

## Supplementary Material

# Two Comprehensive and Practical Methods for Simulating Pan Evaporation under Different Climate Conditions in Iran

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This file includes Supplementary Tables S1–S9 and Figures S1–S3 referred to in the main article.

**Table S1.** Experimental relationships used in the literature to simulate evaporation from open water surfaces.

	Experimental relationship	Description	Reference
1	$E = 0.35(e_s - e_d)(0.5 + U_2/100)$	$e_s - e_d = \left[ e^{\frac{16.78T-116.9}{T+237.3}} \right] (1 - \frac{RH}{100})$	[1]
2	$E = 0.291(A^{-0.05})(U_2)(e_s - e_d)$	Use mass transfer method to calculate evaporation, For reservoirs with an area of 0.5 hectares to 12,000 hectares	[2]
3	$E = (1 + \frac{U}{16})(C)(e_s - e_d)$	Meyer's formula	[3]
4	$E = 0.833(4.75T + 43.3)$	United States Bureau of Reclamation (USBR)	[4]
5	$E = 0.028(U)(e_s - e_d)$	Hefner formula	[5]
6	$E = (0.116 + 0.017U)(e_s - e_d)$	Shahtin formula	[6]
7	$E = 0.03(U)(e_s - e_d)$	Marciano formula	[7,8]
8	$E = 0.0018(T + 2.5)^2(100 + RH)$	Ivanov formula	[9]
9	$E = 0.033 + 0.0531Td_{max}$	----	[10]
10	$E = -0.188 + 1.92e_d + 0.115T_{max}$	----	[10]

**Table S2.** Results of previous studies on sensitive input parameters in simulating pan evaporation.

Source	Case study	Methods	Meteorological parameters	Summary of results
[11]	Tabriz and Urmia, Iran	MLP RBNN	Air temperature, solar radiation, air pressure, relative humidity, wind speed	Air temperature and solar radiation are effective parameters in estimation of daily evaporation
[12]	Bobo-Dioulasso, Burkina Faso	BPNN	Mean temperature, maximum temperature, minimum temperature, relative humidity, wind speed, sunshine duration	Wind speed is the effective parameter in estimation of daily evaporation
[13]	Fourteen stations from several climatic regions in Turkey, Cyprus, Iraq, Iran, and Libya	FFNN ANFIS SVR	Mean temperature, maximum temperature, minimum temperature, mean relative humidity, maximum and minimum wind speed, precipitation, mean wind speed, solar radiation, surface pressure,	Depending on the climate of the region, solar radiation, temperatures, and surface pressure are the most dominant parameters
[14]	Uttarakhand, India	ANN MLR	One day-lagged rainfall, one day-lagged relative humidity, daily maximum temperature, and minimum temperature	Based on sensitivity analysis, one day-lagged relative humidity is the most effective parameter, followed by one day-lagged rainfall, maximum temperature and minimum temperature
[15]	Thissio, Athens	Penman	Surface air temperature, relative humidity, wind speed, and sun-shine duration	During summer months, temperature has a greater influence on monthly evaporation, while relative humidity greatly influences evaporation during winter months.
[16]	Eight stations in Burkina Faso	Penman-Monteith	Maximum and minimum temperature, solar radiation, wind speed, and maximum and minimum relative humidity.	Evaporation is most sensitive to variations in solar radiation, maximal temperature and wind speed.
[17]	Senegal River basin	Penman-Monteith	Maximum temperature, minimum temperature, wind speed,	Sensitivity analysis revealed that evapotranspiration is

			relative humidity and solar radiation	more sensitive to relative humidity, maximum temperature and solar radiation
[18]	Tabriz, Iran	Garson Equation and Artificial Neural Network	Daily mean temperature, relative humidity, sunshine hours, solar radiation, wind speed, and pressure	Daily mean temperature and relative humidity are the most effective variables.
[19]	Guinea, Savanna, and Sahel, West Africa	Nonparametric trend test of the Mann-Kendall, and Kolmogorov-Smirnov	Air temperature, precipitation, and cloud cover	Maximum temperature, more than other dominant climatic parameters, contributes significantly
[20]	The prefecture of Florina, Western Macedonia, Greece	Penman-Monteith	Mean (Tmean), minimum (Tmin) and maximum (Tmax) temperature, the minimum (RHmin) and maximum (RHmax) relative humidity, wind speed at 2m high (u2), solar radiation (Rs), sunshine duration (n).	Solar radiation and temperature are the main parameters affecting evapotranspiration
[21]	Garmsar, Iran	GMDH-NN	Minimum (Tmin) and maximum (Tmax) temperature, wind speed at 2m high (u2), relative humidity (%), air humidity (RH), sun-shine duration (n), air pressure (Pa)	Sensitivity analysis showed that minimum temperature and relative humidity (%) have a higher effect on evaporation pan modeling than other input parameters.

**Table S3.** Results of previous studies on simulating pan evaporation using MLP-NN.

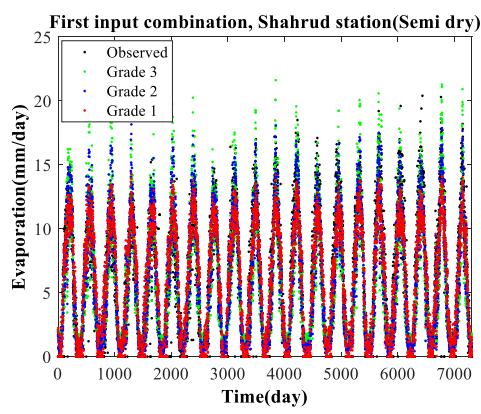
Source	Case study	Methods	Meteorological parameters	Summary of results
[22]	Rome, Italy	MLP	Precipitation, temperature, relative humidity, solar radiation, wind speed	Artificial neural network has less error than Priestley-Taylor multiple linear regression.
[23]	Eğirdir Lake, Turkey	MLP	Water surface temperature, temperature, relative humidity, solar radiation, wind speed, air pressure	Artificial neural network gives higher correlation with values of pan evaporation measured by the Penman method
[24]	Fresno, Los Angeles and San Diego, United States	MLP RBNN GRNN	Temperature, relative humidity, solar radiation, wind speed, air pressure	The results showed superiority of the MLP and RBNN models.
[25]	Himalayas in Uttarak-	ANN	Maximum and mini-	The ANN model with

	hand state, India	CANFIS MLR	mean air temperature, relative humidity in the morning (7 am) and afternoon (2 pm), wind speed, and sunshine hours	six input variables gives better predictions than the CANFIS and MLR models.
[13]	Fourteen stations from several climatic regions in Turkey, Cyprus, Iraq, Iran, and Libya	FFNN ANFIS SVR	Mean temperature, maximum temperature, minimum temperature, mean relative humidity, maximum and minimum wind speed, precipitation, mean wind speed, solar radiation, surface pressure,	Artificial intelligence-based ensemble modeling is preferable to empirical ensemble modeling.
[26]	Anzali and Astara, Iran krill herd optimization – the MLP-KH model	MLP,	Rainfall; air temperature (maximum, minimum and mean); relative humidity (maximum, minimum, and mean); actual sunshine hours; and wind speed	MLP-KH is a good choice to be used as an estimation model in the study area
[27]	Tabriz, Iran	SVR ANN WSVR WANN	Air temperature, solar radiation, relative humidity, wind speed, evaporation	The ANN model produces better results than the other models tested.
[28]	Kuwait International Airport	ANN	Mean temperature, wind speed, and mean relative humidity	ANN is satisfactory in modeling pan evaporation in hyper-arid climatic conditions
[29]	Anzali and Astara, Iran	MLP SVM SOMNN	Mean temperature, maximum temperature, minimum temperature, mean relative humidity, maximum and minimum relative humidity, precipitation, wind speed, sunshine duration	The results showed superiority of the SOMNN model.
[30]	Gangtok and Imphal, India	MLR ANN	Minimum and maximum air temperature, maximum and minimum relative humidity, wind speed, sunshine hours	The ANN model performs better than the MLR model.

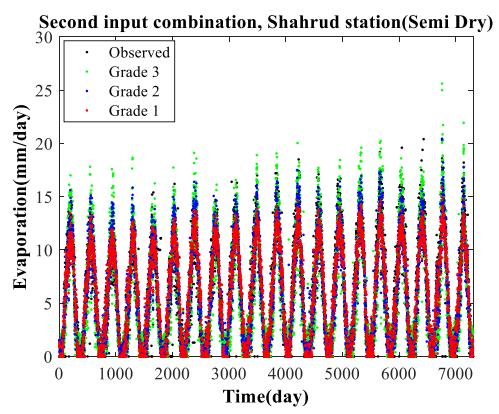
**Table S4.** Location of synoptic stations in Iran from which data were obtained for the present study.

	Station name	Lat.	Long.	Elevation	Climate	Used for
1	Semnan	35.58	53.42	1127	Dry	Modeling
2	Garmsar	35.24	52.36	899.9	Dry	Validation

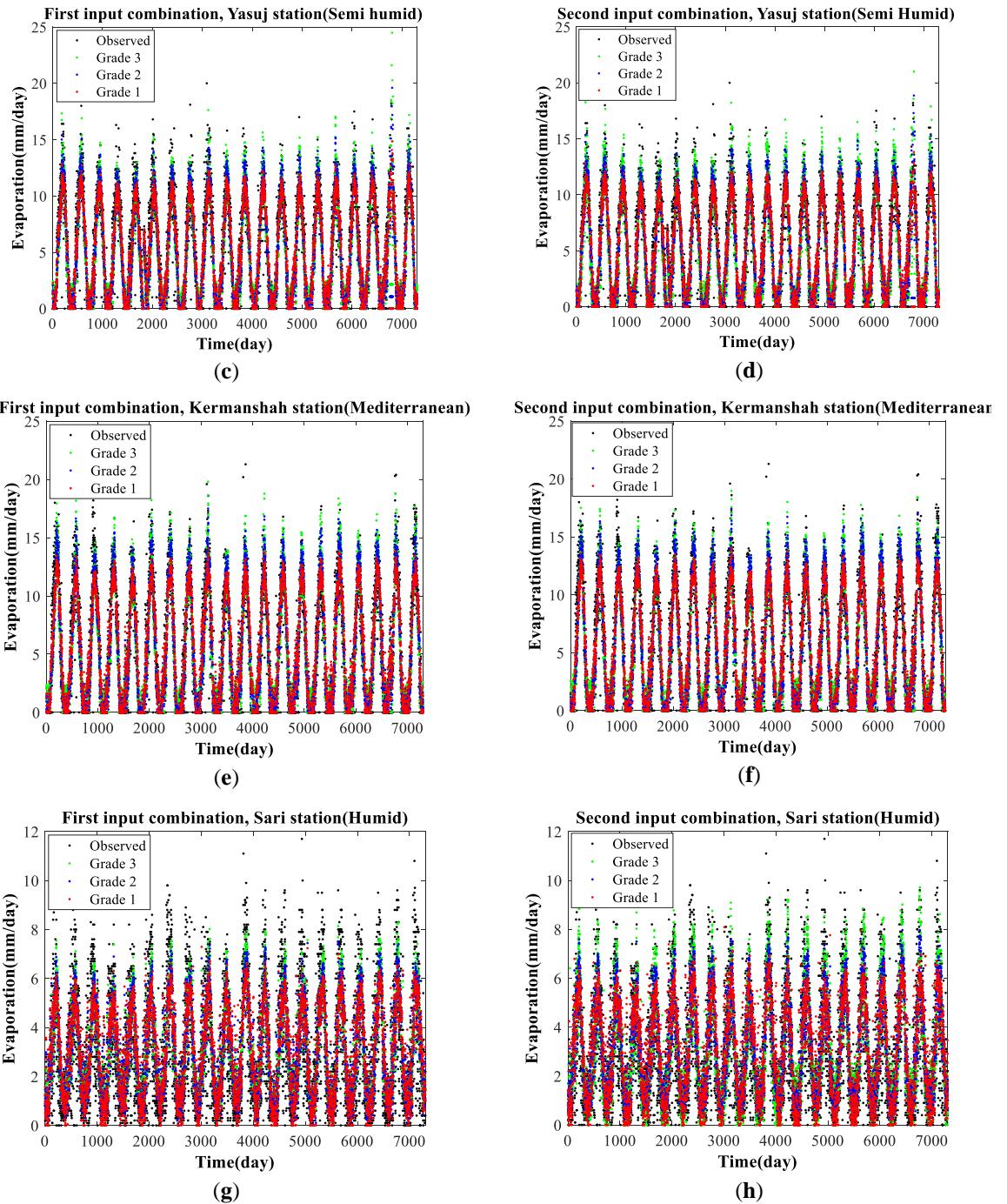
3	Kerman	30.25	56.96	1754	Dry	Validation
4	Tehran	35.79	51.48	1549.1	Dry	Validation
5	Karaj	35.80	50.95	1292.9	Dry	Validation
6	Qom	34.77	50.85	879.1	Dry	Validation
7	Esfahan	35.51	51.70	1550.4	Dry	Validation
8	Yazd	31.90	54.28	1230.2	Dry	Validation
9	Zahedan	29.47	60.90	1370	Dry	Validation
10	Ahvaz	31.34	48.74	22.5	Dry	Validation
11	Hajiabad	28.31	55.91	931.2	Dry	Validation
12	Borazjan	29.25	51.16	89.9	Dry	Validation
13	Bojnourd	37.48	57.30	1065	Dry	Validation
14	Shahrud	36.38	54.92	1325.2	Semi-Dry	Modeling
15	Mashhad	36.23	59.63	999.2	Semi-Dry	Validation
16	Damghan	36.14	54.32	1155.4	Semi-Dry	Validation
17	Arak	34.07	49.78	1702.8	Semi-Dry	Validation
18	Qazvin	36.31	50.02	1279.1	Semi-Dry	Validation
19	Sanandaj	35.25	47.01	1373.4	Semi-Dry	Validation
20	Birjand	32.89	59.28	1491	Semi-Dry	Validation
22	Nahavand	31.14	48.41	1677.8	Semi-Dry	Validation
22	Shiraz	29.56	52.6	1488	Semi-Dry	Validation
23	Rasht	37.32	49.62	-8.6	Very Humid	Modeling
24	Lahijan	37.19	50.01	34.2	Very Humid	Validation
25	Bandar Anzali	37.47	49.45	-23.6	Very Humid	Validation
26	Sari	36.53	52.98	23	Humid	Modeling
27	Gorgan	36.9	54.41	0	Humid	Validation
28	Babolsar	36.72	52.65	-21	Humid	Validation
29	Noshahr	36.66	51.46	-20.9	Humid	Validation
30	Yasuj	30.69	51.55	1816.3	Semi-Humid	Modeling
31	Kuhrang	32.45	50.12	2365	Semi-Humid	Validation
32	Khoramabad	33.43	48.28	1147.8	Semi-Humid	Validation
33	Kermanshah	34.35	47.15	1318.5	Mediterranean	Modeling
34	Ilam	33.58	46.39	1337	Mediterranean	Validation
35	Orumiye	37.65	40.05	1328	Mediterranean	Validation
36	Tabriz	38.12	46.24	1361	Mediterranean	Validation
37	Khalkhal	37.6	48.53	1797.4	Mediterranean	Validation
38	Ardebil	38.21	48.32	1335.2	Mediterranean	Validation



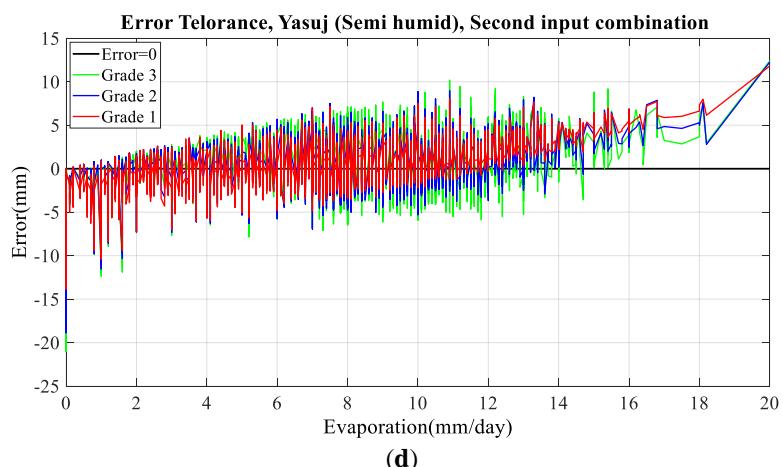
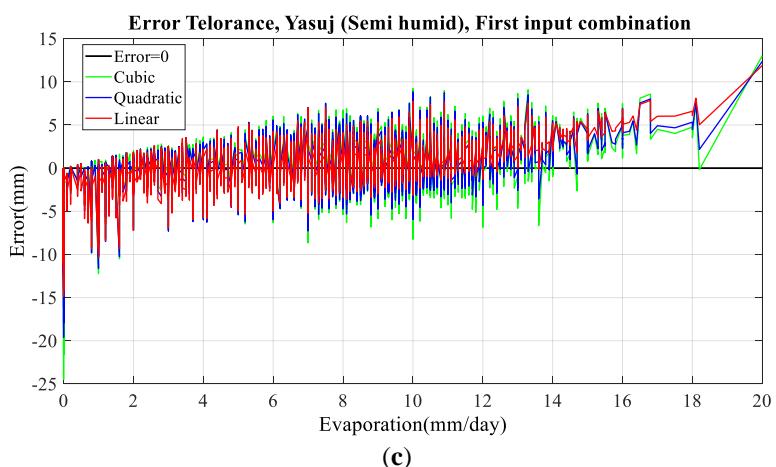
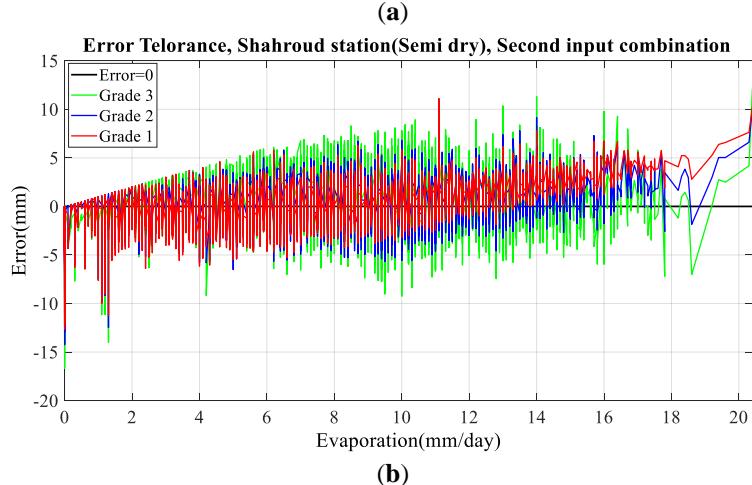
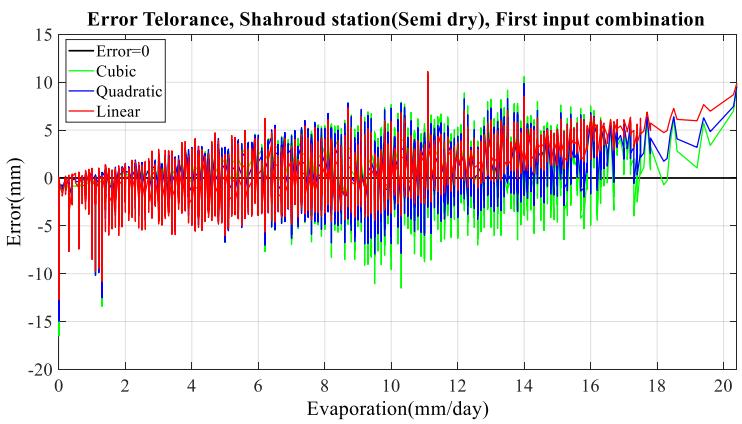
(a)

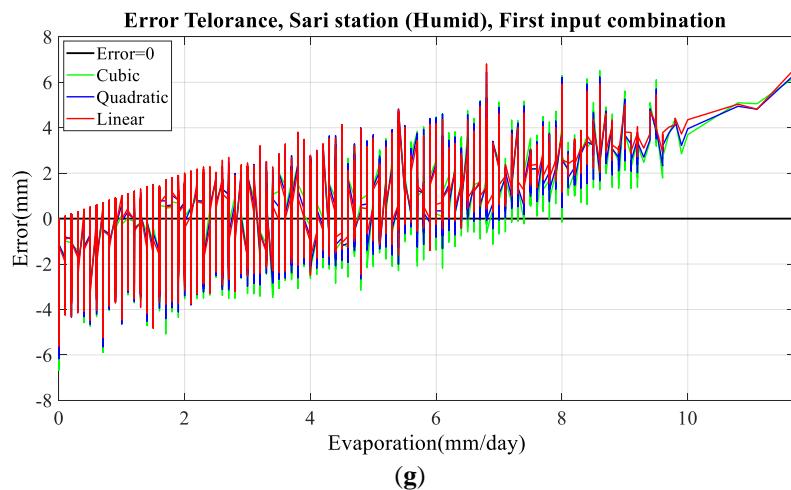
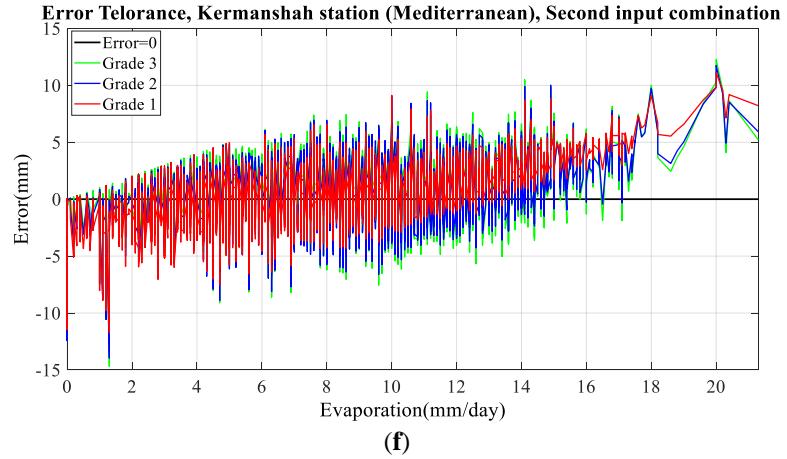
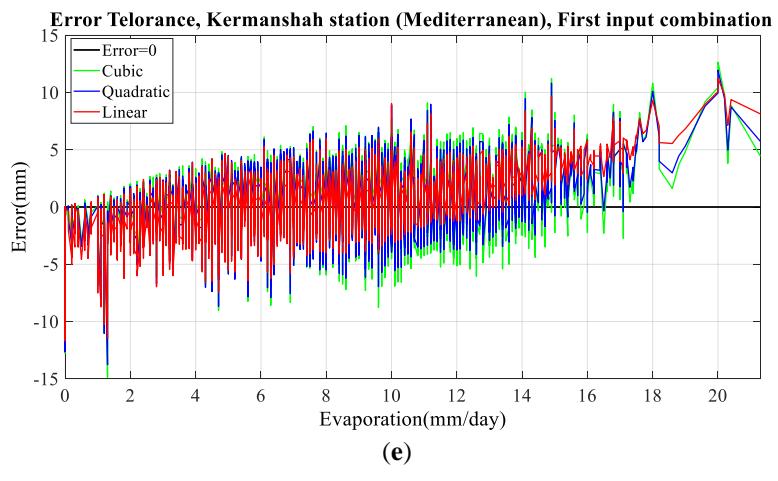


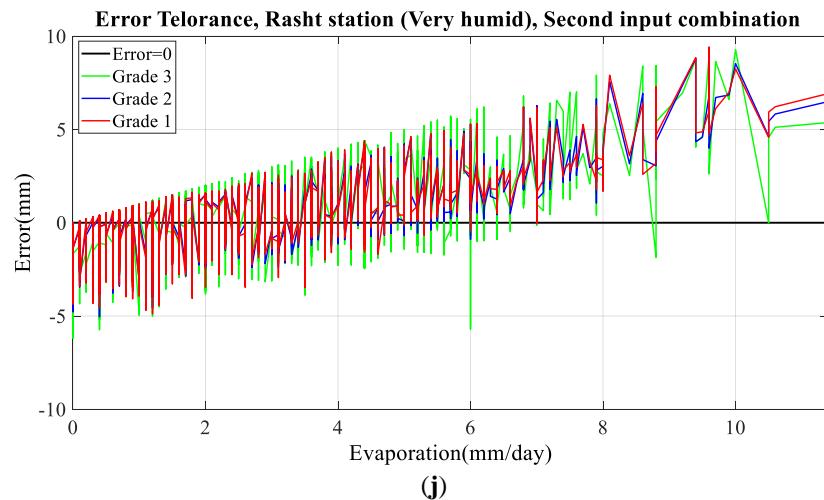
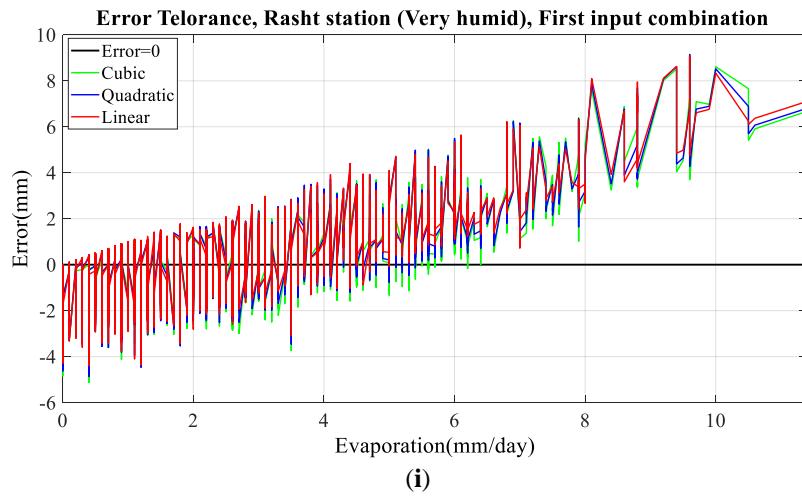
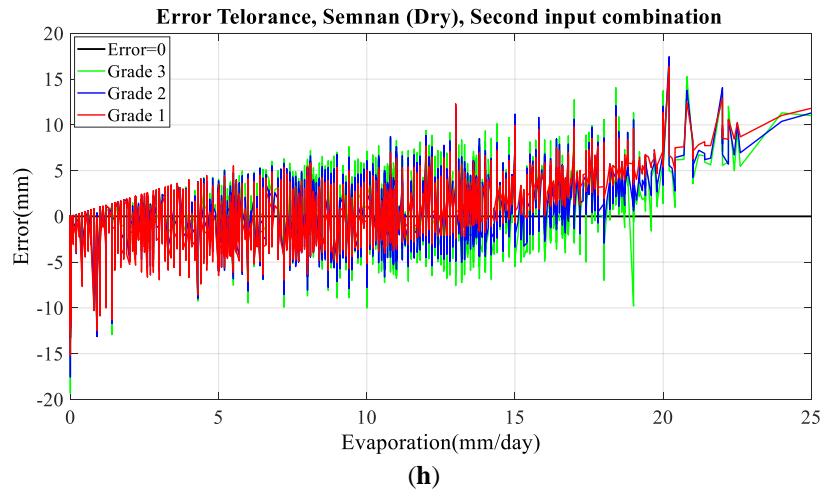
(b)



**Figure S1.** Time series of observed and simulated pan evaporation using linear, quadratic, and cubic experimental relationships and both input combinations (2020-2000) for: (a) Shahroud station (semi-dry, two-parameter input combination), (b) Shahroud station (semi-dry, four-parameter input combination), (c) Yasuj station (semi-humid, two-parameter input combination), (d) Yasuj station (semi-humid, four-parameter input combination), (e) Kermanshah station (Mediterranean, two-parameter input combination), (f) Kermanshah station (Mediterranean, four-parameter input combination), (g) Sari station (humid, two-parameter input combination), (h) Sari station (humid, four-parameter input combination).







**Figure S2.** Error tolerance of linear, quadratic, and cubic experimental relationships in estimating pan evaporation (2020-2000) at: (a) Shahroud station (semi-dry, two-parameter input combination), (b) Shahroud station (semi-dry, four-parameter input combination), (c) Yasuj station (semi-humid, two-parameter input combination), (d) Yasuj station (semi-humid, four-parameter input combination), (e) Kermanshah station (Mediterranean, two-parameter input combination), (f) Kermanshah station (Mediterranean, four-parameter input combination), (g) Sari station (humid, two-parameter input combination) (h) Sari station (humid, four-parameter input combination), (i) Rasht station (very humid, two-parameter input combination), (k) Rasht station (very humid, four-parameter input combination).

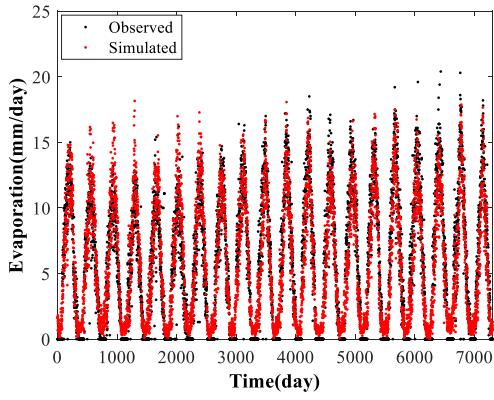
**Table S5.** Values of statistical coefficients obtained in comparisons between observed pan evaporation and pan evaporation simulated using linear, quadratic, and cubic experimental relationships (2000–2020). The yellow shading indicates the best experimental relationship in each input combination for the six stations.

Scenario number	Eq number	Station name	Climate	r	NSE	PBIAS	RMSE
1	1	Semnan	Dry	0.90	0.81	-2.891	2.538
1	2	Semnan	Dry	0.90	0.82	-0.135	2.530
1	3	Semnan	Dry	0.88	0.77	-0.273	2.772
2	1	Semnan	Dry	0.90	0.81	-3.300	2.497
2	2	Semnan	Dry	0.90	0.82	-0.192	2.455
2	3	Semnan	Dry	0.88	0.77	0.612	2.735
1	1	Shahrood	Semi-Dry	0.90	0.82	-2.795	2.105
1	2	Shahrood	Semi-Dry	0.90	0.82	0.003	2.136
1	3	Shahrood	Semi-Dry	0.87	0.75	0.779	2.448
2	1	Shahrood	Semi-Dry	0.92	0.85	-2.914	1.898
2	2	Shahrood	Semi-Dry	0.92	0.84	-0.368	1.943
2	3	Shahrood	Semi-Dry	0.87	0.75	1.253	2.463
1	1	Kermanshah	Mediterranean	0.92	0.83	-4.145	2.081
1	2	Kermanshah	Mediterranean	0.92	0.84	-0.414	2.065
1	3	Kermanshah	Mediterranean	0.89	0.79	-0.705	2.297
2	1	Kermanshah	Mediterranean	0.92	0.84	-4.033	2.041
2	2	Kermanshah	Mediterranean	0.91	0.84	-0.581	2.025
2	3	Kermanshah	Mediterranean	0.90	0.81	-1.406	2.229
1	1	Yasuj	Semi-Humid	0.90	0.81	-3.223	1.965
1	2	Yasuj	Semi-Humid	0.90	0.80	-0.343	2.056
1	3	Yasuj	Semi-Humid	0.86	0.74	-0.354	2.329
2	1	Yasuj	Semi-Humid	0.90	0.82	-3.145	1.957
2	2	Yasuj	Semi-Humid	0.89	0.80	-0.582	2.043
2	3	Yasuj	Semi-Humid	0.86	0.74	0.757	2.350
1	1	Sari	Humid	0.78	0.61	-0.229	1.411
1	2	Sari	Humid	0.80	0.64	-0.0004	1.370
1	3	Sari	Humid	0.79	0.63	0.429	1.379
2	1	Sari	Humid	0.78	0.61	-0.70	1.407
2	2	Sari	Humid	0.80	0.64	0.017	1.361
2	3	Sari	Humid	0.74	0.52	1.383	1.571
1	1	Rasht	Very Humid	0.75	0.57	-0.583	1.241
1	2	Rasht	Very Humid	0.78	0.60	-0.008	1.195
1	3	Rasht	Very Humid	0.78	0.60	0.220	1.186
2	1	Rasht	Very Humid	0.76	0.58	-0.504	1.221
2	2	Rasht	Very Humid	0.78	0.61	0.008	1.177
2	3	Rasht	Very Humid	0.67	0.42	2.034	1.436

**Table S6.** Weights of linear, quadratic, and cubic experimental relationships obtained using the genetic algorithm for the six climate types with the two-parameter and four-parameter input combinations.

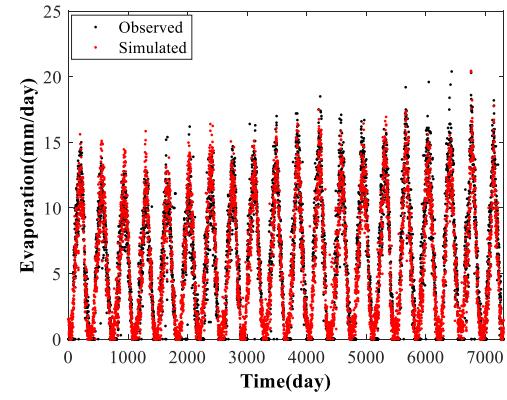
Comb num- ber	Equation type	Station name	Climate	a	b	c	d	e
1	Linear	Semnan	Dry	0.5032	0.0052	-3.1419	-	-
1	Quadratic	Semnan	Dry	0.01288	-0.0001	0.8786	-	-
1	Cubic	Semnan	Dry	0.0003	$-5 \times 10^{-6}$	2.5671	-	-
2	Linear	Semnan	Dry	0.4524	0.4013	0.1183	0.0032	-3.9509
2	Quadratic	Semnan	Dry	0.0118	0.0700	0.0050	-0.0001	0.4585
2	Cubic	Semnan	Dry	0.0003	0.0110	0.0015	$-1 \times 10^{-6}$	0.6849
1	Linear	Shahrood	Semi-Dry	0.4649	0.0003	-1.4336	-	-
1	Quadratic	Shahrood	Semi-Dry	0.0151	-0.0001	1.0043	-	-
1	Cubic	Shahrood	Semi-Dry	0.0005	$-1 \times 10^{-6}$	1.8975	-	-
2	Linear	Shahrood	Semi-Dry	0.4035	0.6599	0.0972	0.0016	-2.8272
2	Quadratic	Shahrood	Semi-Dry	0.01286	0.1183	0.0031	-0.0002	0.9686
2	Cubic	Shahrood	Semi-Dry	0.0004	0.01792	0.00296	$4 \times 10^{-6}$	-1.1247
1	Linear	Kermanshah	Mediterra- nean	0.4231	-0.0251	-0.4579	-	-
1	Quadratic	Kermanshah	Mediterra- nean	0.01344	-0.0002	1.0432	-	-
1	Cubic	Kermanshah	Mediterra- nean	0.0004	$-5 \times 10^{-6}$	2.4833	-	-
2	Linear	Kermanshah	Mediterra- nean	0.4257	-0.0234	0.1545	-0.0074	-2.4030
2	Quadratic	Kermanshah	Mediterra- nean	0.0130	-0.0044	0.0090	-0.0001	0.3438
2	Cubic	Kermanshah	Mediterra- nean	0.0003	-0.0007	0.0009	$-4 \times 10^{-6}$	2.1078
1	Linear	Yasuj	Semi-Humid	0.4609	-0.0114	-1.4563	-	-
1	Quadratic	Yasuj	Semi-Humid	0.0146	-0.0002	1.0604	-	-
1	Cubic	Yasuj	Semi-Humid	0.0004	$-3 \times 10^{-6}$	2.1461	-	-
2	Linear	Yasuj	Semi-Humid	0.4642	-0.0996	0.0794	-0.0006	-2.4981
2	Quadratic	Yasuj	Semi-Humid	0.0142	0.0030	0.0038	-0.0001	0.7824
2	Cubic	Yasuj	Semi-Humid	0.0004	0.0060	0.0021	$1 \times 10^{-6}$	-0.4868
1	Linear	Sari	Humid	0.2018	-0.04557	2.9802	-	-
1	Quadratic	Sari	Humid	0.00587	-0.0002	2.4794	-	-
1	Cubic	Sari	Humid	0.0002	$-1 \times 10^{-6}$	1.8954	-	-
2	Linear	Sari	Humid	0.2059	0.14834	0.0069	-0.0570	3.5499
2	Quadratic	Sari	Humid	0.0060	0.05189	0.0120	$6 \times 10^{-5}$	-0.3573
2	Cubic	Sari	Humid	0.0002	0.01242	0.0017	$5 \times 10^{-6}$	-2.4353
1	Linear	Rasht	Very Humid	0.1655	-0.0319	2.1763	-	-
1	Quadratic	Rasht	Very Humid	0.0049	-0.0002	2.3670	-	-
1	Cubic	Rasht	Very Humid	0.0001	$-1 \times 10^{-6}$	2.0612	-	-
2	Linear	Rasht	Very Humid	0.1480	0.1325	0.04514	-0.0371	2.4924
2	Quadratic	Rasht	Very Humid	0.0050	0.0269	0.0046	-0.0001	1.2651
2	Cubic	Rasht	Very Humid	0.0001	0.0095	0.0015	$4 \times 10^{-6}$	-2.5768

First input combination, Shahrud station(Semi Dry),  $C_c = 1$



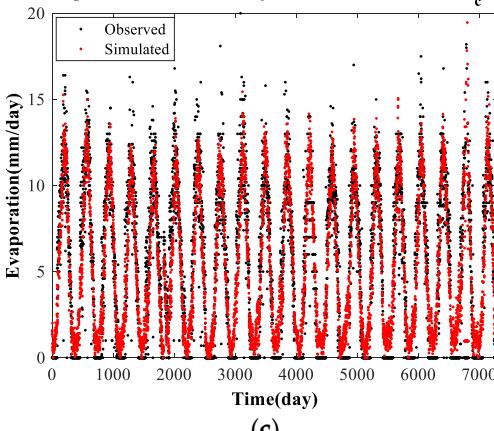
(a)

Second input combination, Shahrud station(Semi Dry),  $C_c = 1$



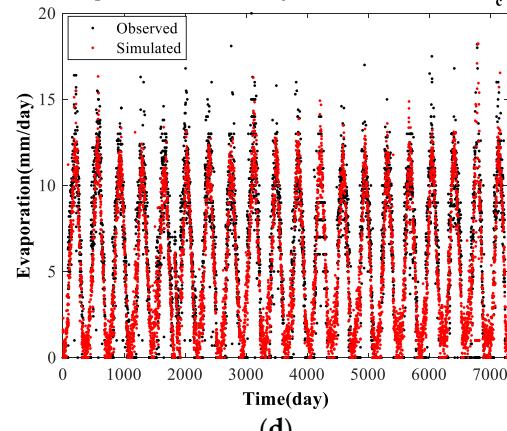
(b)

First input combination, Yasuj station(Semi Humid),  $C_c = 0.96$



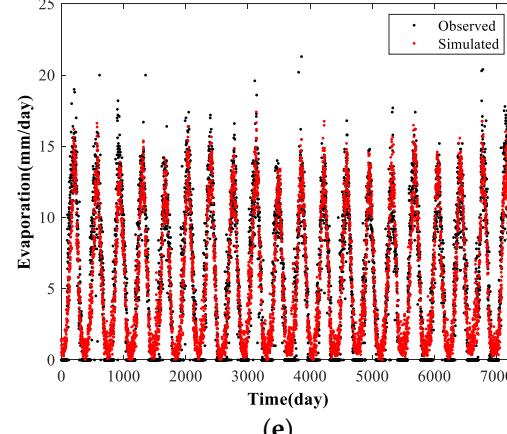
(c)

Second input combination, Yasuj station(Semi Humid),  $C_c = 0.96$



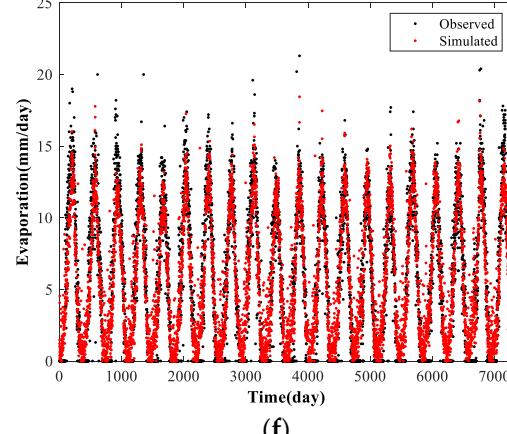
(d)

First input combination, Kermanshah station(Mediterranean),  $C_c = 0.89$



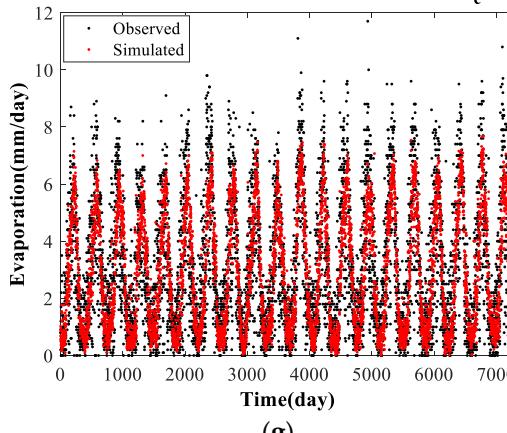
(e)

Second input combination, Kermanshah station(Mediterranean),  $C_c = 0.88$



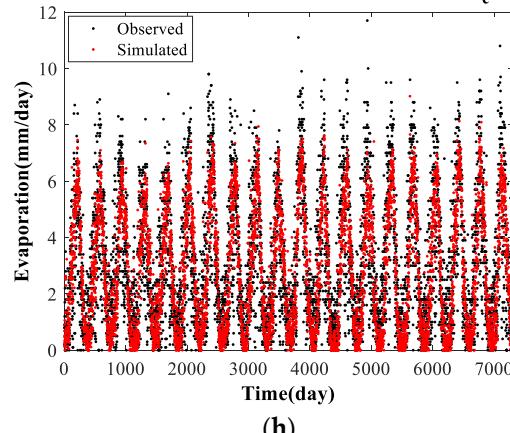
(f)

First input combination, Sari station(Humid),  $C_c = 0.47$



(g)

Second input combination, Sari station(Humid),  $C_c = 0.57$



(h)

**Figure S3.** Time series of observed and simulated evaporation using the basic relationship with the six climate correction coefficients (2020–2000) for: (a) Shahrood station (semi-dry, two-parameter input combination), (b) Shahrood station (semi-dry, four-parameter input combination), (c) Yasuj station (semi-humid, two-parameter input combination), (d) Yasuj station (semi-humid, four-parameter input combination), (e) Kermanshah station (Mediterranean, two-parameter input combination), (f) Kermanshah station (Mediterranean, four-parameter input combination), (g) Sari station (humid, two-parameter input combination), (h) Sari station (humid, four-parameter input combination).

**Table S7.** Statistical coefficients obtained for comparisons between observed pan evaporation and pan evaporation simulated using correction coefficients ( $C_c$ ) and the basic relationship for six selected stations representing different climate conditions and both input combinations.

Comb no.	Basic equa- tion (Cli- mate)	Station name	Climate	$C_c$	r	NSE	PBIAS (%)	RMSE
1	Quadratic (Semi-Dry)	Semnan	Dry	0.845	0.90	0.81	-1.708	2.540
1	Quadratic (Semi-Dry)	Shahrood	Semi-Dry	1	0.90	0.82	0.003	2.136
1	Quadratic (Semi-Dry)	Kermanshah	Mediterra- nean	0.889	0.91	0.83	-3.087	2.095
1	Quadratic (Semi-Dry)	Yasuj	Semi-Humid	0.962	0.90	0.80	-2.611	2.072
1	Quadratic (Semi-Dry)	Sari	Humid	0.476	0.79	0.61	5.049	1.423
1	Quadratic (Semi-Dry)	Rasht	Very Humid	0.411	0.76	0.57	4.973	1.244
2	Quadratic (Semi-Dry)	Semnan	Dry	0.882	0.90	0.81	-2.340	2.496
2	Quadratic (Semi-Dry)	Shahrood	Semi-Dry	1	0.87	0.75	1.253	2.463
2	Quadratic (Semi-Dry)	Kermanshah	Mediterra- nean	0.884	0.89	0.78	-5.282	2.351
2	Quadratic (Semi-Dry)	Yasuj	Semi-Humid	0.962	0.89	0.78	-3.195	2.123
2	Quadratic (Semi-Dry)	Sari	Humid	0.568	0.79	0.60	8.064	1.423
2	Quadratic (Semi-Dry)	Rasht	Very Humid	0.424	0.77	0.56	10.079	1.252

**Table S8.** Statistical coefficients obtained for comparisons between observed pan evaporation and pan evaporation simulated using the best experimental relationships in the validation step (2000–2020).

Comb. no.	Best Eq. number	Station name	Climate	r	NSE	PBIAS	RMSE
1	Quadratic	Garmsar	Dry	0.91	0.83	3.174	2.745
1	Quadratic	Yazd	Dry	0.90	0.77	13.252	2.878
1	Quadratic	Tehran	Dry	0.91	0.81	-10.839	1.971
1	Quadratic	Karaj	Dry	0.88	0.77	5.741	2.411
1	Quadratic	Qom	Dry	0.90	0.79	9.578	2.753
1	Quadratic	Esfahan	Dry	0.90	0.78	4.9988	2.2448
1	Quadratic	Kerman	Dry	0.90	0.73	18.974	2.680
1	Quadratic	Zahedan	Dry	0.87	0.71	13.512	2.891
1	Quadratic	Ahvaz	Dry	0.86	0.55	-21.952	3.897
1	Quadratic	Hajiabad	Dry	0.86	0.63	17.521	3.254

1	Quadratic	Borazjan	Dry	0.88	0.70	12.243	2.765
1	Quadratic	Bojnurd	Dry	0.87	0.71	17.260	2.368
1	Quadratic	Mashhad	Semi-Dry	0.92	0.80	-15.979	2.160
1	Quadratic	Damghan	Semi-Dry	0.89	0.78	-12.898	3.144
1	Quadratic	Arak	Semi-Dry	0.92	0.83	-6.240	1.936
1	Quadratic	Qazvin	Semi-Dry	0.92	0.80	-17.817	1.966
1	Quadratic	Nahavand	Semi-Dry	0.89	0.76	-7.368	2.186
1	Quadratic	Shiraz	Semi-Dry	0.90	0.67	-15.374	2.601
1	Quadratic	Sanandaj	Semi-Dry	0.92	0.84	-8.178	1.924
1	Quadratic	Birjand	Semi-Dry	0.87	0.75	-4.604	2.208
1	Quadratic	Ilam	Mediterranean	0.90	0.81	-1.122	2.292
1	Quadratic	Khahkhal	Mediterranean	0.87	0.70	24.330	1.903
1	Quadratic	Ardebil	Mediterranean	0.70	0.53	28.620	2.297
1	Quadratic	Orumiyeh	Mediterranean	0.88	0.78	8.906	1.772
1	Quadratic	Tabriz	Mediterranean	0.90	0.75	21.693	2.633
1	Quadratic	Koohrang	Semi-Humid	0.89	0.76	13.974	1.884
1	Quadratic	Khoramabad	Semi-Humid	0.94	0.74	-30.212	2.433
1	Quadratic	Gorgan	Humid	0.84	0.64	15.851	1.778
1	Quadratic	Babolsar	Humid	0.82	0.62	-18.006	1.279
1	Quadratic	Noshahr	Humid	0.78	0.60	7.324	1.338
1	Quadratic	Lahijan	Very Humid	0.79	0.62	-1.581	1.346
1	Quadratic	Bandar anzali	Very Humid	0.83	0.65	11.056	1.299
2	Quadratic	Garmsar	Dry	0.90	0.74	17.937	3.051
2	Quadratic	Yazd	Dry	0.91	0.82	-2.434	2.752
2	Quadratic	Tehran	Dry	0.90	0.82	-4.1139	1.916
2	Quadratic	Karaj	Dry	0.88	0.77	0.461	2.375
2	Quadratic	Qom	Dry	0.90	0.78	7.113	2.707
2	Quadratic	Esfahan	Dry	0.90	0.80	4.698	2.230
2	Quadratic	Kerman	Dry	0.88	0.72	16.666	2.768
2	Quadratic	Zahedan	Dry	0.85	0.72	6.898	2.820
2	Quadratic	Ahvaz	Dry	0.87	0.55	-23.243	3.786
2	Quadratic	Hajiabad	Dry	0.86	0.62	18.234	3.456
2	Quadratic	Borazjan	Dry	0.88	0.67	13.657	2.987
2	Quadratic	Bojnurd	Dry	0.87	0.75	11.398	2.187
2	Quadratic	Mashhad	Semi-Dry	0.91	0.79	-18.398	2.222
2	Quadratic	Damghan	Semi-Dry	0.89	0.78	-10.336	3.069
2	Quadratic	Arak	Semi-Dry	0.87	0.77	-0.268	2.294
2	Quadratic	Qazvin	Semi-Dry	0.88	0.76	-8.793	2.090
2	Quadratic	Nahavand	Semi-Dry	0.83	0.67	-11.225	2.611
2	Quadratic	Shiraz	Semi-Dry	0.90	0.76	-8.209	2.190
2	Quadratic	Sanandaj	Semi-Dry	0.91	0.83	-5.320	1.997
2	Quadratic	Birjand	Semi-Dry	0.86	0.74	-6.121	2.251
2	Quadratic	Ilam	Mediterranean	0.90	0.81	-2.211	2.268
2	Quadratic	Khahkhal	Mediterranean	0.88	0.73	19.414	1.832

2	Quadratic	Ardebil	Mediterranean	0.78	0.56	21.081	2.139
2	Quadratic	Orumiyeh	Mediterranean	0.89	0.78	3.027	1.740
2	Quadratic	Tabriz	Mediterranean	0.90	0.76	20.780	2.608
2	Quadratic	Koohrang	Semi-Humid	0.89	0.77	14.195	1.847
2	Quadratic	Khoramabad	Semi-Humid	0.92	0.71	-27.651	2.474
2	Quadratic	Gorgan	Humid	0.84	0.68	10.093	1.680
2	Quadratic	Babolsar	Humid	0.79	0.55	-22.959	1.434
2	Quadratic	Noshhahr	Humid	0.80	0.63	-2.977	1.259
2	Quadratic	Lahijan	Very Humid	0.78	0.61	3.057	1.354
2	Quadratic	Bandar anzali	Very Humid	0.81	0.65	1.302	1.298

**Table S9.** Statistical coefficients obtained for comparisons between observed pan evaporation and pan evaporation simulated using the basic relationship and correction coefficients ( $C_c$ ) in the validation step (2000–2020).

Scenario no.	Station name	Climate	$C_c$	r	NSE	PBIAS	RMSE
1	Garmsar	Dry	0.845	0.91	0.83	-2.518	2.733
1	Yazd	Dry	0.845	0.90	0.80	8.266	2.735
1	Tehran	Dry	0.845	0.91	0.81	-13.940	2.002
1	Karaj	Dry	0.845	0.88	0.78	2.549	2.392
1	Qom	Dry	0.845	0.90	0.79	7.757	2.744
1	Esfahan	Dry	0.845	0.90	0.80	3.709	2.243
1	Kerman	Dry	0.845	0.90	0.73	18.974	2.680
1	Zahedan	Dry	0.845	0.86	0.71	13.512	2.891
1	Ahvaz	Dry	0.845	0.86	0.55	-21.952	3.897
1	Hajiabad	Dry	0.845	0.87	0.66	16.453	3.123
1	Borazjan	Dry	0.845	0.89	0.71	12.170	2.750
1	Bojnourd	Dry	0.845	0.87	0.73	11.587	2.291
1	Mashhad	Semi-Dry	1	0.91	0.80	-15.979	2.160
1	Damghan	Semi-Dry	1	0.89	0.78	-12.898	3.144
1	Arak	Semi-Dry	1	0.92	0.83	-6.240	1.936
1	Qazvin	Semi-Dry	1	0.92	0.80	-17.817	1.966
1	Nahavand	Semi-Dry	1	0.89	0.76	-7.368	2.186
1	Shiraz	Semi-Dry	1	0.90	0.67	-15.374	2.601
1	Sanandaj	Semi-Dry	1	0.92	0.84	-8.178	1.924
1	Birjand	Semi-Dry	1	0.87	0.75	-4.604	2.208
1	Ilam	Mediterranean	0.889	0.90	0.81	-3.375	2.307
1	Khahkhal	Mediterranean	0.889	0.88	0.72	14.072	1.802
1	Ardebil	Mediterranean	0.889	0.80	0.60	13.025	2.119
1	Orumiyeh	Mediterranean	0.889	0.89	0.79	1.455	1.737
1	Tabriz	Mediterranean	0.889	0.90	0.76	17.978	2.588
1	Koohrang	Semi-Humid	0.962	0.89	0.76	10.908	1.894
1	Khoramabad	Semi-Humid	0.962	0.94	0.74	-27.414	2.412

1	Gorgan	Humid	0.476	0.84	0.62	22.652	1.845
1	Babolsar	Humid	0.476	0.81	0.61	-13.381	1.298
1	Noshahr	Humid	0.476	0.77	0.57	10.431	1.375
1	Lahijan	Very Humid	0.411	0.78	0.60	6.153	1.368
1	Bandar anzali	Very Humid	0.411	0.83	0.65	14.179	1.301
2	Garmsar	Dry	0.882	0.90	0.76	14.887	2.945
2	Yazd	Dry	0.882	0.91	0.83	-1.929	2.738
2	Tehran	Dry	0.882	0.91	0.82	-4.972	1.952
2	Karaj	Dry	0.882	0.87	0.75	-4.805	2.502
2	Qom	Dry	0.882	0.90	0.79	4.320	2.757
2	Esfahan	Dry	0.882	0.89	0.79	3.052	2.291
2	Kerman	Dry	0.882	0.86	0.70	12.370	2.809
2	Zahedan	Dry	0.882	0.82	0.67	1.976	3.025
2	Ahvaz	Dry	0.882	0.87	0.58	-22.850	3.635
2	Hajiabad	Dry	0.882	0.85	0.62	17.456	3.221
2	Borazjan	Dry	0.882	0.88	0.70	12.345	2.678
2	Bojnourd	Dry	0.882	0.87	0.75	6.388	2.227
2	Mashhad	Semi-Dry	1	0.91	0.79	-18.398	2.222
2	Damghan	Semi-Dry	1	0.89	0.78	-10.336	3.069
2	Arak	Semi-Dry	1	0.87	0.77	-0.268	2.294
2	Qazvin	Semi-Dry	1	0.88	0.76	-8.793	2.090
2	Nahavand	Semi-Dry	1	0.83	0.67	-11.225	2.611
2	Shiraz	Semi-Dry	1	0.90	0.76	-8.209	2.190
2	Sanandaj	Semi-Dry	1	0.91	0.83	-5.320	1.997
2	Birjand	Semi-Dry	1	0.86	0.74	-6.121	2.251
2	Ilam	Mediterrane-an	0.884	0.89	0.78	-3.229	2.461
2	Khahkhal	Mediterrane-an	0.884	0.83	0.68	5.882	2.000
2	Ardebil	Mediterrane-an	0.884	0.75	0.55	-11.231	2.602
2	Orumiyeh	Mediterrane-an	0.884	0.87	0.75	0.095	1.876
2	Tabriz	Mediterrane-an	0.884	0.90	0.80	2.424	2.389
2	Koohrang	Semi-Humid	0.962	0.86	0.73	6.359	1.994
2	Khoramabad	Semi-Humid	0.962	0.91	0.65	-36.018	2.747
2	Gorgan	Humid	0.568	0.84	0.68	14.672	1.680
2	Babolsar	Humid	0.568	0.80	0.57	-12.156	1.403
2	Noshahr	Humid	0.568	0.78	0.58	9.212	1.352
2	Lahijan	Very Humid	0.424	0.77	0.58	9.174	1.393
2	Bandar anzali	Very Humid	0.424	0.72	0.50	0.577	1.553

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