

EXTREME ATMOSPHERIC PRECIPITATION IN WESTERN SIBERIA BASED ON DIFFERENT DATABASES



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Weather and Climatic
Extremes:
Data, Analysis and Impact

September 8-10

WCEDAI
2020

Goal

- Investigation and the comparative analysis of mean and extreme precipitation over the territory of West Siberia based on different datasets for the period of 1979 – 2019.

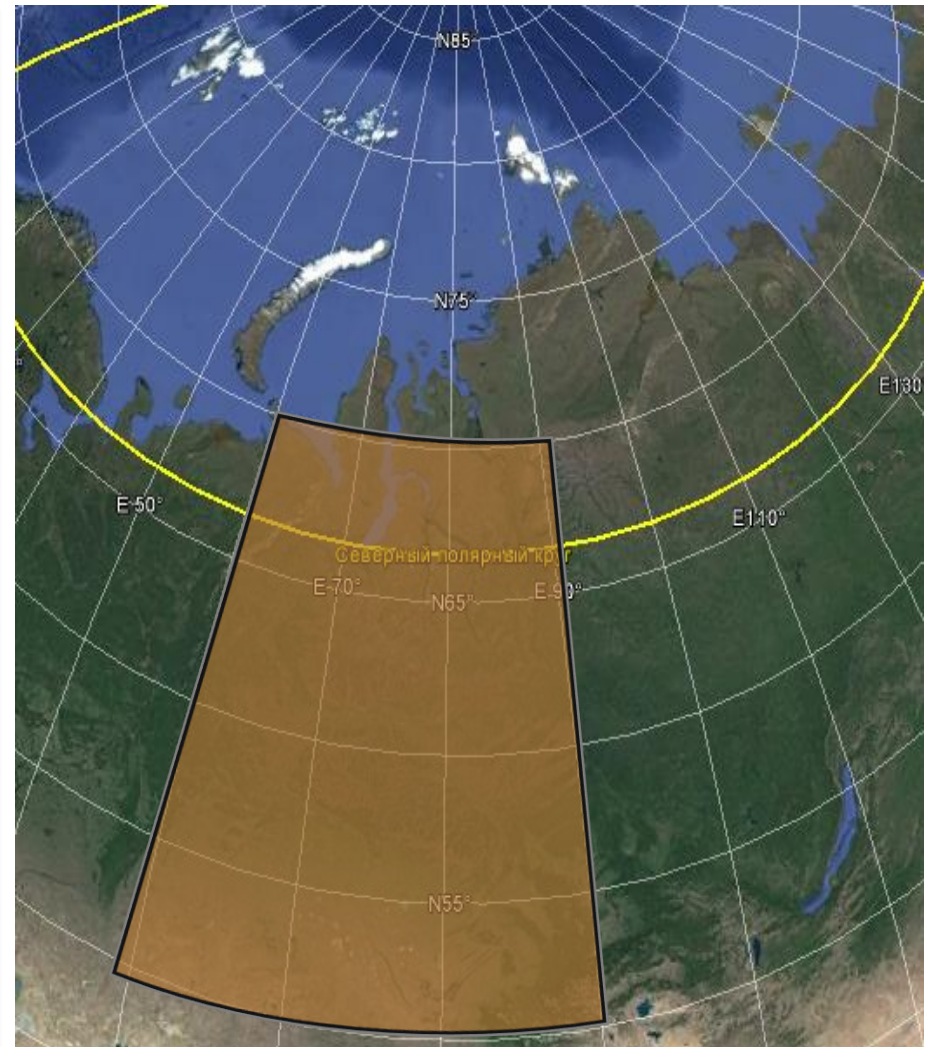
Initial data

(Monthly averaged)

Database	Time interval	Spatial distribution
Observational data		
RIHMI-WDC	1979-1998 1999-2019	
Another Datasets		
APHRODITE (APHRO)	1979-1998 1999-2007	0.25°x0.25°
GPCC	1979-1998 1999-2016	0.50°x0.50°
NCEP	1979-1998 1999-2018	1.90°x1.90°
ERA-5	1979-1998 1999-2019	0.25°x0.25°

Western Siberia

(50–70N, 60–90E)



Statistical characteristics

Extreme values

threshold percentiles of the sample probability distribution function

1% and 5% - extreme low

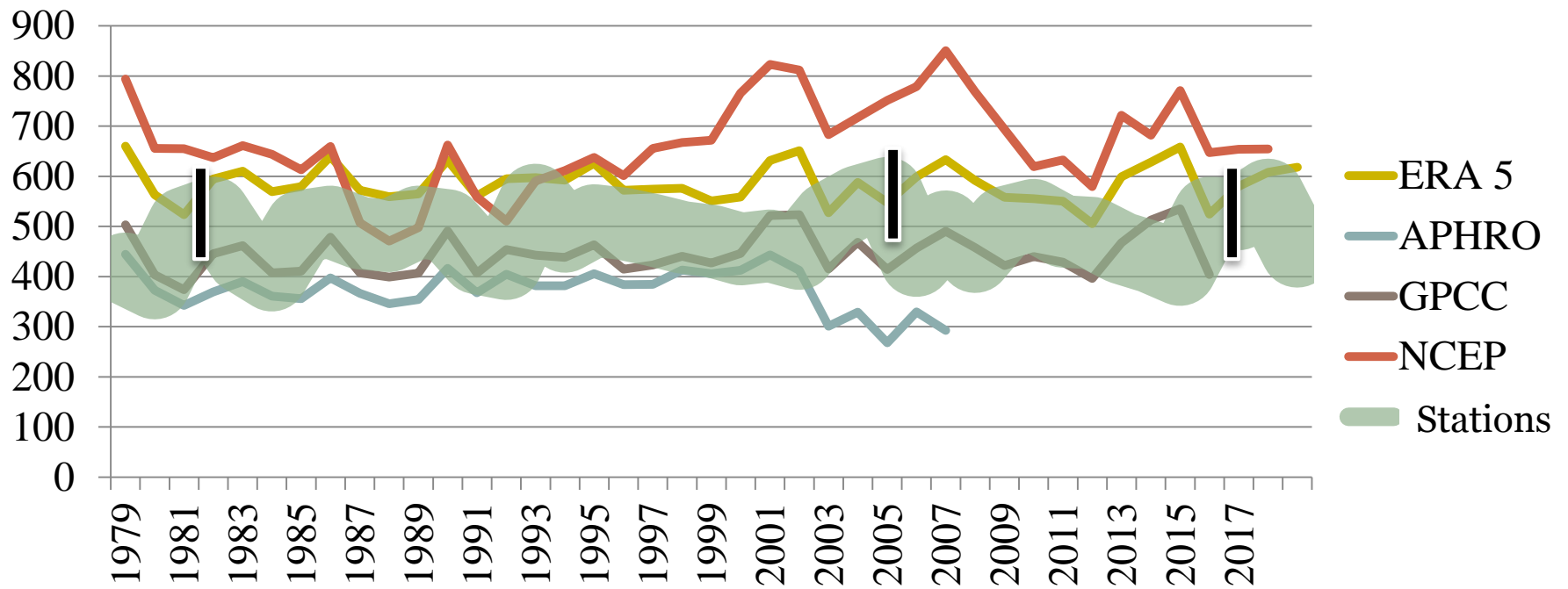
95% and 99% - extreme high

Interpolation types

- Linear (interpolation of values from nearest nodes)
- Nearest (values in nearest nodes)
- Cubic (cubic interpolation of values from nearest nodes)
- Makima (based on piecewise linear function of polynomial)
- Spline (cubic interpolation, taking into account derivative)

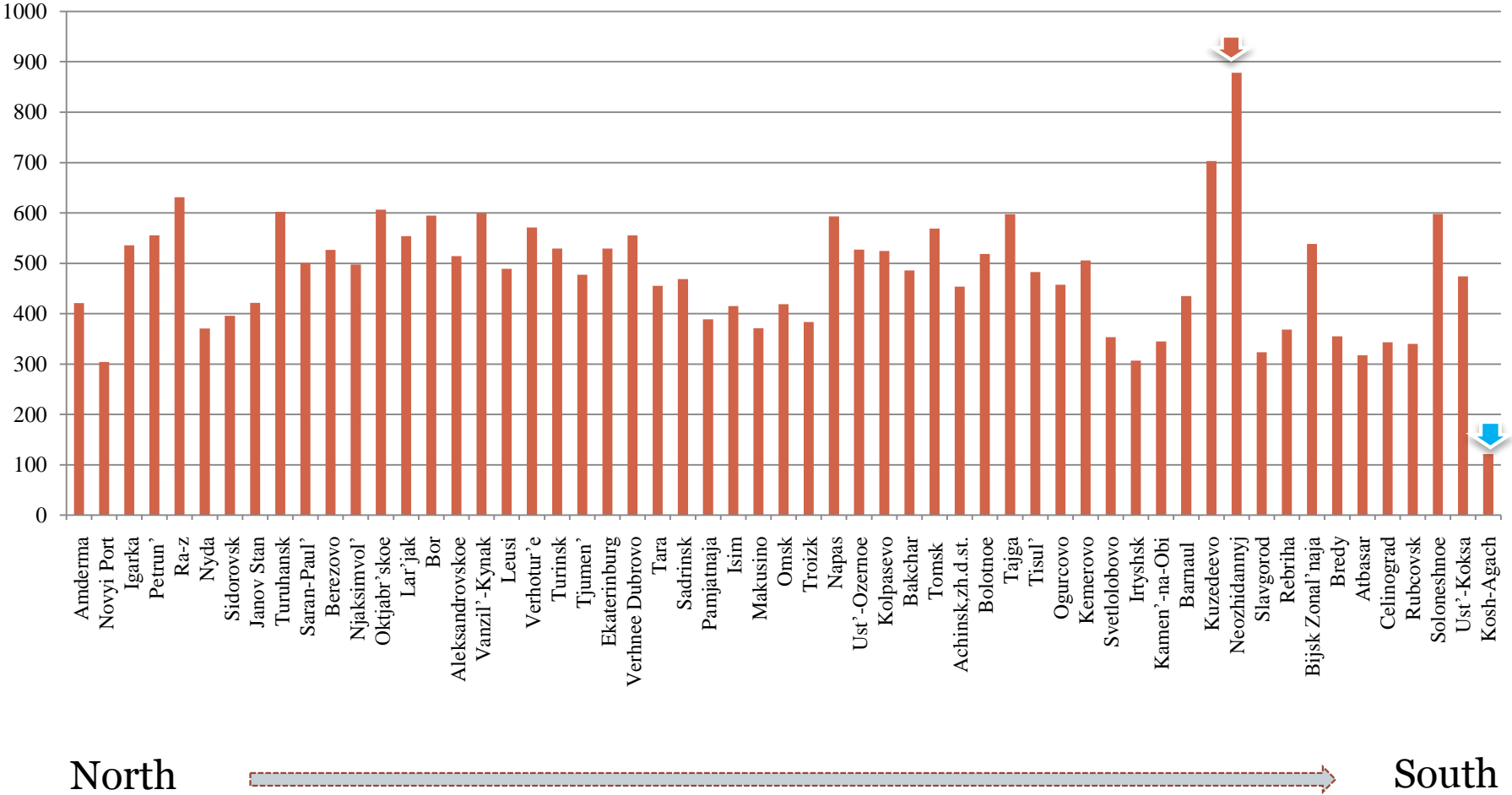
The observational data were interpolated into the $1^{\circ} \times 1^{\circ}$ grid nodes using the kriging algorithm.

Interannual variability of averaged by the territory of Western Siberia mean precipitation



Annual averaged precipitation

Stations 1979-2019



North

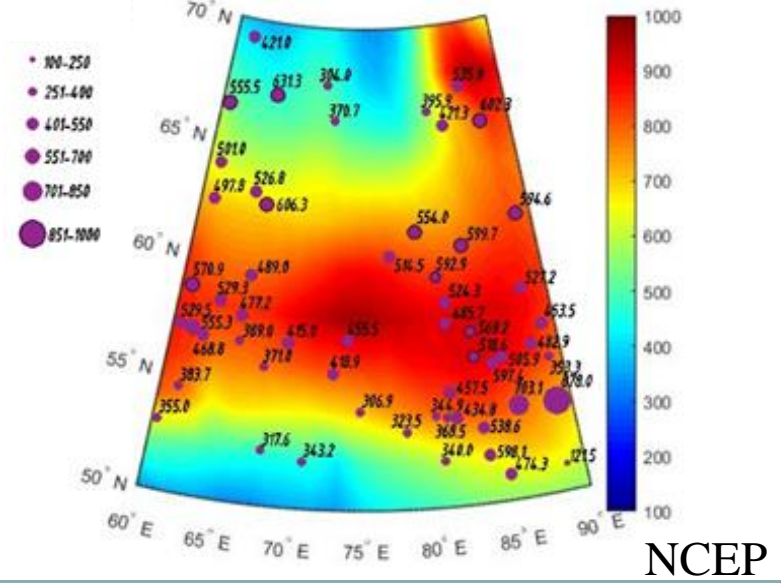
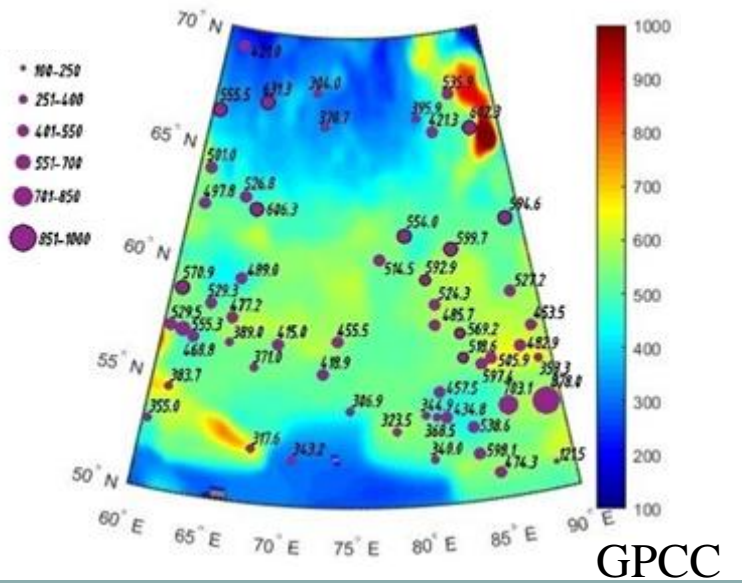
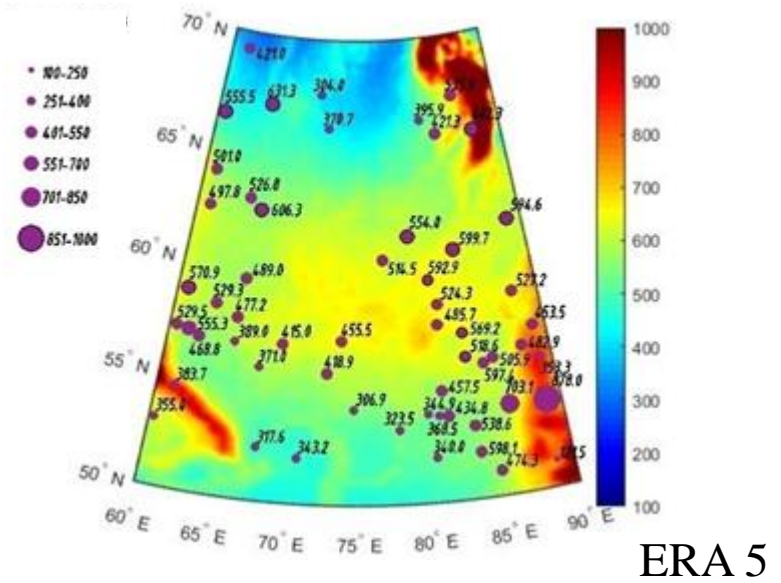
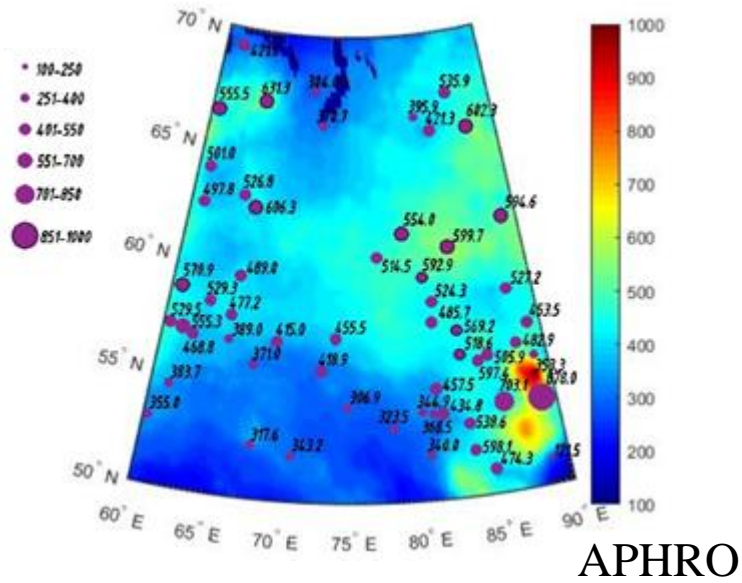
South

Statistical characteristics

1979-2019

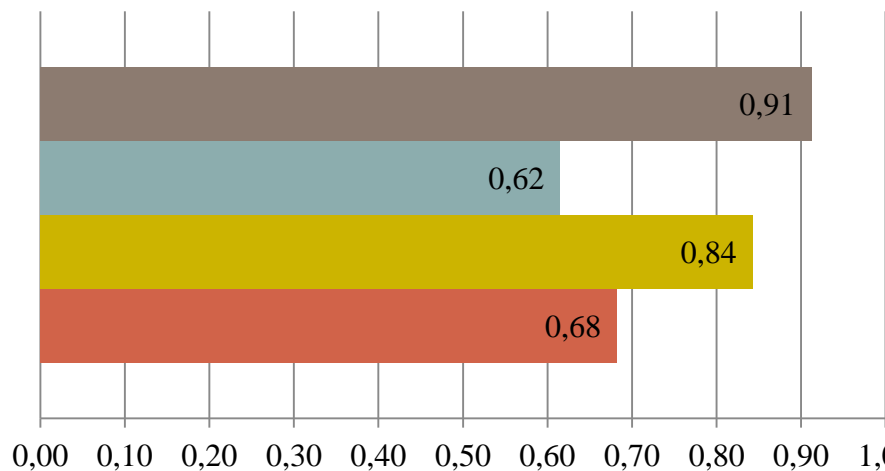
	Mean values					Standard deviation				
	Stations	GPCC	APHRO	ERA	NCEP	Stations	APHRO	ERA	NCEP	GPCC
Warm season	302.8	298	236.2	365.1	441.3	72.3	57.8	65.5	118.6	63.1
Cold season	174.4	183.7	158.9	220	222.8	43.4	36.7	42.2	53.9	40.5
Year	477.2	483	405.7	585.1	664.1	91.6	79.9	80.8	141.2	79.4

Spatial distribution

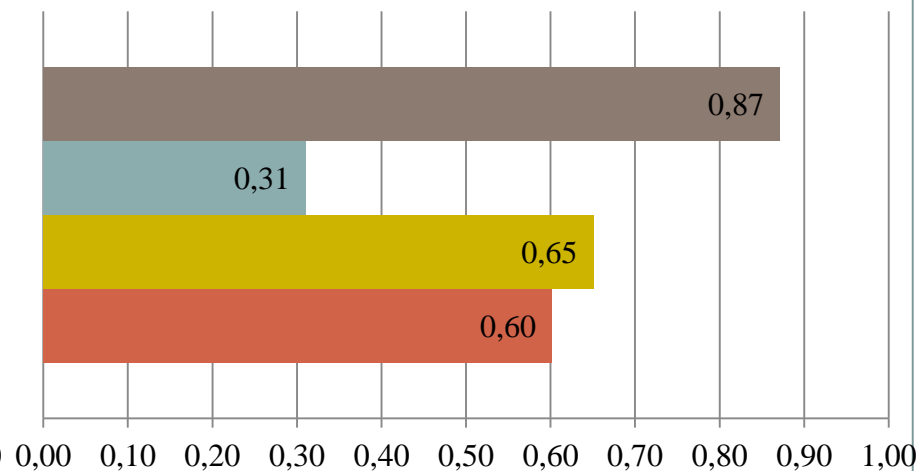


Correlation coefficients with observational data 1979-2019

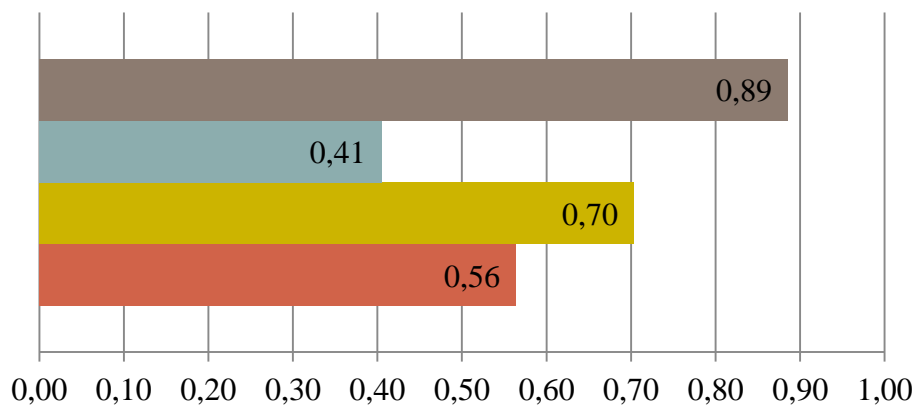
Cold season



Warm season



Year



■ GPPC ■ NCEP ■ APHRO ■ ERA 5

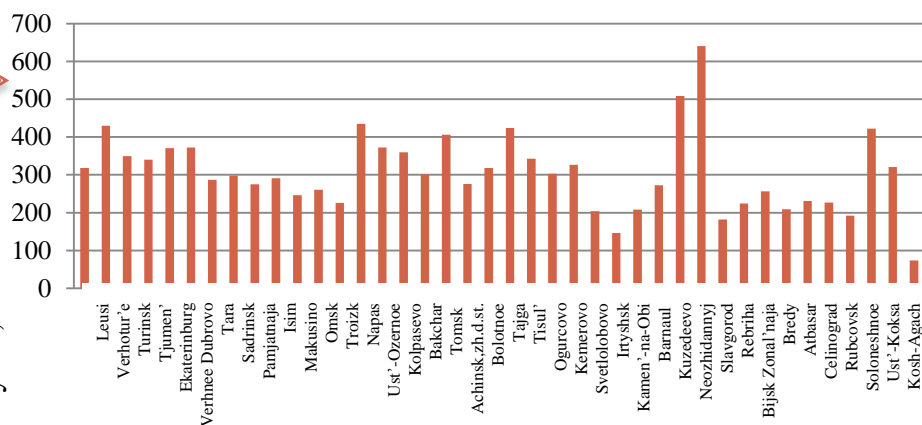
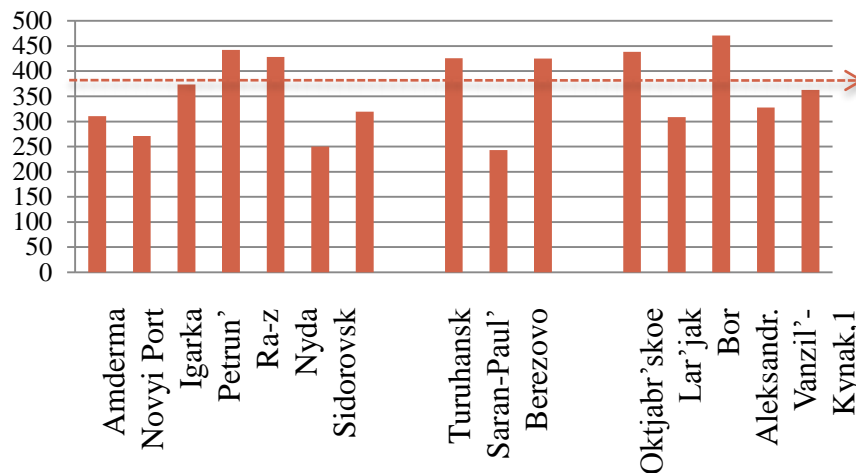
Extreme precipitation

Annual averaged values at stations

Northern stations. 1%

1979-1998

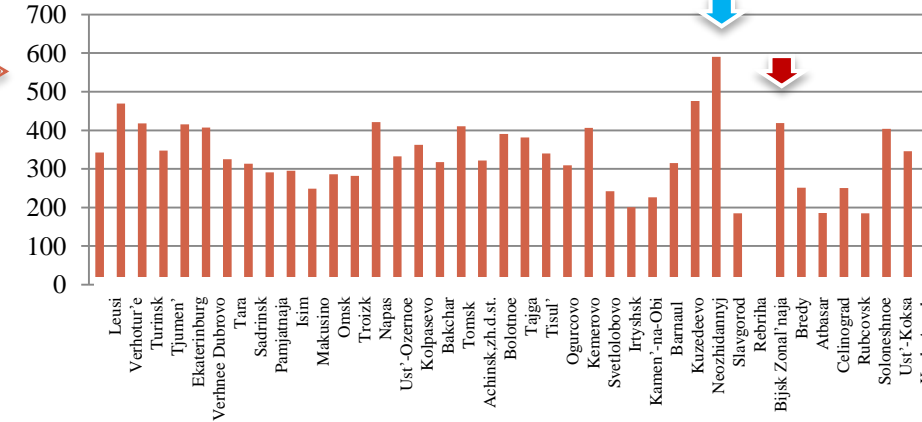
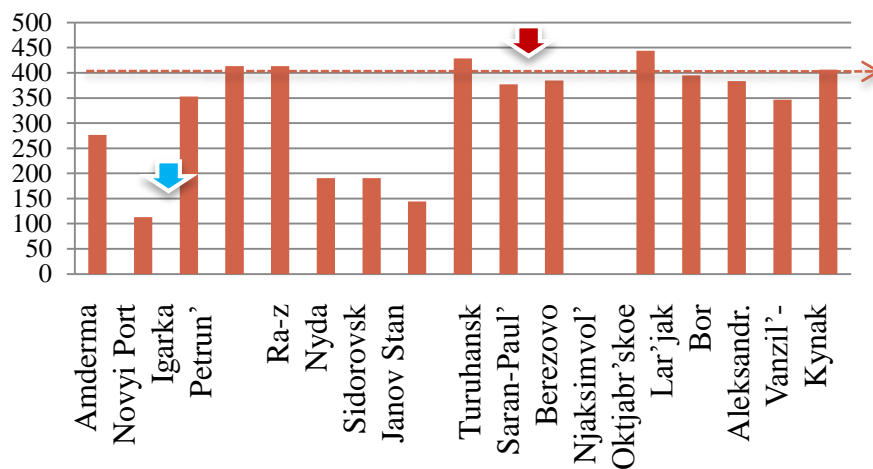
Southern stations. 1%



Northern stations. 1%

1999-2019

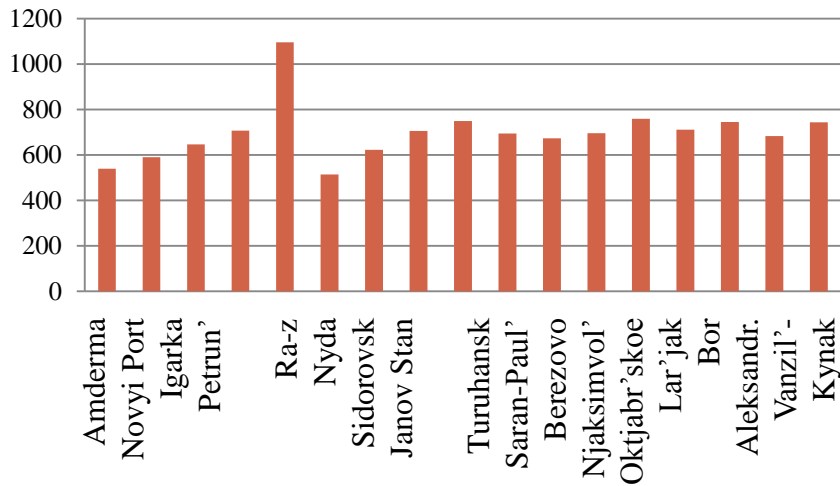
Southern stations. 1%



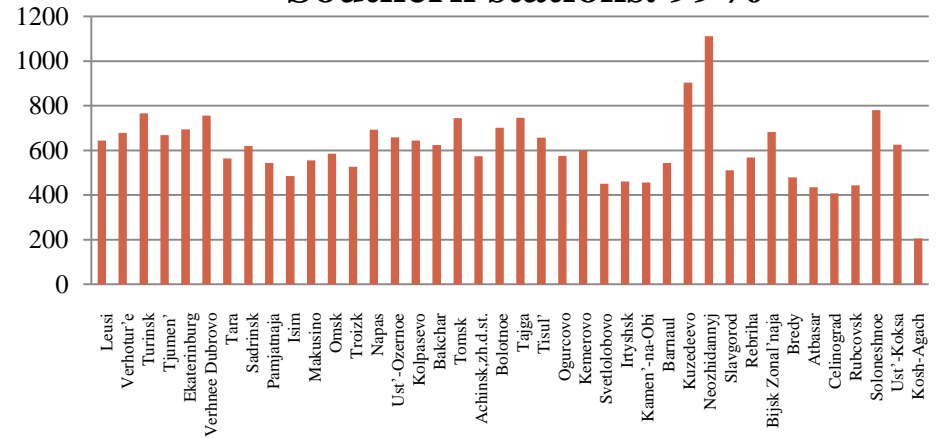
Extreme precipitation

Annual averaged values at stations

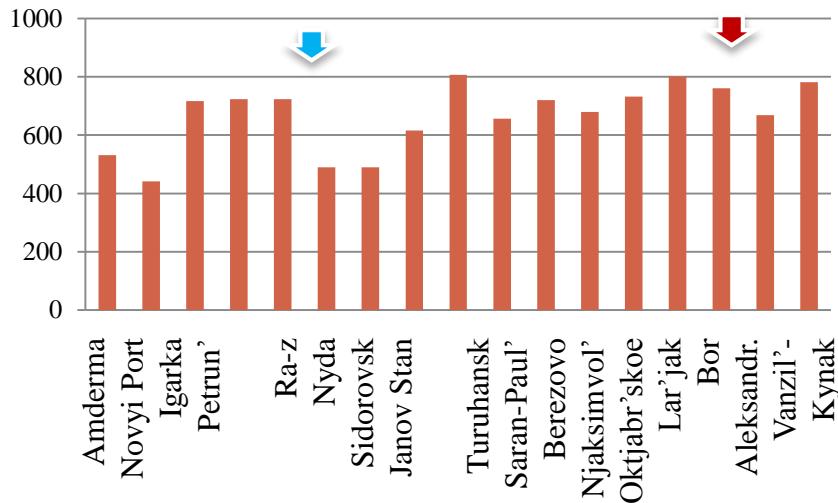
Northern stations. 99% 1979-1998



Southern stations. 99%

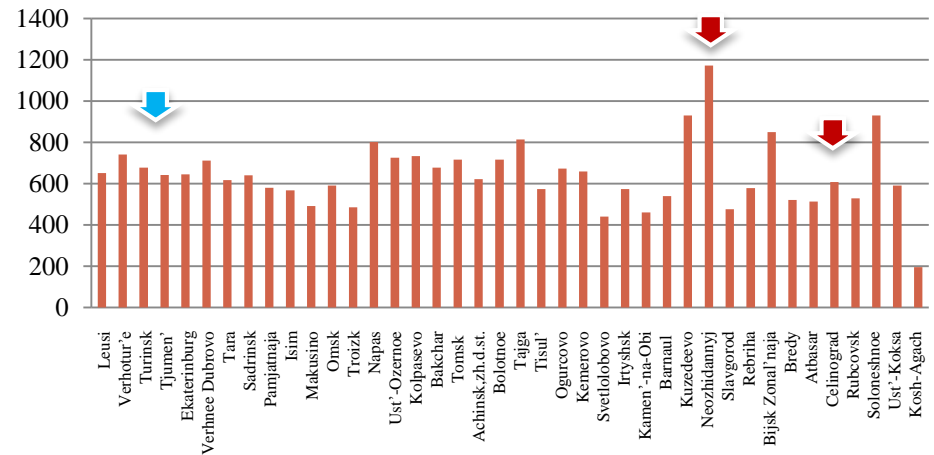


Northern stations. 99%



1999-2019

Southern stations. 99%



Precipitation values by threshold quantile

1979-2019

	APHRO								
	0.01	0.05	0.10	0.25	0.50	0.75	0.90	0.95	0.99
Warm season	58.9	119.8	158.5	213.3	274	332.9	380.6	414.2	500.4
Cold season	37.4	50.9	64.2	87.8	115.6	143.3	170.5	189.9	227.2
Year	106.7	187.7	236.7	314.3	391.9	468.1	531.4	577.6	693.2
	ERA 5								
Warm season	163	235	275	342	414	484	557	621	867
Cold season	75	95	107	130	156	189	229	265	376
Year	283	358	407	486	570	660	761	853	1000
	NCEP								
Warm season	134.2	194.3	242.6	344.2	490.9	633.2	744.6	809.3	912.5
Cold season	57.9	81.6	96.9	127.5	165.6	208.1	250.3	277.5	321.3
Year	227.9	306.2	361.9	486.8	659.3	832.7	969.4	1047.7	1174.9
	GPCC								
Warm season	105.5	164.9	198.5	264.4	337.9	403	466.6	509.5	609.5
Cold season	41.6	62.5	75.6	99.9	133.4	168.6	206.6	233.4	302.2
Year	181.3	248.5	290.2	377.8	476.2	565.4	647.9	699.9	828.8
	Stations (interpolated data)								
Warm season	165.0	200.0	219.6	252.1	291.2	328.9	369.0	395.8	463.7
Cold season	94.0	110.9	121.8	140.8	168.8	205.9	242.9	267.0	321.0
Year	269.0	315.9	342.9	395.1	464.3	531.1	599.6	641.4	760.9

Correlation coefficients

with observational data

Cold season

1979-1998

APHRO

Quantile	Linear	Nearest	Cubic	Makima	Spline
0,01	0,63	0,74	0,67	0,51	0,48
0,05	0,63	0,75	0,68	0,29	0,55
0,1	0,64	0,75	0,68	0,24	0,60
0,25	0,71	0,88	0,77	0,25	0,80
0,5	0,77	0,90	0,81	0,34	0,55
0,75	0,77	0,89	0,80	0,28	0,67
0,9	0,78	0,89	0,81	0,46	0,57
0,95	0,80	0,90	0,83	0,49	0,62
0,99	0,81	0,90	0,84	0,46	0,67

ERA 5

Quantile	Linear	Nearest	Cubic	Makima	Spline
0,01	0,74	0,73	0,74	0,75	0,57
0,05	0,76	0,75	0,76	0,77	0,58
0,1	0,73	0,72	0,73	0,75	0,56
0,25	0,83	0,83	0,83	0,84	0,61
0,5	0,78	0,79	0,79	0,80	0,62
0,75	0,76	0,76	0,76	0,78	0,62
0,9	0,72	0,73	0,72	0,74	0,59
0,95	0,76	0,76	0,76	0,77	0,57
0,99	0,78	0,77	0,78	0,79	0,57

GPCC

1999-2016

Quantile	Linear	Nearest	Cubic	Makima	Spline
0,01	0,77	0,78	0,78	0,75	0,62
0,05	0,72	0,72	0,72	0,70	0,64
0,1	0,82	0,83	0,82	0,39	0,37
0,25	0,92	0,92	0,92	0,07	0,25
0,5	0,92	0,93	0,92	0,13	0,40
0,75	0,95	0,95	0,96	0,22	0,43
0,9	0,95	0,96	0,96	0,04	0,21
0,95	0,96	0,97	0,97	0,15	0,51
0,99	0,95	0,95	0,96	0,29	0,43

ERA 5

Quantile	Linear	Nearest	Cubic	Makima	Spline
0,01	0,73	0,72	0,73	0,75	0,57
0,05	0,69	0,69	0,69	0,71	0,54
0,1	0,76	0,75	0,76	0,78	0,58
0,25	0,81	0,80	0,81	0,82	0,59
0,5	0,80	0,80	0,80	0,82	0,62
0,75	0,76	0,77	0,77	0,78	0,62
0,9	0,73	0,73	0,73	0,74	0,60
0,95	0,77	0,77	0,77	0,78	0,59
0,99	0,81	0,81	0,81	0,82	0,59

Results

- Temporal variability of average annual precipitation in different datasets was similar. However, ERA5 and NCEP reanalysis data were overestimated values from observational data.
- A significant discrepancy between the reanalysis data and observational ones was revealed in the southern part of Western Siberia.
- The greatest agreement with observational data was observed with GPCP ($r > 0.95$) and the smallest one - with NCEP (0.65-0.77). The highest correlation was derived with ERA5 and APHRO - 0.79-0.90.
- There was a decrease of extreme values for the 1% and 99% percentile at the northern stations and their increase for the same percentiles at the southern stations from the interval 1979-1998 to the interval 1999-2019. The opportunity of dry periods in the north and wet periods in the south was occurred.
- The greatest agreement of extreme values with observational data was observed for GPCP. The smallest one for NCEP reanalysis data.

Derived precipitation values from various sources depend on data assimilation method and grid resolution.