Quality control of daily data on example of Central European series of air temperature, relative humidity and precipitation

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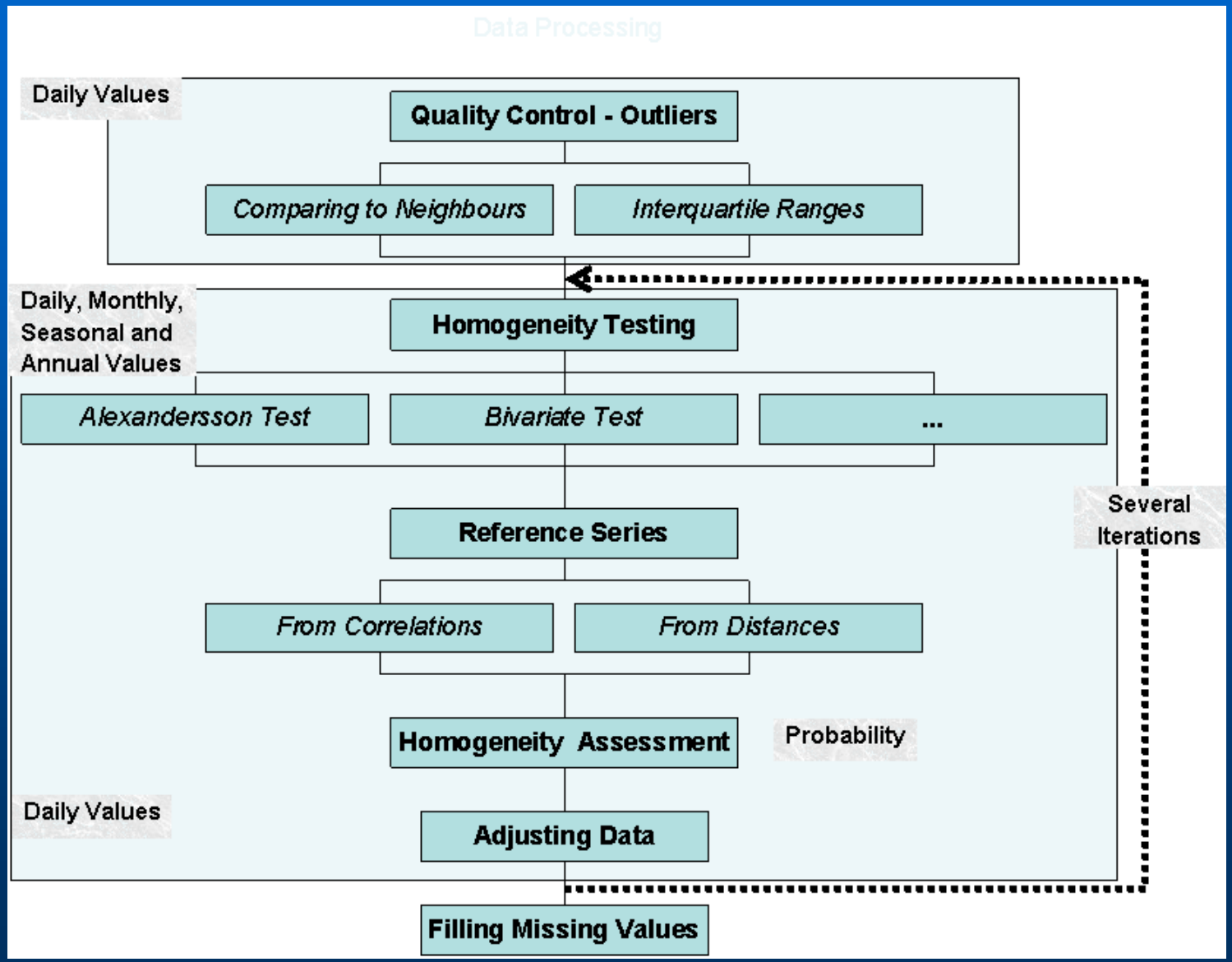
COST-ESO601 meeting and

Sixth Seminar for Homogenization and Quality Control in Climatological Databases

Processing before any data analysis

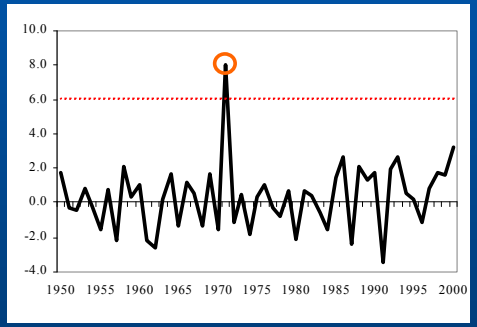


Software AnClim, ProClimDB

Data Quality Control
Finding Outliers

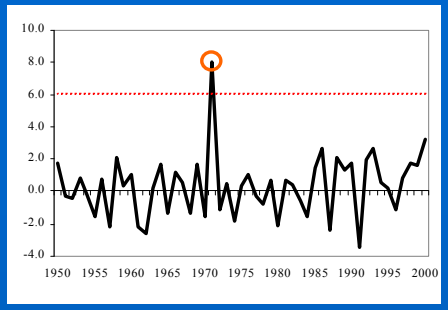
Two main approaches:

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



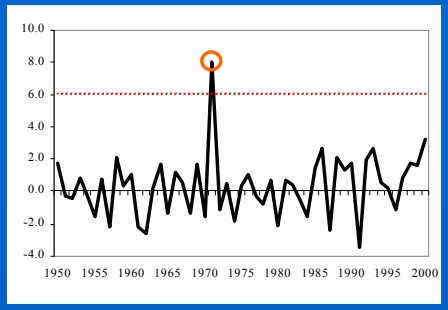
- **comparing values to values of neighbouring stations (spatial analysis)**

Data Quality Control
Finding Outliers



- **1. Using limits derived from interquartile range**
  - **relatively, series of diffs./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**

Creating Reference Series



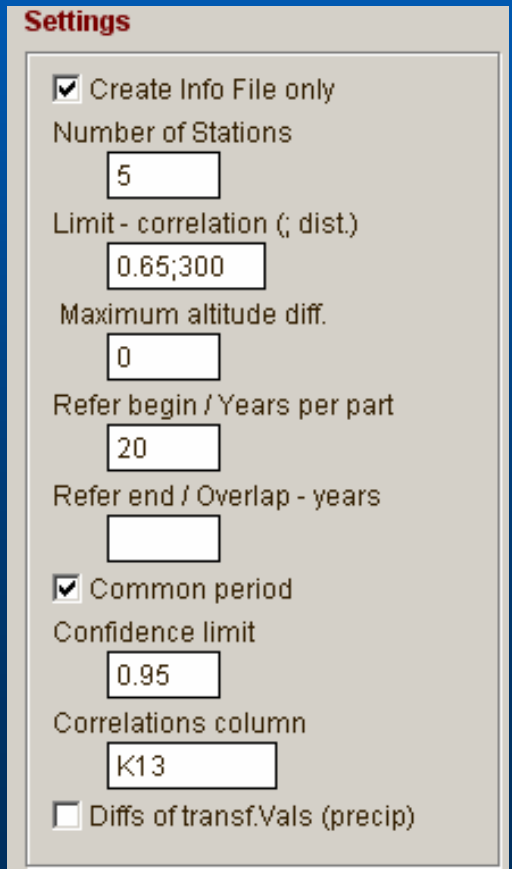
- for monthly, daily data (each month individually)
- weighted/unweighted mean from neighbouring stations
- criterions used for stations selection (or combination of it):
  - best correlated / nearest neighbours

    (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	
	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

Selection according to correlations, distances and altitudes

Data Quality Control
Finding Outliers

- **2. comparing values to values of neighbouring stations**
  - **comparing to min. 3 to 10 best correlated (nearest) stations**
  - **calculating series of standardized differences (logarithms of ratios)**
  - **number of cases exceeding 95% confidence limits is counted**

Example:

Comparing base station to its neighbours

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,li	*225.0*	*280.0*	*176.0*	*190.0*	*240.0*							
B1HLUK01				st_1, distar	*6.8*											
B1VELV01				st_2, distar		*8.9*										
B1STRZ01				st_3, distar			*10.4*									
B1BZEN01				st_4, distar				*12.2*								
B1RADE01				st_5, distar					*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	

Data Quality Control
Finding Outliers

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  - **number of cases exceeding 95% confidence limits is counted**
  - **Standardization of neighbours to base station values (AVG, STD, Altitude),**
  - **calcualting various characterestics from these values**
  - **Comparison with „expected“ value – (calculated as weighted mean from standardized neighbours values) <- interpolation method**

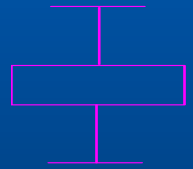
Data Quality Control
Neighbours values Standardization

- **Standardizing to average and/or standard deviation of base station**
  (for each month individually)
- **To altitude of the base station**
  - **Linear regression calculated for each month individually**
  - **For each row (particular month or day) individually (GIS)**

Data Quality Control
Neighbours values Standardization

- **Characteristics calculated from the standardized values:**
  - **coefficient of Interquartile range (ranges are estimated from standardized neighbours values)**
  - **difference of base station and median from neighbours values (probability):**

    CDF for ((base station – median_from_standardized_neighbors_values)/STD_base_station)

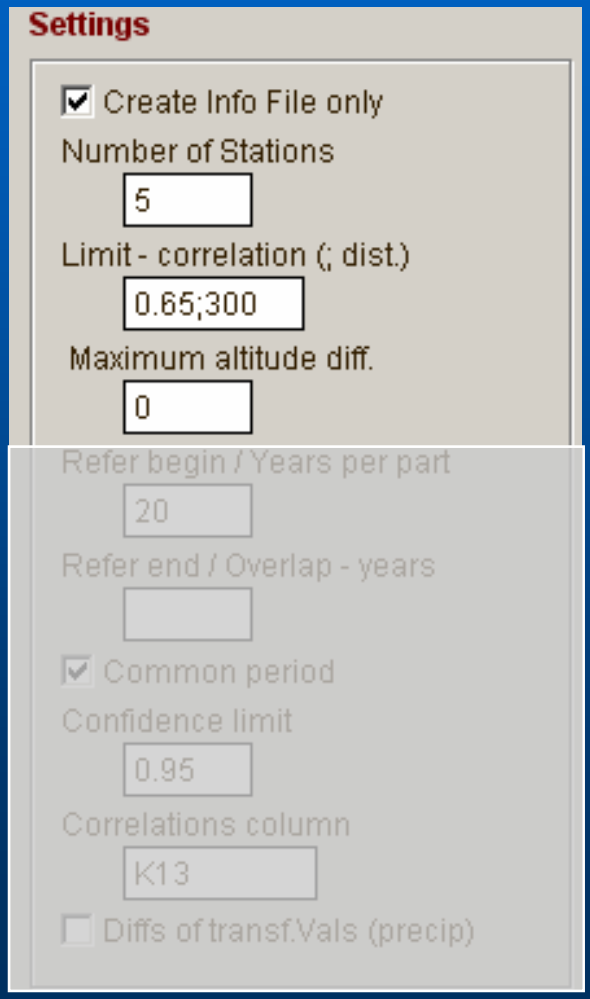


  - **„Expected“ value (as weighted mean with weights 1/distance or correlations, arbitrary power; possibility of using trimmed mean)**

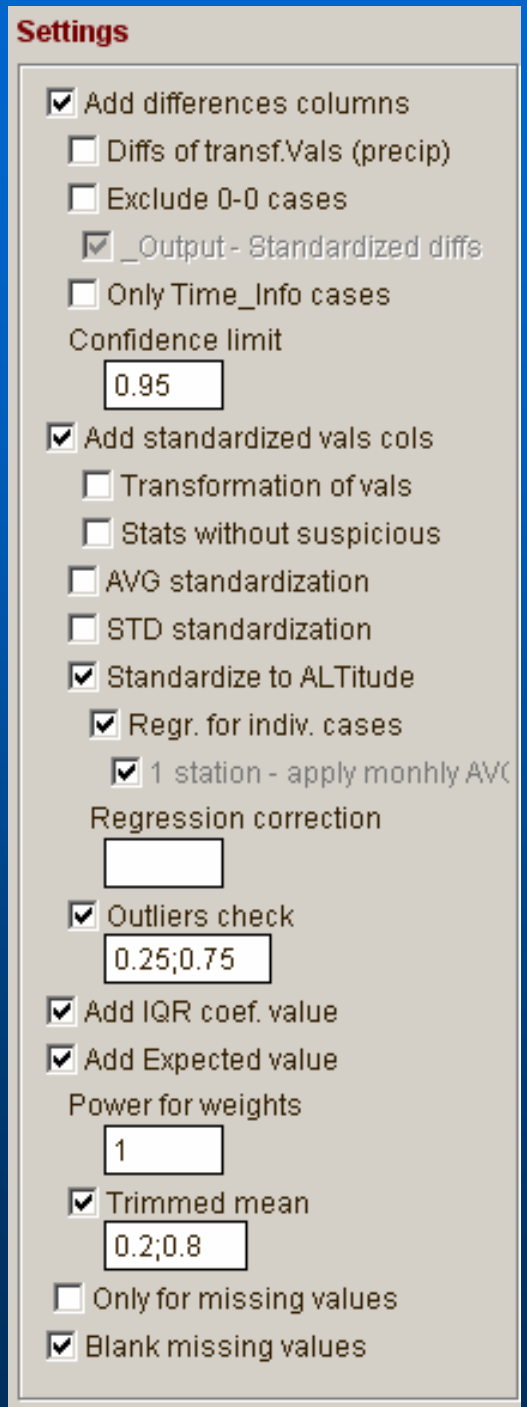
QC, Settings in the software

processing the whole database

1. Finding neighbours:



2. Calculation:



Example of outputs for outliers assessment

Suspicious values

Expected value

Neighbour stations values

List of neighbours

Altitudes and distances of neighbours

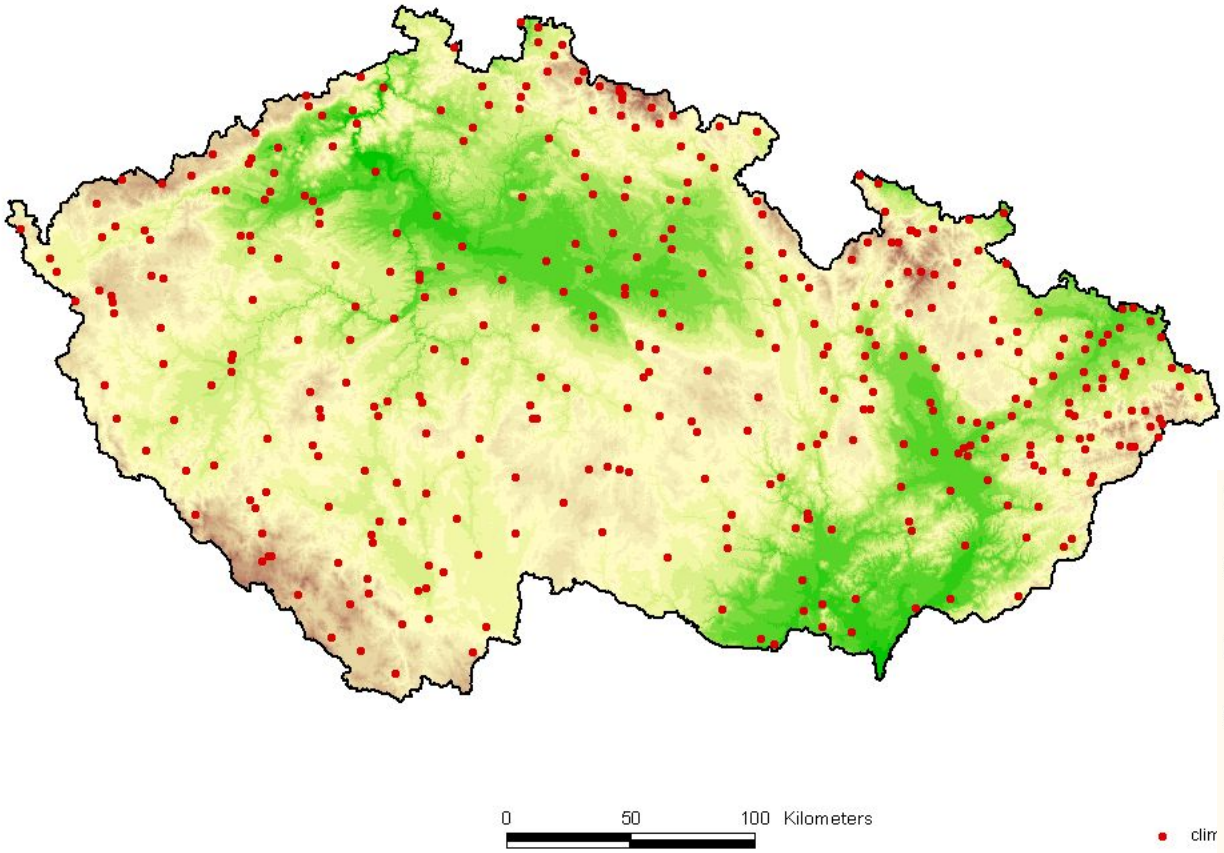
	B	C	D	E	F	G	H	I	J	K	L	M
	ID	YE	MONT	DA	ST_BASE	EXPECT_	REMAR	ST_1	ST_2	ST_3	ST_4	ST_5
0	B2BTUR01_T_03:30				241,00		Altitude	235,00	670,00	203,00	210,00	749,00
0	B2BZAB01_T_03:30						st_1, di	11,58				
0	B1PROT01_T_03:30						st_2, di		36,85			
0	O3PRER01_T_03:30						st_3, di			59,12		
0	O2OLOM01_T_03:30						st_4, di				62,88	
0	O1CERV01_T_03:30						st_5, di					91,95
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		Altitude	235,00	670,00	203,00	210,00	749,00
5	B2BZAB01_T_03:45						st_1, di	11,58				
5	B1PROT01_T_03:45						st_2, di		36,85			
5	O3PRER01_T_03:45						st_3, di			59,12		
5	O2OLOM01_T_03:45						st_4, di				62,88	
5	O1CERV01_T_03:45						st_5, di					91,95
5	**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		Altitude	235,00	670,00	203,00	210,00	749,00
0	B2BZAB01_T_04:00						st_1, di	11,58				
0	B1PROT01_T_04:00						st_2, di		36,85			
0	O3PRER01_T_04:00						st_3, di			59,12		
0	O2OLOM01_T_04:00						st_4, di				62,88	
0	O1CERV01_T_04:00						st_5, di					91,95
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		Altitude	235,00	670,00	203,00	210,00	749,00
0	B2BZAB01_T_05:00						st_1, di	11,58				
0	B1PROT01_T_05:00						st_2, di		36,85			
0	O3PRER01_T_05:00						st_3, di			59,12		
0	O2OLOM01_T_05:00						st_4, di				62,88	
0	O1CERV01_T_05:00						st_5, di					91,95
0	**B2BTUR01_T_05:00**	**2006**	**6**	**25**	**24,70**	**17,52**		**17,30**	**17,20**	**17,30**	**16,30**	**17,20**

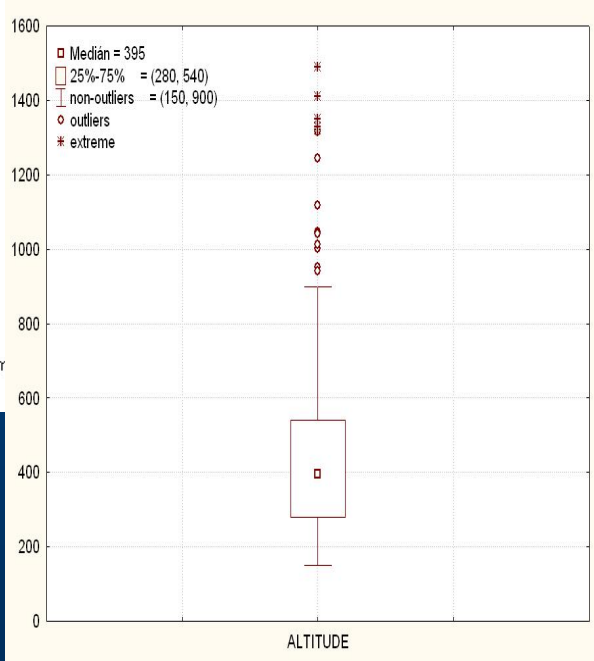
Quality control

- Run for period 1961-2007, dialy data (measured values in observation hours)
- All stations (200 climatological stations, 800 precipitation stations)
- All meteorological elements (T, TMA, TMI, TPM, SRA, SCE, SNO, E, RV, H, F) – parameters set individually

- Historical records will follow now

Spatial distribution of climatological stations





- period 1961-2007
- 200 stations
- mean minimum distance: 12 km

Settings in the software
Air temperature

Spatial correlations, max. temperature

Annual values …

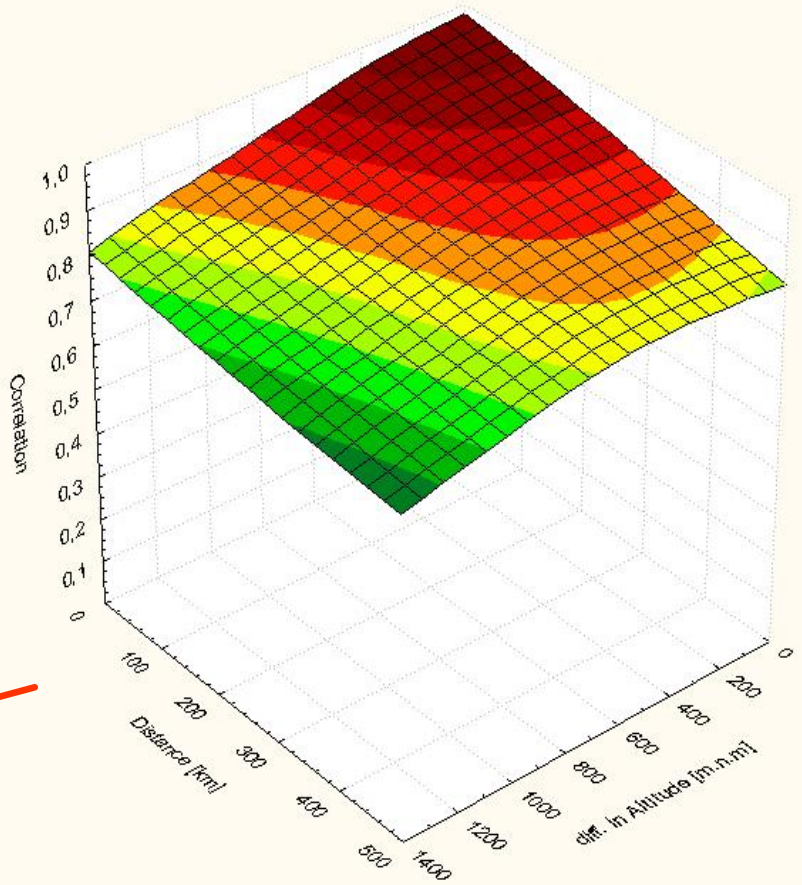
Settings

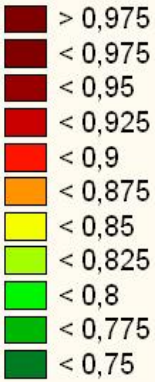
- [x] Add differences columns
  - [ ] Diffs of transf.Vals (precip)
  - [ ] Exclude 0-0 cases
    - [x] _Output - Standardized diffs
  - [ ] Only Time_Info cases

  Confidence limit: 0.95
- [x] Add standardized vals cols
  - [ ] Transformation of vals (precip.)
  - [ ] Stats without suspicious
- [ ] AVG standardization
- [ ] STD standardization
- [x] Standardize to ALTitude
  - [x] Regr. for indiv. cases
    - [ ] 1 station - apply monhly AVG(+STD)

  Regression correction: 0
- [x] Outliers check: 0.99
- [x] Add IQR coef. value
- [x] Add Expected value

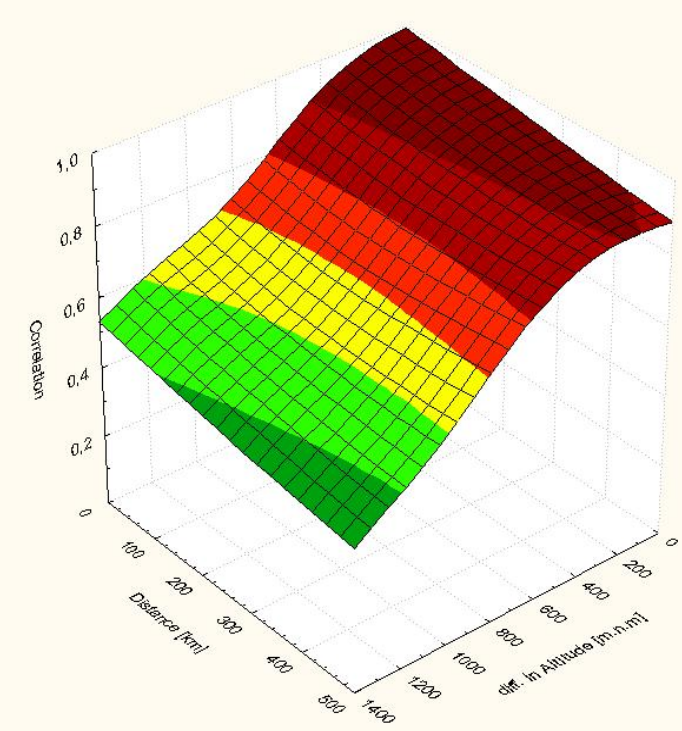
  Power for weights: 1
- [x] Trimmed mean: 0.2;0.8
- [ ] Only for missing values
- [x] Blank missing values



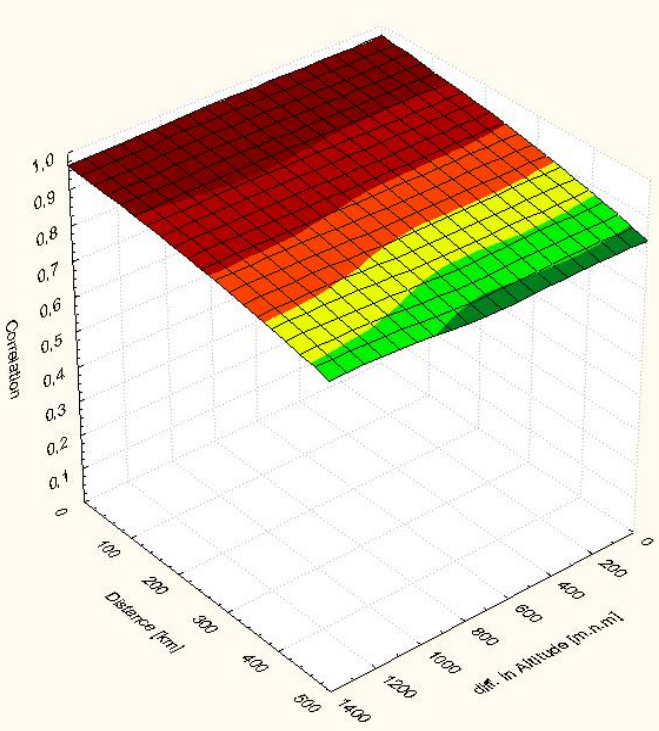


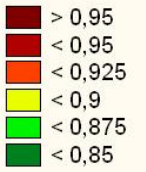
Spatial correlations, max. temperature

January



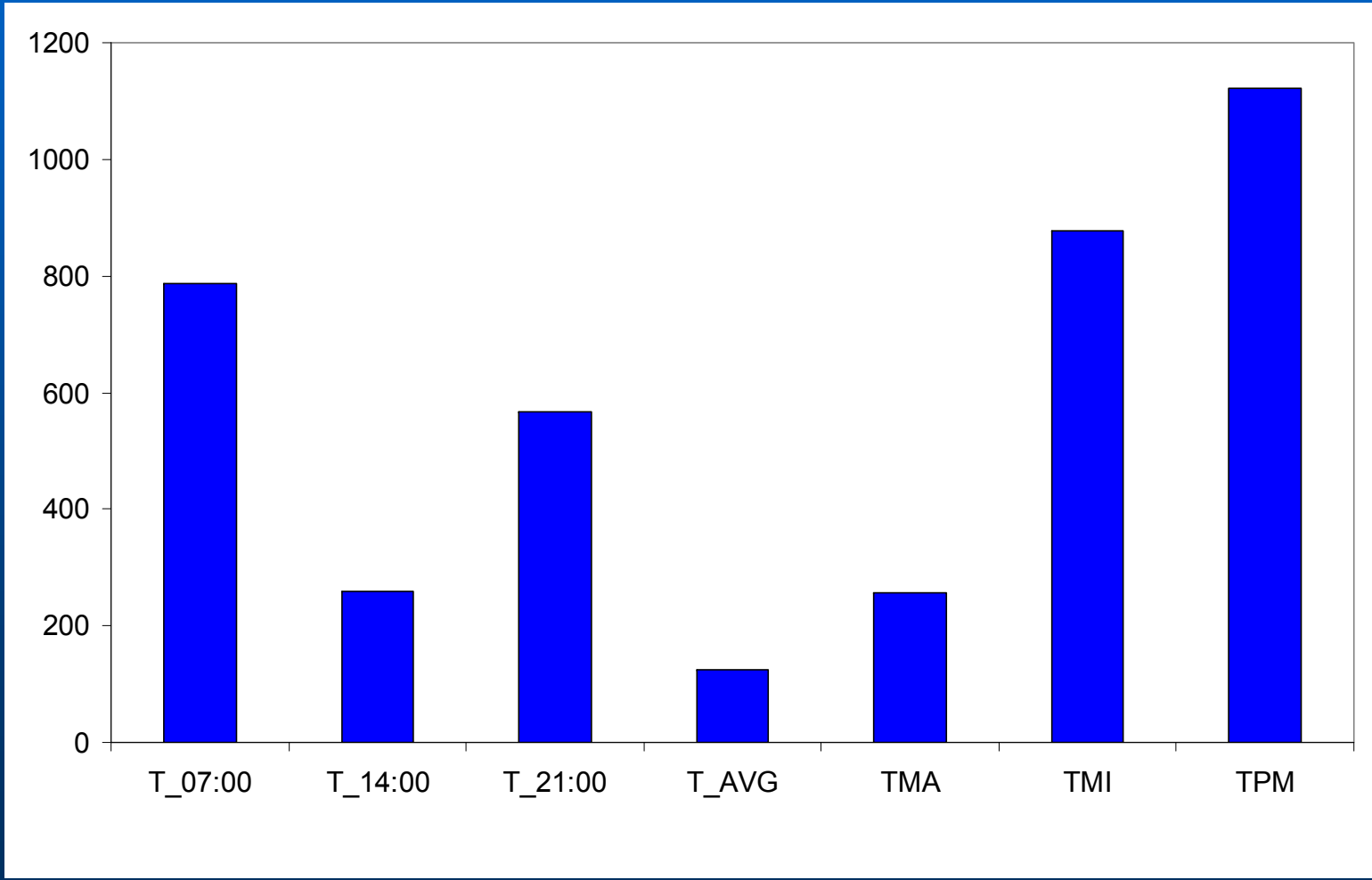
July





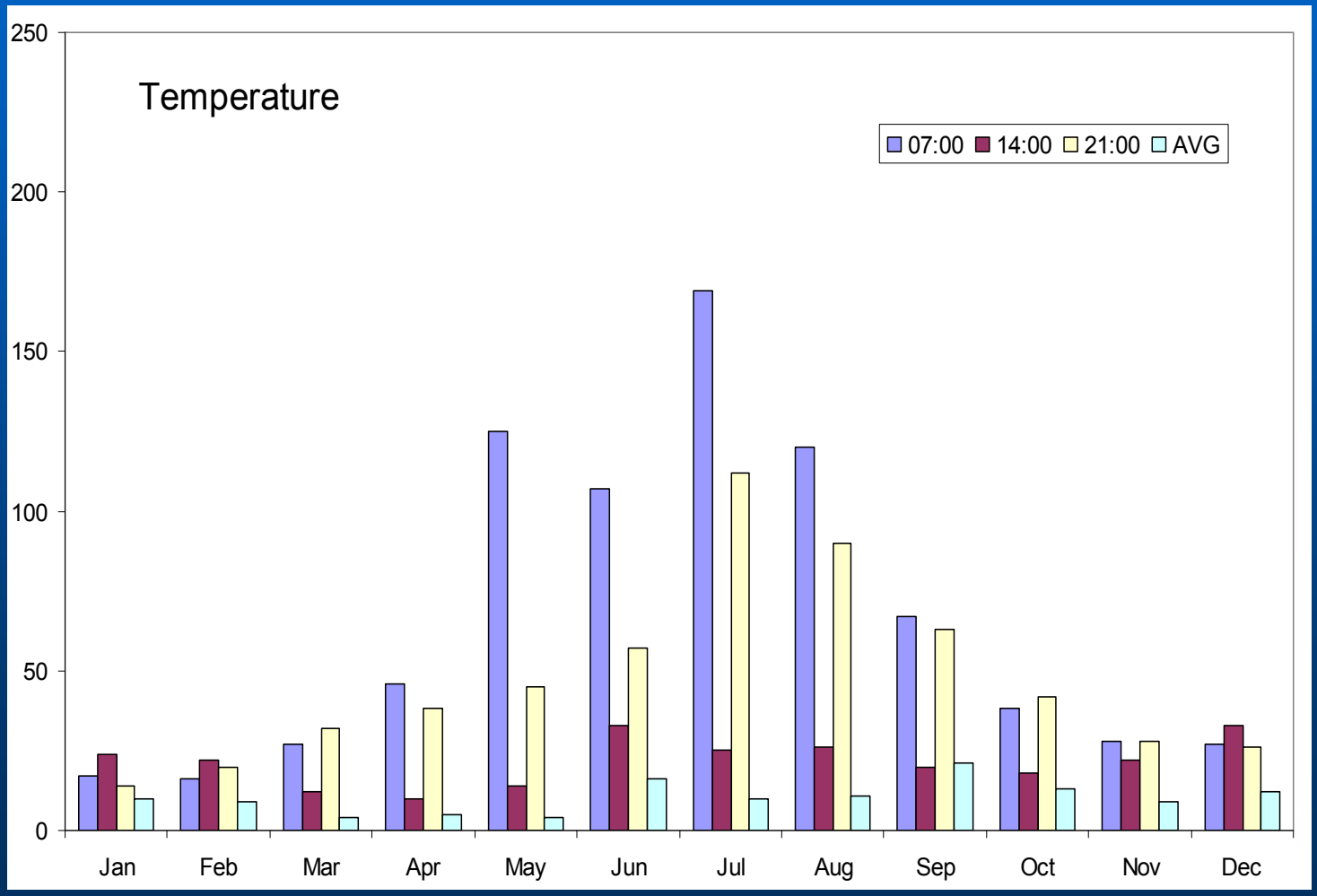
Air temperature, number of outliers 1961-2007, from 3.431.000 station-days

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



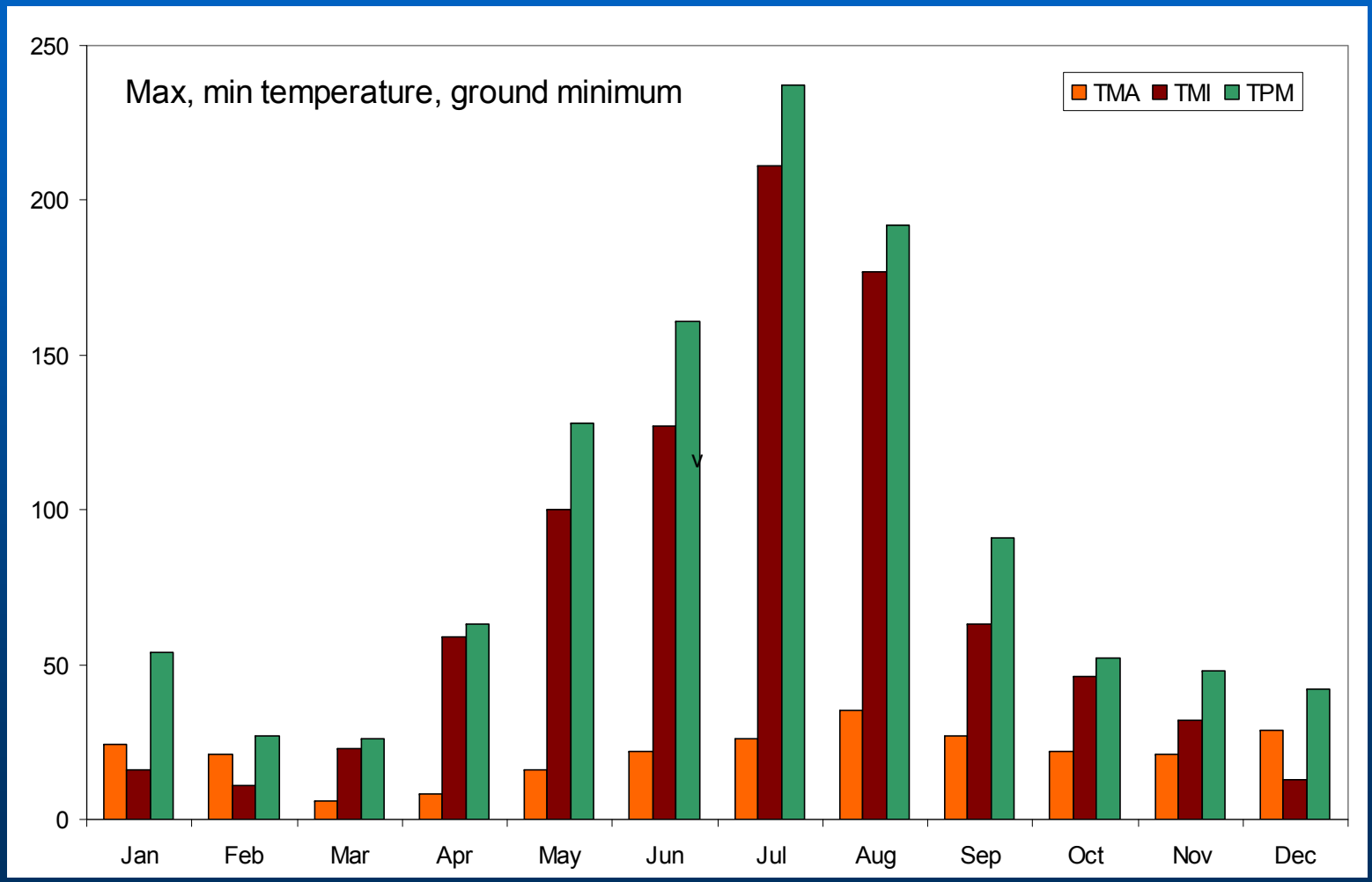
Air temperature, number of outliers 1961-2007, from 3.431.000 station-days

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



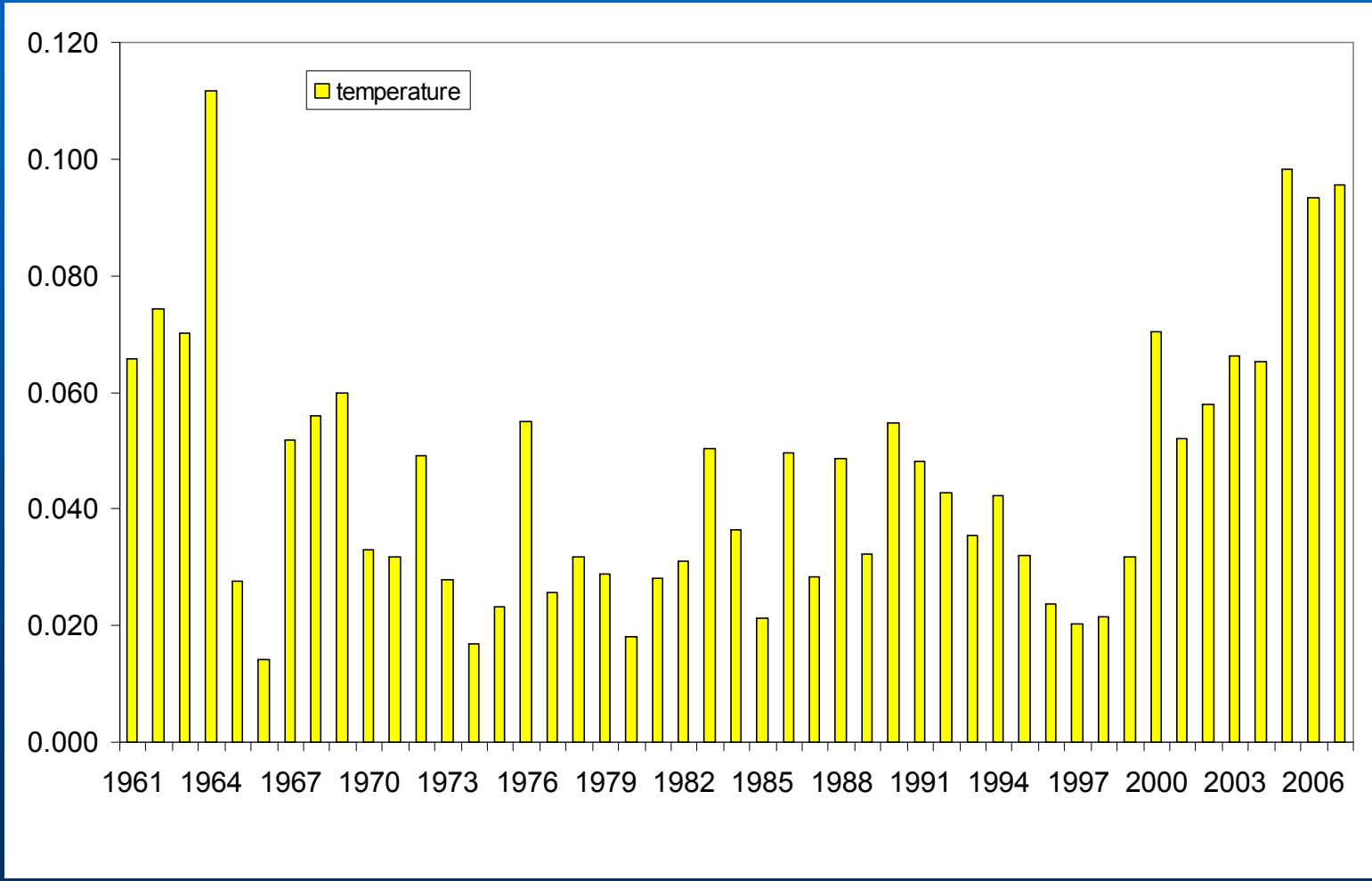
Air temperature, number of outliers 1961-2007, from 3.431.000 station-days

TMA – daily maximum temp., TMI – daily min. temp., TPM – daily ground minimum temp.



Air temperature, number of outliers 1961-2007,

Number of outliers per one station (all observation hours, AVG)



Settings in the software
Water vapor pressure

Spatial correlations, water vapor pressure

Settings

- [x] Add differences columns
  - [ ] Diffs of transf.Vals (precip)
  - [ ] Exclude 0-0 cases
    - [x] _Output - Standardized diffs
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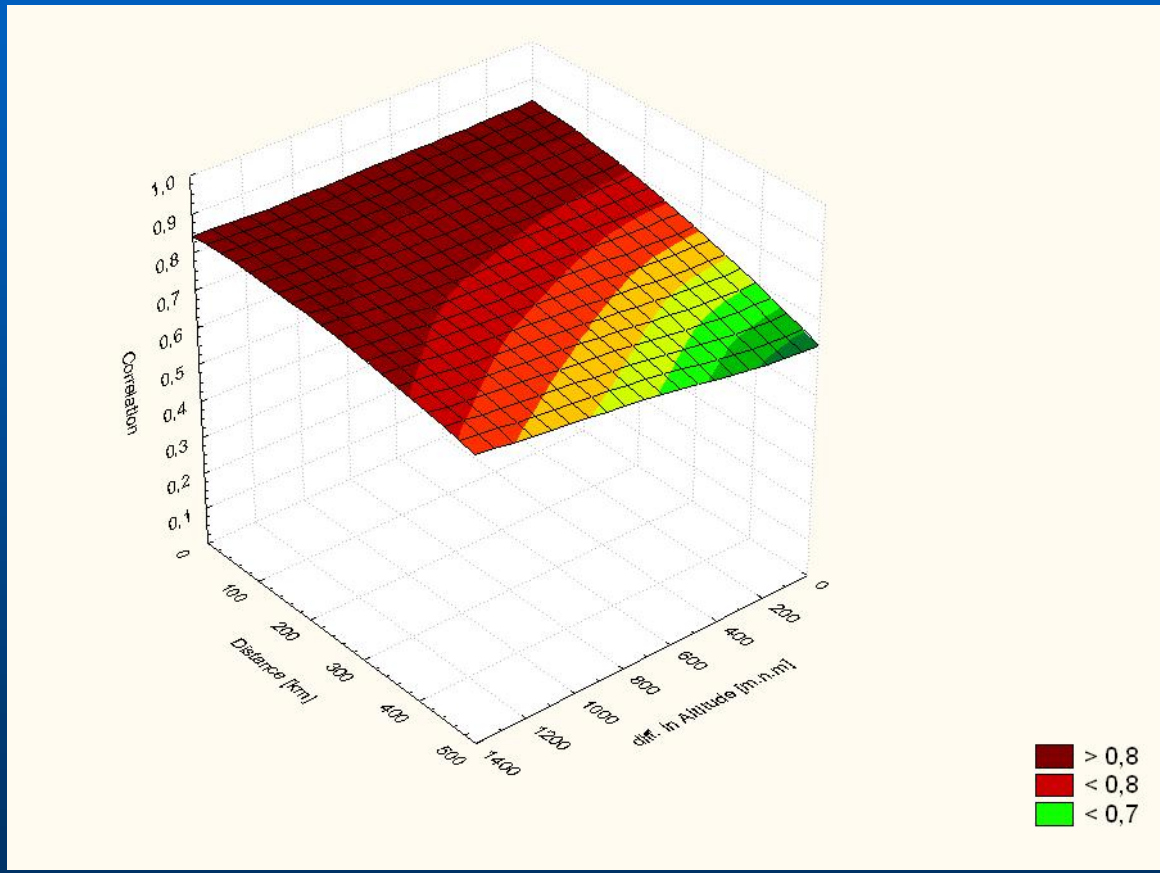
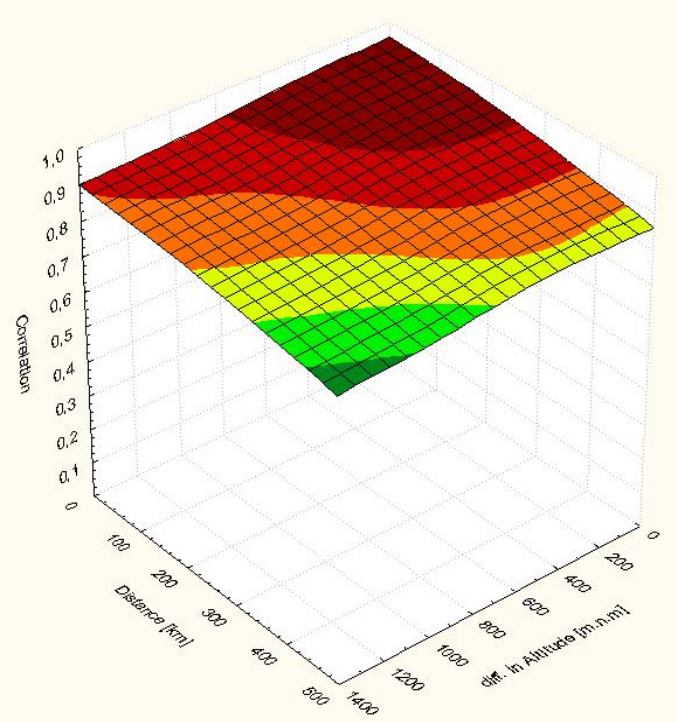
Annual values …

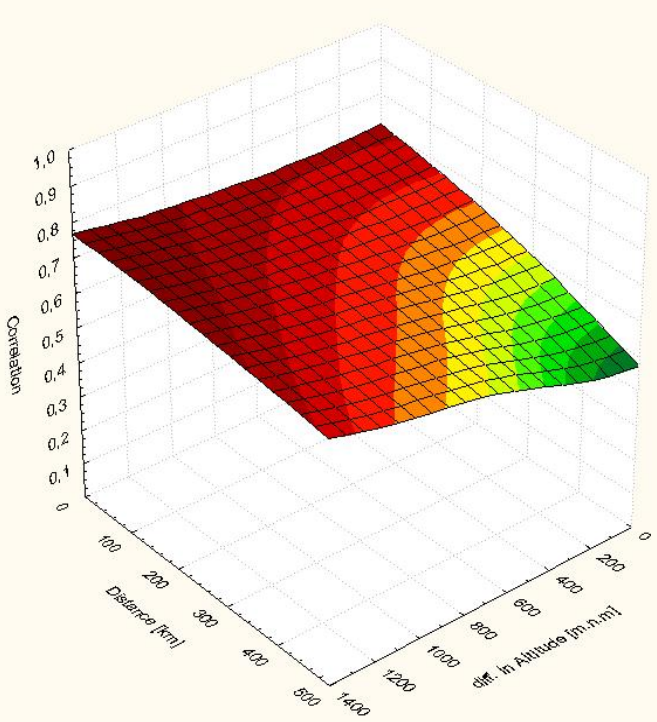


Spatial correlations, water vapor pressure

January

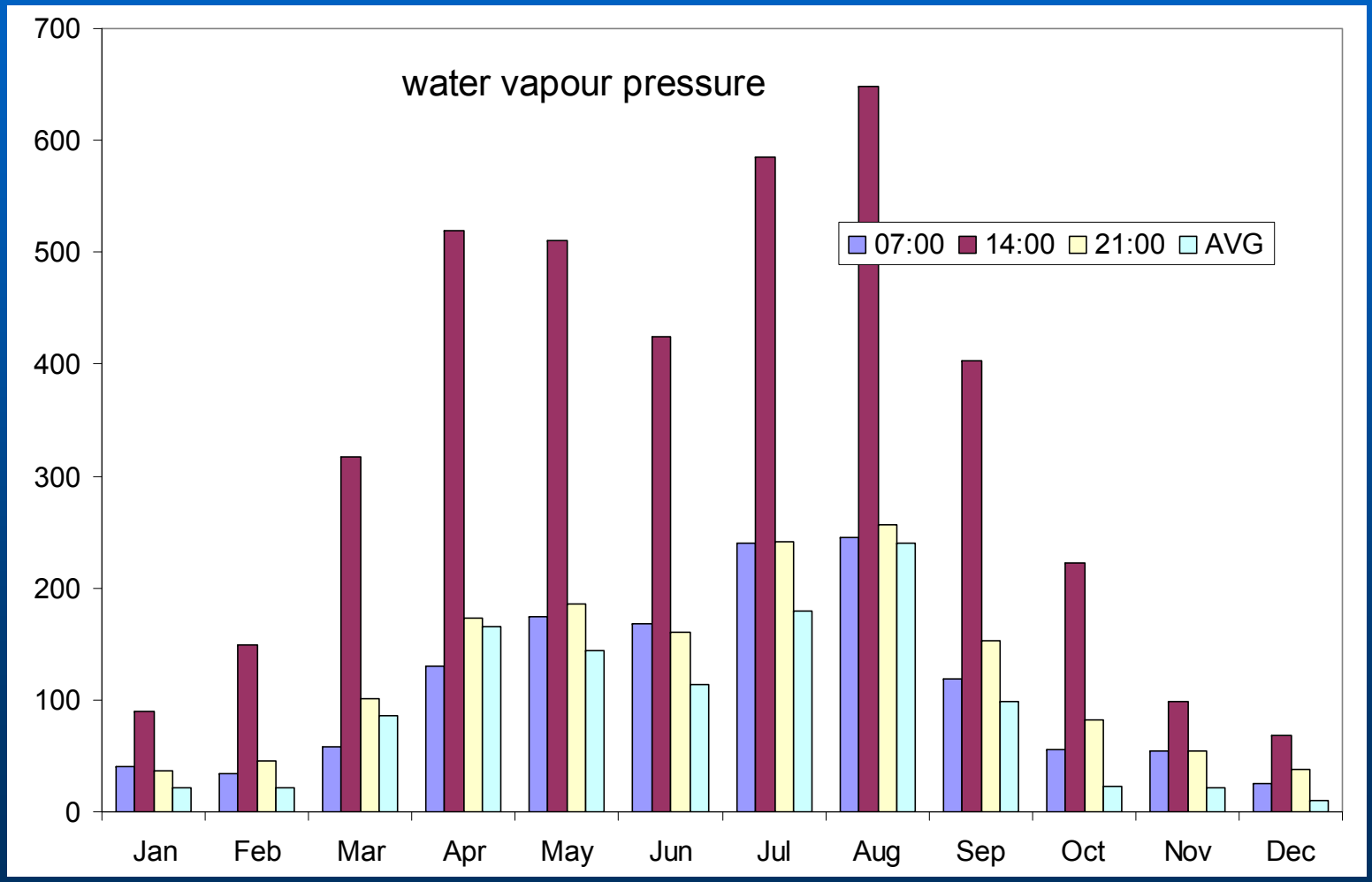


July

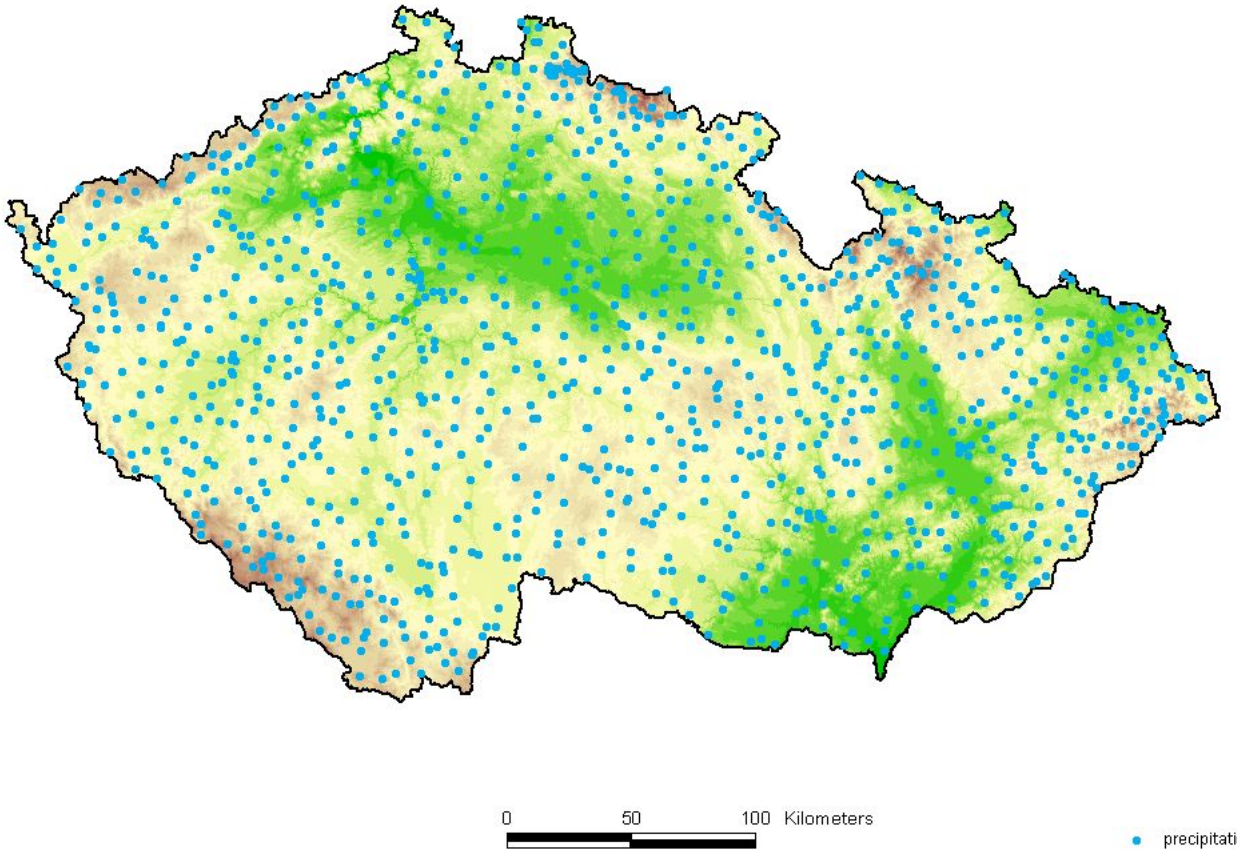


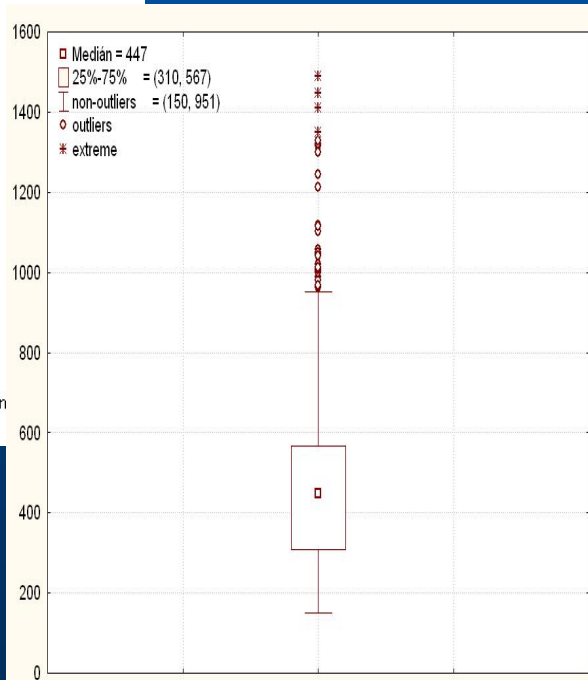
Water vapor pressure, number of outliers 1961-2007, from 3.431.000 station-days

Water vapor pressure at obs. hour, AVG – daily average



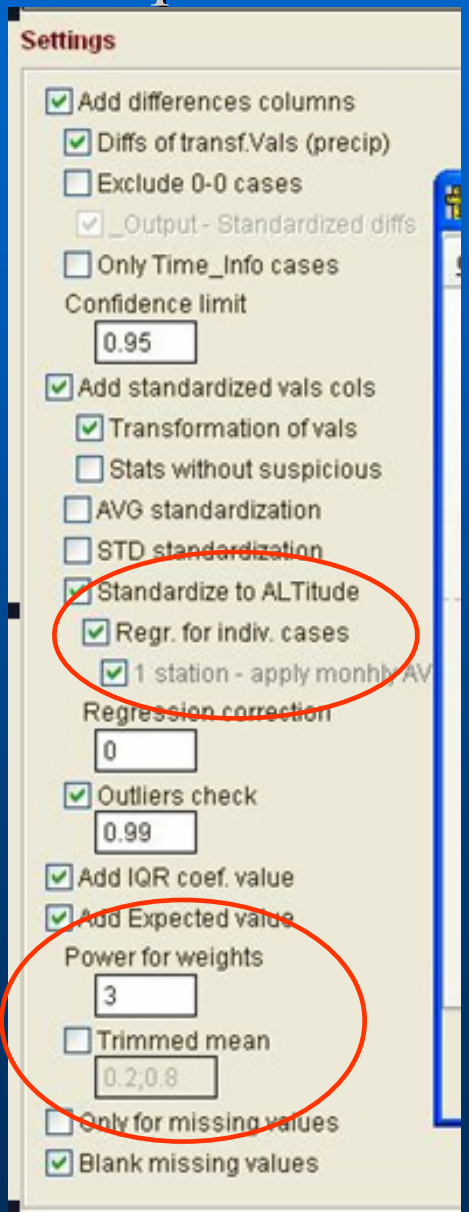
Spatial distribution of precipitation stations





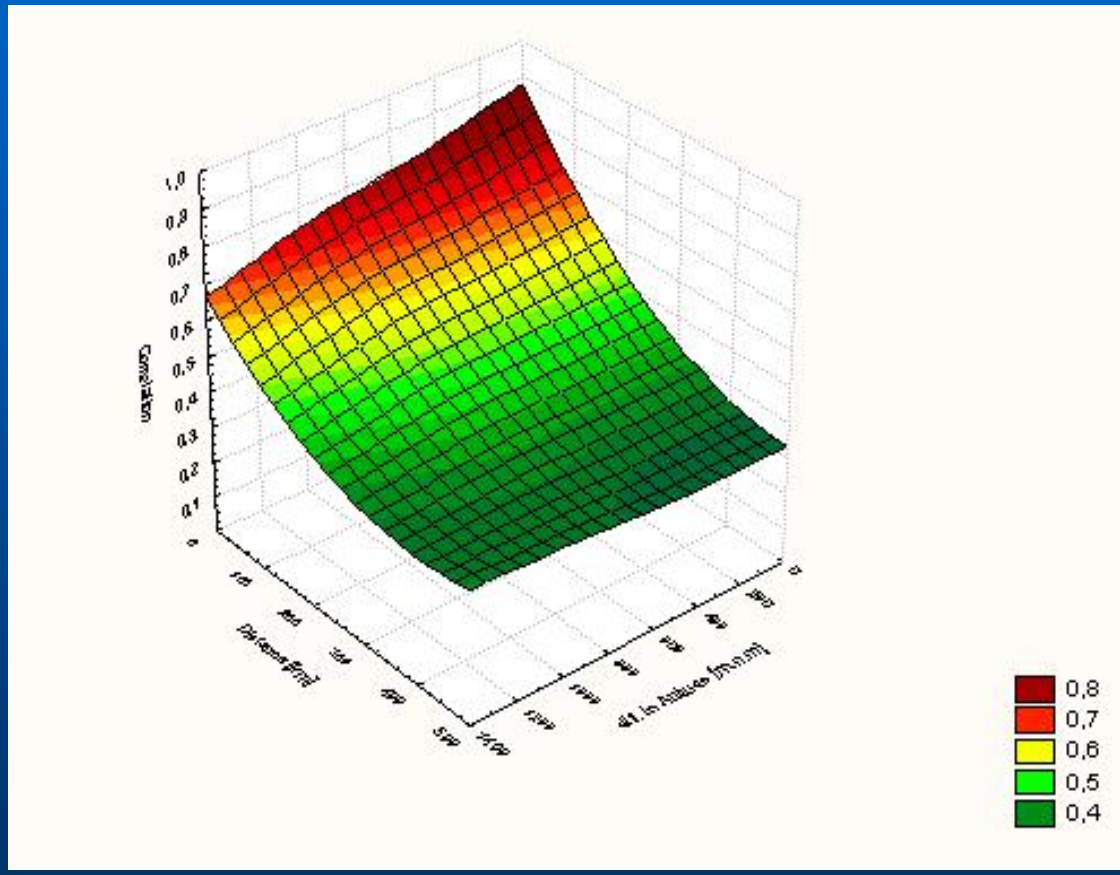
- period 1961-2007
- 600 stations
- mean minimum distance: 7.5 km

Settings in the software Precipitation



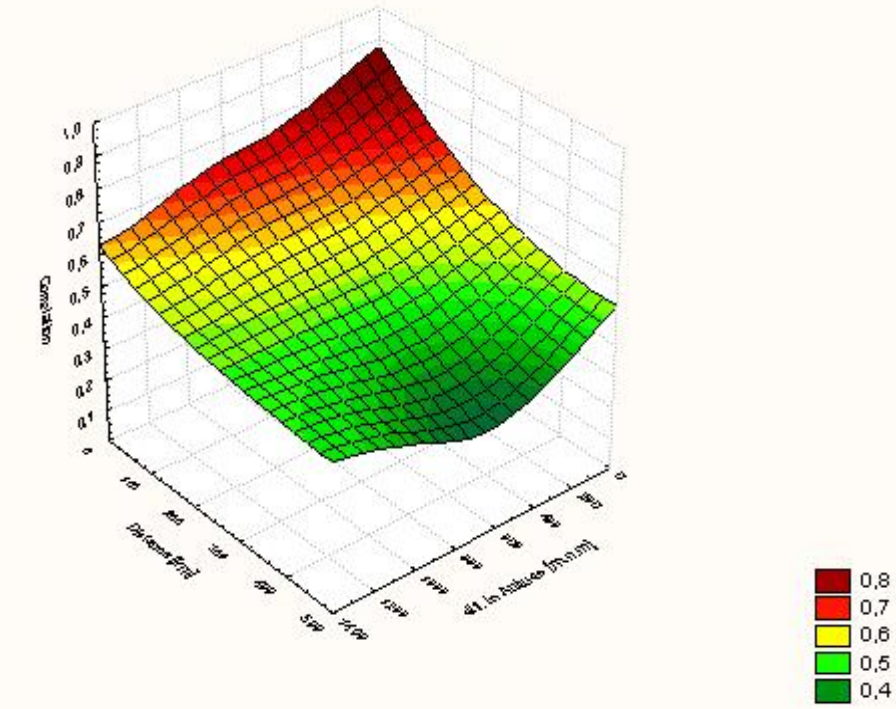
Spatial correlations, precipitation

Annual values …

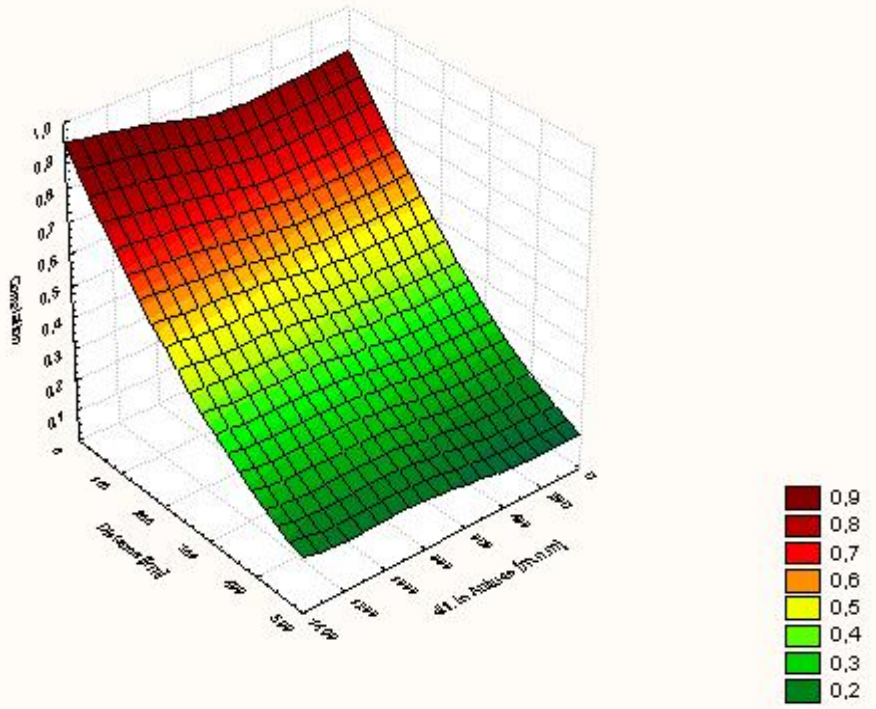


Spatial correlations, precipitation

January



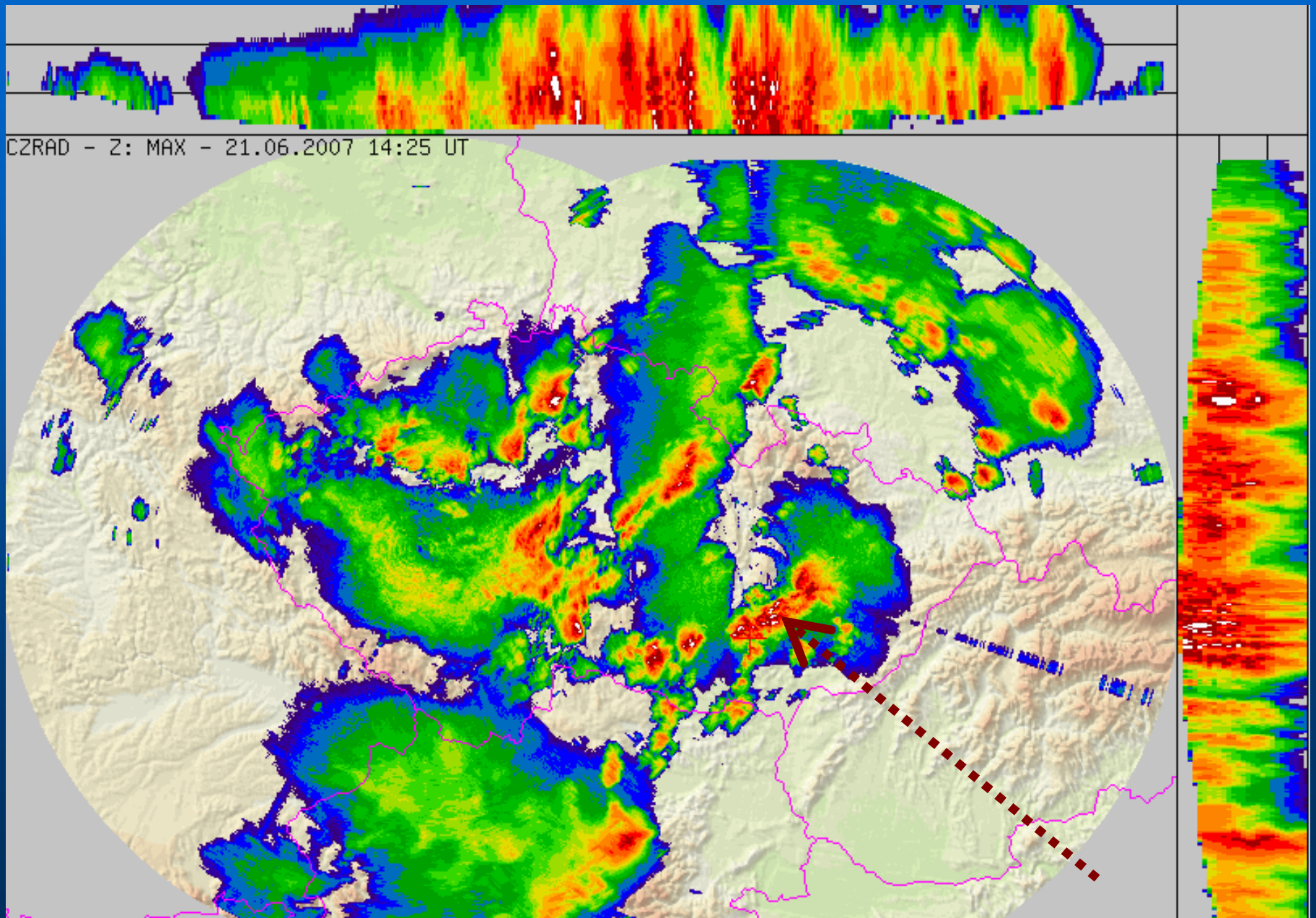
July



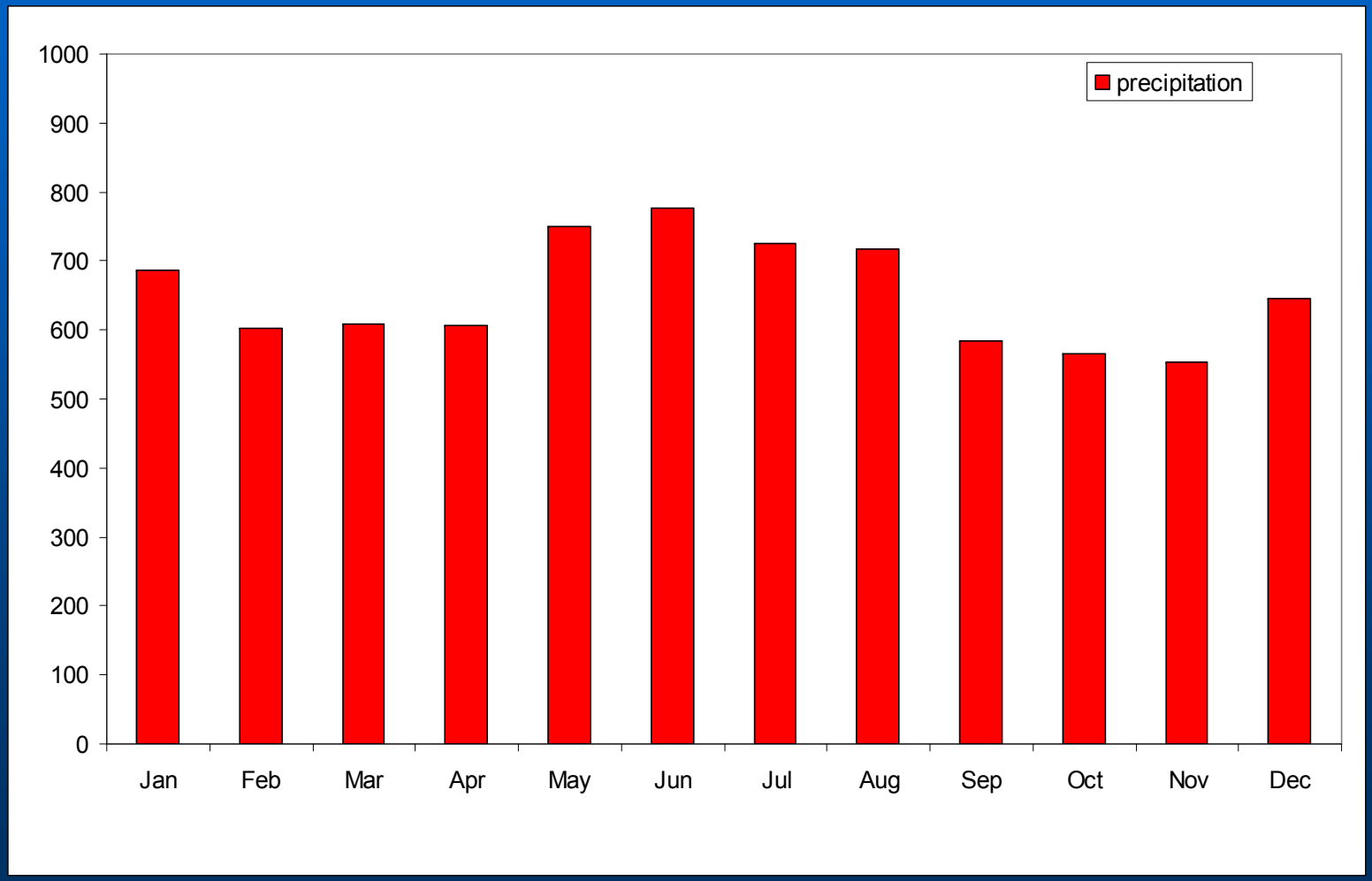
Problematic detections (heavy rainfall)

ID	YEAR	MONTH	DAY	ST_BASE	EXPECT_VAL	REMARK	ST_1	ST_2	ST_3	ST_4	ST_5	D
B2BTUR01_SRA3H_16:00				241,00		Altitude	235,00	670,00	203,00	210,00	749,00	
B2BZAB01_SRA3H_16:00						st_1, di	11,58					
B1PROT01_SRA3H_16:00						st_2, di		36,85				
O3PRER01_SRA3H_16:00						st_3, di			59,12			
O2OLOM01_SRA3H_16:00						st_4, di				62,88		
O1CERV01_SRA3H_16:00						st_5, di					91,95	
B2BTUR01_SRA3H_16:00	**2005**	**4**	**6**	**10,00**	**1,47**		**1,50**	**0,00**	**0,20**	**0,00**	**0,30**	
B2BTUR01_SRA3H_16:00	**2006**	**7**	**14**	**8,70**	**0,32**		**0,30**	**0,50**	**0,20**	**0,00**		
B2BTUR01_SRA3H_16:00	**2006**	**8**	**13**	**7,00**	**0,13**		**0,10**	**0,70**	**0,00**	**0,00**	**0,00**	
B2BTUR01_SRA3H_16:00	**2007**	**6**	**21**	**21,70**	**0,66**		**0,70**		**3,00**	**4,70**	**0,10**	
B2BTUR01_SRA3H_16:00	**2007**	**7**	**11**	**9,40**	**0,04**		**0,00**	**0,60**	**0,00**	**0,00**	**1,40**	
B2BTUR01_SRA3H_19:00				241,00		Altitude	235,00	670,00	203,00	210,00	749,00	
B2BZAB01_SRA3H_19:00						st_1, di	11,58					
B1PROT01_SRA3H_19:00						st_2, di		36,85				
O3PRER01_SRA3H_19:00						st_3, di			59,12			
O2OLOM01_SRA3H_19:00						st_4, di				62,88		
O1CERV01_SRA3H_19:00						st_5, di					91,95	
B2BTUR01_SRA3H_19:00	**2005**	**5**	**23**	**8,00**	**0,03**		**0,00**	**0,20**	**0,00**	**0,00**	**0,00**	
B2BTUR01_SRA3H_19:00	**2005**	**7**	**23**	**7,00**	**1,73**		**1,80**	**1,00**	**0,00**	**0,00**	**0,00**	
B2BTUR01_SRA3H_19:00	**2006**	**5**	**13**	**4,40**	**0,02**		**0,00**	**0,00**	**0,00**	**0,00**	**0,10**	
B2BTUR01_SRA3H_19:00	**2006**	**7**	**8**	**13,70**	**-0,04**		**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	
B2BTUR01_SRA3H_19:00	**2006**	**8**	**7**	**5,90**	**0,25**		**0,20**	**0,90**	**0,90**	**0,00**	**0,00**	
B2BTUR01_SRA3H_19:00	**2007**	**1**	**1**	**3,40**	**0,69**		**0,70**	**0,60**	**0,30**	**0,00**	**1,10**	
B2BTUR01_SRA3H_19:00	**2007**	**6**	**14**	**9,00**	**0,03**		**0,00**	**0,00**	**0,30**	**0,00**	**0,00**	
B2BTUR01_SRA3H_22:00				241,00		Altitude	235,00	670,00	203,00	210,00	749,00	
B2BZAB01_SRA3H_22:00						st_1, di	11,58					
B1PROT01_SRA3H_22:00						st_2, di		36,85				
O3PRER01_SRA3H_22:00						st_3, di			59,12			
O2OLOM01_SRA3H_22:00						st_4, di				62,88		
O1CERV01_SRA3H_22:00						st_5, di					91,95	
B2BTUR01_SRA3H_22:00	**2005**	**4**	**25**	**1,90**	**0,39**		**0,40**	**0,10**	**0,20**	**0,00**	**0,10**	
B2BTUR01_SRA3H_22:00	**2005**	**6**	**25**	**20,00**	**7,68**		**7,70**		**8,00**	**8,60**	**8,00**	

Problematic detections (heavy rainfall), Radar information

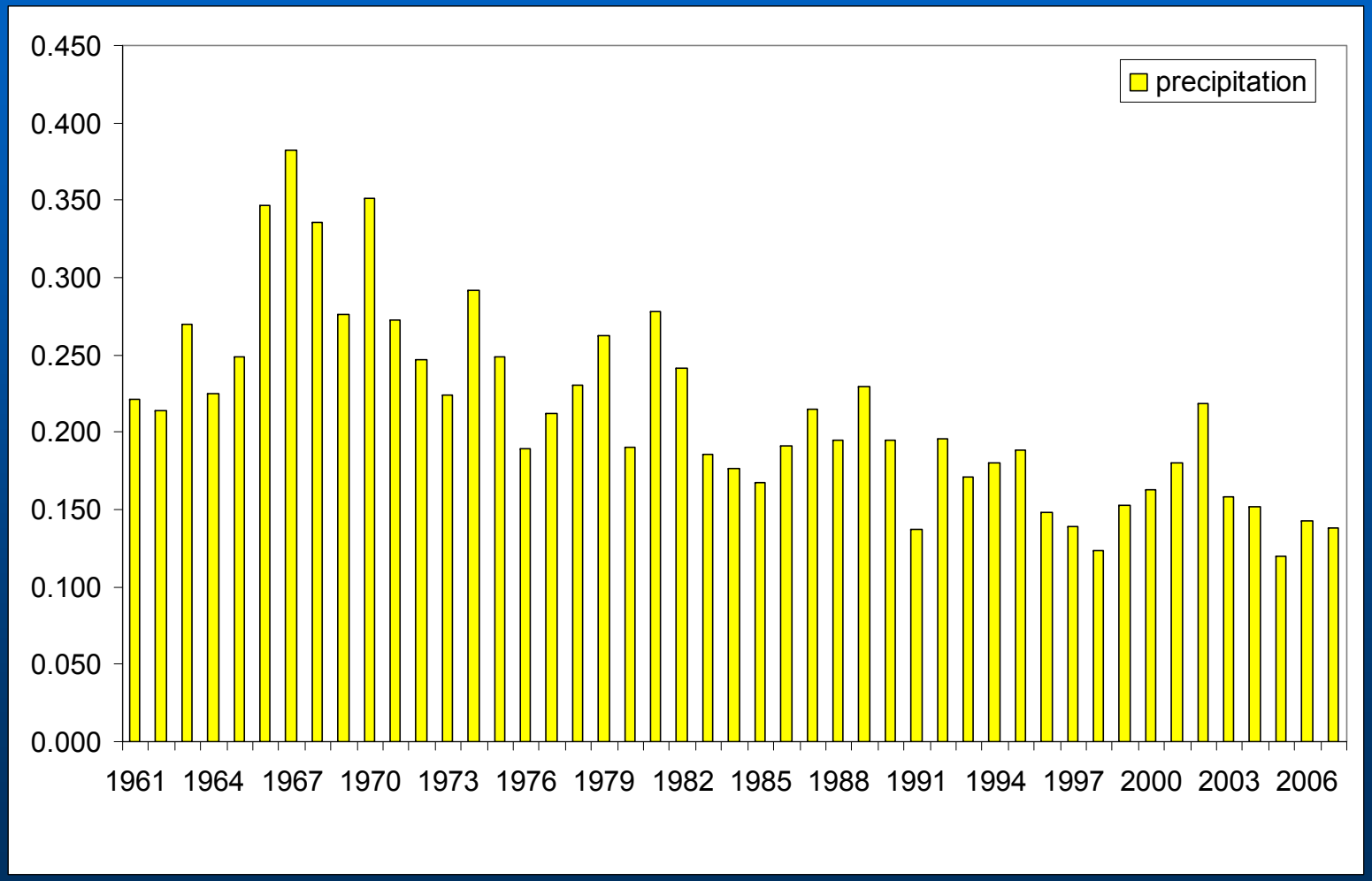


Precipitation, number of outliers 1961-2007, from 13.724.000 station-days



Precipitation, number of outliers 1961-2007,

Number of outliers per one station



Detecting 15 minute data (automated weather stations)

- **for Temperature – it works well**
- **Precipitation – big problems – spatial variability needs to be combined with further information (e.g. meteorological elements observed at station)**

Presented method can be further applied for

- **Filling missing values (the “expected” value – from interpolation)**
- **Calculation of technical series (e.g. for grid points - to be used for RCM validations or correction, EC FP6 project CECILIA), …**

Conclusions

- **Only combination of several methods for outliers detection leads to satisfying results ("real" outliers detection, supressing fault detection -> Emsemble approach)**
- **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)**
- Errors found in all elements and investigated countries (AT, CZ, SK, HU)

Outlook

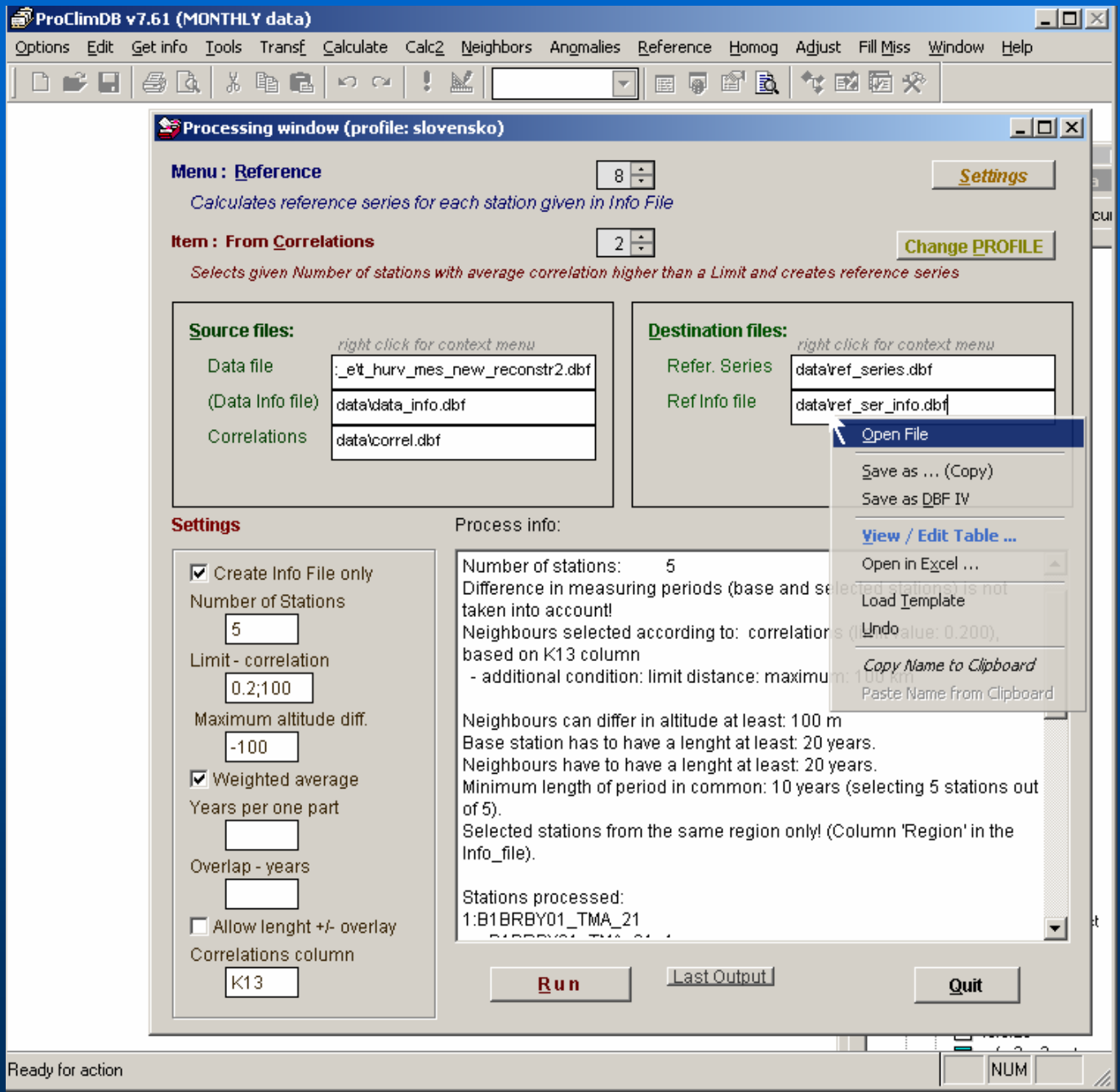
- Improving methods by applying kriging (co-kriging)
- Including (combining) further information (meteorological phenomenon to precipitation, wind direction to wind speed, …)
- Connecting with R-software and utilization of other already programmed functions

Software used for data processing

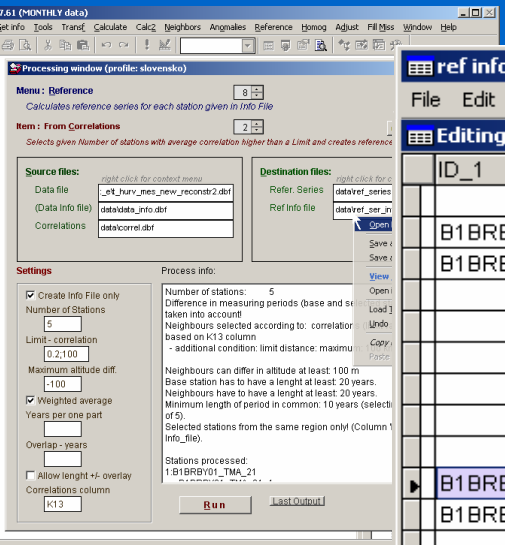
- **LoadData - application for downloading data from central database (e.g. Oracle)**
- **ProClimDB software for processing whole dataset (finding outliers, combining series, creating reference series, preparing data for homogeneity testing, extreme value analysis, RCM outputs validation, correction, …)**
- **AnClim software for homogeneity testing**

http://www.climahom.eu

ProClimDB software



ProClimDB software



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	0st.		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
	B1VIZO01_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:						0.00	0.0	50
B1BRBY01_T_14:00	B1BRBY01_T_14:00_2_d	T_14:						92.80	122.8	50
	B1LUHA01_T_14:00	T_14:						18.25	176.4	50
	B1VIZO01_T_14:00	T_14:						18.71	134.4	50
	O3HUSL01_T_14:00	T_14:						23.66	70.3	50
	O3VSET01_T_14:00	T_14:						26.76	93.1	50
	B1ZLIN01_T_14:00	T_14:						29.30	150.3	50
B1BRBY01_T_21:00	B1BRBY01_T_21:00_1_d	T_21:						0.00	0.0	50
B1BRBY01_T_21:00	B1BRBY01_T_21:00_2_d	T_21:						92.80	122.8	50
	B1LUHA01_T_21:00	T_21:						18.25	176.4	50
	B1VIZO01_T_21:00	T_21:						18.71	134.4	50
	O3HUSL01_T_21:00	T_21:						23.66	70.3	50
	O3VSET01_T_21:00	T_21:						26.76	93.1	50
	B1ZLIN01_T_21:00	T_21:						29.30	150.3	50
B1BRBY01_T_AVG	B1BRBY01_T_AVG_1_d	T_AVG						0.00	0.0	50
B1BRBY01_T_AVG	B1BRBY01_T_AVG_2_d	T_AVG						92.80	122.8	50
	B1LUHA01_T_AVG	T_AVG						18.25	176.4	50
	B1VIZO01_T_AVG	T_AVG						18.71	134.4	50
	O3HUSL01_T_AVG	T_AVG						23.66	70.3	50
	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
			. .	. .						

Right click for context menu ...

- Sort data according to this column
- Sort data according to All columns CTRL+O
- *Find a string* *CTRL+F*
- *Find next* *F3*
- Replace strings CTRL+L
- *List cases of the column* *CTRL+T*
- *Filter (show rows of a particular case)*
- *Filter out into new Application*
- Blank the cell CTRL+B
- Insert row CTRL+I
- Mark/Unmark record for deleting CTRL+D
- Delete rest (mark) CTRL+A
- Recall rest (unmark) CTRL+R
- *Copy row(s) to Clipboard* *CTRL+W*
- Paste row(s) from Clipboard CTRL+E
- *Display DBF file*
- Quit viewer CTRL+Q

No Bottom Sort Delete Insert Modi Stru Command Excel Close ?

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