

Table S1. Historical Data of flooding sites used for validation (According to General Directorate of Civil Defense (personal communication, 21 Jan 2019))

Year of flood	Flooded area	Flood hazard class
1963, 1966, 1991, 2018	Maan	Low, Medium and High
1966, 2007, 2018	Madaba	Medium and High
1987	Azzrqa	Medium and High
1991	Tafielh	Low, Medium and High
1991	Karak	Medium and High
1994	Irbid	Medium and High
2015	Amman	Medium and High
2018	DS/ Balka	Medium and High

Table S2. Soil type

Soil type	Texture	Minimum rate of infiltration, and cover types
A	Deep sands, deep loess, and silt	Highly infiltration rates
B	Shallow loess and sandy loam	Moderately porous soil
C	Clay loam, shallow sandy loam, soils of low organic	Moderately impervious soil
D	Clay and salty soils	High streamflow potential

Table S3. Soil group disruption and calculated curve number (CN)

Assigned CN	92.00	91.00	77.00	
Basin no	Soil Group			Calculated (CN)
	D	C/D	A	
1	90%	3%	7%	90.92
2	80%	18%	2%	91.52
3	80%	18%	2%	91.52
4	90%	8%	2%	91.62
5	50%	45%	5%	90.80
6		98%	2%	90.72
7	85%	13%	2%	91.57
8	85%	12%	3%	91.43
9	85%	12%	3%	91.43
10	80%	17%	3%	91.38
11	85%	12%	3%	91.43
12	90%	7%	3%	91.48
13	92%	5%	3%	91.50
14	92%	5%	3%	91.50
15	92%	5%	3%	91.50
Average	80%	17%	3%	-

Table S4. Specifications of Tipping Bucket rain gauge

Property	Description/Value
Receiver	200 mm (8 inch) or 282.8 mm (11.1 inch) diameter with machined aluminum rim
Sensitivity	One tip at 0.2, 0.5, 1.0 mm or 0.01 inch
Measurements	Range: 0-700 mm/hour Accuracy: $\pm 2\%$ 25-500 mm/hour, ± 1 tip from 1-25 mm/hour
Sensor	Tipping bucket with siphon
Siphon	0.4mm capacity of rainfall - made from brass with a non-hygroscopic outer body
Contacts	Type: dual reed-switch (make contact), momentary Rating:12 VA (0.5 amp max) Duration: 0.1 second
Physical dimensions	Height x diameter: 342 mm (13.5") x 229 mm 9" Weight: 3 kg (6.6 lbs)
Bucket	Chrome plated, injected molded non-hygroscopic ABS balanced ± 0.05 gms
Base	Die-cast aluminum
Mounting holes	Three (3) 10mm diameter mounting holes
Drain fittings	Able to attach 12 mm inside diameter tubing, to catch rainfall after passing through buckets
Pivots	Ground sapphire pivots with stainless steel shaft
Insect covers	Stainless steel mesh on all openings to prevent insects from entering the gauge
Outer enclosure	Keyed to enable the release of the outer enclosure without the need for the removal of the three securing screws

Table S5. Proportional Systematic Error and Constant Systematic Error (Slope (M) & Intercept(C))

Stations	VALUES	ERA	MER	VALUES	ERA	MER	VALUES	ERA	MER
1	m	0.21	0.56	m1	0.52	0.49	m2	1.30	2.17
	c	0.33	1.04	c1	0.85	0.91	c2	-1.63	-1.85
	m	0.20	0.53	m1	0.50	0.46	m2	1.41	2.35
2	c	0.35	1.11	c1	0.89	0.96	c2	-1.78	-2.10
	m	0.18	0.11	m1	0.08	0.06	m2	14.03	17.88
	c	0.60	0.52	c1	0.26	0.27	c2	-3.34	-4.54
3	m	0.23	0.23	m1	0.35	0.38	m2	2.54	2.25
	c	0.34	0.30	c1	0.51	0.49	c2	-1.47	-1.28
	m	0.28	0.26	m1	0.46	0.46	m2	1.75	1.76
4	c	0.57	0.55	c1	0.97	0.98	c2	-2.09	-2.16
	m	0.19	0.22	m1	0.39	0.51	m2	2.07	1.39
	c	0.59	0.42	c1	1.20	0.96	c2	-3.11	-1.87
5	m	0.26	0.24	m1	0.32	0.33	m2	2.93	2.79
	c	0.45	0.40	c1	0.55	0.54	c2	-1.72	-1.66
	m	0.29	0.38	m1	0.14	0.41	m2	1.17	1.86
6	c	0.49	0.43	c1	0.23	0.46	c2	-1.62	-2.15
	m	0.13	0.29	m1	0.38	0.19	m2	1.97	5.97
	c	0.13	0.81	c1	0.39	0.51	c2	-1.03	-2.76
7	m	0.18	0.28	m1	0.34	0.22	m2	2.52	4.93
	c	0.26	0.74	c1	0.48	0.57	c2	-1.44	-2.65
	m	0.19	0.62	m1	0.47	0.55	m2	1.54	1.97
8	c	0.46	1.08	c1	1.12	0.96	c2	-2.38	-1.75
	m	3.92	5.12	m1	0.21	0.20	m2	1.30	2.17
	c	-2.79	-3.09	c1	0.60	0.61	c2	-1.63	-1.85

13	m	0.20	0.28	m1	0.39	0.22	m2	2.04	4.74
	c	0.28	0.89	c1	0.56	0.71	c2	-1.41	-3.20
14	m	0.20	0.35	m1	0.14	0.06	m2	7.46	21.24
	c	0.21	0.94	c1	0.15	0.16	c2	-1.04	-2.66

Table S6. Correction quality of s ERA and MER dataset (calculated R2)

Stations	MCP		LA-developed	
	ERA	MER	ERA	MER
1	0.30	0.24	0.82	0.54
2	0.25	0.19	0.81	0.50
3	0.02	0.01	0.44	0.45
4	0.21	0.20	0.79	0.77
5	0.29	0.24	0.78	0.76
6	0.24	0.34	0.85	0.84
7	0.18	0.16	0.74	0.73
8	0.13	0.15	0.88	0.53
9	0.17	0.04	0.87	0.37
10	0.16	0.05	0.80	0.44
11	0.33	0.30	0.88	0.56
12	0.06	0.05	0.94	0.56
13	0.21	0.07	0.82	0.51
14	0.05	0.01	0.61	0.10

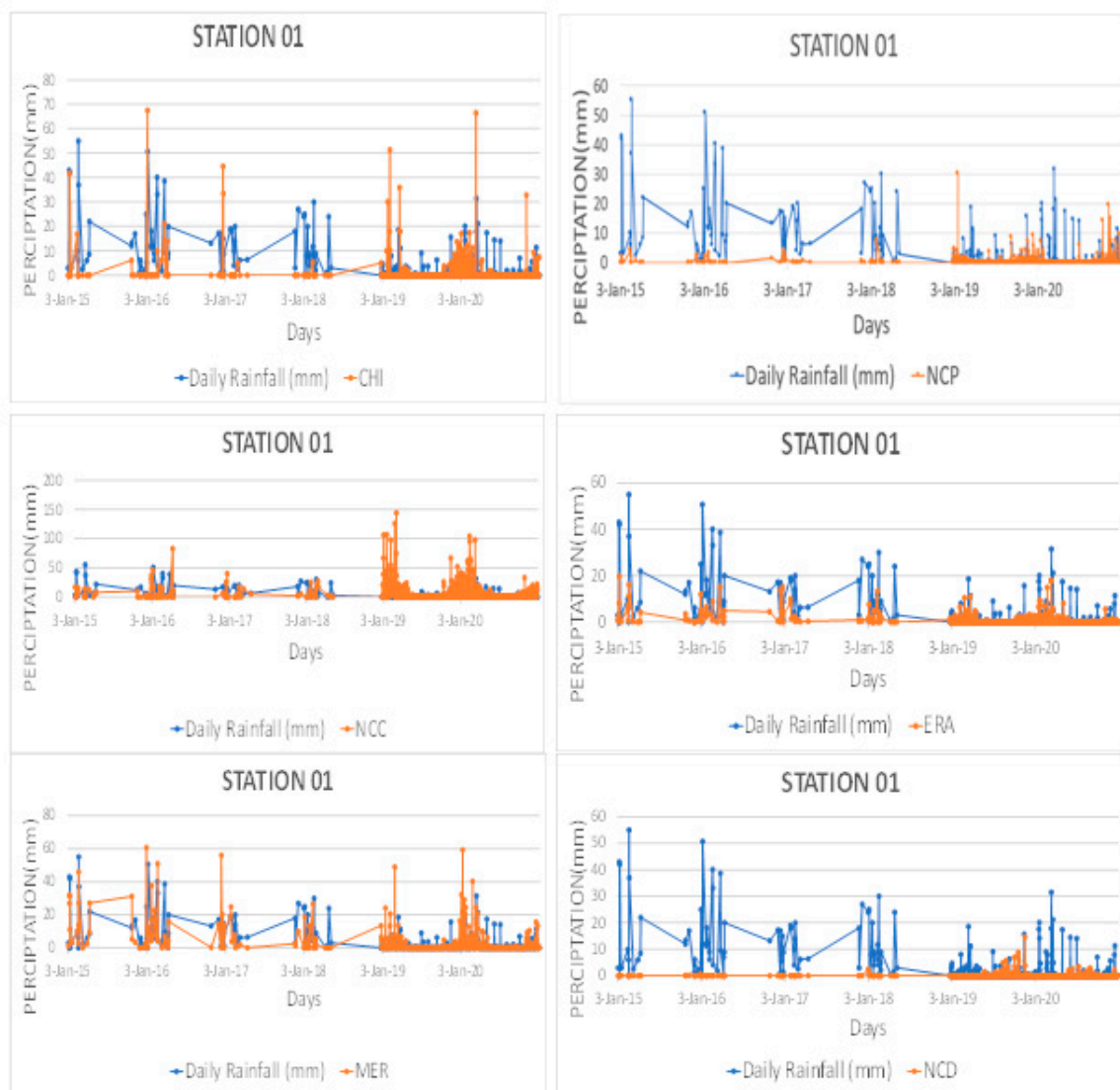


Figure S1. Multi-precipitation products with gauge-observed data at station 01

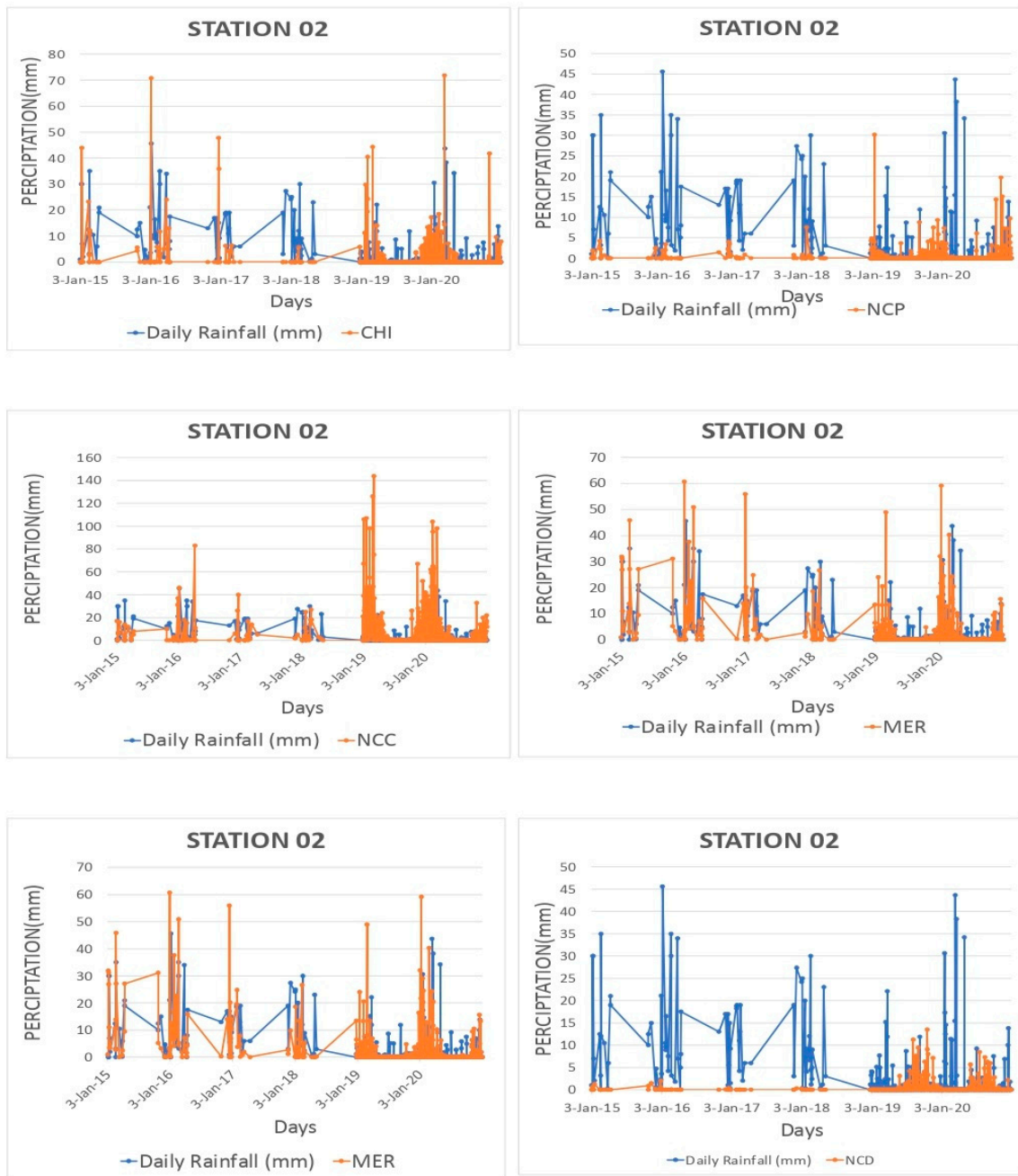


Figure S2. Multi-precipitation products with gauge-observed data at station 02

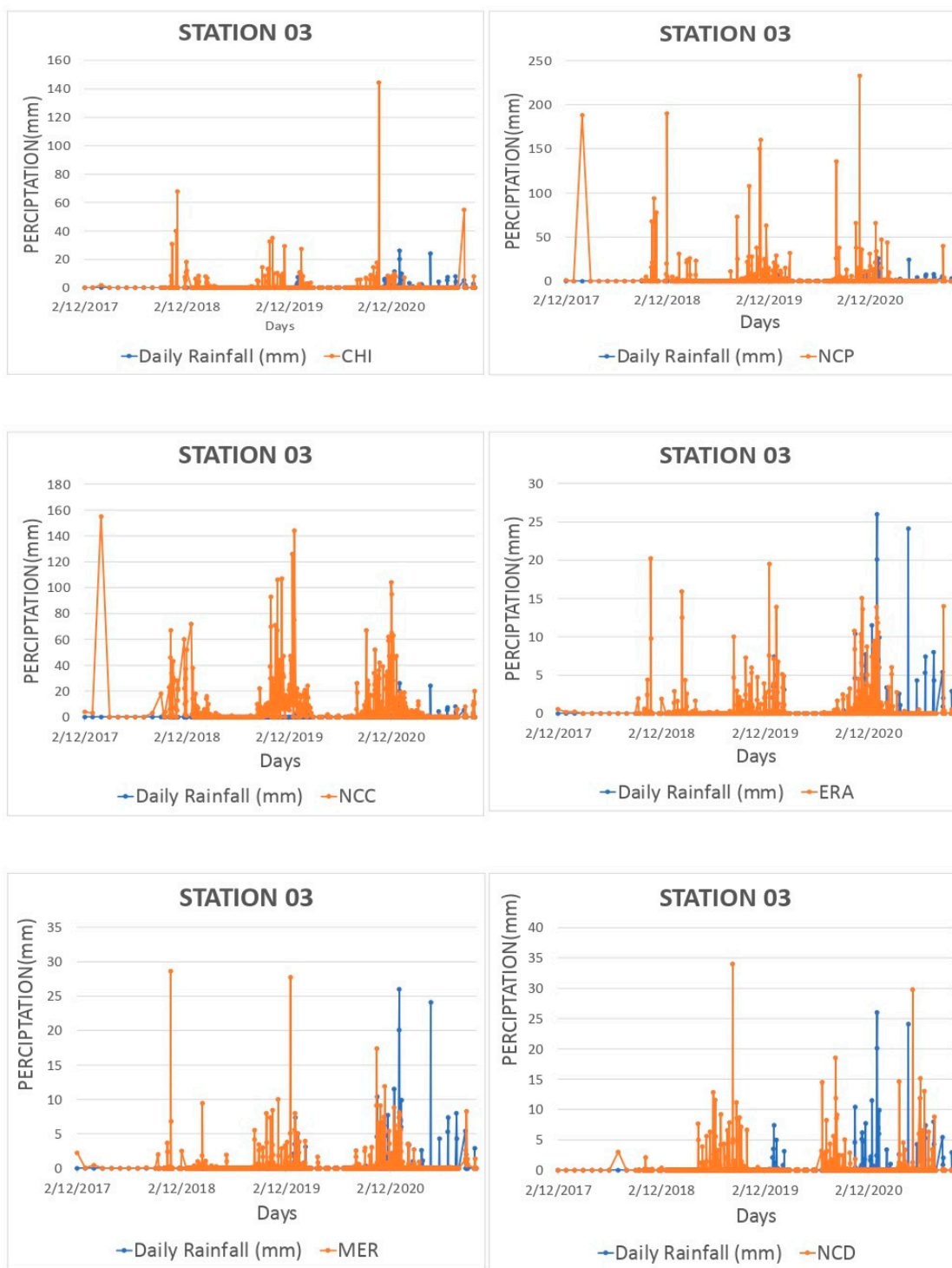


Figure S3. Multi-precipitation products with gauge-observed data at station 03.

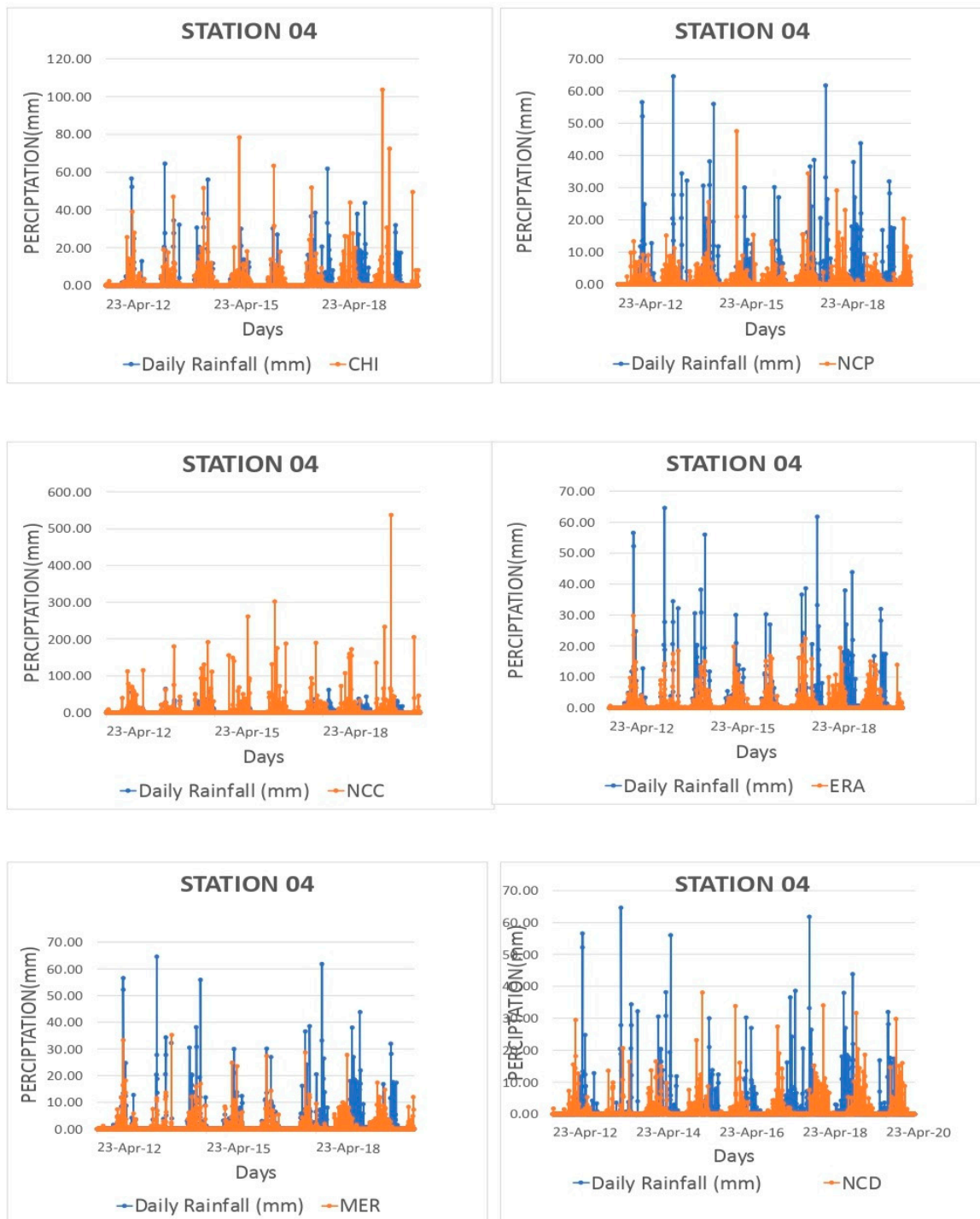


Figure S4. Multi-precipitation products with gauge-observed data at station 04.

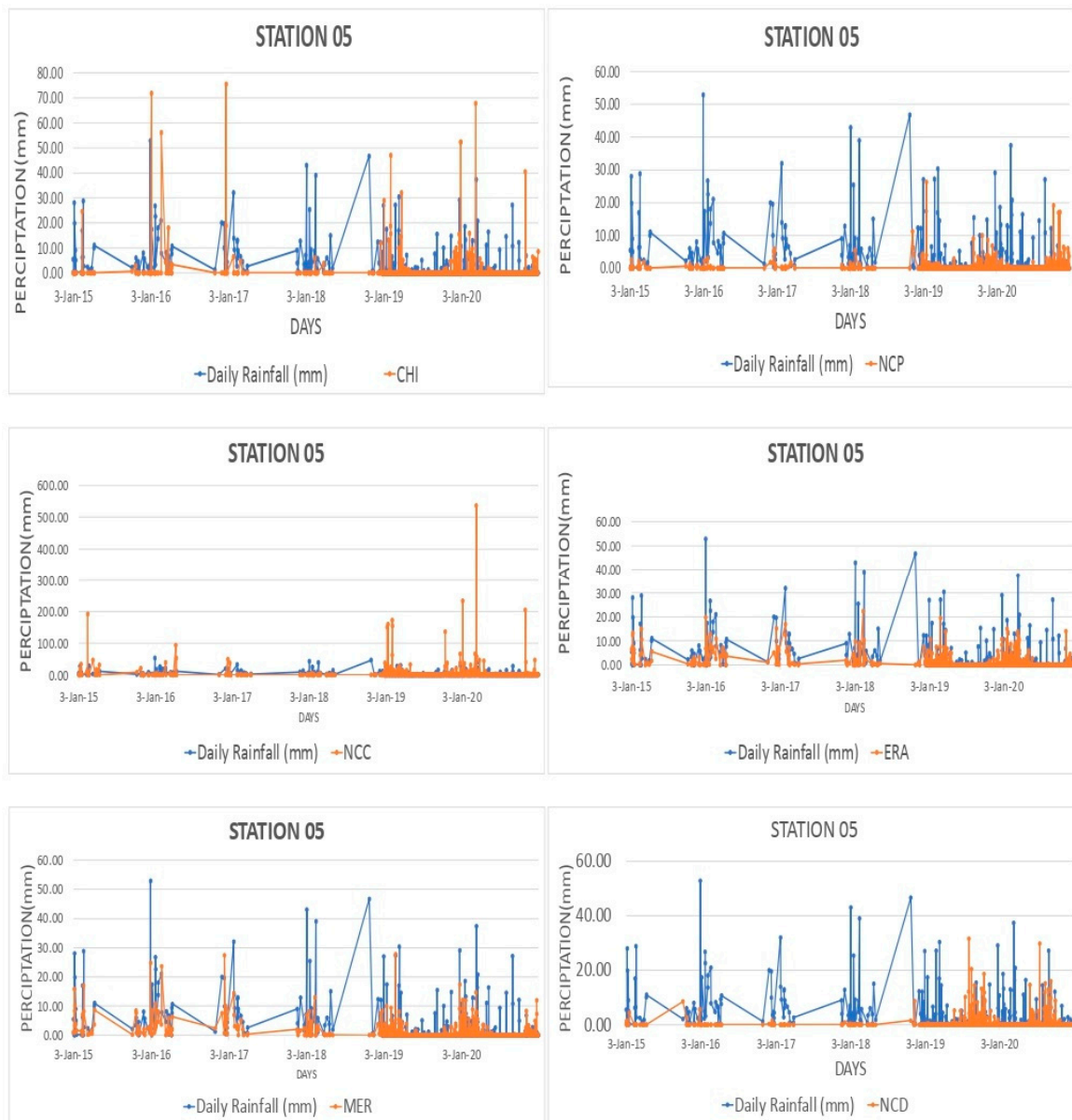


Figure S5. Multi-precipitation products with gauge-observed data at station 05.

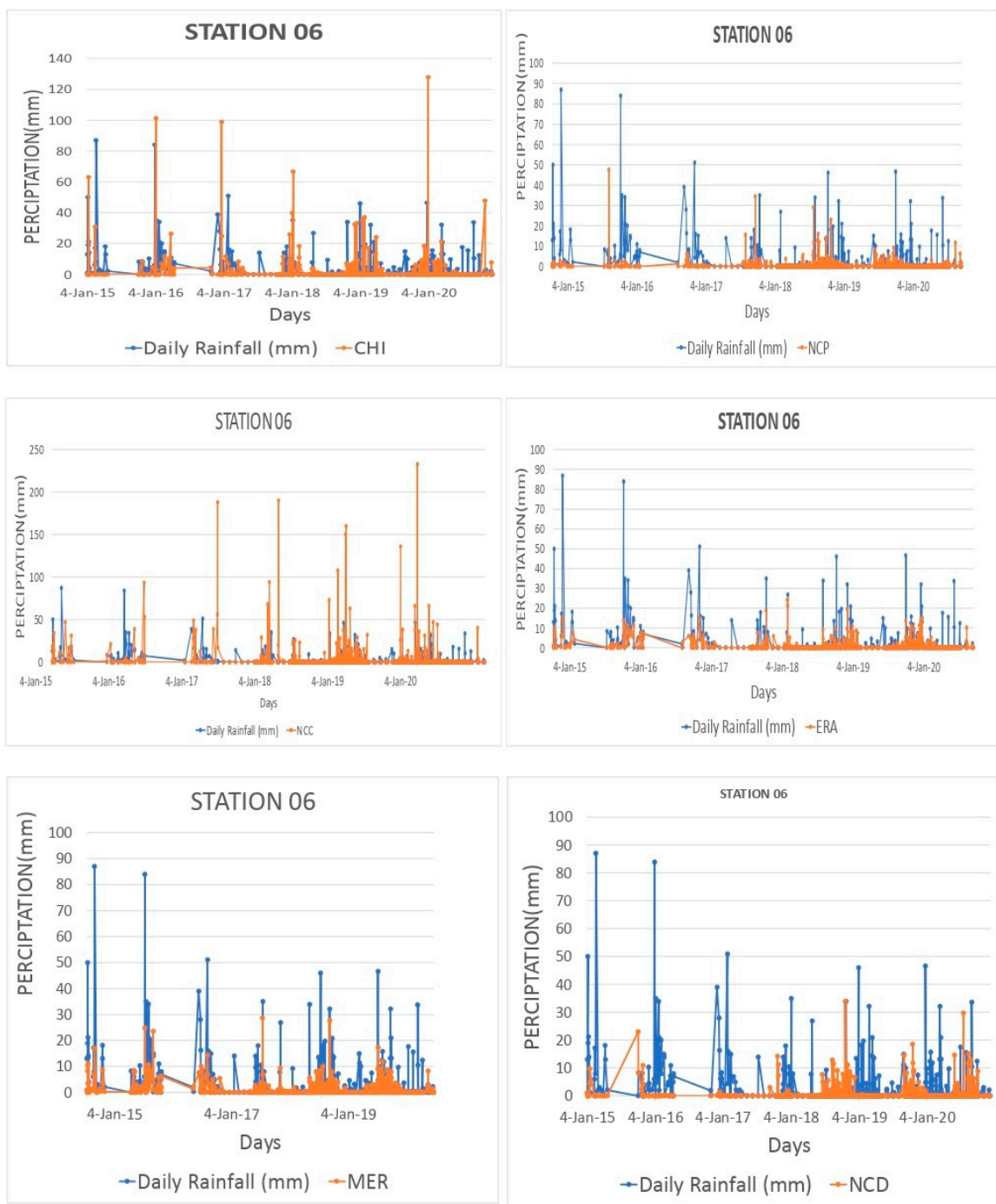


Figure S6. Multi-precipitation products with gauge-observed data at station 06.

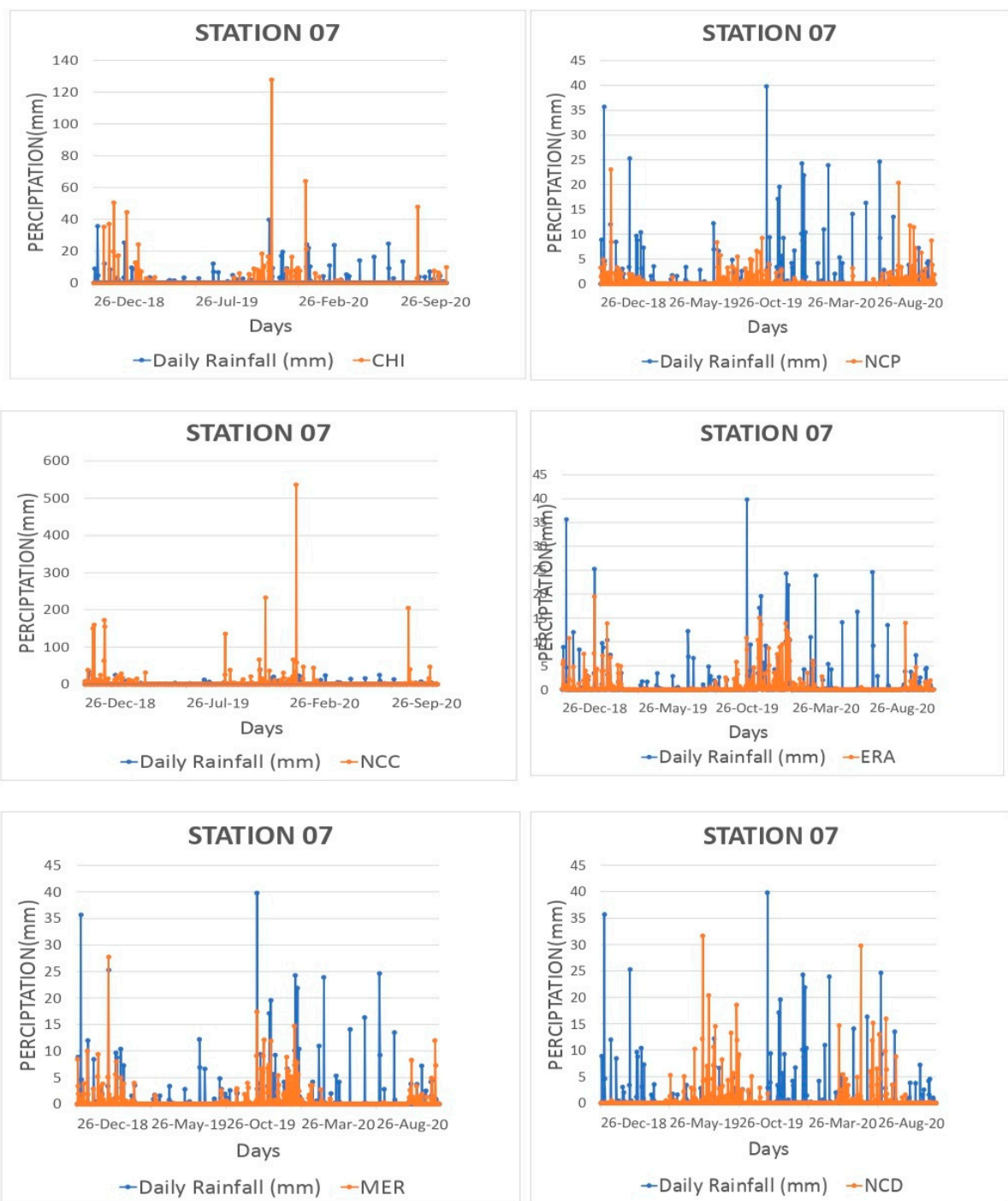


Figure S7. Multi-precipitation products with gauge-observed data at station 07.

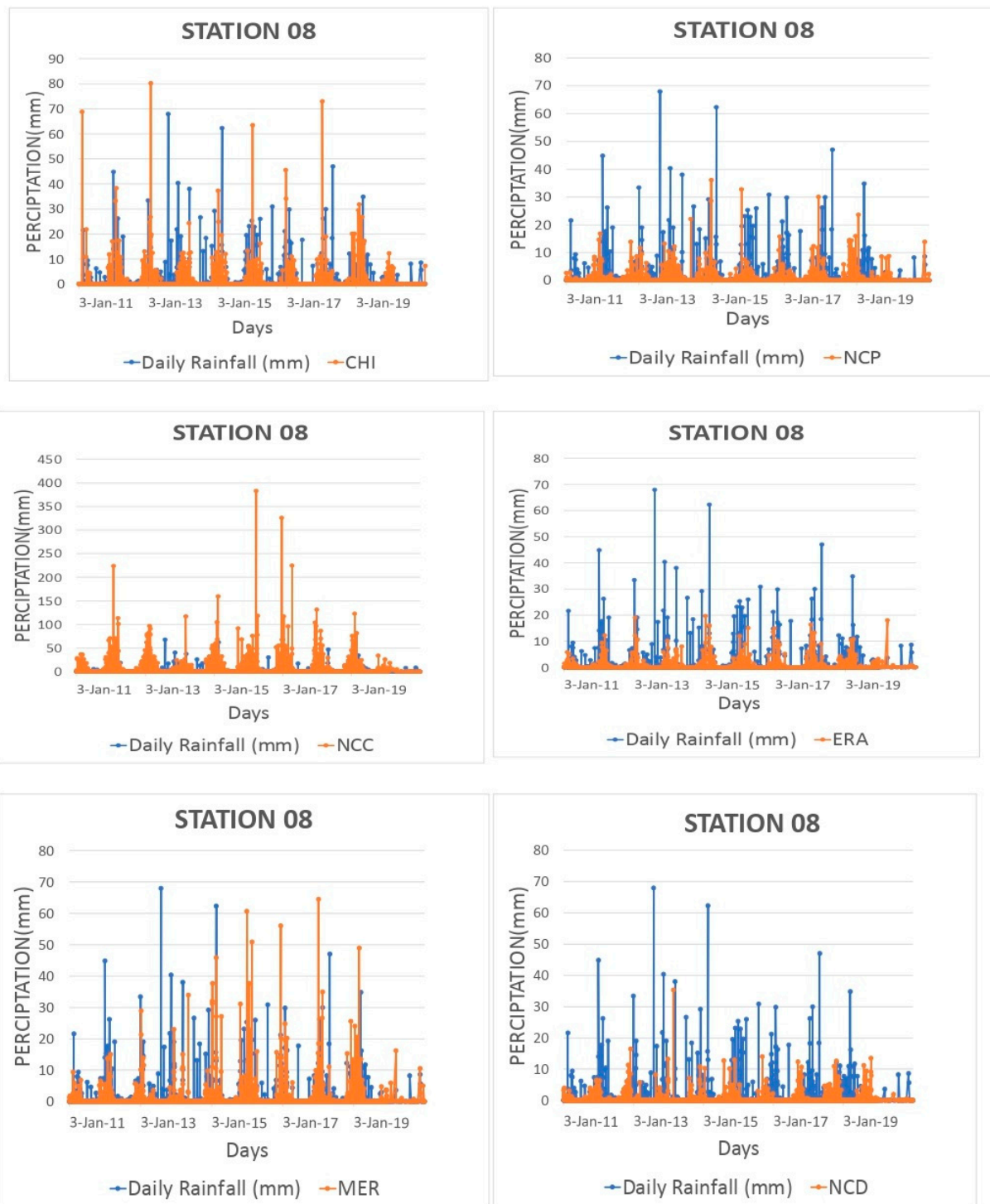


Figure S8. Multi-precipitation products with gauge-observed data at station 09.

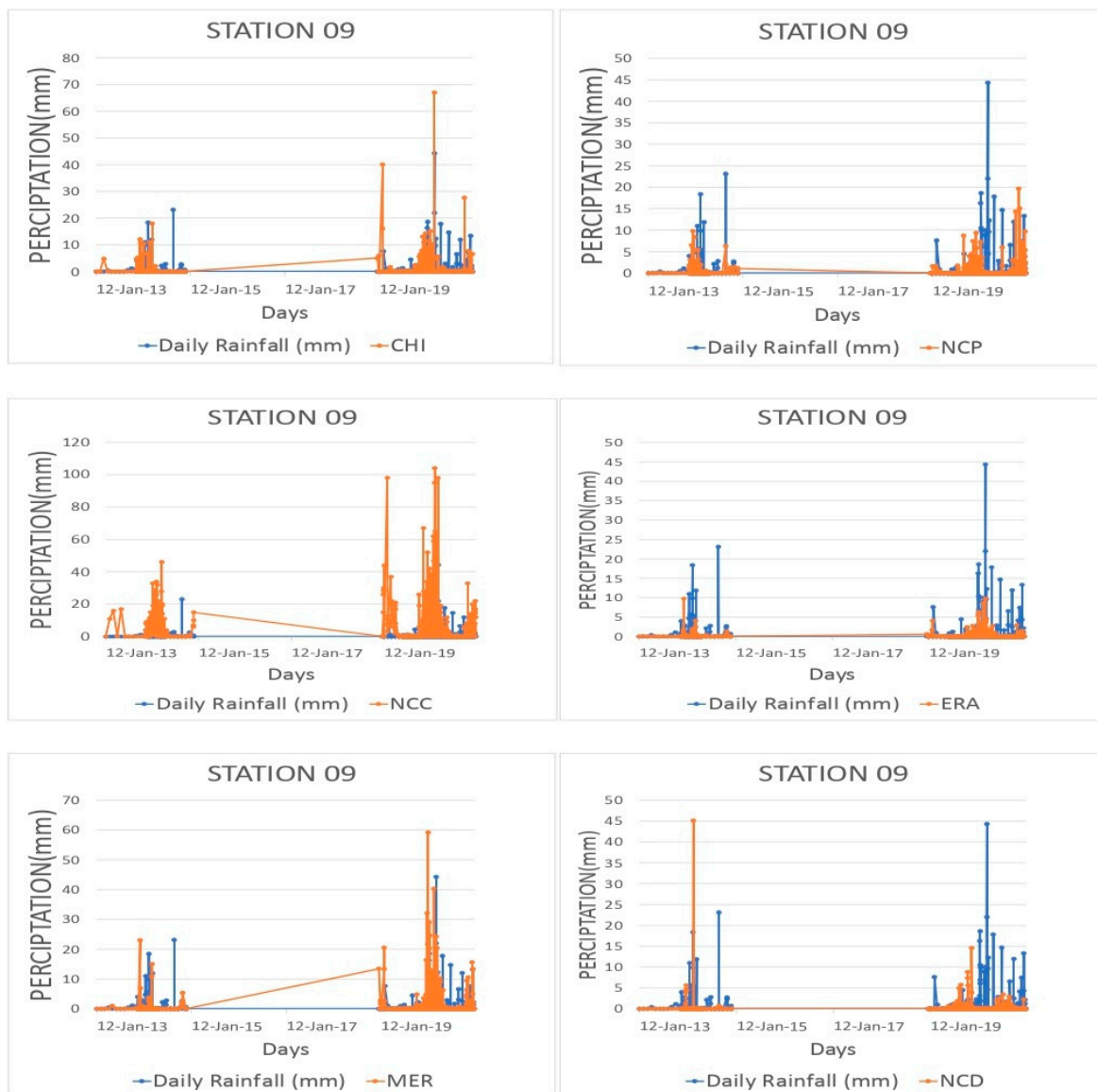


Figure S9. Multi-precipitation products with gauge-observed data at station 09.

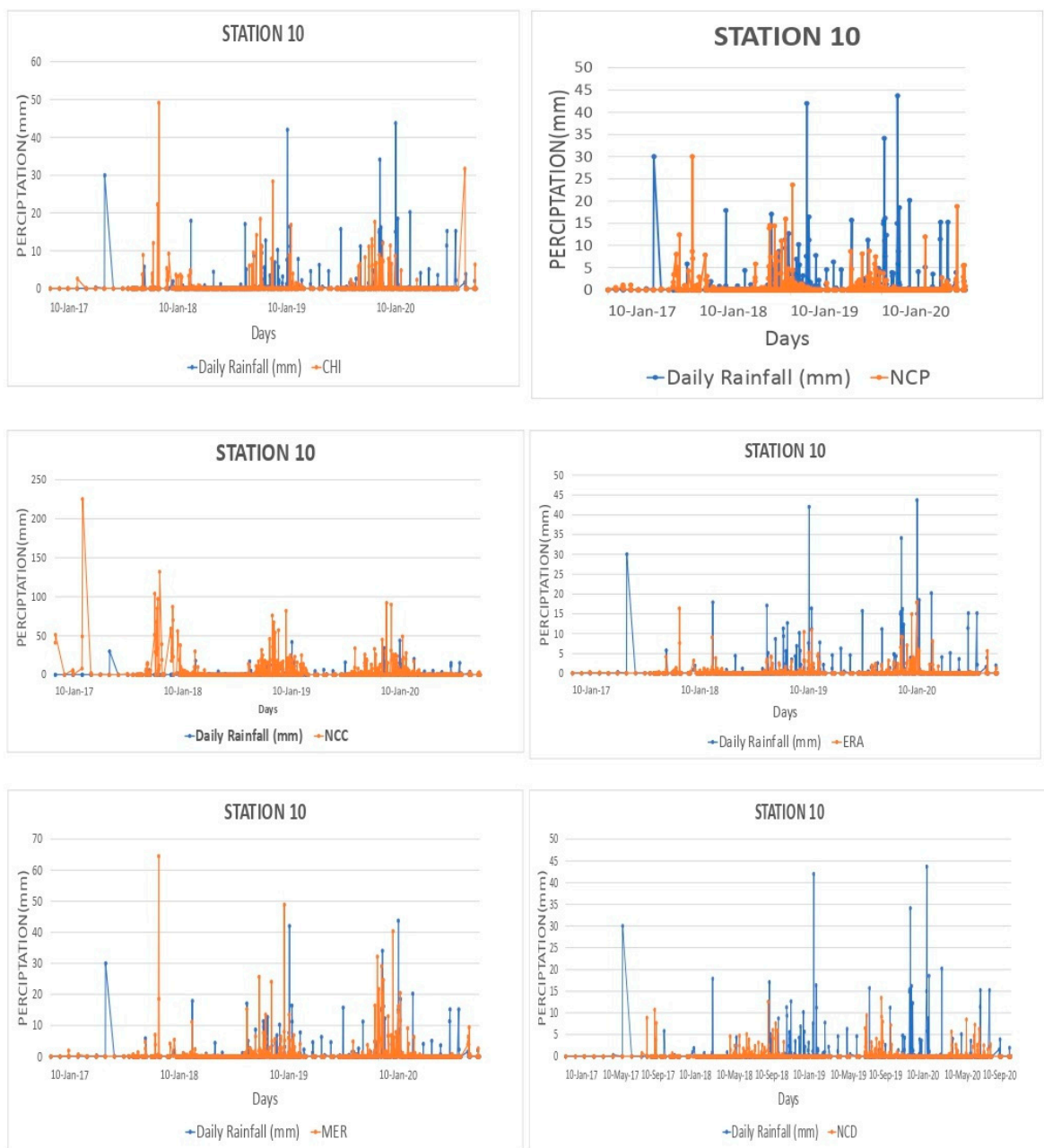


Figure S10. Multi-precipitation products with gauge-observed data at station 10.

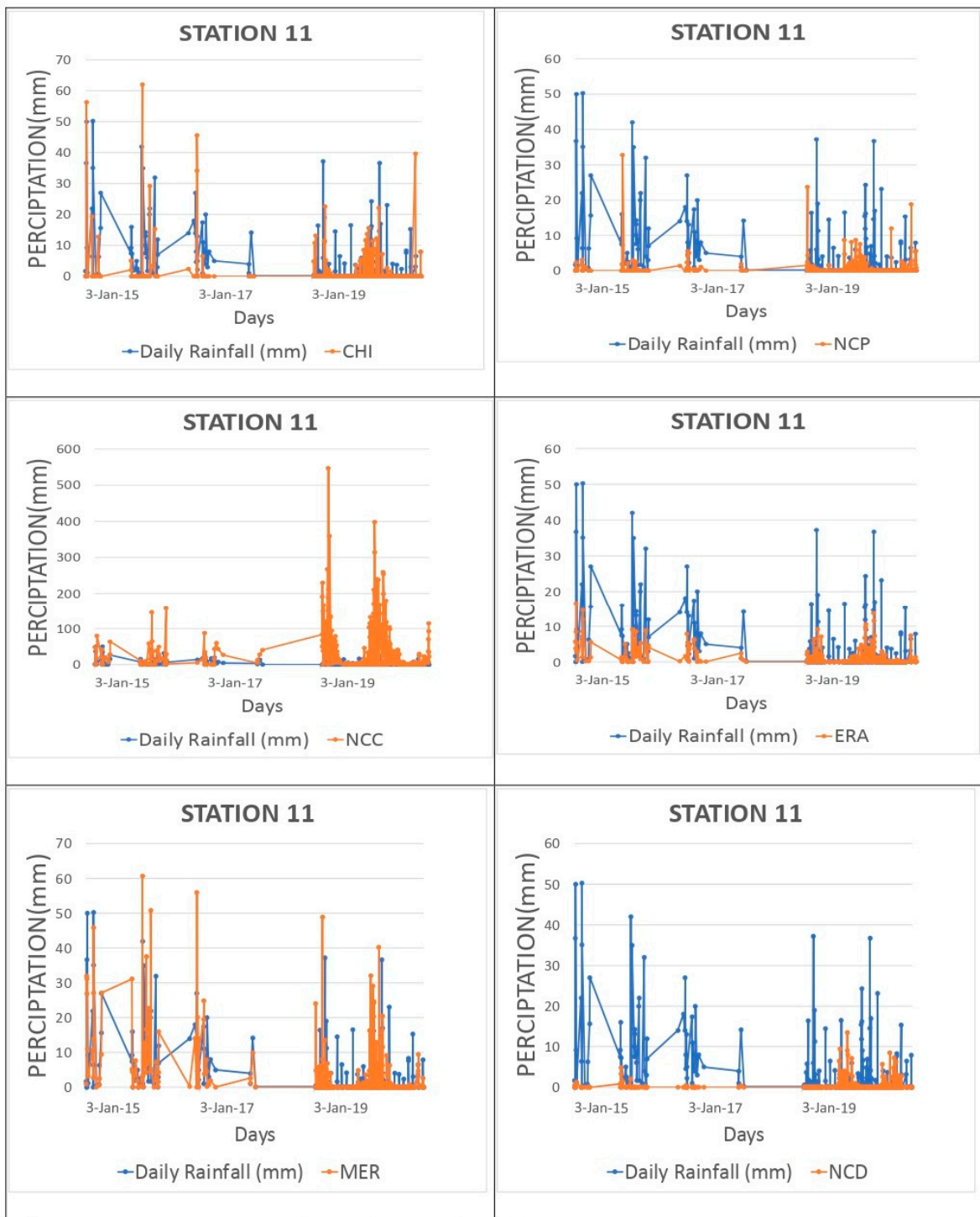


Figure S11. Multi-precipitation products with gauge-observed data at station 11.

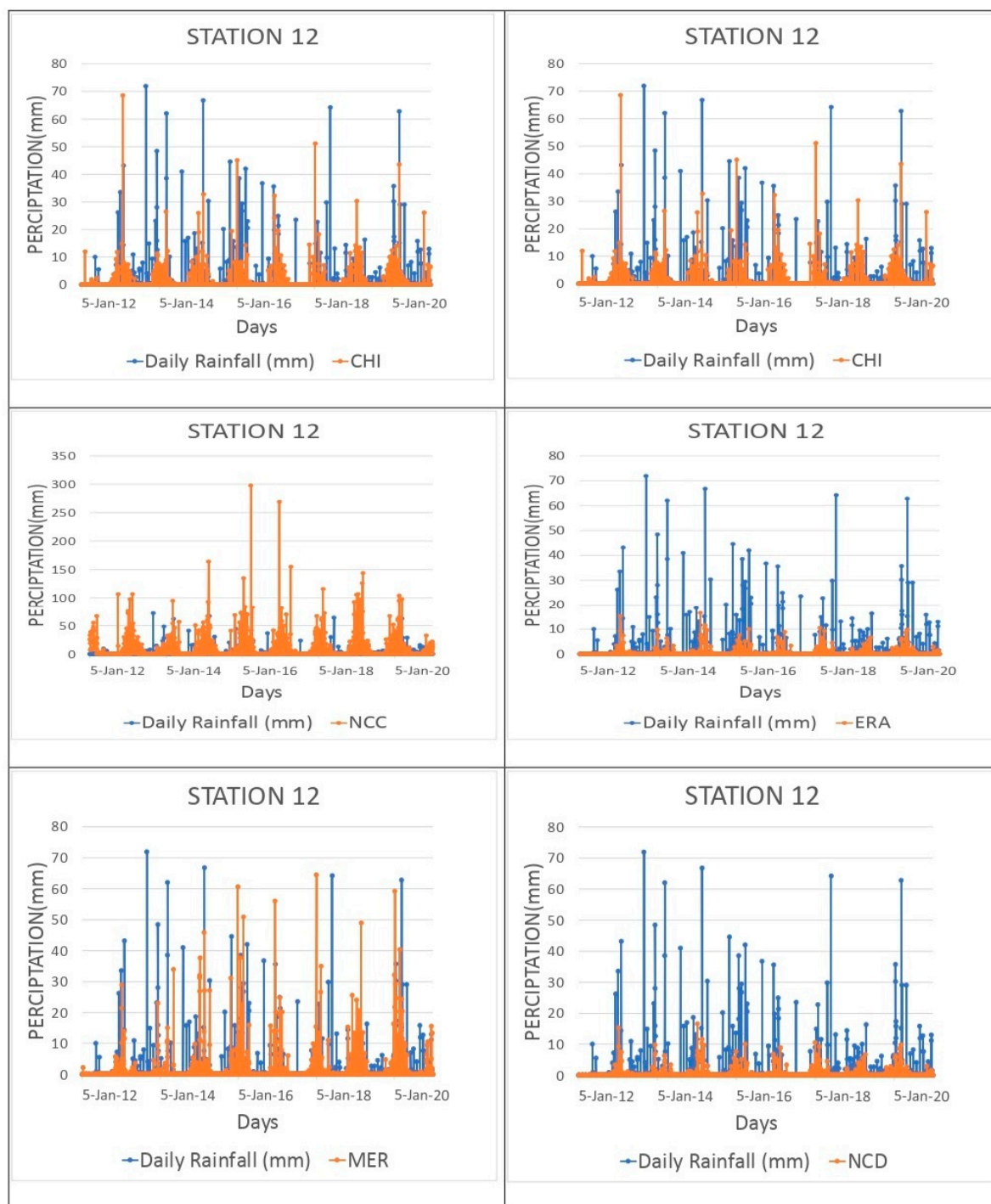


Figure S12. Multi-precipitation products with gauge-observed data at station 12.

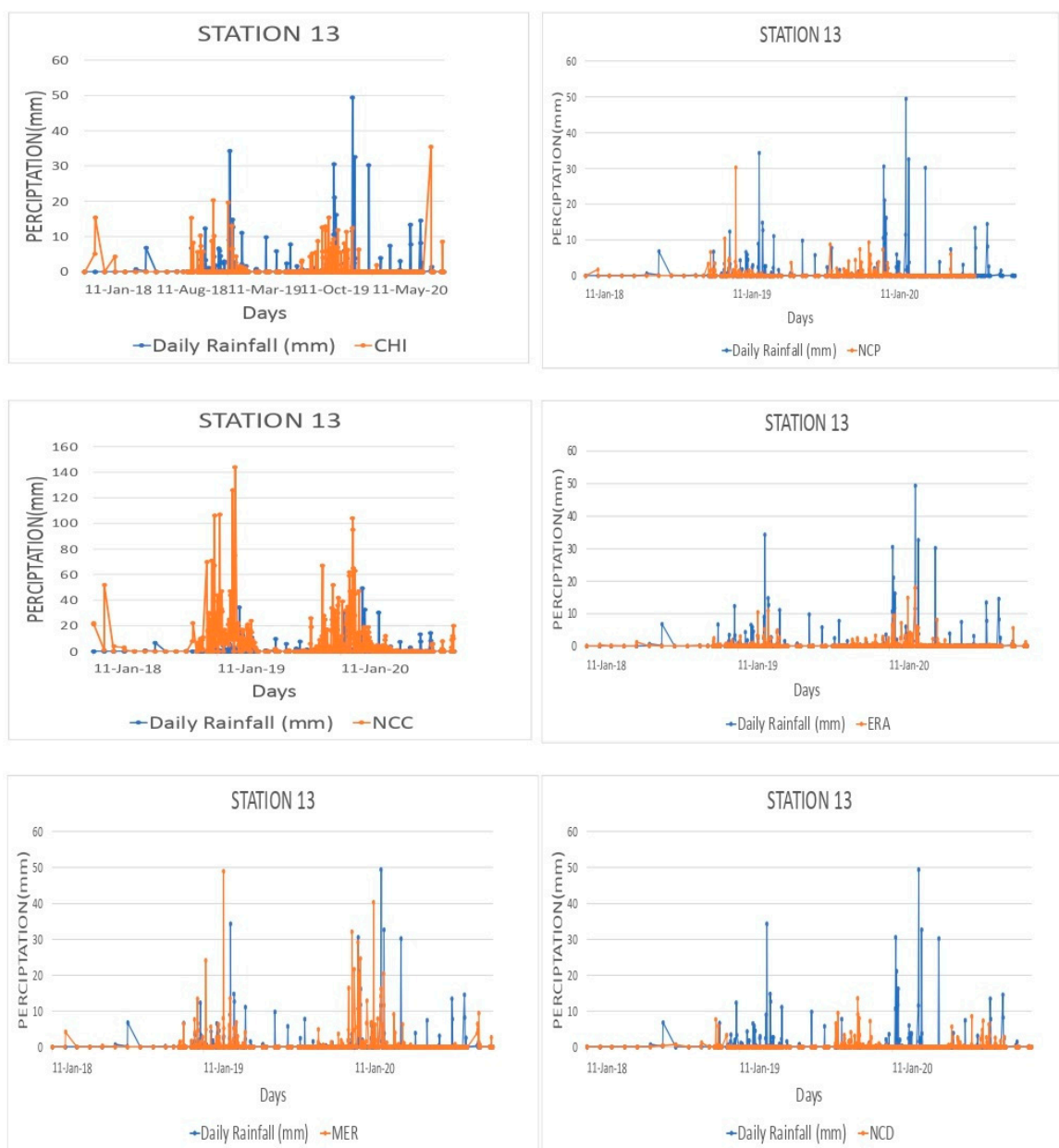


Figure S13. Multi-precipitation products with gauge-observed data at station 13.

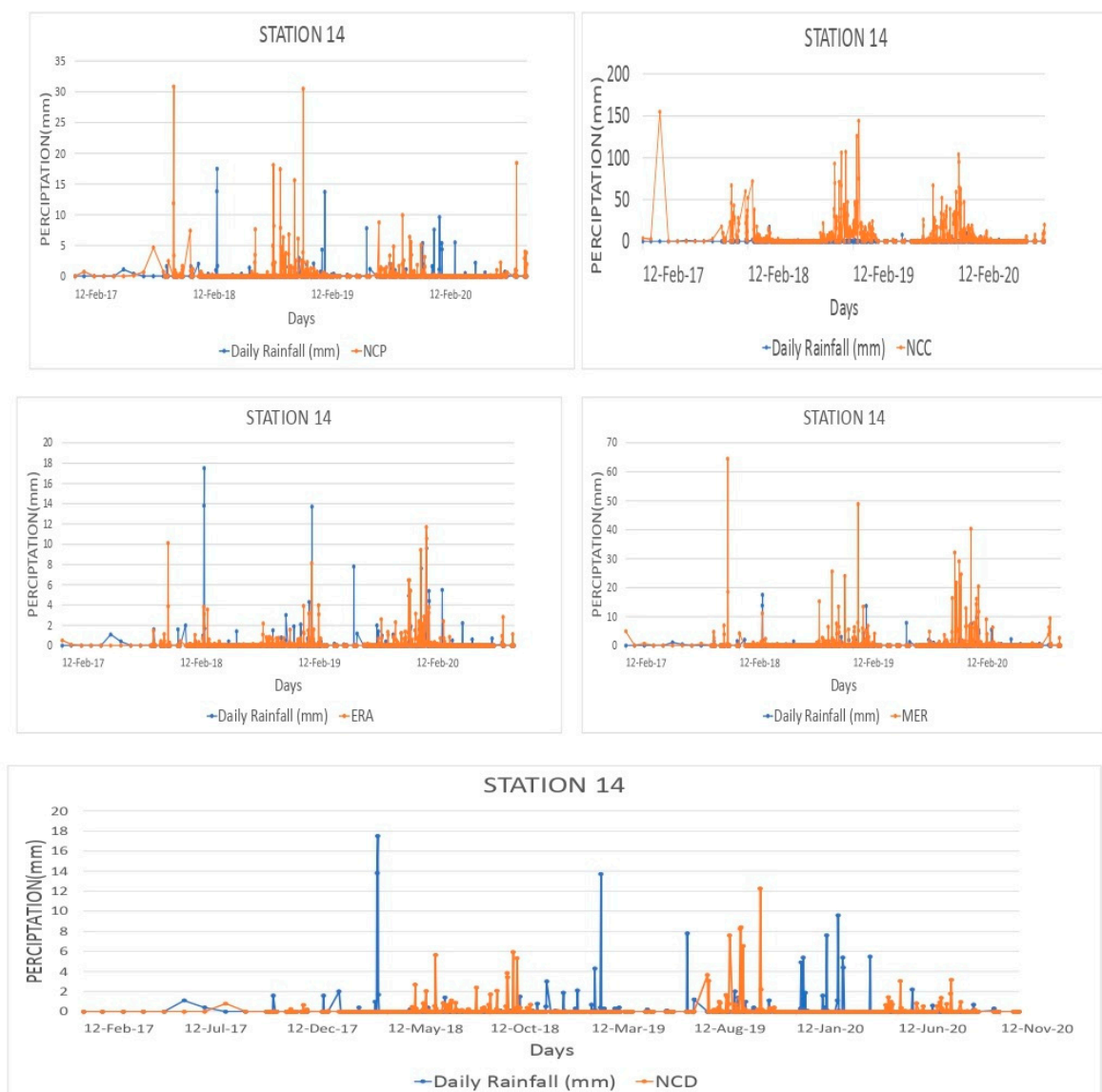
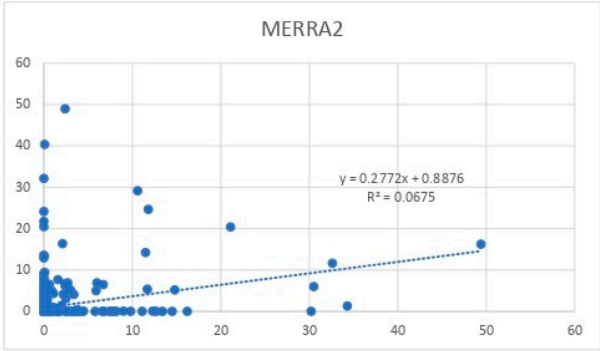
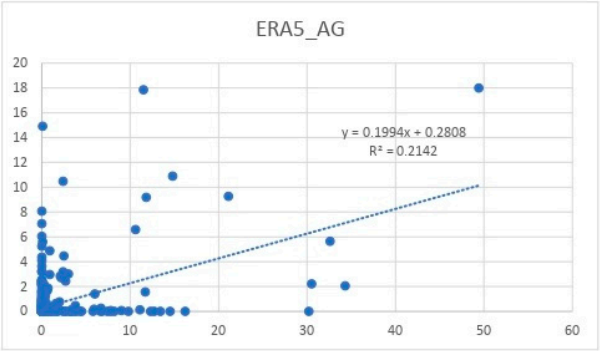


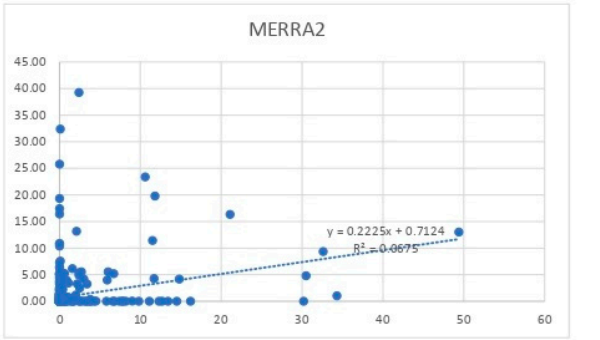
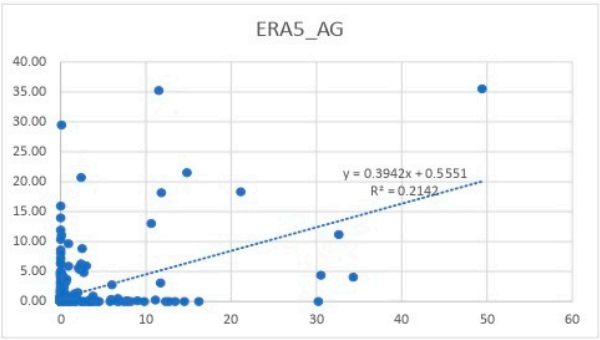
Figure S3. Multi-precipitation products with gauge-observed data at station 14

Station 13

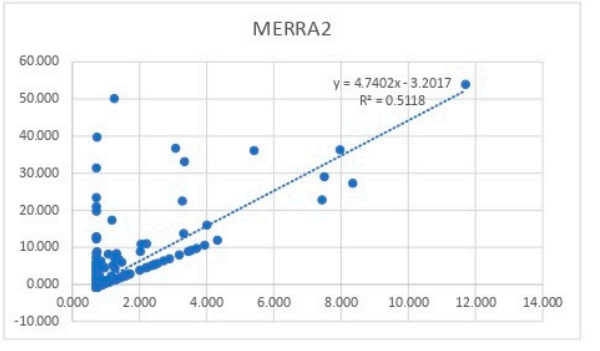
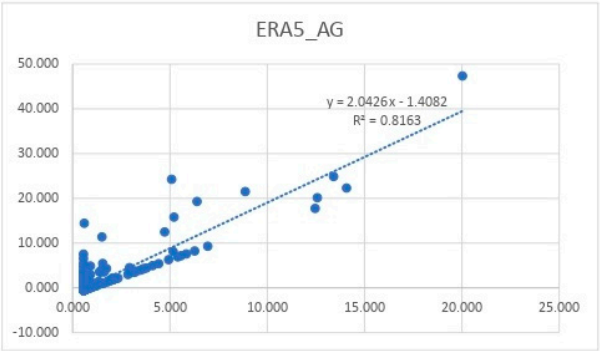
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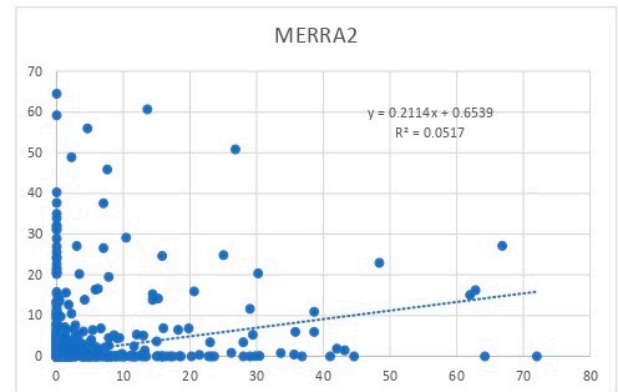
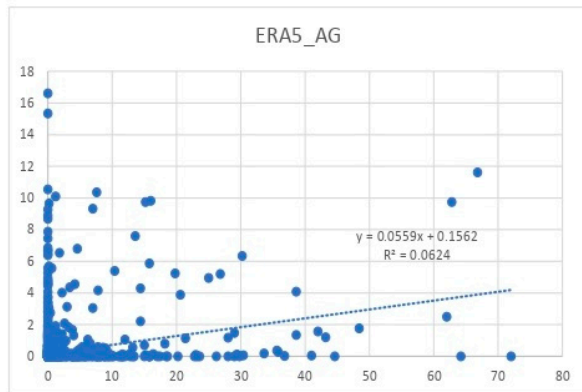


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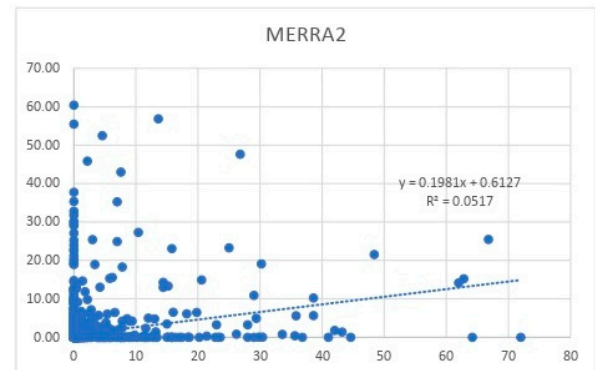
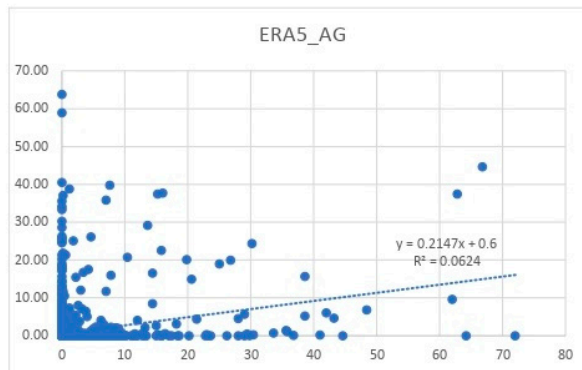


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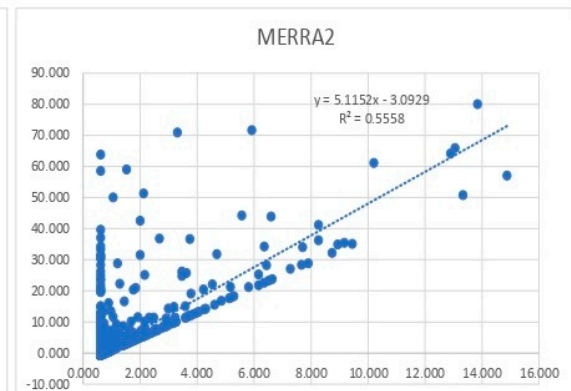
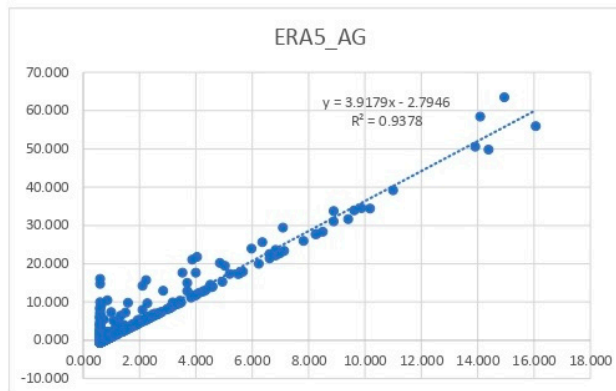
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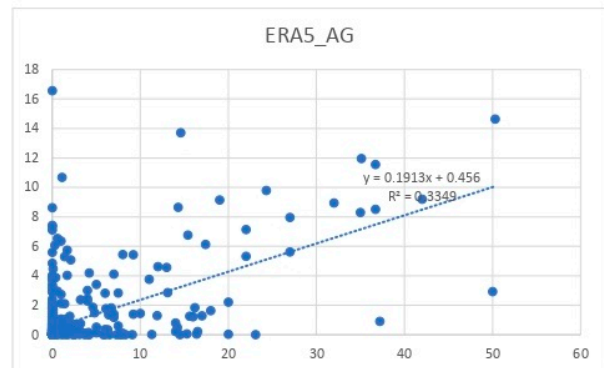
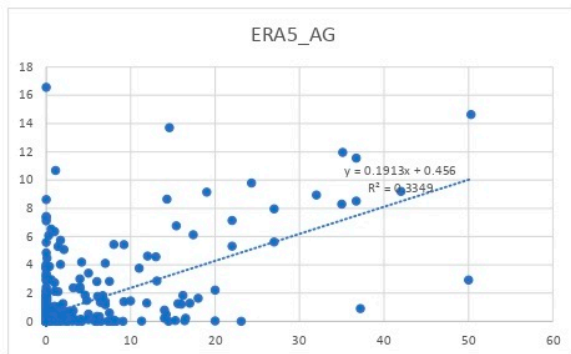


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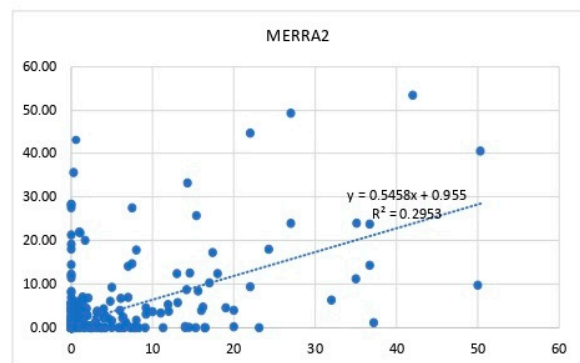
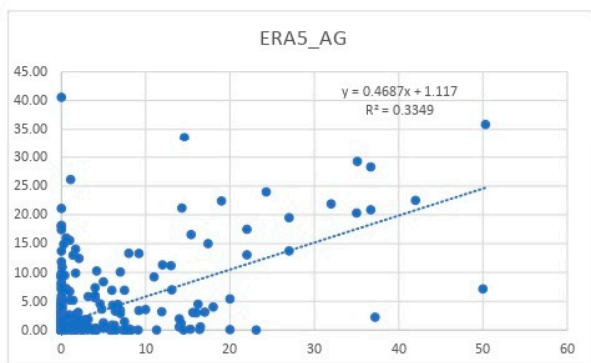


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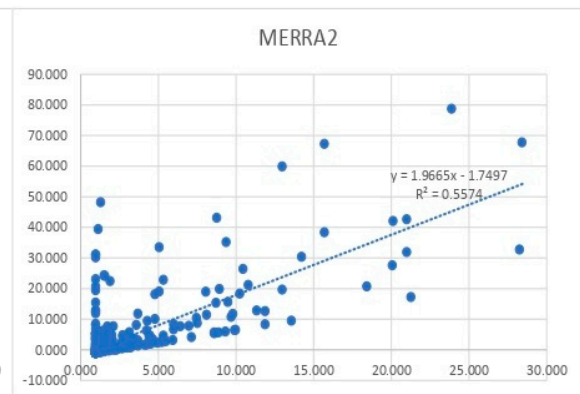
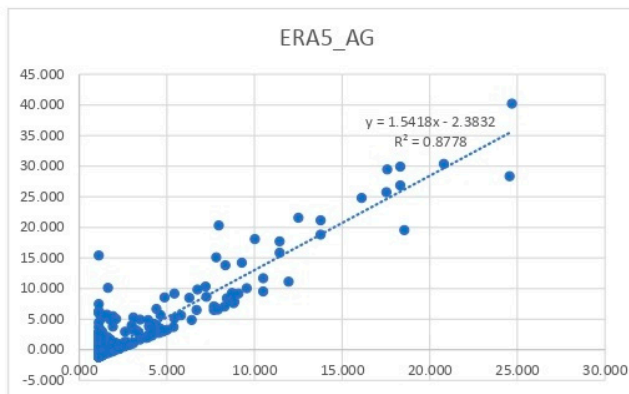
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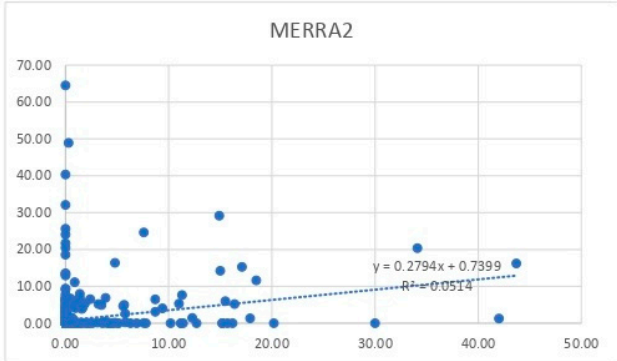
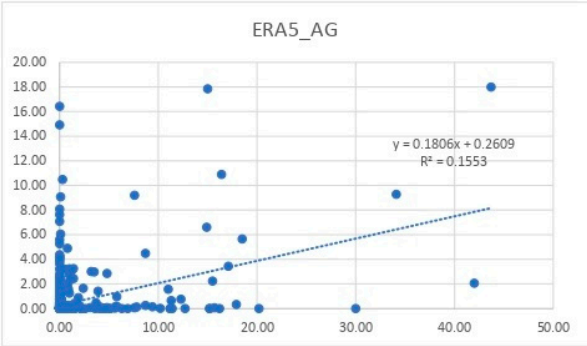


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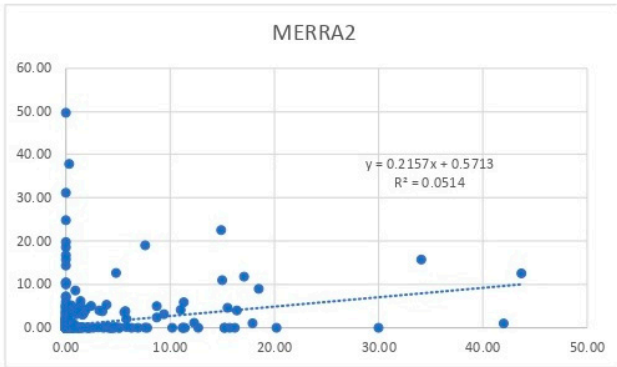
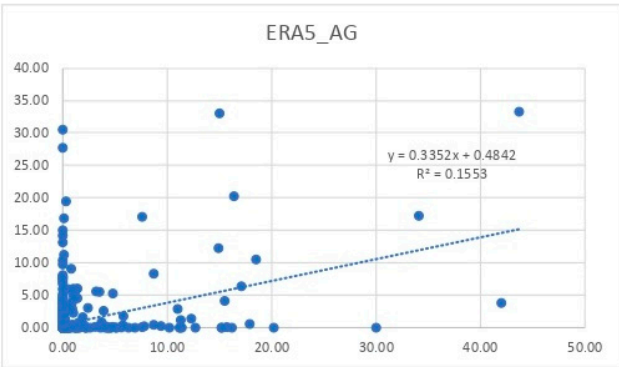


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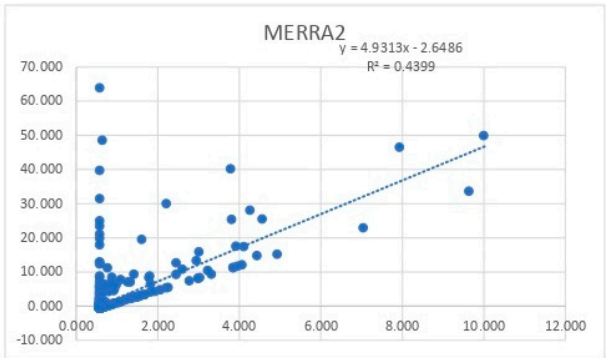
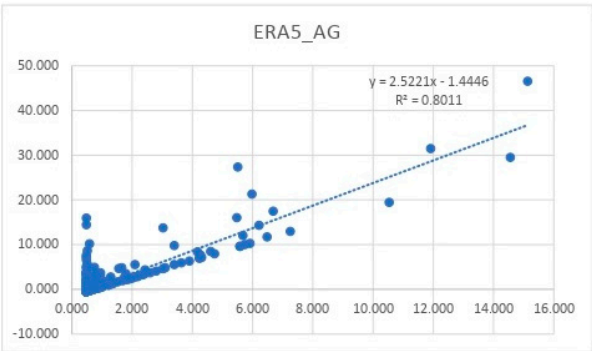
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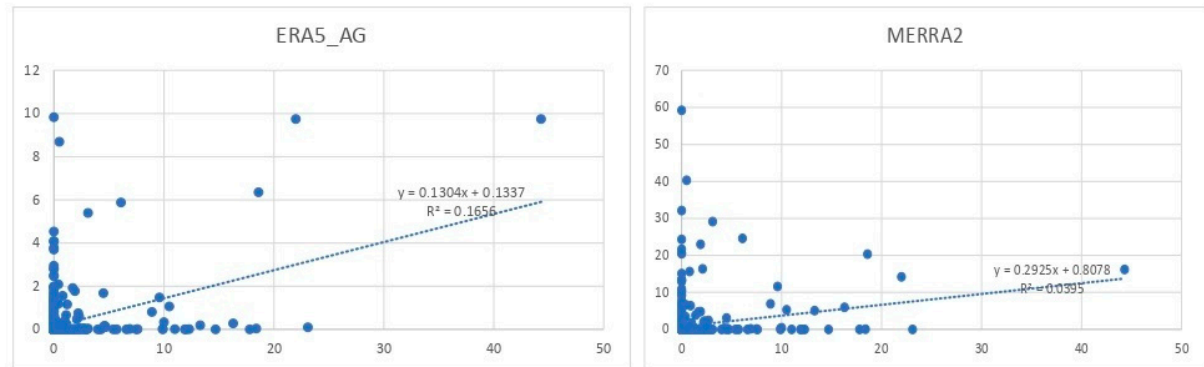


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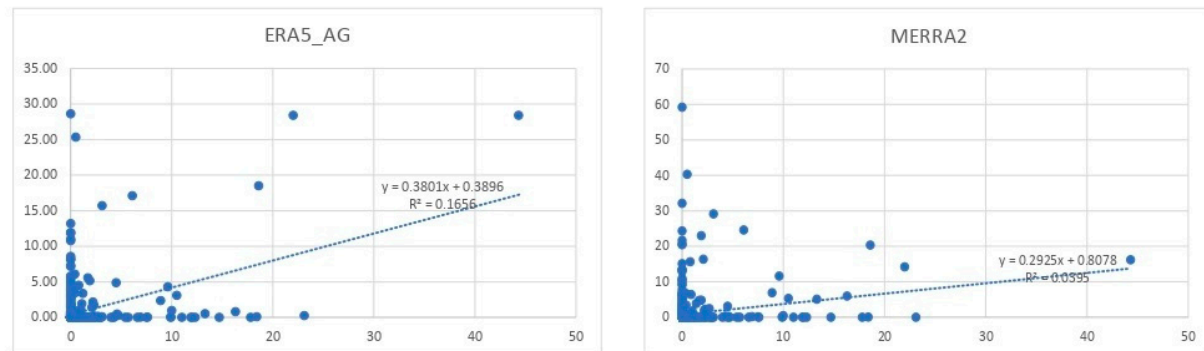


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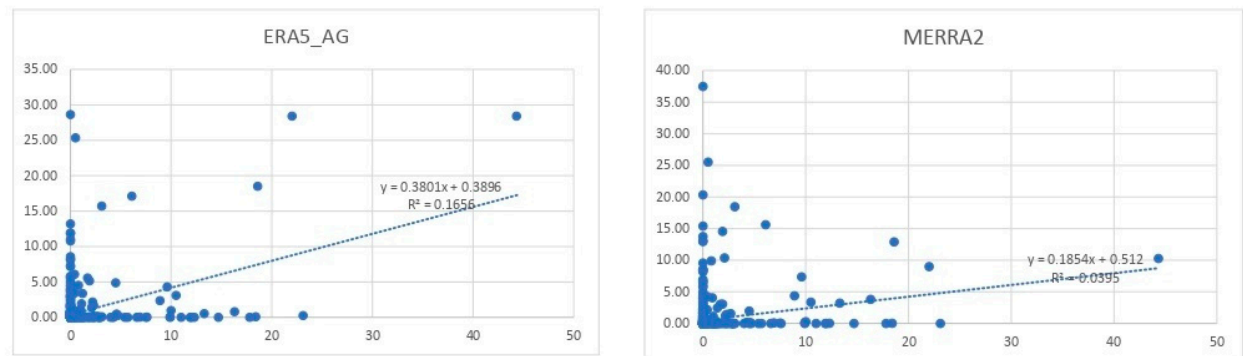
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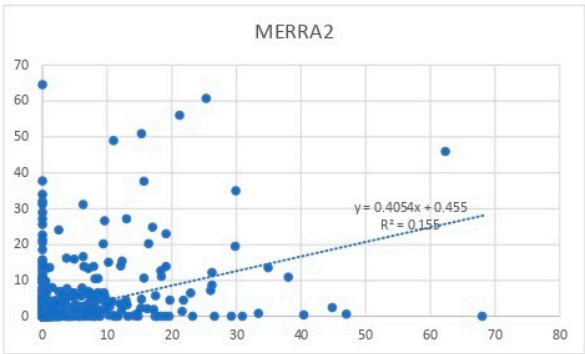
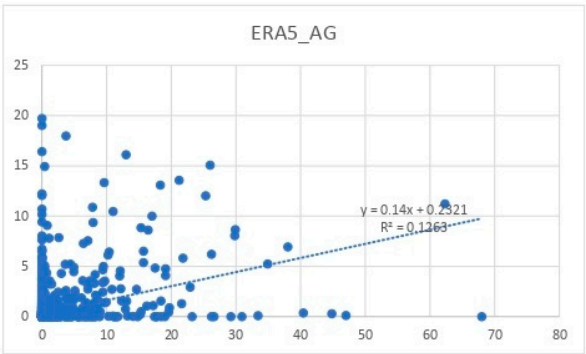


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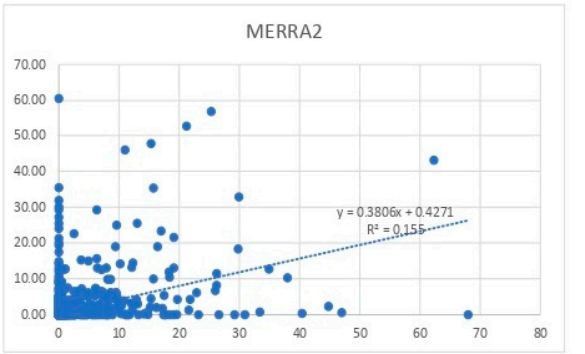
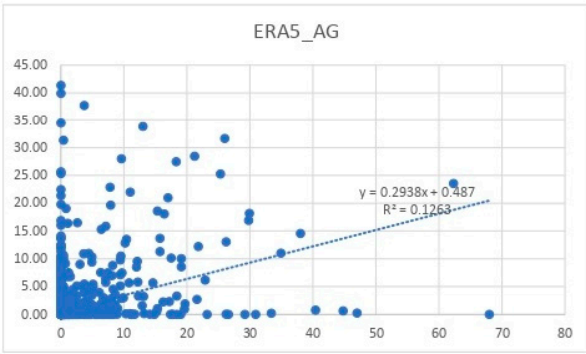


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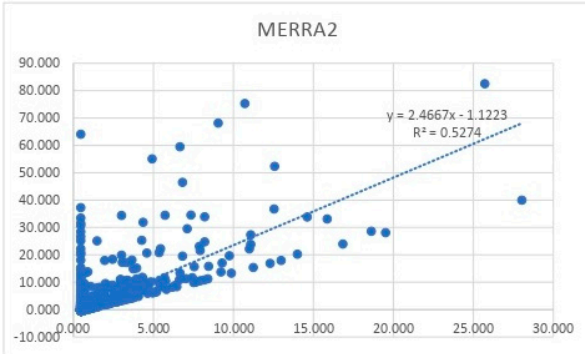
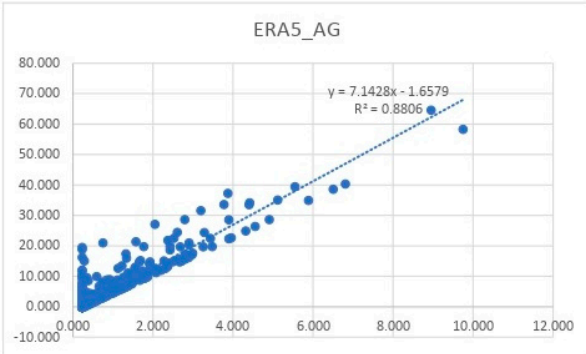
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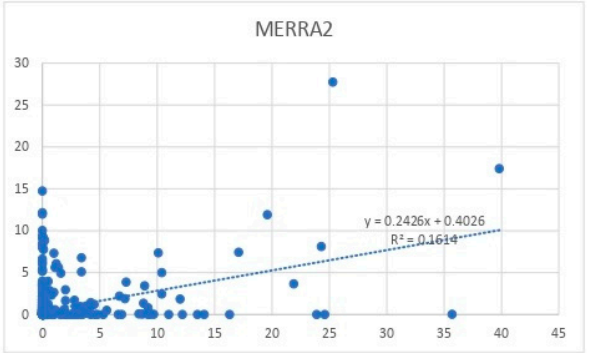
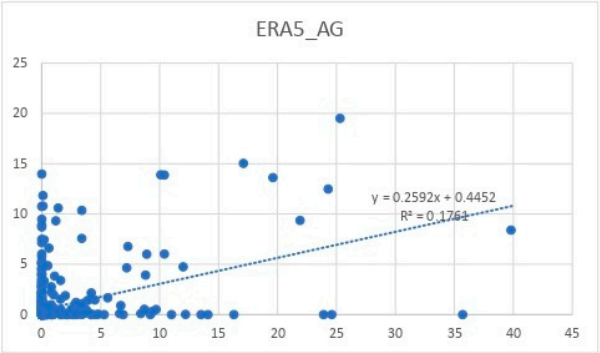


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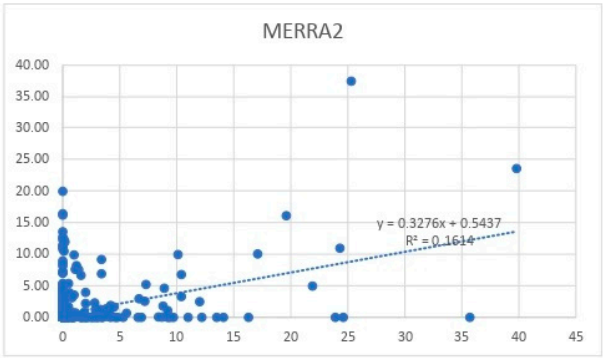
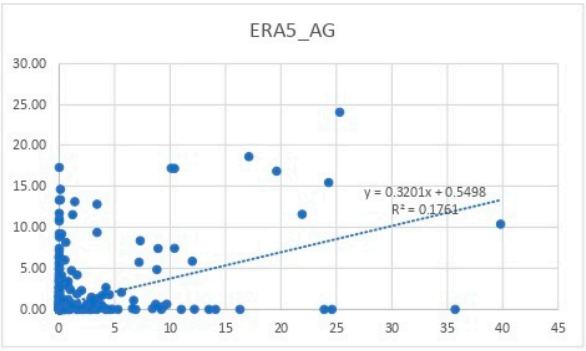


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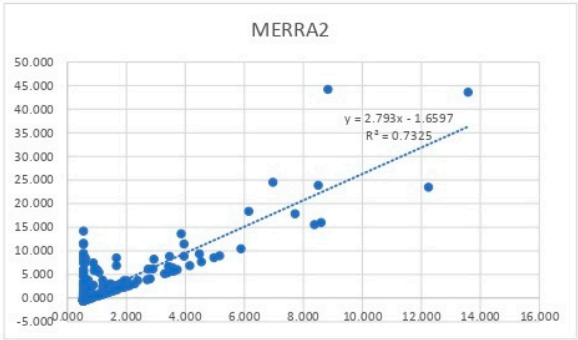
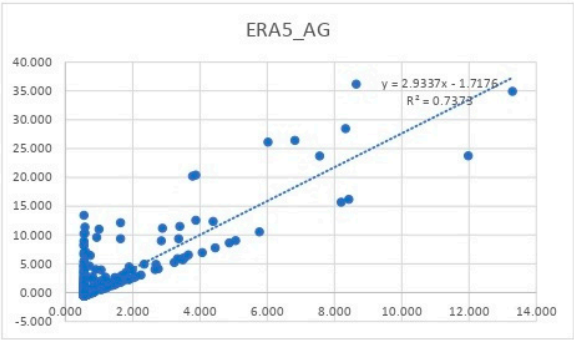
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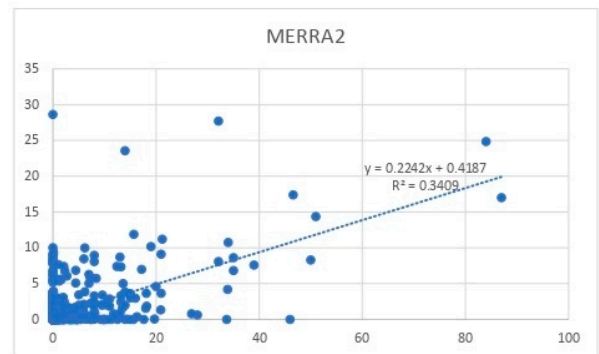
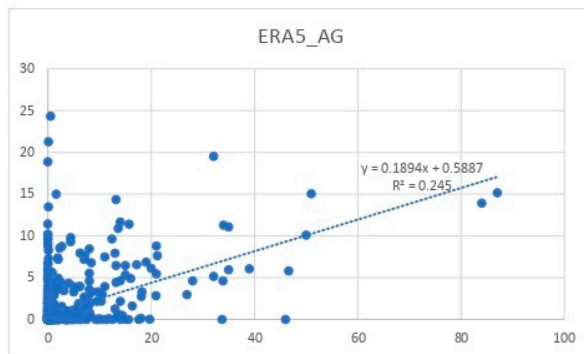


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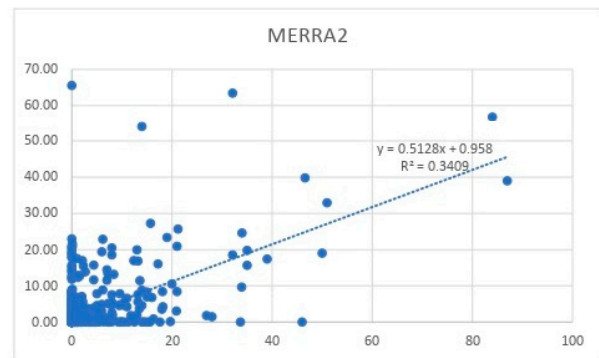
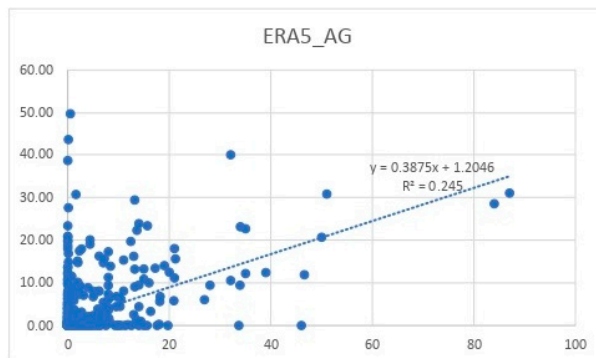


Station 06

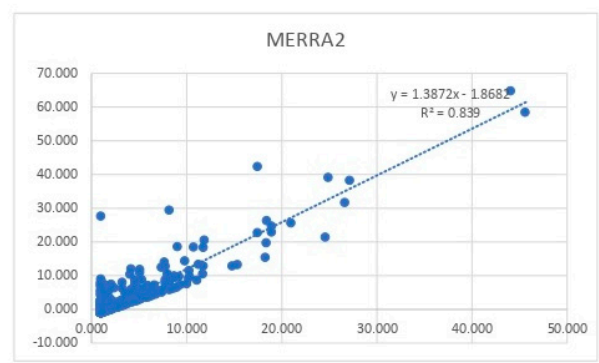
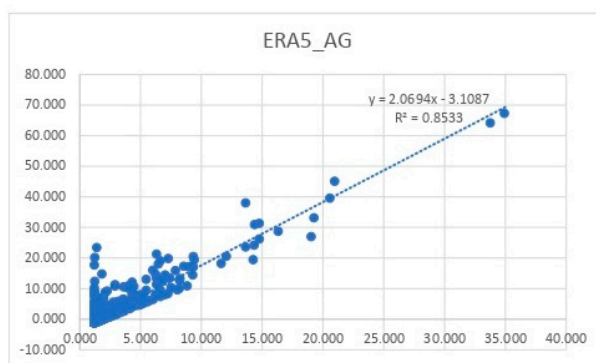
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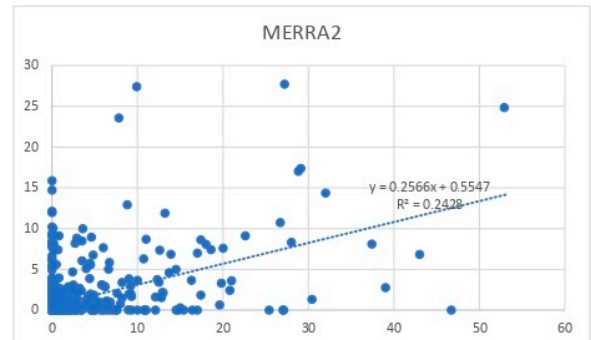
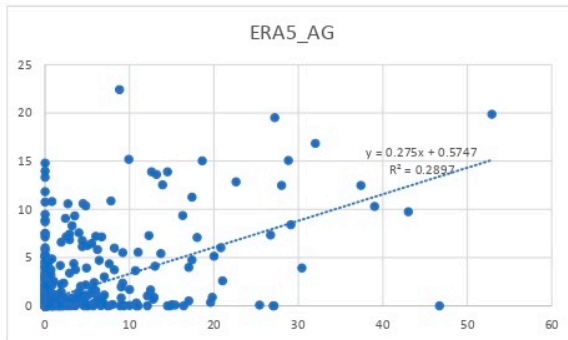


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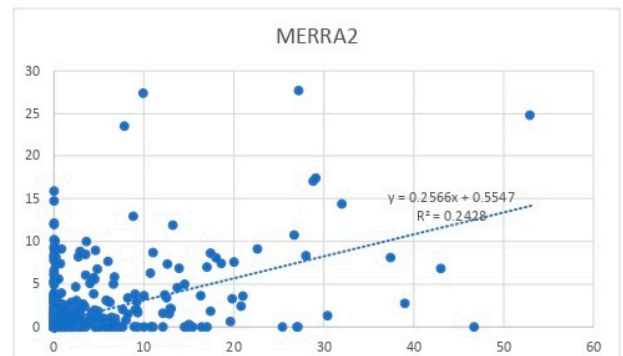
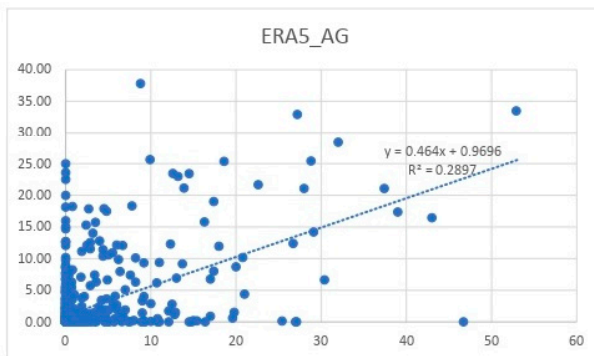


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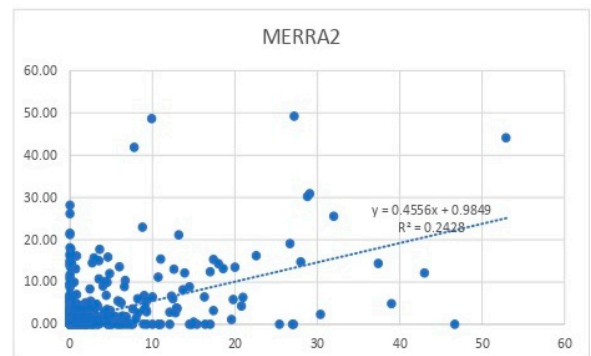
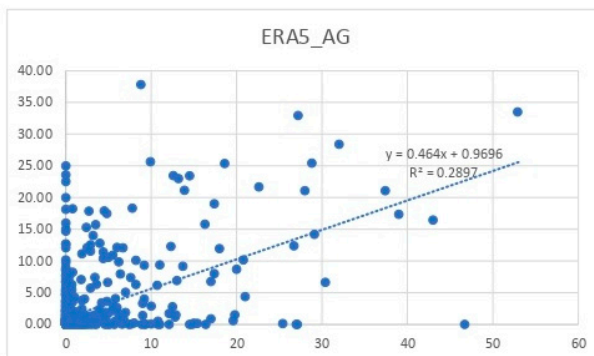
ACTUAL VS REANALYSIS DATASET



ACTUAL VS MCP

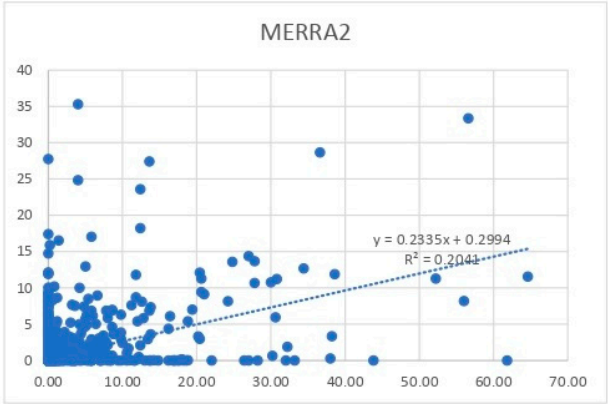
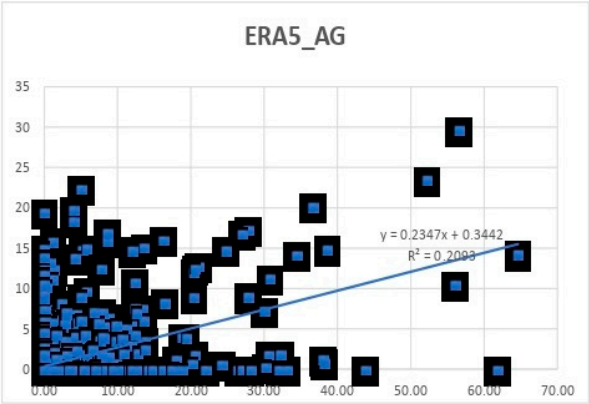


NEW ESTIMATED R DATA (GHIEEN) AND ESTIMATED R (Re)

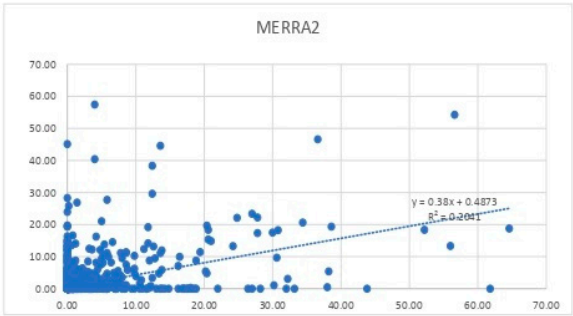
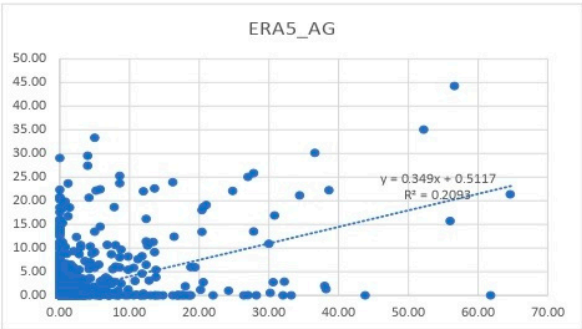


Station 04

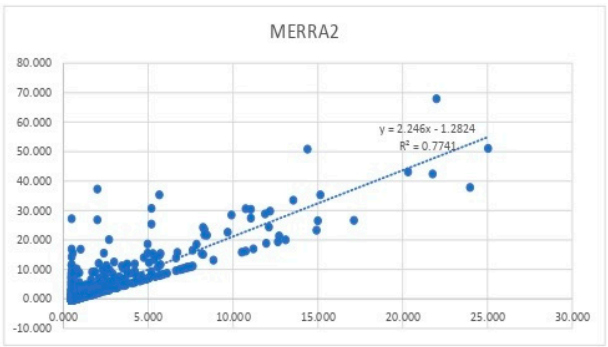
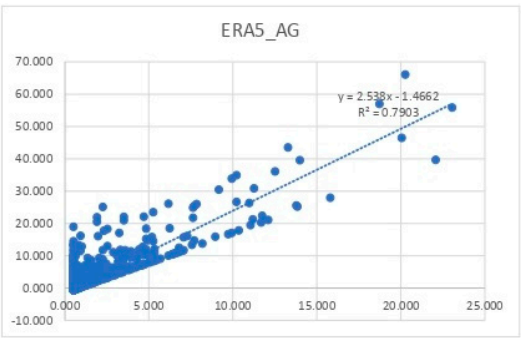
ACTUAL VS REANALYSIS DATASET



ACTUAL VS MCP

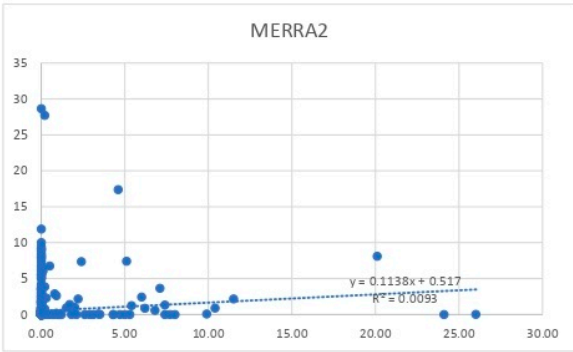
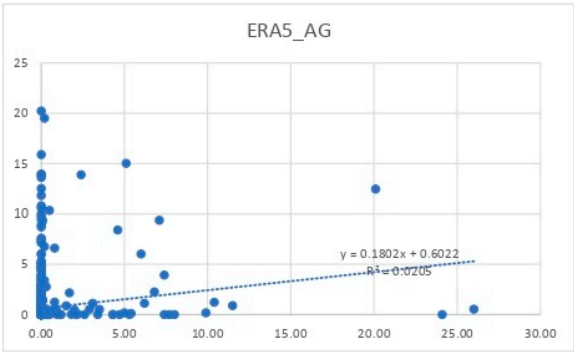


NEW ESTIMATED R DATA (GHIEN) AND ESTIMATED R (Re)

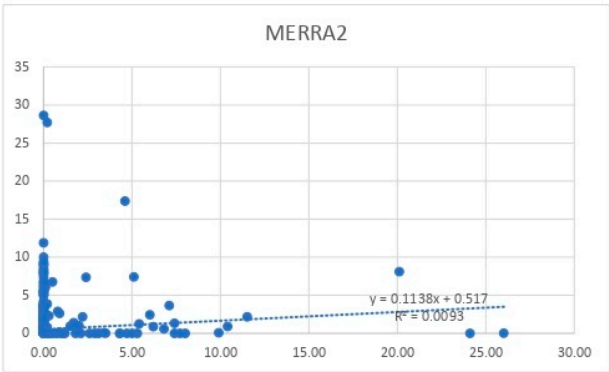
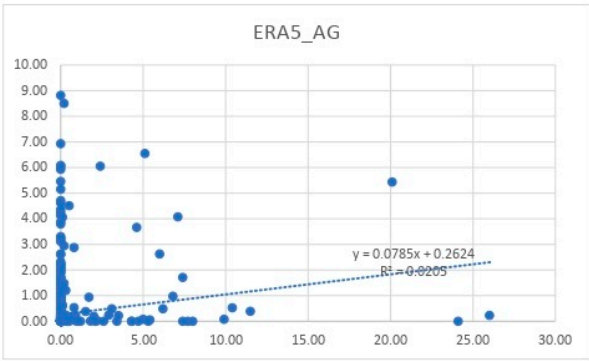


Station 03

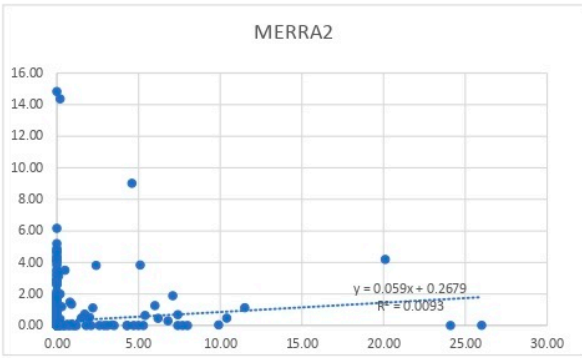
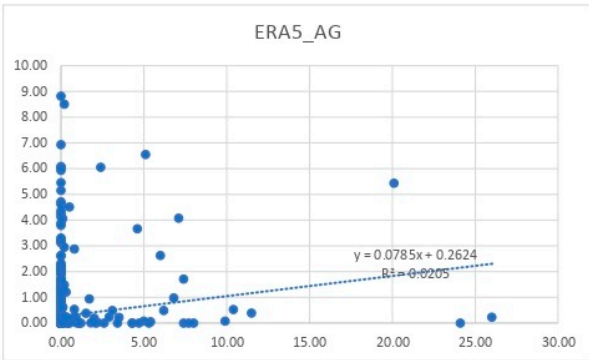
ACTUAL VS REANALYSIS DATASET



ACTUAL VS MCP

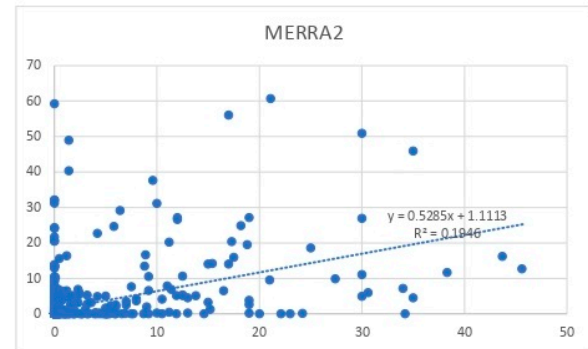
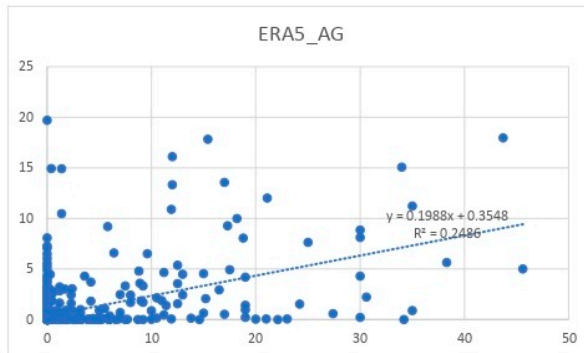


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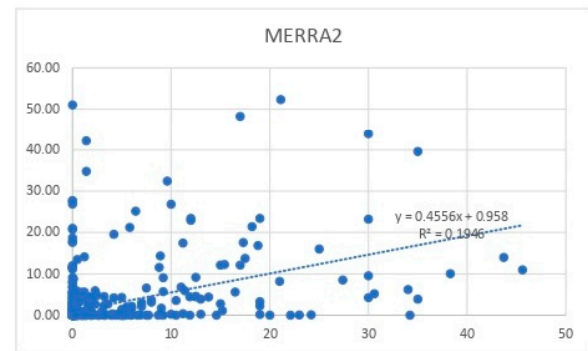
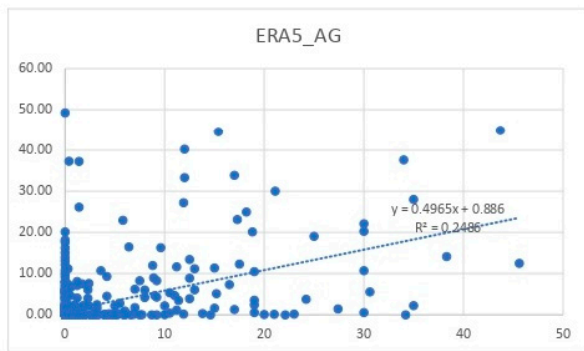


Station 02

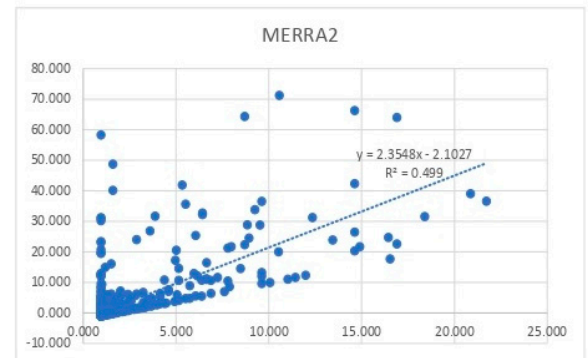
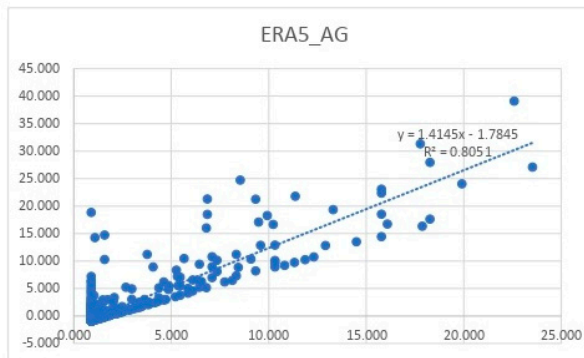
ACTUAL VS REANALYSIS DATASET



ACTUAL VS MCP

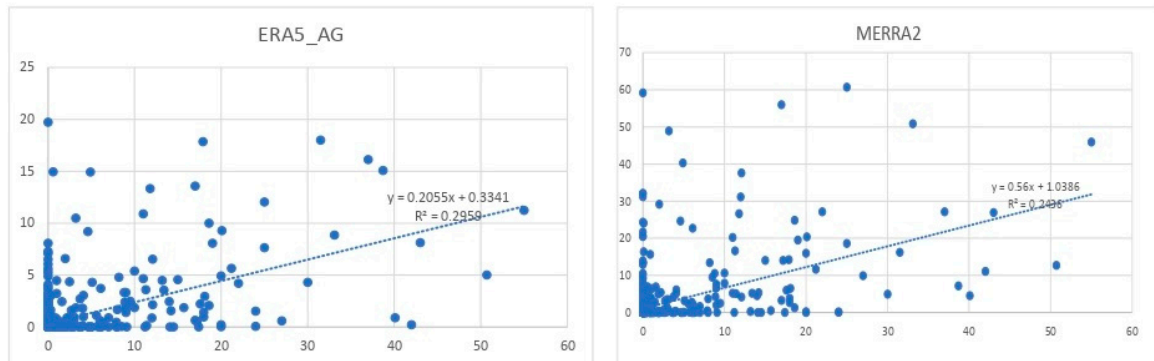


NEW ESTIMATED R DATA (GHEN) AND ESTIMATED R (Re)

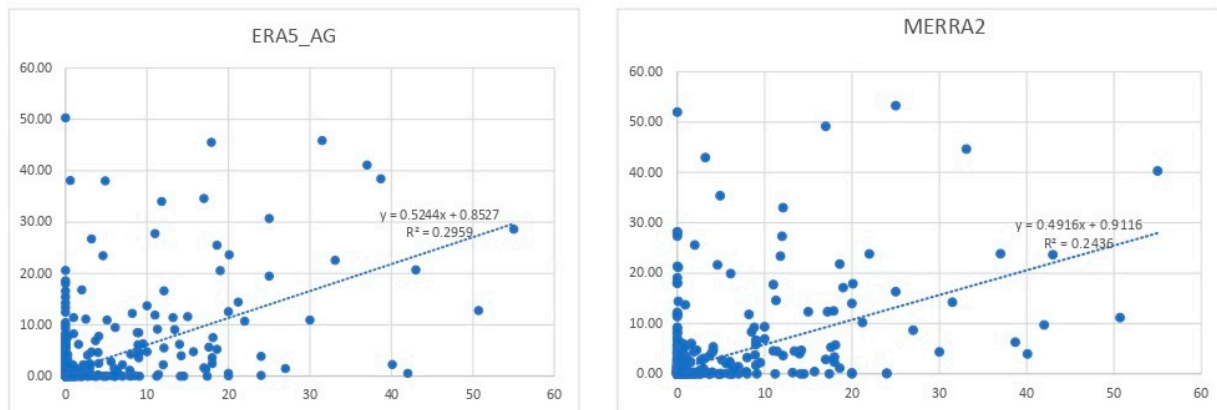


Station 01

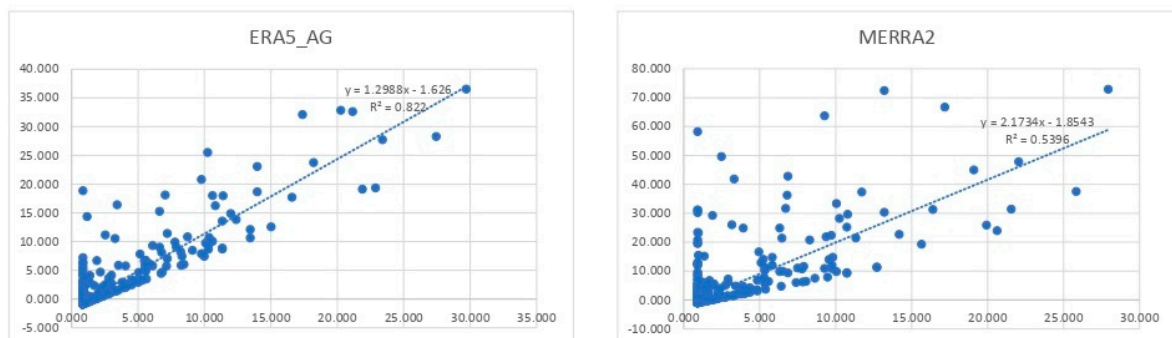
ACTUAL VS REANALYSIS DATASET



ACTUAL VS MCP

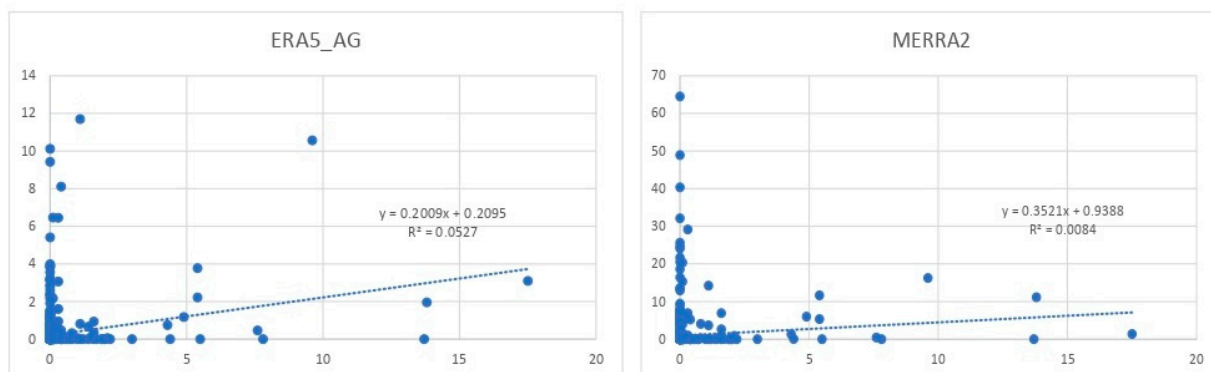


NEW ESTIMATED R DATA (GHEN) AND ESTIMATED R (Re)

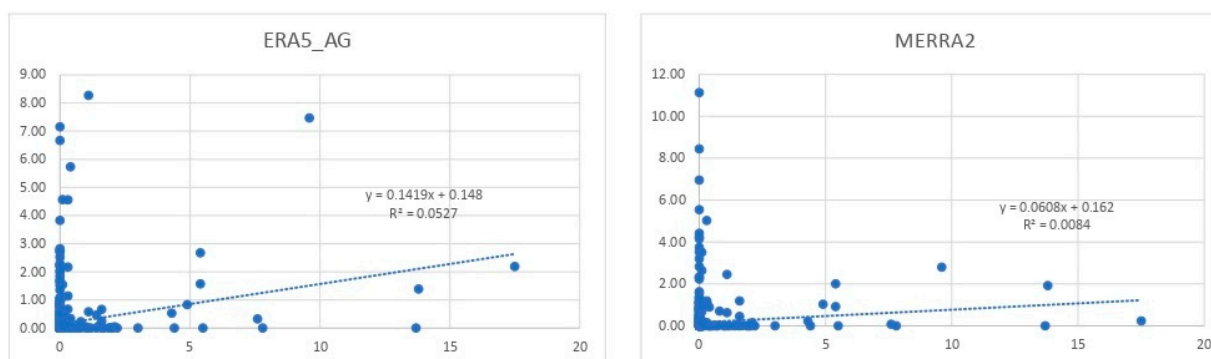


Station 14

ACTUAL VS REANALYSIS DATASET



ACTUAL VS MCP



NEW ESTIMATED R DATA (GHEN) AND ESTIMATED R (Re)

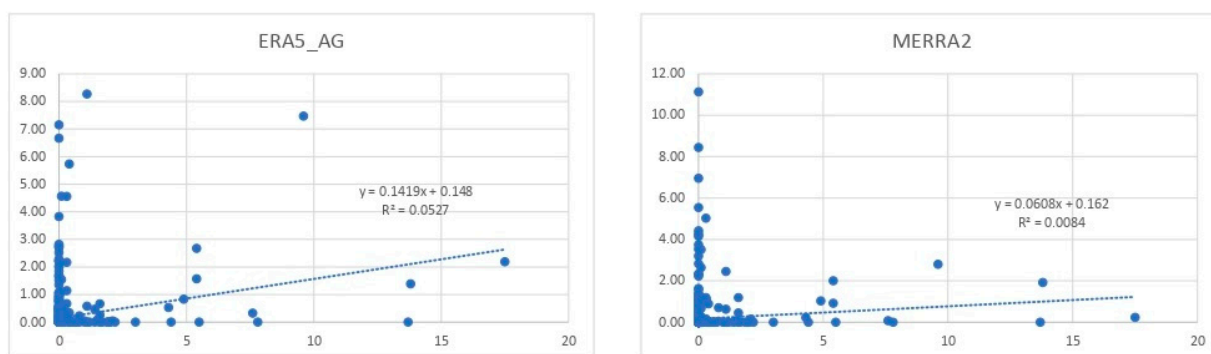
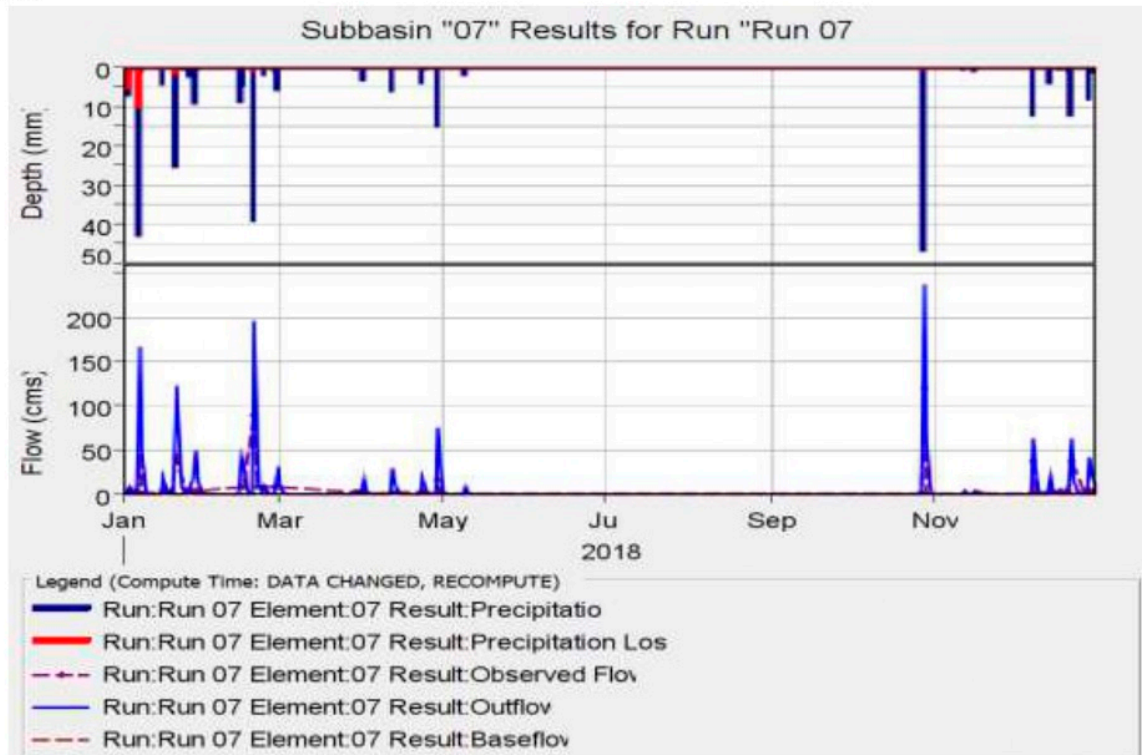


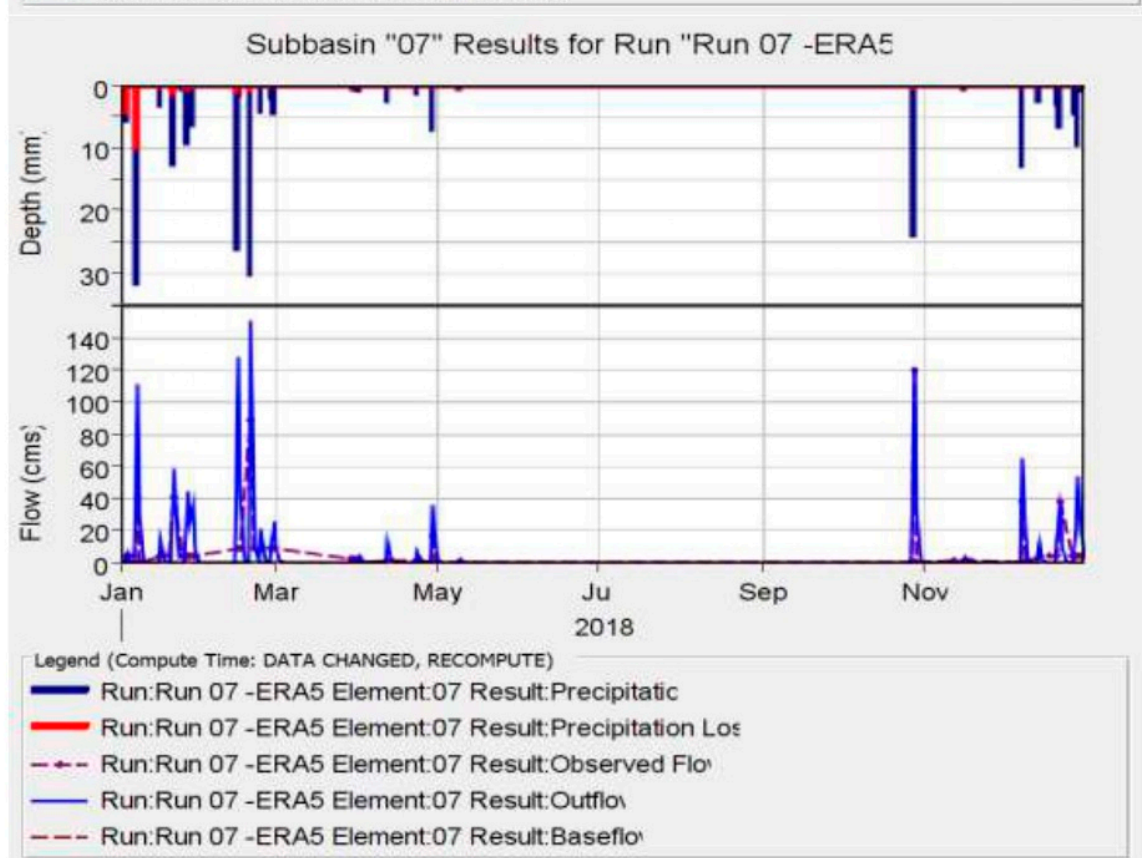
Figure S15.Scatter plot diagram -correction methods

Basin -07

Actual vs observed data

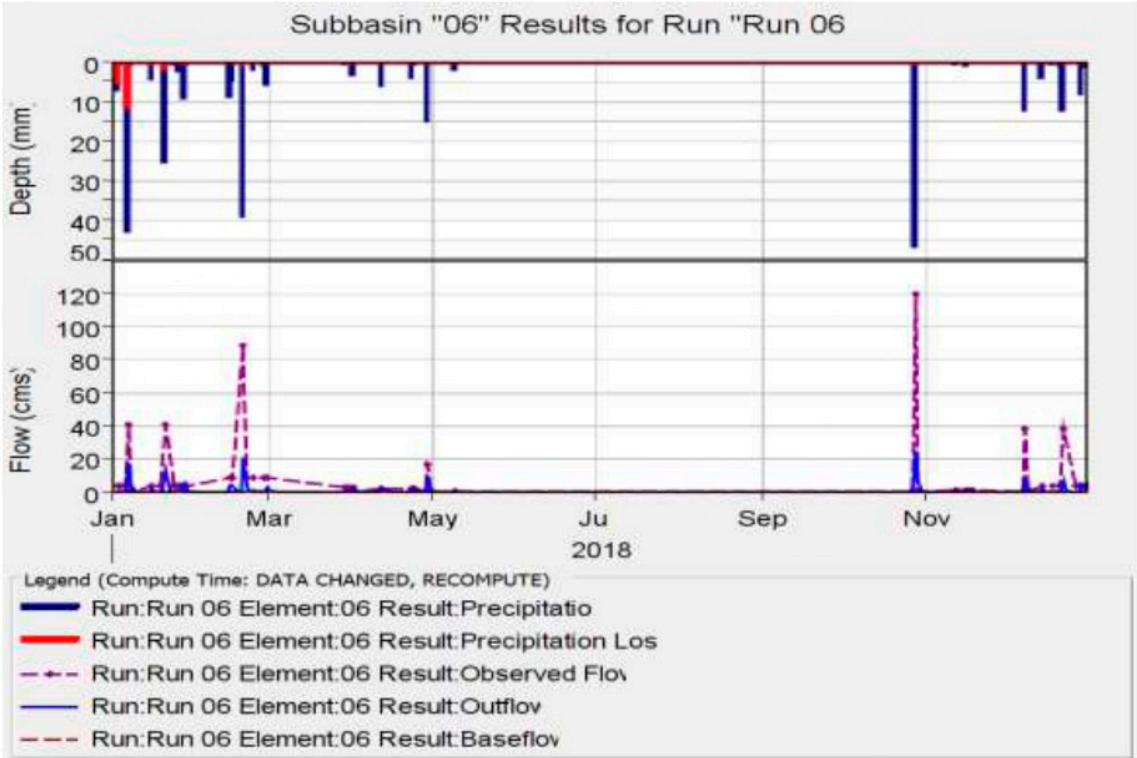


ERA5 vs observed data

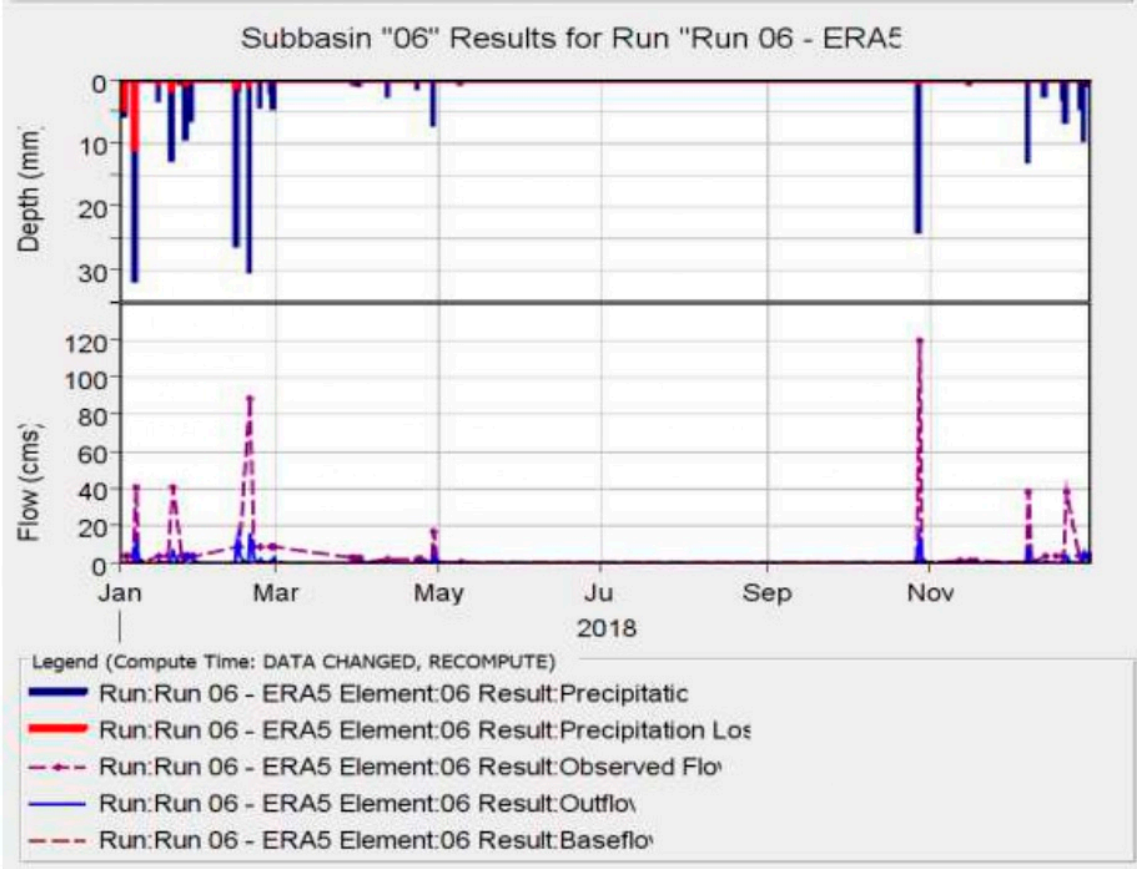


Basin 06

Actual vs observed data

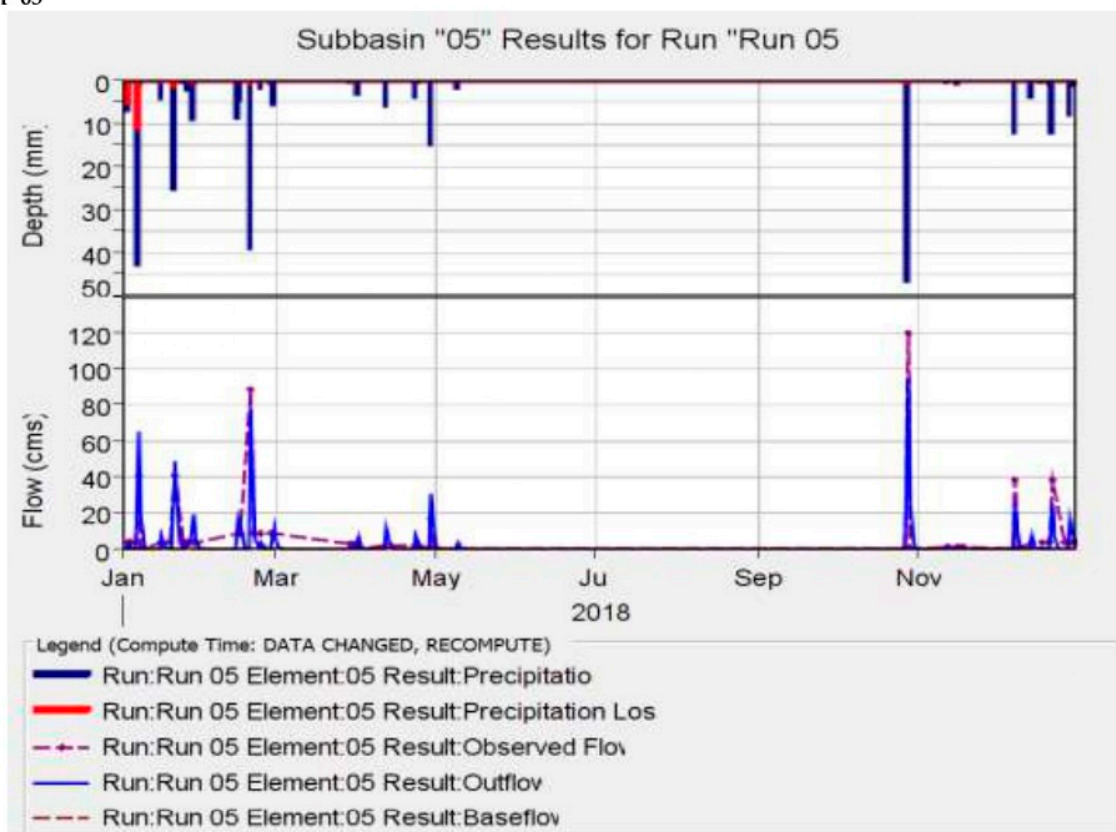


ERA vs observed data

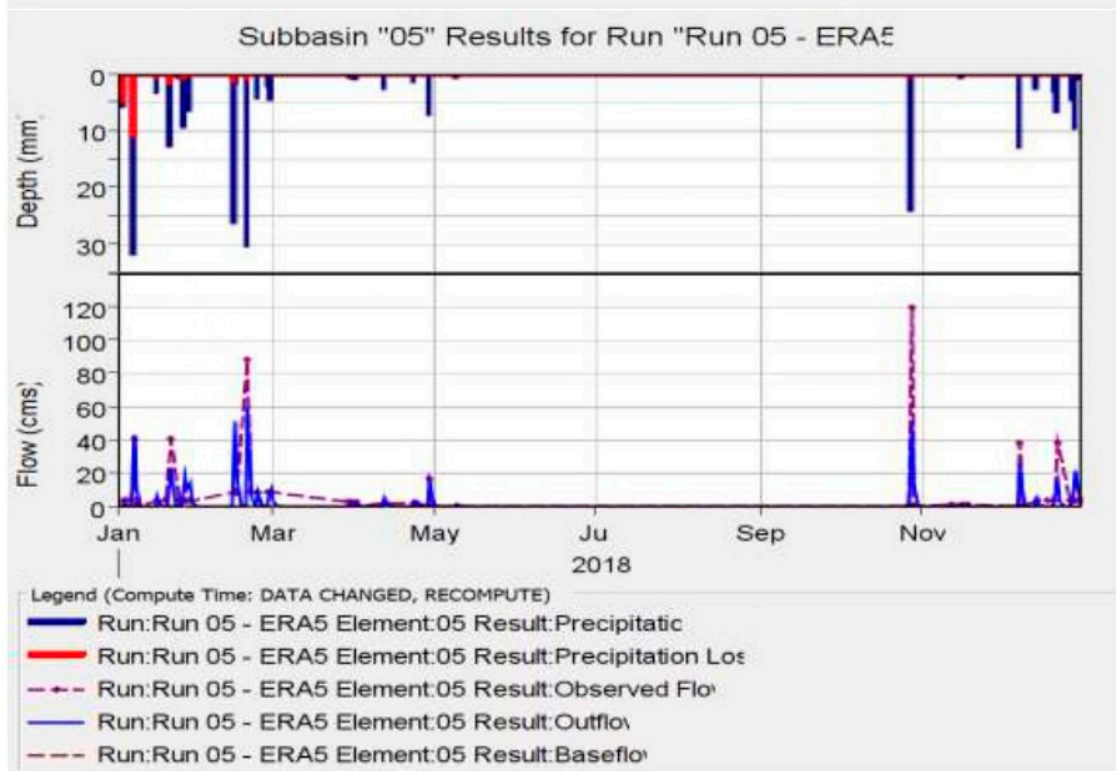


Basin -05

Actual vs observed data

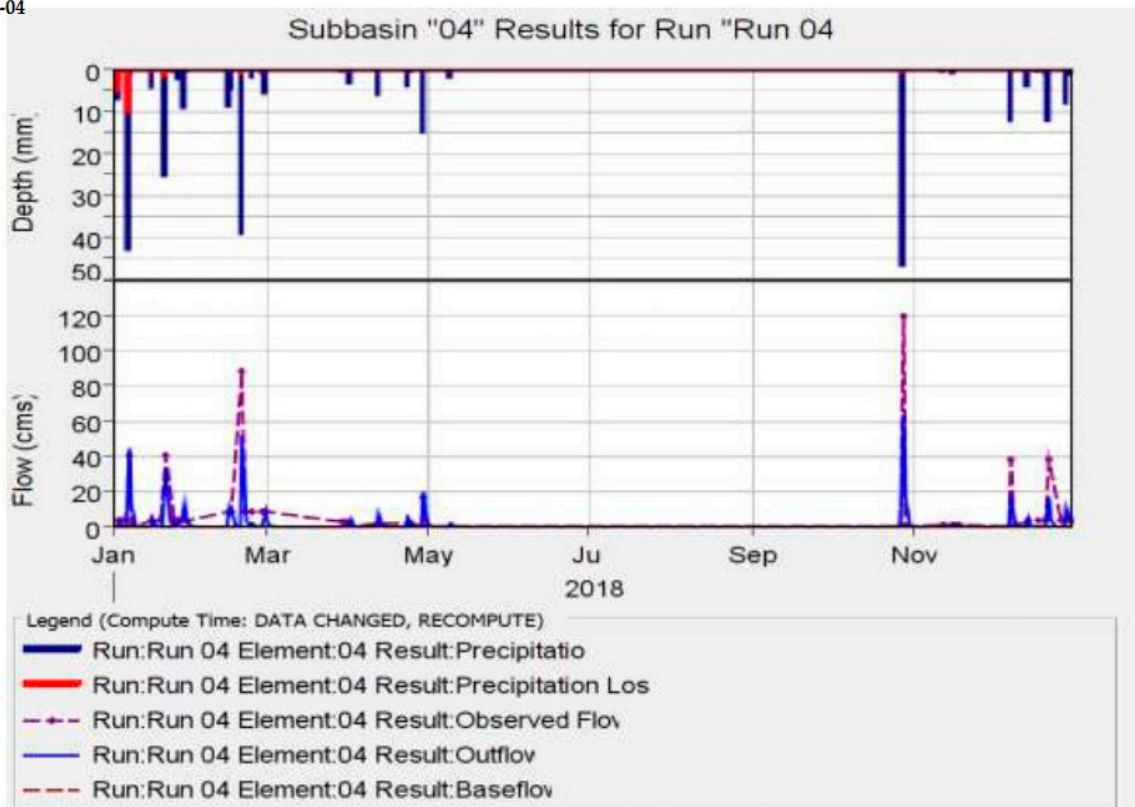


ERA vs observed data

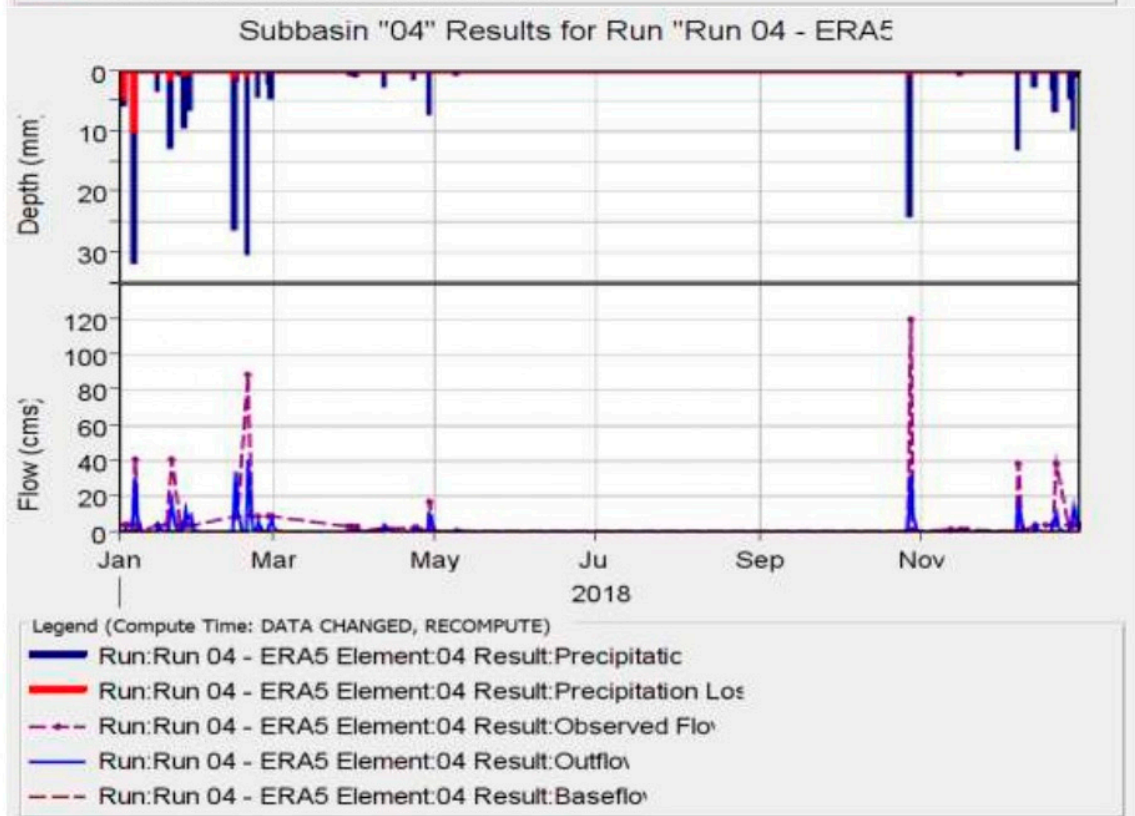


Basin -04

Actual vs observed data

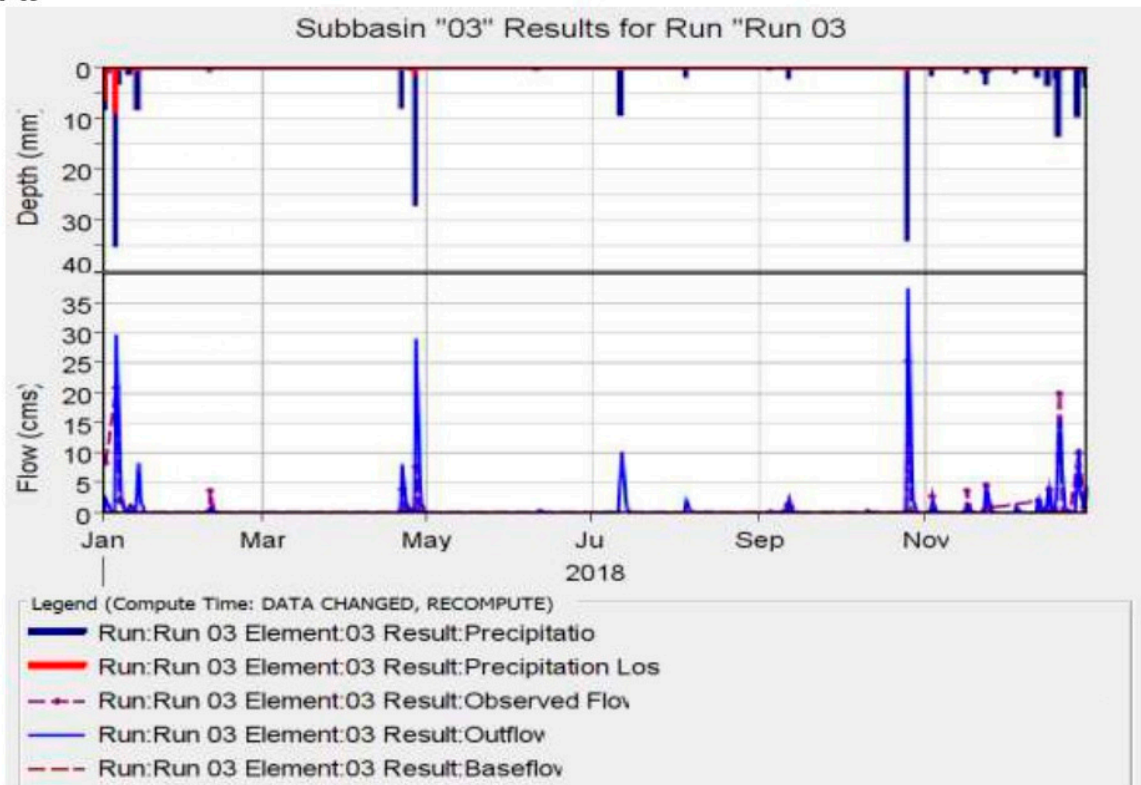


ERA5 vs observed data

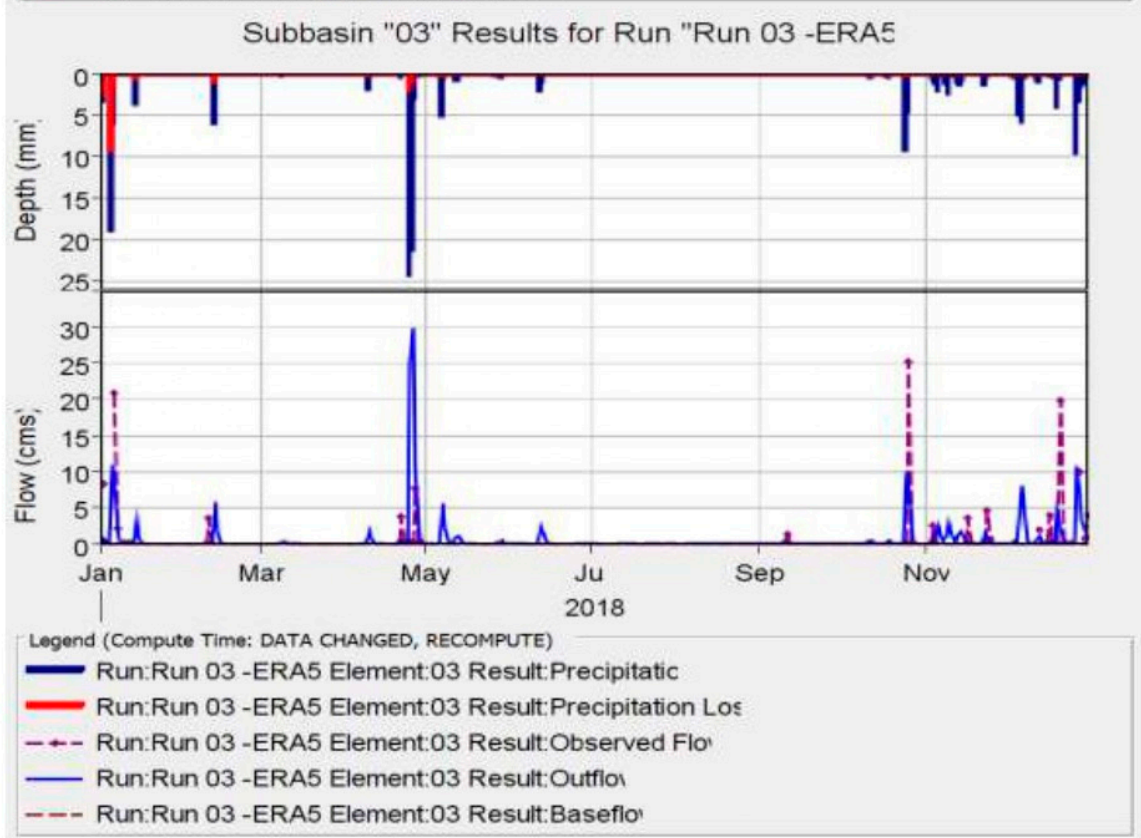


Basin -03

Actual vs observed data



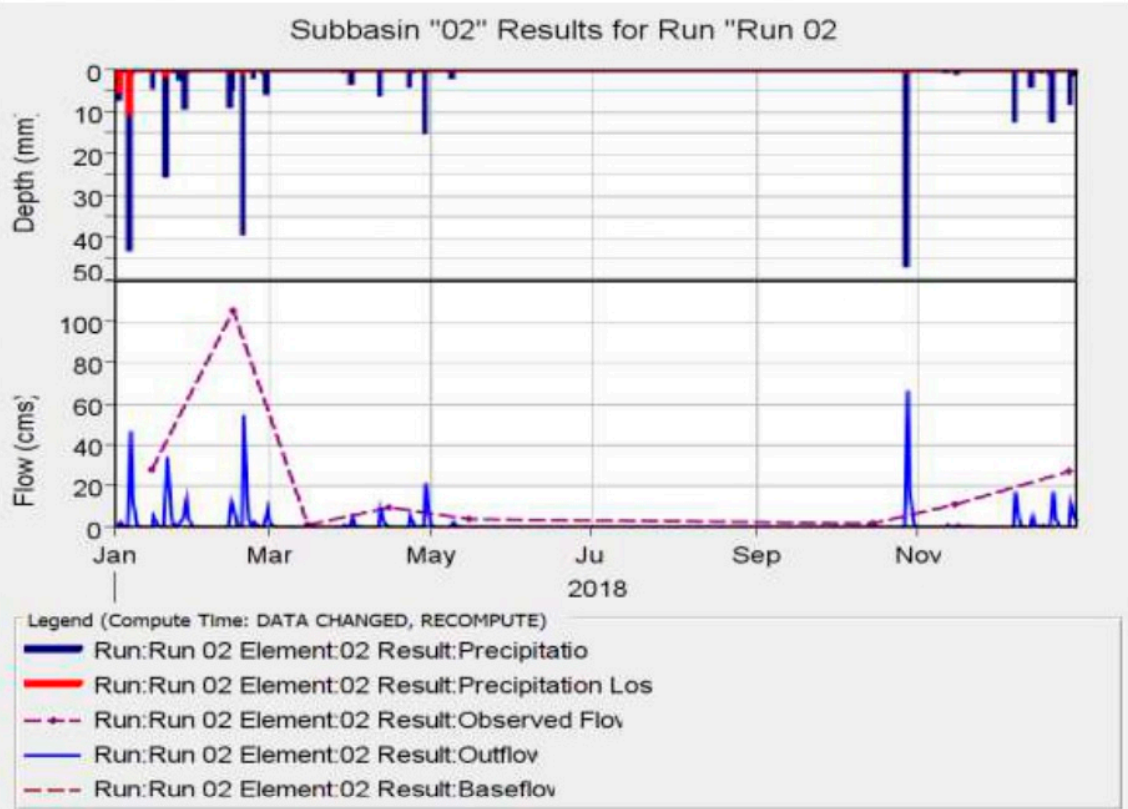
ERA5 vs observed data



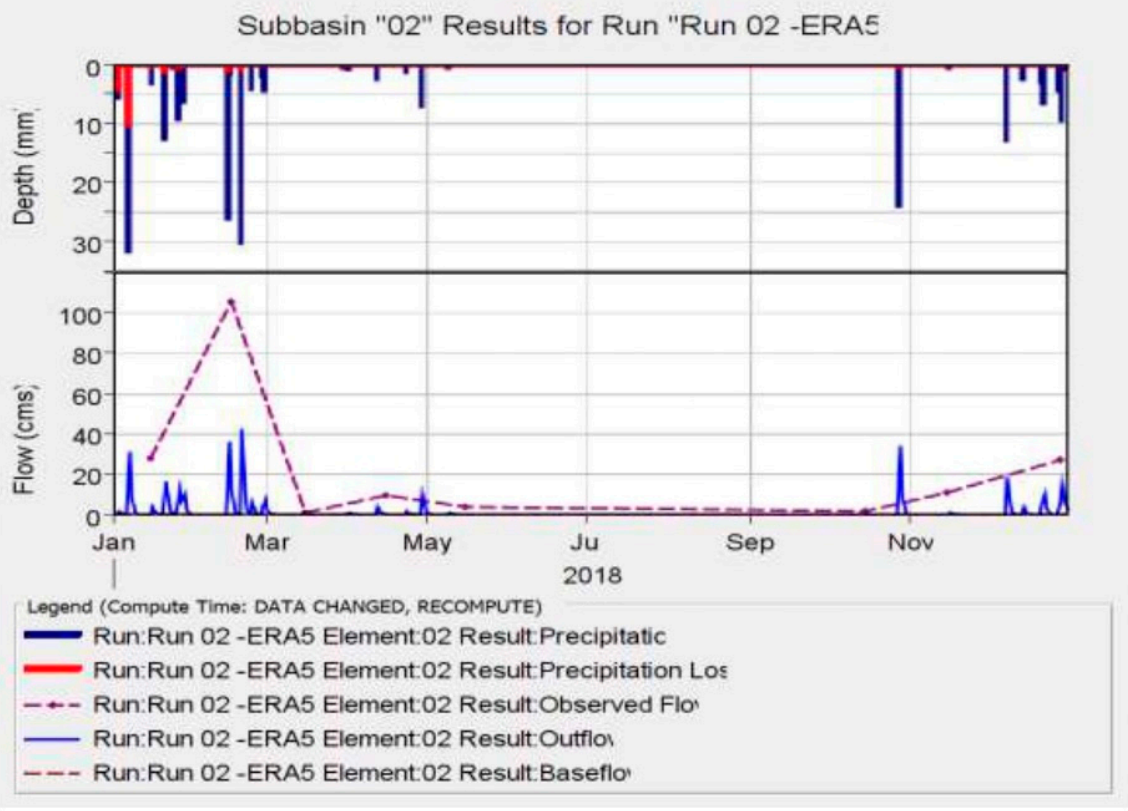
Basin -04

Basin -02

Actual vs observed data

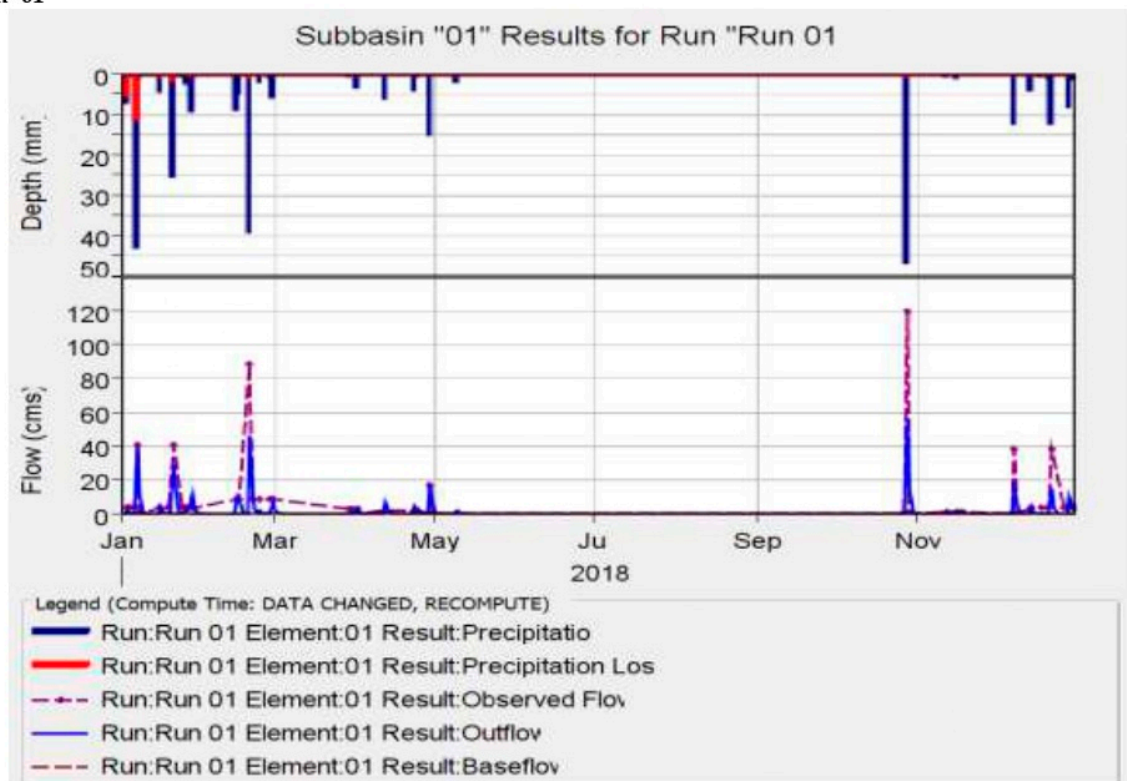


ERA5 vs observed data

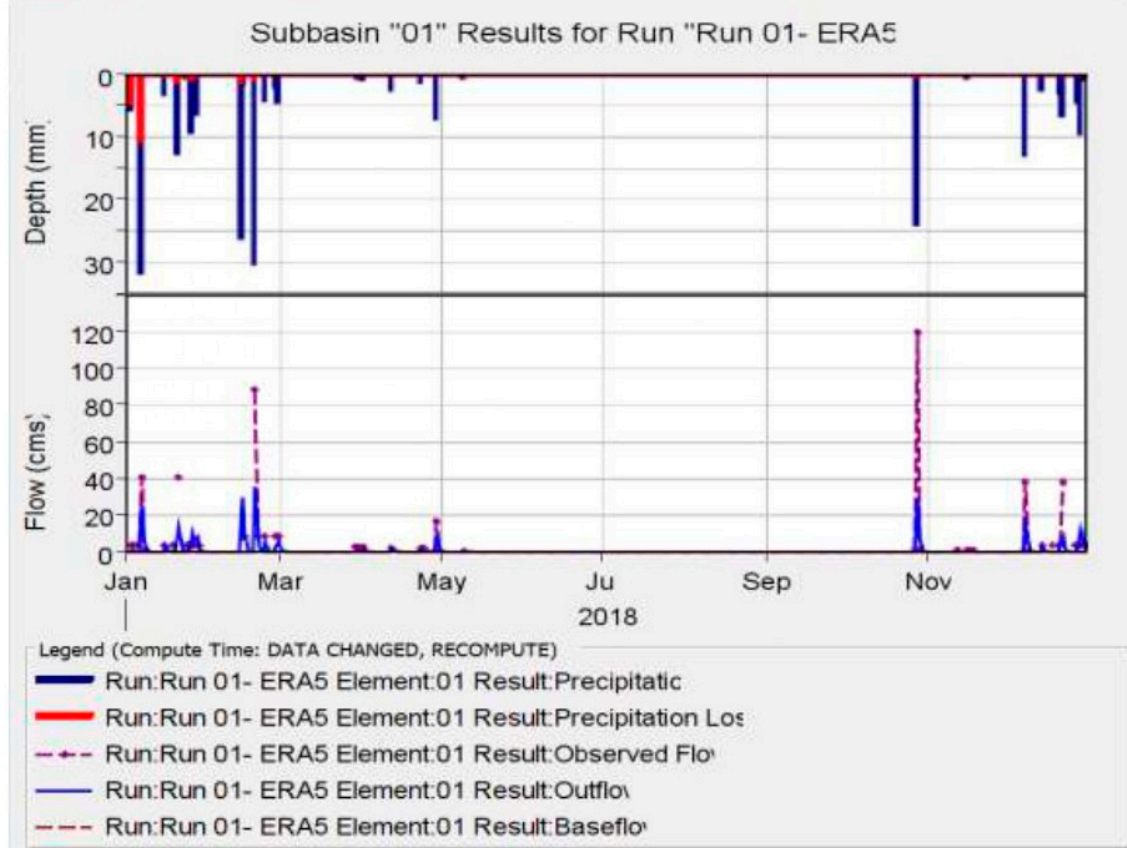


Basin -01

Actual vs observed data

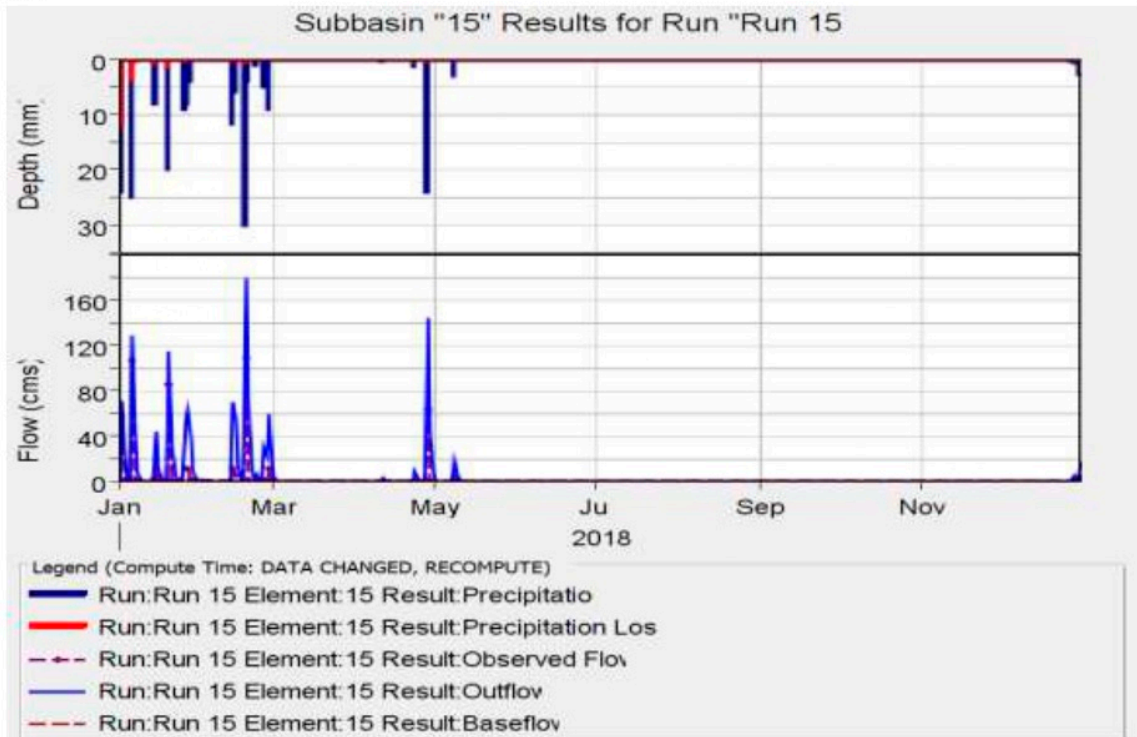


ERA5 vs observed data

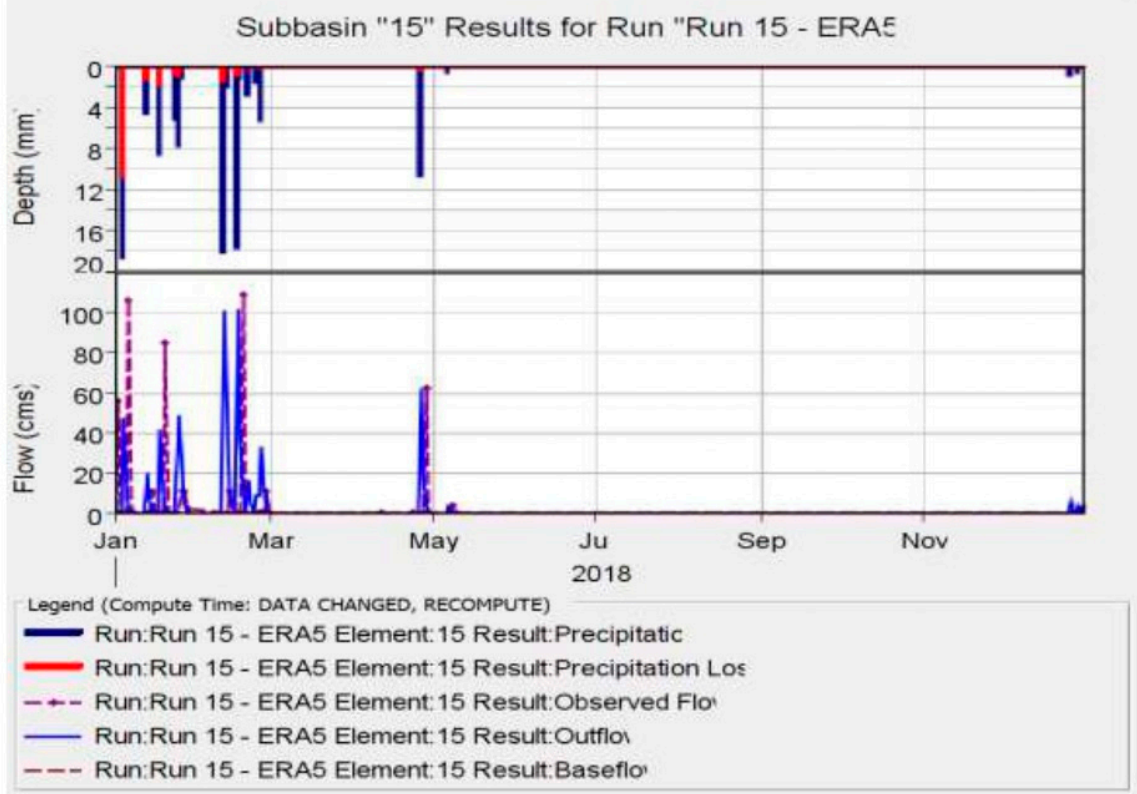


Basin -15

Actual vs observed data

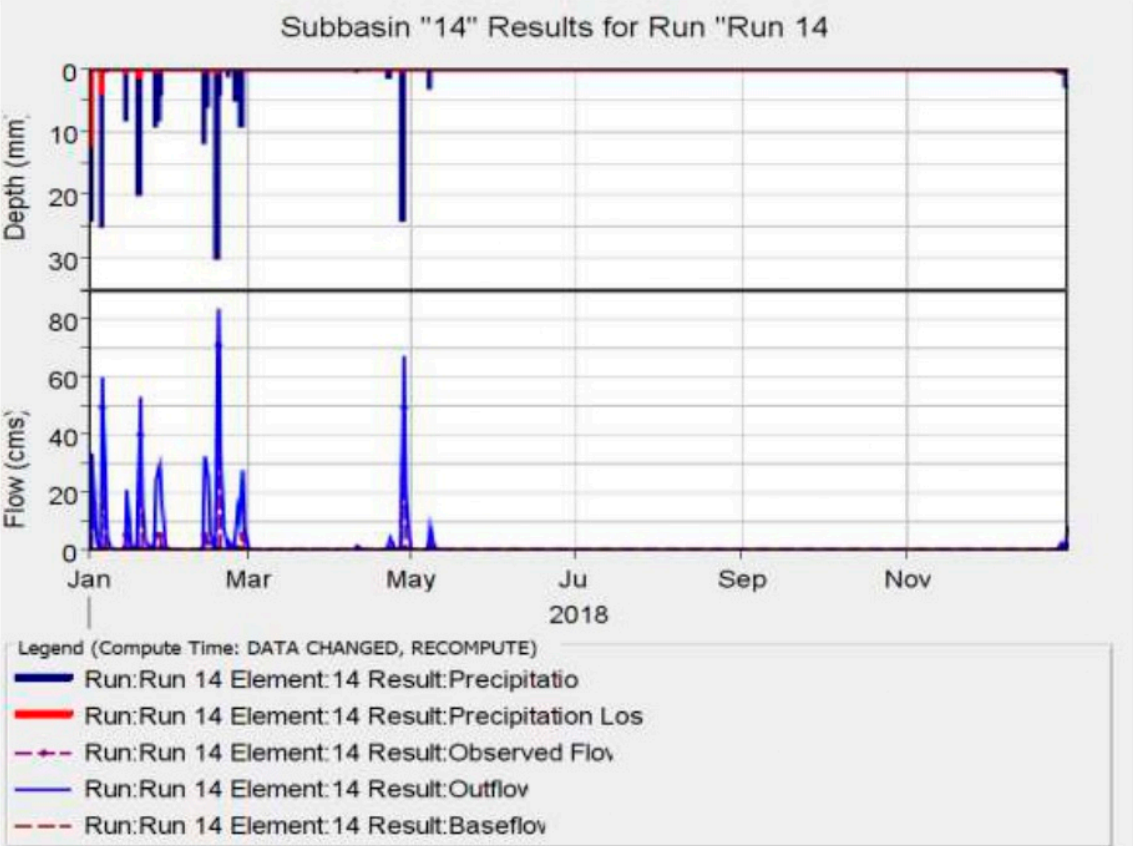


ERA5 vs observed data

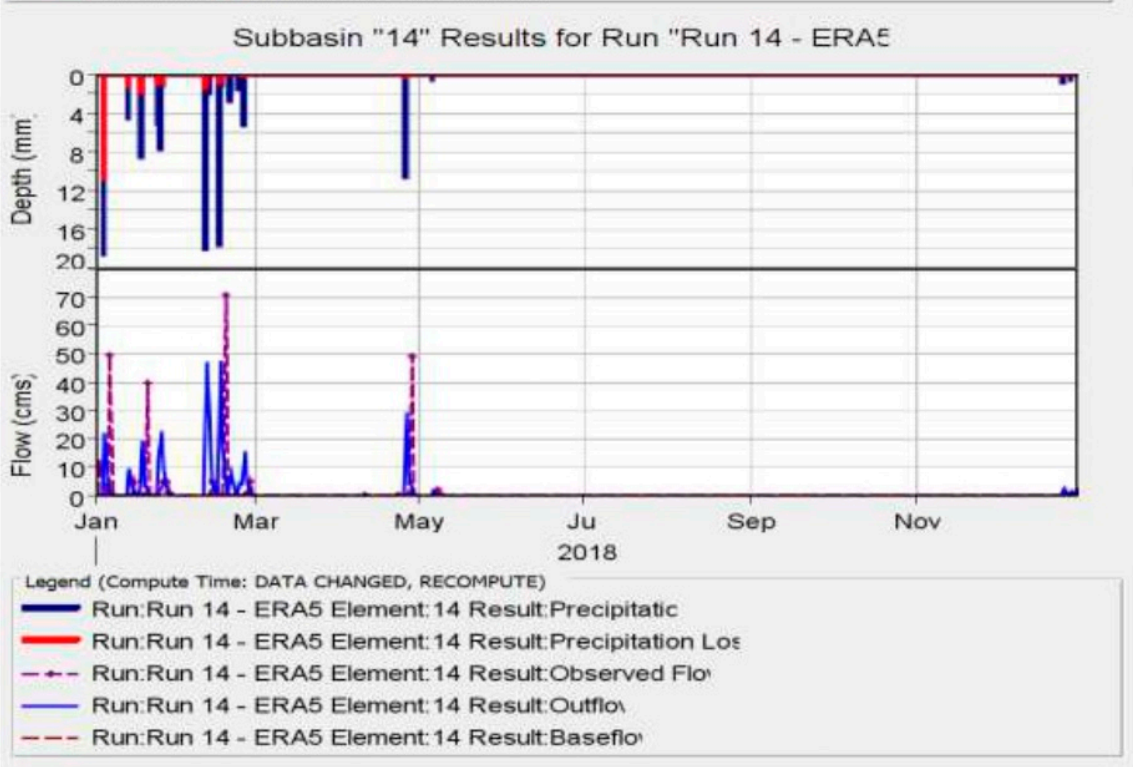


Basin -14

Actual vs observed data

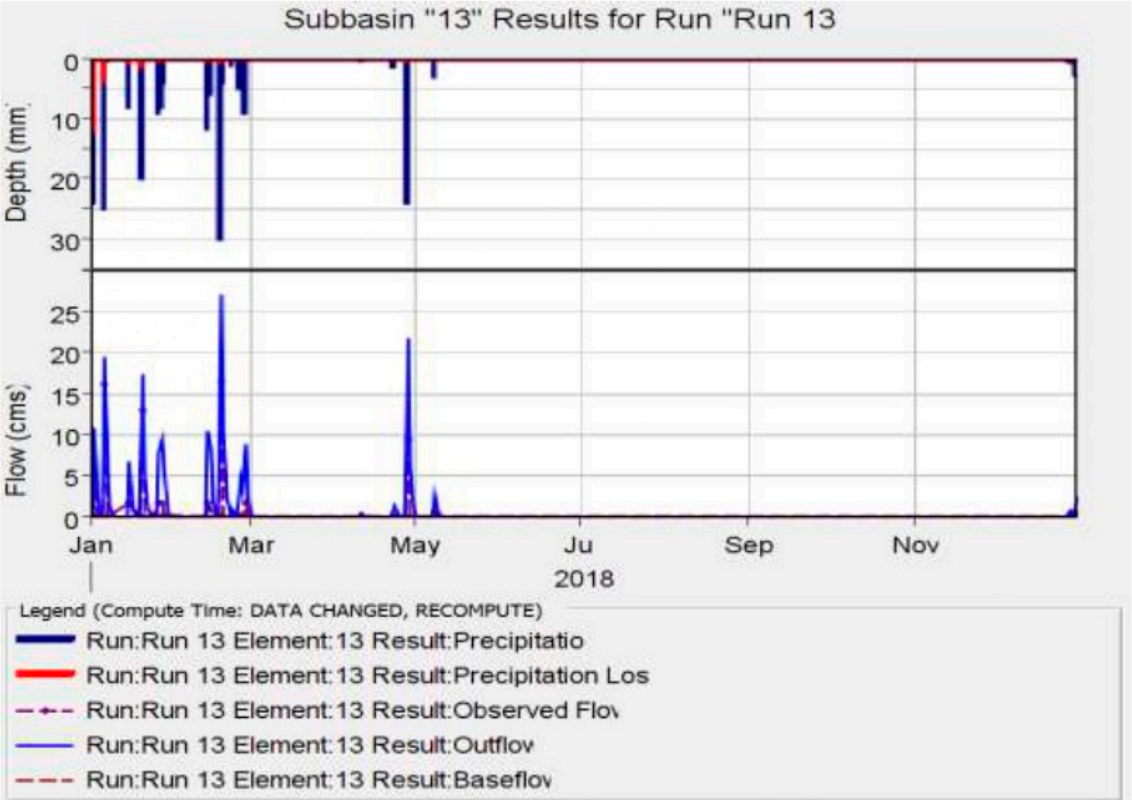


ERA5 vs observed data

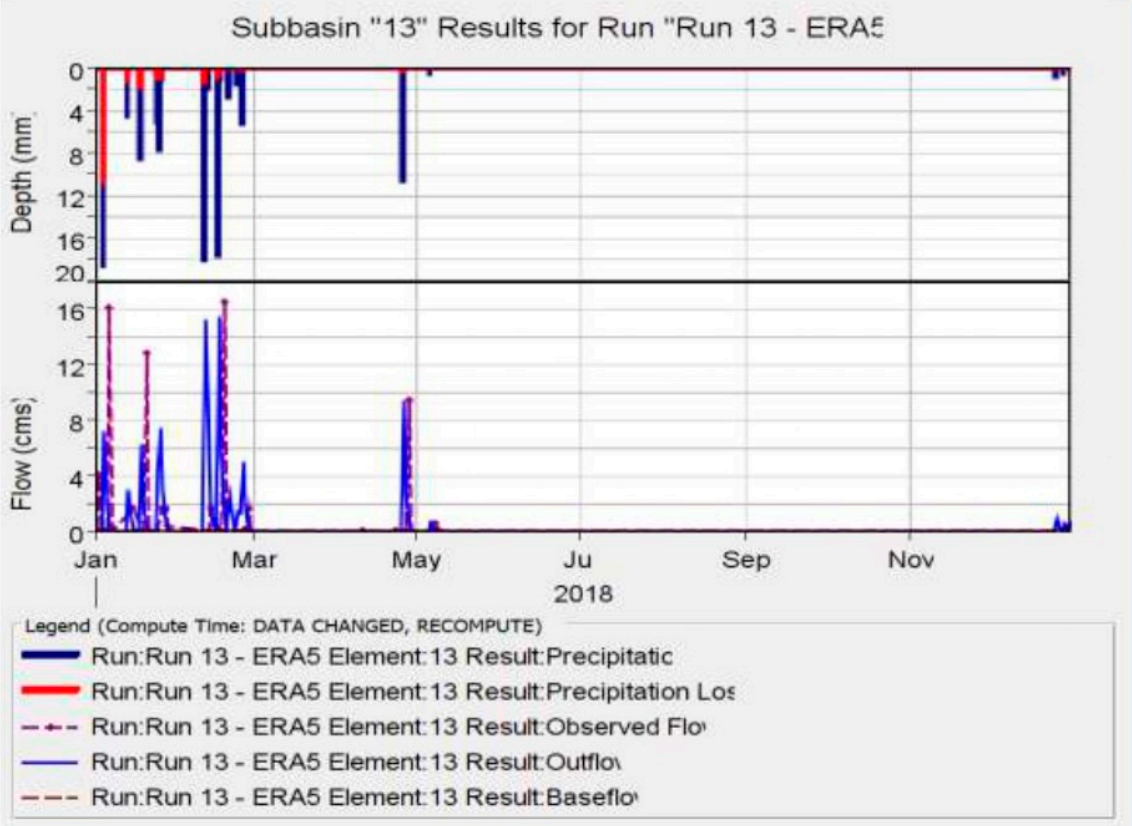


Basin -13

Actual vs observed data

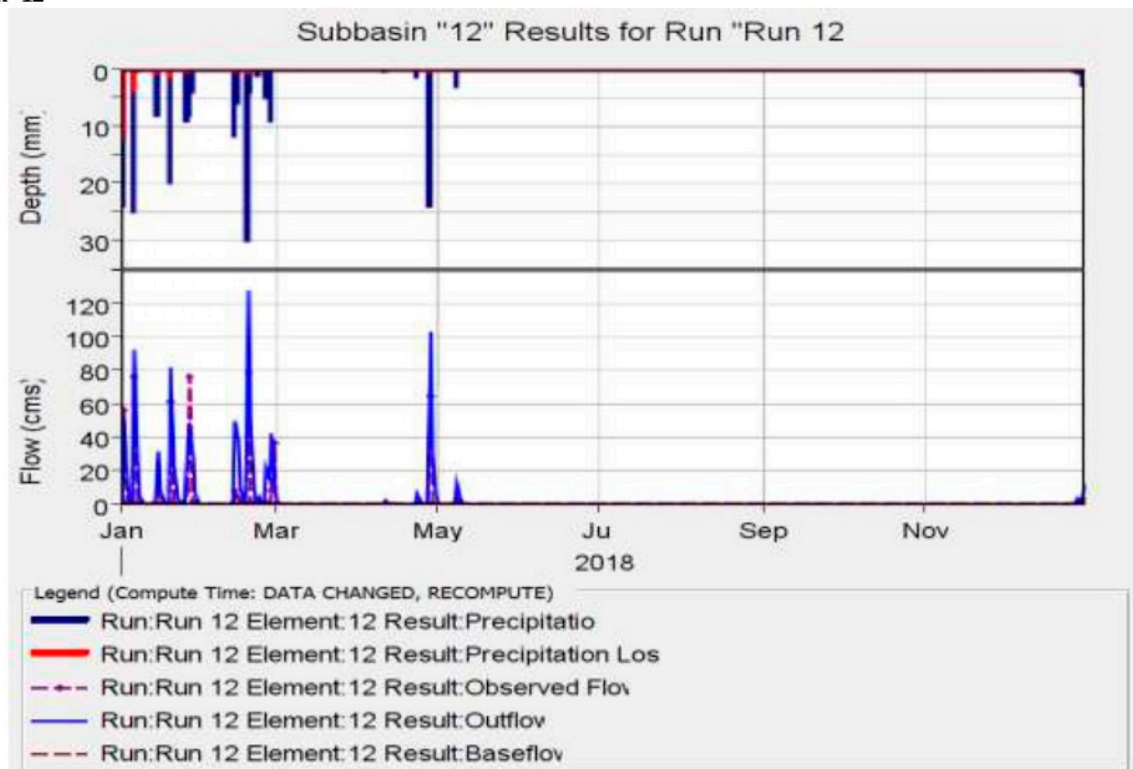


ERA5 vs observed data

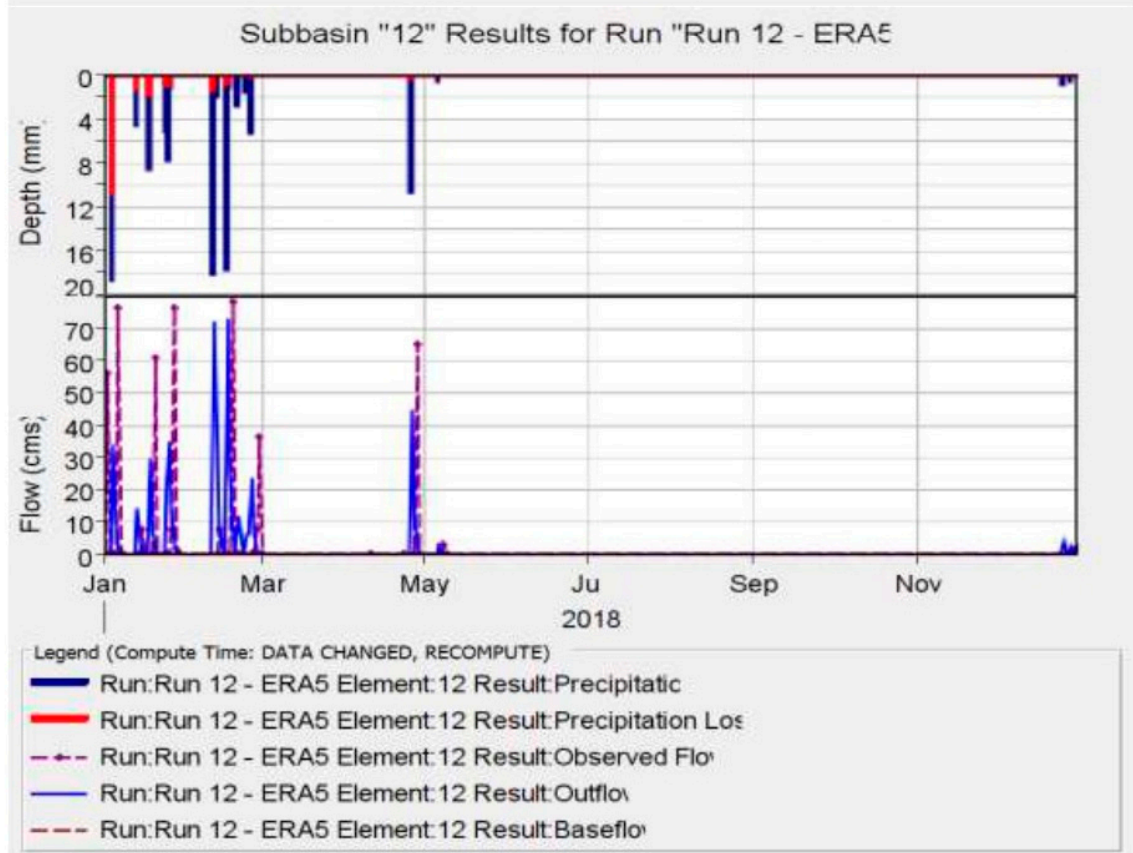


Basin -12

Actual vs observed data

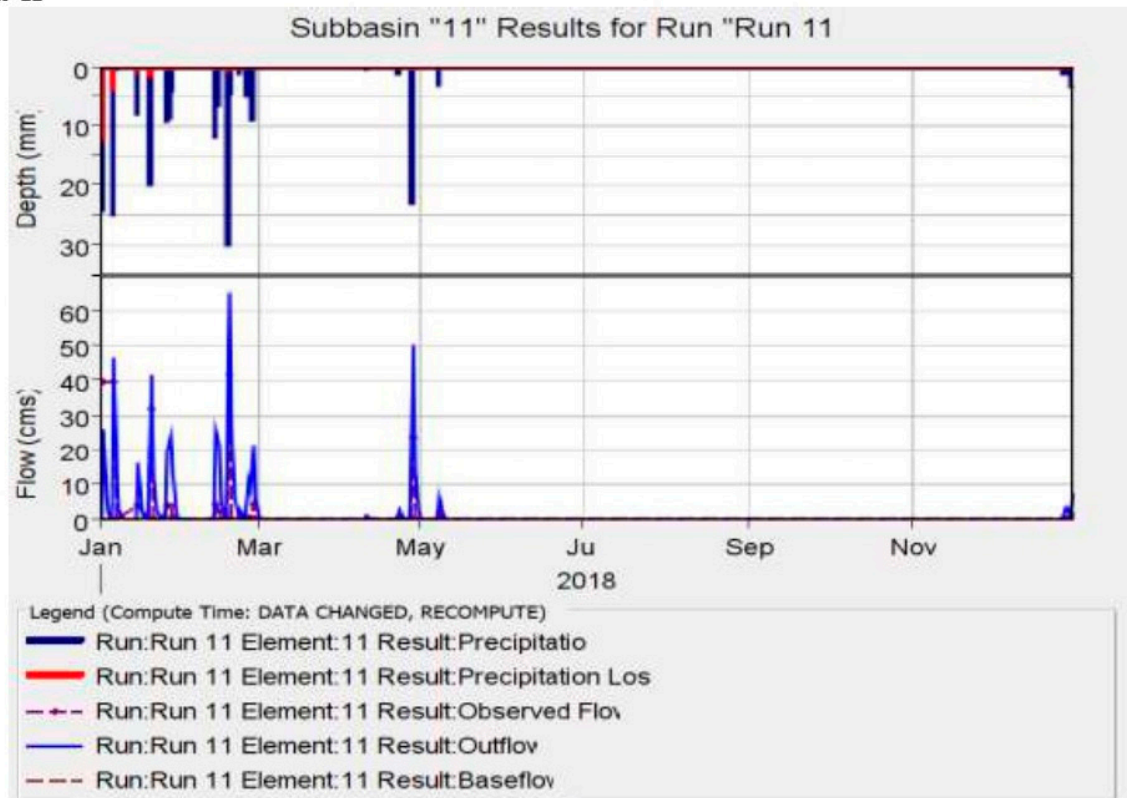


ERA5 vs observed data

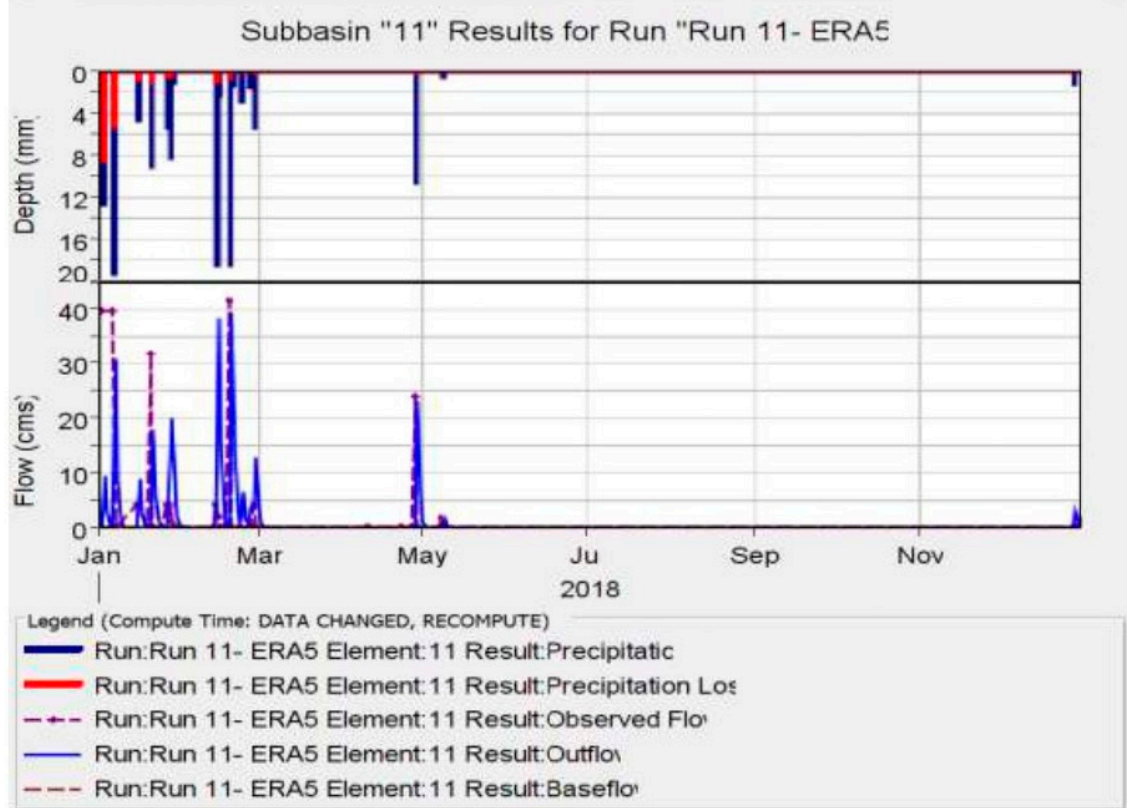


Basin -11

Actual vs observed data

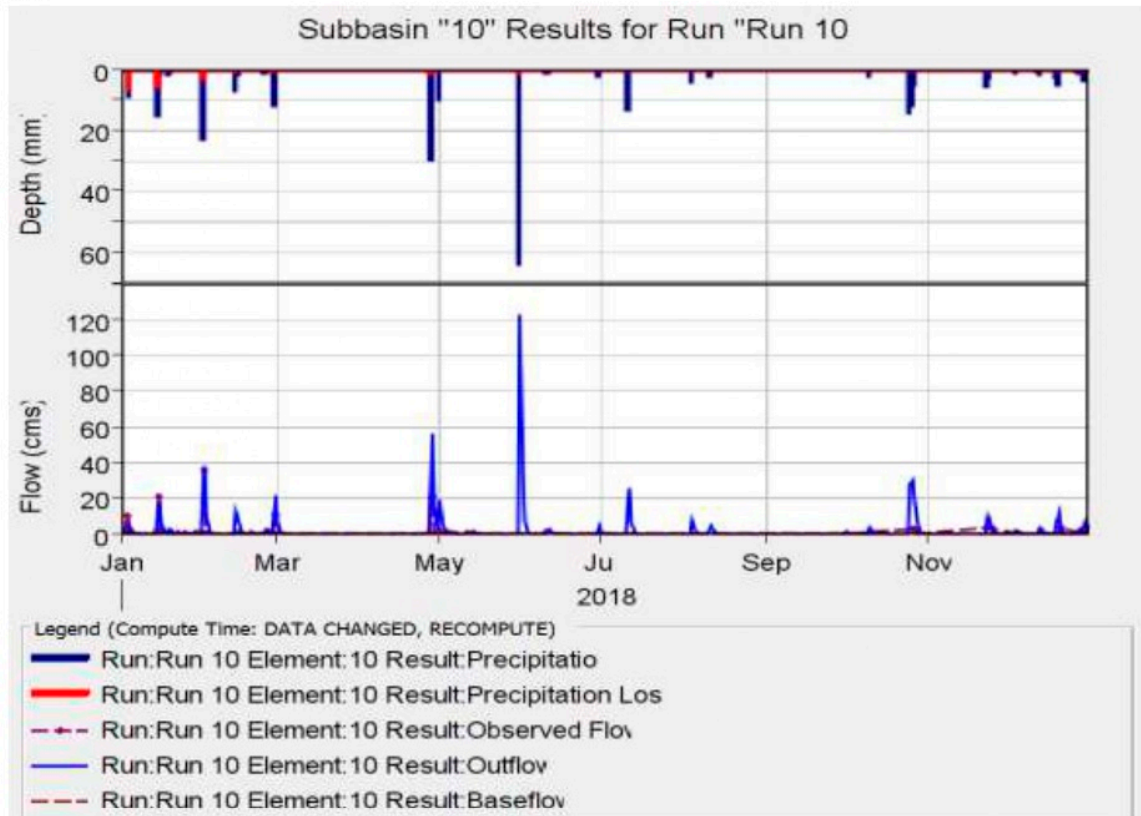


ERA5 vs observed data

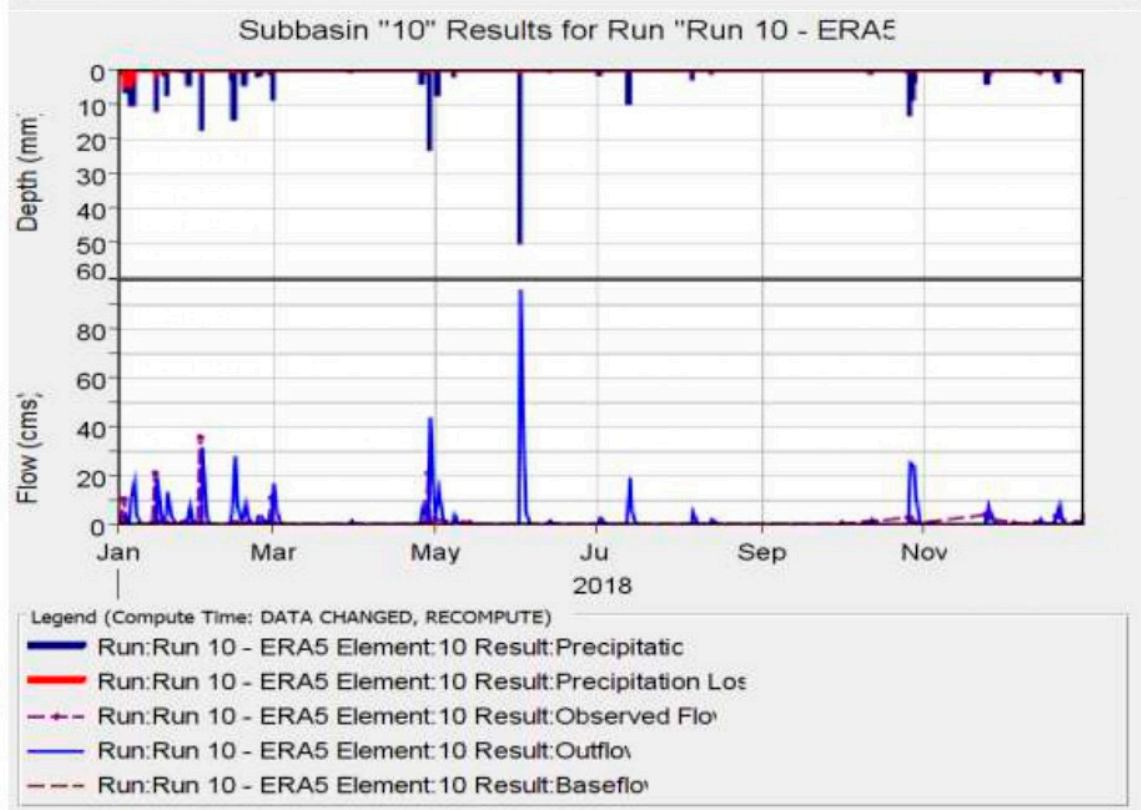


Basin -10

Actual vs observed data

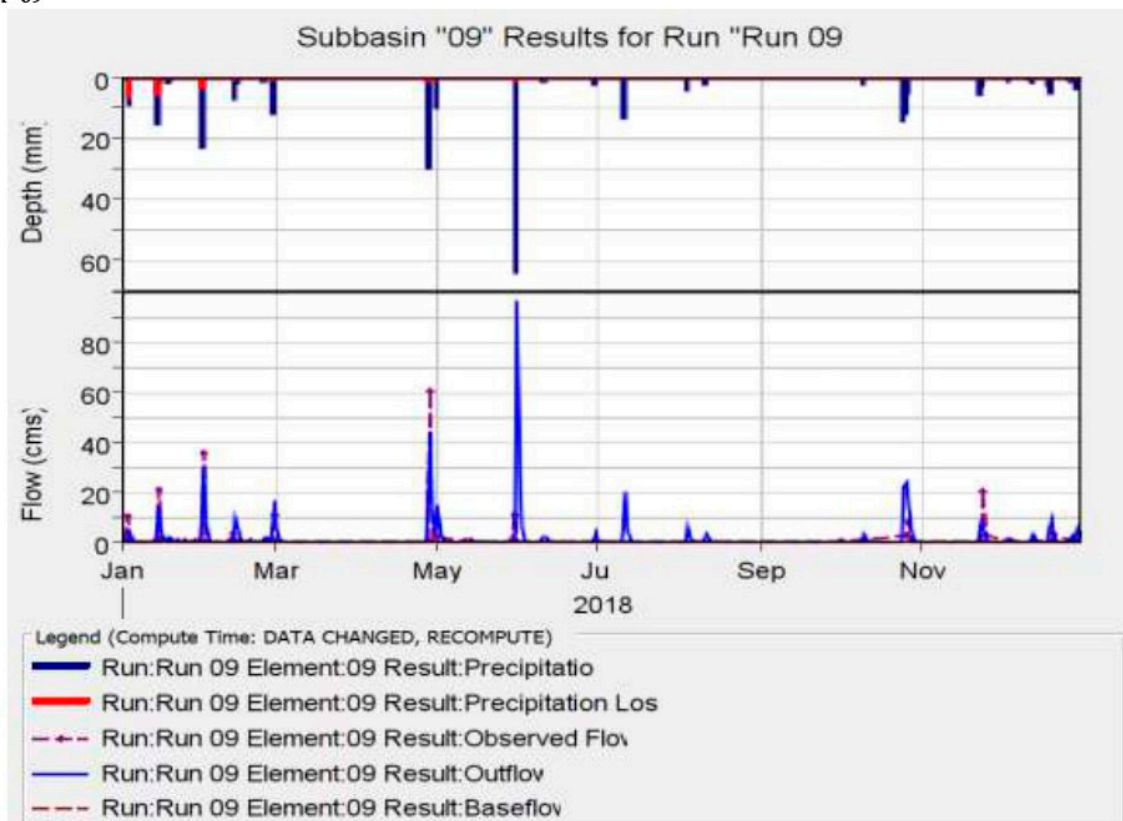


ERA5 vs observed data

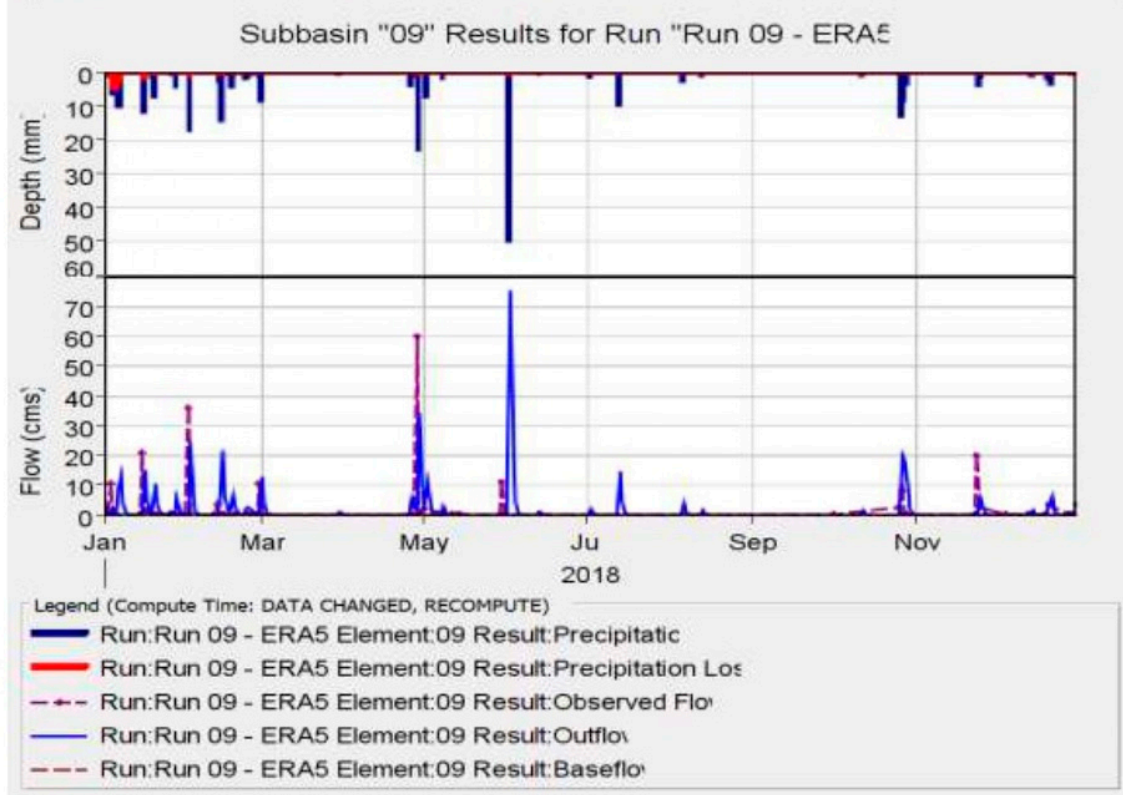


Basin -09

Actual vs observed data

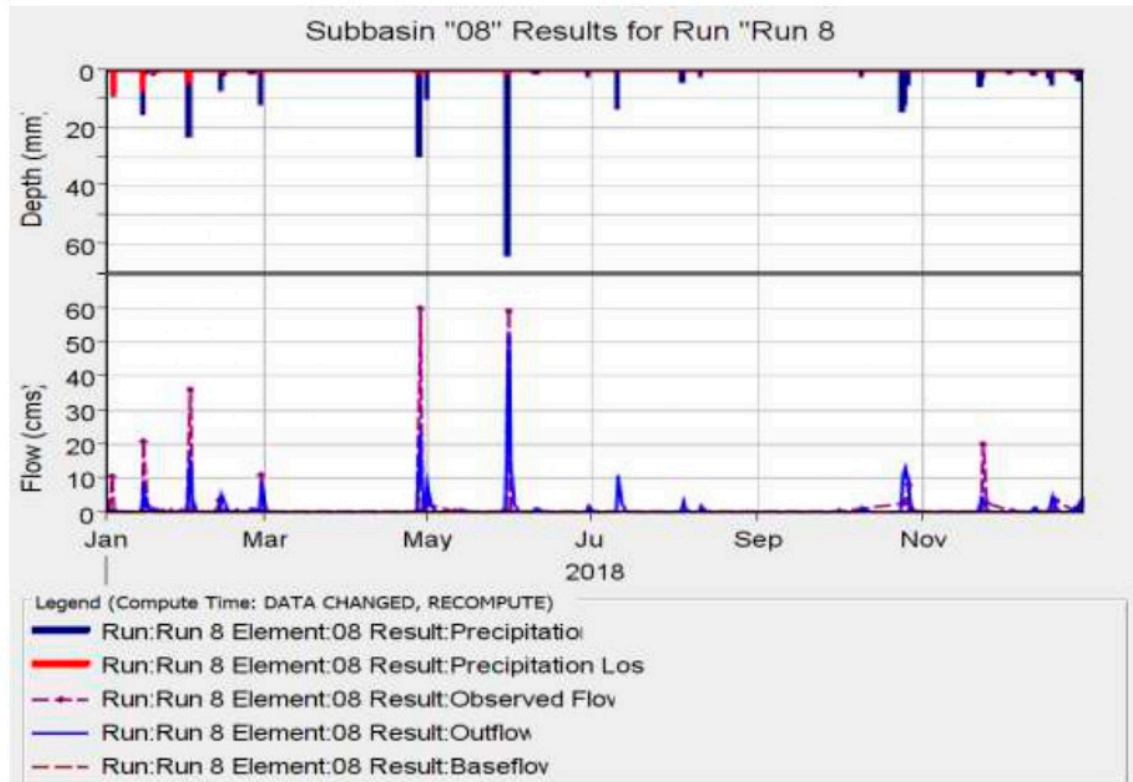


ERA5 vs observed data



Basin -08

Actual vs observed data



ERA5 vs observed data

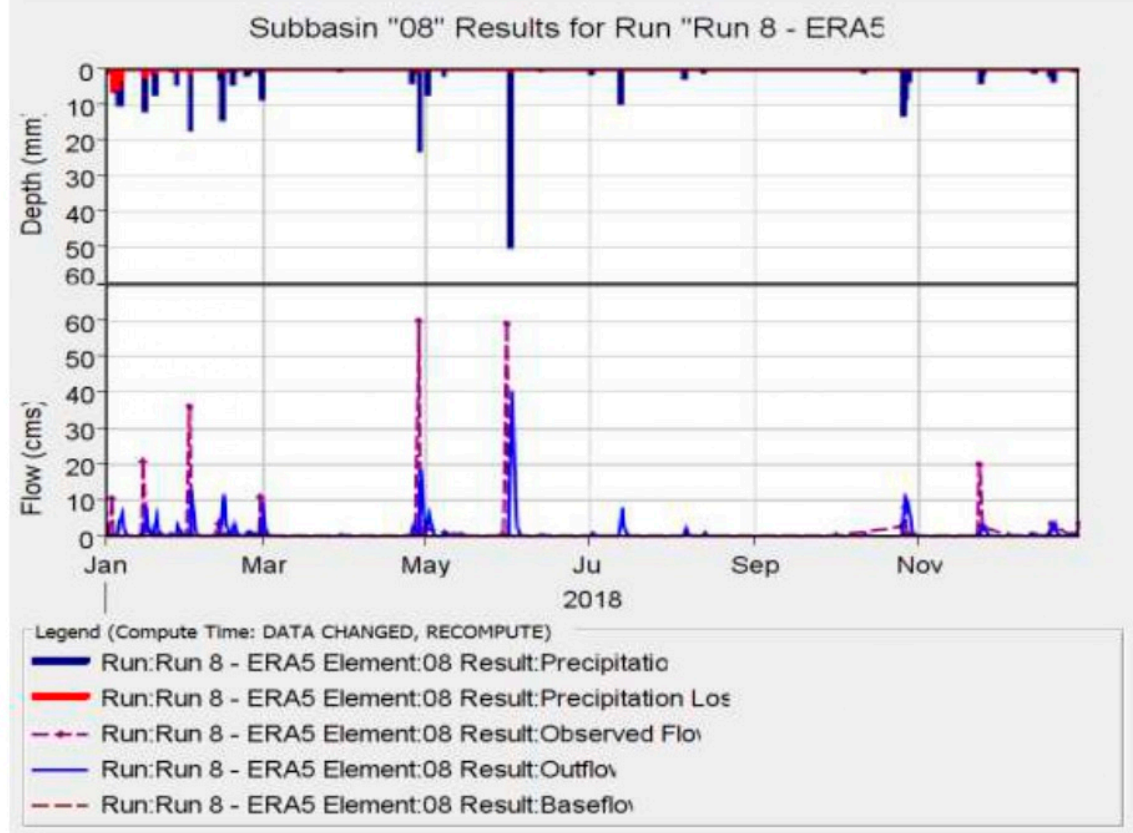
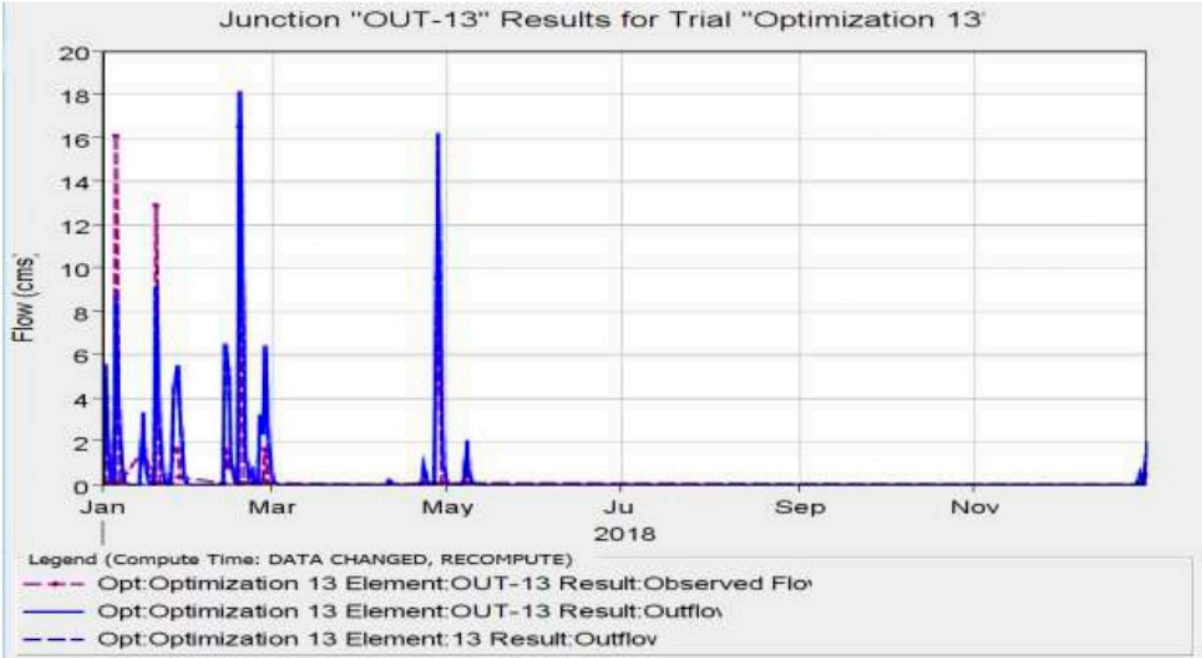
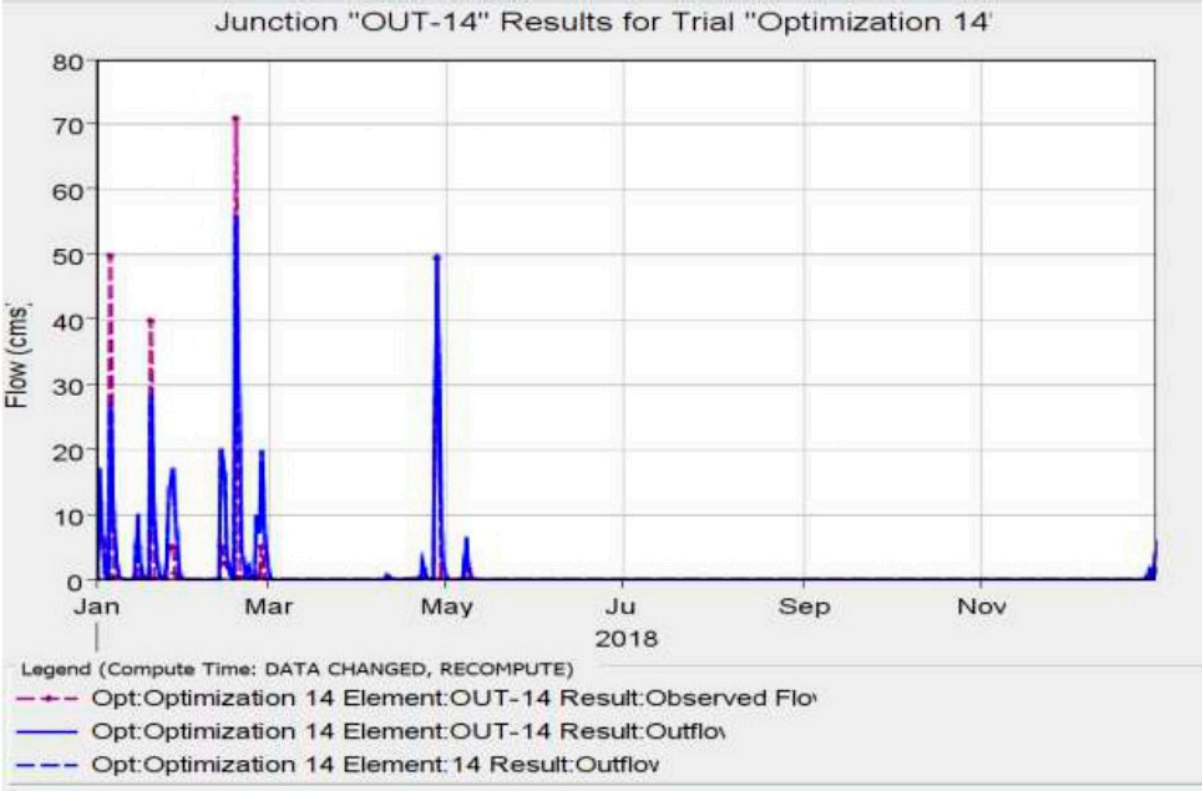


Figure S4. Simulated (actual and ERA5 data set) and observed runoff for the event year 2018.

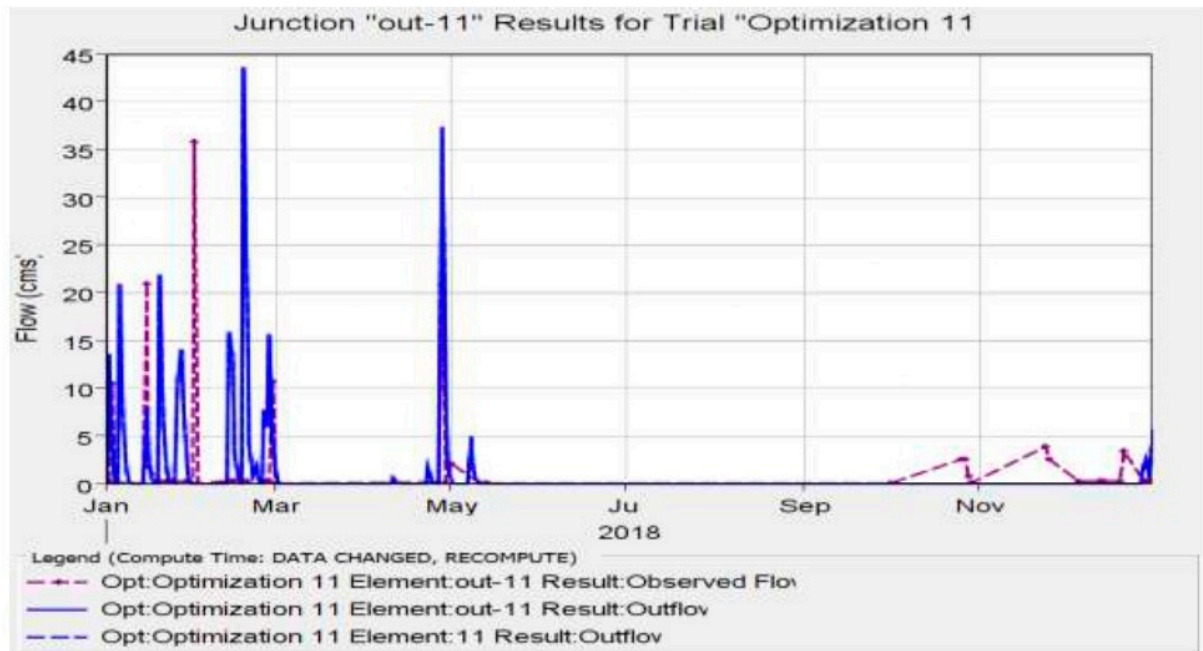
Basin -13



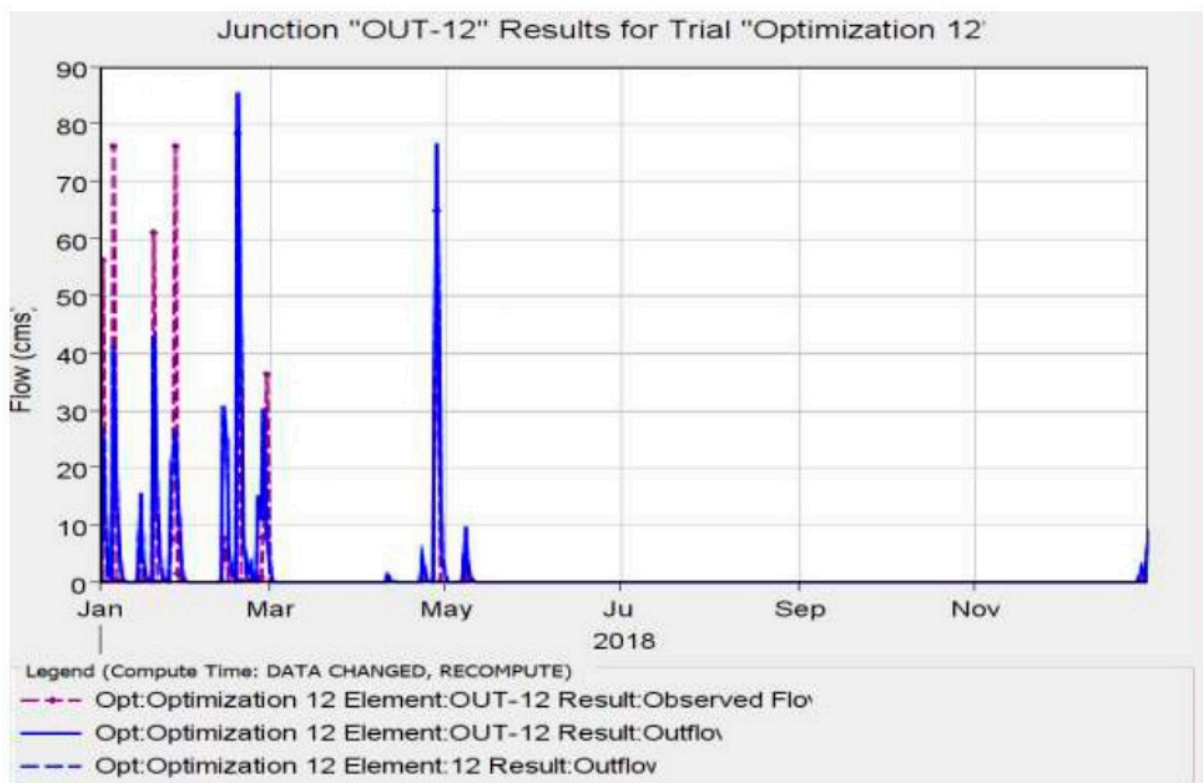
Basin -14



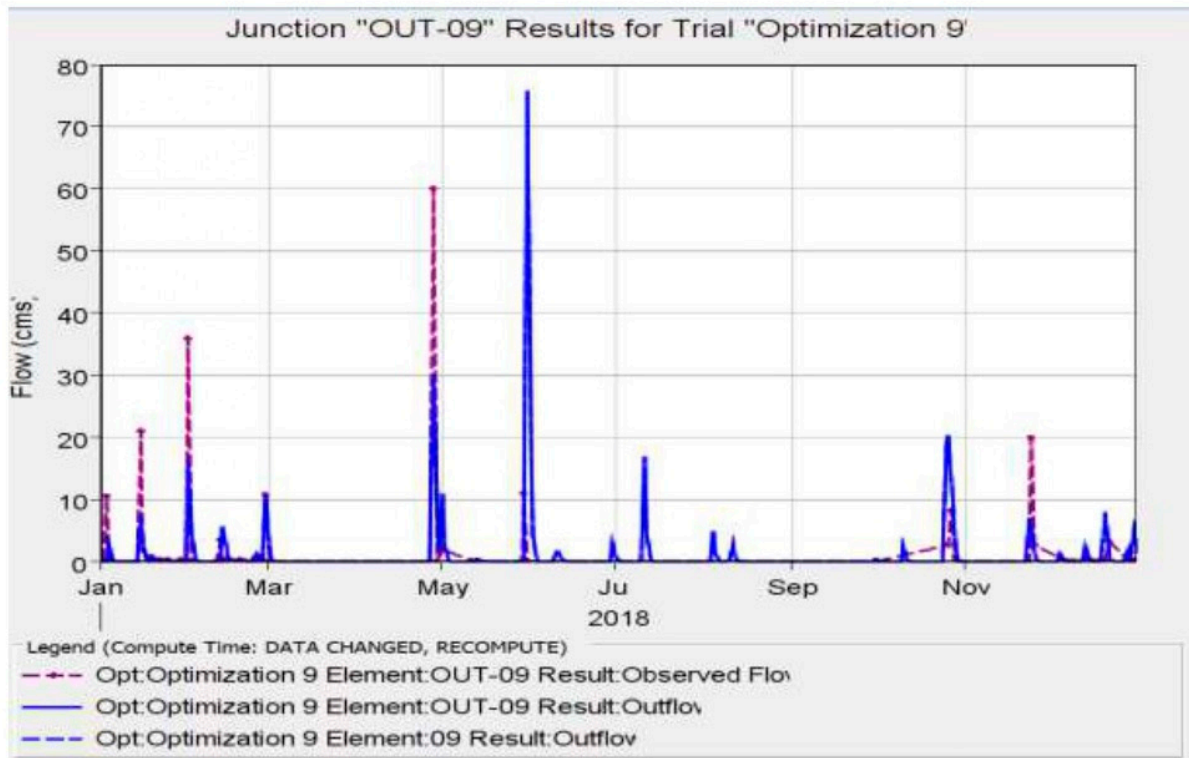
Basin -11



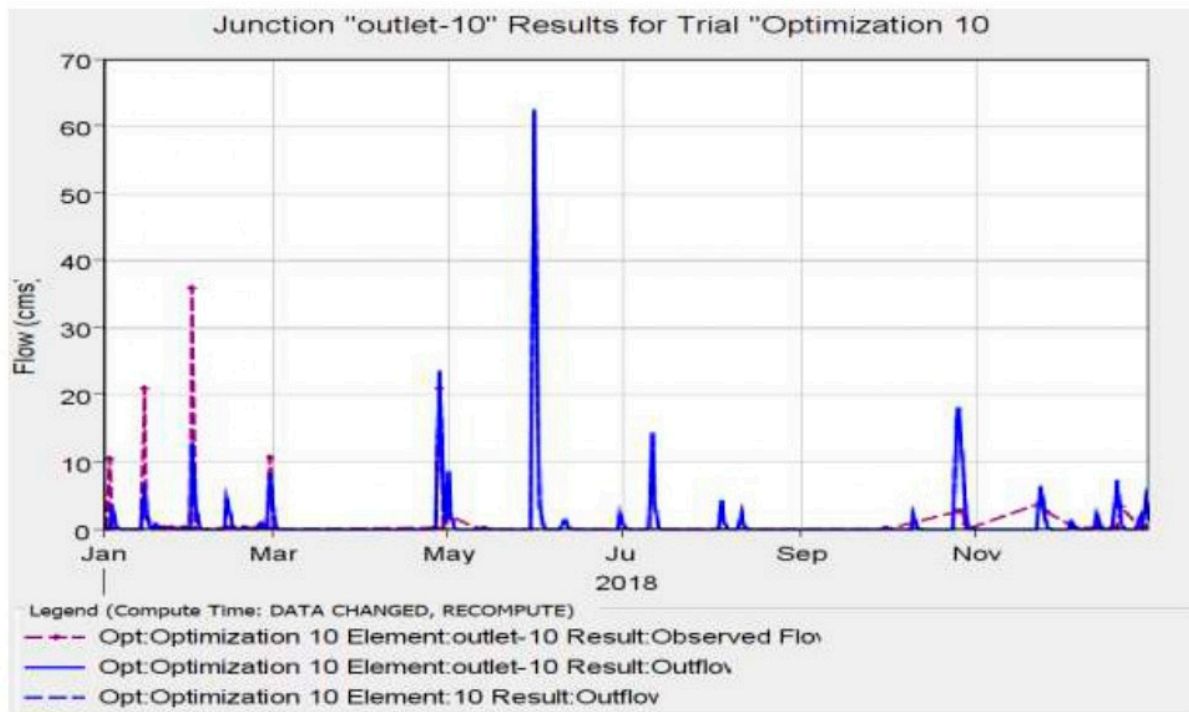
Basin -12



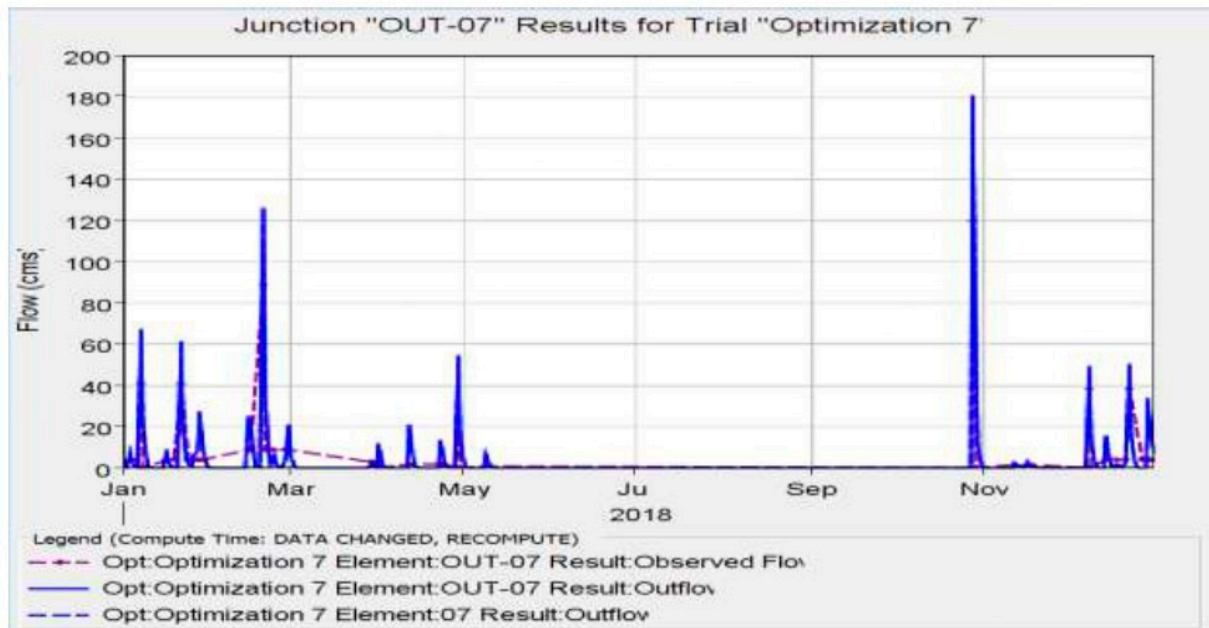
Basin-09



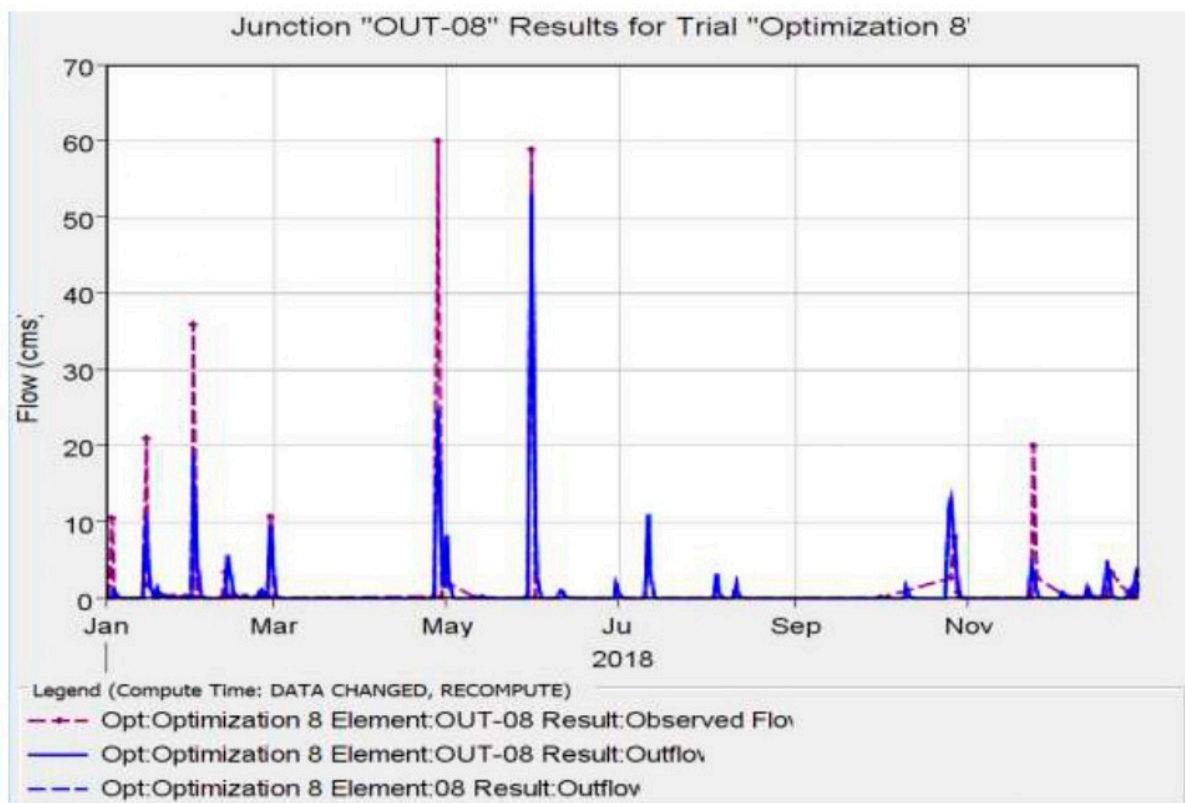
Basin-10



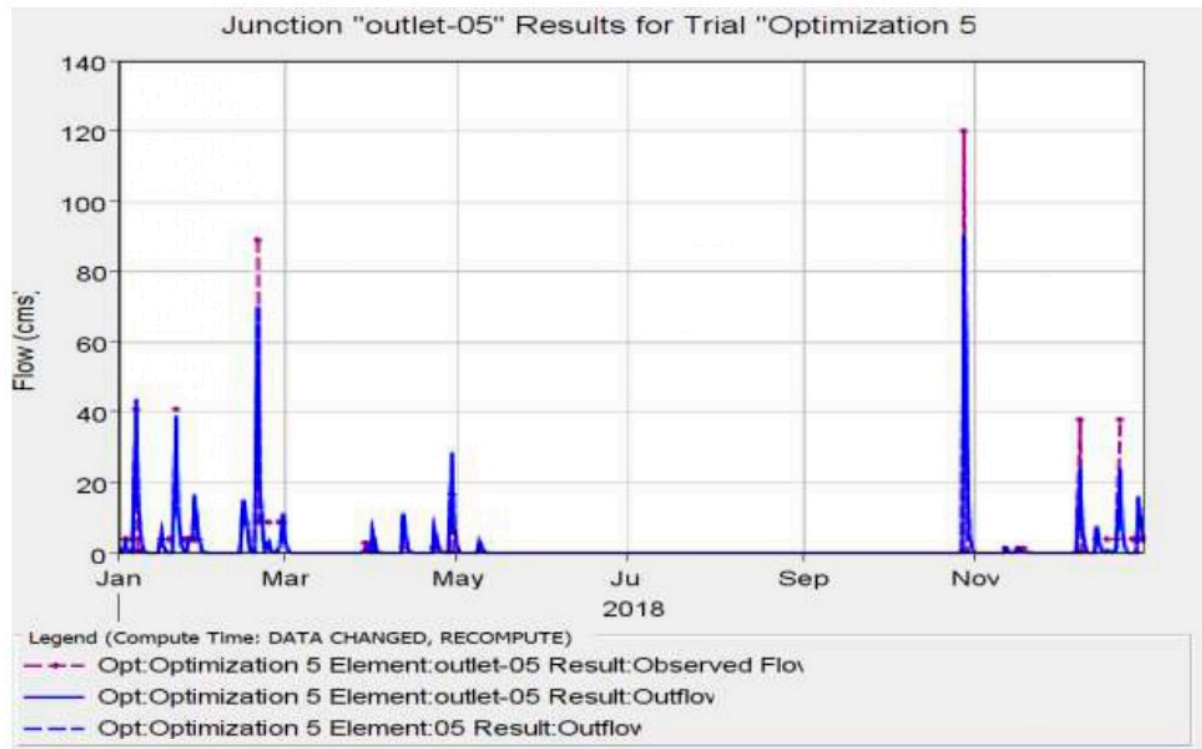
Basin-07



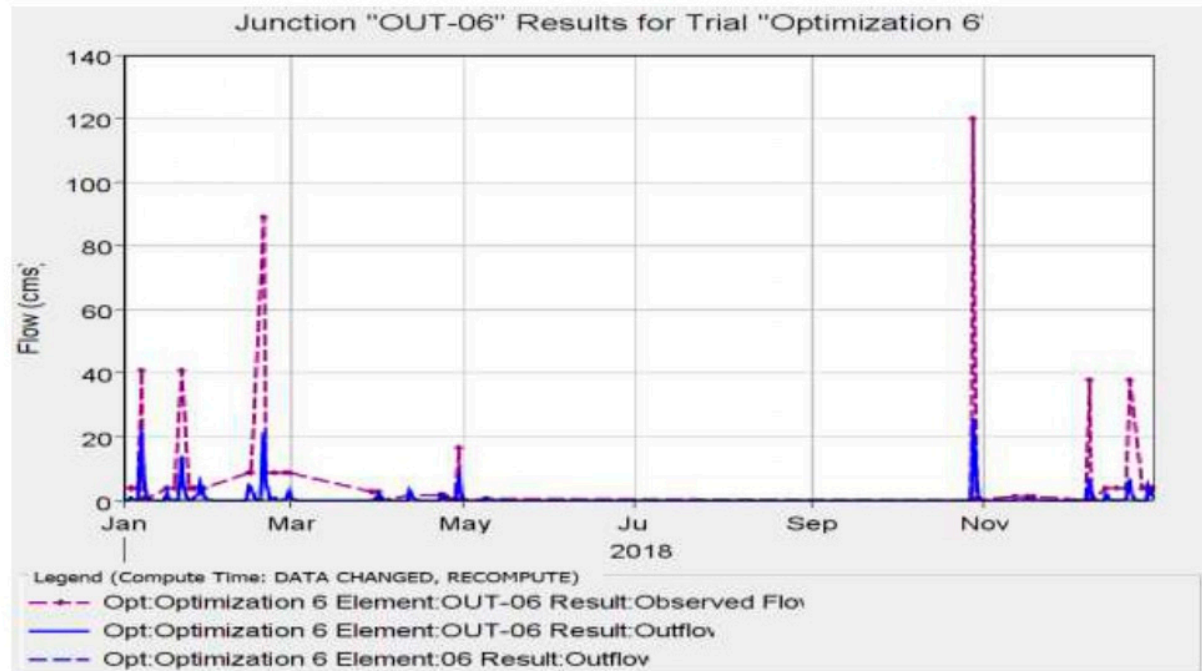
Basin -08



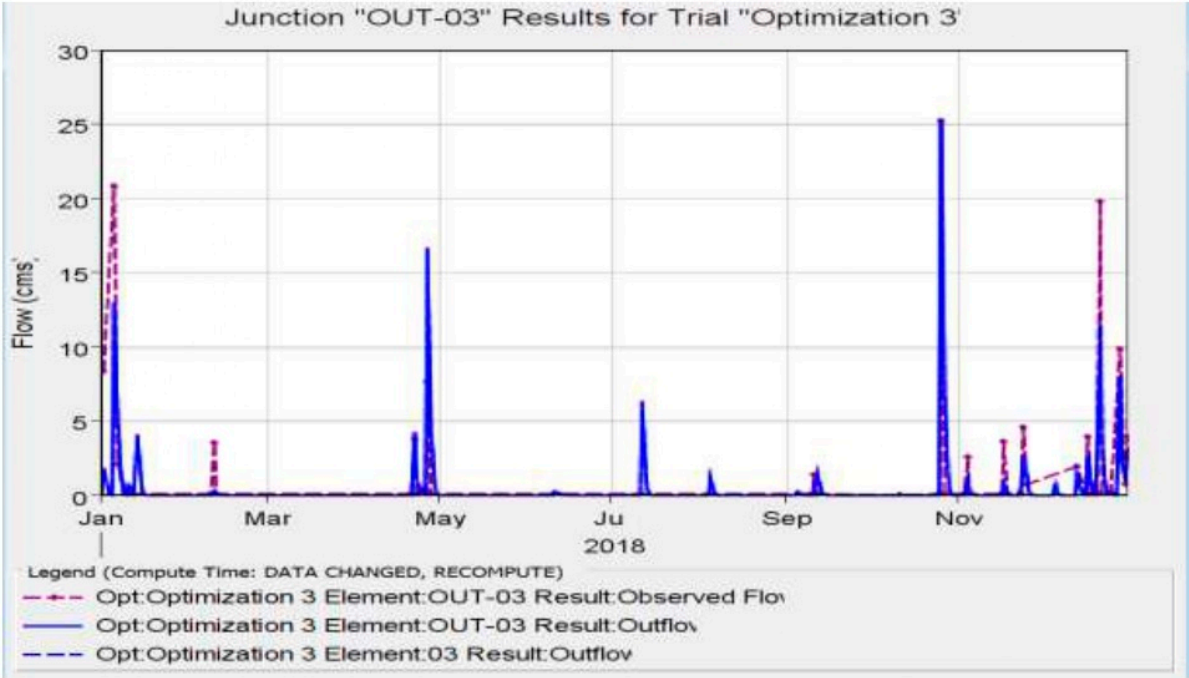
Basin-05



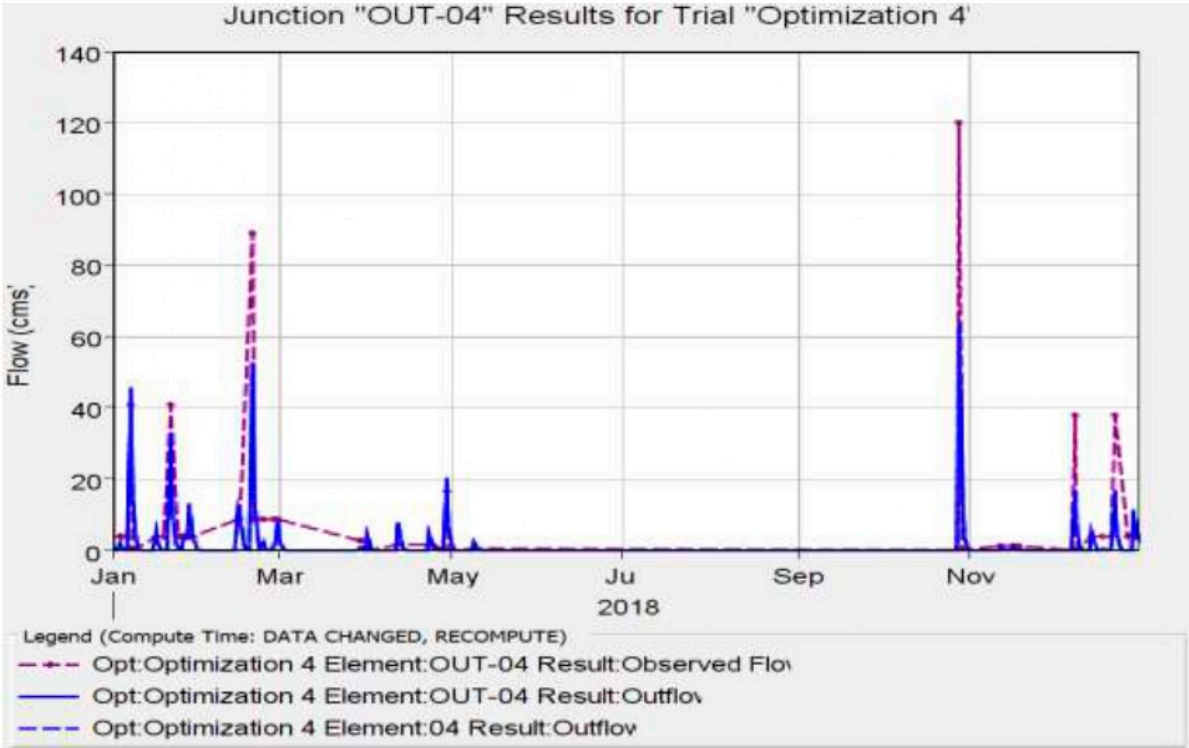
Basin -06



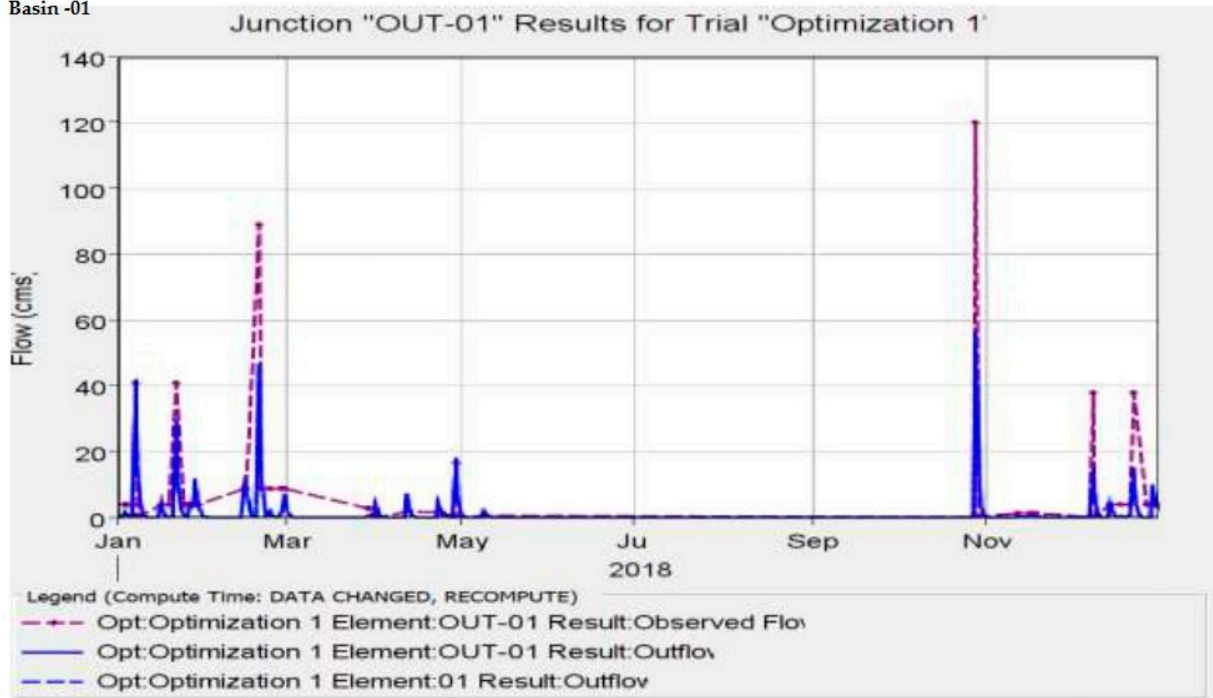
Basin -03



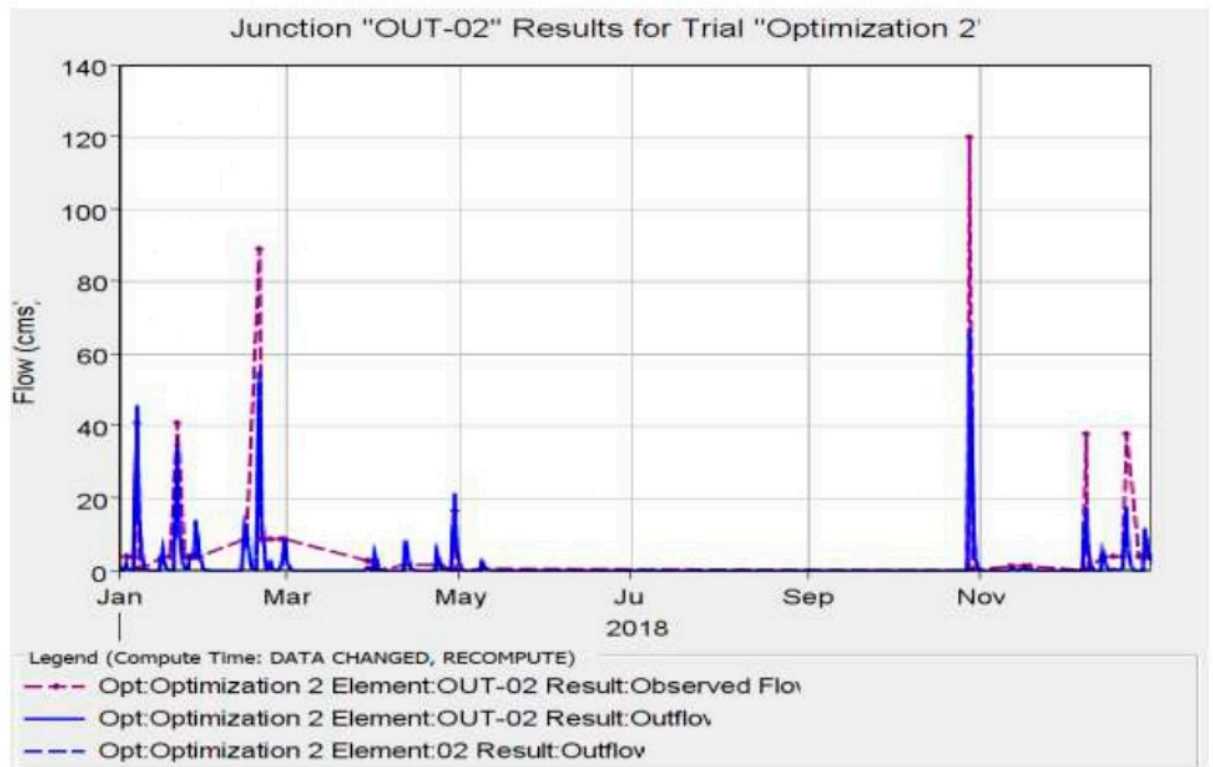
Basin -04



Basin -01



Basin -02



Basin -15

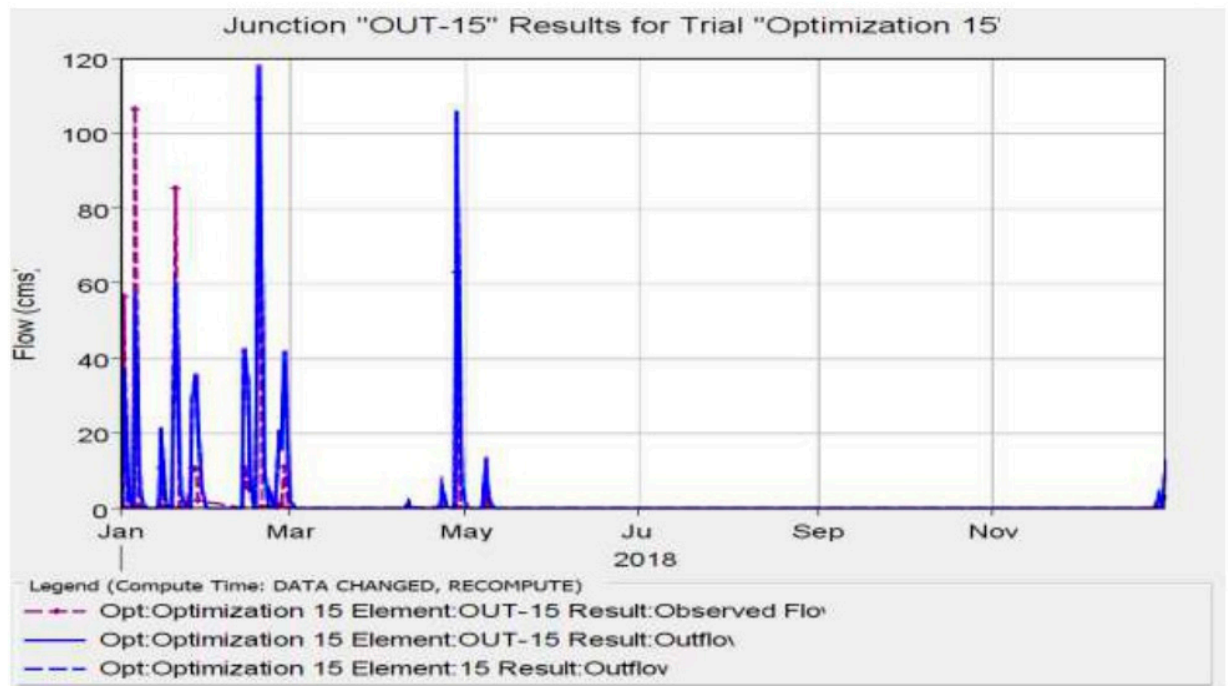


Figure S5.Calibrated and observed runoff for the event year 2018.

Table S7. Corresponding parameters for calibration for each basin.

BASIN	SC - Curve Number		SC - Initial Abstraction(mm)		SCS Unit Hydrograph - Lag Time (Min)	
	Ini.	Opt.	Ini.	Opt.	Ini.	Opt.
	value	value	value	value	value	value
1	90.92	95.00	5.07	10.00	216.84	500.00
2	91.52	93.30	4.71	9.77	135.37	423.15
3	91.52	50.65	4.71	5.17	118.78	249.15
4	91.62	93.00	4.65	10.00	107.60	500.00
5	90.80	78.99	5.15	5.30	159.69	189.60
6	90.72	99.00	5.20	0.05	303.30	30.00
7	91.57	50.00	4.68	9.77	237.89	478.24
8	91.43	99.00	4.76	1.00	86.52	60.00
9	91.43	99.00	4.76	10.00	118.23	300.00
10	91.38	30.00	4.79	3.00	154.25	50.00
11	91.43	50.00	4.76	1.00	138.42	100.00
12	91.48	50.00	4.73	1.00	150.91	100.00
13	91.50	50.24	4.72	5.35	103.65	245.61
14	91.50	50.00	4.72	1.00	334.67	250.00
15	91.50	50.00	4.72	1.00	332.70	200.00

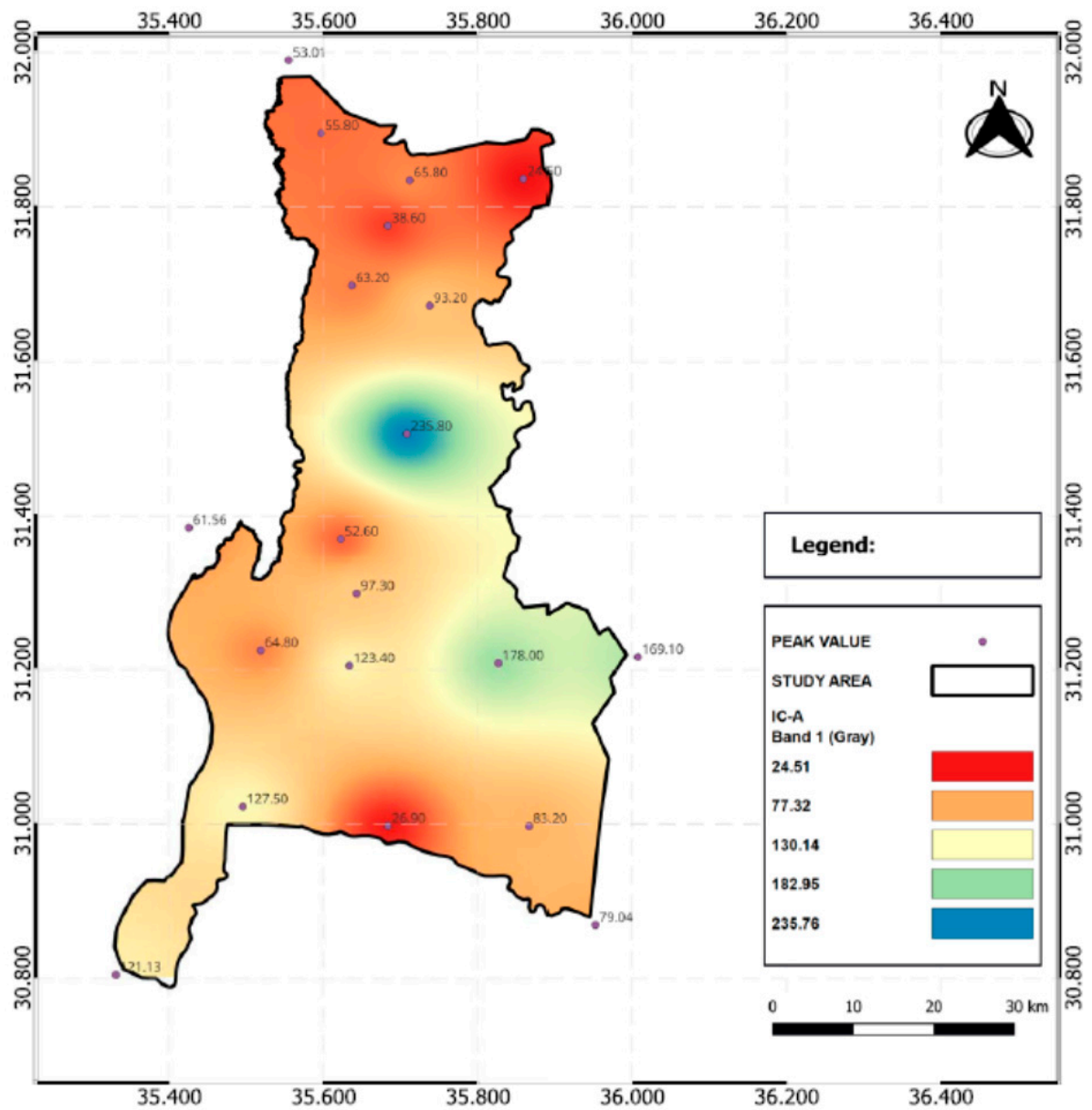
BASIN	GA- Conductivity (mm/hr)		GA- Suction(mm)		IC- Constant Rate (mm/hr)		IC - Initial Loss (mm)	
	Ini.	Opt.	Ini.	Opt.	Ini.	Opt.	Ini.	Opt.
	value	value	value	value	value	value	value	value
1	0.96	0.30	207.29	200.00	0.05	0.00	3.81	2.54
2	0.37	0.30	218.81	200.00	0.05	0.00	3.81	2.54
3	0.37	0.37	218.81	218.81	0.05	0.92	3.81	2.88
4	0.38	0.30	216.76	200.00	0.04	0.00	3.81	2.54
5	0.69	0.30	219.28	200.00	0.08	0.19	3.81	3.56
6	0.29	0.30	235.21	200.00	0.11	0.00	3.81	2.54
7	0.37	0.95	217.79	232.63	0.04	1.45	3.81	3.64
8	0.49	0.30	215.89	200.00	0.04	0.00	3.81	2.96
9	0.49	1.50	215.89	316.30	0.04	4.00	3.81	2.54
10	0.48	0.69	216.92	219.77	0.05	1.12	3.81	3.07
11	0.49	0.66	215.89	218.36	0.04	4.00	3.81	2.54
12	0.49	0.30	214.87	200.00	0.04	0.51	3.81	4.38
13	0.49	0.34	214.46	203.73	0.04	0.62	3.81	4.33
14	0.49	0.30	214.46	200.00	0.04	0.48	3.81	4.38
15	0.49	0.31	214.46	200.59	0.04	0.60	3.81	4.37

Table S8. Model performance parameters

IN.	BA.	SC-A	SC-E	SC-O	IC-A	IC-E	IC-O	GA-A	GA-E	GA-O
R2	1	0.83	0.6	0.82	0.77	0.85	0.77	0.55	0.55	0.84
	2	0.83	0.83	0.83	0.77	0.83	0.77	0.55	0.59	0.84
	3	0.71	0.03	0.73	0.71	0.61	0.65	0.03	0.00	0.59
	4	0.83	0.6	0.82	0.77	0.83	0.77	0.55	0.59	0.84
	5	0.83	0.6	0.87	0.77	0.84	0.77	0.01	0.01	0.83
	6	0.83	0.6	0.79	0.77	0.84	0.77	0.55	0.59	0.84
	7	0.83	0.6	0.88	0.55	0.83	0.75	0.77	0.59	0.85
	8	0.69	0.02	0.72	0.72	0.57	0.72	0.02	0.01	0.63
	9	0.65	0.02	0.65	0.67	0.72	0.64	0.67	0.01	0.64
	10	0.53	0.03	0.36	0.61	0.38	0.59	0.03	0.02	0.59
	11	0.69	0.06	0.57	0.81	0.60	0.82	0.02	0.05	0.57
	12	0.67	0.02	0.59	0.72	0.02	0.68	0.54	0.02	0.60
	13	0.77	0.01	0.66	0.77	0.64	0.80	0.01	0.01	0.77
	14	0.8	0.01	0.76	0.77	0.79	0.85	0.01	0.01	0.89
	15	0.77	0.01	0.65	0.82	0.65	0.86	0.01	0.01	0.78
RMSE	1	0.60	0.80	0.60	0.60	0.90	0.60	0.80	1.00	0.70
	2	0.60	0.50	0.50	1.10	1.20	0.50	1.10	1.20	0.60
	3	0.90	1.30	0.50	1.00	0.70	0.60	1.40	1.10	0.70
	4	0.50	0.70	0.50	0.50	0.70	0.50	0.70	0.90	0.60
	5	0.40	0.60	0.40	0.50	0.60	0.50	1.10	1.10	0.50
	6	0.80	0.90	0.80	0.90	0.90	1.10	1.00	1.00	0.90
	7	1.70	1.20	0.80	1.90	0.90	0.50	1.40	0.70	0.40
	8	0.60	1.10	0.60	0.60	0.70	0.60	1.10	1.10	0.70
	9	0.40	1.30	0.60	1.40	1.30	0.90	1.30	1.10	1.00
	10	1.30	2.00	0.80	1.30	0.80	0.80	1.90	1.20	0.80
	11	1.00	1.50	0.70	0.90	0.70	1.00	1.30	1.10	1.00
	12	0.90	1.10	0.70	0.23	1.10	0.60	0.70	1.10	0.60
	13	1.20	1.10	0.70	1.30	0.60	0.50	1.10	1.10	0.50
	14	0.80	1.10	0.50	0.90	0.50	0.40	1.10	1.10	0.40
	15	1.10	1.10	0.70	1.20	0.60	0.40	1.10	1.10	0.50

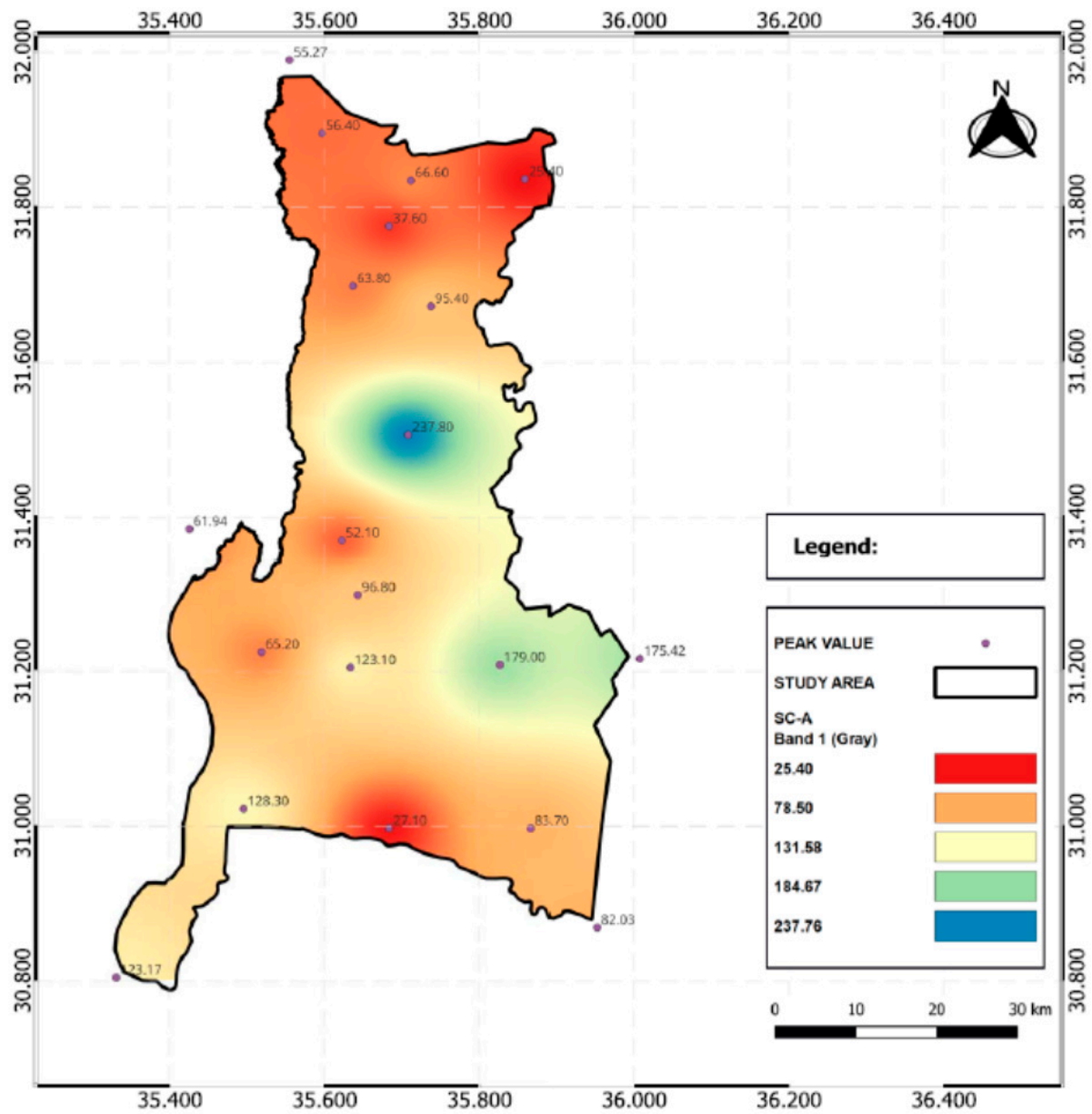
Cont's. Table S8. Model performance parameters

IN.	BA.	SC-A	SC-E	SC-O	IC-A	IC-E	IC-O	GA-A	GA-E	GA-O
NSE	1	0.67	0.40	0.68	0.66	0.23	0.67	0.40	-0.05	0.52
	2	0.67	0.75	0.75	-0.32	-0.47	0.73	-0.23	-0.36	0.61
	3	0.23	-0.80	0.73	0.05	0.57	0.61	-0.87	-0.32	0.56
	4	0.73	0.45	0.73	0.71	0.55	0.72	0.45	0.21	0.59
	5	0.82	0.58	0.85	0.76	0.60	0.77	-0.25	-0.22	0.78
	6	0.28	0.11	0.29	0.27	0.17	-0.10	0.10	-0.01	0.16
	7	-1.97	-0.53	0.37	-2.53	0.16	0.75	-0.89	0.55	0.85
	8	0.65	-0.23	0.69	0.68	0.44	0.69	-0.23	-0.15	0.53
	9	0.82	-0.72	0.64	-1.10	-0.72	0.11	-0.72	-0.19	-0.05
	10	-0.74	-2.84	0.34	-0.65	0.37	0.40	-2.70	-0.40	0.39
	11	0.00	-1.26	0.51	0.10	0.57	-0.04	-0.57	-0.24	-0.04
	12	0.23	-0.30	0.58	0.21	0.40	0.68	0.50	-0.21	0.60
	13	-0.42	-0.27	0.50	-0.60	0.64	0.79	-0.25	-0.18	0.75
	14	0.29	-0.20	0.70	0.17	0.70	0.83	-0.19	-0.15	0.88
	15	-0.26	-0.26	0.54	-0.34	0.64	0.84	-0.24	-0.17	0.75
BIAS	1	-0.29	-0.44	-0.28	-31.05	-78.16	-24.98	-45.09	-87.47	-59.95
	2	0.05	-0.16	-0.16	-95.50	-98.91	-11.54	-91.47	-95.83	-52.36
	3	0.58	-0.03	-0.03	54.40	-23.97	-37.79	-10.47	-64.11	-34.72
	4	-0.19	-0.36	-0.19	-20.84	-58.85	-15.49	-36.67	-73.17	-54.26
	5	0.19	-0.05	0.05	11.11	-55.10	-5.47	-86.72	-96.22	-31.64
	6	-0.68	-0.75	-0.66	-71.70	-82.05	-92.99	-78.13	-88.12	-82.10
	7	2.00	1.38	0.93	195.24	54.18	-10.62	136.18	0.60	-8.00
	8	-0.18	-0.55	-0.12	-17.42	-61.48	-12.37	-57.69	-88.07	-54.01
	9	0.19	0.05	0.29	75.30	-22.76	-60.78	-3.41	-72.76	-53.06
	10	1.55	1.10	0.17	143.44	-22.92	-41.85	88.73	-45.13	-42.04
	11	1.45	0.13	0.52	144.98	-19.72	-45.19	-59.07	-73.99	-45.19
	12	1.06	-0.54	0.26	108.23	-5.98	1.03	-31.71	-89.13	-7.46
	13	1.88	-0.47	0.77	192.89	-3.57	27.14	-48.81	-87.53	25.12
	14	1.48	-0.54	0.52	148.61	-17.95	26.00	-54.86	-89.01	13.41
	15	1.79	-0.47	0.69	183.52	-7.07	24.53	-49.15	-87.41	27.47

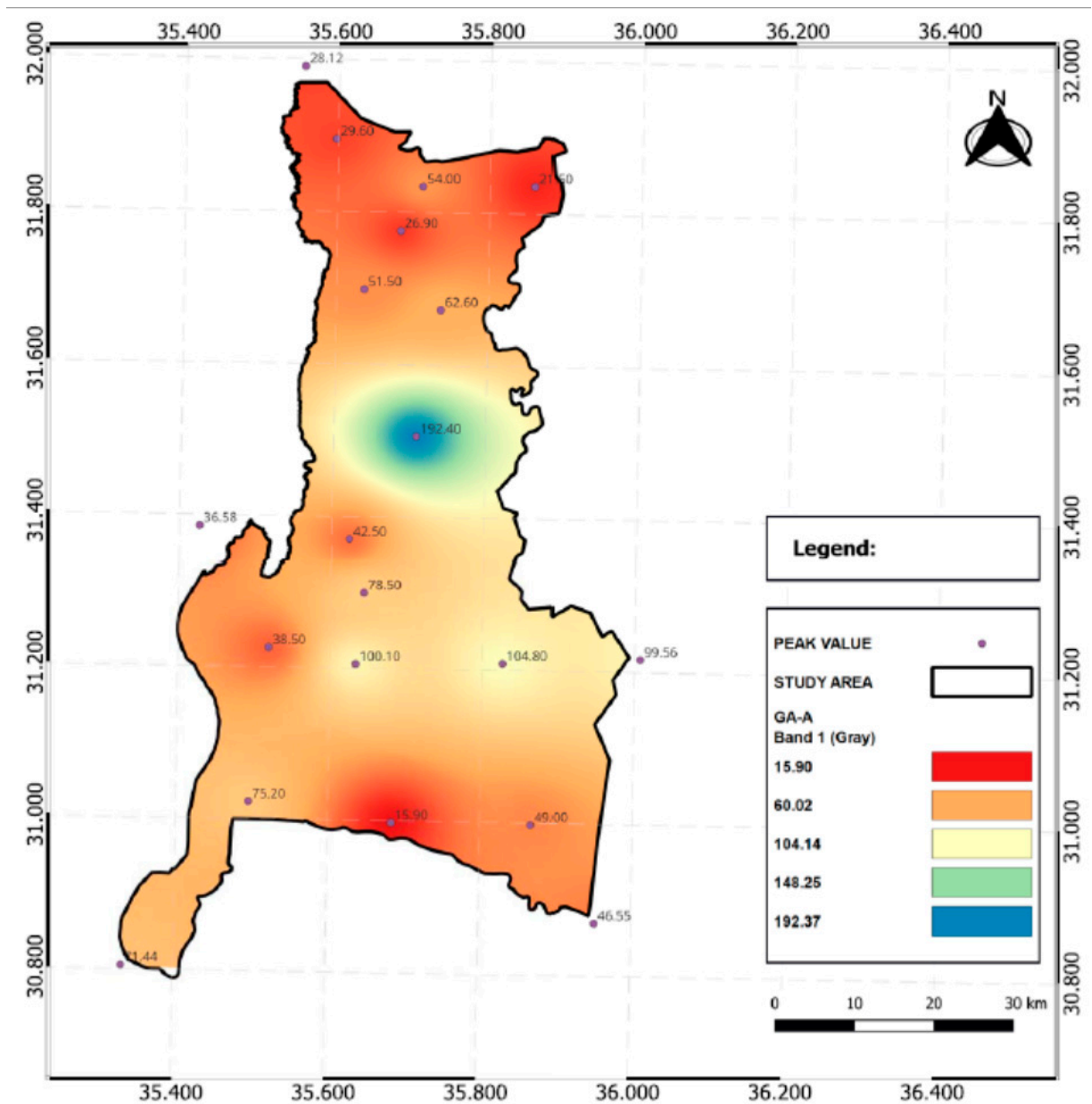


a. IC-A

SC



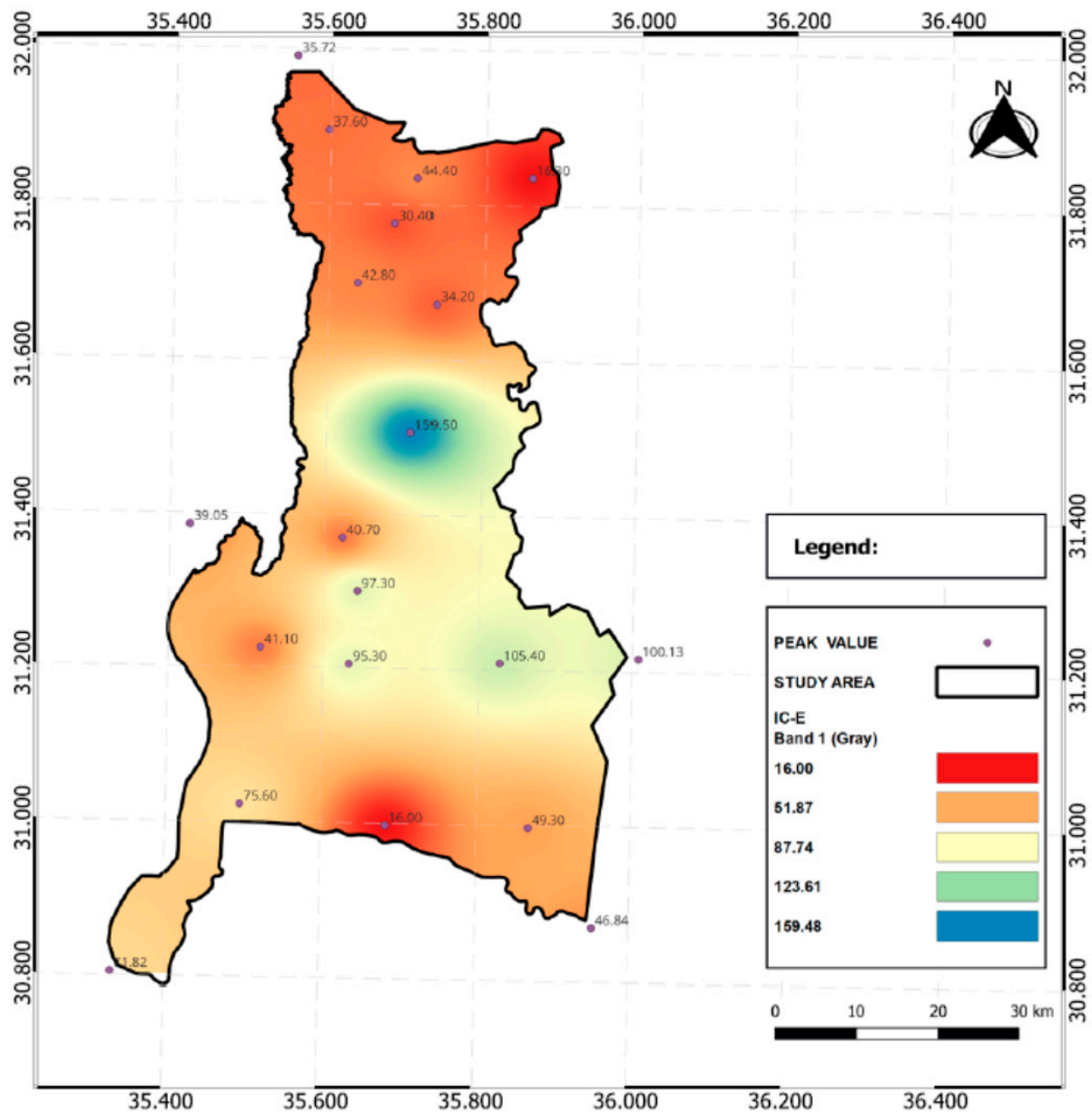
b. SC-A



c. GA-A

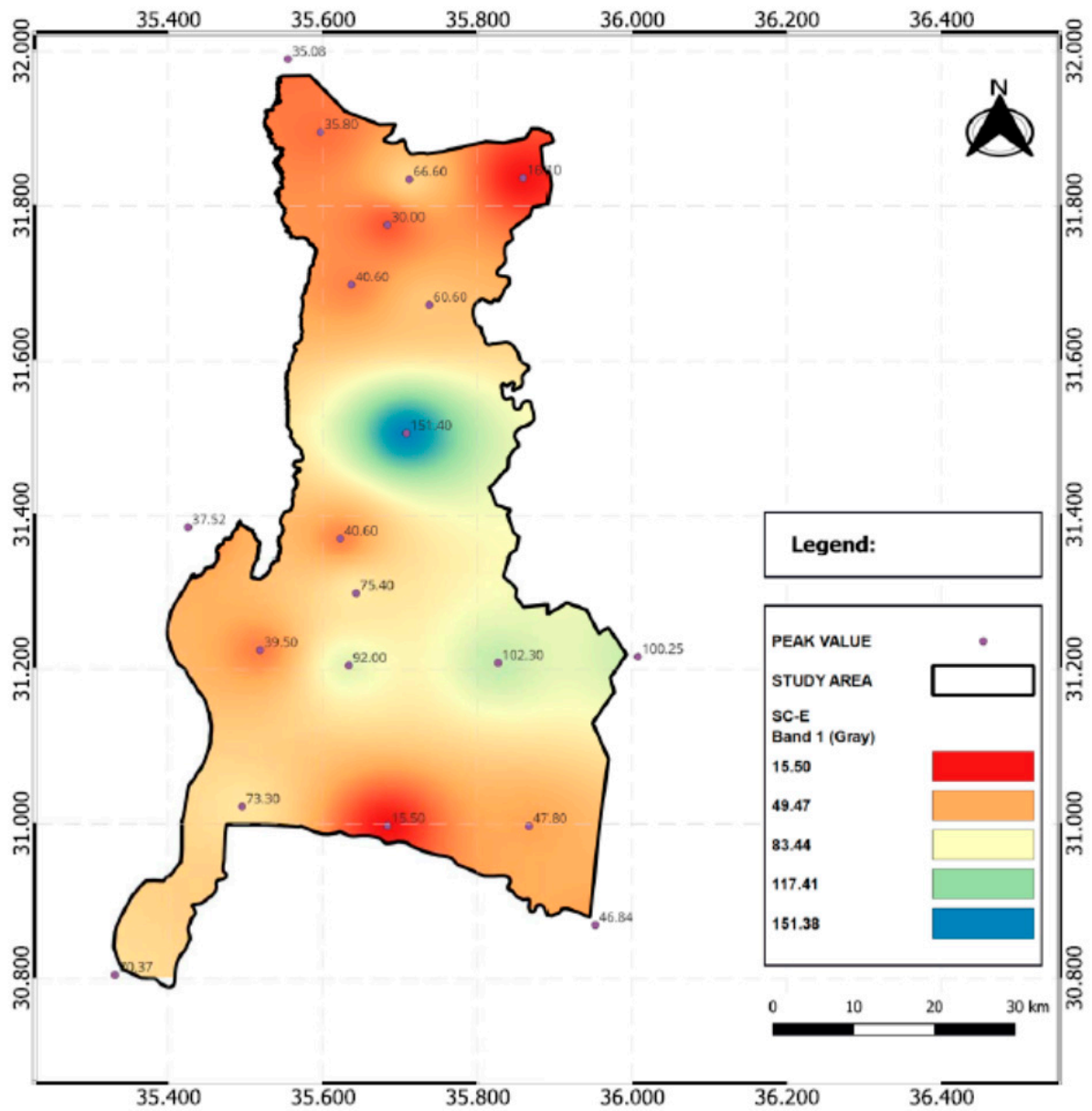
Figure S18. Simulated peak discharge using actual percieptation

ICIC

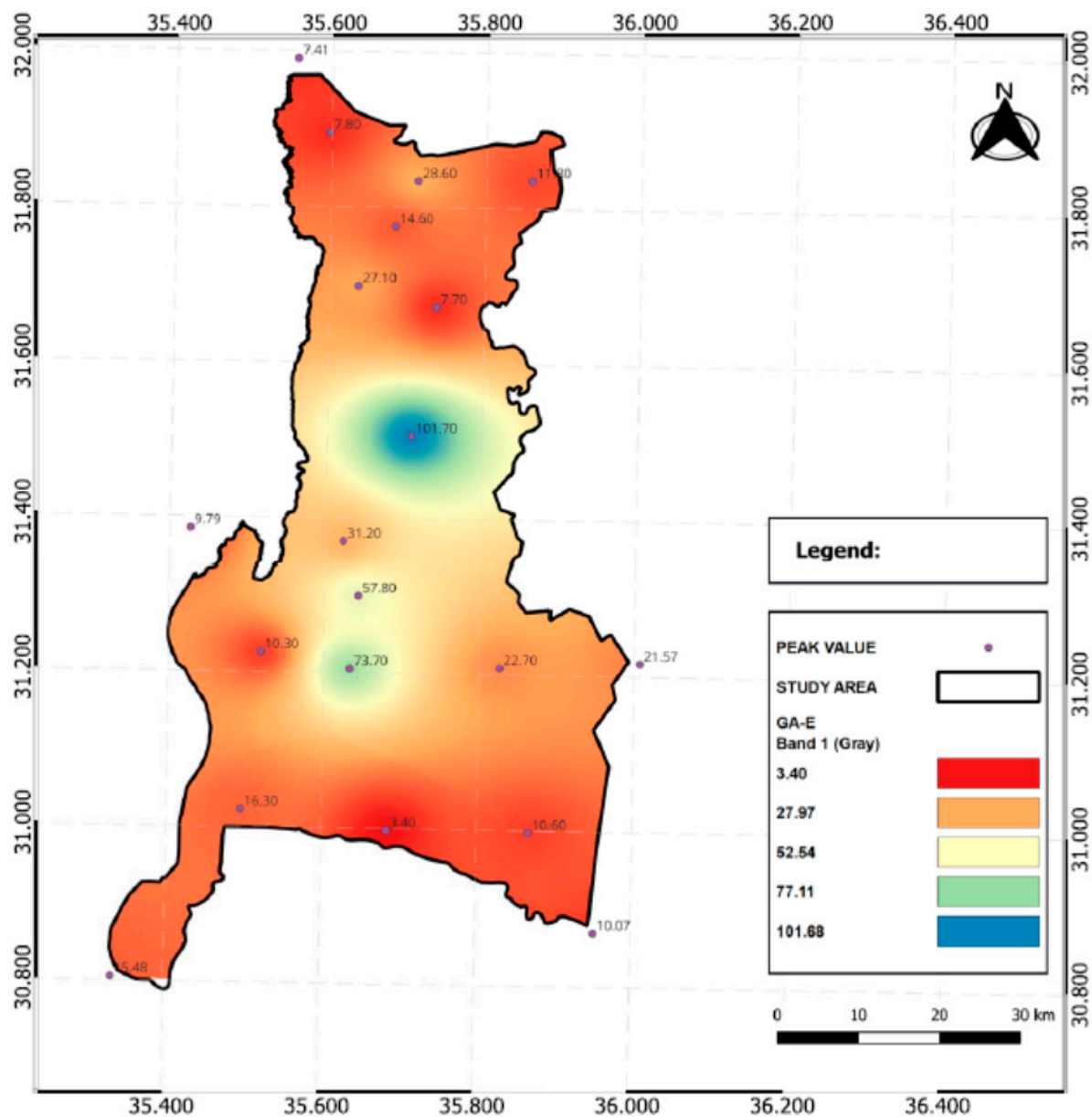


a. IC-E

SC



b. SC-E



c. GA-E

Figure S19. SCN- Peak discharge using ERA dataset