

ORIGINAL RESEARCH ARTICLE

**Assessing long-term groundwater level trends in
Karakalpakstan using non-parametric statistical methods**

Supplementary Files

Table S1. Mann-Kendall test for groundwater levels

Province	Statistical parameter	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Beruniy Province	<i>n</i>	34	34	34	34	34	34	34	34	34	34	33	33	34
	Alpha	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	MK state	-42	59	30	221	272	300	297	298	298	201	201	153	56
	S.E.	67.407	67.446	67.366	67.358	67.199	67.365	67.387	67.436	67.436	67.406	67.446	64.384	64.529
	Z-test	-0.608	0.86	0.43	3.266	4.033	4.439	4.393	4.404	4.404	3.694	2.965	2.361	0.852
	<i>p</i> -value	0.543	0.39	0.667	0.001	0	0	0	0	0	0	0.003	0.018	0.394
Amudarya Province	Trend	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	<i>n</i>	34	34	34	34	34	34	34	34	34	34	33	33	34
	Alpha	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	MK state	-42	59	30	221	272	300	297	298	298	250	201	153	56
	S.E.	67.407	67.446	67.366	67.358	67.199	67.365	67.387	67.436	67.436	67.406	67.446	64.384	64.529
	Z-test	-0.608	0.86	0.43	3.266	4.033	4.439	4.393	4.404	4.404	3.694	2.965	2.361	0.852
Khojeli Province	<i>p</i> -value	0.543	0.39	0.667	0.001	0	0	0	0	0	0.003	0.018	0.394	0.004
	Trend	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	<i>n</i>	34	34	34	34	34	34	34	34	34	34	34	33	34
	Alpha	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	MK state	-9	111	96	247	273	157	93	161	161	112	60	85	6
	S.E.	67.452	67.422	67.453	67.387	67.338	67.402	67.423	67.305	67.305	67.333	67.31	64.389	64.511
Takhiatash Province	Z-test	-0.119	1.632	1.408	3.651	4.039	2.314	1.365	2.377	1.649	0.877	1.305	0.078	0.877
	<i>p</i> -value	0.906	0.103	0.159	0	0	0.021	0.172	0.017	0.099	0.381	0.192	0.938	0.381
	Trend	No	No	No	Yes	Yes	Yes	No	Yes	No	No	No	No	No
	<i>n</i>	6	6	6	6	6	6	6	6	6	6	5	5	6
	Alpha	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	MK state	11	6	-2	-2	-7	-1	5	-1	-1	-1	-10	-10	2
Shumanay Province	S.E.	5.323	5.281	5.281	5.281	5.323	5.323	5.323	5.323	5.323	5.281	4.082	4.082	5.323
	Z-test	1.879	0.947	-0.189	-0.189	-1.127	0	0.751	0	0	-1.704	-2.205	0.245	0
	<i>p</i> -value	0.06	0.344	0.85	0.85	0.26	1	0.452	1	1	0.088	0.027	0.807	1
	Trend	No	No	No	No	No	No	No	No	No	No	Yes	No	No
	<i>n</i>	34	34	34	34	34	34	34	34	34	34	33	33	34
	Alpha	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

(Cont'd...)

Groundwater trends in Karakalpakstan

Table S1. (Continued)

Province	Statistical parameter	January	February	March	April	May	June	July	August	September	October	November	December	Annual	
Kantlikul Province	MK state	147	135	168	210	199	236	207	209	202	150	80	158	214	
	S.E.	67.423	67.387	67.436	67.436	67.446	67.406	67.387	67.387	67.387	67.436	64.529	64.467	67.453	
	Z-test	2.165	1.989	2.476	3.099	2.936	3.486	3.057	3.087	3.087	2.981	1.224	2.435	3.158	
	p-value	0.03	0.047	0.013	0.002	0.003	0	0.002	0.002	0.002	0.003	0.027	0.015	0.002	
	Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	
	n	34	34	34	34	34	34	34	34	34	34	33	33	34	
	Alpha	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
	MK state	68	98	133	184	247	201	149	149	143	170	174	132	91	176
	S.E.	67.331	67.406	67.423	67.407	67.387	67.387	67.434	67.434	67.209	67.364	67.365	64.505	64.389	67.445
	Z-test	0.995	1.439	1.958	2.715	3.651	2.968	2.195	2.113	2.113	2.509	2.568	2.031	1.398	2.595
Kungiroi Province	p-value	0.32	0.15	0.05	0.007	0	0.003	0.028	0.035	0.035	0.012	0.01	0.042	0.162	0.009
	Trend	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	n	34	34	34	34	34	34	34	34	34	34	33	33	34	
	Alpha	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
	MK state	93	108	153	163	237	241	225	184	184	151	146	112	117	193
	S.E.	67.403	67.436	67.36	67.387	67.446	67.422	67.446	67.446	67.436	67.446	67.445	64.483	64.519	67.456
	Z-test	1.365	1.587	2.257	2.404	3.499	3.56	3.321	2.714	2.714	2.224	2.15	1.721	1.798	2.846
	p-value	0.172	0.113	0.024	0.016	0	0	0.001	0.001	0.007	0.026	0.032	0.085	0.072	0.004
	Trend	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes
	n	34	34	34	34	34	34	34	34	34	34	34	33	33	34
Muynak Province	Alpha	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
	MK state	228	277	254	263	292	334	287	266	266	243	217	252	232	263
	S.E.	67.436	67.456	67.406	67.456	67.453	67.453	67.446	67.446	67.436	67.456	67.456	64.539	64.529	67.456
	Z-test	3.366	4.092	3.753	3.884	4.314	4.937	4.24	3.93	3.93	3.588	3.202	3.889	3.58	3.884
	p-value	0.001	0	0	0	0	0	0	0	0	0	0.001	0	0	
	Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	n	34	34	34	34	34	34	34	34	34	34	34	33	33	34
	Alpha	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
	MK state	107	82	-34	-63	139	75	123	94	94	-24	-12	14	57	79
	S.E.	67.423	67.436	67.406	67.387	67.423	67.429	67.434	67.407	67.407	67.406	67.407	64.467	64.495	67.456

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Table S1. (Continued)

Province	Statistical parameter	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Kegeyli Province	Z-test	1.572	1.201	-0.49	-0.92	2.047	1.097	1.809	1.38	-0.341	-0.163	0.202	0.868	1.156
	p-value	0.116	0.23	0.624	0.358	0.041	0.272	0.07	0.168	0.733	0.87	0.84	0.385	0.248
	Trend	No	No	No	No	Yes	No	No	No	No	No	No	No	No
	n	34	34	34	34	34	34	34	34	34	34	33	33	34
	Alpha	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	MK state	152	148	74	130	163	188	186	186	152	162	186	179	185
	S.E.	67.436	67.453	67.453	67.436	67.423	67.436	67.436	67.436	67.436	67.436	67.436	64.536	64.536
	Z-test	2.239	2.179	1.082	1.913	2.403	2.773	2.743	2.743	2.239	2.387	2.743	2.758	2.851
	p-value	0.025	0.029	0.279	0.056	0.016	0.006	0.006	0.006	0.025	0.017	0.006	0.006	0.004
	Trend	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Buzatau Province	n	18	18	18	18	18	18	18	18	18	18	17	17	18
	Alpha	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	MK state	53	53	55	66	83	79	86	86	75	80	74	62	64
	S.E.	26.401	26.401	26.401	26.392	26.401	26.401	26.392	26.392	26.401	26.344	26.392	24.276	24.276
	Z-test	1.97	1.97	2.045	2.463	3.106	2.954	3.221	3.221	2.803	2.999	2.766	2.513	2.595
	p-value	0.049	0.049	0.041	0.014	0.002	0.003	0.001	0.001	0.005	0.003	0.006	0.012	0.009
	Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	n	34	34	34	34	34	34	34	34	34	34	34	33	33
	Alpha	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	MK state	134	173	189	245	232	231	178	178	180	175	218	166	196
Chimbay Province	S.E.	67.366	67.446	67.446	67.423	67.445	67.423	67.453	67.382	67.446	67.436	64.467	64.529	67.456
	Z-test	1.974	2.55	2.787	3.619	3.425	3.411	2.624	2.657	2.58	3.218	2.559	3.022	3.172
	p-value	0.048	0.011	0.005	0	0.001	0.001	0.009	0.008	0.01	0.001	0.01	0.003	0.002
	Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	n	34	34	34	34	34	0.05	34	34	34	34	33	33	34
	Alpha	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	MK state	136	186	208	148	186	67.4364	225	196	196	115	67.3309	102	148
	S.E.	67.436	67.407	67.382	67.365	67.436	2.536	67.387	67.334	67.446	67.446	1.53	64.529	64.539
	Z-test	2.002	2.745	3.072	2.182	2.743	0.011	3.324	2.896	1.69	1.69	0.126	1.565	2.278
	p-value	0.045	0.006	0.002	0.029	0.006	Yes	0.001	0.004	0.091	0.091	No	0.118	0.023
Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	0.05	No	Yes	

(Cont'd...)

Table S1. (Continued)

Province	Statistical parameter	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Takhtrakopir Province	<i>n</i>	34	34	34	34	34	34	34	34	34	34	33	33	34
	Alpha	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	MK state	97	131	31	81	149	152	131	131	131	217	199	194	153
	S.E.	67.387	67.387	67.387	67.387	67.423	67.453	67.423	67.423	67.423	67.446	67.434	64.467	64.519
	Z-test	1.425	1.929	0.445	1.187	2.195	2.239	1.928	1.928	1.928	3.203	2.936	2.994	2.356
Republic of Karakalpakstan	<i>p</i> -value	0.154	0.054	0.656	0.235	0.028	0.025	0.054	0.054	0.054	0.001	0.003	0.003	0.018
	Trend	No	No	No	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes
	<i>n</i>	34	34	34	34	34	34	34	34	34	34	34	33	34
	Alpha	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	MK state	122	147	186	249	251	291	293	285	285	241	225	200	176
S.E.	S.E.	67.453	67.456	67.453	67.456	67.456	67.456	67.456	67.456	67.456	67.456	64.539	64.539	67.453
	Z-test	1.794	2.164	2.743	3.676	3.706	4.299	4.329	4.21	4.21	3.558	3.321	3.083	2.712
	<i>p</i> -value	0.073	0.03	0.006	0	0	0	0	0	0	0	0.001	0.002	0.007
	Trend	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: *n*: Sample size; α : Significance level; MK state: Mann-Kendall test statistic; S.E.: Standard error; Z-test: Standardized test statistic; *p*-value: Probability value for significance; Trend: "Yes" indicates statistically significant trend at $\alpha = 0.05$.

Table S2. Monthly innovative polygon trend analysis statistical metrics (arithmetic mean and standard deviation)

		Province											
Elikkala Province	Index Section	Months											
		January	February	March	April	May	June	July	August	September	October	November	December
Elikkala Province	Mean	246.5	247.7	213	174.1	180.1	184.9	173.7	166.3	178.8	199.5	216.7	231
		246	246.3	217.7	198.6	203.2	205.8	200.6	201.1	214.9	227.4	236.1	247.6
	SD	29.1	33.4	29.7	26.1	24.8	21.7	20.8	24.4	27.1	27.1	26.7	27.2
		57	57	42.4	36	33.6	35.1	40.4	47.6	51.4	51.7	49.2	51.4
Beruniy Province	Index Metric	January–February	February–March	March–April	April–May	May–June	June–July	July–August	August–September	September–October	October–November	November–December	December–January
	Mean	1.4	4.9	24.9	33.6	31.1	34	43.9	50.1	45.5	33.9	25.5	16.6
		0.3	0.8	0.5	0.8	0.6	0.5	-0.1	1.1	0.6	0.5	0.8	-0.1
	SD	36.6	26.8	16.1	13.2	16	23.7	30.3	33.6	34.6	33.3	33.1	37
Beruniy Province	Mean	0	4	1.8	1.9	-0.5	-5.9	2.1	1.4	49.9	7.4	5.1	2.9
	SD												
Beruniy Province	Index Metric	January–February	February–March	March–April	April–May	May–June	June–July	July–August	August–September	September–October	October–November	November–December	December–January
	Mean	14.6	15.6	13.9	24	37.8	44.4	44.5	43.2	37.9	32	26.2	16
		-0.2	1.2	0.2	1.9	-3.4	1.1	-4.8	0.8	0.8	0.8	0.1	-28.6
	SD	18.7	8.2	5.6	3.6	7.2	12.8	13.9	11.5	8.4	3.8	3.3	17.9
Beruniy Province	Mean	-2.9	-45.8	0.5	-6.1	-3.5	-1.2	0.3	0.7	-0.7	-1.1	9.7	4.4
	SD												

(Cont'd...)

Table S2. (Continued)

		Province											
Amudaryya Province	Index Section	Months											
		January	February	March	April	May	June	July	August	September	October	November	December
Mean	1 st half	197.8	170.8	120.6	120.6	142.4	148.8	129.9	121.3	145.2	172.9	193.8	205.4
	2 nd half	174.1	176.6	144	150.9	167.2	173.9	152.6	145.1	157.1	179.5	195.9	191.5
	1 st half	30	35.1	30.7	10.9	9.6	9.8	9.8	11.7	18.3	20.8	20	21.7
	2 nd half	41.9	32.1	14.9	14.5	14.6	17.7	13.7	14.7	15.1	16.3	17.3	28.8
SD	1 st half	24.5	24	38.1	39	35.3	33.8	32.9	26.6	13.6	6.9	14	27.5
	2 nd half	-0.1	0.7	39.3	0.8	1	1.1	0.9	0.5	0.8	0.8	-0.4	2.3
	1 st half	12.2	16	16.2	6.1	9.3	8.9	5	4.4	5.5	5.2	7.6	13.8
	2 nd half	-1.9	3.9	0	-0.1	16.6	60.4	0.5	0.1	0.5	-1.3	6.8	1.6
Mean	Trend length	185.4	169.8	144.8	141.7	161.6	172.3	171.5	162.7	180.3	206.4	216.6	209.3
	Trend slope	189.8	188.9	158.4	161.7	181.9	191.5	180.5	173.6	191.4	215.9	228.4	213.5
	1 st half	33.1	37.5	30.7	20.9	12.7	15.5	18	22.4	23.6	22	22.1	25.4
	2 nd half	48.1	42.9	28.3	23.2	15.3	22.4	21.9	20.2	23.5	25.7	24.3	36.3
SD	1 st half	19.6	23.4	24.2	28.5	27.9	21.1	14.1	15.5	14.6	15.1	12.5	6.1
	2 nd half	0.1	1.2	-1.1	1	0.9	14.3	0.8	1	0.9	1.2	2	1
	1 st half	15.9	5.9	3.4	3.5	7.3	7.9	4.4	2.1	3.7	4.3	11.2	18.5
	2 nd half	-1.2	2.1	0.5	1	2.5	-0.2	-0.4	2.7	-1.3	-15.7	3.6	1.5
Mean	Trend length	185.4	169.8	144.8	141.7	161.6	172.3	171.5	162.7	180.3	206.4	216.6	209.3
	Trend slope	189.8	188.9	158.4	161.7	181.9	191.5	180.5	173.6	191.4	215.9	228.4	213.5
	1 st half	33.1	37.5	30.7	20.9	12.7	15.5	18	22.4	23.6	22	22.1	25.4
	2 nd half	48.1	42.9	28.3	23.2	15.3	22.4	21.9	20.2	23.5	25.7	24.3	36.3
SD	1 st half	19.6	23.4	24.2	28.5	27.9	21.1	14.1	15.5	14.6	15.1	12.5	6.1
	2 nd half	0.1	1.2	-1.1	1	0.9	14.3	0.8	1	0.9	1.2	2	1
	1 st half	15.9	5.9	3.4	3.5	7.3	7.9	4.4	2.1	3.7	4.3	11.2	18.5
	2 nd half	-1.2	2.1	0.5	1	2.5	-0.2	-0.4	2.7	-1.3	-15.7	3.6	1.5

(Cont'd...)

Table S2. (Continued)

		Province												
Takhiatash Province	Index Section	Months												
		January	February	March	April	May	June	July	August	September	October	November	December	
Mean	1 st half	154	167	126.7	151.7	174.7	178.7	161.3	161.7	178.7	204	224.3	207.3	
	2 nd half	204.3	165	134.7	147.7	169.3	181	170	166	175	188.7	200	209.5	
	1 st half	2.6	3.6	1.2	15.8	4	11.2	10.1	9.7	9.6	2.6	3.8	22	
	2 nd half	11.6	21.6	15	6.5	6	10	6.1	4.4	9	14.3	1.4	7.8	
SD	Index Metric	January–February	February–March	March–April	April–May	May–June	June–July	July–August	August–September	September–October	October–November	November–December	December–January	
	Trend length	50.4	8.2	8.9	6.7	5.8	9	9.7	5.7	15.8	28.8	24.4	50.4	
	Trend slope	-3	0.8	0.5	0.9	2.9	0.6	-12	0.5	0.5	0.6	-0.6	0.1	
	Trend length	20.1	22.7	16.7	9.5	2.3	4.1	6.7	5.4	11.7	11.9	14.4	16.8	
Trend slope	Trend slope	10.5	2.7	-0.6	0	0.6	3.6	4.9	-44.8	-0.8	-11.3	0.3	-0.2	
	Shumanay Province													
	Index Section	Months												
		January	February	March	April	May	June	July	August	September	October	November	December	
Mean	1 st half	220.1	215.3	197.5	195.5	204.4	211.9	212.9	215.6	230.4	246.5	256.2	244.4	
	2 nd half	239.9	237	223.4	221.5	223.2	229.9	233.3	235.1	241.8	252.2	257.2	251.2	
	1 st half	115.3	99.4	74	96.7	69.7	60	58.2	74.2	100.3	98.3	97.1	115.8	
	2 nd half	63	62.6	54	50.4	43.8	40.1	40	40.2	41.1	44.8	48.8	57.6	
SD	Index Metric	January–February	February–March	March–April	April–May	May–June	June–July	July–August	August–September	September–October	October–November	November–December	December–January	
	Trend length	29.4	33.8	36.7	32.1	26	27.2	28.1	22.5	12.7	5.8	6.9	20.9	
	Trend slope	0.6	0.8	0.9	0.2	0.9	3.2	0.7	0.5	0.6	0.5	0.5	0.5	
	Trend length	63.9	41.8	50.5	53.1	32.6	27	38.6	68.2	79.8	72.1	75.7	78.3	
Trend slope	Trend slope	0	0.3	-0.2	0.2	0.4	0.1	0	0	-1.9	-3.3	0.5	-9.5	

(Cont'd...)

Table S2. (Continued)

Kanlikul Province	Index Section	Province											
		January	February	March	April	May	June	July	August	September	October	November	December
Mean	1 st half	220.1	215.3	197.5	195.5	204.4	211.9	212.9	215.6	230.4	246.5	256.2	244.4
	2 nd half	239.9	237	223.4	221.5	223.2	229.9	233.3	235.1	241.8	252.2	257.2	251.2
	1 st half	115.3	99.4	74	96.7	69.7	60	58.2	74.2	100.3	98.3	97.1	115.8
	2 nd half	63	62.6	54	50.4	43.8	40.1	40	40.2	41.1	44.8	48.8	57.6
SD	1 st half	29.4	33.8	36.7	32.1	26	27.2	28.1	22.5	12.7	5.8	6.9	20.9
	2 nd half	0.6	0.8	0.9	0.2	0.9	3.2	0.7	0.5	0.6	0.5	0.5	0.5
	1 st half	63.9	41.8	50.5	53.1	32.6	27	38.6	68.2	79.8	72.1	75.7	78.3
	2 nd half	0	0.3	-0.2	0.2	0.4	0.1	0	0	-1.9	-3.3	0.5	-9.5
Trend length		29.4	33.8	36.7	32.1	26	27.2	28.1	22.5	12.7	5.8	6.9	20.9
		0.6	0.8	0.9	0.2	0.9	3.2	0.7	0.5	0.6	0.5	0.5	0.5
		63.9	41.8	50.5	53.1	32.6	27	38.6	68.2	79.8	72.1	75.7	78.3
		0	0.3	-0.2	0.2	0.4	0.1	0	0	-1.9	-3.3	0.5	-9.5
Trend slope		29.4	33.8	36.7	32.1	26	27.2	28.1	22.5	12.7	5.8	6.9	20.9
		0.6	0.8	0.9	0.2	0.9	3.2	0.7	0.5	0.6	0.5	0.5	0.5
		63.9	41.8	50.5	53.1	32.6	27	38.6	68.2	79.8	72.1	75.7	78.3
		0	0.3	-0.2	0.2	0.4	0.1	0	0	-1.9	-3.3	0.5	-9.5
Muynak Province	1 st half	244.8	249	230.2	215.1	201.4	201.1	192.5	197.5	205.6	230.3	242.9	245.8
	2 nd half	268.2	269.1	251.7	244.1	249.4	242.7	239	236	245.5	259.9	268	271.5
	1 st half	66.8	63.4	61.9	66.1	66.7	79.2	73	74.7	73.3	68.4	65.1	66
	2 nd half	78.6	77.3	62.2	70.1	72.4	54.8	60.6	64.8	75	75.1	74.8	78.1
Mean	1 st half	30.8	29.4	36.1	56.2	63.6	62.4	60.4	55.5	49.7	38.8	35.9	34.8
	2 nd half	0.2	0.9	0.5	-0.4	22.9	0.4	-0.6	1.2	0.6	0.6	1.2	3.5
	1 st half	18.2	13.9	4.1	7	25	27.3	15.8	10	7	11.8	15.5	16.9
	2 nd half	0.4	10.1	1.9	3.6	-1.4	-0.9	2.5	-7.7	0	0.1	3.9	0.6
Trend length		30.8	29.4	36.1	56.2	63.6	62.4	60.4	55.5	49.7	38.8	35.9	34.8
		0.2	0.9	0.5	-0.4	22.9	0.4	-0.6	1.2	0.6	0.6	1.2	3.5
		18.2	13.9	4.1	7	25	27.3	15.8	10	7	11.8	15.5	16.9
		0.4	10.1	1.9	3.6	-1.4	-0.9	2.5	-7.7	0	0.1	3.9	0.6
Trend slope		30.8	29.4	36.1	56.2	63.6	62.4	60.4	55.5	49.7	38.8	35.9	34.8
		0.2	0.9	0.5	-0.4	22.9	0.4	-0.6	1.2	0.6	0.6	1.2	3.5
		18.2	13.9	4.1	7	25	27.3	15.8	10	7	11.8	15.5	16.9
		0.4	10.1	1.9	3.6	-1.4	-0.9	2.5	-7.7	0	0.1	3.9	0.6

(Cont'd...)

Table S2. (Continued)

		Province											
Nukus Province	Index Section	Months											
		January	February	March	April	May	June	July	August	September	October	November	December
Nukus Province	Mean	237.3	242.2	229.3	218.8	199.5	186.1	183.8	186.1	193.7	225.5	242.5	240.1
	2 nd half	237.9	239.3	221	209	212.3	201.3	202	200.2	192.3	219	236.8	238.9
	SD	50.5	49.1	49.7	36.3	36.1	32.1	36.6	37.5	39.7	37.5	39.2	43.5
	2 nd half	28.5	26.1	29.8	23.2	20.7	24.6	26.3	31.4	26	22	18.9	24
Nukus Province	Index Metric	January–February–March–April–May–June–July–August–September–October–November–December–January	February–March–April–May–June–July–August–September–October–November–December–January	March–April–May–June–July–August–September–October–November–December–January	April–May–June–July–August–September–October–November–December–January	May–June–July–August–September–October–November–December–January	June–July–August–September–October–November–December–January	July–August–September–October–November–December–January	August–September–October–November–December–January	September–October–November–December–January	October–November–December–January	November–December–January	December–January
	Mean	3	8.8	12.9	16.2	19.9	23.8	23.1	14.2	6.7	8.7	5.8	1.3
	Trend length	0.3	1.4	1.1	-0.2	0.8	-0.3	-0.8	-1	0.8	1.1	-0.9	0.4
	SD	31.8	30.4	23.8	20.3	17.2	12.8	12	15	20.7	25.6	28.2	29.4
Nukus Province	Trend length	1.8	6.3	0.5	17.1	-1	0.4	5.8	-2.4	1.8	-1.8	1.2	0.7
	Trend slope												
Kegeyli Province	Index Section	January–February–March–April–May–June–July–August–September–October–November–December–January	February–March–April–May–June–July–August–September–October–November–December–January	March–April–May–June–July–August–September–October–November–December–January	April–May–June–July–August–September–October–November–December–January	May–June–July–August–September–October–November–December–January	June–July–August–September–October–November–December–January	July–August–September–October–November–December–January	August–September–October–November–December–January	September–October–November–December–January	October–November–December–January	November–December–January	December–January
	Mean	224.2	217.6	209.9	194.5	195.8	201.8	207.7	202.5	214.8	232.5	244.2	234.8
	2 nd half	250.5	247.6	224.9	219.3	223.8	235.8	240.6	238.9	246.9	264.1	274.2	269.5
	SD	79.3	79.7	75.6	76.7	68.4	60.7	57.1	57.7	59.9	60	60.6	69.9
Kegeyli Province	2 nd half	58.2	58.8	55.9	50.6	46.1	43.1	44.3	42.8	41.2	32.9	36.5	47.1
	Index Metric	January–February–March–April–May–June–July–August–September–October–November–December–January	February–March–April–May–June–July–August–September–October–November–December–January	March–April–May–June–July–August–September–October–November–December–January	April–May–June–July–August–September–October–November–December–January	May–June–July–August–September–October–November–December–January	June–July–August–September–October–November–December–January	July–August–September–October–November–December–January	August–September–October–November–December–January	September–October–November–December–January	October–November–December–January	November–December–January	December–January
	Mean	39.8	33.5	29	37.4	44.1	47.3	49.1	48.5	45.1	43.6	45.9	43.5
	Trend length	0.4	2.9	0.4	3.7	2	0.8	0.3	0.6	1	0.9	0.5	1.8
Kegeyli Province	Trend slope	29.7	28.7	32.6	34.2	28.4	21.8	19.6	23.9	32.9	36.3	33.2	31.1
	SD	1.8	0.7	-4.9	0.5	0.4	-0.3	-2.2	-0.8	-76.5	5.4	1.2	1.2
	Trend length												
	Trend slope												

(Cont'd...)

Table S2. (Continued)

		Province											
Buzatau Province	Index Section	Months											
		January	February	March	April	May	June	July	August	September	October	November	December
	Mean	250.5	257.3	249.3	220	211.6	215.8	221.6	226.5	231.5	240.1	247.5	252.5
	2 nd half	322.9	326	307.2	306.6	306.3	300.2	308.9	311.7	324.3	334.1	343.1	348.1
	SD	27.9	22.4	23.1	16.1	25.2	24.1	24.1	22.9	17.8	24.8	22.2	19.2
	2 nd half	124.1	127.8	100.7	113.6	108	110.5	99.7	102	118.1	120.1	119.3	123
	Index Metric	January–February	February–March	March–April	April–May	May–June	June–July	July–August	August–September	September–October	October–November	November–December	December–January
	Mean	99.8	89.9	104.2	128.3	126.9	121.5	121.9	126	132.1	134.1	135.2	119.9
	Trend length												
	Trend slope	0.5	2.3	0	0	-1.5	1.5	0.6	2.5	1.1	1.2	1	12.6
	SD	142.7	130.8	124.6	127.9	119.6	114.8	109.4	127.7	138.3	136	142.1	141.5
	Trend length												
	Trend slope	-0.7	-40.4	-1.9	-0.6	-2.4	1005.1	-1.9	-3.2	0.3	0.3	-1.3	0.1
	Index Metric	January–February	February–March	March–April	April–May	May–June	June–July	July–August	August–September	September–October	October–November	November–December	December–January
	Mean	227.4	212.3	197.4	194.8	207.9	208.6	220.8	220.5	226.3	246.4	254.3	232.1
	2 nd half	247.2	245.3	219.4	215.4	223.6	242.1	242.6	242.2	257.6	281.9	282.5	270.3
	SD	87.8	85.9	85.3	82.7	78.7	70.8	66.8	69.4	70.7	70.1	66.8	79
	2 nd half	77.4	73.2	58.7	57.8	54	51.2	53.2	56.7	57.7	50.7	48.3	65.1
	Index Metric	January–February	February–March	March–April	April–May	May–June	June–July	July–August	August–September	September–October	October–November	November–December	December–January
	Mean	38.5	39.7	30.2	25.9	37	40	30.8	38.2	47.3	45.3	47.5	43.1
	Trend length												
	Trend slope	0.1	1.7	1.5	0.6	26.2	0	1.2	2.6	1.2	0.1	0.5	4.8
	SD	16.4	29.4	36.4	35	31.4	23.8	18.6	18.2	23.4	26.8	23.1	17.3
	Trend length												
	Trend slope	2.1	24.6	0.4	0.9	0.4	-0.5	1.3	0.8	11.5	0.7	1.4	1.4

(Cont'd...)

Table S2. (Continued)

		Province											
Karauzyak Province	Index Section	Months											
		January	February	March	April	May	June	July	August	September	October	November	December
Mean	1 st half	227.4	224.6	208.4	212.4	210.4	205.4	196.9	196.7	216.6	244.1	252.4	237.1
	2 nd half	238.4	243.7	219	209.6	213.5	217.6	219.6	219.8	230.8	248.2	257.8	256.6
	1 st half	113.3	114.6	116.4	112.2	99.7	83.5	75.7	82.9	87.6	89.7	93.7	106.1
	2 nd half	72.5	65.7	61.3	60.9	51.8	44.6	45.1	49.6	54.3	50.2	53.5	65
SD	1 st half	63.7	73.7	75.3	70.2	61.7	49.5	45.3	47.1	51.7	56.4	57.5	57.9
	2 nd half	22	21.8	11	4.2	12.7	25.8	32.4	27.1	14.8	6.8	20.2	22.4
	Trend length	-1.9	1.5	-2.4	-2	-0.8	-0.2	-1.2	0.6	0.6	1.1	0.1	1.9
	Trend slope	63.7	73.7	75.3	70.2	61.7	49.5	45.3	47.1	51.7	56.4	57.5	57.9
Trend slope	1 st half	-5	-2.4	0.1	0.7	0.4	-0.1	0.6	1	-1.9	0.8	0.9	1
	2 nd half	22	21.8	11	4.2	12.7	25.8	32.4	27.1	14.8	6.8	20.2	22.4
	Trend length	-1.9	1.5	-2.4	-2	-0.8	-0.2	-1.2	0.6	0.6	1.1	0.1	1.9
	Trend slope	63.7	73.7	75.3	70.2	61.7	49.5	45.3	47.1	51.7	56.4	57.5	57.9
Takhtakopir Province	1 st half	271.5	271	264.2	254.6	239.5	220.8	221	227.9	230.2	253.1	257.9	265.1
	2 nd half	272.3	272.4	258.1	253.6	255.6	252.3	248.6	253.9	264.7	278.2	282.1	279.8
	1 st half	79.9	77.9	72.9	76.2	71.9	61.5	59.3	64.1	73.2	73.9	72.4	79.1
	2 nd half	59.9	52.1	53.5	57.6	56.4	60.7	60.1	63	64.4	61.4	58.7	62.5
Mean	1 st half	271.5	271	264.2	254.6	239.5	220.8	221	227.9	230.2	253.1	257.9	265.1
	2 nd half	272.3	272.4	258.1	253.6	255.6	252.3	248.6	253.9	264.7	278.2	282.1	279.8
	1 st half	79.9	77.9	72.9	76.2	71.9	61.5	59.3	64.1	73.2	73.9	72.4	79.1
	2 nd half	59.9	52.1	53.5	57.6	56.4	60.7	60.1	63	64.4	61.4	58.7	62.5
SD	1 st half	32.7	32.4	26.9	24.2	15.5	1.2	1.4	8.8	15.2	18.5	21.6	25.9
	2 nd half	1.5	6.2	6.1	16.1	35.4	42	38	43.2	42.6	34.9	28.3	14.7
	Trend length	-0.2	2.1	0.5	-0.1	0.2	-15.7	0.8	4.6	0.6	0.8	-0.3	-1.2
	Trend slope	32.7	32.4	26.9	24.2	15.5	1.2	1.4	8.8	15.2	18.5	21.6	25.9
Trend slope	1 st half	4.1	-0.3	1.3	0.3	-0.4	0.2	0.6	0.2	-4.5	1.9	0.6	-3.4
	2 nd half	1.5	6.2	6.1	16.1	35.4	42	38	43.2	42.6	34.9	28.3	14.7
	Trend length	-0.2	2.1	0.5	-0.1	0.2	-15.7	0.8	4.6	0.6	0.8	-0.3	-1.2
	Trend slope	32.7	32.4	26.9	24.2	15.5	1.2	1.4	8.8	15.2	18.5	21.6	25.9

(Cont'd...)

Table S2. (Continued)

Republic of Karakalpakstan	Index	Section	Province											
			Months											
			January	February	March	April	May	June	July	August	September	October	November	December
	Mean	1 st half	240.9	235.7	214.1	203.8	205.5	204.4	201.3	200.5	213	235.3	246.7	246.5
		2 nd half	248.9	249.5	227.1	221.2	228.1	231.1	227.5	226.2	234.8	251.7	245.6	244.5
	SD	1 st half	64.8	63.5	56.8	59.9	56.4	50.6	47.8	50.1	59.3	58.3	57.9	61.5
		2 nd half	43.3	41.6	32.3	30.4	27.7	25.4	26.5	28.6	30.1	29.3	69.3	71.8
Index	Metric	January– February	February– March	March– April	April– May	May– June	June– July	July– August	August– September	September– October	October– November	November– December	December– January	
Mean	Trend length	16	19.1	21.8	28.5	35	37.4	36.6	33.6	27.3	16.4	2.3	8.3	
	Trend slope	-0.1	1	0.6	4	-2.5	1.2	1.8	0.7	0.8	-0.5	4.6	-0.8	
SD	Trend length	30.7	32.9	38.3	41.1	38.2	33.1	30.4	36.3	41.1	31.1	15.3	23.8	
	Trend slope	1.4	1.4	-0.6	0.8	0.4	-0.4	0.9	0.2	0.8	-103	0.7	-8.7	

Note: SD: Standard deviation.

Table S3. Outcomes of Spearman's rank correlation trend analysis

Province	Month	r_s	Trend	t -static	t -distribution	Significance
Ellikkala Province	January	-0.134	Decrease	-0.77	2.04	Not significant
	February	-0.105	Decrease	-0.6	2.04	Not significant
	March	0.005	Increase	0.03	2.04	Not significant
	April	0.691	Increase	5.41	2.04	Significant
	May	0.601	Increase	4.25	2.04	Significant
	June	0.527	Increase	3.5	2.04	Significant
	July	0.583	Increase	4.05	2.04	Significant
	August	0.656	Increase	4.92	2.04	Significant
	September	0.588	Increase	4.11	2.04	Significant
	October	0.359	Increase	2.18	2.04	Significant
	November	0.22	Increase	1.28	2.04	Not significant
	December	0.171	Increase	0.98	2.04	Not significant
Beruniy Province	January	-0.066	Decrease	-0.37	2.04	Not significant
	February	0.148	Increase	0.85	2.04	Not significant
	March	0.06	Increase	0.34	2.04	Not significant
	April	0.539	Increase	3.62	2.04	Significant
	May	0.684	Increase	5.31	2.04	Significant
	June	0.736	Increase	6.16	2.04	Significant
	July	0.723	Increase	5.93	2.04	Significant
	August	0.727	Increase	5.98	2.04	Significant
	September	0.602	Increase	4.26	2.04	Significant
	October	0.456	Increase	2.9	2.04	Significant
	November	0.432	Increase	2.71	2.04	Significant
	December	0.233	Increase	1.36	2.04	Not significant
Amudarya Province	January	-0.287	Decrease	-1.69	2.04	Not significant
	February	0.182	Increase	1.05	2.04	Not significant
	March	0.483	Increase	3.12	2.04	Significant
	April	0.81	Increase	7.82	2.04	Significant
	May	0.816	Increase	7.99	2.04	Significant
	June	0.779	Increase	7.03	2.04	Significant
	July	0.799	Increase	7.51	2.04	Significant
	August	0.745	Increase	6.31	2.04	Significant
	September	0.324	Increase	1.94	2.04	Not significant
	October	0.174	Increase	1	2.04	Not significant
	November	0.089	Increase	0.5	2.04	Not significant
	December	-0.148	Decrease	-0.85	2.04	Not significant
Khojeli Province	January	-0.003	Decrease	-0.02	2.04	Not significant
	February	0.309	Increase	1.84	2.04	Not significant
	March	0.248	Increase	1.45	2.04	Not significant
	April	0.614	Increase	4.4	2.04	Significant

(Cont'd...)

Groundwater trends in Karakalpakstan

Table S3. (Continued)

Province	Month	r_s	Trend	t -static	t -distribution	Significance	
Takhiatash Province	May	0.682	Increase	5.27	2.04	Significant	
	June	0.387	Increase	2.37	2.04	Significant	
	July	0.232	Increase	1.35	2.04	Not significant	
	August	0.38	Increase	2.33	2.04	Significant	
	September	0.257	Increase	1.5	2.04	Not significant	
	October	0.135	Increase	0.77	2.04	Not significant	
	November	0.275	Increase	1.62	2.04	Not significant	
	December	0.102	Increase	0.58	2.04	Not significant	
	January	0.886	Increase	3.82	2.04	Significant	
	February	0.571	Increase	1.39	2.04	Not significant	
	March	-0.114	Decrease	-0.23	2.04	Not significant	
	April	-0.057	Decrease	-0.11	2.04	Not significant	
	May	-0.657	Decrease	-1.74	2.04	Not significant	
	June	0.029	Increase	0.06	2.04	Not significant	
	July	0.486	Increase	1.11	2.04	Not significant	
	August	-0.143	Decrease	-0.29	2.04	Not significant	
	September	-0.029	Decrease	-0.06	2.04	Not significant	
	October	-0.8	Decrease	-2.67	2.04	Not significant	
	November	-0.65	Decrease	-1.48	2.04	Not significant	
	December	0.3	Increase	0.54	2.04	Not significant	
	Shumanay Province	January	0.398	Increase	2.45	2.04	Significant
		February	0.344	Increase	2.07	2.04	Significant
		March	0.43	Increase	2.69	2.04	Significant
		April	0.562	Increase	3.85	2.04	Significant
May		0.538	Increase	3.61	2.04	Significant	
June		0.589	Increase	4.13	2.04	Significant	
July		0.527	Increase	3.5	2.04	Significant	
August		0.522	Increase	3.46	2.04	Significant	
September		0.522	Increase	3.46	2.04	Significant	
October		0.382	Increase	2.34	2.04	Significant	
November		0.286	Increase	1.69	2.04	Not significant	
December		0.458	Increase	2.91	2.04	Significant	
Kanlikul Province	January	0.175	Increase	1.01	2.04	Not significant	
	February	0.238	Increase	1.38	2.04	Not significant	
	March	0.335	Increase	2.01	2.04	Not significant	
	April	0.477	Increase	3.07	2.04	Significant	
	May	0.611	Increase	4.37	2.04	Significant	
	June	0.53	Increase	3.54	2.04	Significant	
	July	0.401	Increase	2.48	2.04	Significant	
	August	0.388	Increase	2.38	2.04	Significant	

(Cont'd...)

Table S3. (Continued)

Province	Month	r_s	Trend	t -static	t -distribution	Significance
Kungirok Province	September	0.398	Increase	2.45	2.04	Significant
	October	0.419	Increase	2.61	2.04	Significant
	November	0.337	Increase	1.99	2.04	Not significant
	December	0.24	Increase	1.38	2.04	Not significant
	January	0.271	Increase	1.59	2.04	Not significant
	February	0.278	Increase	1.64	2.04	Not significant
	March	0.425	Increase	2.66	2.04	Significant
	April	0.436	Increase	2.74	2.04	Significant
	May	0.613	Increase	4.38	2.04	Significant
	June	0.602	Increase	4.27	2.04	Significant
	July	0.586	Increase	4.09	2.04	Significant
	August	0.488	Increase	3.17	2.04	Significant
Muynak Province	September	0.418	Increase	2.61	2.04	Significant
	October	0.376	Increase	2.3	2.04	Significant
	November	0.31	Increase	1.82	2.04	Not significant
	December	0.292	Increase	1.7	2.04	Not significant
	January	0.614	Increase	4.4	2.04	Significant
	February	0.67	Increase	5.1	2.04	Significant
	March	0.638	Increase	4.69	2.04	Significant
	April	0.63	Increase	4.59	2.04	Significant
	May	0.676	Increase	5.19	2.04	Significant
	June	0.764	Increase	6.7	2.04	Significant
	July	0.672	Increase	5.13	2.04	Significant
	August	0.644	Increase	4.76	2.04	Significant
Nukus Province	September	0.634	Increase	4.64	2.04	Significant
	October	0.607	Increase	4.32	2.04	Significant
	November	0.674	Increase	5.09	2.04	Significant
	December	0.63	Increase	4.51	2.04	Significant
	January	0.259	Increase	1.52	2.04	Not significant
	February	0.208	Increase	1.2	2.04	Not significant
	March	-0.118	Decrease	-0.67	2.04	Not significant
	April	-0.162	Decrease	-0.93	2.04	Not significant
	May	0.391	Increase	2.4	2.04	Significant
	June	0.209	Increase	1.21	2.04	Not significant
	July	0.311	Increase	1.85	2.04	Not significant
	August	0.245	Increase	1.43	2.04	Not significant
September	-0.086	Decrease	-0.49	2.04	Not significant	
October	-0.046	Decrease	-0.26	2.04	Not significant	
November	0.024	Increase	0.13	2.04	Not significant	
December	0.177	Increase	1	2.04	Not significant	

(Cont'd...)

Groundwater trends in Karakalpakstan

Table S3. (Continued)

Province	Month	r_s	Trend	t -static	t -distribution	Significance
Kegeyli Province	January	0.383	Increase	2.35	2.04	Significant
	February	0.39	Increase	2.4	2.04	Significant
	March	0.215	Increase	1.24	2.04	Not significant
	April	0.375	Increase	2.29	2.04	Significant
	May	0.468	Increase	3	2.04	Significant
	June	0.473	Increase	3.04	2.04	Significant
	July	0.437	Increase	2.75	2.04	Significant
	August	0.404	Increase	2.5	2.04	Significant
	September	0.461	Increase	2.94	2.04	Significant
	October	0.51	Increase	3.36	2.04	Significant
	November	0.509	Increase	3.29	2.04	Significant
	December	0.49	Increase	3.13	2.04	Significant
Buzatau Province	January	0.591	Increase	2.93	2.12	Significant
	February	0.556	Increase	2.68	2.12	Significant
	March	0.575	Increase	2.81	2.12	Significant
	April	0.619	Increase	3.15	2.12	Significant
	May	0.732	Increase	4.29	2.12	Significant
	June	0.707	Increase	4	2.12	Significant
	July	0.753	Increase	4.58	2.12	Significant
	August	0.721	Increase	4.17	2.12	Significant
	September	0.72	Increase	4.15	2.12	Significant
	October	0.679	Increase	3.7	2.12	Significant
	November	0.248	Increase	0.99	2.13	Not significant
	December	0.277	Increase	1.12	2.13	Not significant
Chimbay Province	January	0.328	Increase	1.97	2.04	Not significant
	February	0.407	Increase	2.52	2.04	Significant
	March	0.475	Increase	3.05	2.04	Significant
	April	0.605	Increase	4.29	2.04	Significant
	May	0.571	Increase	3.93	2.04	Significant
	June	0.581	Increase	4.04	2.04	Significant
	July	0.446	Increase	2.82	2.04	Significant
	August	0.459	Increase	2.92	2.04	Significant
	September	0.45	Increase	2.85	2.04	Significant
	October	0.541	Increase	3.64	2.04	Significant
	November	0.442	Increase	2.74	2.04	Significant
	December	0.51	Increase	3.3	2.04	Significant
Karauzyak Province	January	0.34	Increase	2.04	2.04	Significant
	February	0.474	Increase	3.04	2.04	Significant
	March	0.493	Increase	3.21	2.04	Significant
	April	0.361	Increase	2.19	2.04	Significant

(Cont'd...)

Table S3. (Continued)

Province	Month	r_s	Trend	t -static	t -distribution	Significance
Takhtakopir Province	May	0.468	Increase	2.99	2.04	Significant
	June	0.429	Increase	2.69	2.04	Significant
	July	0.569	Increase	3.92	2.04	Significant
	August	0.515	Increase	3.4	2.04	Significant
	September	0.311	Increase	1.85	2.04	Not significant
	October	0.274	Increase	1.61	2.04	Not significant
	November	0.295	Increase	1.72	2.04	Not significant
	December	0.416	Increase	2.55	2.04	Significant
	January	0.245	Increase	1.43	2.04	Not significant
	February	0.308	Increase	1.83	2.04	Not significant
	March	0.111	Increase	0.63	2.04	Not significant
	April	0.202	Increase	1.17	2.04	Not significant
Republic of Karakalpakstan	May	0.378	Increase	2.31	2.04	Significant
	June	0.373	Increase	2.27	2.04	Significant
	July	0.343	Increase	2.07	2.04	Significant
	August	0.325	Increase	1.94	2.04	Not significant
	September	0.325	Increase	1.94	2.04	Not significant
	October	0.506	Increase	3.32	2.04	Significant
	November	0.52	Increase	3.39	2.04	Significant
	December	0.426	Increase	2.62	2.04	Significant
	January	0.348	Increase	2.1	2.04	Significant
	February	0.397	Increase	2.45	2.04	Significant
	March	0.476	Increase	3.06	2.04	Significant
	April	0.641	Increase	4.72	2.04	Significant
May	0.643	Increase	4.75	2.04	Significant	
June	0.706	Increase	5.64	2.04	Significant	
July	0.712	Increase	5.73	2.04	Significant	
August	0.688	Increase	5.36	2.04	Significant	
September	0.591	Increase	4.15	2.04	Significant	
October	0.555	Increase	3.77	2.04	Significant	
November	0.532	Increase	3.5	2.04	Significant	
December	0.503	Increase	3.24	2.04	Significant	

Note: r_s : Spearman's rank correlation coefficient.

Groundwater trends in Karakalpakstan

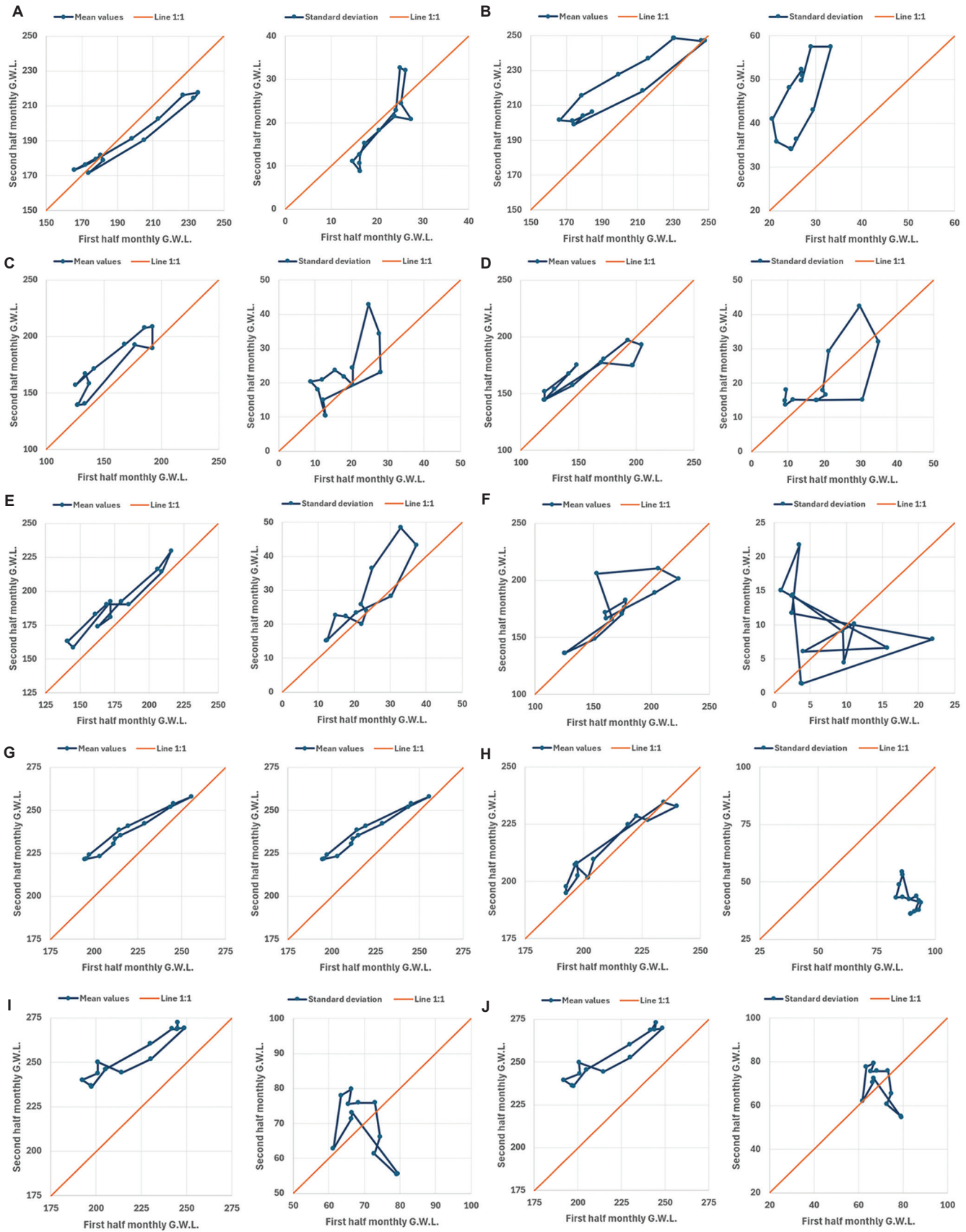


Figure S1. (Cont'd...)

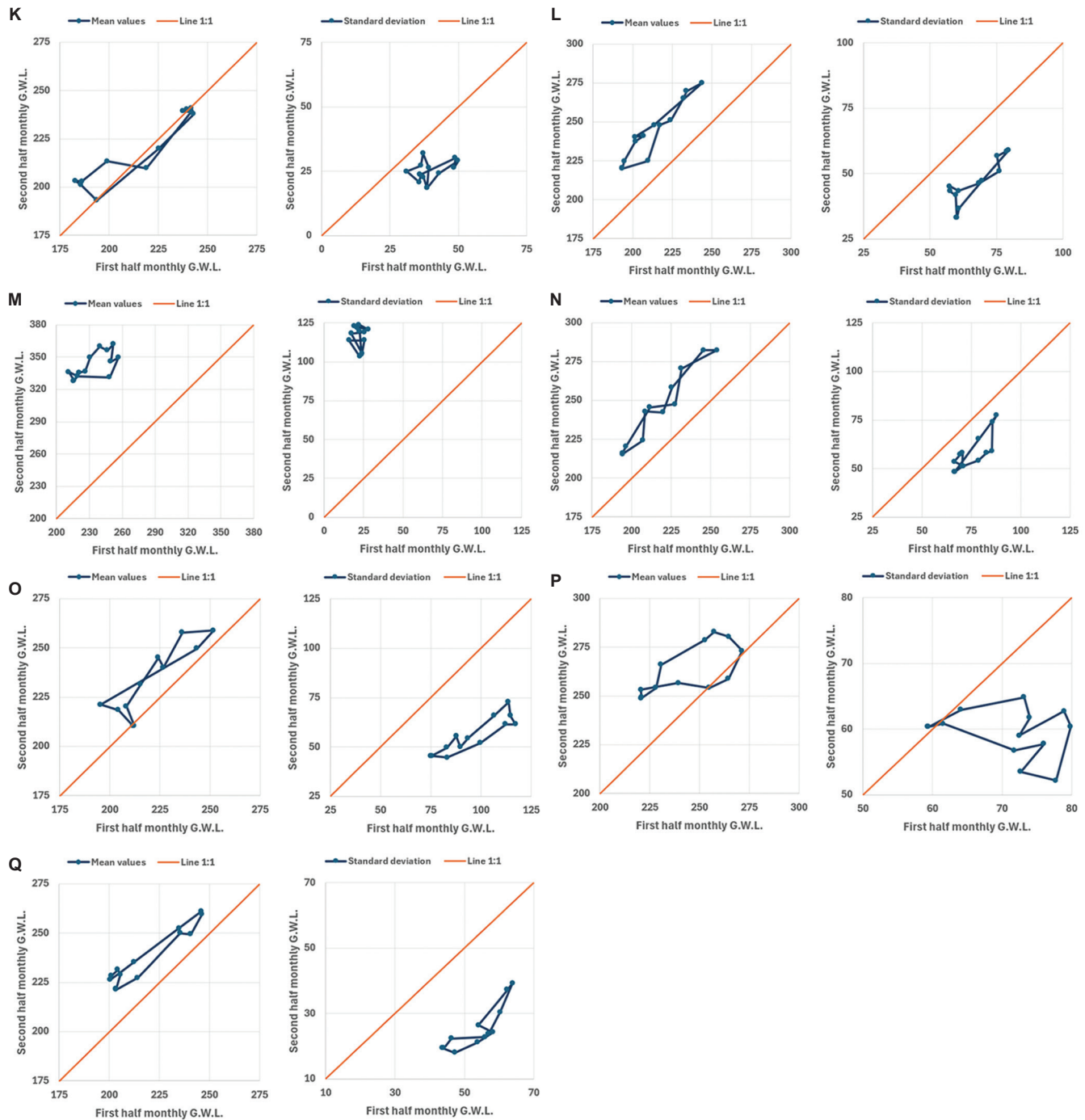


Figure S1. Innovative polygon trend analysis graph: Groundwater level (G.W.L.) records. (A) Turtkul Province, (B) Ellikkala Province, (C) Beruniy Province, (D) Amudarya Province, (E) Khojeli Province, (F) Takhiatash Province, (G) Shumanay Province, (H) Kanlikul Province, (I) Kongirot Province, (J) Muynak Province, (K) Nukus Province, (L) Kegeyli Province, (M) Buzatau Province, (N) Chimbay Province, (O) Karauzyak Province, (P) Takhtakopir Province, (Q) Republic of Karakalpakstan