013	0,46	-0,002	0,87
	summer	483,7	513,3	81,3	84,1	22,8	0,9	0,009	0,51	0,020	0,10
	autumn	296,3	314,3	87,1	90,2	14,2	1,0	0,024	0,38	0,040	0,11
	winter	156,6	166,9	53,1	57,2	7,8	1,0	-0,021	0,54	-0,006	0,80
	year	1196,9	1269,8	136,4	136,4	54,1	0,8	0,001	0,96	0,016	0,12
Bregenz (1961-2015)	spring	441,4	376,8	128,4	113,2	40,0	0,9	-0,021	0,37	-0,041	0,09
	summer	668,9	566,5	144,9	107,4	67,5	0,7	0,016	0,39	-0,007	0,77
	autumn	407,7	346,9	127,8	112,1	39,9	0,9	0,032	0,18	0,026	0,29
	winter	312,5	265,5	109,0	88,9	32,3	0,9	-0,032	0,35	-0,038	0,32
	year	1829,3	1554,5	268,1	213,2	171,4	0,5	0,005	0,77	-0,007	0,56
Graz University (1961-2015)	spring	185,7	188,6	60,9	62,3	3,1	1,0	0,000	0,97	0,006	0,86
	summer	370,7	377,3	93,2	94,6	7,1	1,0	0,002	0,91	0,007	0,77
	autumn	199,3	202,7	55,3	56,4	4,6	1,0	0,017	0,50	0,021	0,37
	winter	91,6	93,0	39,6	40,3	1,3	1,0	-0,010	0,74	-0,003	0,92
	year	846,4	860,6	136,0	137,9	12,8	1,0	0,000	1,00	0,005	0,74
Wr.Neustadt (1961-2015)	spring	148,2	140,6	56,3	52,2	7,5	1,0	0,021	0,51	0,003	0,89
	summer	251,1	236,8	76,9	74,1	18,5	0,9	0,019	0,48	-0,001	0,95
	autumn	138,7	129,8	47,2	41,0	16,6	0,9	**0,053**	0,04	0,037	0,16
	winter	82,4	76,8	30,4	28,3	10,8	0,9	0,000	0,96	-0,021	0,56
	year	620,2	583,6	113,4	101,2	49,1	0,8	0,020	0,25	-0,002	0,94
Zell am See 1961-2015	spring	253,3	252,6	66,4	64,4	7,2	1,0	0,028	0,32	0,044	0,09
	summer	471,6	472,6	80,5	78,6	15,3	1,0	0,015	0,24	**0,038**	0,02
	autumn	250,7	250,0	78,4	78,9	7,5	1,0	0,050	0,06	**0,066**	0,00
	winter	191,2	191,1	78,9	77,7	5,7	1,0	-0,012	0,78	0,006	0,91
	year	1166,9	1166,5	146,4	143,1	30,8	1,0	0,010	0,30	**0,033**	0,01

max. difference from trends as mm/(1961-2015) <|2mm|

Trend from relative time series to mean 1961-2000 (Sen-Theil method)

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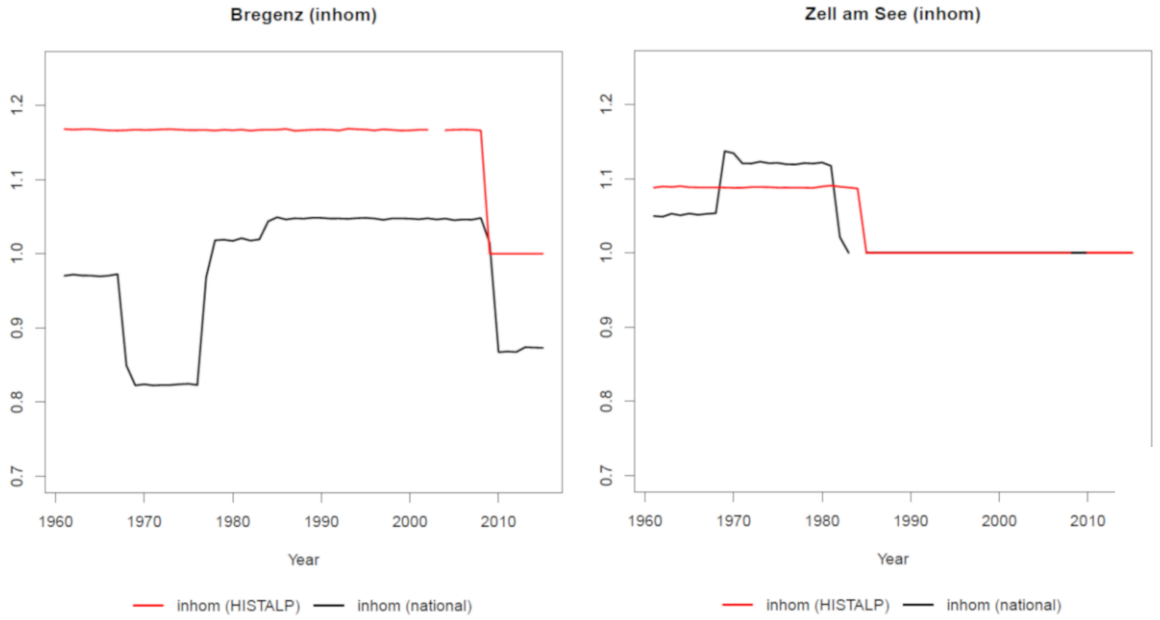
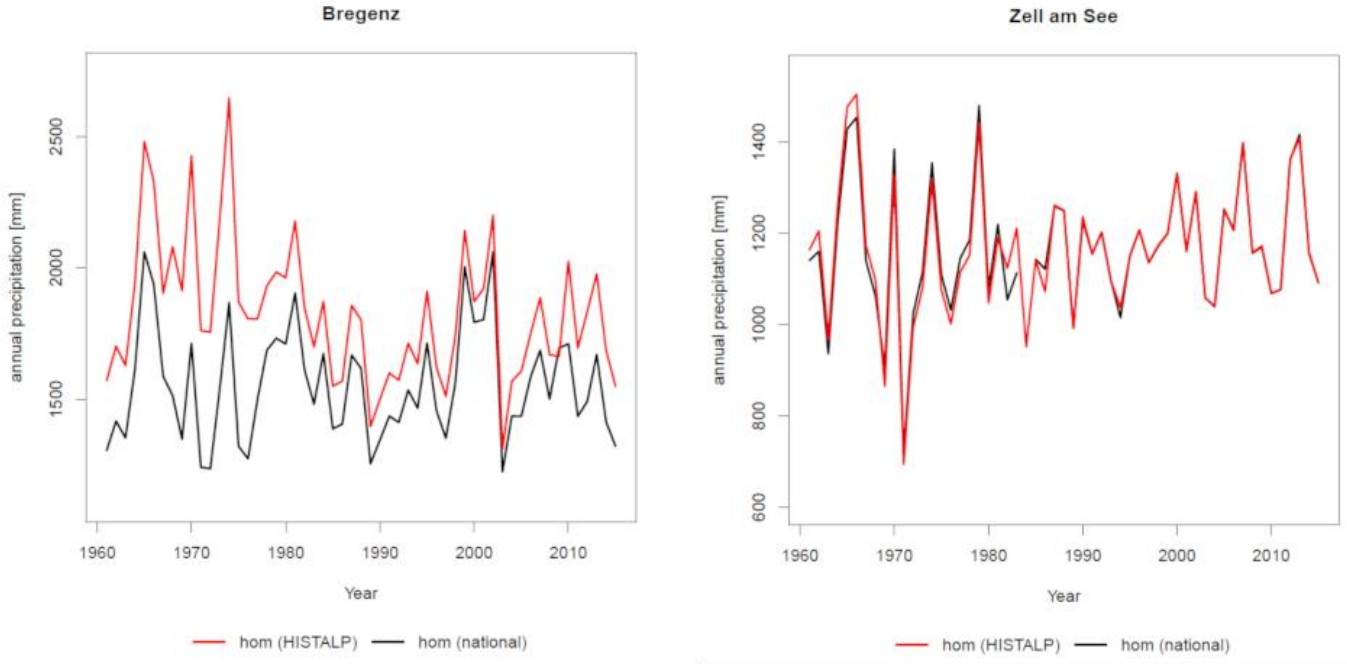
Comparison with other homogenised data sets





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Quintessence

Difference between datasets caused by:

- in part original data (Italy, Hungary)
- differences in gap filling
- Homogenisation method + timing of homogenisation
- Selection of reference stations
- Comparison shows necessity for closer examination for small number of single stations: Bregenz, Pècs

On the whole good agreement between different datasets.

It seem reasonable to homogenise stations together that are used together.

⇒ Paper submitted to Special Issue to homogenisierung at International Journal of Climatology
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Next steps

- Correction of Hungarian original data
- Examination of suspect stations and if necessary new homogenisation:
- Changes in structure of HISTALP-Database to keep overview on versions of original and homogenised data.

Longer term plans

- For Uncertainty information: homogenisation for complete dataset with additional methods
- Homogenisation of temperature (and other parameters)

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Thanks for your attention