

Software solution for data quality control and homogenization of time series

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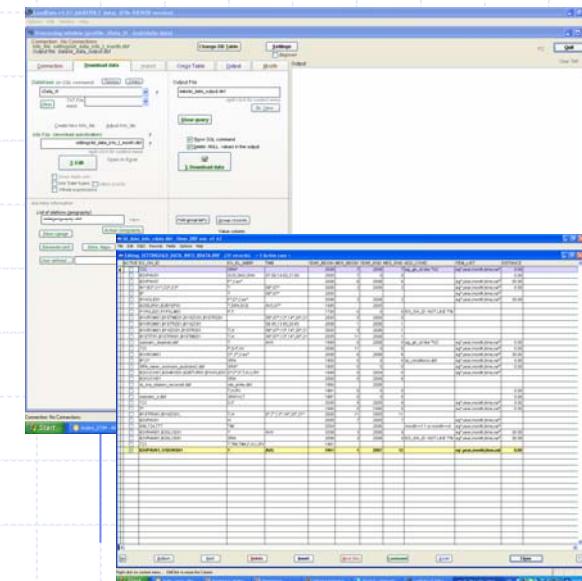
Software package to be presented

- ◆ Originally created for homogeneity testing and time series analysis (trends, cycles, correlation analysis)
- ◆ Recently added functions for extreme values analysis (GEV, GPD), RCM outputs validation and correction, multivariate analysis (connection with R software)

<http://www.climahom.eu>

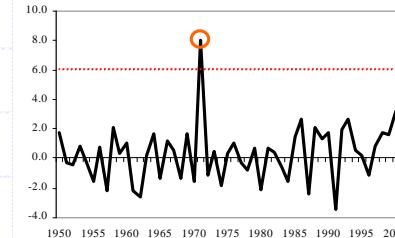
Download data from database (e.g. Oracle)

(LoadData)



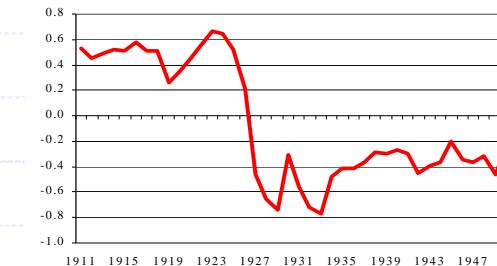
Quality control

(ProClimDB)



Homogenization

(ProClimDB/AnClim)



A	B10N	ID	MONT	ST_BAS	1000RH	HUMAR	ST_1	ST_2	ST_3	ST_4	ST_5	DIFLJ	I
T_03_30	BIRUTROU_T_03_30		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_30	BORNARO_T_03_30		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_30	BIRUTROU_T_03_30		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_30	COPRED_T_03_30		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_30	COOLOMH_T_03_30		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_30	DIFLJ_T_03_30		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_30	HUMAR_T_03_30		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_30	MONT_T_03_30		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_30	ST_BAS_T_03_30		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_30	1000RH_T_03_30		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_40	BIRUTROU_T_03_40		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_40	BORNARO_T_03_40		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_40	BIRUTROU_T_03_40		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_40	COPRED_T_03_40		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_40	COOLOMH_T_03_40		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_40	DIFLJ_T_03_40		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_40	HUMAR_T_03_40		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_40	MONT_T_03_40		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_40	ST_BAS_T_03_40		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_40	1000RH_T_03_40		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_45	BIRUTROU_T_03_45		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_45	BORNARO_T_03_45		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_45	BIRUTROU_T_03_45		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_45	COPRED_T_03_45		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_45	COOLOMH_T_03_45		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_45	DIFLJ_T_03_45		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_45	HUMAR_T_03_45		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_45	MONT_T_03_45		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_45	ST_BAS_T_03_45		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_45	1000RH_T_03_45		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_50	BIRUTROU_T_03_50		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_50	BORNARO_T_03_50		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_50	BIRUTROU_T_03_50		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_50	COPRED_T_03_50		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_50	COOLOMH_T_03_50		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_50	DIFLJ_T_03_50		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_50	HUMAR_T_03_50		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_50	MONT_T_03_50		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_50	ST_BAS_T_03_50		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_50	1000RH_T_03_50		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_55	BIRUTROU_T_03_55		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_55	BORNARO_T_03_55		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_55	BIRUTROU_T_03_55		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_55	COPRED_T_03_55		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_55	COOLOMH_T_03_55		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_55	DIFLJ_T_03_55		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_55	HUMAR_T_03_55		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_55	MONT_T_03_55		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_55	ST_BAS_T_03_55		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_55	1000RH_T_03_55		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_60	BIRUTROU_T_03_60		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_60	BORNARO_T_03_60		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_60	BIRUTROU_T_03_60		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_60	COPRED_T_03_60		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_60	COOLOMH_T_03_60		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_60	DIFLJ_T_03_60		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_60	HUMAR_T_03_60		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_60	MONT_T_03_60		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_60	ST_BAS_T_03_60		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_60	1000RH_T_03_60		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_65	BIRUTROU_T_03_65		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_65	BORNARO_T_03_65		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_65	BIRUTROU_T_03_65		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_65	COPRED_T_03_65		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_65	COOLOMH_T_03_65		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_65	DIFLJ_T_03_65		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_65	HUMAR_T_03_65		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_65	MONT_T_03_65		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_65	ST_BAS_T_03_65		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_65	1000RH_T_03_65		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_70	BIRUTROU_T_03_70		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_70	BORNARO_T_03_70		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_70	BIRUTROU_T_03_70		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_70	COPRED_T_03_70		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_70	COOLOMH_T_03_70		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_70	DIFLJ_T_03_70		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_70	HUMAR_T_03_70		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_70	MONT_T_03_70		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_70	ST_BAS_T_03_70		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_03_70	1000RH_T_03_70		240,00				225,00	670,00	203,00	210,00	740,00	1	
T_0													

Statistical analysis

...

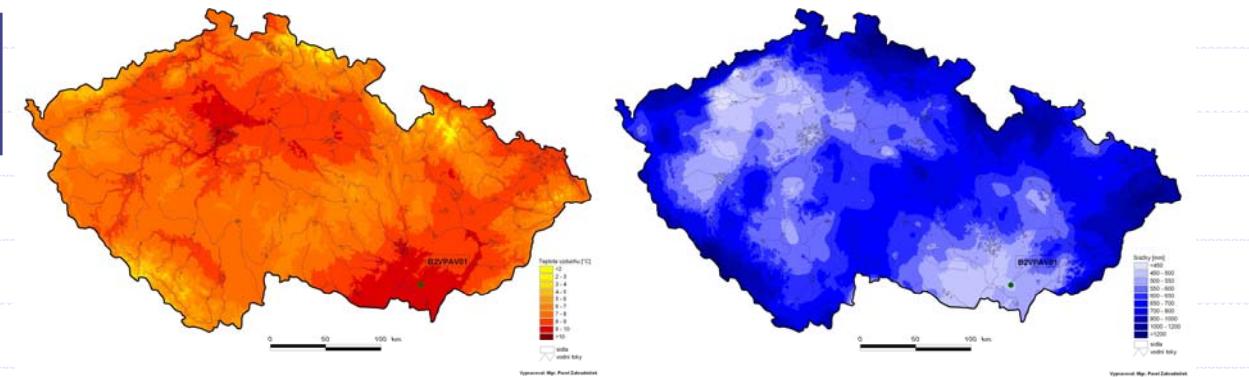
Validation of RCM outputs

Extreme value analysis

Correction of RCM outputs

Spatial analysis

(connection ProClimDB - ArcView)



Further tools:

(connection ProClimDB - R)

Software Package for Processing Climatological Data

- ◆ Application for downloading data from central database (e.g. Oracle)
- ◆ ProClimDB software for processing whole dataset (finding outliers, combining series, creating reference series, preparing data for homogeneity testing, analysis ...)
- ◆ AnClim software for homogeneity testing

<http://www.climahom.eu>

LoadData software, SQL commands generator (based on given *Database Table* and *Info_file*)

Processing window (profile: v_day_n)

Connection **Download data** **Info** **Cross Table** **Output** **Modify** **Output** **Last Output**

Database: (SQL command) **Tables** **Views**
V_DAY_N **?**

Output File: **data\output.dbf** **right click for context menu** **View**

Desc **Create New Info_file**
Adjust Info_file

Info File (download specification): **?**
settings\ld_data_info_day_n.dbf **?** **Show SQL command**

3. Download data

	Active	Eg_gh_id	Eg_el_abbr	Time	Begin	End	Last_days	Add_cond	Distance
	0	B1VIZ001	T%		5.2.2005	11.2.2005	0		0.0
	0	B2DYJA01	HPU*		1.3.2005	..	0		0.0
	0	B2BTUR01	JEV,A		1.1.1990	..	0		0.0
	0	B2BZAB*	SRA*		3		0.0
List	0	B1PROT01	T,H	AVG	1.1.1961	..	0		15.0
	0	723,667	Fmax		7.11.2000	9.11.2002	0		0.0
	1	B2BZAB*	T*		1.5.2005	..	0		0.0

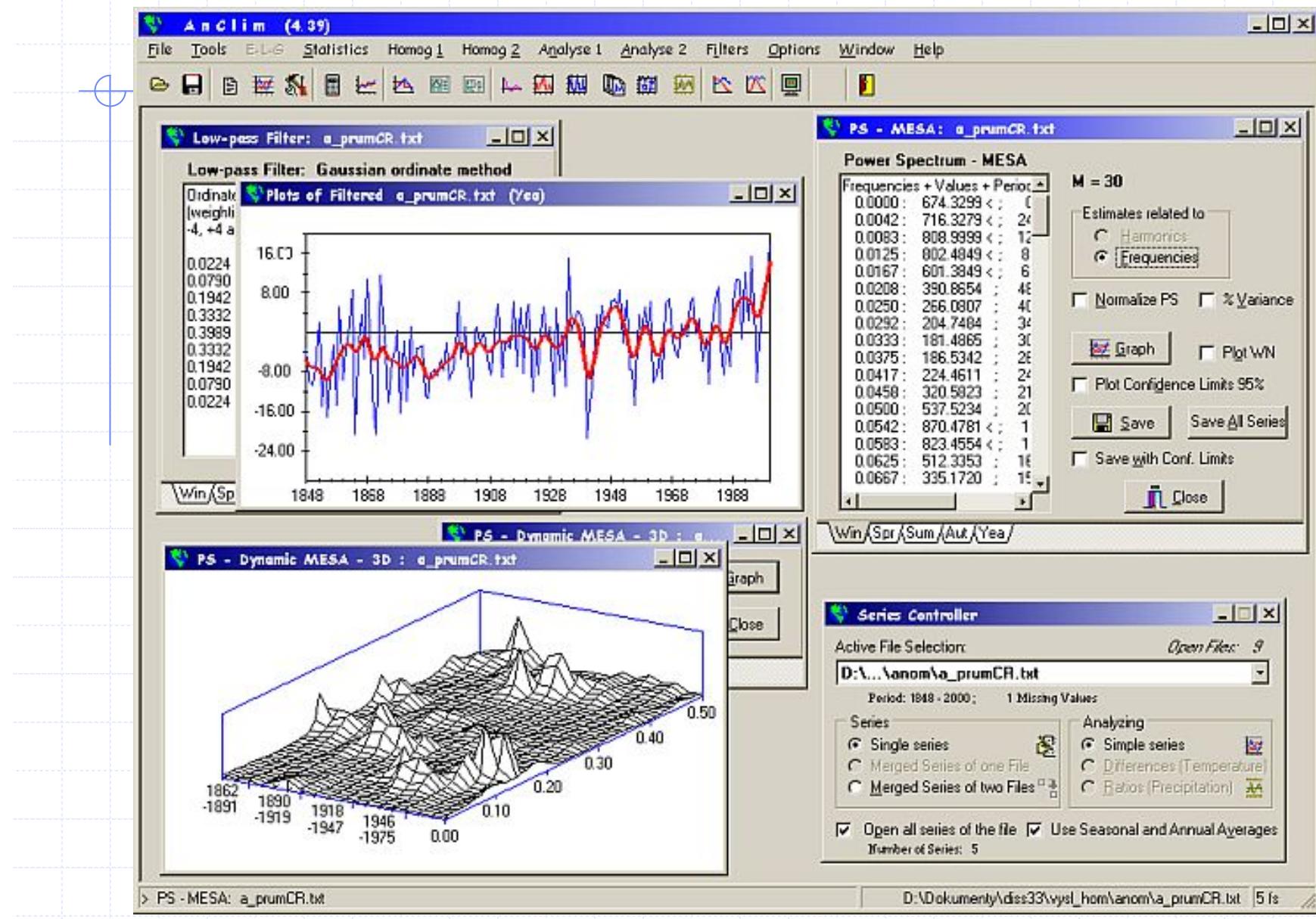
Elements (all) **Elem. flags**

time

Connection: oraclebr
Info_file: settings\ld_data_info_day_n.dbf **Settings** **Change PROFILE** **Quit**

AnClim software, TXT files (each station has its own text file)

Monthly (seasonal, annual) or daily data processing
convenient for learning of statistical methods in climatology (tutorials)



Examples of Data formats – AnClim, monthly data

Edit precip_bohemia.txt																		
1876	19.0	78.0	76.0	37.0	42.0	69.0	55.0	60.0	91.0	16.0	39.0	50.0	632.0					
1877	56.0	76.0	46.0	30.0	50.0	43.0	100.0	62.0	53.0	24.0	32.0	41.0	613.0					
1878	48.0	19.0	82.0	52.0	68.0	49.0	69.0	88.0	46.0	49.0	37.0	30.0	637.0					
1879	29.0	52.0	33.0	49.0	70.0	114.0	86.0	78.0	40.0	36.0	63.0	29.0	679.0					
1880	32.0	22.0	34.0	48.0	114.0	82.0	93.0	117.0	53.0	85.0	41.0	98.0	819.0					
1881	13.0	20.0	72.0	28.0	88.0	93.0	79.0	98.0	77.0	52.0	18.0	24.0	662.0					
1882	14.0	25.0	23.0	55.0	84.0	87.0	139.0	109.0	84.0	52.0	85.0	73.0	830.0					
1883	31.0	19.0	33.0	18.0	33.0	123.0	110.0	50.0	66.0	36.0	24.0	59.0	602.0					
1884	44.0	12.0	40.0	27.0	32.0	121.0	84.0	60.0	36.0	104.0	36.0	61.0	657.0					
1885	11.0	16.0	48.0	14.0	51.0	36.0	76.0	65.0	89.0	48.0	55.0	51.0	560.0					
1886	35.0	12.0	52.0	59.0	53.0	147.0	93.0	51.0	42.0	42.0	31.0	83.0	700.0					
1887	10.0	18.0	56.0	29.0	117.0	39.0	45.0	74.0	34.0	15.0	60.0	44.0	541.0					
1888	38.0	47.0	80.0	56.0	28.0	104.0	95.0	123.0	67.0	65.0	32.0	15.0	750.0					
1889	20.0	62.0	41.0	59.0	68.0	71.0	103.0	53.0	80.0	82.0	18.0	20.0	677.0					
1890	65.0	7.0	23.0	89.0	74.0	105.0	92.0	145.0	111.0	48.0	85.0	6.0	850.0					
1891	49.0	12.0	44.0	47.0	50.0	95.0	136.0	72.0	39.0	16.0	41.0	64.0	665.0					
1892	52.0	47.0	34.0	48.0	52.0	97.0	71.0	27.0	85.0	62.0	12.0	38.0	625.0					
1893	48.0	53.0	39.0	2.0	71.0	47.0	80.0	41.0	52.0	56.0	50.0	18.0	557.0					
1894	7.0	47.0	63.0	64.0	99.0	84.0	98.0	82.0	73.0	113.0	15.0	30.0	775.0					
1895	58.0	32.0	54.0	50.0	95.0	80.0	84.0	79.0	31.0	51.0	46.0	78.0	738.0					
1896	34.0	14.0	56.0	55.0	96.0	103.0	92.0	98.0	75.0	28.0	29.0	24.0	704.0					
1897	38.0	48.0	67.0	39.0	125.0	50.0	182.0	101.0	74.0	26.0	26.0	27.0	803.0					
1898	42.0	45.0	46.0	73.0	80.0	63.0	61.0	51.0	43.0	61.0	29.0	36.0	630.0					
1899	50.0	18.0	15.0	78.0	136.0	62.0	102.0	65.0	127.0	22.0	28.0	55.0	758.0					
1900	91.0	81.0	81.0	51.0	52.0	95.0	99.0	40.0	31.0	64.0	55.0	64.0	804.0					
1901	34.0	38.0	56.0	67.0	53.0	74.0	105.0	74.0	37.0	67.0	46.0	51.0	702.0					
1902	37.0	35.0	49.0	47.0	74.0	82.0	92.0	75.0	64.0	50.0	39.0	44.0	688.0					
1903	31.0	34.0	17.0	63.0	49.0	61.0	115.0	93.0	52.0	67.0	89.0	20.0	691.0					
1904	21.0	57.0	31.0	68.0	61.0	39.0	23.0	16.0	54.0	66.0	74.0	35.0	545.0					
1905	46.0	40.0	49.0	54.0	61.0	50.0	86.0	105.0	53.0	68.0	56.0	32.0	700.0					
1906	45.0	29.0	70.0	23.0	85.0	77.0	71.0	61.0	129.0	31.0	33.0	45.0	699.0					
1907	59.0	27.0	52.0	59.0	48.0	68.0	137.0	62.0	37.0	31.0	27.0	67.0	674.0					
1908	32.0	56.0	28.0	51.0	65.0	66.0	69.0	84.0	49.0	1.0	30.0	12.0	543.0					
1909	32.0	76.0	28.0	58.0	50.0	100.0	138.0	45.0	58.0	24.0	52.0	71.0	732.0					
1910	34.0	28.0	22.0	44.0	86.0	121.0	93.0	95.0	105.0	27.0	104.0	40.0	799.0					
1911	31.0	51.0	35.0	32.0	74.0	32.0	28.0	35.0	58.0	29.0	36.0	64.0	505.0					

Examples of Data formats – AnClim, daily data

Year	Day	1	2	3	4	5	6	7	8	9	10	11	12
1917	11	0.0	-9.8	-4.6	2.0	9.2	16.2	15.0	15.4	11.8	8.4	5.3	-2.5
1917	12	-4.6	-7.6	-4.6	8.4	11.2	17.0	13.8	17.2	18.9	5.2	3.2	0.0
1917	13	-2.0	-6.8	2.4	10.0	11.0	17.8	14.4	19.2	13.0	7.7	1.2	-2.0
1917	14	-6.0	-13.2	0.8	4.0	12.4	17.6	18.0	24.6	9.0	12.3	0.2	-2.0
1917	15	-0.6	-6.8	3.4	4.6	14.2	15.4	18.0	18.7	8.6	8.7	1.0	2.0
1917	16	0.0	-10.4	-6.8	6.2	15.8	18.6	21.4	15.4	7.3	6.0	0.5	-1.2
1917	17	8.4	-11.6	-3.8	3.2	13.8	19.2	19.4	14.0	11.4	4.6	-0.8	-0.5
1917	18	-2.6	-2.6	2.2	3.2	12.2	21.8	16.4	15.2	17.3	12.8	0.2	-0.6
1917	19	-2.6	-1.6	2.2	0.0	21.0	22.4	20.0	15.4	14.6	6.4	4.4	-3.8
1917	20	-9.0	0.0	3.4	0.4	19.0	25.0	21.0	21.4	18.0	4.3	4.6	-9.0
1917	21	-14.6	-1.2	1.0	3.0	12.4	26.0	17.0	17.8	15.0	9.1	5.8	-10.8
1917	22	-13.8	-2.8	-2.8	2.4	6.6	25.0	14.2	15.6	9.3	5.6	1.8	-3.2
1917	23	-11.6	-7.0	-2.8	0.1	11.4	16.2	14.8	14.2	6.6	6.6	1.0	-4.6
1917	24	-10.4	-11.6	-1.8	1.4	15.2	12.6	16.2	23.3	8.4	7.6	6.5	-8.4
1917	25	-10.4	-0.1	-1.6	2.2	17.4	11.2	17.0	17.2	7.4	4.1	7.8	-6.0
1917	26	-11.8	0.4	-1.2	1.6	13.8	20.0	17.8	15.2	7.7	2.8	1.4	-5.0
1917	27	-11.0	0.6	3.0	5.2	11.0	20.0	19.0	18.6	8.8	6.1	-2.4	-7.1
1917	28	-13.0	-1.0	0.0	5.0	18.6	17.2	17.2	13.4	14.8	11.8	5.8	-7.2
1917	29	-11.0	missing	-1.0	4.8	21.0	22.0	23.0	21.6	11.2	14.6	8.4	-2.4
1917	30	-11.2	missing	3.8	11.4	20.0	23.4	20.6	12.4	10.2	4.2	5.6	-2.0
1917	31	-8.6	missing	4.6	missing	23.6	missing	24.0	14.2	missing	7.8	missing	-5.0
1918	1	-5.6	-3.2	4.0	3.6	9.4	12.3	12.2	13.0	13.2	8.3	6.0	-2.8
1918	2	-7.4	-1.0	7.0	12.6	7.6	9.8	11.8	17.0	13.4	7.0	4.4	-3.6
1918	3	-10.8	-1.8	10.0	8.4	9.4	9.8	15.0	16.8	11.8	4.1	4.4	-6.0
1918	4	-13.6	-2.6	6.3	5.1	11.6	7.0	13.4	17.3	10.8	5.4	6.3	0.0

ProClimDB software

7.6.1 (MONTHLY data)

File Tools Trend Calculate Calc2 Neighbors Reference Homog Adjust Fill Miss Window Help

Processing window (profile: slovensko)

Menu : Reference 0

Calculates reference series for each station given in Info File

Item : From Correlations 2

Selects given Number of stations with average correlation higher than a Limit and creates reference

Source files: *right click for context menu*

Data file: *at_harv_mes_never_reconstr2.dbf*
(Data info file) *datastas_info.dbf*
Correlations *datacorrel.dbr*

Destination files: *right click here*

Ref. Series *dataset_series*
Ref. Info file *dataset_ser_n*

Settings

Create Info File only
Number of Stations: 5
Limit correlation: 0.2,100
Maximum altitude diff.: -100
 Weighted average
Years per one part:
Overlap years:
Allow length & overlay
Correlations column: K13

Process info:

Number of stations: 5
Difference in measuring periods (base and site) taken into account!
Neighbours selected according to: correlation based on K13 column
- additional condition: limit distance: maximum
Neighbours can differ in altitude at least: 100 m
Base station has to have a length at least: 20 years.
Neighbours have to have a length at least: 20 years.
Minimum length of period in common: 10 years (select of 5).
Selected stations from the same region only! (Column 1 Info_file).

Stations processed: 1.B1BRBY01_TMA_21

Run **Last Output**

ref info t.dbf - Show_DBF.exe v1.2.4

File Edit Edit2 Records Fields Options Help

Editing D:\dokumenty\progr\proc data\DATA\zprac_CR\Vse_od61\ref info t.dbf (12306 records, 20 marked for deleting)

ID_1	ID_2	REGION	BEGIN	END	LENGTH	REMARK	CORREL	DISTANCE	AZIMUTH	AL
B1BRBY01_T_07:00	B1BRBY01_T_07:00_1_d	T_07:00	1.1.1960	31.12.1989	10958	Ost.		0.00	0.0	50
B1BRBY01_T_07:00	B1BRBY01_T_07:00_2_d	T_07:00	31.12.1964	31.12.1994	10957	5st. (I:29.3		92.80	122.8	50
	B1LUHA01_T_07:00	T_07:00	31.12.1960	31.12.2007		10957 y. com		18.25	176.4	50
	B1VIZ001_T_07:00	T_07:00	31.12.1960	31.12.2007		10957 y. com		18.71	134.4	50
	O3HUSL01_T_07:00	T_07:00	31.12.1960	31.12.2007		10957 y. com		23.66	70.3	50
	O3VSET01_T_07:00	T_07:00	31.12.1960	31.12.2007		10957 y. com		26.76	93.1	50
	B1ZLIN01_T_07:00	T_07:00	31.12.1960	31.12.1996		10957 y. com		29.30	150.3	50
B1BRBY01_T_14:00	B1BRBY01_T_14:00_1_d	T_14:00				Right click for context menu ...				
	B1BRBY01_T_14:00	B1BRBY01_T_14:00_2_d	T_14:00			Sort data according to this column				
	B1LUHA01_T_14:00	T_14:00				Sort data according to All columns CTRL+O				
	B1VIZ001_T_14:00	T_14:00				Find a string CTRL+F				
	O3HUSL01_T_14:00	T_14:00				Find next F3				
	O3VSET01_T_14:00	T_14:00				Replace strings CTRL+L				
	B1ZLIN01_T_14:00	T_14:00				List cases of the column CTRL+T				
B1BRBY01_T_21:00	B1BRBY01_T_21:00_1_d	T_21:00				Filter (show rows of a particular case)				
	B1BRBY01_T_21:00	B1BRBY01_T_21:00_2_d	T_21:00			Filter out into new Application				
	B1LUHA01_T_21:00	T_21:00				Blank the cell CTRL+B				
	B1VIZ001_T_21:00	T_21:00				Insert row CTRL+I				
	O3HUSL01_T_21:00	T_21:00				Mark/Unmark record for deleting CTRL+D				
	O3VSET01_T_21:00	T_21:00				Delete rest (mark) CTRL+A				
	B1ZLIN01_T_21:00	T_21:00				Recall rest (unmark) CTRL+R				
B1BRBY01_T_AVG	B1BRBY01_T_AVG_1_d	T_AVG				Copy row(s) to Clipboard CTRL+W				
	B1BRBY01_T_AVG	B1BRBY01_T_AVG_2_d	T_AVG			Paste row(s) from Clipboard CTRL+E				
	B1LUHA01_T_AVG	T_AVG				Display DBF file				
	B1VIZ001_T_AVG	T_AVG				Quit viewer CTRL+Q				
	O3HUSL01_T_AVG	T_AVG								
	O3VSET01_T_AVG	T_AVG	31.12.1960	31.12.2007		10957 y. com		26.76	93.1	50
	B1ZLIN01_T_AVG	T_AVG	31.12.1960	31.12.1996		10957 y. com		29.30	150.3	50

No Bottom Sort Delete Insert Modi Stru Command Excel Close ?

ProcData software, only one Data file, accompanied by Info_file

database processing

Processing window (profile: slovensko)

Menu : Reference
Calculates reference series for each station given

Item : From Correlations
Selects given Number of stations with average corr.

Source files: right click for context menu

Data file	\et_hurv_mes_new_reconstr2
(Data Info file)	data\data_info.dbf

Set **N** **L** **M** **Y** **O** **Q** **Show longitude & latitude**

Correlations column K13

ID	EG_EL_ABBR	YEAR	DAY	TIME	N1	N2	N3	N4	N5	N6	N7	N8		
B1BYSH01_SCE_07:00	SCE	2006	24	07:00	30.00	10.00	0.00	0.00	0.00	0.00	0.00	-999.00		
B1BYSH01_SCE_07:00	SCE	2006	25	07:00	28.00	10.00	0.00	0.00	0.00	0.00	0.00	-999.00		
B1BYSH01_SCE_07:00	SCE	2006	26	07:00	28.00	12.00	0.00	0.00	0.00	0.00	0.00	-999.00		
B1BYSH01_SCE_07:00	SCE	2006	27	07:00	28.00	9.00	0.00	0.00	0.00	0.00	0.00	-999.00		
B1BYSH01_SCE_07:00	SCE	2006	28	07:00	28.00	9.00	0.00	0.00	0.00	0.00	0.00	-999.00		
B1BYSH01_SCE_07:00	SCE	2006	29	07:00	28.00	-999.00	0.00	0.00	0.00	0.00	0.00	-999.00		
B1BYSH01_SCE_07:00	SCE	2006	30	07:00	28.00	-999.00	0.00	0.00	0.00	0.00	0.00	-999.00		
B1BYSH01_SCE_07:00	SCE	2006	31	07:00	27.00	-999.00	0.00	-999.00	0.00	-999.00	0.00	-999.00		
B1BYSH01_SNO_07:00	SNO	1961	1	07:00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
B1BYSH01_SNO_07:00	SNO	1961	2	07:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
B1BYSH01_SNO_07:00	SNO	1961	3	07:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
B1BYSH01_SNO_07:00	SNO	1961	4	07:00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00		
B1BYSH01_SNO_07:00	SNO	1961	5	07:00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00		
B1BYSH01_SNO_07:00	SNO	1961	6	07:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
B1BYSH01_SNO_07:00	SNO	1961	7	07:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
B1BYSH01_SNO_07:00	SNO	1961	8	07:00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00		
NAME	ID	B	E	IDXXX	III	REGION	LATITUDE	LONGITUDE	ALTITUDE	BEGIN	END	LENGTH	MISS_CN	
X Bystřice pod Hostýnem	B1BYSH01_SCE_07:00			B1BYSH01	SCE	17.67	49.40	315	1.1.1961	31.1.2006	46	0.00	0.00	0.00
X Bystřice pod Hostýnem	B1BYSH01_SNO_07:00			B1BYSH01	SNO	17.67	49.40	315	1.1.1961	31.1.2006	46	0.00	0.00	0.00
Bystřice pod Hostýnem	B1BYSH01_SRA_07:00			B1BYSH01	SRA	17.67	49.40	315	1.1.1872	31.1.2006	135	0.00	0.00	0.00
X Bystřice pod Hostýnem	B1BYSH01_SVH_07:00			B1BYSH01	SVH	17.67	49.40	315	1.1.1961	31.1.2006	46	0.00	0.00	0.00
X Holešov	B1HOLE01_SCE_07:00			B1HOLE01	SCE	17.57	49.32	224	1.1.1961	31.1.2006	46	0.00	0.00	0.00
X Holešov	B1HOLE01_SNO_07:00			B1HOLE01	SNO	17.57	49.32	224	1.1.1961	31.1.2006	46	0.00	0.00	0.00
X Holešov	B1HOLE01_SRA_07:00			B1HOLE01	SRA	17.57	49.32	224	1.1.1953	31.1.2006	54	0.00	0.00	0.00
X Holešov	B1HOLE01_SVH_07:00			B1HOLE01	SVH	17.57	49.32	224	1.1.1979	31.1.2006	28	0.00	0.00	0.00
X Napajedla	B1NAPA01_SCE_07:00			B1NAPA01	SCE	17.52	49.18	185	1.1.1961	31.1.2006	46	0.00	0.00	0.00
X Napajedla	B1NAPA01_SNO_07:00			B1NAPA01	SNO	17.52	49.18	185	1.1.1961	31.1.2006	46	0.00	0.00	0.00
Napajedla	B1NAPA01_SRA_07:00			B1NAPA01	SRA	17.52	49.18	185	1.1.1889	31.1.2006	118			
X Napajedla	B1NAPA01_SVH_07:00			B1NAPA01	SVH	17.52	49.18	185	1.1.1977	31.1.2006	30			
Brno	B2BKVE01_SCE_07:00			B2BKVE01	SCE	16.57	49.19	223	2.1.1922	31.1.1970	49			
Brno	B2BKVE01_SNO_07:00			B2BKVE01	SNO	16.57	49.19	223	3.1.1931	31.1.1970	40			
Brno	B2BKVE01_SRA_07:00			B2BKVE01	SRA	16.57	49.19	223	1.1.1922	31.1.1970	49			
Brno	B2BPIS01_SCE_07:00			B2BPIS01	SCE	16.57	49.20	203	1.1.1919	31.1.1979	61			
Brno	B2BPIS01_SNO_07:00			B2BPIS01	SNO	16.57	49.20	203	4.1.1931	31.1.1979	49			
Brno	B2BPIS01_SRA_07:00			B2BPIS01	SRA	16.57	49.20	203	1.1.1916	31.1.1979	64			
X Brno	B2BPIS01_SVH_07:00			B2BPIS01	SVH	16.57	49.20	203	1.1.1961	31.1.1979	19			
X Brno	B2BTUR01_SCE_07:00			B2BTUR01	SCE	16.70	49.16	241	1.1.1961	31.1.2006	46			
X Brno	B2BTUR01_SNO_07:00			B2BTUR01	SNO	16.70	49.16	241	1.1.1961	31.1.2006	46			
X Brno	B2BTUR01_SRA_07:00			B2BTUR01	SRA	16.70	49.16	241	1.1.1961	31.1.2006	46			
X Brno	B2BTUR01_SVH_07:00			B2BTUR01	SVH	16.70	49.16	241	1.1.1969	31.1.2006	38			
Jihlava	B2JIHL01_SCE_07:00			B2JIHL01	SCE	15.54	49.39	560	1.1.1961	31.1.1969	9			
X Jihlava	B2JIHL01_SNO_07:00			B2JIHL01	SNO	15.54	49.39	560	1.1.1961	31.1.1969	9			

Data formats - ProClimDB

- ◆ DBF files (the only DBF file for data + Info file)
- ◆ Macro in MS-Excel to load TXT,XLS,... files and to create a DBF data file
- ◆ function in ProClimDB to import from TXT,DBF files / export to TXT,... files
- ◆ Monthly (seasonal, annual) or daily (even individual time) data processing

Examples of Data formats – ProClimDB, monthly data

	Id	Year	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12	Remark
	11801_RV_07:00	1961	88.0	89.0	86.0	74.0	81.0	80.0	75.0	72.0	67.0	67.0	76.0	73.0	
	11801_RV_07:00	1962	87.0	81.0	79.0	68.0	75.0	68.0	70.0	78.0	80.0	87.0	89.0	87.0	
	11801_RV_07:00	1963	83.0	86.0	84.0	80.0	84.0	79.0	74.0	80.0	84.0	89.0	82.0	87.0	
	11801_RV_07:00	1964	85.0	78.0	84.0	75.0	77.0	79.0	80.0	83.0	83.0	87.0	89.0	92.0	
	11801_RV_07:00	1965	91.0	88.0	87.0	86.0	81.0	82.0	82.0	83.0	85.0	92.0	86.0	87.0	
	11801_RV_07:00	1966	87.0	86.0	88.0	84.0	77.0	80.0	85.0	88.0	90.0	88.0	89.0	88.0	
	11801_RV_07:00	1967	86.0	88.0	85.0	83.0	75.0	80.0	78.0	82.0	90.0	88.0	90.0	87.0	
	11801_RV_07:00	1968	87.0	91.0	82.0	75.0	74.0	73.0	77.0	87.0	89.0	92.0	90.0	88.0	
	11801_RV_07:00	1969	89.0	88.0	89.0	79.0	74.0	86.0	81.0	86.0	88.0	88.0	86.0	93.0	
	11801_RV_07:00	1970	90.0	92.0	89.0	84.0	78.0	78.0	84.0	88.0	89.0	93.0	87.0	91.0	
	11801_RV_07:00	1971	90.0	92.0	87.0	78.0	80.0	82.0	80.0	80.0	91.0	91.0	90.0	92.0	
	11801_RV_07:00	1972	88.0	86.0	75.0	85.0	84.0	78.0	85.0	86.0	88.0	88.0	87.0	87.0	
	11801_RV_07:00	1973	85.0	90.0	82.0	79.0	75.0	79.0	82.0	81.0	85.0	85.0	81.0	82.0	

(ID, Year, Months in columns: very useful format > easy processing of individual months)

	Id	Year	Pav_4h	Pdsav_4h	Pdssdv_4h	Pf20_4h	Pf40_4h	Pf50_4h	Pf60_4h	Pf80_4h	Pf90_4h
	ADAMCLISI	1961	1.221	6.886	6.355	0.957	0.880	0.814	0.756	0.542	0.38
	ADAMCLISI	1962	0.966	6.383	6.149	0.944	0.861	0.762	0.729	0.489	0.36
	ADAMCLISI	1963	1.079	6.522	6.306	0.950	0.878	0.804	0.737	0.545	0.36
	ADAMCLISI	1964	1.051	6.756	5.713	0.936	0.884	0.835	0.772	0.575	0.36
	ADAMCLISI	1965	1.055	7.119	7.178	0.925	0.843	0.796	0.721	0.511	0.36
	ADAMCLISI	1966	1.723	6.796	7.322	0.959	0.860	0.800	0.710	0.472	0.36
	ADAMCLISI	1967	0.976	6.864	5.201	0.949	0.865	0.782	0.709	0.510	0.36
	ADAMCLISI	1968	1.117	7.625	9.771	0.955	0.880	0.823	0.749	0.522	0.36
	ADAMCLISI	1969	1.493	7.317	10.978	0.963	0.904	0.855	0.799	0.600	0.46
	ADAMCLISI	1970	1.633	6.348	5.941	0.966	0.906	0.840	0.782	0.562	0.36
	ADAMCLISI	1971	1.670	6.042	5.694	0.964	0.899	0.841	0.789	0.612	0.46
	ADAMCLISI	1972	1.533	7.974	7.103	0.967	0.911	0.861	0.803	0.615	0.46
	ADAMCLISI	1973	1.264	7.200	6.444	0.967	0.900	0.824	0.754	0.560	0.46

(ID, Year, Annual data (e.g. various indexes) in columns: e.g. individual months, seasons and year can be used > easy processing of individual columns)

Examples of Data formats - ProClimDB, daily data

	Id	Year	Day	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12
►	B1BYSH01_T_07:00	1866	1	-3.7	-0.6	2.8	3.8	11.6	16.0	17.4	9.3	11.3	9.7	4.1	-2.1
	B1BYSH01_T_07:00	1866	2	-3.2	2.7	2.5	4.5	15.0	16.0	15.8	9.7	11.4	12.0	0.5	-3.4
	B1BYSH01_T_07:00	1866	3	-3.0	5.7	0.8	5.8	4.7	15.7	17.0	12.8	12.3	9.1	3.5	1.0
	B1BYSH01_T_07:00	1866	4	-1.3	1.0	-3.2	8.0	4.8	14.5	10.5	13.0	8.8	8.0	5.0	1.5
	B1BYSH01_T_07:00	1866	5	-4.5	1.0	0.5	5.3	10.7	16.4	14.0	11.8	10.5	8.0	4.5	4.0
	B1BYSH01_T_07:00	1866	6	-6.5	1.1	-0.1	5.6	5.0	14.4	14.0	11.5	11.3	7.3	3.8	1.5
	B1BYSH01_T_07:00	1866	7	-3.9	5.0	2.9	8.1	4.1	14.5	11.7	9.0	12.6	1.0	6.8	3.3
	B1BYSH01_T_07:00	1866	8	-4.4	3.9	-1.1	8.7	5.6	14.8	10.6	13.8	14.2	0.8	4.5	2.2
	B1BYSH01_T_07:00	1866	9	-2.0	0.0	0.3	11.6	9.5	14.0	10.7	15.8	14.2	0.7	5.0	-1.5
	B1BYSH01_T_07:00	1866	10	-1.7	1.5	2.7	11.2	11.9	13.5	11.9	11.7	12.4	3.0	0.8	-2.0
	B1BYSH01_T_07:00	1866	11	-1.8	1.4	-0.6	6.8	6.8	14.6	12.3	10.7	12.5	0.5	-4.0	0.0
	B1BYSH01_T_07:00	1866	12	2.3	4.5	0.0	5.8	9.5	16.7	11.8	8.7	12.5	3.2	0.5	-5.5
	B1BYSH01_T_07:00	1866	13	-1.9	2.1	1.6	6.4	6.0	16.4	14.5	8.9	10.5	6.0	4.0	0.6
	B1BYSH01_T_07:00	1866	14	-3.6	-1.7	2.4	5.3	6.2	15.7	15.0	9.5	6.5	8.5	6.1	4.0
	B1BYSH01_T_07:00	1866	15	1.1	-3.0	-3.7	9.4	6.8	13.0	16.2	10.5	11.4	5.0	1.9	-6.2
	B1BYSH01_T_07:00	1866	16	0.0	0.0	-4.3	4.8	5.5	11.4	16.7	11.3	13.5	2.8	-0.3	-6.0
	B1BYSH01_T_07:00	1866	17	1.0	0.5	-1.6	6.9	3.5	15.5	16.2	10.5	7.7	0.0	4.0	-2.2
	B1BYSH01_T_07:00	1866	18	0.0	1.9	4.0	6.7	4.2	8.8	15.7	10.0	10.5	-2.1	-5.0	-1.4
	B1BYSH01_T_07:00	1866	19	3.0	3.3	2.4	6.9	3.0	11.6	13.5	10.5	8.8	-0.1	-1.0	-0.9
	B1BYSH01_T_07:00	1866	20	1.0	-2.0	6.0	1.7	2.1	14.7	12.8	10.5	9.0	-1.5	-6.2	-3.9
	B1BYSH01_T_07:00	1866	21	0.0	-0.3	0.0	7.0	1.8	11.8	10.4	12.5	7.5	-1.1	-6.0	-4.0

(ID, Year, Day, Months in columns: very useful format > easy processing of individual months)

	Year	Month	Day	Id	Value2
	1961	1	1	T1HOLE01	-0.4
	1961	1	1	T1IVAN01	-1.6
	1961	1	1	T1KIOM01	-1.0
	1961	1	1	T1LUHA01	-0.6
	1961	1	1	T1TYSH01	-1.2
	1961	1	2	T1HOLE01	-2.3
	1961	1	2	T1IVAN01	-2.9
	1961	1	2	T1KIOM01	-3.5
	1961	1	2	T1LUHA01	-1.1
	1961	1	2	T1TYSH01	-3.5
	1961	1	3	T1HOLE01	-2.0
	1961	1	3	T1IVAN01	-2.2
	1961	1	3	T1KIOM01	-1.5
	1961	1	3	T1LUHA01	-2.9
	1961	1	3	T1TYSH01	-2.9
	1961	1	4	T1HOLE01	3.5

(ID, Year, Month, Day, Value:
very space consuming > long time
calculations ...)

Examples of Data formats - ProClimDB, daily data

ID	YEAR	MONT	VAL01	VAL02	VAL03	VAL04	VAL05	VAL06	VAL07	VAL08	VAL09	VAL10	VAL11	VAL12	VAL13	VAL14	VAL15	VAL16	VAL17	VAL18	VAL19	VAL20
B2DVES02	2001	3	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	
B2DVES02	2001	4	4.2	0.0	12.1	13.5	8.8	9.7	11.0	7.7	7.4	7.8	9.5	8.4	3.6	2.6	4.3	7.1	6.3	8.3	6.6	6
B2DVES02	2001	5	18.4	-999.0	21.2	19.5	18.7	-999.0	12.6	15.0	16.5	16.5	15.3	13.2	14.4	15.3	15.5	18.8	20.1	14.2	13.0	14
B2DVES02	2001	6	13.2	14.6	13.0	11.1	13.2	14.8	17.9	18.0	14.7	14.7	12.3	14.9	17.0	17.4	20.0	18.3	16.8	16.6	14.9	17
B2DVES02	2001	7	18.7	18.2	15.9	19.0	20.8	22.3	23.0	20.4	20.9	23.4	19.2	20.3	22.0	24.8	27.2	21.6	15.3	19.6	20.4	17
B2DVES02	2001	8	-999.0	22.5	25.9	22.1	19.3	21.3	22.0	21.6	21.0	17.7	17.0	17.7	19.7	-999.0	23.7	24.5	-999.0	24.4	25.1	21
B2DVES02	2001	9	15.9	16.9	18.5	16.4	13.9	14.8	14.1	15.4	11.9	11.9	12.8	-999.0	13.5	13.3	12.9	11.8	11.3	10.6	12.0	12
B2DVES02	2001	10	17.4	19.8	15.5	14.7	13.6	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	12.9	14.3	11.1	12.0	12.1	12.4
B2DVES02	2001	12	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	0.0	0	
B2DVES02	2002	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
B2DVES02	2002	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-999.0	-999.0	-999.0	-999.0	-999.0	
B2DVES02	2002	3	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999.0	-999	
B2DVES02	2002	4	0.0	0.0	0.0	0.0	2.5	0.8	2.7	6.2	7.0	5.2	7.8	8.3	9.9	9.4	8.5	10.0	11.8	13.1	11.5	11
B2DVES02	2002	5	16.1	19.5	22.6	22.8	13.3	15.2	16.7	18.1	18.5	17.3	18.1	18.9	18.6	17.3	16.4	18.1	21.8	18.5	17.9	16
B2DVES02	2002	6	15.8	13.8	17.4	20.6	19.8	17.3	15.4	15.6	16.5	16.7	16.7	19.8	21.7	21.9	21.4	22.4	22.6	25.4	25.7	26
B2DVES02	2002	7	22.6	21.5	25.3	17.1	19.5	22.4	20.8	22.8	24.6	28.5	21.2	22.3	22.1	22.5	23.9	21.7	21.4	20.4	19.1	21
B2DVES02	2002	8	22.7	10.5	0.0	0.0	17.8	20.9	19.7	20.7	20.5	21.0	19.8	17.0	17.3	19.5	19.1	21.0	21.7	22.2	21	
B2DVES02	2002	9	18.9	16.6	20.1	21.3	20.4	18.6	19.2	20.4	21.2	18.7	17.9	14.0	13.8	15.2	12.9	12.8	13.6	15.5	16.1	
B2DVES02	2002	10	11.1	11.3	12.0	12.1	10.8	11.7	7.4	7.7	8.1	7.7	5.4	3.8	5.6	4.0	0.9	10.4	11.6	8.5	7.3	6

(ID, Year, Month, Days in columns)

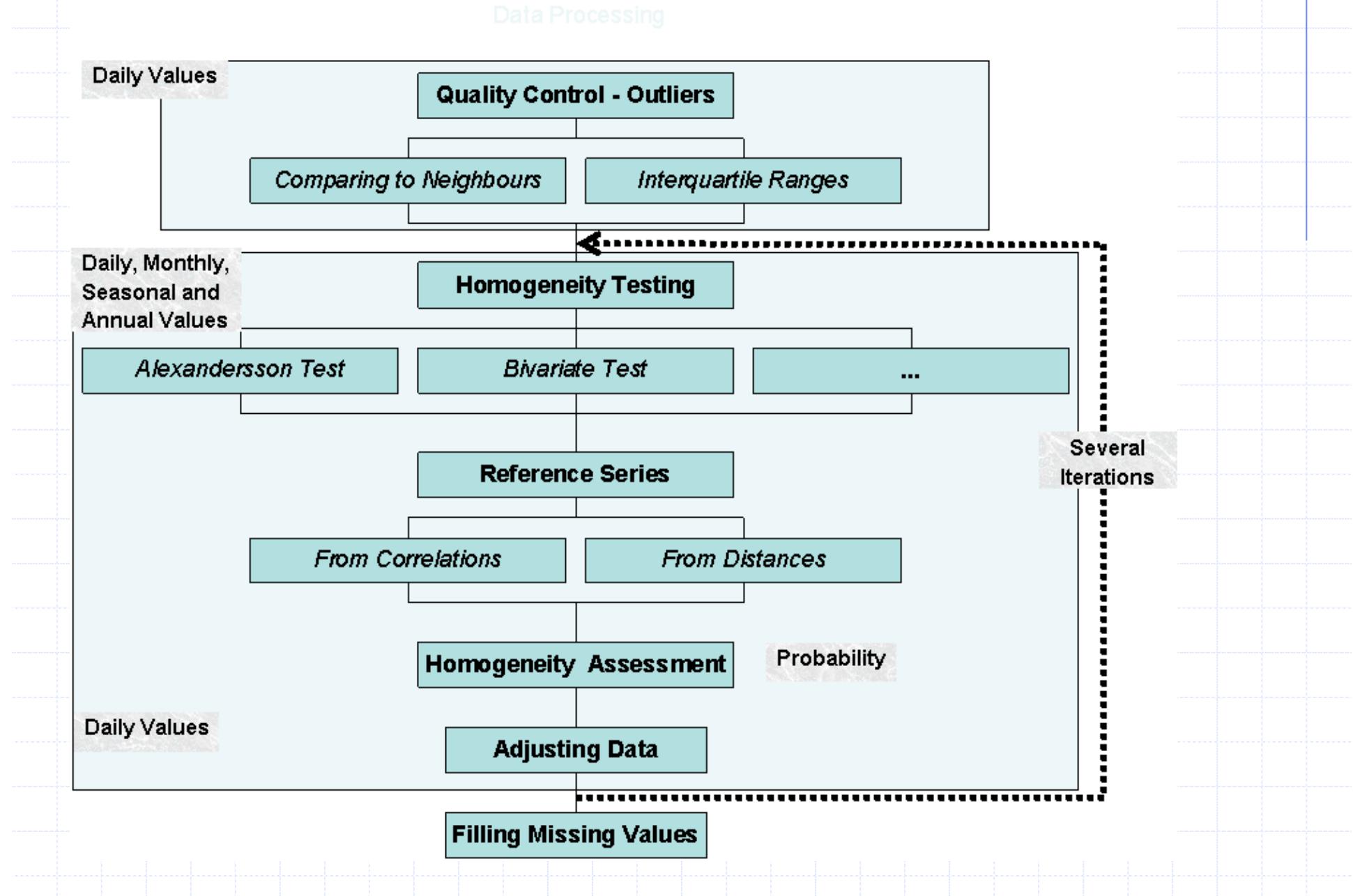
Year	Month	Day	T1hole01	T1ivan01	T1kiom01	T1luha01	T1piot01	T1tity01	T1tysh01
1961	1	1	-0.4	-1.6	-1.0	-0.6	-999	-999	-1.2
1961	1	2	-2.3	-2.9	-3.5	-1.1	-999	-999	-3.5
1961	1	3	-1.1	-1.3	-0.6	-2.0	-999	-999	-2.0
1961	1	4	3.5	0.3	1.0	3.1	-999	-999	2.6
1961	1	5	0.3	-1.4	-1.0	0.4	-999	-999	-0.5
1961	1	6	-3.4	-3.5	-8.0	-3.9	-999	-999	-4.5
1961	1	7	1.4	-1.9	-2.5	1.1	-999	-999	0.5
1961	1	8	-1.6	-2.4	-2.6	-1.4	-999	-999	-2.5
1961	1	9	-0.6	-1.4	-4.0	-0.8	-999	-999	-1.0
1961	1	10	-0.9	-1.1	-1.0	-0.9	-999	-999	-0.5
1961	1	11	0.2	0.1	-0.3	0.1	-999	-999	-2.0
1961	1	12	-0.3	-1.4	-0.3	-0.3	-999	-999	-2.2
1961	1	13	-6.2	-8.5	-7.5	-4.4	-999	-999	-8.5

(Year, Month, Day, ID's – stations in individual columns > suitable in case of the same period of measurements)

ProcData software, info_file

NAME	ID	B	E	L	IDXXX	III	REGION	LATITUDE	LONGITUDE	ALTITUDE	BEGIN	END	LENGTH	MISS_CN
✗ Bystřice pod Hostýnem	B1BYSH01_SCE_07:00				B1BYSH01		SCE	17.67	49.40	315	1.1.1961	31.1.2006	46	
✗ Bystřice pod Hostýnem	B1BYSH01_SNO_07:00				B1BYSH01		SNO	17.67	49.40	315	1.1.1961	31.1.2006	46	
✗ Bystřice pod Hostýnem	B1BYSH01_SRA_07:00				B1BYSH01		SRA	17.67	49.40	315	1.1.1872	31.1.2006	135	
✗ Bystřice pod Hostýnem	B1BYSH01_SVH_07:00				B1BYSH01		SVH	17.67	49.40	315	1.1.1961	31.1.2006	46	
✗ Holešov	B1HOLE01_SCE_07:00				B1HOLE01		SCE	17.57	49.32	224	1.1.1961	31.1.2006	46	
✗ Holešov	B1HOLE01_SNO_07:00				B1HOLE01		SNO	17.57	49.32	224	1.1.1961	31.1.2006	46	
✗ Holešov	B1HOLE01_SRA_07:00				B1HOLE01		SRA	17.57	49.32	224	1.1.1953	31.1.2006	54	
✗ Holešov	B1HOLE01_SVH_07:00				B1HOLE01		SVH	17.57	49.32	224	1.1.1979	31.1.2006	28	
✗ Napajedla	B1NAPA01_SCE_07:00				B1NAPA01		SCE	17.52	49.18	185	1.1.1961	31.1.2006	46	
✗ Napajedla	B1NAPA01_SNO_07:00				B1NAPA01		SNO	17.52	49.18	185	1.1.1961	31.1.2006	46	
Napajedla	B1NAPA01_SRA_07:00				B1NAPA01		SRA	17.52	49.18	185	1.1.1889	31.1.2006	118	
✗ Napajedla	B1NAPA01_SVH_07:00				B1NAPA01		SVH	17.52	49.18	185	1.1.1977	31.1.2006	30	
Brno	B2BKVE01_SCE_07:00				B2BKVE01		SCE	16.57	49.19	223	2.1.1922	31.1.1970	49	
Brno	B2BKVE01_SNO_07:00				B2BKVE01		SNO	16.57	49.19	223	3.1.1931	31.1.1970	40	
Brno	B2BKVE01_SRA_07:00				B2BKVE01		SRA	16.57	49.19	223	1.1.1922	31.1.1970	49	
Brno	B2BPIS01_SCE_07:00				B2BPIS01		SCE	16.57	49.20	203	1.1.1919	31.1.1979	61	
Brno	B2BPIS01_SNO_07:00				B2BPIS01		SNO	16.57	49.20	203	4.1.1931	31.1.1979	49	
Brno	B2BPIS01_SRA_07:00				B2BPIS01		SRA	16.57	49.20	203	1.1.1916	31.1.1979	64	
✗ Brno	B2BPIS01_SVH_07:00				B2BPIS01		SVH	16.57	49.20	203	1.1.1961	31.1.1979	19	
✗ Brno	B2BTUR01_SCE_07:00				B2BTUR01		SCE	16.70	49.16	241	1.1.1961	31.1.2006	46	
✗ Brno	B2BTUR01_SNO_07:00				B2BTUR01		SNO	16.70	49.16	241	1.1.1961	31.1.2006	46	
✗ Brno	B2BTUR01_SRA_07:00				B2BTUR01		SRA	16.70	49.16	241	1.1.1961	31.1.2006	46	
✗ Brno	B2BTUR01_SVH_07:00				B2BTUR01		SVH	16.70	49.16	241	1.1.1969	31.1.2006	38	
Jihlava	B2JIHL01_SCE_07:00				B2JIHL01		SCE	15.54	49.39	560	1.1.1961	31.1.1969	9	
✗ Jihlava	B2JIHL01_SNO_07:00				B2JIHL01		SNO	15.54	49.39	560	1.1.1961	31.1.1969	9	

General scheme of data processing before time series analysis

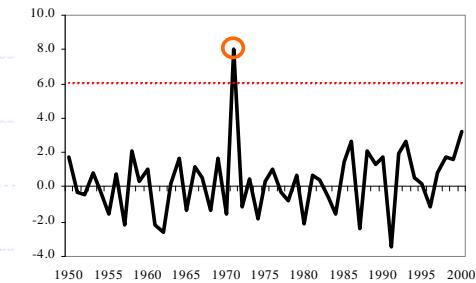


Data Quality Control

Finding suspicious values

Two main approaches:

- ❖ Using limits derived from interquartile ranges (time series)

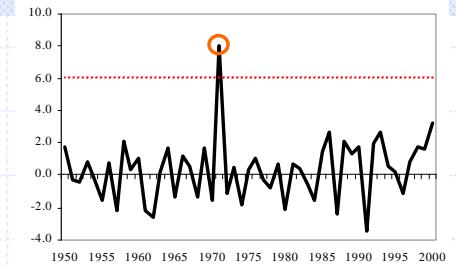


- ❖ comparing values to values of neighbouring stations
(spatial analysis)



Data Quality Control

Finding Outliers



◆ 1. Limits derived from interquartile range

- relatively, series of ratios (logarithms) of tested and reference series
 - ◆ reference series created as an average of 5 mostly correlated stations, max. distance 35 km (precipitation)
 - ◆ limits: coefficient (multiple) = 3.0
- absolutely, in the past when only one station is available
 - ◆ in cases when less than three neighbours have been found
 - ◆ limits: coefficient (multiple) = 5.0

Data Quality Control

Finding Outliers

- 2. comparing values to values of neighbouring stations
 - comparing to min. 3 to 5 best correlated stations
 - series of standardized differences (logarithms of ratios)
 - number of cases exceeding 95% confidence limits
 - Comparison to „expected“ value – calculated from neighbours (using distances or correlations)

ID	YEAR	MON	ST_BASE	REMARK	ST_1	ST_2	ST_3	ST_4	ST_5	Rat1 STND	Rat2 STND	Rat3 STND	Rat4 STND	Rat5 STND	CDF_MAX	No sign.
B1BLAT01			211.0	Altitudes,II	225.0	280.0	176.0	190.0	240.0							
B1HLUK01				st. 1, dista	6.8											
B1VELV01				st. 2, dista		8.9										
B1STRZ01				st. 3, dista			10.4									
B1BZEN01				st. 4, dista				12.2								
B1RADE01				st. 5, dista					13.3							
B1BLAT01	1961	1	14.5		21.7	16.9	15.5	23.7	19.6	1.140	-0.365	0.769	1.817	0.911	0.965	
B1BLAT01	1961	2	39.2		33.7	63.1	40.9	39.5	49.0	-0.646	0.467	0.233	-0.088	0.312	0.950	
B1BLAT01	1961	3	15.1		20.4	21.0	14.9	21.2	22.2	0.560	0.389	0.516	1.344	1.180	0.911	
B1BLAT01	1961	4	57.7		56.1	34.5	34.7	105.3	44.6	-0.042	-2.589	-1.295	2.145	-1.126	1.000	2
B1BLAT01	1961	5	73.5		62.6	95.9	96.3	71.1	114.6	-0.601	0.891	1.322	0.239	1.718	0.957	
B1BLAT01	1961	6	148.3		208.3	158.3	79.4	101.2	76.2	1.305	-0.135	-1.805	-0.915	-2.374	1.000	1
B1BLAT01	1961	7	77.5		89.2	106.9	102.3	86.0	123.2	0.475	0.988	1.549	0.604	1.658	0.951	
B1BLAT01	1961	8	29.3		23.4	42.8	34.2	30.9	35.6	-0.654	0.829	0.567	0.212	0.372	0.951	
B1BLAT01	1961	9	12.4		12.2	16.3	10.3	13.3	12.2	0.125	0.769	-0.202	0.862	0.148	0.885	
B1BLAT01	1961	10	56.0		51.7	77.6	74.1	81.4	82.7	-0.406	0.651	1.419	1.770	1.182	0.962	
B1BLAT01	1961	11	60.8		54.5	99.5	65.0	55.8	79.6	-0.643	1.751	0.775	-0.505	1.479	0.960	
B1BLAT01	1961	12	45.5		32.5	48.4	35.3	33.6	45.1	-1.565	-1.319	-1.066	-1.436	-0.641	0.995	
B1BLAT01	1962	1	12.5		26.3	8.7	12.5	11.3	13.0	2.264	-2.377	0.492	-0.493	-0.106	1.000	2
B1BLAT01	1962	2	28.9		27.3	55.4	37.1	26.6	46.7	-0.178	1.064	0.977	-0.371	1.217	0.915	
B1BLAT01	1962	3	49.5		47.0	55.9	43.7	44.4	49.4	-0.540	-0.427	-0.293	-0.369	-0.394	0.938	
B1BLAT01	1962	4	44.1		51.3	70.8	49.6	43.2	54.5	0.575	0.666	0.555	0.282	0.247	0.774	
B1BLAT01	1962	5	113.2		111.6	129.3	115.5	137.7	110.7	0.000	0.294	0.495	0.918	0.038	0.841	
B1BLAT01	1962	6	29.2		24.1	23.9	39.5	18.6	29.6	-0.504	-1.225	1.036	-1.138	0.131	0.987	
B1BLAT01	1962	7	143.1		157.1	103.3	84.7	177.8	115.8	0.284	-2.197	-1.579	0.947	-0.881	0.999	1
B1BLAT01	1962	8	51.1		58.4	13.9	14.1	18.8	14.9	0.614	-3.961	-3.217	-2.477	-3.306	1.000	4
B1BLAT01	1962	9	39.6		39.9	36.0	35.8	36.8	33.3	0.191	-0.815	0.145	0.061	-0.329	0.965	
B1BLAT01	1962	10	44.5		43.8	55.5	47.7	45.4	50.2	-0.070	-0.298	0.674	0.162	0.447	0.858	

Example of outputs for outliers assessment

	B	C	D	E	F	G	H	I	J	K	L	M	
	ID	YE	MONT	DA	ST_BASE	EXPECT	REMAR	ST_1	ST_2	ST_3	ST_4	ST_5	Altitude
0	B2BTUR01_T_03:30				241,00			235,00	670,00	203,00	210,00	749,00	
0	B2BZAB01_T_03:30							Altitude					
0	B1PROT01_T_03:30							st_1, di					
0	O3PRER01_T_03:30							11,58					
0	O2OLOM01_T_03:30												
0	O1CERV01_T_03:30												
0	B2BTUR01_T_03:30	2006	6	25	27,30	17,28		17,30	16,10	15,50	15,80	16,10	
5	B2BTUR01_T_03:45				241,00			235,00	670,00	203,00	210,00	749,00	
5	B2BZAB01_T_03:45							Altitude					
5	B1PROT01_T_03:45							st_1, di					
5	O3PRER01_T_03:45							11,58					
5	O2OLOM01_T_03:45												
5	O1CERV01_T_03:45												
0	B2BTUR01_T_03:45	2006	6	25	26,50	17,26		17,30	16,30	15,80	15,60	16,20	
0	B2BTUR01_T_04:00				241,00			235,00	670,00	203,00	210,00	749,00	
0	B2BZAB01_T_04:00							Altitude					
0	B1PROT01_T_04:00							st_1, di					
0	O3PRER01_T_04:00							11,58					
0	O2OLOM01_T_04:00												
0	O1CERV01_T_04:00												
0	B2BTUR01_T_04:00	2006	6	25	26,30	17,41		17,30	16,50	16,50	15,90	16,20	
0	B2BTUR01_T_05:00				241,00			235,00	670,00	203,00	210,00	749,00	
0	B2BZAB01_T_05:00							Altitude					
0	B1PROT01_T_05:00							st_1, di					
0	O3PRER01_T_05:00							11,58					
0	O2OLOM01_T_05:00												
0	O1CERV01_T_05:00												
0	R2BTUR01_T_05:00	2006	6	25	24,70	17,52		17,30	17,20	17,30	16,30	17,20	

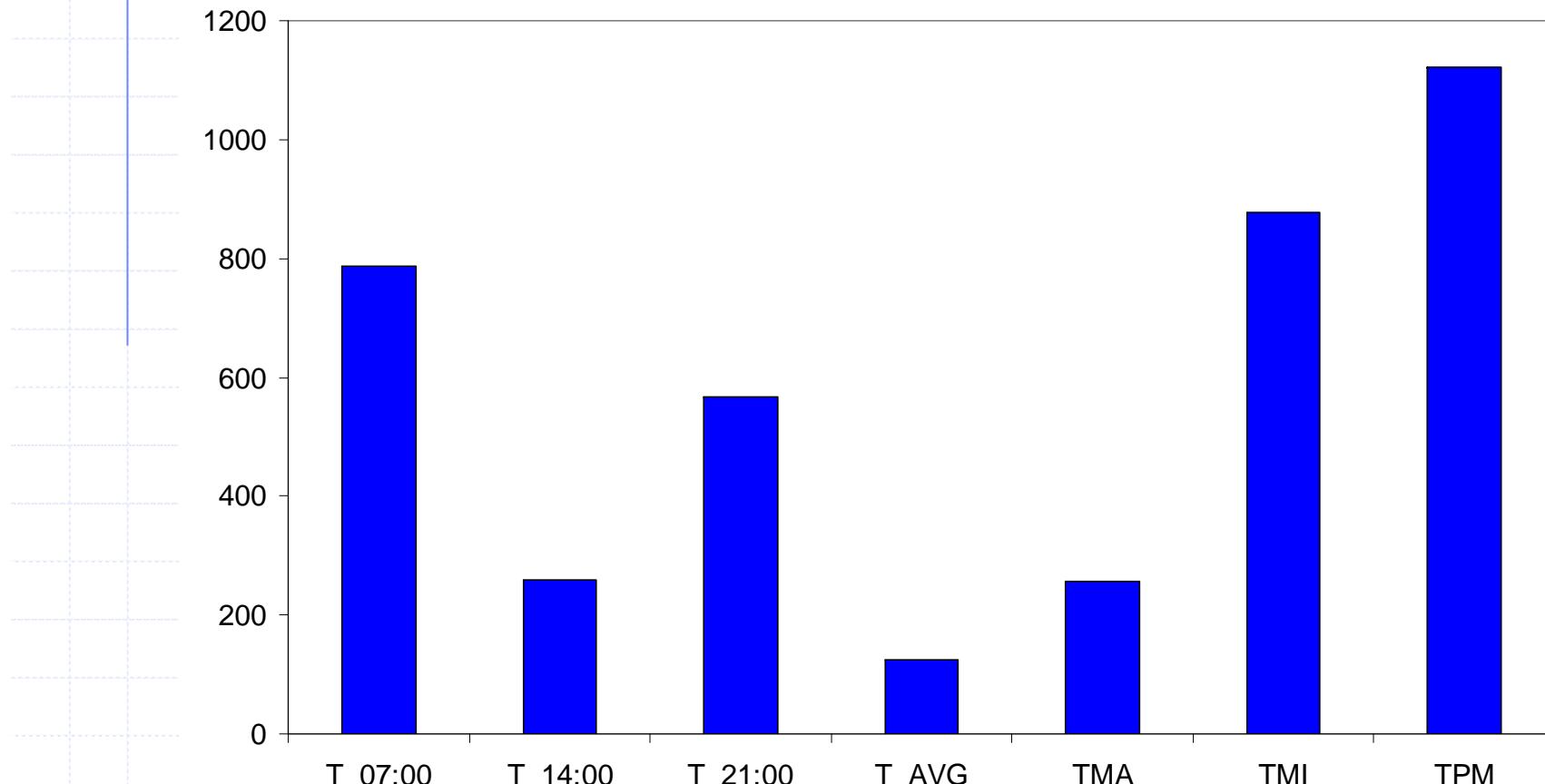
Quality control

- ◆ Run for CZ period 1961-2007, daily data (measured values in observation hours)
- ◆ All stations (CZ: 200 climatological stations, 800 precipitation stations)
- ◆ All meteorological elements (T, TMA, TMI, TPM, SRA, SCE, SNO, E, RV, H, F)
- ◆ Found optimal settings in the software for each met. element

- ◆ Historical records will follow now

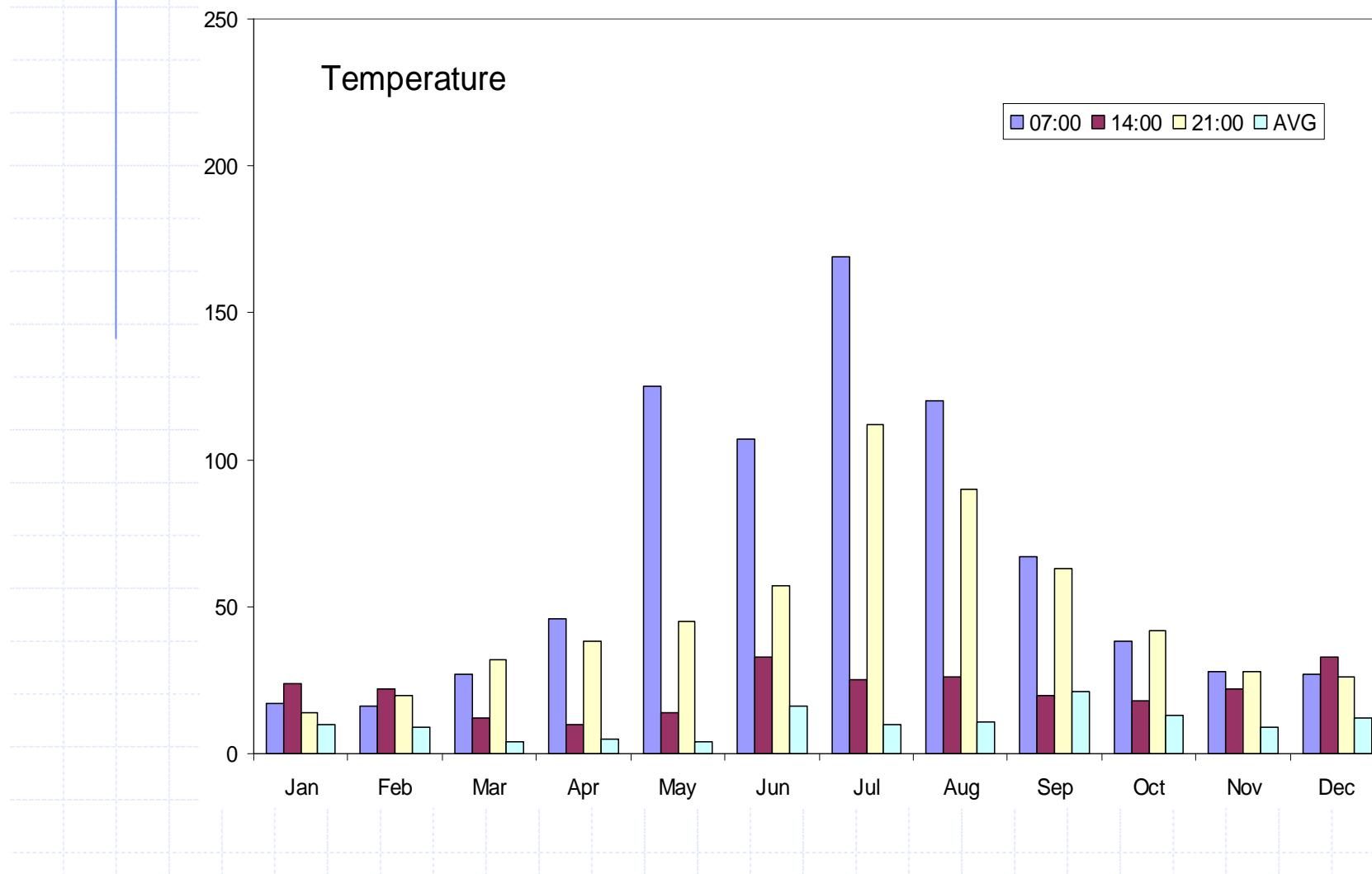
Air temperature, number of outliers 1961-2007, from 3.431.000 station-days

T – air temperature at obs. hour, TMA – daily maximum temp., TMI – daily min. temp., TPM – daily ground minimum temp.



Air temperature, number of outliers 1961-2007, from 3.431.000 station-days

Air temperature at obs. hour, AVG – daily average temp.

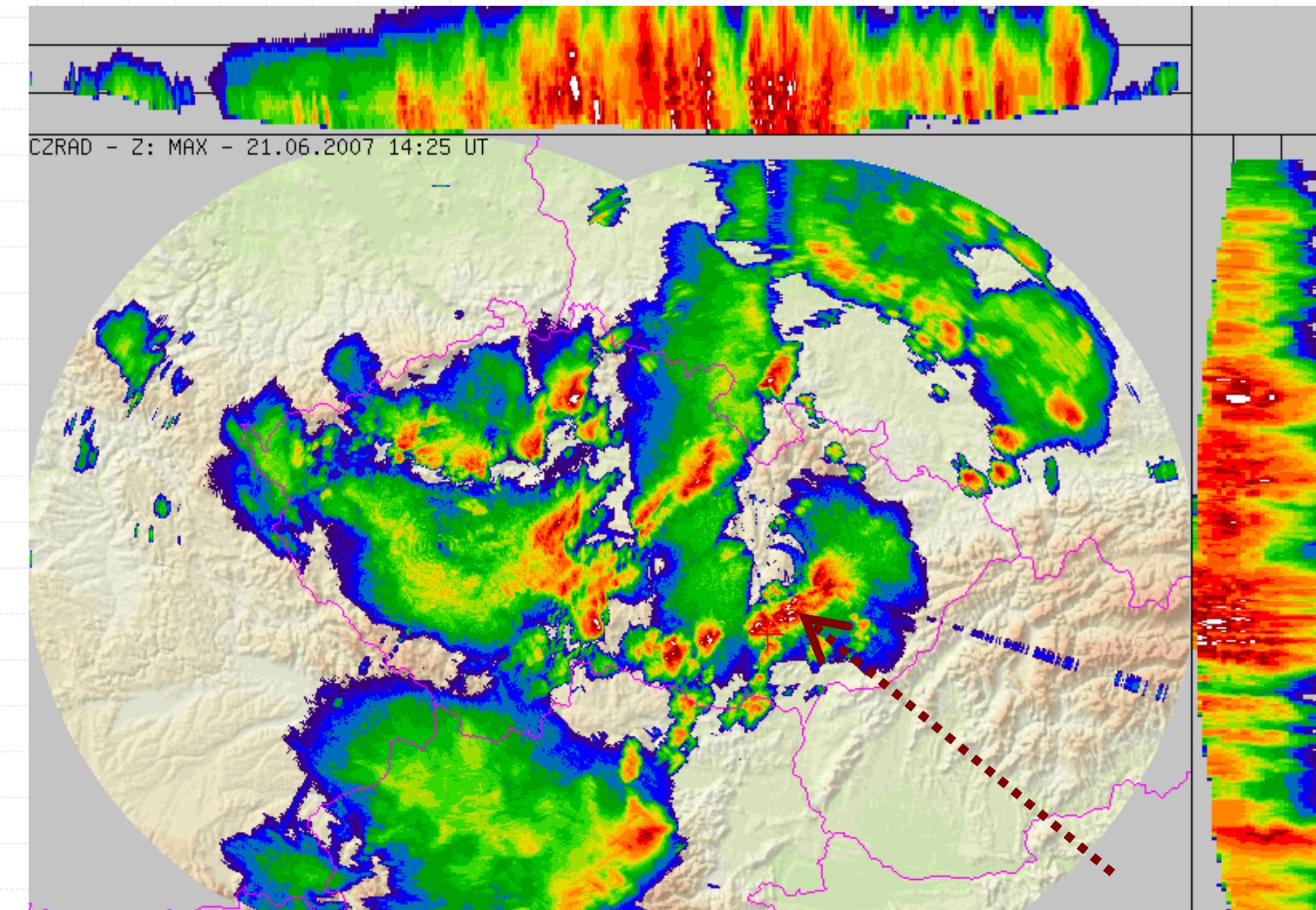


Problematic detections (heavy rainfall)

ID	YEAR	MONTH	DAY	ST_BASE	EXPECT_VAL	REMARK	ST_1	ST_2	ST_3	ST_4	ST_5	ST_6	ST_7	ST_8	ST_9	ST_10	ST_11	ST_12	ST_13	ST_14	ST_15	ST_16	ST_17	ST_18	ST_19	ST_20	ST_21	ST_22	ST_23	ST_24	ST_25	ST_26	ST_27	ST_28	ST_29	ST_30	ST_31	ST_32	ST_33	ST_34	ST_35	ST_36	ST_37	ST_38	ST_39	ST_40	ST_41	ST_42	ST_43	ST_44	ST_45	ST_46	ST_47	ST_48	ST_49	ST_50	ST_51	ST_52	ST_53	ST_54	ST_55	ST_56	ST_57	ST_58	ST_59	ST_60	ST_61	ST_62	ST_63	ST_64	ST_65	ST_66	ST_67	ST_68	ST_69	ST_70	ST_71	ST_72	ST_73	ST_74	ST_75	ST_76	ST_77	ST_78	ST_79	ST_80	ST_81	ST_82	ST_83	ST_84	ST_85	ST_86	ST_87	ST_88	ST_89	ST_90	ST_91	ST_92	ST_93	ST_94	ST_95	ST_96	ST_97	ST_98	ST_99	ST_100	ST_101	ST_102	ST_103	ST_104	ST_105	ST_106	ST_107	ST_108	ST_109	ST_110	ST_111	ST_112	ST_113	ST_114	ST_115	ST_116	ST_117	ST_118	ST_119	ST_120	ST_121	ST_122	ST_123	ST_124	ST_125	ST_126	ST_127	ST_128	ST_129	ST_130	ST_131	ST_132	ST_133	ST_134	ST_135	ST_136	ST_137	ST_138	ST_139	ST_140	ST_141	ST_142	ST_143	ST_144	ST_145	ST_146	ST_147	ST_148	ST_149	ST_150	ST_151	ST_152	ST_153	ST_154	ST_155	ST_156	ST_157	ST_158	ST_159	ST_160	ST_161	ST_162	ST_163	ST_164	ST_165	ST_166	ST_167	ST_168	ST_169	ST_170	ST_171	ST_172	ST_173	ST_174	ST_175	ST_176	ST_177	ST_178	ST_179	ST_180	ST_181	ST_182	ST_183	ST_184	ST_185	ST_186	ST_187	ST_188	ST_189	ST_190	ST_191	ST_192	ST_193	ST_194	ST_195	ST_196	ST_197	ST_198	ST_199	ST_200	ST_201	ST_202	ST_203	ST_204	ST_205	ST_206	ST_207	ST_208	ST_209	ST_210	ST_211	ST_212	ST_213	ST_214	ST_215	ST_216	ST_217	ST_218	ST_219	ST_220	ST_221	ST_222	ST_223	ST_224	ST_225	ST_226	ST_227	ST_228	ST_229	ST_230	ST_231	ST_232	ST_233	ST_234	ST_235	ST_236	ST_237	ST_238	ST_239	ST_240	ST_241	ST_242	ST_243	ST_244	ST_245	ST_246	ST_247	ST_248	ST_249	ST_250	ST_251	ST_252	ST_253	ST_254	ST_255	ST_256	ST_257	ST_258	ST_259	ST_260	ST_261	ST_262	ST_263	ST_264	ST_265	ST_266	ST_267	ST_268	ST_269	ST_270	ST_271	ST_272	ST_273	ST_274	ST_275	ST_276	ST_277	ST_278	ST_279	ST_280	ST_281	ST_282	ST_283	ST_284	ST_285	ST_286	ST_287	ST_288	ST_289	ST_290	ST_291	ST_292	ST_293	ST_294	ST_295	ST_296	ST_297	ST_298	ST_299	ST_300	ST_301	ST_302	ST_303	ST_304	ST_305	ST_306	ST_307	ST_308	ST_309	ST_310	ST_311	ST_312	ST_313	ST_314	ST_315	ST_316	ST_317	ST_318	ST_319	ST_320	ST_321	ST_322	ST_323	ST_324	ST_325	ST_326	ST_327	ST_328	ST_329	ST_330	ST_331	ST_332	ST_333	ST_334	ST_335	ST_336	ST_337	ST_338	ST_339	ST_340	ST_341	ST_342	ST_343	ST_344	ST_345	ST_346	ST_347	ST_348	ST_349	ST_350	ST_351	ST_352	ST_353	ST_354	ST_355	ST_356	ST_357	ST_358	ST_359	ST_360	ST_361	ST_362	ST_363	ST_364	ST_365	ST_366	ST_367	ST_368	ST_369	ST_370	ST_371	ST_372	ST_373	ST_374	ST_375	ST_376	ST_377	ST_378	ST_379	ST_380	ST_381	ST_382	ST_383	ST_384	ST_385	ST_386	ST_387	ST_388	ST_389	ST_390	ST_391	ST_392	ST_393	ST_394	ST_395	ST_396	ST_397	ST_398	ST_399	ST_400	ST_401	ST_402	ST_403	ST_404	ST_405	ST_406	ST_407	ST_408	ST_409	ST_410	ST_411	ST_412	ST_413	ST_414	ST_415	ST_416	ST_417	ST_418	ST_419	ST_420	ST_421	ST_422	ST_423	ST_424	ST_425	ST_426	ST_427	ST_428	ST_429	ST_430	ST_431	ST_432	ST_433	ST_434	ST_435	ST_436	ST_437	ST_438	ST_439	ST_440	ST_441	ST_442	ST_443	ST_444	ST_445	ST_446	ST_447	ST_448	ST_449	ST_450	ST_451	ST_452	ST_453	ST_454	ST_455	ST_456	ST_457	ST_458	ST_459	ST_460	ST_461	ST_462	ST_463	ST_464	ST_465	ST_466	ST_467	ST_468	ST_469	ST_470	ST_471	ST_472	ST_473	ST_474	ST_475	ST_476	ST_477	ST_478	ST_479	ST_480	ST_481	ST_482	ST_483	ST_484	ST_485	ST_486	ST_487	ST_488	ST_489	ST_490	ST_491	ST_492	ST_493	ST_494	ST_495	ST_496	ST_497	ST_498	ST_499	ST_500	ST_501	ST_502	ST_503	ST_504	ST_505	ST_506	ST_507	ST_508	ST_509	ST_510	ST_511	ST_512	ST_513	ST_514	ST_515	ST_516	ST_517	ST_518	ST_519	ST_520	ST_521	ST_522	ST_523	ST_524	ST_525	ST_526	ST_527	ST_528	ST_529	ST_530	ST_531	ST_532	ST_533	ST_534	ST_535	ST_536	ST_537	ST_538	ST_539	ST_540	ST_541	ST_542	ST_543	ST_544	ST_545	ST_546	ST_547	ST_548	ST_549	ST_550	ST_551	ST_552	ST_553	ST_554	ST_555	ST_556	ST_557	ST_558	ST_559	ST_560	ST_561	ST_562	ST_563	ST_564	ST_565	ST_566	ST_567	ST_568	ST_569	ST_570	ST_571	ST_572	ST_573	ST_574	ST_575	ST_576	ST_577	ST_578	ST_579	ST_580	ST_581	ST_582	ST_583	ST_584	ST_585	ST_586	ST_587	ST_588	ST_589	ST_590	ST_591	ST_592	ST_593	ST_594	ST_595	ST_596	ST_597	ST_598	ST_599	ST_600	ST_601	ST_602	ST_603	ST_604	ST_605	ST_606	ST_607	ST_608	ST_609	ST_610	ST_611	ST_612	ST_613	ST_614	ST_615	ST_616	ST_617	ST_618	ST_619	ST_620	ST_621	ST_622	ST_623	ST_624	ST_625	ST_626	ST_627	ST_628	ST_629	ST_630	ST_631	ST_632	ST_633	ST_634	ST_635	ST_636	ST_637	ST_638	ST_639	ST_640	ST_641	ST_642	ST_643	ST_644	ST_645	ST_646	ST_647	ST_648	ST_649	ST_650	ST_651	ST_652	ST_653	ST_654	ST_655	ST_656	ST_657	ST_658	ST_659	ST_660	ST_661	ST_662	ST_663	ST_664	ST_665	ST_666	ST_667	ST_668	ST_669	ST_670	ST_671	ST_672	ST_673	ST_674	ST_675	ST_676	ST_677	ST_678	ST_679	ST_680	ST_681	ST_682	ST_683	ST_684	ST_685	ST_686	ST_687	ST_688	ST_689	ST_690	ST_691	ST_692	ST_693	ST_694	ST_695	ST_696	ST_697	ST_698	ST_699	ST_700	ST_701	ST_702	ST_703	ST_704	ST_705	ST_706	ST_707	ST_708	ST_709	ST_710	ST_711	ST_712	ST_713	ST_714	ST_715	ST_716	ST_717	ST_718	ST_719	ST_720	ST_721	ST_722	ST_723	ST_724	ST_725	ST_726	ST_727	ST_728	ST_729	ST_730	ST_731	ST_732	ST_733	ST_734	ST_735	ST_736	ST_737	ST_738	ST_739	ST_740	ST_741	ST_742	ST_743	ST_744	ST_745	ST_746	ST_747	ST_748	ST_749	ST_750	ST_751	ST_752	ST_753	ST_754	ST_755	ST_756	ST_757	ST_758	ST_759	ST_760	ST_761	ST_762	ST_763	ST_764	ST_765	ST_766	ST_767	ST_768	ST_769	ST_770	ST_771	ST_772	ST_773	ST_774	ST_775	ST_776	ST_777	ST_778	ST_779	ST_780	ST_781	ST_782	ST_783	ST_784	ST_785	ST_786	ST_787	ST_788	ST_789	ST_790	ST_791	ST_792	ST_793	ST_794	ST_795	ST_796	ST_797	ST_798	ST_799	ST_800	ST_801	ST_802	ST_803	ST_804	ST_805	ST_806	ST_807	ST_808	ST_809	ST_810	ST_811	ST_812	ST_813	ST_814	ST_815	ST_816	ST_817	ST_818	ST_819	ST_820	ST_821	ST_822	ST_823	ST_824	ST_825	ST_826	ST_827	ST_828	ST_829	ST_830	ST_831	ST_832	ST_833	ST_834	ST_835	ST_836	ST_837	ST_838	ST_839	ST_840	ST_841	ST_842	ST_843	ST_844	ST_845	ST_846	ST_847	ST_848	ST_849	ST_850	ST_851	ST_852	ST_853	ST_854	ST_855	ST_856	ST_857	ST_858	ST_859	ST_860	ST_861	ST_862	ST_863	ST_864	ST_865	ST_866	ST_867	ST_868	ST_869	ST_870	ST_871	ST_872	ST_873	ST_874	ST_875	ST_876	ST_877	ST_878	ST_879	ST_880	ST_881	ST_882	ST_883	ST_884	ST_885	ST_886	ST_887	ST_888	ST_889	ST_890	ST_891	ST_892	ST_893	ST_894	ST_895	ST_896	ST_897	ST_898	ST_899	ST_900	ST_901	ST_902	ST_903	ST_904	ST_905	ST_906	ST_907	ST_908	ST_909	ST_910	ST_911	ST_912	ST_913	ST_914	ST_915	ST_916	ST_917	ST_918	ST_919	ST_920	ST_921	ST_922	ST_923	ST_924	ST_925	ST_926	ST_927	ST_928	ST_929	ST_930	ST_931	ST_932	ST_933	ST_934	ST_935	ST_936	ST_937	ST_938	ST_939	ST_940	ST_941	ST_942	ST_943	ST_944	ST_945	ST_946	ST_947	ST_948	ST_949	ST_950	ST_951	ST_952	ST_953	ST_954	ST_955	ST_956	ST_957	ST_958	ST_959	ST_960	ST_961	ST_962	ST_963	ST_964	ST_965	ST_966	ST_967	ST_968	ST_969	ST_970	ST_971	ST_972	ST_973	ST_974	ST_975	ST_976	ST_977	ST_978	ST_979	ST_980	ST_981	ST_982	ST_983	ST_984	ST_985	ST_986	ST_987	ST_988	ST_989	ST_990	ST_991	ST_992	ST_993	ST_994	ST_995	ST_996	ST_997	ST_998	ST_999	ST_1000	ST_1001	ST_1002	ST_1003	ST_1004	ST_1005	ST_1006	ST_1007	ST_1008	ST_1009	ST_1010	ST_1011	ST_1012	ST_1013	ST_1014	ST_1015	ST_1016	ST_1017	ST_1018	ST_1019	ST_1020	ST_1021	ST_1022	ST_1023	ST_1024	ST_1025	ST_1026	ST_1027	ST_1028	ST_1029	ST_1030	ST_1031	ST_1032	ST_1033	ST_1034	ST_1035	ST_1036	ST_1037	ST_1038	ST_1039	ST_1040	ST_1041	ST_1042	ST_1043	ST_1044	ST_1045	ST_1046	ST_1047	ST_1048	ST_1049	ST_1050	ST_1051	ST_1052	ST_1053	ST_1054	ST_1055	ST_1056	ST_1057	ST_1058	ST_1059	ST_1060	ST_1061	ST_1062	ST_1063	ST_1064	ST_1065	ST_1066	ST_1067	ST_1068	ST_1069	ST_1070	ST_1071	ST_1072	ST_1073	ST_1074	ST_1075	ST_1076	ST_1077	ST_1078	ST_1079	ST_1080	ST_1081	ST_1082	ST_1083	ST_1084	ST_1085	ST_1086	ST_1087	ST_1088	ST_1089	ST_1090	ST_1091	ST_1092	ST_1093	ST_1094	ST_1095	ST_1096	ST_1097	ST_1098	ST_1099	ST_1100	ST_1101	ST_1102	ST_1103	ST_1104	ST_1105	ST_1106	

Problematic detections

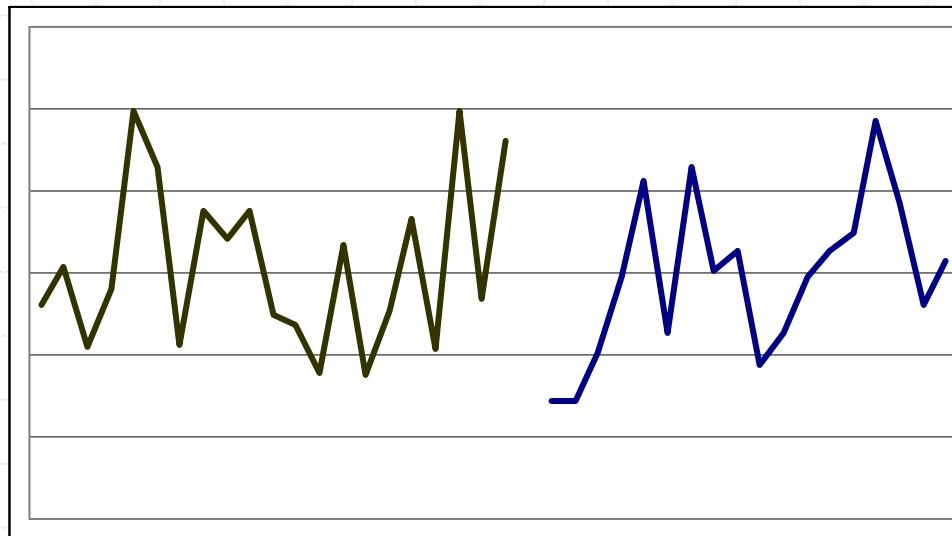
(heavy rainfall),
combination with Radar information



Remarks to QC

- ◆ Only combination of several methods for outliers detection leads to satisfying results ("real" outliers detection, supressing fault detection -> Ensemble approach) and makes it possible to automatize QC
- ◆ Parameters (settings) has to be found individually for each meteorological element, maybe also region (terrain complexity) and part of a year (noticeable annual cycle in number of outliers)
- ◆ Similar to homogenization of time series, it is important to use measured value (e.g. from observation hours) - outliers are masked in daily average (and even more in monthly or annual ones)

Combining measurements of neighbouring stations



Combining measurements of neighbouring stations

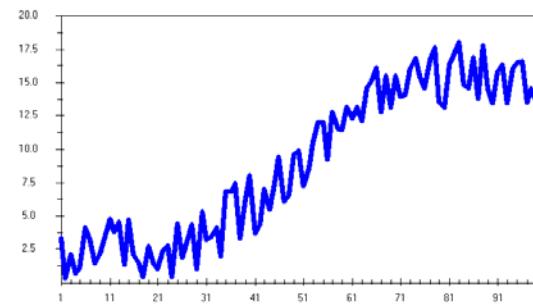
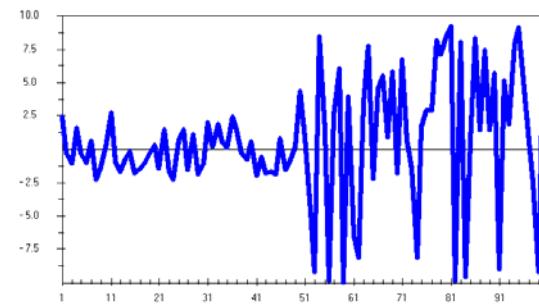
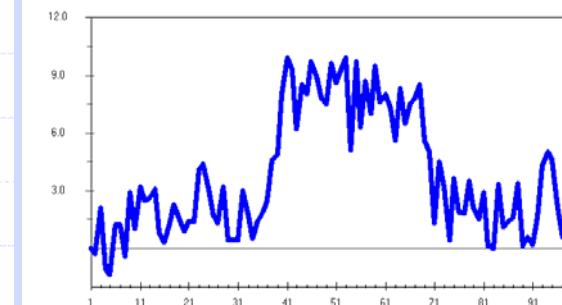
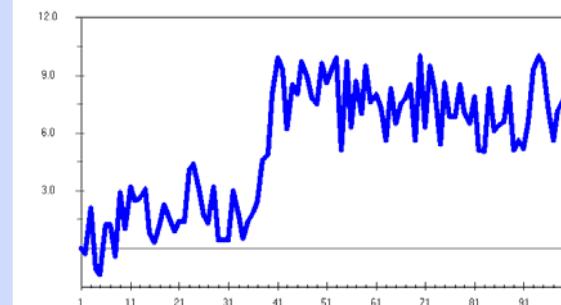
- ◆ Selecting neighbours till ... km
- ◆ gap between two series: maximum ... years
- ◆ resulting series: at least ... years long

Example:

Combining series of neighbouring stations

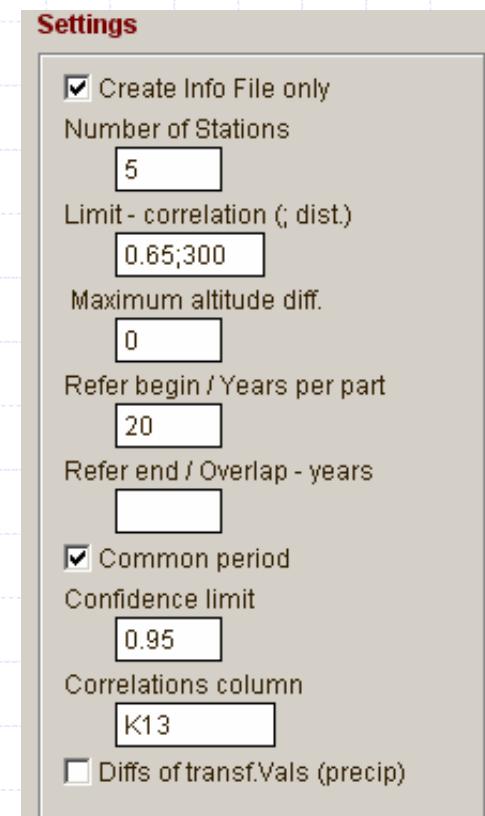
Homogeneity testing

- ◆ Change in shift or variance, trend detection,
 $p=0.05$



Creating Reference Series

- ◆ for monthly, daily data (each month individually)
- ◆ weighted/unweighted mean from neighbouring stations
- ◆ criterions used for stations selection (or combination of it):
 - best correlated / nearest neighbours
(correlations – from the first differenced series)
 - limit correlation, limit distance
 - limit difference in altitudes
- ◆ neighbouring stations series should be standardized to test series AVG and / or STD
(temperature - elevation, precipitation - variance)
 - missing data are not so big problem then



Example:

Proposed list of stations used for creating reference series

ID_1	ID_2	BEGIN	END	LEN	REMARK	CORREL	DISTANCE	ALT_1	ALT_2	
B1BLAT01		1961	2000	40	5st. (l:0.88			211		Selection according to correlations
	B1HLUK01	1961	2000	40	y. comm.p	0.931	6.78	211	225	
	B1VELV01	1961	2000	40	y. comm.p	0.921	8.94	211	280	
	B1STRZ01	1961	2000	40	y. comm.p	0.910	10.39	211	176	
	B1UHBR01	1961	2000	40	y. comm.p	0.901	17.11	211	222	
	B1RADE01	1961	2000	40	y. comm.p	0.884	13.32	211	240	
B1BOJK01		1961	2000	40	5st. (l:0.89			302		
	B1STRN01	1961	2000	40	y. comm.p	0.920	16.55	302	385	
	B1STHR01	1961	2000	40	y. comm.p	0.917	7.29	302	412	
	B1LUHA01	1961	2000	40	y. comm.p	0.908	9.62	302	254	
	B1VIZO01	1961	2000	40	y. comm.p	0.895	21.20	302	315	
	B1UHBR01	1961	2000	40	y. comm.p	0.891	11.68	302	222	
B1BRBY01		1961	1994	34	5st. (l:0.87			350		
	B1BOJK01	1961	2000	34	y. comm.p	0.888	16.54	350	302	
	O3ZDEC01	1961	2000	34	y. comm.p	0.886	18.34	350	520	
	O3HUSL01	1961	2000	34	y. comm.p	0.881	23.66	350	450	
	B1HLHO01	1961	2000	34	y. comm.p	0.875	17.36	350	340	
	B1STHR01	1961	2000	34	y. comm.p	0.873	18.59	350	412	
B1BUCH01		1961	2000	40	5st. (l:0.86			280		
	B1STME01	1961	2000	40	y. comm.p	0.919	7.29	280	235	
	B2KYJO01	1961	2000	40	y. comm.p	0.879	16.54	280	195	
	B2KORC01	1961	2000	40	y. comm.p	0.873	11.72	280	305	
	B1BZEN01	1961	2000	40	y. comm.p	0.869	12.44	280	190	
	B1NAPA01	1961	2000	40	y. comm.p	0.869	17.08	280	205	

Relative homogeneity testing



- Alexandersson SNHT
- Bivariate test of Maronna and Yohai
- Mann – Whitney – Pettit test
- t-test
- Easterling and Peterson test
- Vincent method
- ...

40 year parts of the series (10 years overlap),

in SNHT splitting into subperiods in position of detected significant changepoint

(30-40 years per one inhomogeneity)

Homogeneity assessment

- ❖ Various outputs created for better inhomogeneities assessment
- ❖ Combining results with information from metadata
- ❖ Decision about „undoubted“ inhomogeneities

Example I: Homogeneity assessment

ID	REFERENCE	ELEM	TEST	BEGIN	END	CO	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Win	Spr	Sum	Aut	Year	
B1BOJK01	B1BOJK01_1_dw	x	A	1961	2000		1973	x	1985	2000	x	x	x	x	x	x	x	x	1994	1985	x	x	1994	
B1BOJK01		x	A				1988*<											1988*<						
B1BOJK01	B1BOJK01_1_dw	x	As	1961	2000															1994	1985	x	x	1994
B1BOJK01		x	As																1971*<	1992*<				
B1BOJK01	B1BOJK01_1_dw	x	B	1961	2000		1973	x	1985	2000	x	x	x	x	x	x	x	x	1997	1985	x	x	x	
B1BOJK01		x	B				1988*<											1988*<						
B1BOJK01	B1BOJK01_1_dw	x	Bs	1961	2000														1997	1985	x	x	x	
B1BOJK01		x	Bs															1966*<	1992*<					
B1BOJK01	B1BOJK01_1_dw	x	t_F	1961	2000		1973	1997	1985	1998	1985	1968	1966	1963	x	x	x	1996 <						
B1BOJK01	B1BOJK01_1_dw	x	t_Fs	1961	2000														1994	1985	x	x	1994	
B1BOJK01	B1BOJK01_1_dw	x	Uk	1961	2000		1973	x	1985	x	x	x	x	x	x	x	x	x	1994	1985	x	x	1994	
B1BOJK01	B1BOJK01_1_dw	x	Uks	1961	2000														x	1985	x	x	1985	
B1BOJK01	B1BOJK01_1_cw	x	A	1961	2000		1973	x	1985	x	x	2000	1966	x	x	x	x	x	1994	1985	x	x	1994	
B1BOJK01		x	A				1988*<											1988*<						
B1BOJK01	B1BOJK01_1_cw	x	As	1961	2000														1994	1985	x	x	x	
B1BOJK01		x	As															1971*1981*<					1981*	
B1BOJK01	B1BOJK01_1_cw	x	B	1961	2000		x	x	1985	x	x	x	x	x	x	x	x	x	1994	1985	x	x	1994	
B1BOJK01		x	B				1988*<											1982*<	1985*<					
B1BOJK01	B1BOJK01_1_cw	x	Bs	1961	2000														1994	1985	x	x	x	
B1BOJK01		x	Bs															1971*<					1981*	
B1BOJK01	B1BOJK01_1_cw	x	t_F	1961	2000		1973	1997	1985	1998	x	1992	1966	x	1999	x	x	1993 <						
B1BOJK01	B1BOJK01_1_cw	x	t_Fs	1961	2000														1994	1985	x	x	1994	
B1BOJK01	B1BOJK01_1_cw	x	Uk	1961	2000		1973	x	1985	x	x	x	x	x	x	x	x	x	1994	1985	x	x	1994	
B1BOJK01	B1BOJK01_1_cw	x	Uks	1961	2000														x	1988	1985	x	x	1985

Example II:

Homogeneity assessment

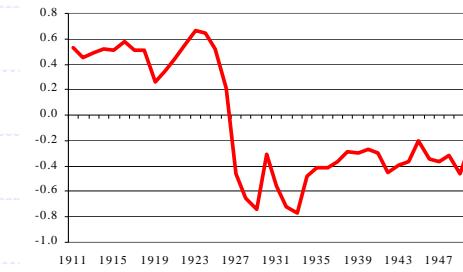
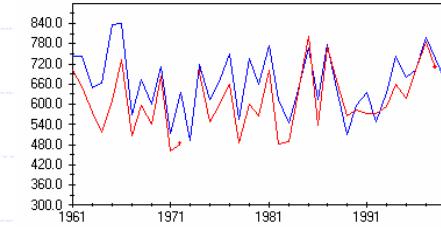
ID	BEGIN	END	LENGTH	YEAR_INHOM	YEAR_COUNT	Y_PORTION	Y_POSSIBL
B1KROM01	1961	2000	40		104	36.24	36.11
B1KROM01				1977	18	6.27	6.25
B1KROM01				1978	13	4.53	4.51
B1KROM01				1975	11	3.83	3.82
B1KROM01				1974	10	3.48	3.47
B1KROM01				1983	8	2.79	2.78
B1KROM01				1987	8	2.79	2.78
B1KROM01				1989	7	2.44	2.43
B1KROM01				1988	5	1.74	1.74
B1KROM01				1971	4	1.39	1.39
B1KROM01				1962	3	1.05	1.04
B1KROM01				1982	3	1.05	1.04
B1KROM01				1972	3	1.05	1.04
B1KROM01				1964	3	1.05	1.04
B1KROM01				1973	2	0.70	0.69
B1KROM01				1986	2	0.70	0.69
B1KROM01				1963	1	0.35	0.35
B1KROM01				1984	1	0.35	0.35
B1KROM01				1965	1	0.35	0.35
B1KROM01				1995	1	0.35	0.35
B1KROM01	1962	1965	4		8	2.79	2.78
B1KROM01	1971	1975	5		30	10.45	10.42
B1KROM01	1977	1978	2		31	10.80	10.76
B1KROM01	1982	1984	3		12	4.18	4.17
B1KROM01	1986	1989	4		22	7.67	7.64
B1KROM01	1961	1970	10		8	2.79	2.78
B1KROM01	1971	1980	10		61	21.25	21.18
B1KROM01	1981	1990	10		34	11.85	11.81
B1KROM01	1991	2000	10		1	0.35	0.35

Summed numbers of
detections for
individual years

Homogeneity assessment

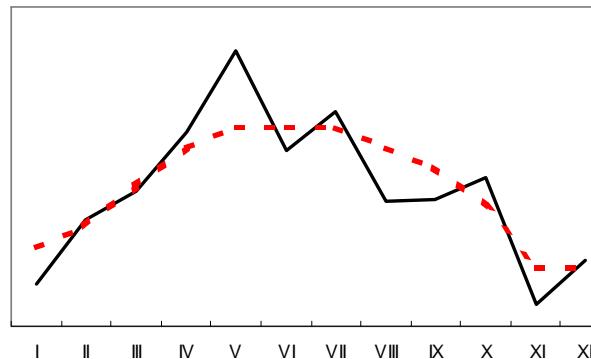
- Deciding which years to adjust for inhomogeneities
(using metadata, plots, ...)

ID	EL	YEAR_BEGIN	YEAR_END	YEAR_COUNY	Y_POSSIBL	YEAR_MIS	X_BEGIN	X_END	DATA_X	X_LL	X_RB	REMARK	CC
x B1BOJK01	x	1985			41	14.24	12	23.3.1984	31.3.2003	# #		Echange	
B1BOJK01	x	1985			41	14.24	12	23.3.1984	31.12.9999	# #		obs	VB
B1BYSH01	x	1978			37	12.85							
? B1BYSH01	x	1979			33	11.46							
? B1BYSH01	x	1980			43	14.93							
? B1HLHO01	x	1965			31	10.76	4	1					
B1HOLE01	x	1976			33	11.46							
B1KROM01	x		1977	1978	31	10.76							
x B1RADE01	x	1994			44	15.28	2	1.1.1994	31.12.9999	# #		Echange	
B1RADE01	x	1994			44	15.28	2	1.1.1994	31.12.9999	# #		obs	JcB
x B1RYCH01	x	1973			49	17.01		1.5.1973	28.2.1991	# #		Vchange	
B1RYCH01	x	1973			49	17.01		1.9.1972	28.2.1991	# #		obs	MB
xx? B1STRZ01	x	1987			53	18.40							
B1STRZ01	x	1988			30	10.42							
B1UHBR01	x	1983			31	10.76		18.2.1984	31.1.1999	# #		Uchange	
B1UHBR01	x	1983			31	10.76		18.2.1984	12.5.1993	# #		obs	JcB
x B1UHBR01	x	1984			77	26.74		18.2.1984	31.1.1999	# #		Uchange	
B1UHBR01	x	1984			77	26.74		18.2.1984	12.5.1993	# #		obs	JcB
B1VELI01	x	1978			31	10.76							
? B1VELI01	x		1977	1978	44	15.28							
? B1VKLO01	x	1984			29	10.07							
x B1VYSK01	x	1999			32	11.11	-1	1.4.1998	31.12.9999	# #		Vchange	
B1VYSK01	x	1999			32	11.11	-1	1.4.1998	31.12.9999	# #		obs	VB
B2BOSK01	x	1968			33	11.46							
B2BREC01	x	1968			35	12.15							
B2BRUM01	x	1989			51	17.71		1.2.1989	31.3.1994	# #		Echange	
B2BRUM01	x	1989			51	17.71		1.2.1989	31.3.1994	# #		obs	MB



Adjusting data

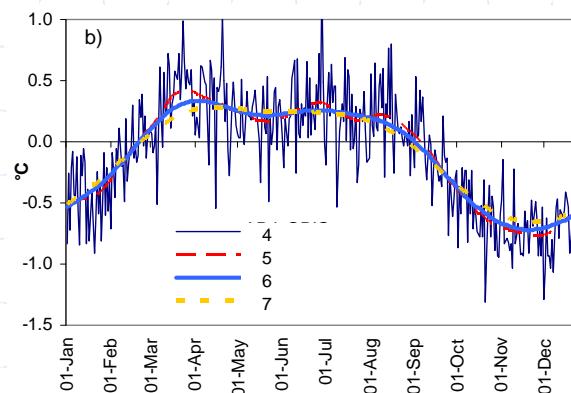
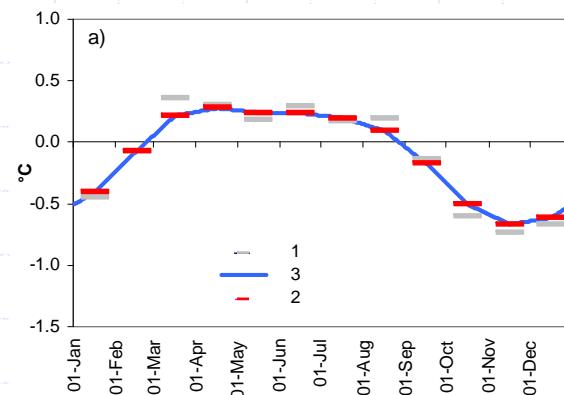
- ❖ using reference series based on correlations
- ❖ adjustment: from differences (ratios) ... years before and after a change, monthly
- ❖ smoothing monthly adjustments (low-pass filter for adjacent values)



Adjustments (Delta method)

- ◆ The same final adjustments may be obtained from either monthly averages or through direct use of daily data

(for the daily-values-based approach, it seems reasonable to smooth with a low-pass filter for 60 days. The same results may be derived using a low-pass filter for two months (weights approximately 1:2:1) and subsequently distributing the smoothed monthly adjustments into daily values)



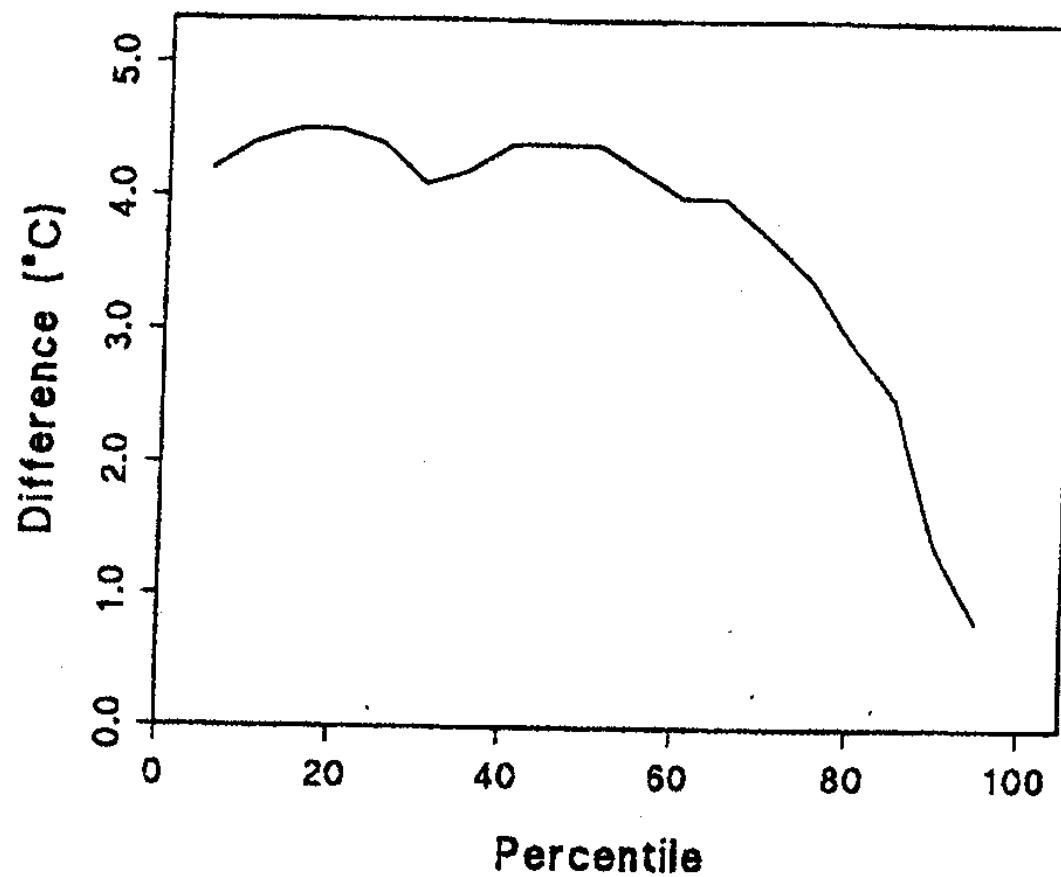
(1 – raw adjustments, 2 – smoothed adjustments, 3 – smoothed adjustments distributed into individual days), b) daily-based approach (4 – individual calendar day adjustments, 5 – daily adjustments smoothed by low-pass filter for 30 days, 6 – for 60 days, 7 – for 90 days)

Variable correction

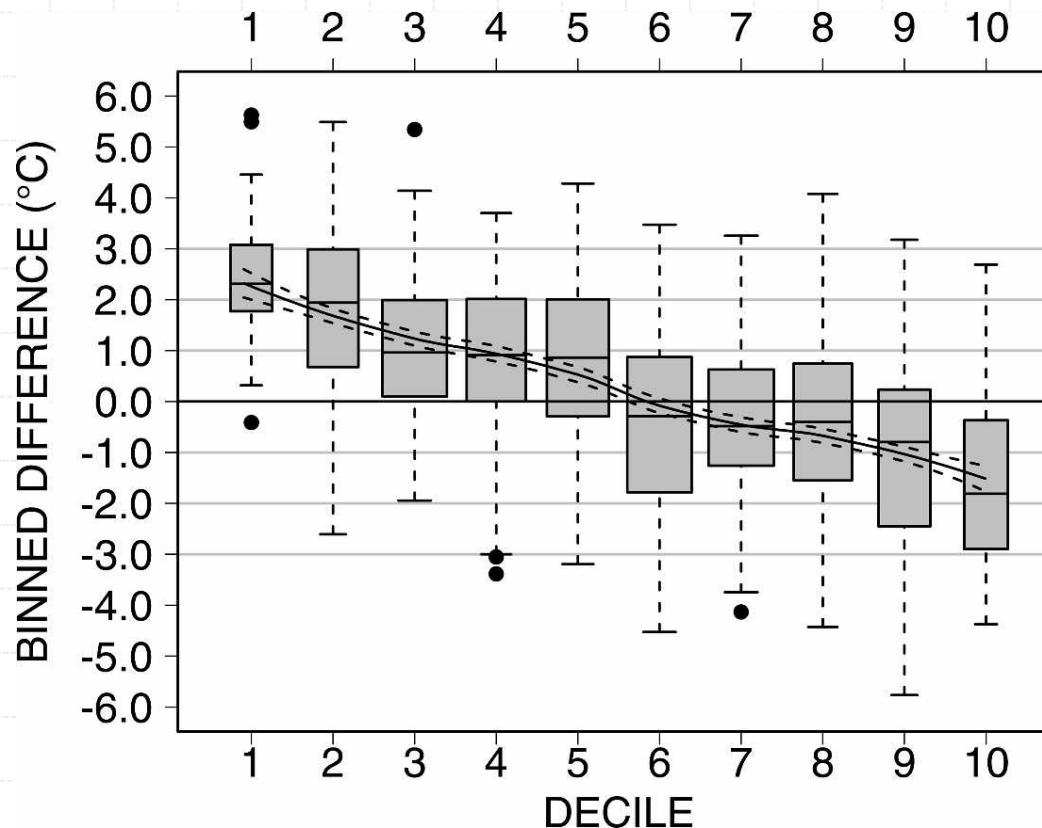
A.

B. C. TREWIN AND A. C. F. TREVITT

1996



Variable correction, The higher-order moments method



DELLA-MARTA AND
WANNER, JOURNAL OF
CLIMATE 19 (2006)
4179-4197

Example:

Adjusting values - evaluation

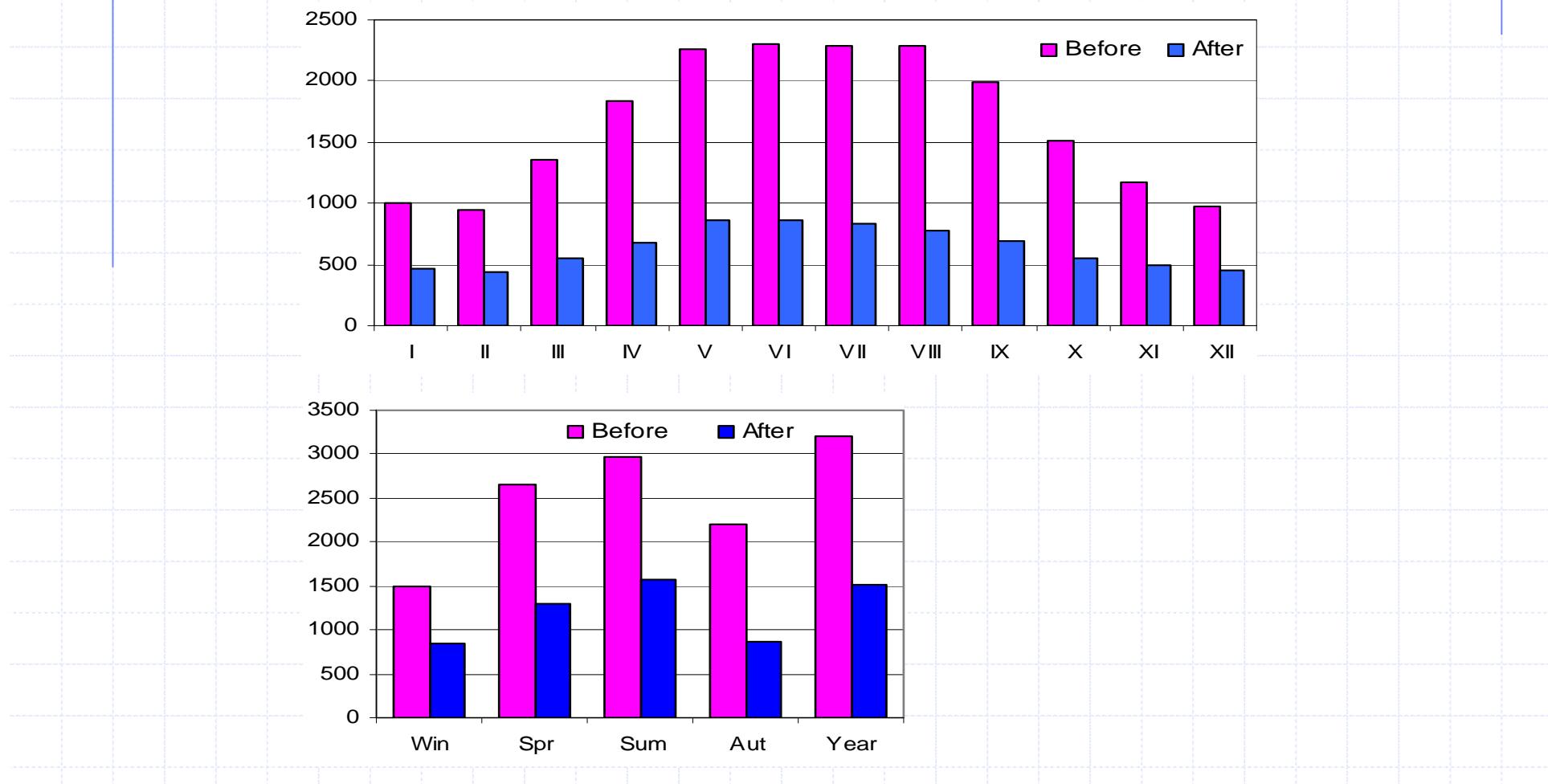
ID	1	pII	BEGIN	END	YEAR	MONTH	REMARK	C	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12
B1RYCH01		E	1961	1992	1973	5	ADJust		1.135	1.197	1.155	1.333	1.149	1.070	1.088	1.354	1.145	1.116	1.136	1.265
B1RYCH01							DIFF1		0.905	0.875	0.912	0.813	0.906	0.956	0.896	0.786	0.912	0.956	0.908	0.855
B1RYCH01							DIFF2		1.027	1.048	1.053	1.084	1.041	1.024	0.975	1.064	1.045	1.067	1.032	1.081
B1RYCH01							corr		0.964	0.930	0.963	0.915	0.888	0.870	0.866	0.927	0.961	0.952	0.956	0.875
B1RYCH01							corr+		0.007	0.017	0.006	0.026	0.014	0.006	0.008	-0.001	-0.002	0.017	0.010	0.033
B1RYCH01							t		1.904	2.144	2.443	3.897	1.957	0.936	0.874	3.424	1.937	1.507	2.252	3.415
B1RYCH01							t_crit		2.042	2.048	2.045	2.045	2.045	2.045	2.042	2.042	2.042	2.042	2.042	2.045
B1RYCH01							Std_1		0.171	0.184	0.108	0.216	0.206	0.168	0.274	0.146	0.241	0.255	0.139	0.159
B1RYCH01							Std_2		0.178	0.235	0.181	0.169	0.175	0.209	0.232	0.256	0.146	0.164	0.157	0.185
B1RYCH01							t2		1.923	2.252	2.730	3.685	1.884	0.985	0.837	3.904	1.718	1.351	2.325	3.569
B1RYCH01							t2_crit		1.960	1.961	1.960	1.961	1.961	1.960	1.961	1.960	1.961	1.961	1.960	1.960
B1RYCH01							No_1		12	12	12	12	12	12	12	12	12	12	12	11
B1RYCH01							No_2		20	18	19	19	19	19	20	20	20	20	20	20
B1RYCH01							b1_1		-0.015	-0.016	0.002	0.017	0.028	0.002	-0.035	0.002	0.035	0.040	0.015	-0.012
B1RYCH01							b1_2		-0.007	-0.024	-0.002	0.001	-0.008	0.018	-0.022	-0.002	-0.007	-0.016	-0.014	-0.024
B1RYCH01			> 2n:0.479,0.233		1973	5	ADJ_sm		1.180	1.178	1.206	1.238	1.172	1.107	1.149	1.229	1.185	1.138	1.162	1.199
B1RYCH01							corr		0.964	0.930	0.963	0.915	0.888	0.870	0.866	0.927	0.961	0.952	0.956	0.875
B1RYCH01							corr+(AD)		0.007	0.016	0.003	0.026	0.014	0.006	0.009	0.010	-0.005	0.019	0.009	0.030

Iterative homogeneity testing

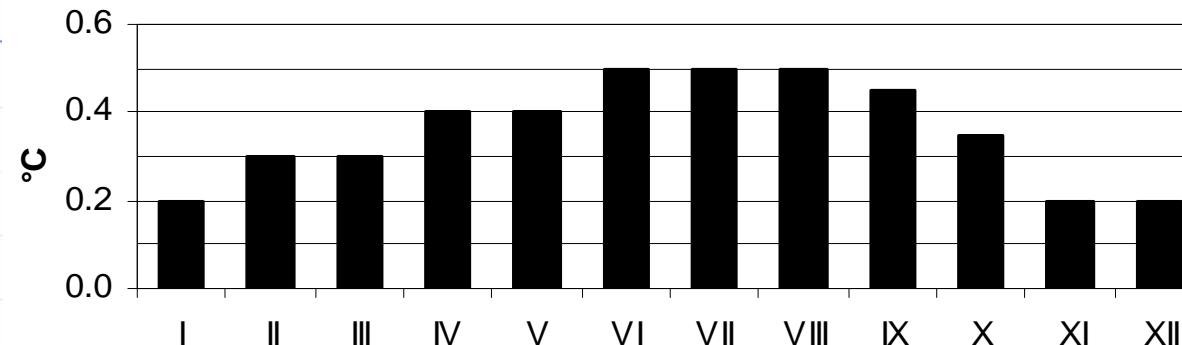
- ◆ several iteration of testing and results evaluation
 - several iterations of homogeneity testing and series adjusting (3 iterations should be sufficient)
 - question of homogeneity of reference series is thus solved:
 - ◆ possible inhomogeneities should be eliminated by using averages of several neighbouring stations
 - ◆ if this is not true: in next iteration neighbours should be already homogenized

Example: CZ, air temperature (200 stations, 1848-2000)

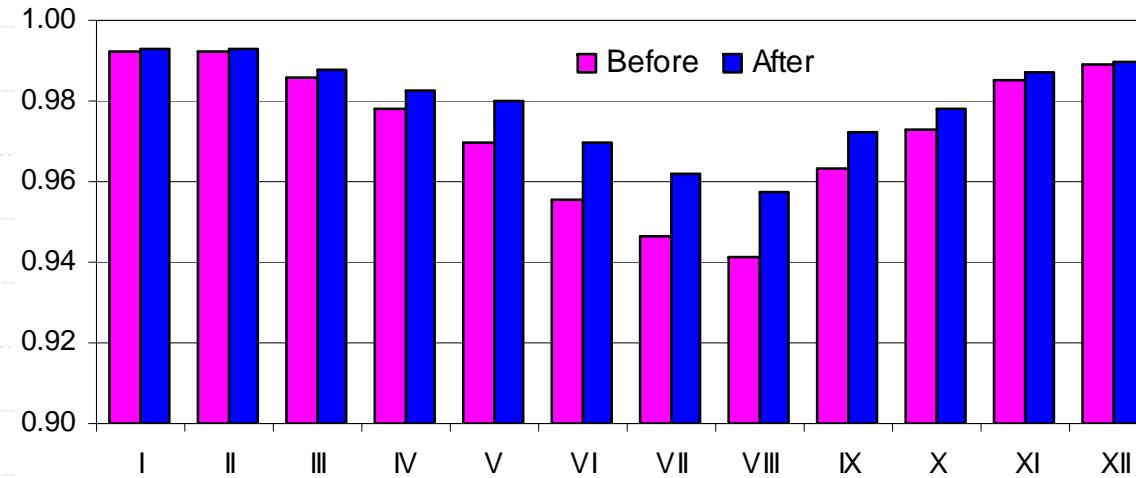
Number of significant inhomogeneities before and after homogenization ($p=0.05$)



Amount of adjustments for homogenised series (absolute values) - median



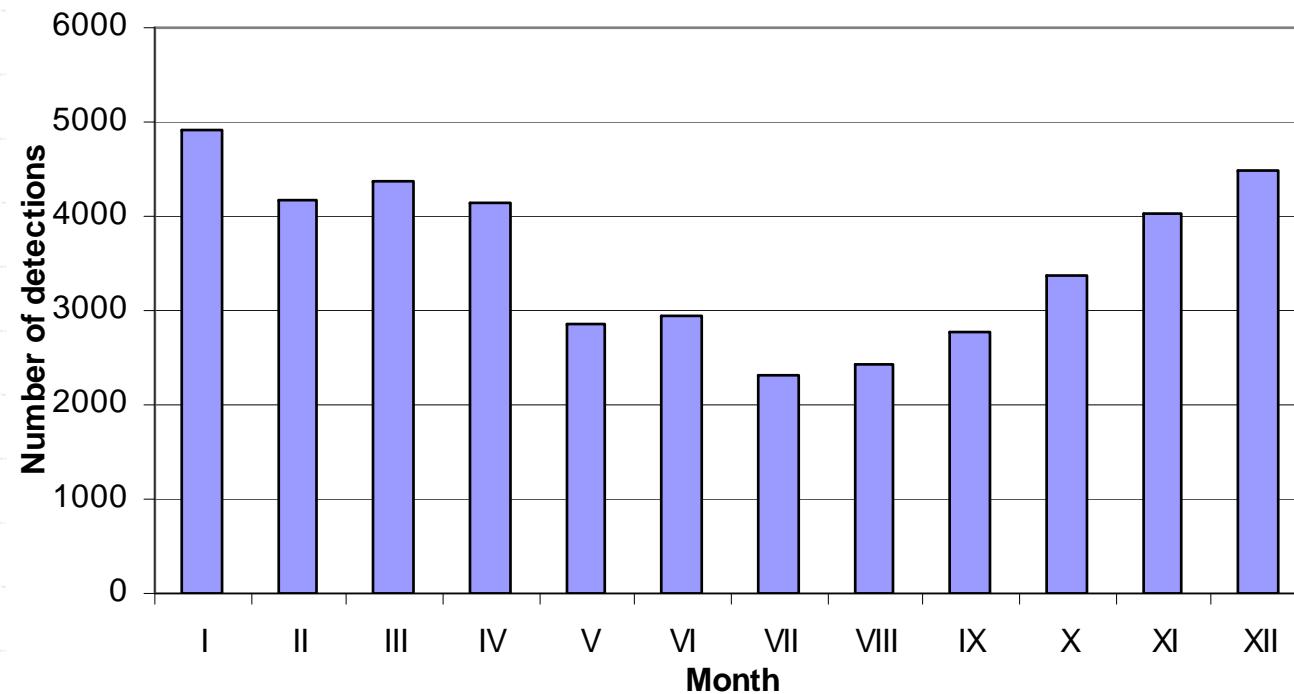
Correlation coefficients between candidate and reference series before and after homogenization (median)



Example: CZ, precipitation

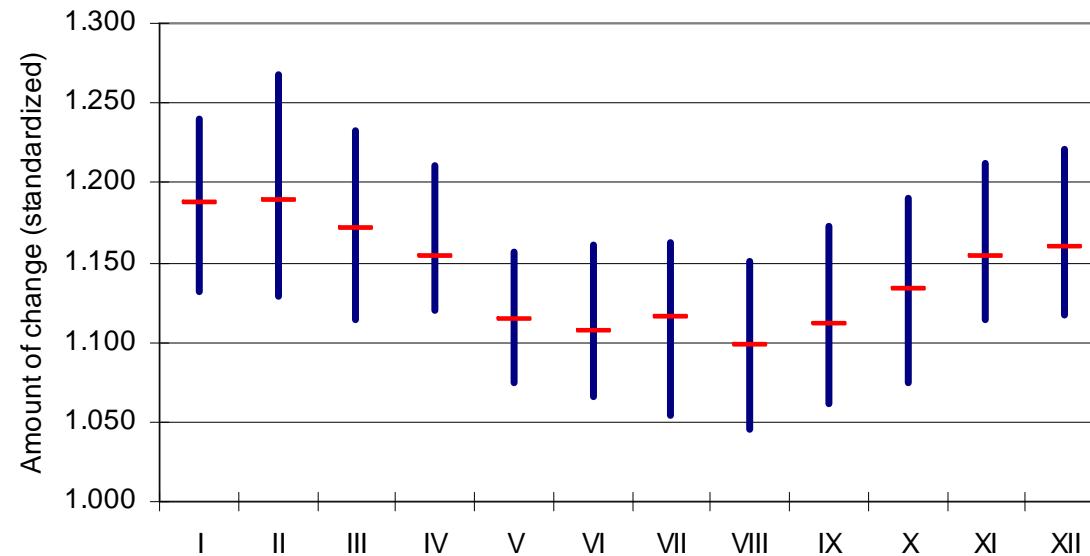
(800 stations, 1961-2000)

- ◆ 4 tests, 4 reference series, 12 months + 4 seasons and year
- ◆ Number of detected inhomogeneities (significant)



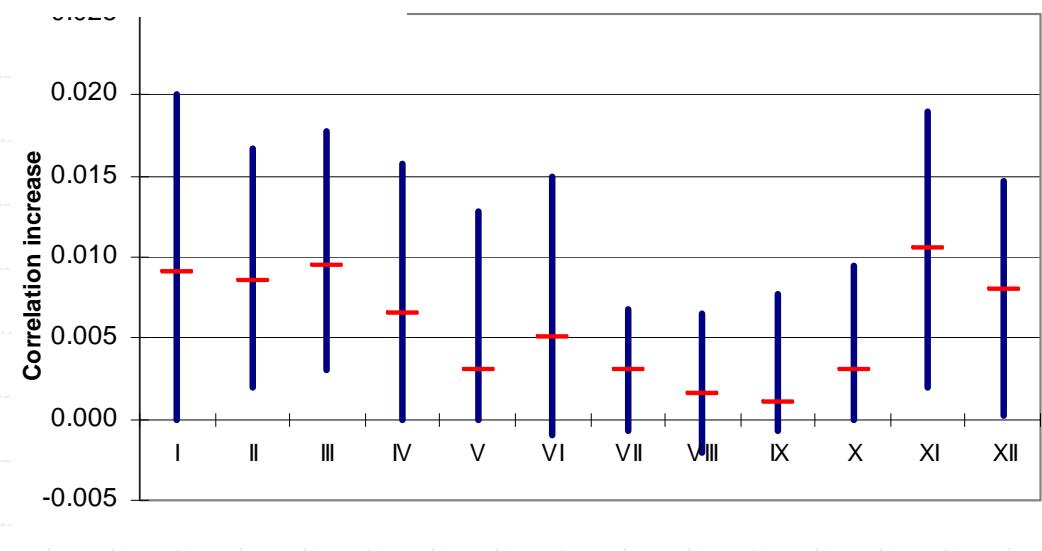
Amount of change (ratios – standardized to be >1.0), precipitation

(reference series calculation based on correlations)



Boxplots:
- Median
- Upper and lower quartiles
(for 589 testes series)

Correlation improvement



Remarks - Homogenization recommendations 1/2

- ◆ data quality control before homogenization is of very importance (if it is not part of it)
- ◆ Using series of observation hours (complementarily to daily AVG) is highly recommended (different manifestation of breaks)
- ◆ be aware of annual cycle of inhomogeneities, adjustments, ...

Remarks - Homogenization

recommendations 2/2

- ❖ Because of Noise in the time series it makes sense:
 - ❖ - „Ensemble“ approach to homogenization (combining information from different statistical tests, time frames, overlapping periods, reference series, meteorological elements, ...)
 - ❖ - more information for inhomogeneities assessment – higher quality of homogenization in case metadata are incomplete

Technical series calculation

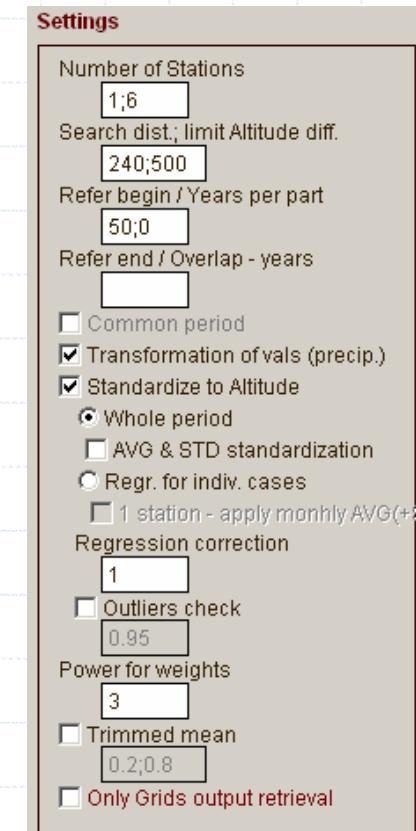
Output:

- ◆ Station technical series (QC, homogenized, filled gaps)
- ◆ Grid points series (regular network)

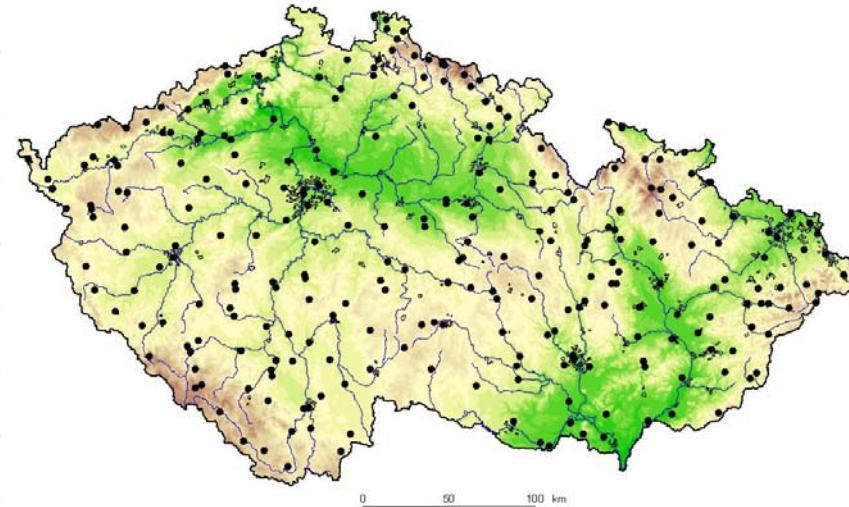
- ◆ Daily scale
- ◆ 1961-2000 / 2008 (adding new years)
- ◆ Various elements (T,TMA,TMI,SRA,SSV,E,F)
- ◆ Various regions:
 - whole CZ, various spatial resolution (10, 25km)
 - whole SK (10 km)
 - CECILIA region (10 km)

Technical series calculation

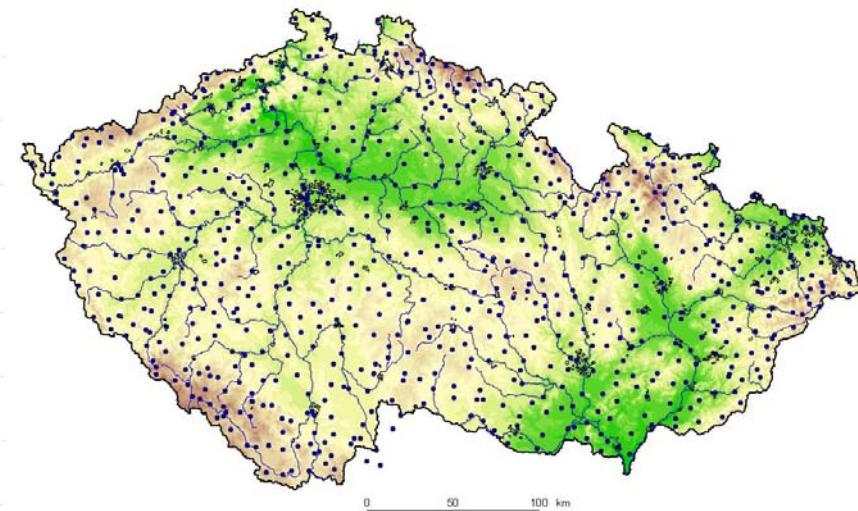
- ◆ Method of interpolation:
 - Local linear regression – standardization of neighbour stations values to altitude of given location
 - IDW method for “expected” value calculation (applied different power of inverse distance for various met. elements)
- ◆ Time series calculated for arbitrary point, in daily scale
- ◆ Single realization in time (each day individually) (it solves inversion etc...),



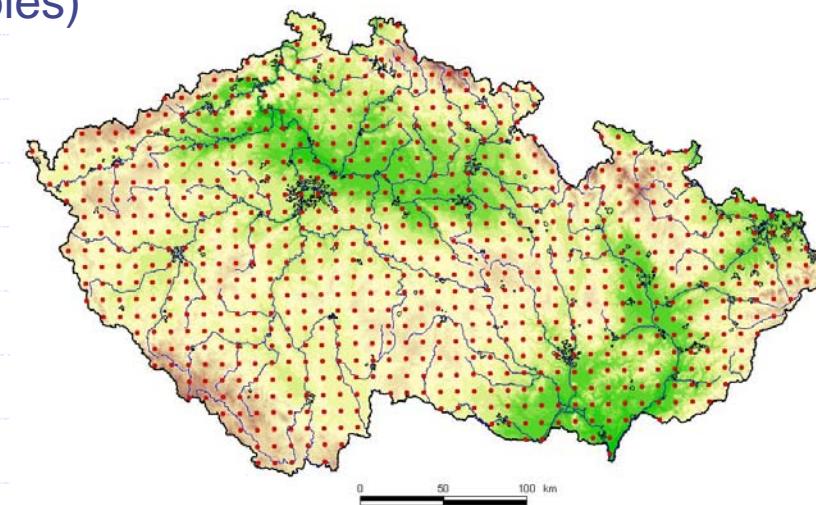
Stations (268) with calculated technical series,
climatological stations



Stations with technical series,
precipitation stations

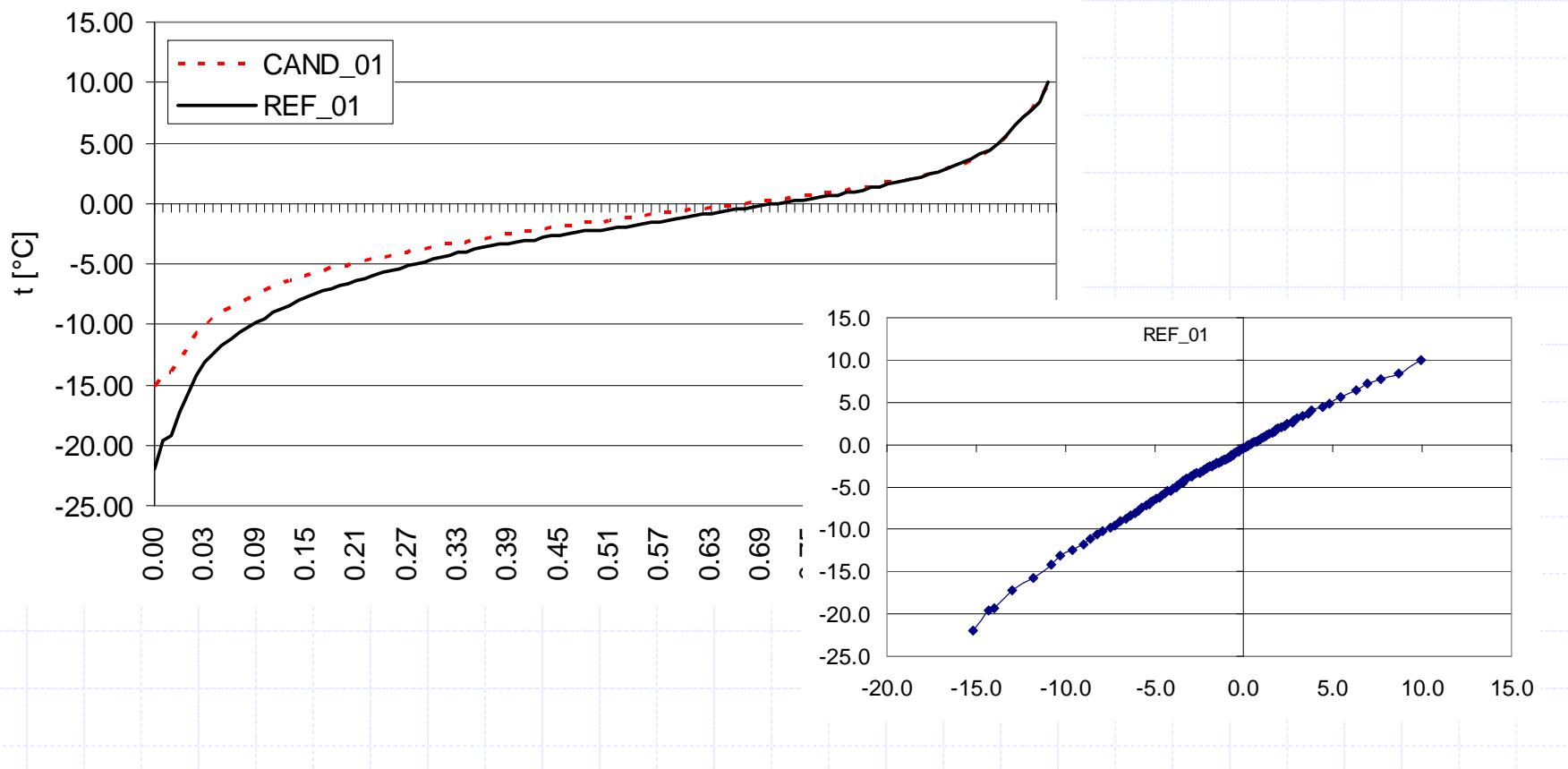


Stations with technical series, for grid points of ALADIN-Climate/CZ
(1961-2008, 7 met. variables)



Model output correction

- an approach of Michel Déqué (2007) based on variable correction using individual percentiles
- for each grid point and month individually



Software package – conclusions

- ◆ Learning the methods in climatology with AnClim
- ◆ Processing whole national datasets using LoadData and ProClimDB
- ◆ Freeware versions
- ◆ Continuous improvement via user feedbacks (adding new functionality)

<http://www.climahom.eu>