

Evaluation of various tree-based ensemble models for estimating solar energy resource potential in different climatic zones of China

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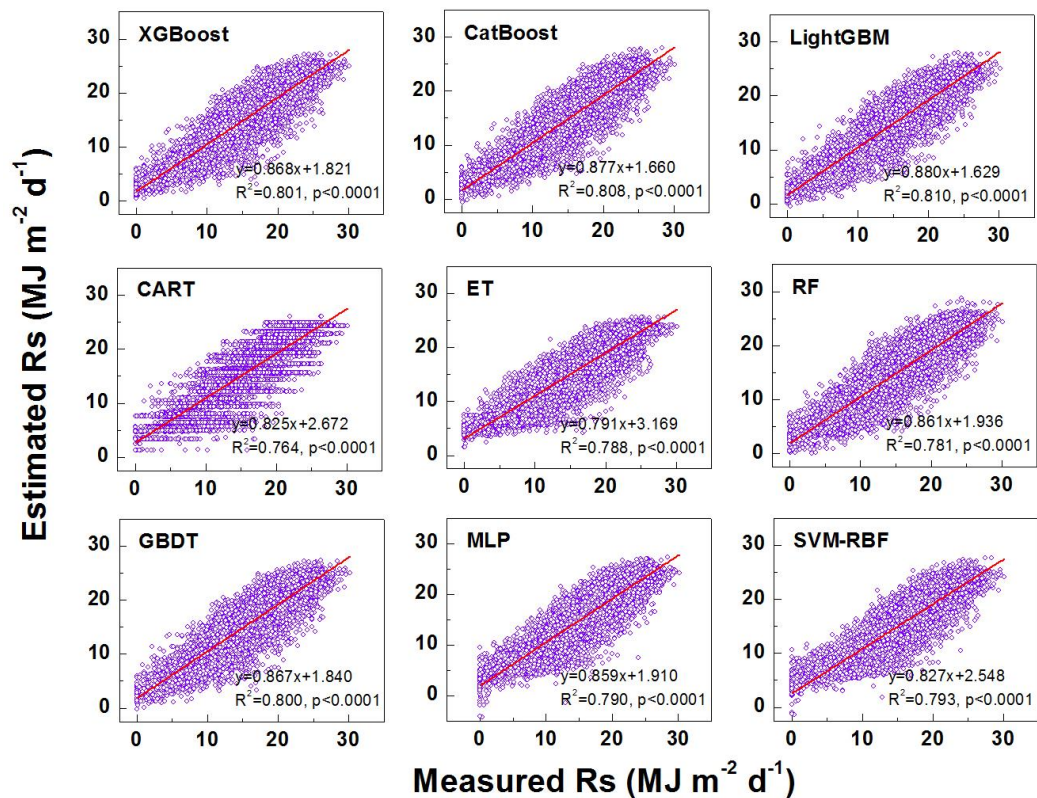


Figure S1. The R_s estimates of the developed algorithms versus measurements at

Sanya station under complete input combinations.

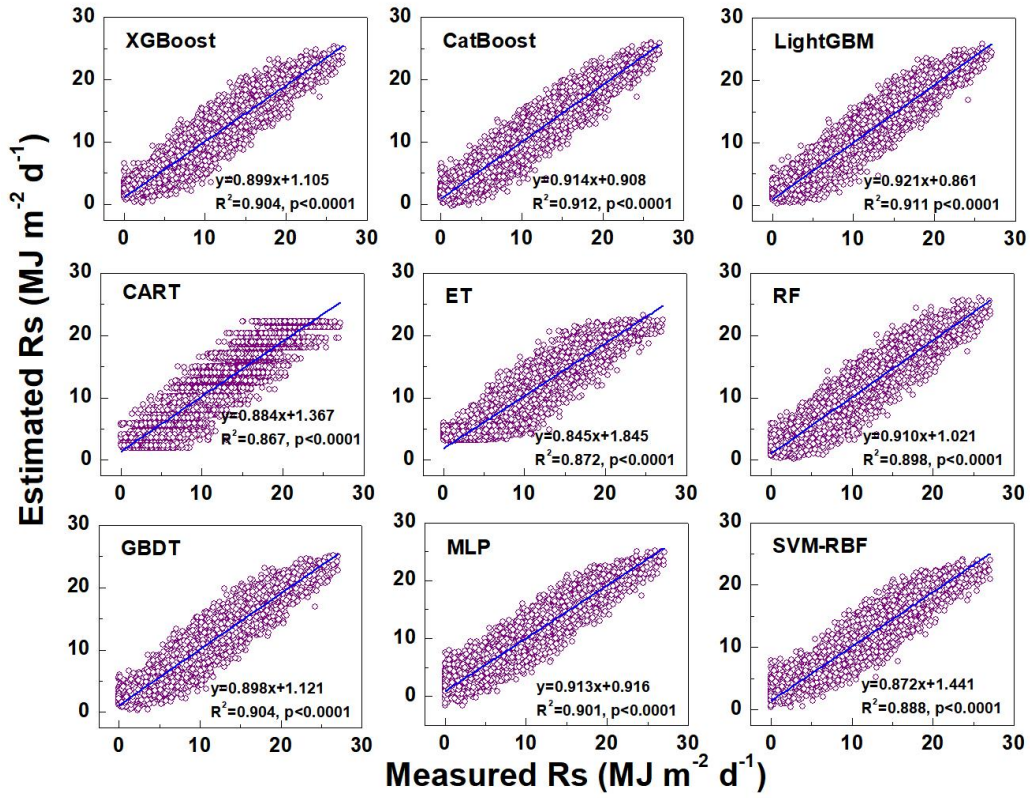


Figure S2. Same as Figure S1 but at Guangzhou station.

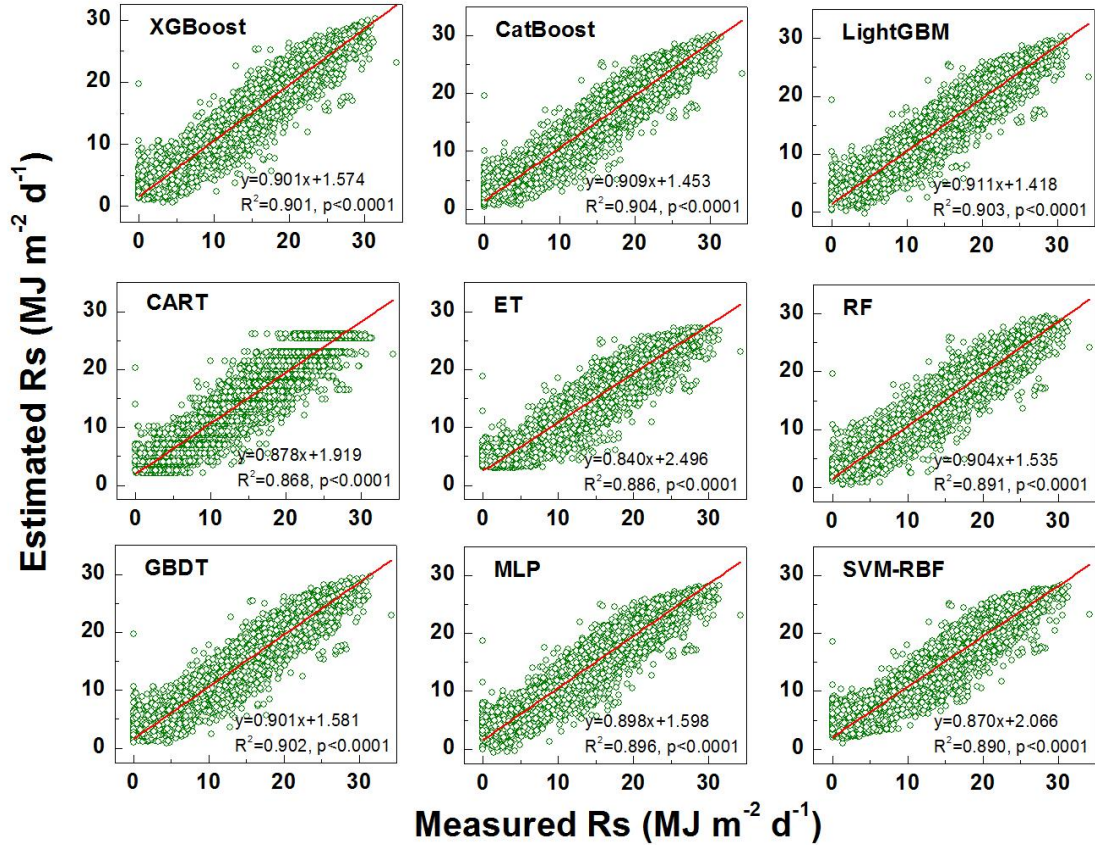


Figure S3. Same as Figure S1 but at Kunming station.

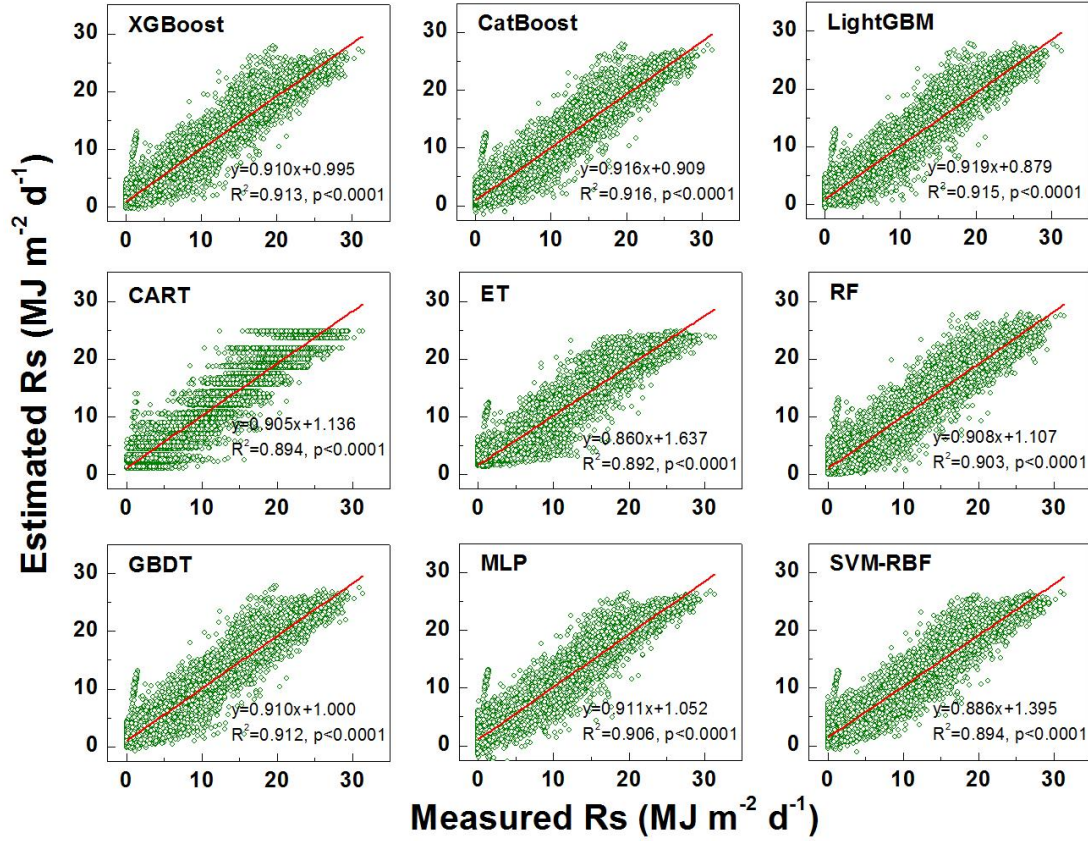


Figure S4. Same as Figure S1 but at Wuhan station.

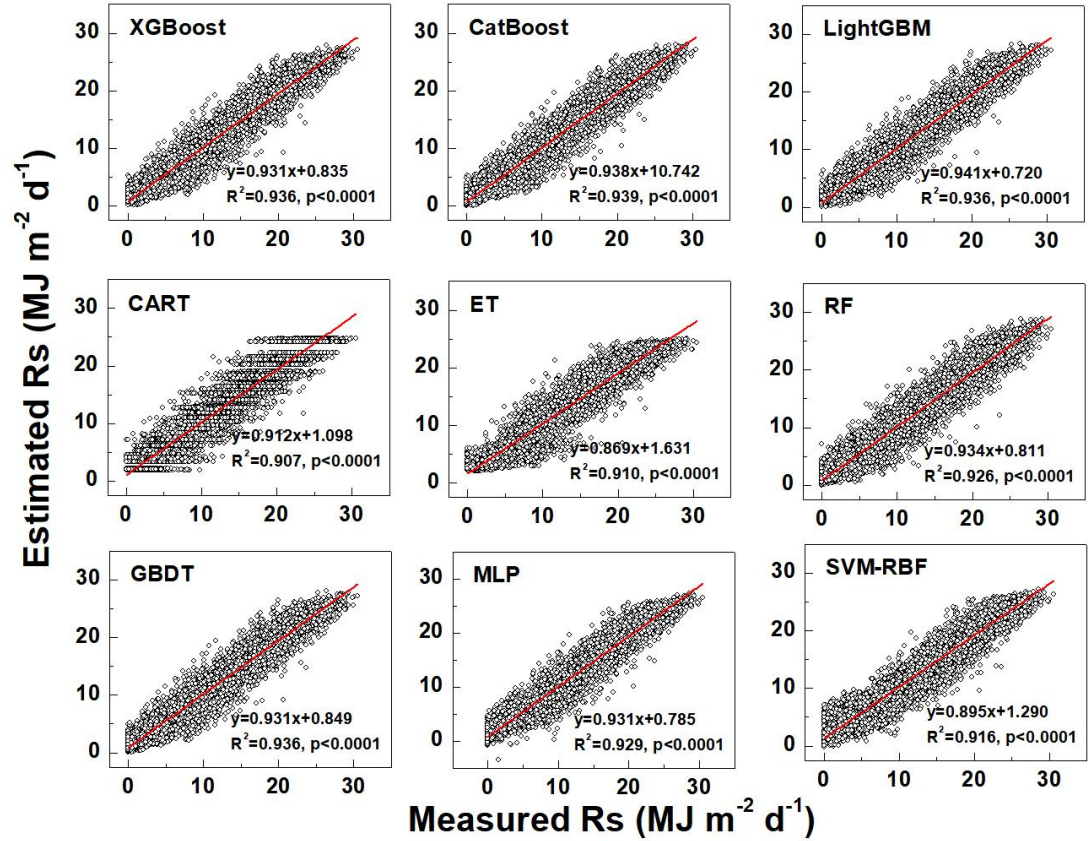


Figure S5. Same as Figure S1 but at Shanghai station.

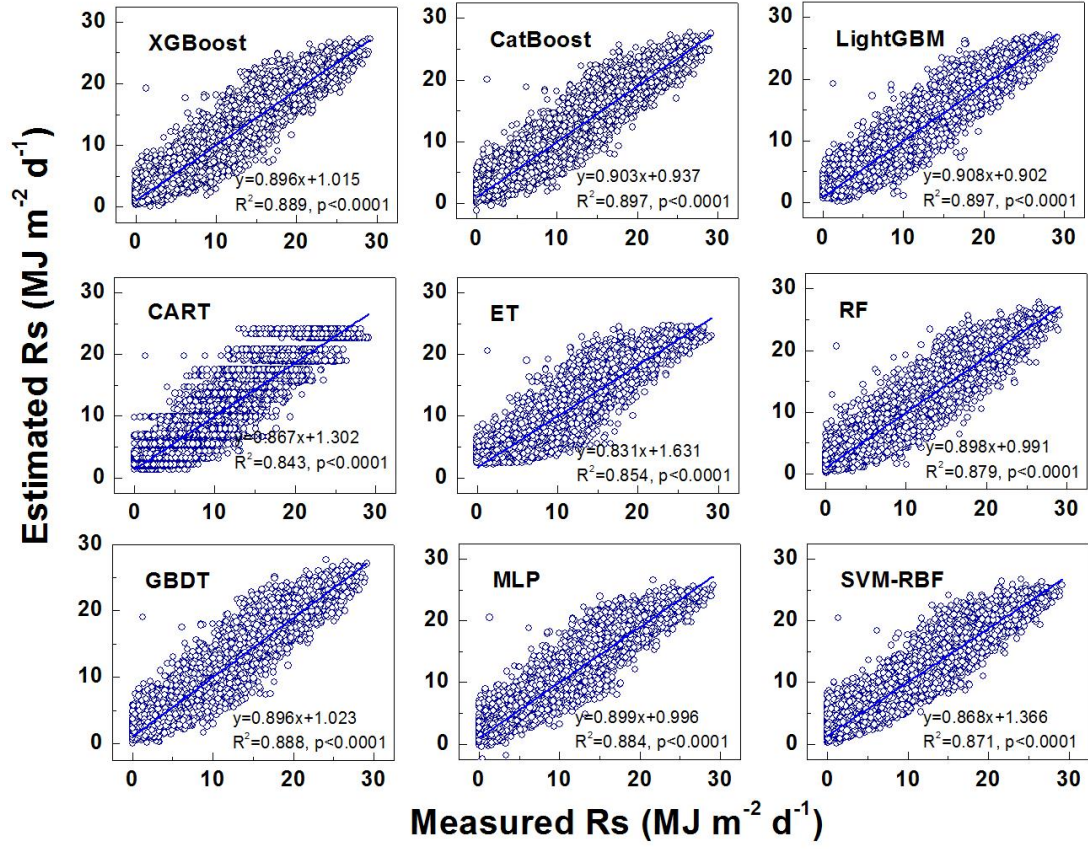


Figure S6. Same as Figure S1 but at Chengdu station.

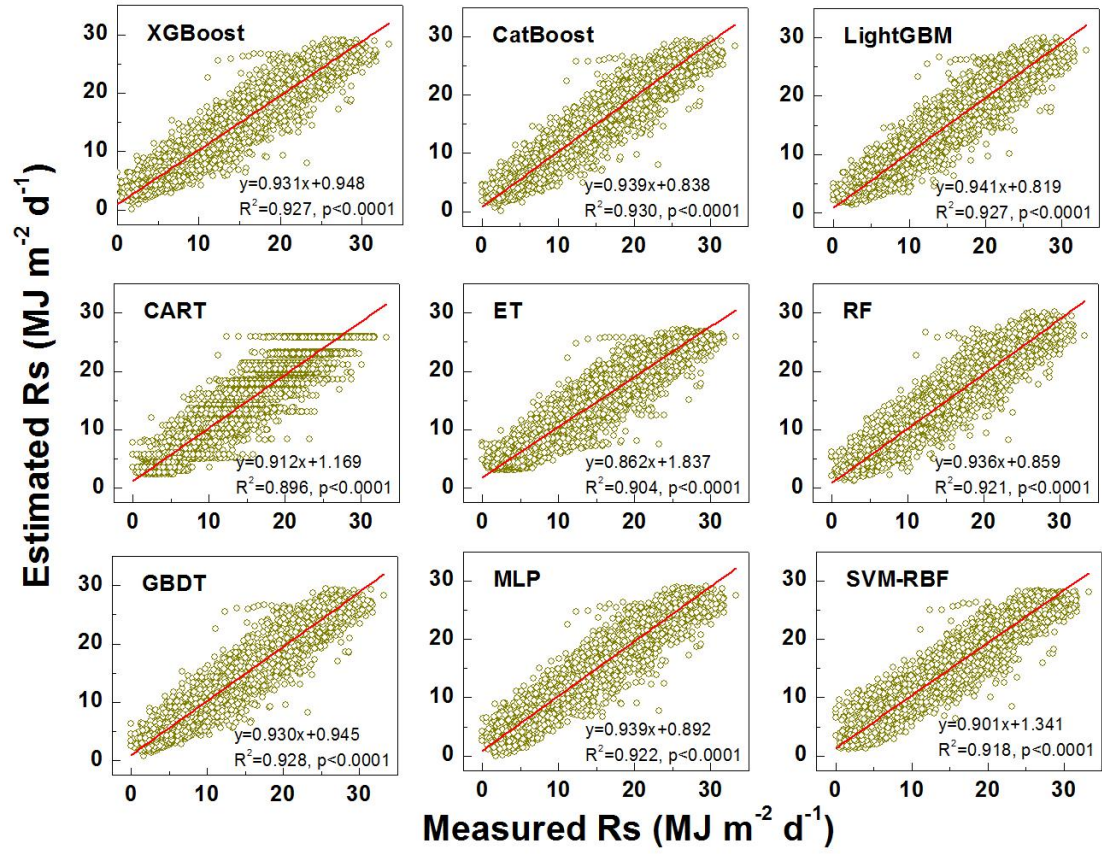


Figure S7. Same as Figure S1 but at Haerbin station.

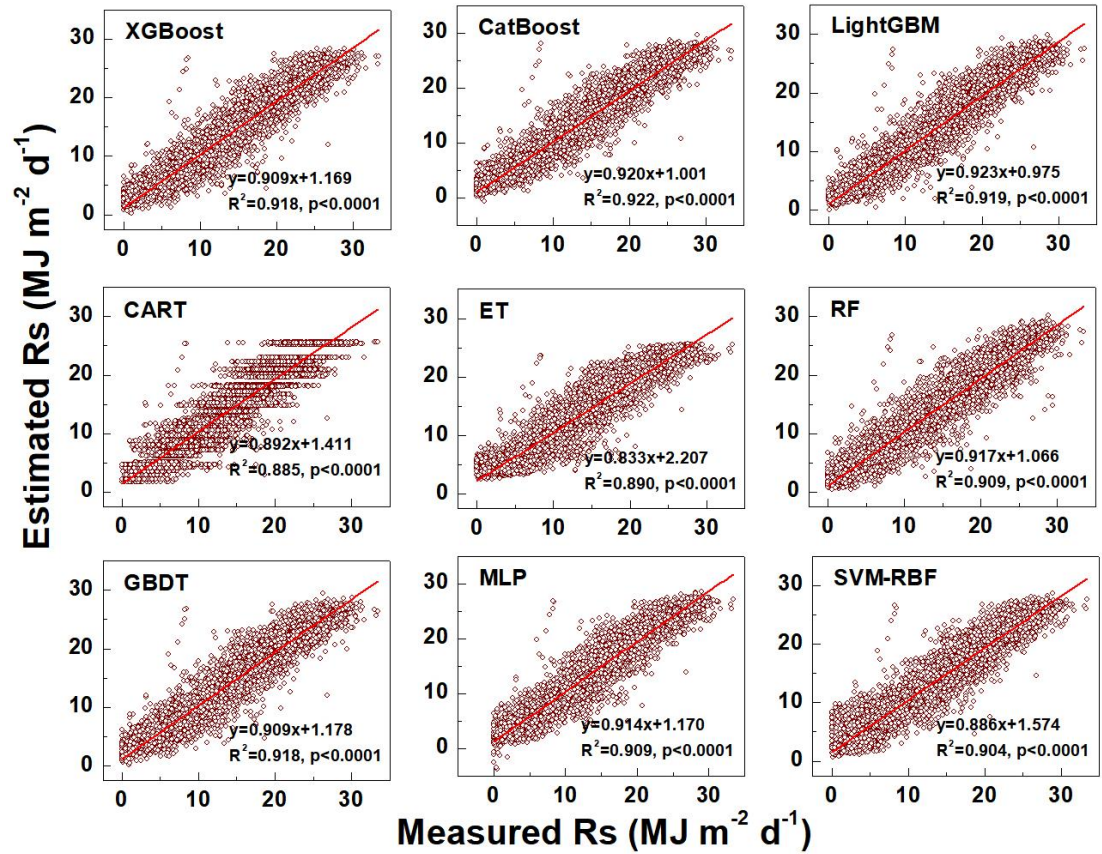


Figure S8. Same as Figure S1 but at Shenyang station.

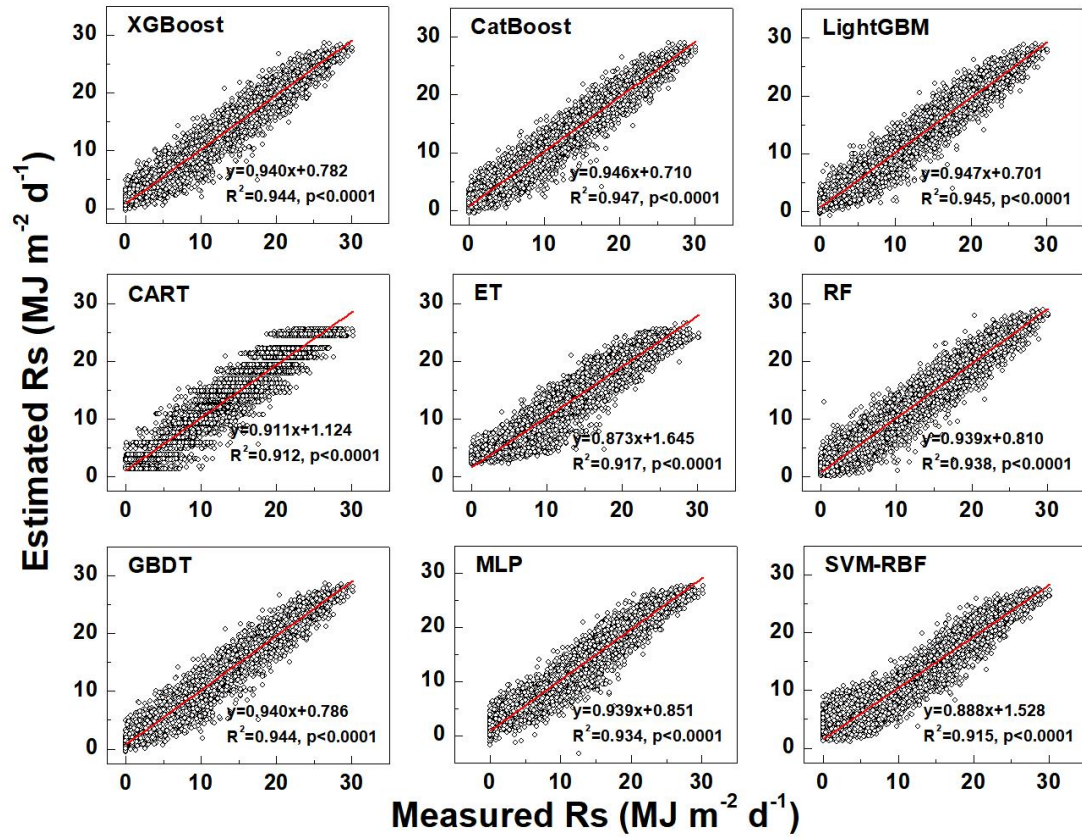


Figure S9. Same as Figure S1 but at Zhengzhou station.

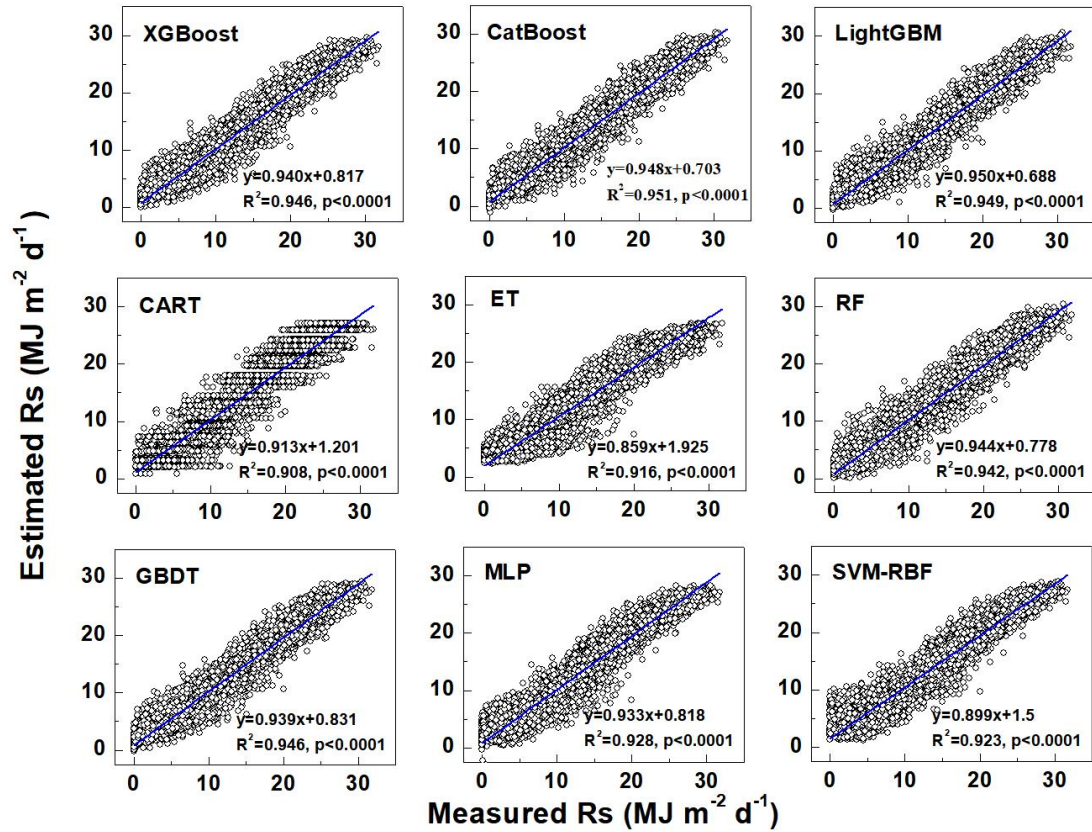


Figure S10. Same as Figure S1 but at Beijing station.

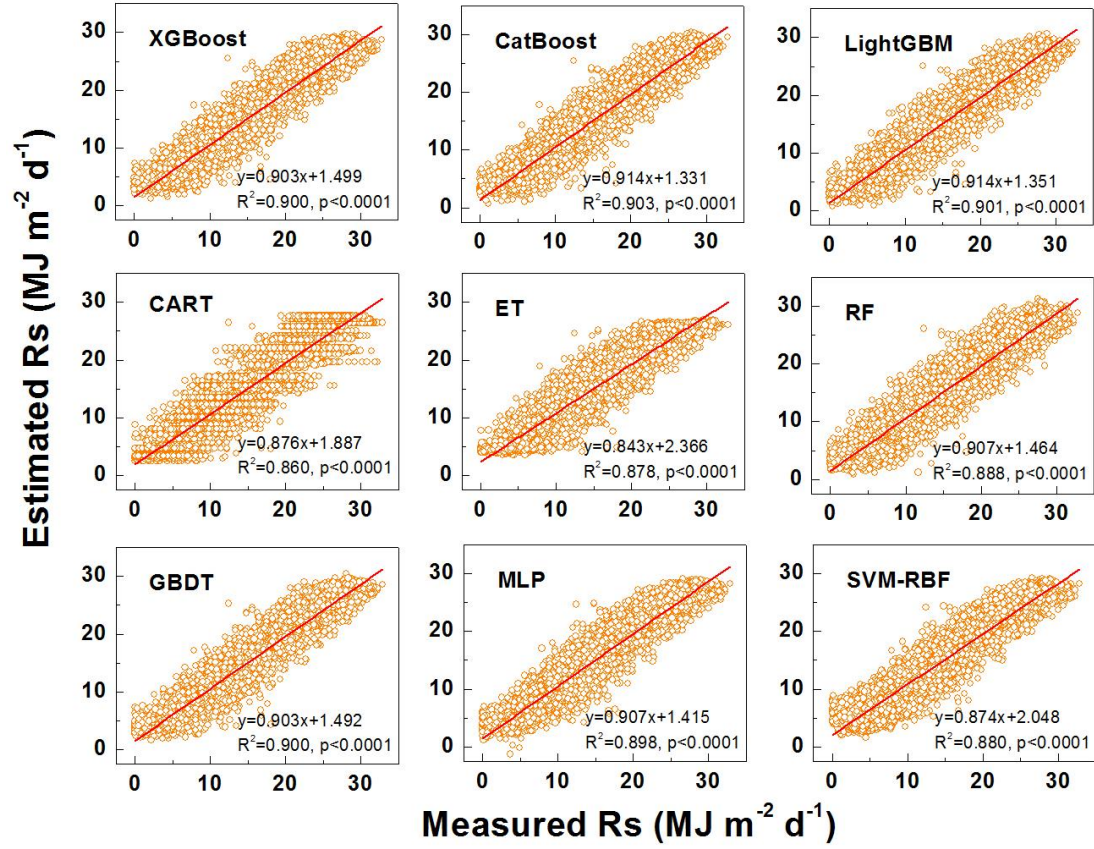


Figure S11. Same as Figure S1 but at Lanzhou station.

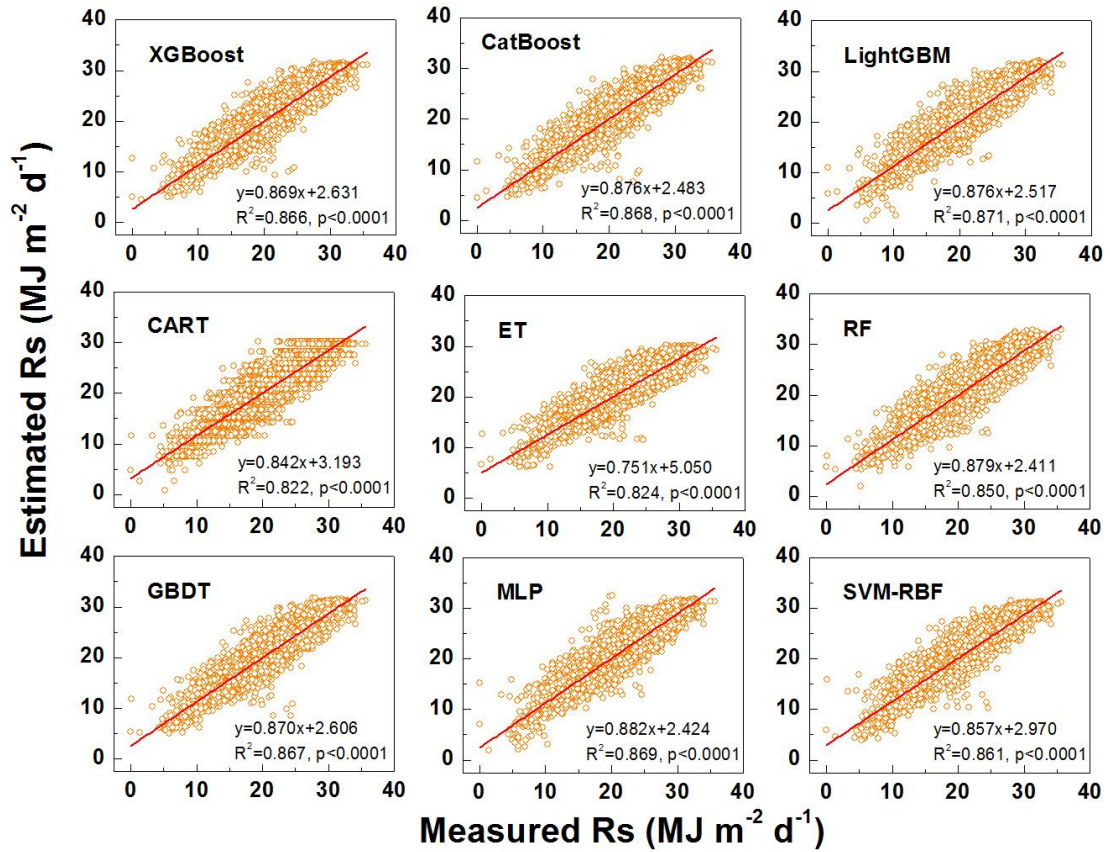


Figure S12. Same as Figure S1 but at Lasa station.

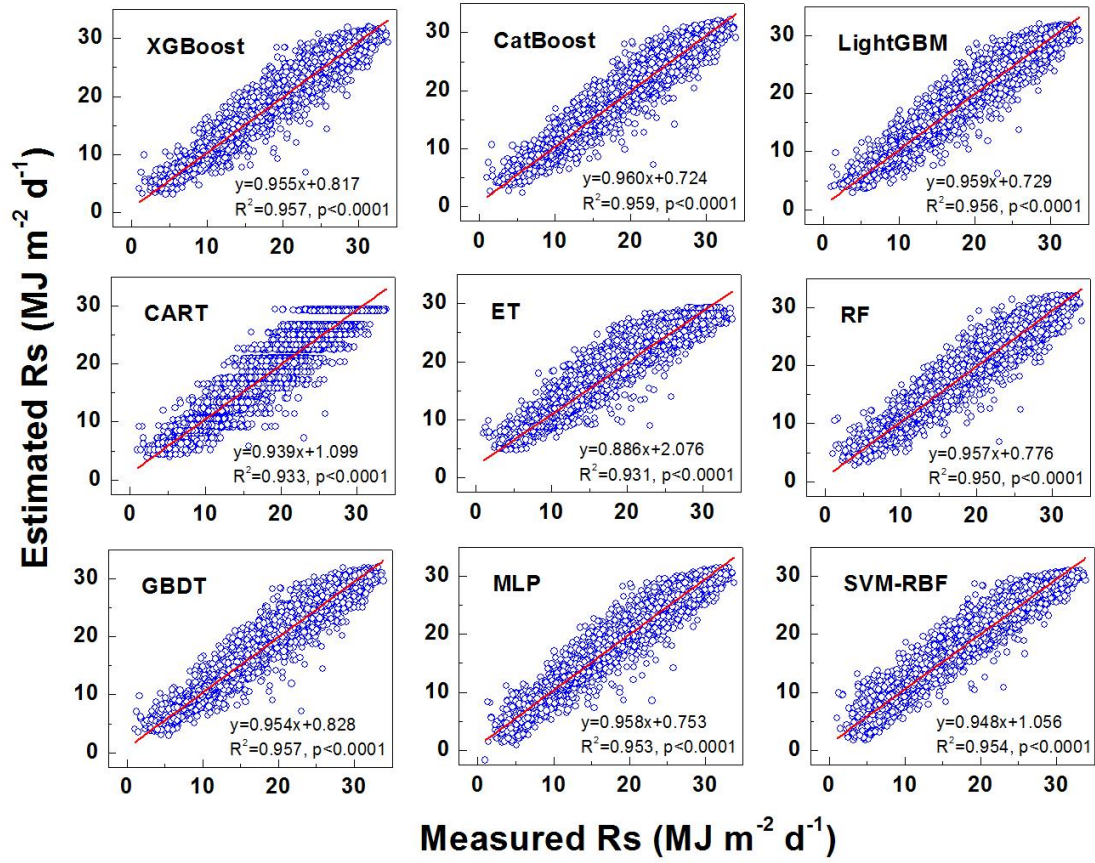


Figure S13. Same as Figure S1 but at Ejinaqi station.

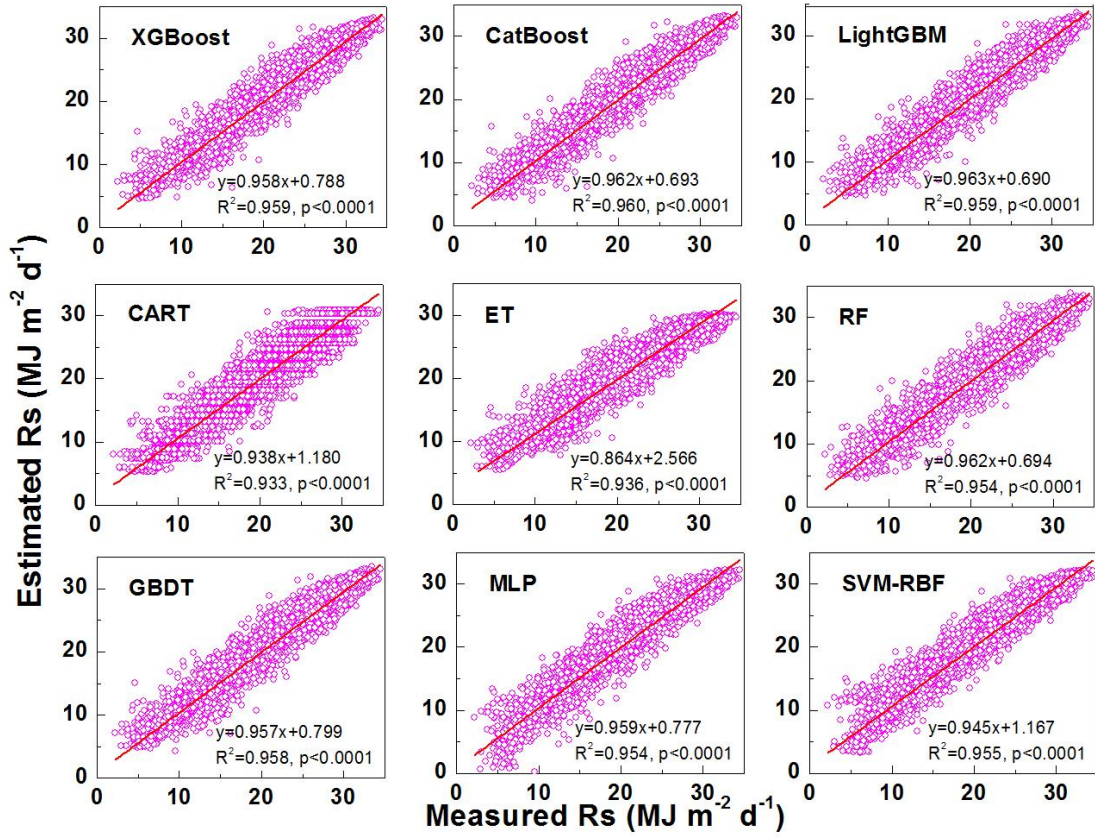


Figure S14. Same as Figure S1 but at Geermu station.

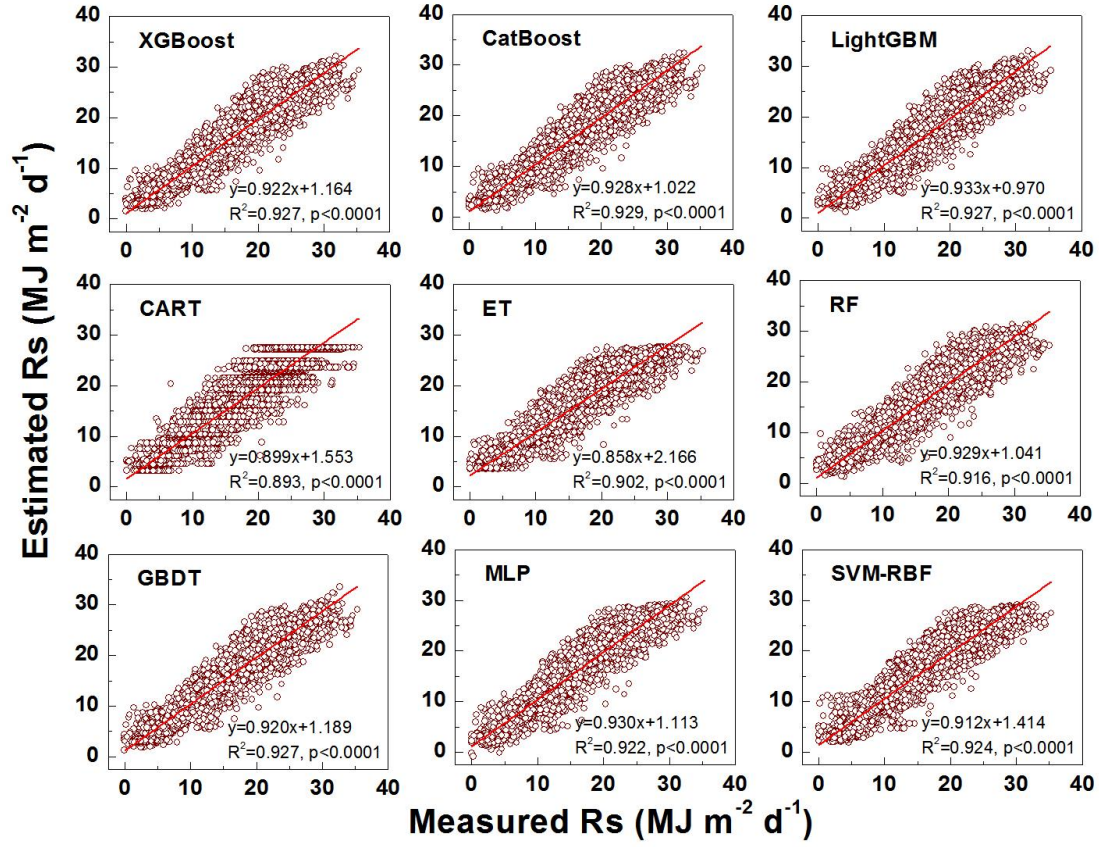


Figure S15. Same as Figure S1 but at Kashi station.

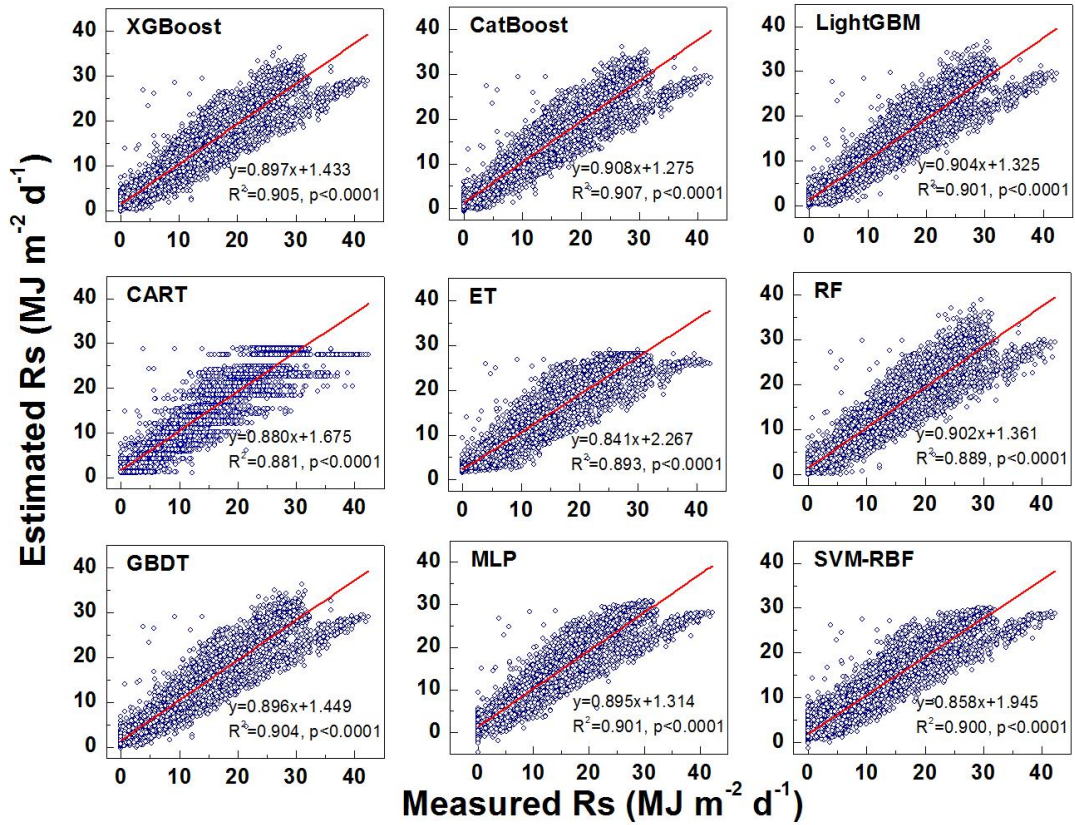


Figure S16. Same as Figure S1 but at Wulumuqi station.

Table S1 Statistical values of the developed models (CART, ET, RF, GBDT, XGBoost, CatBoost, LightGBM, MLP and SVM) with various input combinations during training and testing stages at Sanya station.

Input/Model	Training				Testing			
	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)
<i>R_a n/N (C1)</i>								
XGBoost1	0.846	2.357	1.787	0.001	0.796	2.703	2.094	-0.025
Catboost1	0.842	2.388	1.812	0.000	0.797	2.700	2.092	-0.029
LightGBM1	0.862	2.231	1.690	0.000	0.789	2.753	2.127	-0.034
CART1	0.830	2.475	1.899	0.000	0.782	2.797	2.184	-0.024
ET1	0.828	2.493	1.928	0.000	0.788	2.759	2.172	-0.042
RF1	0.962	1.167	0.823	0.002	0.738	3.070	2.354	-0.014
GBDT1	0.847	2.350	1.784	0.000	0.796	2.706	2.094	-0.027
MLP1	0.827	2.496	1.906	0.026	0.795	2.711	2.105	0.008
SVM-RBF1	0.823	2.525	1.916	-0.023	0.787	2.764	2.139	-0.048
<i>R_a n/N T_{max} T_{min} (C2)</i>								
XGBoost2	0.870	2.164	1.649	0.000	0.784	2.770	2.145	0.235
Catboost2	0.874	2.133	1.623	0.000	0.786	2.762	2.133	0.250
LightGBM2	0.903	1.868	1.425	0.000	0.781	2.789	2.154	0.266
CART2	0.837	2.423	1.866	0.000	0.770	2.870	2.230	0.046
ET2	0.829	2.481	1.935	0.000	0.782	2.801	2.212	0.043
RF2	0.971	1.024	0.721	-0.001	0.757	2.946	2.266	0.248
GBDT2	0.871	2.159	1.646	0.000	0.786	2.761	2.134	0.231
MLP2	0.834	2.448	1.871	0.112	0.789	2.738	2.135	0.256
SVM-RBF2	0.834	2.449	1.849	-0.079	0.784	2.778	2.151	0.078
<i>R_a n/N H₀ U₁₀ (C3)</i>								
XGBoost3	0.870	2.169	1.628	0.000	0.756	2.946	2.281	0.342
Catboost3	0.871	2.157	1.619	0.000	0.748	2.986	2.308	0.375
LightGBM3	0.902	1.879	1.422	0.000	0.739	3.046	2.350	0.335
CART3	0.839	2.410	1.847	0.000	0.757	2.950	2.277	0.157
ET3	0.834	2.449	1.891	0.000	0.787	2.763	2.168	0.078
RF3	0.970	1.045	0.732	0.000	0.727	3.127	2.398	0.321
GBDT3	0.870	2.164	1.627	0.000	0.755	2.949	2.280	0.342
MLP3	0.837	2.427	1.841	0.002	0.781	2.794	2.167	0.278
SVM-RBF	0.833	2.458	1.832	-0.124	0.777	2.820	2.162	0.148
<i>R_a n/N P_{re} P_{rs} (C4)</i>								
XGBoost4	0.882	2.064	1.567	0.001	0.794	2.702	2.106	0.453
Catboost4	0.882	2.061	1.569	0.000	0.793	2.707	2.103	0.464
LightGBM4	0.911	1.797	1.378	0.000	0.789	2.734	2.122	0.471
CART4	0.848	2.346	1.807	0.000	0.772	2.861	2.216	0.184
ET4	0.844	2.374	1.830	0.000	0.797	2.700	2.124	0.121
RF4	0.973	0.993	0.701	-0.013	0.770	2.865	2.222	0.437
GBDT4	0.883	2.059	1.564	0.000	0.794	2.703	2.106	0.449
MLP4	0.851	2.317	1.752	0.006	0.775	2.823	2.199	0.475
SVM-RBF4	0.852	2.313	1.740	-0.080	0.783	2.774	2.158	0.398
<i>R_a n/N T_{max} T_{min} H₀ U₁₀ (C5)</i>								
XGBoost5	0.884	2.047	1.549	0.000	0.774	2.835	2.182	0.332
Catboost5	0.893	1.967	1.488	0.000	0.777	2.813	2.165	0.350
LightGBM5	0.924	1.655	1.271	0.000	0.776	2.821	2.172	0.321
CART5	0.841	2.395	1.837	0.000	0.755	2.963	2.292	0.203
ET5	0.837	2.427	1.878	0.000	0.779	2.813	2.207	0.110
RF5	0.974	0.971	0.683	-0.006	0.762	2.914	2.237	0.315
GBDT5	0.884	2.044	1.547	0.000	0.772	2.845	2.192	0.339
MLP5	0.841	2.396	1.818	0.012	0.780	2.796	2.166	0.310
SVM-RBF5	0.838	2.417	1.800	-0.129	0.787	2.760	2.113	0.131
<i>R_a n/N T_{max} T_{min} P_{re} P_{rs} (C6)</i>								
XGBoost6	0.896	1.941	1.485	0.000	0.805	2.623	2.045	0.455
Catboost6	0.901	1.891	1.449	0.000	0.814	2.569	2.002	0.447
LightGBM6	0.930	1.595	1.233	0.000	0.814	2.571	2.000	0.443
CART6	0.850	2.327	1.797	0.000	0.768	2.883	2.242	0.218
ET6	0.849	2.330	1.809	0.000	0.793	2.729	2.146	0.186
RF6	0.977	0.920	0.653	0.002	0.791	2.727	2.125	0.436
GBDT6	0.896	1.933	1.480	0.000	0.806	2.622	2.043	0.454
MLP6	0.851	2.313	1.765	0.094	0.792	2.723	2.118	0.502
SVM-RBF6	0.858	2.260	1.709	-0.068	0.798	2.680	2.095	0.365
<i>R_a n/N T_{max} T_{min} H₀ U₁₀ P_{re} P_{rs} (C7)</i>								
XGBoost7	0.899	1.906	1.455	0.000	0.801	2.662	2.069	0.344
Catboost7	0.907	1.830	1.399	0.000	0.808	2.619	2.033	0.355
LightGBM7	0.937	1.507	1.168	0.000	0.810	2.604	2.025	0.346
CART7	0.851	2.322	1.794	0.000	0.764	2.913	2.260	0.190
ET7	0.845	2.363	1.835	0.000	0.788	2.754	2.164	0.191
RF7	0.977	0.911	0.651	-0.002	0.781	2.793	2.165	0.353
GBDT7	0.900	1.903	1.454	0.000	0.800	2.669	2.074	0.336
MLP7	0.853	2.302	1.754	0.067	0.790	2.735	2.121	0.480
SVM-RBF7	0.856	2.276	1.721	-0.081	0.793	2.716	2.127	0.289

Table S2 Same as Table S4 but at Guangzhou station.

Input/Model	Training				Testing			
	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)
R_a n/N (C1)								
XGBoost1	0.899	1.890	1.483	0.000	0.875	2.054	1.635	-0.030
Catboost1	0.895	1.924	1.510	0.000	0.876	2.045	1.628	-0.033
LightGBM1	0.907	1.810	1.415	0.000	0.871	2.093	1.666	-0.027
CART1	0.883	2.036	1.610	0.000	0.860	2.182	1.744	-0.026
ET1	0.882	2.043	1.628	0.000	0.865	2.136	1.709	-0.035
RF1	0.974	0.956	0.692	0.000	0.830	2.404	1.892	-0.025
GBDT1	0.900	1.883	1.478	0.000	0.875	2.054	1.636	-0.030
MLP1	0.885	2.016	1.592	0.050	0.869	2.108	1.684	0.022
SVM-RBF1	0.870	2.145	1.689	-0.091	0.855	2.213	1.767	-0.120
R_a n/N T_{max} T_{min} (C2)								
XGBoost2	0.918	1.707	1.335	0.000	0.892	1.909	1.516	-0.020
Catboost2	0.921	1.669	1.298	0.000	0.897	1.868	1.477	-0.015
LightGBM2	0.938	1.477	1.148	0.000	0.893	1.902	1.504	-0.026
CART2	0.890	1.973	1.561	0.000	0.866	2.135	1.704	-0.030
ET2	0.887	1.998	1.588	0.000	0.871	2.092	1.672	-0.037
RF2	0.981	0.809	0.584	0.001	0.876	2.052	1.618	-0.010
GBDT2	0.918	1.704	1.333	0.000	0.892	1.909	1.516	-0.019
MLP2	0.901	1.867	1.457	0.043	0.892	1.916	1.507	0.014
SVM-RBF2	0.892	1.958	1.529	-0.065	0.878	2.030	1.606	-0.096
R_a n/N H_0 U_0 (C3)								
XGBoost3	0.919	1.697	1.318	0.000	0.885	1.978	1.588	0.072
Catboost3	0.917	1.709	1.326	0.000	0.885	1.977	1.587	0.098
LightGBM3	0.936	1.506	1.164	0.000	0.882	2.000	1.596	0.093
CART3	0.892	1.954	1.541	0.000	0.864	2.151	1.716	-0.003
ET3	0.889	1.984	1.579	0.000	0.871	2.092	1.677	-0.009
RF3	0.981	0.809	0.587	-0.001	0.864	2.149	1.714	0.069
GBDT3	0.919	1.694	1.317	0.000	0.884	1.987	1.595	0.089
MLP3	0.903	1.850	1.447	-0.004	0.879	2.027	1.627	0.108
SVM-RBF	0.889	1.978	1.555	-0.084	0.866	2.134	1.713	0.011
R_a n/N P_{re} P_{rs} (C4)								
XGBoost4	0.918	1.705	1.350	0.000	0.889	1.932	1.554	-0.006
Catboost4	0.917	1.711	1.354	0.000	0.890	1.924	1.547	0.001
LightGBM4	0.935	1.512	1.196	0.000	0.885	1.970	1.579	-0.009
CART4	0.893	1.944	1.539	0.000	0.867	2.122	1.694	-0.012
ET4	0.886	2.010	1.594	0.000	0.867	2.121	1.696	-0.024
RF4	0.981	0.816	0.598	-0.003	0.868	2.115	1.681	-0.010
GBDT4	0.918	1.702	1.349	0.000	0.889	1.935	1.557	-0.004
MLP4	0.894	1.933	1.527	0.008	0.875	2.052	1.640	0.014
SVM-RBF4	0.877	2.081	1.644	-0.059	0.861	2.171	1.742	-0.059
R_a n/N T_{max} T_{min} H_0 U_0 (C5)								
XGBoost5	0.931	1.565	1.215	0.000	0.898	1.856	1.480	0.075
Catboost5	0.935	1.521	1.174	0.000	0.903	1.820	1.453	0.115
LightGBM5	0.953	1.283	0.992	0.000	0.903	1.814	1.437	0.089
CART5	0.895	1.924	1.517	0.000	0.867	2.124	1.692	-0.012
ET5	0.892	1.952	1.549	0.000	0.871	2.090	1.669	0.012
RF5	0.984	0.742	0.537	-0.001	0.888	1.955	1.553	0.079
GBDT5	0.931	1.562	1.213	0.000	0.899	1.852	1.477	0.072
MLP5	0.918	1.699	1.313	-0.076	0.895	1.882	1.482	0.018
SVM-RBF5	0.907	1.814	1.403	-0.086	0.888	1.950	1.543	-0.002
R_a n/N T_{max} T_{min} P_{re} P_{rs} (C6)								
XGBoost6	0.933	1.543	1.218	0.000	0.904	1.804	1.449	0.013
Catboost6	0.938	1.479	1.159	0.000	0.910	1.749	1.401	0.037
LightGBM6	0.955	1.260	0.986	0.000	0.906	1.782	1.420	0.024
CART6	0.896	1.913	1.512	0.000	0.869	2.111	1.682	-0.012
ET6	0.891	1.967	1.559	0.000	0.873	2.078	1.656	-0.034
RF6	0.985	0.735	0.531	0.000	0.894	1.893	1.501	-0.008
GBDT6	0.933	1.537	1.213	0.000	0.904	1.805	1.449	0.011
MLP6	0.911	1.771	1.384	-0.041	0.894	1.896	1.494	-0.003
SVM-RBF6	0.896	1.913	1.505	-0.044	0.877	2.040	1.627	0.000
R_a n/N T_{max} T_{min} H_0 U_0 P_{re} P_{rs} (C7)								
XGBoost7	0.938	1.486	1.163	0.000	0.904	1.804	1.443	0.079
Catboost7	0.943	1.424	1.107	0.000	0.912	1.734	1.385	0.096
LightGBM7	0.961	1.170	0.912	0.000	0.911	1.740	1.381	0.061
CART7	0.897	1.909	1.508	0.000	0.867	2.123	1.692	-0.005
ET7	0.890	1.969	1.563	0.000	0.872	2.082	1.666	-0.012
RF7	0.986	0.704	0.514	-0.003	0.898	1.858	1.477	0.043
GBDT7	0.938	1.485	1.163	0.000	0.904	1.808	1.448	0.073
MLP7	0.923	1.653	1.275	-0.057	0.901	1.837	1.445	0.018
SVM-RBF7	0.908	1.803	1.408	-0.038	0.888	1.952	1.555	0.057

Table S3 Same as Table S4 but at Kunming station.

Input/Model	Training				Testing			
	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)
<i>R_e n/N (C1)</i>								
XGBoost1	0.908	1.991	1.446	0.001	0.890	2.159	1.570	-0.050
Catboost1	0.903	2.040	1.477	0.000	0.891	2.142	1.556	-0.058
LightGBM1	0.916	1.898	1.383	0.000	0.887	2.188	1.599	-0.051
CART1	0.883	2.238	1.675	0.000	0.865	2.392	1.796	-0.041
ET1	0.884	2.233	1.672	0.000	0.876	2.296	1.711	-0.037
RF1	0.977	0.993	0.683	0.000	0.857	2.463	1.821	-0.033
GBDT1	0.909	1.979	1.439	0.000	0.889	2.161	1.572	-0.053
MLP1	0.894	2.137	1.561	-0.002	0.888	2.177	1.585	-0.042
SVM-RBF1	0.887	2.203	1.603	-0.045	0.883	2.229	1.626	-0.083
<i>R_e n/N T_{max} T_{min} (C2)</i>								
XGBoost2	0.918	1.875	1.377	0.001	0.898	2.079	1.531	-0.044
Catboost2	0.918	1.875	1.372	0.000	0.900	2.054	1.512	-0.032
LightGBM2	0.937	1.650	1.214	0.000	0.897	2.087	1.541	-0.038
CART2	0.889	2.186	1.652	0.000	0.868	2.364	1.784	-0.021
ET2	0.889	2.178	1.639	0.000	0.883	2.232	1.678	-0.063
RF2	0.981	0.899	0.622	0.005	0.884	2.217	1.645	-0.039
GBDT2	0.919	1.864	1.372	0.000	0.898	2.074	1.526	-0.042
MLP2	0.901	2.066	1.524	0.009	0.895	2.105	1.557	-0.022
SVM-RBF2	0.898	2.091	1.531	-0.015	0.894	2.125	1.564	-0.049
<i>R_e n/N H₀ U₀ (C3)</i>								
XGBoost3	0.915	1.912	1.398	0.001	0.893	2.128	1.558	-0.031
Catboost3	0.913	1.931	1.405	0.000	0.894	2.116	1.548	-0.024
LightGBM3	0.933	1.695	1.246	0.000	0.889	2.167	1.588	-0.032
CART3	0.885	2.221	1.666	0.000	0.865	2.386	1.795	-0.032
ET3	0.886	2.211	1.666	0.000	0.877	2.281	1.705	-0.043
RF3	0.980	0.930	0.638	0.001	0.873	2.318	1.708	-0.039
GBDT3	0.915	1.905	1.394	0.000	0.893	2.127	1.556	-0.035
MLP3	0.897	2.097	1.534	0.087	0.890	2.158	1.579	0.043
SVM-RBF	0.890	2.173	1.583	-0.030	0.884	2.219	1.624	-0.075
<i>R_e n/N P_{re} P_{rs} (C4)</i>								
XGBoost4	0.913	1.934	1.406	0.000	0.893	2.128	1.546	-0.052
Catboost4	0.912	1.945	1.414	0.000	0.894	2.109	1.534	-0.059
LightGBM4	0.932	1.711	1.259	0.000	0.890	2.154	1.568	-0.060
CART4	0.884	2.228	1.671	0.000	0.864	2.396	1.799	-0.044
ET4	0.885	2.225	1.664	0.000	0.879	2.265	1.691	-0.036
RF4	0.979	0.938	0.646	-0.008	0.875	2.302	1.706	-0.090
GBDT4	0.914	1.924	1.402	0.000	0.892	2.139	1.555	-0.060
MLP4	0.895	2.126	1.554	-0.036	0.890	2.158	1.577	-0.077
SVM-RBF4	0.889	2.181	1.588	-0.023	0.885	2.209	1.610	-0.060
<i>R_e n/N T_{max} T_{min} H₀ U₀ (C5)</i>								
XGBoost5	0.923	1.823	1.346	0.000	0.900	2.061	1.524	-0.025
Catboost5	0.924	1.801	1.326	0.000	0.901	2.049	1.522	-0.008
LightGBM5	0.945	1.531	1.134	0.000	0.899	2.072	1.536	-0.016
CART5	0.889	2.177	1.651	0.000	0.867	2.374	1.794	-0.014
ET5	0.893	2.145	1.606	0.000	0.884	2.220	1.663	-0.032
RF5	0.982	0.877	0.602	-0.001	0.888	2.174	1.617	-0.046
GBDT5	0.923	1.814	1.341	0.000	0.900	2.062	1.526	-0.032
MLP5	0.903	2.043	1.512	-0.069	0.894	2.122	1.571	-0.122
SVM-RBF5	0.898	2.095	1.538	-0.018	0.892	2.145	1.587	-0.051
<i>R_e n/N T_{max} T_{min} P_{re} P_{rs} (C6)</i>								
XGBoost6	0.922	1.828	1.346	0.000	0.901	2.049	1.515	-0.050
Catboost6	0.924	1.800	1.323	0.000	0.904	2.017	1.494	-0.033
LightGBM6	0.945	1.539	1.140	0.000	0.902	2.039	1.508	-0.037
CART6	0.889	2.180	1.651	0.000	0.868	2.363	1.786	-0.022
ET6	0.888	2.189	1.653	0.000	0.882	2.238	1.684	-0.053
RF6	0.982	0.878	0.605	-0.001	0.888	2.177	1.621	-0.067
GBDT6	0.923	1.820	1.343	0.000	0.901	2.043	1.507	-0.045
MLP6	0.903	2.039	1.501	-0.009	0.896	2.097	1.545	-0.039
SVM-RBF6	0.897	2.098	1.541	-0.008	0.892	2.136	1.575	-0.043
<i>R_e n/N T_{max} T_{min} H₀ U₀ P_{re} P_{rs} (C7)</i>								
XGBoost7	0.924	1.802	1.330	0.000	0.901	2.044	1.511	-0.037
Catboost7	0.928	1.762	1.298	0.000	0.904	2.019	1.500	-0.033
LightGBM7	0.950	1.465	1.089	0.000	0.903	2.030	1.501	-0.026
CART7	0.890	2.175	1.652	0.000	0.868	2.362	1.788	-0.020
ET7	0.892	2.154	1.619	0.000	0.886	2.197	1.651	-0.032
RF7	0.983	0.865	0.598	-0.008	0.891	2.146	1.601	-0.056
GBDT7	0.925	1.794	1.327	0.000	0.902	2.041	1.510	-0.034
MLP7	0.904	2.034	1.503	-0.046	0.896	2.099	1.557	-0.095
SVM-RBF7	0.896	2.109	1.552	-0.007	0.890	2.165	1.603	-0.041

Table S4 Same as Table S4 but at Wuhan station.

Input/Model	Training				Testing			
	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)
<i>R_e n/N (C1)</i>								
XGBoost1	0.906	2.314	1.736	0.000	0.890	2.475	1.868	-0.012
Catboost1	0.903	2.351	1.762	0.000	0.891	2.467	1.859	-0.014
LightGBM1	0.914	2.207	1.660	0.000	0.887	2.511	1.901	-0.008
CART1	0.893	2.465	1.887	0.000	0.880	2.600	1.986	-0.026
ET1	0.891	2.488	1.898	0.000	0.883	2.561	1.966	-0.002
RF1	0.976	1.174	0.813	0.000	0.854	2.863	2.155	0.012
GBDT1	0.907	2.303	1.730	0.000	0.890	2.476	1.869	-0.009
MLP1	0.893	2.464	1.865	-0.005	0.888	2.511	1.908	-0.015
SVM-RBF1	0.887	2.538	1.909	-0.104	0.881	2.585	1.961	-0.121
<i>R_e n/N T_{max} T_{min} (C2)</i>								
XGBoost2	0.918	2.163	1.618	0.000	0.900	2.366	1.776	-0.012
Catboost2	0.922	2.101	1.573	0.000	0.904	2.312	1.723	-0.004
LightGBM2	0.940	1.850	1.388	0.000	0.902	2.339	1.742	-0.004
CART2	0.899	2.399	1.840	0.000	0.884	2.551	1.950	-0.021
ET2	0.894	2.447	1.869	0.000	0.887	2.517	1.926	-0.015
RF2	0.981	1.028	0.707	-0.001	0.887	2.520	1.870	-0.005
GBDT2	0.918	2.156	1.615	0.000	0.900	2.365	1.776	-0.010
MLP2	0.903	2.349	1.754	0.026	0.898	2.387	1.786	0.036
SVM-RBF2	0.895	2.439	1.816	-0.149	0.891	2.471	1.853	-0.143
<i>R_e n/N H₀ U₀ (C3)</i>								
XGBoost3	0.919	2.145	1.590	0.000	0.895	2.408	1.829	0.054
Catboost3	0.919	2.146	1.582	0.000	0.895	2.413	1.829	0.069
LightGBM3	0.936	1.901	1.414	0.000	0.890	2.468	1.861	0.037
CART3	0.901	2.370	1.802	0.000	0.884	2.552	1.936	-0.013
ET3	0.898	2.410	1.831	0.000	0.890	2.487	1.908	0.007
RF3	0.981	1.026	0.714	0.001	0.875	2.643	1.996	0.068
GBDT3	0.919	2.139	1.587	0.000	0.895	2.410	1.829	0.052
MLP3	0.902	2.356	1.765	-0.046	0.889	2.484	1.900	0.004
SVM-RBF	0.898	2.402	1.794	-0.079	0.887	2.510	1.913	-0.018
<i>R_e n/N P_{re} P_{rs} (C4)</i>								
XGBoost4	0.925	2.064	1.527	0.000	0.910	2.239	1.669	-0.012
Catboost4	0.925	2.068	1.528	0.000	0.911	2.226	1.659	-0.011
LightGBM4	0.940	1.841	1.375	0.000	0.907	2.275	1.697	-0.013
CART4	0.906	2.304	1.741	0.000	0.893	2.445	1.847	-0.038
ET4	0.892	2.473	1.893	0.000	0.885	2.543	1.953	-0.010
RF4	0.982	1.007	0.700	0.008	0.891	2.468	1.856	-0.007
GBDT4	0.926	2.054	1.523	0.000	0.910	2.240	1.671	-0.010
MLP4	0.904	2.337	1.753	0.049	0.895	2.413	1.829	0.040
SVM-RBF4	0.895	2.441	1.824	-0.097	0.890	2.487	1.877	-0.115
<i>R_e n/N T_{max} T_{min} H₀ U₀ (C5)</i>								
XGBoost5	0.925	2.060	1.524	0.000	0.902	2.335	1.761	0.066
Catboost5	0.931	1.982	1.465	0.000	0.904	2.303	1.724	0.094
LightGBM5	0.950	1.692	1.261	0.000	0.904	2.316	1.721	0.066
CART5	0.904	2.339	1.784	0.000	0.885	2.535	1.922	0.003
ET5	0.898	2.408	1.844	0.000	0.890	2.478	1.911	-0.014
RF5	0.983	0.970	0.669	0.008	0.890	2.480	1.850	0.091
GBDT5	0.926	2.053	1.522	0.000	0.901	2.339	1.765	0.074
MLP5	0.911	2.253	1.669	-0.031	0.902	2.344	1.759	0.025
SVM-RBF5	0.901	2.366	1.762	-0.131	0.893	2.450	1.856	-0.055
<i>R_e n/N T_{max} T_{min} P_{re} P_{rs} (C6)</i>								
XGBoost6	0.931	1.972	1.457	0.000	0.915	2.169	1.611	-0.017
Catboost6	0.935	1.913	1.414	0.000	0.918	2.127	1.572	0.000
LightGBM6	0.953	1.640	1.220	0.000	0.916	2.159	1.592	-0.007
CART6	0.908	2.282	1.729	0.000	0.895	2.422	1.831	-0.036
ET6	0.898	2.403	1.841	0.000	0.892	2.458	1.891	-0.003
RF6	0.985	0.931	0.646	-0.001	0.903	2.330	1.739	-0.005
GBDT6	0.932	1.964	1.456	0.000	0.915	2.171	1.614	-0.014
MLP6	0.913	2.217	1.634	-0.014	0.910	2.243	1.655	-0.003
SVM-RBF6	0.901	2.371	1.768	-0.135	0.897	2.407	1.808	-0.135
<i>R_e n/N T_{max} T_{min} H₀ U₀ P_{re} P_{rs} (C7)</i>								
XGBoost7	0.933	1.947	1.438	0.000	0.913	2.197	1.644	0.063
Catboost7	0.938	1.873	1.380	0.000	0.916	2.152	1.599	0.079
LightGBM7	0.957	1.562	1.163	0.000	0.915	2.172	1.611	0.071
CART7	0.908	2.280	1.730	0.000	0.894	2.434	1.842	-0.016
ET7	0.901	2.373	1.817	0.000	0.892	2.457	1.885	-0.001
RF7	0.985	0.930	0.641	0.010	0.903	2.323	1.735	0.087
GBDT7	0.934	1.941	1.437	0.000	0.913	2.199	1.646	0.061
MLP7	0.915	2.200	1.628	0.074	0.906	2.294	1.719	0.123
SVM-RBF7	0.903	2.353	1.758	-0.122	0.894	2.432	1.849	-0.053

Table S5 Same as Table S4 but at Shanghai station.

Input/Model	Training				Testing			
	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)
R_a n/N (C1)								
XGBoost1	0.925	1.979	1.504	0.000	0.912	2.127	1.618	-0.001
Catboost1	0.922	2.019	1.530	0.000	0.914	2.110	1.599	0.003
LightGBM1	0.931	1.895	1.433	0.000	0.911	2.149	1.633	0.001
CART1	0.908	2.190	1.694	0.000	0.896	2.316	1.785	-0.008
ET1	0.910	2.166	1.676	0.000	0.905	2.211	1.711	-0.006
RF1	0.981	0.998	0.695	0.004	0.883	2.458	1.846	0.021
GBDT1	0.925	1.974	1.501	0.000	0.912	2.128	1.618	-0.001
MLP1	0.915	2.101	1.599	0.043	0.911	2.143	1.633	0.042
SVM-RBF1	0.906	2.214	1.686	0.003	0.901	2.256	1.720	0.006
R_a n/N T_{max} T_{min} (C2)								
XGBoost2	0.933	1.868	1.417	0.000	0.920	2.036	1.553	0.003
Catboost2	0.935	1.836	1.388	0.000	0.923	1.998	1.512	0.010
LightGBM2	0.950	1.621	1.228	0.000	0.919	2.043	1.544	0.001
CART2	0.911	2.154	1.666	0.000	0.899	2.279	1.758	-0.003
ET2	0.912	2.139	1.658	0.000	0.907	2.186	1.694	0.010
RF2	0.985	0.885	0.621	-0.001	0.908	2.179	1.657	-0.011
GBDT2	0.934	1.861	1.413	0.000	0.920	2.036	1.553	0.003
MLP2	0.921	2.023	1.540	0.049	0.918	2.061	1.573	0.055
SVM-RBF2	0.910	2.160	1.642	-0.022	0.906	2.208	1.684	-0.018
R_a n/N H_0 U_0 (C3)								
XGBoost3	0.938	1.799	1.367	0.000	0.926	1.951	1.490	0.036
Catboost3	0.938	1.802	1.364	0.000	0.928	1.933	1.469	0.040
LightGBM3	0.951	1.598	1.212	0.000	0.925	1.972	1.498	0.024
CART3	0.914	2.112	1.632	0.000	0.903	2.241	1.729	0.015
ET3	0.916	2.097	1.627	0.000	0.911	2.140	1.666	0.004
RF3	0.985	0.872	0.615	-0.008	0.912	2.136	1.621	-0.005
GBDT3	0.938	1.796	1.366	0.000	0.926	1.954	1.492	0.029
MLP3	0.928	1.940	1.472	-0.058	0.923	1.989	1.517	-0.031
SVM-RBF	0.920	2.038	1.556	0.030	0.917	2.071	1.587	0.064
R_a n/N P_{re} P_{rs} (C4)								
XGBoost4	0.941	1.747	1.333	0.000	0.930	1.905	1.459	-0.001
Catboost4	0.942	1.741	1.322	0.000	0.932	1.875	1.428	0.003
LightGBM4	0.954	1.549	1.179	0.000	0.928	1.927	1.469	-0.003
CART4	0.917	2.076	1.607	0.000	0.906	2.201	1.703	-0.005
ET4	0.913	2.128	1.659	0.000	0.908	2.184	1.697	0.006
RF4	0.986	0.841	0.595	0.004	0.916	2.079	1.579	-0.013
GBDT4	0.942	1.741	1.329	0.000	0.930	1.907	1.458	-0.001
MLP4	0.927	1.945	1.480	-0.013	0.922	2.002	1.528	-0.017
SVM-RBF4	0.915	2.102	1.598	-0.021	0.911	2.140	1.632	-0.019
R_a n/N T_{max} T_{min} H_0 U_0 (C5)								
XGBoost5	0.942	1.732	1.313	0.000	0.929	1.910	1.457	0.027
Catboost5	0.945	1.688	1.274	0.000	0.933	1.865	1.418	0.038
LightGBM5	0.960	1.438	1.091	0.000	0.930	1.898	1.432	0.017
CART5	0.915	2.104	1.626	0.000	0.902	2.245	1.737	-0.001
ET5	0.917	2.075	1.611	0.000	0.913	2.121	1.645	0.001
RF5	0.987	0.823	0.577	-0.004	0.921	2.015	1.537	0.020
GBDT5	0.943	1.730	1.313	0.000	0.930	1.906	1.454	0.028
MLP5	0.932	1.889	1.431	-0.008	0.926	1.954	1.488	0.012
SVM-RBF5	0.920	2.046	1.567	0.001	0.916	2.084	1.604	0.028
R_a n/N T_{max} T_{min} P_{re} P_{rs} (C6)								
XGBoost6	0.946	1.681	1.284	0.000	0.934	1.851	1.421	0.008
Catboost6	0.948	1.646	1.254	0.000	0.936	1.819	1.391	0.010
LightGBM6	0.962	1.409	1.079	0.000	0.934	1.848	1.407	0.004
CART6	0.918	2.061	1.597	0.000	0.907	2.187	1.689	-0.006
ET6	0.916	2.096	1.623	0.000	0.910	2.153	1.666	-0.006
RF6	0.988	0.805	0.572	0.001	0.924	1.986	1.516	0.007
GBDT6	0.946	1.677	1.283	0.000	0.934	1.852	1.420	0.003
MLP6	0.929	1.920	1.458	-0.043	0.925	1.971	1.504	-0.038
SVM-RBF6	0.916	2.094	1.602	-0.024	0.912	2.131	1.636	-0.017
R_a n/N T_{max} T_{min} H_0 U_0 P_{re} P_{rs} (C7)								
XGBoost7	0.948	1.650	1.261	0.000	0.936	1.823	1.398	0.023
Catboost7	0.951	1.604	1.221	0.000	0.939	1.781	1.360	0.028
LightGBM7	0.966	1.339	1.025	0.000	0.936	1.813	1.377	0.018
CART7	0.918	2.061	1.596	0.000	0.907	2.189	1.691	-0.002
ET7	0.915	2.107	1.638	0.000	0.910	2.157	1.679	0.007
RF7	0.988	0.788	0.560	-0.007	0.926	1.953	1.492	-0.007
GBDT7	0.948	1.645	1.259	0.000	0.936	1.822	1.398	0.016
MLP7	0.933	1.866	1.415	-0.077	0.929	1.917	1.460	-0.060
SVM-RBF7	0.919	2.056	1.586	-0.008	0.916	2.088	1.617	0.015

Table S6 Same as Table S4 but at Chengdu station.

Input/Model	Training				Testing			
	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)
<i>R_e n/N</i> (C1)								
XGBoost1	0.873	2.314	1.782	0.000	0.841	2.531	1.985	-0.065
Catboost1	0.869	2.353	1.807	0.000	0.843	2.514	1.970	-0.067
LightGBM1	0.882	2.232	1.715	0.000	0.837	2.559	2.006	-0.067
CART1	0.856	2.461	1.904	0.000	0.825	2.658	2.084	-0.066
ET1	0.857	2.455	1.907	0.000	0.837	2.566	2.022	-0.054
RF1	0.967	1.182	0.837	0.004	0.785	2.956	2.283	-0.076
GBDT1	0.874	2.308	1.779	0.000	0.841	2.532	1.987	-0.065
MLP1	0.858	2.448	1.894	-0.024	0.839	2.551	2.005	-0.086
SVM-RBF1	0.848	2.535	1.955	-0.082	0.827	2.642	2.073	-0.151
<i>R_e n/N T_{max} T_{min}</i> (C2)								
XGBoost2	0.903	2.024	1.541	0.000	0.871	2.271	1.760	-0.055
Catboost2	0.909	1.964	1.479	0.000	0.878	2.208	1.692	-0.048
LightGBM2	0.929	1.735	1.309	0.000	0.873	2.254	1.718	-0.051
CART2	0.869	2.349	1.805	0.000	0.835	2.582	2.012	-0.042
ET2	0.865	2.385	1.856	0.000	0.845	2.506	1.979	-0.056
RF2	0.978	0.955	0.669	0.011	0.856	2.408	1.831	-0.048
GBDT2	0.903	2.023	1.542	0.000	0.870	2.277	1.766	-0.054
MLP2	0.883	2.224	1.695	0.004	0.867	2.313	1.790	-0.064
SVM-RBF2	0.875	2.292	1.743	-0.098	0.858	2.386	1.842	-0.161
<i>R_e n/N H₀ U₀</i> (C3)								
XGBoost3	0.902	2.034	1.553	0.000	0.874	2.259	1.747	-0.053
Catboost3	0.901	2.044	1.559	0.000	0.876	2.239	1.725	-0.040
LightGBM3	0.921	1.823	1.393	0.000	0.874	2.263	1.751	-0.044
CART3	0.873	2.319	1.783	0.000	0.839	2.554	1.990	-0.057
ET3	0.864	2.392	1.862	0.000	0.843	2.524	1.995	-0.054
RF3	0.977	0.989	0.705	-0.002	0.849	2.479	1.913	-0.049
GBDT3	0.902	2.033	1.554	0.000	0.873	2.267	1.756	-0.053
MLP3	0.879	2.257	1.740	0.024	0.863	2.360	1.839	-0.047
SVM-RBF	0.875	2.298	1.771	-0.005	0.858	2.398	1.870	-0.088
<i>R_e n/N P_{re} P_{rs}</i> (C4)								
XGBoost4	0.889	2.161	1.670	0.000	0.856	2.410	1.892	-0.062
Catboost4	0.890	2.159	1.668	0.000	0.856	2.405	1.887	-0.058
LightGBM4	0.911	1.935	1.499	0.000	0.850	2.463	1.924	-0.067
CART4	0.867	2.372	1.836	0.000	0.835	2.584	2.025	-0.066
ET4	0.858	2.448	1.911	0.000	0.837	2.574	2.039	-0.058
RF4	0.974	1.051	0.752	-0.009	0.828	2.646	2.059	-0.078
GBDT4	0.890	2.154	1.666	0.000	0.855	2.414	1.896	-0.064
MLP4	0.862	2.416	1.876	0.002	0.841	2.535	1.998	-0.055
SVM-RBF4	0.850	2.518	1.950	-0.074	0.829	2.631	2.071	-0.142
<i>R_e n/N T_{max} T_{min} H₀ U₀</i> (C5)								
XGBoost5	0.916	1.881	1.425	0.000	0.888	2.124	1.632	-0.051
Catboost5	0.923	1.804	1.360	0.000	0.895	2.055	1.563	-0.022
LightGBM5	0.945	1.527	1.156	0.000	0.894	2.062	1.564	-0.038
CART5	0.877	2.276	1.748	0.000	0.843	2.522	1.967	-0.056
ET5	0.874	2.304	1.798	0.000	0.855	2.419	1.899	-0.073
RF5	0.982	0.878	0.618	-0.005	0.878	2.220	1.686	-0.027
GBDT5	0.917	1.875	1.423	0.000	0.888	2.122	1.630	-0.047
MLP5	0.897	2.085	1.575	-0.181	0.882	2.178	1.663	-0.252
SVM-RBF5	0.889	2.165	1.644	-0.062	0.875	2.247	1.727	-0.138
<i>R_e n/N T_{max} T_{min} P_{re} P_{rs}</i> (C6)								
XGBoost6	0.910	1.952	1.499	0.000	0.877	2.221	1.733	-0.047
Catboost6	0.917	1.865	1.421	0.000	0.884	2.156	1.668	-0.046
LightGBM6	0.939	1.602	1.221	0.000	0.880	2.192	1.682	-0.043
CART6	0.872	2.322	1.792	0.000	0.839	2.556	1.998	-0.045
ET6	0.868	2.361	1.840	0.000	0.849	2.473	1.951	-0.071
RF6	0.980	0.909	0.644	0.001	0.867	2.317	1.771	-0.048
GBDT6	0.910	1.949	1.498	0.000	0.876	2.224	1.734	-0.049
MLP6	0.891	2.147	1.636	0.032	0.876	2.235	1.723	-0.022
SVM-RBF6	0.874	2.301	1.761	-0.100	0.856	2.408	1.871	-0.165
<i>R_e n/N T_{max} T_{min} H₀ U₀ P_{re} P_{rs}</i> (C7)								
XGBoost7	0.918	1.865	1.415	0.000	0.889	2.120	1.629	-0.048
Catboost7	0.926	1.764	1.333	0.000	0.897	2.038	1.555	-0.032
LightGBM7	0.949	1.467	1.116	0.000	0.897	2.041	1.556	-0.045
CART7	0.878	2.273	1.747	0.000	0.843	2.525	1.968	-0.059
ET7	0.873	2.313	1.807	0.000	0.854	2.427	1.909	-0.084
RF7	0.982	0.880	0.620	0.002	0.879	2.211	1.679	-0.054
GBDT7	0.918	1.863	1.416	0.000	0.888	2.123	1.634	-0.055
MLP7	0.899	2.060	1.561	0.036	0.884	2.163	1.656	-0.025
SVM-RBF7	0.886	2.197	1.678	-0.059	0.871	2.283	1.763	-0.139

Table S7 Same as Table S4 but at Haerbin station.

Input/Model	Training				Testing			
	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)
$R_e n/N$ (C1)								
XGBoost1	0.933	1.873	1.359	0.000	0.915	2.075	1.535	-0.035
Catboost1	0.930	1.912	1.383	0.000	0.916	2.056	1.516	-0.035
LightGBM1	0.940	1.760	1.280	0.000	0.913	2.103	1.550	-0.036
CART1	0.911	2.150	1.596	0.000	0.895	2.318	1.738	-0.027
ET1	0.913	2.124	1.574	0.000	0.905	2.196	1.647	-0.034
RF1	0.983	0.932	0.629	-0.001	0.894	2.331	1.716	-0.029
GBDT1	0.933	1.868	1.356	0.000	0.915	2.078	1.534	-0.035
MLP1	0.920	2.046	1.501	0.018	0.913	2.098	1.561	-0.037
SVM-RBF1	0.924	1.985	1.433	0.043	0.917	2.046	1.506	-0.010
$R_e n/N T_{max} T_{min}$ (C2)								
XGBoost2	0.939	1.777	1.281	0.000	0.921	2.001	1.474	-0.030
Catboost2	0.942	1.743	1.259	0.000	0.923	1.971	1.449	-0.037
LightGBM2	0.956	1.507	1.108	0.000	0.920	2.010	1.478	-0.033
CART2	0.912	2.140	1.589	0.000	0.895	2.321	1.737	-0.021
ET2	0.914	2.122	1.576	0.000	0.906	2.197	1.654	-0.026
RF2	0.986	0.855	0.575	0.007	0.911	2.134	1.571	-0.027
GBDT2	0.940	1.771	1.279	0.000	0.920	2.004	1.475	-0.033
MLP2	0.924	1.984	1.438	-0.003	0.916	2.061	1.518	-0.056
SVM-RBF2	0.926	1.960	1.404	0.029	0.919	2.027	1.483	-0.022
$R_e n/N H_0 U_0$ (C3)								
XGBoost3	0.940	1.767	1.285	0.000	0.920	2.012	1.501	-0.057
Catboost3	0.941	1.756	1.272	0.000	0.922	1.985	1.477	-0.064
LightGBM3	0.956	1.515	1.112	0.000	0.916	2.054	1.521	-0.063
CART3	0.912	2.137	1.585	0.000	0.895	2.320	1.737	-0.019
ET3	0.916	2.097	1.558	0.000	0.906	2.195	1.646	-0.043
RF3	0.986	0.861	0.581	-0.006	0.908	2.167	1.609	-0.068
GBDT3	0.941	1.758	1.281	0.000	0.919	2.014	1.503	-0.058
MLP3	0.927	1.953	1.434	0.072	0.919	2.022	1.513	-0.001
SVM-RBF	0.930	1.907	1.387	0.024	0.922	1.986	1.480	-0.050
$R_e n/N P_{re} P_{rs}$ (C4)								
XGBoost4	0.943	1.720	1.252	0.000	0.925	1.948	1.445	-0.018
Catboost4	0.943	1.719	1.250	0.000	0.927	1.922	1.425	-0.013
LightGBM4	0.957	1.491	1.100	0.000	0.924	1.966	1.456	-0.020
CART4	0.915	2.111	1.570	0.000	0.897	2.298	1.720	-0.025
ET4	0.916	2.090	1.545	0.000	0.906	2.182	1.634	-0.029
RF4	0.987	0.835	0.567	-0.001	0.914	2.091	1.550	-0.011
GBDT4	0.944	1.711	1.247	0.000	0.925	1.948	1.445	-0.014
MLP4	0.925	1.972	1.451	-0.016	0.917	2.056	1.544	-0.061
SVM-RBF4	0.929	1.923	1.393	0.026	0.922	1.988	1.471	-0.013
$R_e n/N T_{max} T_{min} H_0 U_0$ (C5)								
XGBoost5	0.944	1.708	1.238	0.000	0.923	1.971	1.464	-0.053
Catboost5	0.947	1.660	1.201	0.000	0.926	1.932	1.435	-0.067
LightGBM5	0.963	1.384	1.019	0.000	0.922	1.988	1.469	-0.075
CART5	0.913	2.130	1.582	0.000	0.895	2.322	1.740	-0.020
ET5	0.915	2.110	1.568	0.000	0.906	2.188	1.646	-0.039
RF5	0.987	0.817	0.550	0.000	0.915	2.078	1.535	-0.042
GBDT5	0.944	1.701	1.235	0.000	0.923	1.974	1.465	-0.056
MLP5	0.931	1.889	1.369	0.075	0.920	2.003	1.490	0.013
SVM-RBF5	0.928	1.936	1.397	0.025	0.920	2.008	1.486	-0.051
$R_e n/N T_{max} T_{min} P_{re} P_{rs}$ (C6)								
XGBoost6	0.947	1.669	1.213	0.000	0.927	1.917	1.421	-0.021
Catboost6	0.950	1.622	1.179	0.000	0.930	1.880	1.393	-0.019
LightGBM6	0.965	1.358	1.010	0.000	0.927	1.920	1.420	-0.022
CART6	0.915	2.112	1.571	0.000	0.896	2.312	1.730	-0.025
ET6	0.916	2.092	1.553	0.000	0.908	2.168	1.625	-0.054
RF6	0.988	0.796	0.544	-0.004	0.919	2.030	1.505	-0.017
GBDT6	0.947	1.662	1.211	0.000	0.927	1.918	1.422	-0.023
MLP6	0.931	1.899	1.377	0.006	0.924	1.965	1.450	-0.021
SVM-RBF6	0.927	1.952	1.406	0.010	0.919	2.022	1.490	-0.027
$R_e n/N T_{max} T_{min} H_0 U_0 P_{re} P_{rs}$ (C7)								
XGBoost7	0.948	1.638	1.193	0.000	0.927	1.917	1.428	-0.045
Catboost7	0.952	1.584	1.154	0.000	0.930	1.882	1.402	-0.040
LightGBM7	0.968	1.289	0.956	0.000	0.927	1.924	1.425	-0.046
CART7	0.915	2.112	1.571	0.000	0.896	2.313	1.732	-0.028
ET7	0.915	2.108	1.574	0.000	0.904	2.208	1.662	-0.052
RF7	0.988	0.782	0.530	0.005	0.921	2.007	1.484	-0.029
GBDT7	0.949	1.632	1.192	0.000	0.928	1.911	1.424	-0.039
MLP7	0.932	1.880	1.373	-0.083	0.922	1.988	1.487	-0.155
SVM-RBF7	0.927	1.955	1.418	0.004	0.918	2.033	1.513	-0.053

Table S8 Same as Table S4 but at Shenyang station.

Input/Model	Training				Testing			
	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)
<i>R_e n/N (C1)</i>								
XGBoost1	0.915	2.052	1.457	0.000	0.901	2.211	1.581	0.055
Catboost1	0.911	2.095	1.479	0.000	0.903	2.187	1.555	0.048
LightGBM1	0.923	1.946	1.381	0.000	0.897	2.252	1.603	0.052
CART1	0.891	2.324	1.715	0.000	0.879	2.444	1.828	0.042
ET1	0.891	2.319	1.703	0.000	0.888	2.353	1.740	0.041
RF1	0.978	1.040	0.680	0.006	0.872	2.516	1.775	0.071
GBDT1	0.916	2.040	1.454	0.000	0.901	2.214	1.580	0.051
MLP1	0.899	2.235	1.611	0.090	0.897	2.252	1.635	0.129
SVM-RBF1	0.903	2.189	1.547	-0.038	0.900	2.216	1.579	0.011
<i>R_e n/N T_{max} T_{min} (C2)</i>								
XGBoost2	0.925	1.931	1.372	0.000	0.909	2.114	1.512	0.055
Catboost2	0.928	1.881	1.336	0.000	0.914	2.059	1.463	0.058
LightGBM2	0.946	1.633	1.171	0.000	0.909	2.112	1.500	0.060
CART2	0.895	2.284	1.690	0.000	0.879	2.445	1.825	0.049
ET2	0.895	2.283	1.692	0.000	0.890	2.334	1.733	0.032
RF2	0.983	0.921	0.608	0.005	0.898	2.240	1.606	0.073
GBDT2	0.925	1.924	1.370	0.000	0.909	2.113	1.514	0.057
MLP2	0.906	2.156	1.526	0.024	0.901	2.208	1.576	0.062
SVM-RBF2	0.904	2.176	1.529	-0.054	0.901	2.208	1.565	-0.006
<i>R_e n/N H₀ U₀ (C3)</i>								
XGBoost3	0.925	1.926	1.381	0.000	0.910	2.110	1.521	0.060
Catboost3	0.926	1.911	1.364	0.000	0.912	2.084	1.497	0.065
LightGBM3	0.944	1.662	1.207	0.000	0.907	2.141	1.539	0.070
CART3	0.894	2.293	1.692	0.000	0.880	2.436	1.819	0.041
ET3	0.895	2.281	1.676	0.000	0.890	2.333	1.730	0.020
RF3	0.982	0.934	0.622	0.003	0.892	2.311	1.658	0.073
GBDT3	0.926	1.917	1.377	0.000	0.910	2.104	1.520	0.061
MLP3	0.909	2.122	1.522	0.019	0.906	2.150	1.557	0.076
SVM-RBF	0.910	2.116	1.504	-0.053	0.907	2.140	1.538	0.001
<i>R_e n/N P_{re} P_{rs} (C4)</i>								
XGBoost4	0.928	1.890	1.356	0.000	0.913	2.071	1.490	0.046
Catboost4	0.928	1.882	1.342	0.000	0.916	2.040	1.456	0.054
LightGBM4	0.945	1.654	1.198	0.000	0.910	2.109	1.500	0.054
CART4	0.897	2.253	1.663	0.000	0.885	2.385	1.781	0.044
ET4	0.892	2.312	1.722	0.000	0.888	2.355	1.754	0.011
RF4	0.982	0.938	0.621	0.000	0.898	2.247	1.617	0.064
GBDT4	0.928	1.881	1.352	0.000	0.913	2.072	1.490	0.048
MLP4	0.908	2.129	1.531	0.004	0.906	2.158	1.565	0.046
SVM-RBF4	0.909	2.119	1.510	-0.034	0.907	2.144	1.541	0.011
<i>R_e n/N T_{max} T_{min} H₀ U₀ (C5)</i>								
XGBoost5	0.931	1.843	1.327	0.000	0.915	2.047	1.483	0.061
Catboost5	0.937	1.765	1.268	0.000	0.920	1.990	1.433	0.073
LightGBM5	0.955	1.493	1.090	0.000	0.916	2.035	1.467	0.064
CART5	0.897	2.262	1.675	0.000	0.882	2.417	1.811	0.043
ET5	0.896	2.272	1.697	0.000	0.890	2.324	1.744	0.047
RF5	0.984	0.884	0.590	0.009	0.906	2.154	1.565	0.080
GBDT5	0.932	1.836	1.324	0.000	0.915	2.047	1.484	0.063
MLP5	0.914	2.066	1.472	-0.005	0.911	2.094	1.503	0.049
SVM-RBF5	0.907	2.149	1.527	-0.075	0.904	2.176	1.561	-0.025
<i>R_e n/N T_{max} T_{min} P_{re} P_{rs} (C6)</i>								
XGBoost6	0.933	1.823	1.305	0.000	0.918	2.011	1.447	0.055
Catboost6	0.938	1.751	1.249	0.000	0.922	1.965	1.401	0.063
LightGBM6	0.955	1.493	1.080	0.000	0.918	2.012	1.434	0.062
CART6	0.899	2.233	1.656	0.000	0.885	2.383	1.785	0.042
ET6	0.894	2.285	1.698	0.000	0.890	2.334	1.746	0.039
RF6	0.984	0.882	0.584	0.009	0.907	2.144	1.535	0.078
GBDT6	0.934	1.809	1.301	0.000	0.917	2.021	1.454	0.052
MLP6	0.910	2.105	1.507	-0.042	0.907	2.141	1.549	0.000
SVM-RBF6	0.906	2.152	1.529	-0.065	0.903	2.183	1.564	-0.022
<i>R_e n/N T_{max} T_{min} H₀ U₀ P_{re} P_{rs} (C7)</i>								
XGBoost7	0.935	1.792	1.293	0.000	0.918	2.012	1.455	0.057
Catboost7	0.941	1.703	1.228	0.000	0.922	1.961	1.406	0.072
LightGBM7	0.960	1.415	1.036	0.000	0.919	1.996	1.431	0.060
CART7	0.899	2.233	1.655	0.000	0.885	2.382	1.784	0.042
ET7	0.896	2.272	1.692	0.000	0.890	2.333	1.745	0.037
RF7	0.985	0.864	0.576	0.013	0.909	2.117	1.529	0.072
GBDT7	0.936	1.782	1.290	0.000	0.918	2.016	1.461	0.055
MLP7	0.913	2.077	1.502	0.094	0.909	2.125	1.557	0.147
SVM-RBF7	0.907	2.150	1.540	-0.084	0.904	2.176	1.573	-0.040

Table S9 Same as Table S4 but at Zhengzhou station.

Input/Model	Training				Testing			
	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)
<i>R_a n/N (C1)</i>								
XGBoost1	0.931	1.836	1.361	0.000	0.923	1.940	1.457	0.000
Catboost1	0.930	1.860	1.378	0.000	0.924	1.931	1.444	-0.007
LightGBM1	0.937	1.754	1.291	0.000	0.920	1.984	1.480	-0.005
CART1	0.910	2.108	1.634	0.000	0.900	2.217	1.721	0.022
ET1	0.914	2.058	1.568	0.000	0.912	2.080	1.595	-0.009
RF1	0.983	0.921	0.628	-0.005	0.897	2.248	1.657	-0.006
GBDT1	0.932	1.829	1.358	0.000	0.923	1.943	1.459	-0.001
MLP1	0.918	2.004	1.498	-0.029	0.916	2.034	1.530	-0.034
SVM-RBF1	0.908	2.122	1.571	-0.048	0.906	2.147	1.598	-0.051
<i>R_a n/N T_{max} T_{min} (C2)</i>								
XGBoost2	0.940	1.714	1.278	0.000	0.931	1.847	1.394	-0.002
Catboost2	0.944	1.661	1.235	0.000	0.934	1.803	1.350	-0.006
LightGBM2	0.957	1.456	1.092	0.000	0.931	1.839	1.376	-0.011
CART2	0.914	2.052	1.603	0.000	0.904	2.174	1.695	0.021
ET2	0.916	2.032	1.575	0.000	0.912	2.074	1.612	0.002
RF2	0.987	0.805	0.554	-0.008	0.922	1.957	1.459	-0.018
GBDT2	0.941	1.708	1.274	0.000	0.931	1.844	1.391	-0.006
MLP2	0.922	1.953	1.464	-0.036	0.920	1.976	1.489	-0.050
SVM-RBF2	0.911	2.090	1.541	-0.090	0.908	2.120	1.573	-0.096
<i>R_a n/N H₀ U₀ (C3)</i>								
XGBoost3	0.945	1.652	1.227	0.000	0.935	1.784	1.337	0.016
Catboost3	0.945	1.647	1.222	0.000	0.937	1.756	1.315	0.015
LightGBM3	0.957	1.450	1.082	0.000	0.933	1.816	1.357	0.010
CART3	0.918	2.013	1.565	0.000	0.908	2.127	1.649	0.032
ET3	0.917	2.022	1.550	0.000	0.914	2.050	1.582	-0.006
RF3	0.987	0.795	0.546	-0.004	0.923	1.950	1.440	-0.003
GBDT3	0.945	1.649	1.226	0.000	0.935	1.785	1.340	0.012
MLP3	0.929	1.866	1.395	0.060	0.928	1.885	1.419	0.062
SVM-RBF	0.918	2.006	1.481	-0.042	0.917	2.015	1.498	-0.039
<i>R_a n/N P_{re} P_{rs} (C4)</i>								
XGBoost4	0.948	1.596	1.205	0.000	0.940	1.720	1.308	0.001
Catboost4	0.948	1.593	1.203	0.000	0.941	1.705	1.290	0.000
LightGBM4	0.959	1.415	1.072	0.000	0.938	1.739	1.313	-0.009
CART4	0.922	1.959	1.529	0.000	0.913	2.071	1.618	0.016
ET4	0.916	2.028	1.566	0.000	0.914	2.055	1.586	-0.014
RF4	0.988	0.775	0.539	0.001	0.928	1.878	1.421	-0.007
GBDT4	0.949	1.588	1.201	0.000	0.940	1.721	1.308	0.000
MLP4	0.928	1.884	1.423	-0.081	0.926	1.896	1.433	-0.082
SVM-RBF4	0.915	2.046	1.524	-0.047	0.913	2.072	1.551	-0.050
<i>R_a n/N T_{max} T_{min} H₀ U₀ (C5)</i>								
XGBoost5	0.949	1.592	1.187	0.000	0.938	1.741	1.312	0.008
Catboost5	0.952	1.544	1.151	0.000	0.941	1.705	1.280	0.006
LightGBM5	0.966	1.294	0.975	0.000	0.939	1.728	1.294	-0.007
CART5	0.920	1.989	1.554	0.000	0.907	2.135	1.658	0.026
ET5	0.922	1.963	1.520	0.000	0.919	1.996	1.547	0.002
RF5	0.988	0.759	0.524	-0.001	0.931	1.845	1.371	-0.003
GBDT5	0.949	1.589	1.186	0.000	0.938	1.744	1.315	0.004
MLP5	0.933	1.811	1.353	0.018	0.931	1.845	1.393	0.007
SVM-RBF5	0.917	2.019	1.488	-0.077	0.915	2.036	1.512	-0.082
<i>R_a n/N T_{max} T_{min} P_{re} P_{rs} (C6)</i>								
XGBoost6	0.952	1.540	1.166	0.000	0.943	1.678	1.278	-0.002
Catboost6	0.954	1.511	1.144	0.000	0.945	1.650	1.252	-0.001
LightGBM6	0.967	1.276	0.971	0.000	0.943	1.671	1.264	-0.011
CART6	0.923	1.943	1.525	0.000	0.912	2.073	1.621	0.026
ET6	0.917	2.022	1.578	0.000	0.914	2.055	1.607	0.000
RF6	0.989	0.739	0.515	-0.001	0.935	1.781	1.347	-0.007
GBDT6	0.952	1.534	1.163	0.000	0.942	1.681	1.281	-0.004
MLP6	0.931	1.840	1.389	-0.027	0.927	1.887	1.432	-0.037
SVM-RBF6	0.915	2.046	1.523	-0.078	0.912	2.077	1.556	-0.085
<i>R_a n/N T_{max} T_{min} H₀ U₀ P_{re} P_{rs} (C7)</i>								
XGBoost7	0.954	1.508	1.134	0.000	0.944	1.655	1.257	-0.002
Catboost7	0.957	1.459	1.099	0.000	0.947	1.615	1.223	-0.005
LightGBM7	0.971	1.190	0.908	0.000	0.945	1.644	1.241	-0.014
CART7	0.923	1.942	1.524	0.000	0.912	2.074	1.622	0.022
ET7	0.921	1.967	1.527	0.000	0.917	2.022	1.571	0.002
RF7	0.990	0.716	0.499	-0.002	0.938	1.741	1.315	-0.018
GBDT7	0.954	1.503	1.132	0.000	0.944	1.656	1.259	-0.007
MLP7	0.936	1.781	1.330	-0.014	0.934	1.800	1.349	-0.021
SVM-RBF7	0.917	2.019	1.494	-0.078	0.915	2.038	1.520	-0.085

Table S10 Same as Table S4 but at Beijing station.

Input/Model	Training				Testing			
	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)
<i>R_a n/N (C1)</i>								
XGBoost1	0.939	1.748	1.252	0.000	0.928	1.892	1.360	-0.009
Catboost1	0.936	1.777	1.272	0.000	0.929	1.873	1.339	-0.011
LightGBM1	0.945	1.655	1.183	0.000	0.924	1.939	1.384	-0.014
CART1	0.911	2.099	1.596	0.000	0.899	2.245	1.707	-0.015
ET1	0.909	2.123	1.624	0.000	0.905	2.175	1.669	-0.005
RF1	0.984	0.896	0.584	0.002	0.902	2.203	1.552	-0.010
GBDT1	0.939	1.744	1.252	0.000	0.928	1.896	1.363	-0.011
MLP1	0.922	1.972	1.463	-0.020	0.919	2.009	1.488	-0.039
SVM-RBF1	0.926	1.921	1.386	-0.115	0.923	1.957	1.414	-0.130
<i>R_a n/N T_{max} T_{min} (C2)</i>								
XGBoost2	0.947	1.628	1.180	0.000	0.936	1.782	1.296	-0.009
Catboost2	0.951	1.562	1.134	0.000	0.940	1.724	1.239	-0.010
LightGBM2	0.963	1.358	0.996	0.000	0.937	1.766	1.268	-0.012
CART2	0.916	2.038	1.565	0.000	0.905	2.178	1.669	-0.020
ET2	0.914	2.062	1.596	0.000	0.911	2.099	1.623	-0.017
RF2	0.988	0.771	0.513	0.006	0.929	1.874	1.345	0.008
GBDT2	0.947	1.621	1.176	0.000	0.936	1.780	1.294	-0.014
MLP2	0.925	1.927	1.425	0.052	0.923	1.952	1.440	0.042
SVM-RBF2	0.926	1.923	1.372	-0.127	0.922	1.963	1.405	-0.142
<i>R_a n/N H₀ U₀ (C3)</i>								
XGBoost3	0.948	1.601	1.144	0.000	0.939	1.745	1.255	0.003
Catboost3	0.949	1.585	1.133	0.000	0.941	1.711	1.223	0.003
LightGBM3	0.962	1.366	0.990	0.000	0.936	1.779	1.264	-0.015
CART3	0.915	2.053	1.564	0.000	0.903	2.195	1.671	-0.010
ET3	0.918	2.014	1.528	0.000	0.914	2.063	1.560	-0.008
RF3	0.988	0.774	0.512	0.003	0.928	1.891	1.354	-0.002
GBDT3	0.949	1.597	1.142	0.000	0.939	1.744	1.257	0.000
MLP3	0.931	1.853	1.353	0.021	0.929	1.885	1.380	0.016
SVM-RBF3	0.931	1.846	1.320	-0.109	0.929	1.873	1.348	-0.110
<i>R_a n/N P_{re} P_{rs} (C4)</i>								
XGBoost4	0.950	1.573	1.151	0.000	0.940	1.731	1.266	-0.014
Catboost4	0.951	1.559	1.137	0.000	0.942	1.699	1.232	-0.013
LightGBM4	0.963	1.350	1.001	0.000	0.938	1.757	1.270	-0.017
CART4	0.918	2.016	1.543	0.000	0.906	2.164	1.652	-0.013
ET4	0.916	2.043	1.566	0.000	0.912	2.096	1.607	0.001
RF4	0.988	0.769	0.516	0.001	0.930	1.871	1.357	-0.007
GBDT4	0.950	1.572	1.152	0.000	0.940	1.732	1.270	-0.013
MLP4	0.926	1.913	1.428	-0.030	0.923	1.962	1.462	-0.053
SVM-RBF4	0.927	1.901	1.370	-0.117	0.924	1.940	1.401	-0.135
<i>R_a n/N T_{max} T_{min} H₀ U₀ (C5)</i>								
XGBoost5	0.953	1.535	1.114	0.000	0.942	1.694	1.237	0.001
Catboost5	0.957	1.456	1.063	0.000	0.946	1.636	1.191	0.002
LightGBM5	0.970	1.215	0.900	0.000	0.944	1.661	1.202	-0.006
CART5	0.919	2.011	1.544	0.000	0.905	2.169	1.663	-0.017
ET5	0.919	2.002	1.544	0.000	0.915	2.054	1.588	0.009
RF5	0.989	0.724	0.489	-0.004	0.937	1.773	1.284	-0.004
GBDT5	0.953	1.533	1.113	0.000	0.942	1.693	1.236	0.007
MLP5	0.932	1.837	1.348	0.012	0.929	1.872	1.384	0.003
SVM-RBF5	0.929	1.884	1.346	-0.123	0.926	1.918	1.380	-0.124
<i>R_a n/N T_{max} T_{min} P_{re} P_{rs} (C6)</i>								
XGBoost6	0.954	1.504	1.112	0.000	0.944	1.673	1.237	-0.011
Catboost6	0.959	1.434	1.061	0.000	0.948	1.613	1.184	-0.014
LightGBM6	0.971	1.206	0.906	0.000	0.946	1.639	1.202	-0.015
CART6	0.921	1.982	1.526	0.000	0.908	2.139	1.643	-0.022
ET6	0.910	2.112	1.647	0.000	0.906	2.164	1.682	-0.017
RF6	0.990	0.712	0.487	0.004	0.938	1.748	1.278	-0.005
GBDT6	0.955	1.498	1.110	0.000	0.944	1.667	1.232	-0.012
MLP6	0.929	1.871	1.393	0.030	0.927	1.907	1.418	0.024
SVM-RBF6	0.924	1.946	1.393	-0.123	0.920	1.990	1.428	-0.141
<i>R_a n/N T_{max} T_{min} H₀ U₀ P_{re} P_{rs} (C7)</i>								
XGBoost7	0.957	1.468	1.078	0.000	0.946	1.638	1.203	0.000
Catboost7	0.962	1.373	1.012	0.000	0.951	1.566	1.148	-0.002
LightGBM7	0.974	1.126	0.846	0.000	0.949	1.589	1.162	-0.009
CART7	0.921	1.982	1.525	0.000	0.908	2.142	1.645	-0.022
ET7	0.919	2.005	1.552	0.000	0.916	2.042	1.579	0.004
RF7	0.990	0.694	0.471	0.002	0.942	1.700	1.241	0.006
GBDT7	0.957	1.460	1.074	0.000	0.946	1.632	1.199	-0.003
MLP7	0.932	1.839	1.362	-0.054	0.928	1.887	1.403	-0.067
SVM-RBF7	0.926	1.919	1.371	-0.116	0.923	1.954	1.406	-0.120

Table S11 Same as Table S4 but at Lanzhou station.

Input/Model	Training				Testing			
	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)
$R_a n/N$ (C1)								
XGBoost1	0.922	2.063	1.624	0.000	0.893	2.382	1.951	-0.075
Catboost1	0.919	2.105	1.656	0.000	0.894	2.371	1.943	-0.077
LightGBM1	0.930	1.951	1.536	0.000	0.890	2.419	1.975	-0.082
CART1	0.903	2.299	1.811	0.000	0.873	2.599	2.104	-0.079
ET1	0.899	2.339	1.856	0.000	0.879	2.540	2.075	-0.082
RF1	0.981	1.026	0.744	-0.001	0.869	2.639	2.110	-0.088
GBDT1	0.922	2.057	1.620	0.000	0.893	2.382	1.951	-0.077
MLP1	0.908	2.243	1.769	-0.054	0.890	2.422	1.976	-0.132
SVM-RBF1	0.909	2.222	1.724	-0.101	0.879	2.530	2.100	-0.181
$R_a n/N T_{max} T_{min}$ (C2)								
XGBoost2	0.925	2.026	1.594	0.000	0.894	2.373	1.946	-0.070
Catboost2	0.925	2.022	1.593	0.000	0.896	2.351	1.934	-0.075
LightGBM2	0.942	1.774	1.399	0.000	0.892	2.396	1.962	-0.082
CART2	0.890	2.443	1.910	0.000	0.859	2.746	2.196	-0.075
ET2	0.902	2.314	1.835	0.000	0.880	2.525	2.063	-0.072
RF2	0.983	0.960	0.700	0.009	0.879	2.538	2.052	-0.073
GBDT2	0.925	2.021	1.590	0.000	0.894	2.373	1.947	-0.074
MLP2	0.909	2.231	1.760	-0.023	0.888	2.443	1.998	-0.099
SVM-RBF2	0.909	2.224	1.723	-0.123	0.879	2.533	2.105	-0.202
$R_a n/N H_0 U_0$ (C3)								
XGBoost3	0.930	1.954	1.531	0.000	0.902	2.290	1.863	-0.079
Catboost3	0.929	1.970	1.543	0.000	0.902	2.284	1.860	-0.066
LightGBM3	0.945	1.726	1.343	0.000	0.901	2.292	1.841	-0.093
CART3	0.905	2.271	1.792	0.000	0.876	2.574	2.087	-0.081
ET3	0.906	2.266	1.802	0.000	0.885	2.480	2.023	-0.080
RF3	0.984	0.946	0.687	0.001	0.885	2.473	1.989	-0.070
GBDT3	0.930	1.949	1.527	0.000	0.902	2.285	1.859	-0.081
MLP3	0.911	2.197	1.738	0.013	0.890	2.414	1.985	-0.070
SVM-RBF	0.914	2.164	1.688	-0.089	0.883	2.489	2.077	-0.180
$R_a n/N P_{re} P_{rs}$ (C4)								
XGBoost4	0.927	1.995	1.578	0.000	0.897	2.341	1.923	-0.081
Catboost4	0.925	2.019	1.596	0.000	0.898	2.332	1.914	-0.073
LightGBM4	0.942	1.779	1.414	0.000	0.894	2.376	1.945	-0.080
CART4	0.905	2.269	1.790	0.000	0.876	2.574	2.085	-0.076
ET4	0.902	2.310	1.840	0.000	0.882	2.510	2.037	-0.073
RF4	0.983	0.970	0.709	0.010	0.881	2.517	2.033	-0.069
GBDT4	0.927	1.991	1.578	0.000	0.897	2.344	1.926	-0.077
MLP4	0.908	2.233	1.776	0.014	0.891	2.407	1.957	-0.064
SVM-RBF4	0.911	2.196	1.713	-0.119	0.882	2.504	2.085	-0.199
$R_a n/N T_{max} T_{min} H_0 U_0$ (C5)								
XGBoost5	0.930	1.947	1.528	0.000	0.899	2.316	1.892	-0.078
Catboost5	0.932	1.917	1.501	0.000	0.902	2.286	1.867	-0.069
LightGBM5	0.951	1.638	1.278	0.000	0.901	2.298	1.860	-0.091
CART5	0.892	2.424	1.895	0.000	0.861	2.723	2.176	-0.074
ET5	0.902	2.304	1.827	0.000	0.880	2.529	2.067	-0.080
RF5	0.984	0.925	0.673	0.008	0.886	2.468	1.996	-0.083
GBDT5	0.931	1.943	1.526	0.000	0.899	2.315	1.890	-0.083
MLP5	0.913	2.181	1.721	0.088	0.892	2.401	1.975	0.010
SVM-RBF5	0.911	2.200	1.717	-0.098	0.881	2.511	2.090	-0.185
$R_a n/N T_{max} T_{min} P_{re} P_{rs}$ (C6)								
XGBoost6	0.929	1.969	1.558	0.001	0.897	2.339	1.925	-0.074
Catboost6	0.930	1.953	1.542	0.000	0.899	2.317	1.906	-0.077
LightGBM6	0.948	1.675	1.326	0.000	0.896	2.359	1.935	-0.083
CART6	0.892	2.424	1.897	0.000	0.860	2.730	2.185	-0.075
ET6	0.902	2.307	1.834	0.000	0.881	2.521	2.048	-0.079
RF6	0.984	0.943	0.685	0.001	0.886	2.464	1.998	-0.092
GBDT6	0.929	1.964	1.557	0.000	0.897	2.341	1.925	-0.073
MLP6	0.911	2.196	1.746	0.052	0.892	2.400	1.960	-0.027
SVM-RBF6	0.909	2.224	1.732	-0.134	0.880	2.518	2.090	-0.215
$R_a n/N T_{max} T_{min} H_0 U_0 P_{re} P_{rs}$ (C7)								
XGBoost7	0.932	1.930	1.517	0.000	0.900	2.311	1.889	-0.075
Catboost7	0.935	1.886	1.481	0.000	0.903	2.275	1.863	-0.067
LightGBM7	0.954	1.584	1.240	0.000	0.901	2.293	1.861	-0.093
CART7	0.892	2.422	1.896	0.000	0.860	2.729	2.181	-0.077
ET7	0.901	2.318	1.846	0.000	0.878	2.546	2.073	-0.081
RF7	0.984	0.923	0.671	0.000	0.888	2.445	1.974	-0.085
GBDT7	0.932	1.931	1.519	0.000	0.900	2.311	1.890	-0.077
MLP7	0.913	2.181	1.732	-0.036	0.898	2.329	1.896	-0.120
SVM-RBF7	0.908	2.233	1.749	-0.122	0.880	2.525	2.095	-0.211

Table S12 Same as Table S4 but at Lasa station.

Input/Model	Training				Testing			
	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)
<i>R_a n/N (C1)</i>								
XGBoost1	0.889	1.754	1.311	0.000	0.854	1.983	1.484	0.022
Catboost1	0.884	1.791	1.338	0.000	0.855	1.976	1.474	0.026
LightGBM1	0.901	1.655	1.239	0.000	0.850	2.012	1.509	0.036
CART1	0.849	2.044	1.536	0.000	0.817	2.226	1.673	0.003
ET1	0.842	2.086	1.584	0.000	0.827	2.174	1.662	0.012
RF1	0.973	0.866	0.605	-0.002	0.821	2.208	1.662	0.034
GBDT1	0.890	1.741	1.304	0.000	0.855	1.978	1.480	0.025
MLP1	0.868	1.911	1.406	0.002	0.854	1.987	1.485	0.013
SVM-RBF1	0.872	1.881	1.374	-0.119	0.859	1.949	1.448	-0.099
<i>R_a n/N T_{max} T_{min} (C2)</i>								
XGBoost2	0.902	1.649	1.234	0.000	0.866	1.902	1.421	0.026
Catboost2	0.902	1.647	1.230	0.000	0.870	1.873	1.398	0.033
LightGBM2	0.925	1.435	1.073	0.000	0.866	1.906	1.428	0.027
CART2	0.851	2.030	1.532	0.000	0.822	2.197	1.666	0.007
ET2	0.844	2.078	1.590	0.000	0.827	2.167	1.652	0.011
RF2	0.977	0.804	0.558	0.006	0.851	2.017	1.516	0.042
GBDT2	0.902	1.642	1.231	0.000	0.866	1.902	1.421	0.028
MLP2	0.878	1.834	1.342	0.031	0.867	1.898	1.405	0.046
SVM-RBF2	0.879	1.830	1.336	-0.101	0.866	1.895	1.408	-0.080
<i>R_a n/N H₀ U₀ (C3)</i>								
XGBoost3	0.894	1.713	1.282	0.000	0.855	1.977	1.474	0.024
Catboost3	0.890	1.741	1.301	0.000	0.855	1.980	1.475	0.033
LightGBM3	0.920	1.490	1.117	0.000	0.855	1.982	1.469	0.020
CART3	0.849	2.044	1.536	0.000	0.817	2.226	1.673	0.004
ET3	0.845	2.070	1.575	0.000	0.828	2.167	1.652	0.009
RF3	0.975	0.828	0.575	0.006	0.831	2.142	1.600	0.024
GBDT3	0.895	1.703	1.275	0.000	0.856	1.972	1.470	0.025
MLP3	0.868	1.911	1.402	-0.027	0.852	1.995	1.490	-0.018
SVM-RBF	0.872	1.882	1.375	-0.117	0.857	1.960	1.461	-0.102
<i>R_a n/N P_{re} P_{rs} (C4)</i>								
XGBoost4	0.893	1.721	1.292	0.000	0.857	1.968	1.477	0.025
Catboost4	0.889	1.752	1.315	0.000	0.857	1.967	1.467	0.035
LightGBM4	0.916	1.524	1.150	0.000	0.851	2.006	1.498	0.032
CART4	0.850	2.038	1.534	0.000	0.816	2.235	1.678	0.012
ET4	0.844	2.074	1.579	0.000	0.825	2.187	1.666	0.004
RF4	0.975	0.831	0.581	0.008	0.834	2.123	1.590	0.043
GBDT4	0.894	1.711	1.286	0.000	0.857	1.963	1.473	0.025
MLP4	0.874	1.866	1.384	-0.024	0.858	1.958	1.462	0.000
SVM-RBF4	0.875	1.856	1.370	-0.121	0.861	1.933	1.445	-0.093
<i>R_a n/N T_{max} T_{min} H₀ U₀ (C5)</i>								
XGBoost5	0.904	1.629	1.222	0.000	0.867	1.897	1.419	0.028
Catboost5	0.905	1.621	1.210	0.000	0.870	1.874	1.393	0.039
LightGBM5	0.935	1.341	1.010	0.000	0.870	1.874	1.399	0.016
CART5	0.851	2.030	1.531	0.000	0.822	2.197	1.666	0.008
ET5	0.842	2.087	1.596	0.000	0.823	2.199	1.677	0.007
RF5	0.977	0.792	0.549	0.014	0.851	2.016	1.519	0.038
GBDT5	0.905	1.624	1.221	0.000	0.867	1.893	1.415	0.028
MLP5	0.876	1.846	1.359	0.114	0.857	1.963	1.474	0.161
SVM-RBF5	0.876	1.849	1.350	-0.104	0.863	1.918	1.428	-0.083
<i>R_a n/N T_{max} T_{min} P_{re} P_{rs} (C6)</i>								
XGBoost6	0.903	1.641	1.229	0.000	0.867	1.900	1.422	0.022
Catboost6	0.902	1.648	1.232	0.000	0.868	1.885	1.395	0.051
LightGBM6	0.932	1.374	1.031	0.000	0.867	1.897	1.418	0.028
CART6	0.851	2.029	1.531	0.000	0.822	2.197	1.666	0.007
ET6	0.836	2.126	1.626	0.000	0.824	2.191	1.687	-0.004
RF6	0.977	0.798	0.556	0.009	0.849	2.028	1.527	0.059
GBDT6	0.903	1.633	1.227	0.000	0.866	1.900	1.421	0.025
MLP6	0.882	1.810	1.339	0.034	0.863	1.916	1.428	0.058
SVM-RBF6	0.878	1.836	1.351	-0.104	0.865	1.906	1.422	-0.081
<i>R_a n/N T_{max} T_{min} H₀ U₀ P_{re} P_{rs} (C7)</i>								
XGBoost7	0.905	1.623	1.218	0.000	0.866	1.901	1.422	0.030
Catboost7	0.905	1.625	1.216	0.000	0.868	1.885	1.401	0.037
LightGBM7	0.939	1.303	0.981	0.000	0.871	1.872	1.393	0.011
CART7	0.851	2.029	1.531	0.000	0.822	2.197	1.666	0.008
ET7	0.844	2.076	1.588	0.000	0.824	2.189	1.675	0.015
RF7	0.978	0.786	0.547	0.001	0.850	2.020	1.521	0.041
GBDT7	0.906	1.615	1.215	0.000	0.867	1.895	1.415	0.029
MLP7	0.882	1.802	1.335	0.058	0.869	1.882	1.399	0.084
SVM-RBF7	0.875	1.855	1.365	-0.101	0.861	1.932	1.444	-0.076

Table S13 Same as Table S4 but at Ejinaqi station.

Input/Model	Training				Testing			
	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)
<i>R_e n/N (C1)</i>								
XGBoost1	0.959	1.532	1.100	0.000	0.950	1.675	1.206	-0.016
Catboost1	0.957	1.561	1.121	0.000	0.951	1.661	1.193	-0.019
LightGBM1	0.964	1.431	1.036	0.000	0.948	1.711	1.226	-0.020
CART1	0.942	1.820	1.350	0.000	0.933	1.947	1.439	-0.007
ET1	0.939	1.861	1.386	0.000	0.935	1.920	1.424	-0.024
RF1	0.990	0.767	0.509	0.001	0.937	1.881	1.348	-0.014
GBDT1	0.959	1.524	1.097	0.000	0.950	1.680	1.210	-0.017
MLP1	0.949	1.699	1.228	0.048	0.946	1.744	1.262	0.026
SVM-RBF1	0.954	1.627	1.160	-0.055	0.951	1.667	1.195	-0.078
<i>R_e n/N T_{max} T_{min} (C2)</i>								
XGBoost2	0.964	1.430	1.016	0.000	0.954	1.608	1.141	-0.016
Catboost2	0.964	1.428	1.014	0.000	0.955	1.584	1.117	-0.018
LightGBM2	0.974	1.221	0.881	0.000	0.952	1.632	1.151	-0.015
CART2	0.942	1.820	1.349	0.000	0.933	1.948	1.439	-0.006
ET2	0.934	1.935	1.453	0.000	0.929	1.997	1.499	-0.033
RF2	0.991	0.716	0.468	-0.002	0.946	1.751	1.234	-0.020
GBDT2	0.964	1.426	1.014	0.000	0.954	1.605	1.139	-0.019
MLP2	0.955	1.609	1.142	-0.094	0.951	1.659	1.179	-0.103
SVM-RBF2	0.958	1.547	1.089	-0.087	0.955	1.589	1.122	-0.111
<i>R_e n/N H₀ U₀ (C3)</i>								
XGBoost3	0.964	1.441	1.043	0.000	0.954	1.609	1.166	-0.004
Catboost3	0.963	1.449	1.045	0.000	0.955	1.582	1.144	-0.002
LightGBM3	0.973	1.243	0.913	0.000	0.952	1.639	1.178	-0.005
CART3	0.943	1.807	1.342	0.000	0.934	1.939	1.433	-0.006
ET3	0.941	1.827	1.361	0.000	0.938	1.874	1.397	-0.035
RF3	0.991	0.706	0.475	-0.001	0.945	1.752	1.264	0.012
GBDT3	0.964	1.434	1.040	0.000	0.954	1.611	1.168	-0.005
MLP3	0.954	1.623	1.176	0.083	0.951	1.667	1.211	0.070
SVM-RBF	0.956	1.579	1.132	-0.073	0.954	1.612	1.164	-0.086
<i>R_e n/N P_{re} P_{rs} (C4)</i>								
XGBoost4	0.963	1.454	1.040	0.001	0.953	1.622	1.160	-0.016
Catboost4	0.962	1.473	1.051	0.000	0.954	1.603	1.144	-0.014
LightGBM4	0.971	1.282	0.929	0.000	0.952	1.648	1.171	-0.020
CART4	0.942	1.812	1.345	0.000	0.933	1.940	1.433	-0.008
ET4	0.940	1.857	1.387	0.000	0.937	1.885	1.405	-0.025
RF4	0.991	0.718	0.480	0.000	0.944	1.783	1.274	-0.004
GBDT4	0.963	1.449	1.038	0.000	0.953	1.622	1.161	-0.018
MLP4	0.951	1.666	1.199	0.027	0.949	1.694	1.223	0.003
SVM-RBF4	0.955	1.594	1.130	-0.085	0.953	1.632	1.162	-0.107
<i>R_e n/N T_{max} T_{min} H₀ U₀ (C5)</i>								
XGBoost5	0.967	1.381	0.991	0.000	0.956	1.566	1.124	0.000
Catboost5	0.967	1.371	0.982	0.000	0.958	1.533	1.096	0.010
LightGBM5	0.978	1.124	0.823	0.000	0.956	1.577	1.121	0.005
CART5	0.943	1.807	1.342	0.000	0.934	1.939	1.433	-0.006
ET5	0.942	1.827	1.370	0.000	0.938	1.872	1.403	-0.018
RF5	0.992	0.677	0.451	0.003	0.950	1.675	1.195	0.011
GBDT5	0.967	1.376	0.989	0.000	0.956	1.566	1.123	-0.005
MLP5	0.957	1.559	1.115	-0.007	0.955	1.601	1.146	-0.025
SVM-RBF5	0.958	1.541	1.094	-0.089	0.956	1.575	1.125	-0.107
<i>R_e n/N T_{max} T_{min} P_{re} P_{rs} (C6)</i>								
XGBoost6	0.966	1.401	0.999	0.001	0.955	1.579	1.126	-0.017
Catboost6	0.966	1.396	0.995	0.000	0.957	1.548	1.099	-0.007
LightGBM6	0.977	1.153	0.839	0.000	0.955	1.592	1.127	-0.017
CART6	0.942	1.812	1.345	0.000	0.933	1.940	1.433	-0.008
ET6	0.935	1.920	1.448	0.000	0.931	1.975	1.479	-0.019
RF6	0.992	0.695	0.457	-0.001	0.949	1.691	1.200	-0.017
GBDT6	0.966	1.395	0.998	0.000	0.955	1.581	1.128	-0.019
MLP6	0.955	1.604	1.144	-0.019	0.953	1.631	1.165	-0.050
SVM-RBF6	0.957	1.575	1.110	-0.099	0.954	1.614	1.142	-0.125
<i>R_e n/N T_{max} T_{min} H₀ U₀ P_{re} P_{rs} (C7)</i>								
XGBoost7	0.967	1.367	0.982	0.000	0.957	1.561	1.120	0.000
Catboost7	0.968	1.352	0.970	0.000	0.959	1.522	1.090	0.005
LightGBM7	0.979	1.092	0.801	0.000	0.956	1.571	1.117	0.008
CART7	0.943	1.806	1.342	0.000	0.933	1.940	1.433	-0.007
ET7	0.935	1.923	1.443	0.000	0.931	1.973	1.481	-0.029
RF7	0.992	0.669	0.447	0.010	0.950	1.682	1.201	0.011
GBDT7	0.967	1.363	0.982	0.000	0.957	1.561	1.119	-0.002
MLP7	0.955	1.596	1.144	0.025	0.953	1.622	1.166	0.006
SVM-RBF7	0.956	1.584	1.125	-0.097	0.954	1.620	1.158	-0.113

Table S14 Same as Table S4 but at Geermu station.

Input/Model	Training				Testing			
	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)
<i>R_a n/N (C1)</i>								
XGBoost1	0.962	1.376	0.990	0.000	0.956	1.485	1.067	-0.005
Catboost1	0.961	1.401	1.008	0.000	0.957	1.467	1.049	-0.010
LightGBM1	0.968	1.280	0.928	0.000	0.955	1.505	1.076	-0.004
CART1	0.939	1.758	1.322	0.000	0.932	1.845	1.382	-0.014
ET1	0.936	1.800	1.364	0.000	0.935	1.798	1.362	0.004
RF1	0.991	0.688	0.461	-0.004	0.943	1.691	1.205	-0.014
GBDT1	0.963	1.369	0.987	0.000	0.956	1.490	1.069	-0.006
MLP1	0.952	1.551	1.120	0.008	0.952	1.554	1.118	-0.002
SVM-RBF1	0.957	1.475	1.052	-0.110	0.956	1.485	1.059	-0.122
<i>R_a n/N T_{max} T_{min} (C2)</i>								
XGBoost2	0.964	1.340	0.959	0.000	0.957	1.460	1.044	-0.008
Catboost2	0.966	1.314	0.941	0.000	0.959	1.432	1.017	-0.005
LightGBM2	0.975	1.123	0.818	0.000	0.957	1.464	1.039	-0.003
CART2	0.939	1.756	1.320	0.000	0.932	1.844	1.381	-0.015
ET2	0.938	1.768	1.347	0.000	0.938	1.766	1.338	-0.017
RF2	0.991	0.656	0.436	0.003	0.951	1.574	1.123	0.006
GBDT2	0.965	1.336	0.957	0.000	0.957	1.464	1.045	-0.005
MLP2	0.952	1.561	1.120	-0.015	0.951	1.569	1.122	-0.028
SVM-RBF2	0.957	1.480	1.040	-0.122	0.956	1.490	1.046	-0.136
<i>R_a n/N H₀ U₀ (C3)</i>								
XGBoost3	0.966	1.319	0.961	0.000	0.958	1.448	1.047	0.002
Catboost3	0.965	1.327	0.968	0.000	0.959	1.432	1.038	0.010
LightGBM3	0.975	1.130	0.839	0.000	0.957	1.466	1.057	0.011
CART3	0.939	1.749	1.318	0.000	0.932	1.843	1.382	-0.012
ET3	0.941	1.729	1.304	0.000	0.940	1.738	1.308	-0.004
RF3	0.992	0.641	0.435	0.006	0.951	1.568	1.136	0.008
GBDT3	0.966	1.315	0.958	0.000	0.958	1.450	1.048	0.003
MLP3	0.955	1.509	1.096	0.007	0.954	1.523	1.105	0.007
SVM-RBF	0.958	1.452	1.037	-0.122	0.957	1.461	1.043	-0.128
<i>R_a n/N P_{re} P_{rs} (C4)</i>								
XGBoost4	0.965	1.329	0.970	0.000	0.957	1.464	1.057	-0.007
Catboost4	0.964	1.344	0.985	0.000	0.958	1.447	1.045	-0.009
LightGBM4	0.973	1.161	0.861	0.000	0.957	1.475	1.060	-0.002
CART4	0.939	1.747	1.317	0.000	0.932	1.844	1.381	-0.013
ET4	0.936	1.800	1.362	0.000	0.934	1.811	1.372	-0.013
RF4	0.991	0.656	0.445	0.003	0.949	1.598	1.153	-0.007
GBDT4	0.965	1.324	0.968	0.000	0.957	1.469	1.059	-0.008
MLP4	0.955	1.513	1.102	0.023	0.953	1.537	1.108	0.005
SVM-RBF4	0.957	1.469	1.048	-0.123	0.956	1.479	1.054	-0.136
<i>R_a n/N T_{max} T_{min} H₀ U₀ (C5)</i>								
XGBoost5	0.966	1.300	0.941	0.000	0.959	1.438	1.037	0.003
Catboost5	0.968	1.269	0.923	0.000	0.961	1.405	1.011	0.018
LightGBM5	0.978	1.049	0.774	0.000	0.959	1.431	1.021	0.005
CART5	0.939	1.749	1.318	0.000	0.932	1.843	1.382	-0.012
ET5	0.940	1.742	1.324	0.000	0.938	1.766	1.340	-0.007
RF5	0.992	0.630	0.424	0.001	0.953	1.531	1.096	0.010
GBDT5	0.967	1.296	0.940	0.000	0.959	1.440	1.037	0.000
MLP5	0.958	1.459	1.052	0.005	0.957	1.465	1.052	-0.008
SVM-RBF5	0.957	1.470	1.041	-0.122	0.956	1.481	1.047	-0.132
<i>R_a n/N T_{max} T_{min} P_{re} P_{rs} (C6)</i>								
XGBoost6	0.966	1.302	0.944	0.000	0.958	1.450	1.042	-0.005
Catboost6	0.967	1.285	0.936	0.000	0.960	1.422	1.017	-0.003
LightGBM6	0.977	1.066	0.787	0.000	0.958	1.450	1.036	-0.004
CART6	0.939	1.747	1.317	0.000	0.932	1.844	1.381	-0.013
ET6	0.936	1.800	1.373	0.000	0.934	1.812	1.379	-0.005
RF6	0.992	0.633	0.427	0.002	0.952	1.551	1.111	-0.003
GBDT6	0.967	1.298	0.943	0.000	0.958	1.450	1.041	-0.009
MLP6	0.956	1.493	1.076	-0.017	0.954	1.510	1.077	-0.035
SVM-RBF6	0.955	1.499	1.053	-0.131	0.955	1.510	1.061	-0.146
<i>R_a n/N T_{max} T_{min} H₀ U₀ P_{re} P_{rs} (C7)</i>								
XGBoost7	0.967	1.287	0.936	0.000	0.959	1.440	1.039	0.003
Catboost7	0.969	1.253	0.913	0.000	0.960	1.412	1.010	0.014
LightGBM7	0.979	1.025	0.759	0.000	0.959	1.434	1.024	0.009
CART7	0.940	1.747	1.317	0.000	0.933	1.838	1.379	-0.016
ET7	0.938	1.764	1.347	0.000	0.936	1.789	1.357	-0.013
RF7	0.992	0.628	0.422	0.002	0.954	1.515	1.093	0.011
GBDT7	0.967	1.283	0.934	0.000	0.958	1.444	1.037	0.001
MLP7	0.956	1.486	1.071	-0.042	0.954	1.510	1.080	-0.046
SVM-RBF7	0.956	1.497	1.060	-0.126	0.955	1.509	1.068	-0.137

Table S15 Same as Table S4 but at Kashi station.

Input/Model	Training				Testing			
	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)
<i>R_e n/N</i> (C1)								
XGBoost1	0.937	1.914	1.406	0.000	0.924	2.085	1.537	0.002
Catboost1	0.935	1.948	1.428	0.000	0.925	2.064	1.510	0.003
LightGBM1	0.944	1.806	1.333	0.000	0.921	2.118	1.556	0.006
CART1	0.919	2.173	1.639	0.000	0.904	2.345	1.767	-0.007
ET1	0.917	2.197	1.678	0.000	0.910	2.279	1.738	0.006
RF1	0.984	0.952	0.660	-0.010	0.904	2.354	1.742	-0.015
GBDT1	0.937	1.907	1.402	0.000	0.924	2.089	1.538	-0.002
MLP1	0.918	2.181	1.650	-0.022	0.914	2.232	1.681	-0.024
SVM-RBF1	0.929	2.026	1.486	-0.058	0.927	2.049	1.506	-0.060
<i>R_e n/N T_{max} T_{min}</i> (C2)								
XGBoost2	0.943	1.823	1.342	0.001	0.927	2.049	1.504	0.025
Catboost2	0.945	1.790	1.320	0.000	0.929	2.014	1.475	0.047
LightGBM2	0.959	1.549	1.151	0.000	0.926	2.059	1.512	0.041
CART2	0.910	2.291	1.732	0.000	0.893	2.488	1.871	0.011
ET2	0.914	2.240	1.710	0.000	0.908	2.303	1.756	-0.001
RF2	0.987	0.873	0.599	0.004	0.916	2.194	1.625	0.053
GBDT2	0.943	1.815	1.337	0.000	0.927	2.047	1.504	0.023
MLP2	0.930	2.019	1.502	-0.025	0.925	2.069	1.535	-0.015
SVM-RBF2	0.932	1.983	1.457	-0.064	0.929	2.013	1.482	-0.056
<i>R_e n/N H₀ U₀</i> (C3)								
XGBoost3	0.942	1.843	1.361	0.000	0.924	2.080	1.538	0.038
Catboost3	0.941	1.853	1.367	0.000	0.925	2.066	1.518	0.030
LightGBM3	0.956	1.599	1.195	0.000	0.922	2.110	1.554	0.031
CART3	0.919	2.164	1.633	0.000	0.904	2.351	1.772	-0.001
ET3	0.917	2.196	1.677	0.000	0.910	2.280	1.741	0.017
RF3	0.986	0.893	0.620	0.006	0.910	2.267	1.673	0.038
GBDT3	0.942	1.839	1.357	0.000	0.924	2.082	1.540	0.033
MLP3	0.918	2.180	1.653	0.004	0.912	2.239	1.687	-0.007
SVM-RBF	0.930	2.022	1.491	-0.064	0.924	2.081	1.536	-0.054
<i>R_e n/N P_{re} P_{rs}</i> (C4)								
XGBoost4	0.940	1.874	1.379	0.000	0.925	2.068	1.525	-0.005
Catboost4	0.939	1.889	1.383	0.000	0.925	2.061	1.512	0.010
LightGBM4	0.953	1.659	1.231	0.000	0.922	2.116	1.559	-0.001
CART4	0.919	2.165	1.634	0.000	0.905	2.342	1.767	-0.007
ET4	0.915	2.223	1.696	0.000	0.909	2.290	1.744	0.019
RF4	0.986	0.908	0.629	-0.008	0.910	2.272	1.682	-0.009
GBDT4	0.940	1.867	1.375	0.000	0.925	2.073	1.525	-0.003
MLP4	0.922	2.126	1.601	0.046	0.919	2.160	1.623	0.038
SVM-RBF4	0.930	2.022	1.491	-0.064	0.926	2.052	1.517	-0.077
<i>R_e n/N T_{max} T_{min} H₀ U₀</i> (C5)								
XGBoost5	0.946	1.774	1.314	0.001	0.927	2.042	1.507	0.046
Catboost5	0.949	1.722	1.280	0.000	0.929	2.008	1.481	0.071
LightGBM5	0.964	1.440	1.082	0.000	0.928	2.034	1.497	0.039
CART5	0.910	2.287	1.730	0.000	0.893	2.489	1.873	0.009
ET5	0.915	2.218	1.692	0.000	0.906	2.321	1.766	0.003
RF5	0.988	0.843	0.580	0.008	0.916	2.194	1.617	0.073
GBDT5	0.946	1.770	1.312	0.000	0.927	2.040	1.505	0.036
MLP5	0.929	2.023	1.518	0.003	0.919	2.156	1.611	0.042
SVM-RBF5	0.931	2.000	1.471	-0.075	0.926	2.057	1.517	-0.052
<i>R_e n/N T_{max} T_{min} P_{re} P_{rs}</i> (C6)								
XGBoost6	0.945	1.795	1.325	0.000	0.928	2.030	1.494	0.029
Catboost6	0.947	1.757	1.295	0.000	0.929	2.009	1.477	0.065
LightGBM6	0.962	1.482	1.109	0.000	0.926	2.053	1.515	0.072
CART6	0.910	2.287	1.731	0.000	0.893	2.487	1.874	0.007
ET6	0.913	2.253	1.721	0.000	0.903	2.362	1.799	0.012
RF6	0.987	0.856	0.590	0.012	0.915	2.203	1.633	0.060
GBDT6	0.945	1.791	1.323	0.000	0.927	2.037	1.500	0.037
MLP6	0.927	2.057	1.550	0.010	0.919	2.158	1.626	0.032
SVM-RBF6	0.931	2.001	1.475	-0.061	0.928	2.032	1.502	-0.055
<i>R_e n/N T_{max} T_{min} H₀ U₀ P_{re} P_{rs}</i> (C7)								
XGBoost7	0.946	1.765	1.310	0.001	0.927	2.039	1.506	0.036
Catboost7	0.949	1.714	1.271	0.000	0.929	2.015	1.483	0.085
LightGBM7	0.966	1.401	1.056	0.000	0.927	2.041	1.506	0.058
CART7	0.910	2.286	1.730	0.000	0.893	2.491	1.875	0.010
ET7	0.910	2.283	1.751	0.000	0.902	2.383	1.822	0.014
RF7	0.988	0.848	0.582	0.015	0.916	2.198	1.623	0.076
GBDT7	0.947	1.760	1.306	0.000	0.927	2.042	1.509	0.050
MLP7	0.931	2.007	1.505	-0.084	0.922	2.110	1.575	-0.045
SVM-RBF7	0.929	2.031	1.499	-0.066	0.924	2.089	1.548	-0.056

Table S16 Same as Table S4 but at Wulumuqi station.

Input/Model	Training				Testing			
	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)
<i>R_a n/N (C1)</i>								
XGBoost1	0.909	2.678	1.831	0.000	0.898	2.766	2.001	0.071
Catboost1	0.907	2.717	1.851	0.000	0.900	2.732	1.973	0.066
LightGBM1	0.920	2.509	1.742	0.000	0.895	2.821	2.047	0.076
CART1	0.892	2.927	2.052	0.000	0.886	2.953	2.179	0.072
ET1	0.891	2.937	2.031	0.000	0.892	2.847	2.078	0.064
RF1	0.978	1.320	0.879	0.004	0.867	3.212	2.353	0.078
GBDT1	0.911	2.657	1.821	0.000	0.898	2.769	2.001	0.073
MLP1	0.891	2.947	2.066	-0.061	0.891	2.871	2.117	-0.002
SVM-RBF1	0.898	2.835	1.893	0.106	0.905	2.663	1.918	0.158
<i>R_a n/N T_{max} T_{min} (C2)</i>								
XGBoost2	0.914	2.597	1.756	0.000	0.900	2.728	1.958	0.070
Catboost2	0.916	2.564	1.722	0.000	0.903	2.691	1.919	0.072
LightGBM2	0.936	2.240	1.544	0.000	0.899	2.759	1.973	0.085
CART2	0.893	2.912	2.026	0.000	0.887	2.931	2.148	0.072
ET2	0.890	2.955	2.051	0.000	0.892	2.853	2.099	0.052
RF2	0.980	1.260	0.820	-0.002	0.884	2.975	2.160	0.054
GBDT2	0.916	2.575	1.746	0.000	0.900	2.728	1.957	0.073
MLP2	0.892	2.920	2.025	0.066	0.895	2.813	2.058	0.128
SVM-RBF2	0.898	2.834	1.874	0.066	0.905	2.658	1.901	0.116
<i>R_a n/N H₀ U₀ (C3)</i>								
XGBoost3	0.915	2.597	1.767	0.000	0.901	2.718	1.968	0.081
Catboost3	0.915	2.594	1.755	0.000	0.902	2.691	1.944	0.088
LightGBM3	0.936	2.252	1.562	0.000	0.897	2.781	2.018	0.100
CART3	0.887	3.001	2.108	0.000	0.880	3.025	2.225	0.082
ET3	0.891	2.935	2.033	0.000	0.894	2.794	2.057	0.056
RF3	0.980	1.256	0.827	-0.015	0.880	3.028	2.209	0.043
GBDT3	0.915	2.582	1.760	0.000	0.901	2.719	1.967	0.079
MLP3	0.896	2.861	1.971	-0.048	0.896	2.796	2.050	0.027
SVM-RBF3	0.898	2.833	1.906	0.119	0.904	2.672	1.948	0.192
<i>R_a n/N P_{re} P_{rs} (C4)</i>								
XGBoost4	0.917	2.553	1.721	0.001	0.906	2.644	1.898	0.054
Catboost4	0.917	2.554	1.706	0.000	0.908	2.610	1.863	0.055
LightGBM4	0.935	2.252	1.548	0.000	0.902	2.708	1.943	0.065
CART4	0.895	2.883	1.995	0.000	0.889	2.904	2.124	0.062
ET4	0.893	2.908	2.003	0.000	0.895	2.782	2.033	0.067
RF4	0.981	1.223	0.802	0.002	0.884	2.974	2.165	0.074
GBDT4	0.918	2.538	1.714	0.000	0.905	2.650	1.902	0.056
MLP4	0.898	2.831	1.943	-0.112	0.900	2.736	1.991	-0.069
SVM-RBF4	0.901	2.799	1.869	0.118	0.907	2.621	1.894	0.164
<i>R_a n/N T_{max} T_{min} H₀ U₀ (C5)</i>								
XGBoost5	0.918	2.543	1.720	0.001	0.902	2.694	1.939	0.088
Catboost5	0.922	2.476	1.662	0.000	0.904	2.659	1.907	0.088
LightGBM5	0.945	2.084	1.441	0.000	0.900	2.731	1.966	0.088
CART5	0.887	2.998	2.104	0.000	0.880	3.026	2.225	0.082
ET5	0.889	2.968	2.066	0.000	0.890	2.863	2.119	0.034
RF5	0.981	1.218	0.794	-0.006	0.886	2.938	2.133	0.047
GBDT5	0.919	2.528	1.712	0.000	0.902	2.700	1.942	0.087
MLP5	0.899	2.828	1.933	-0.035	0.900	2.706	1.967	0.073
SVM-RBF5	0.897	2.847	1.900	0.070	0.903	2.686	1.946	0.144
<i>R_a n/N T_{max} T_{min} P_{re} P_{rs} (C6)</i>								
XGBoost6	0.920	2.510	1.683	0.001	0.905	2.646	1.890	0.054
Catboost6	0.922	2.475	1.644	0.000	0.908	2.600	1.842	0.048
LightGBM6	0.944	2.090	1.437	0.000	0.903	2.695	1.920	0.056
CART6	0.895	2.883	1.993	0.000	0.889	2.907	2.123	0.056
ET6	0.888	2.975	2.073	0.000	0.891	2.864	2.122	0.021
RF6	0.982	1.201	0.780	-0.018	0.889	2.902	2.086	0.041
GBDT6	0.921	2.497	1.677	0.000	0.905	2.647	1.890	0.046
MLP6	0.900	2.807	1.911	-0.012	0.899	2.749	2.005	0.017
SVM-RBF6	0.898	2.838	1.887	0.067	0.905	2.664	1.915	0.114
<i>R_a n/N T_{max} T_{min} H₀ U₀ P_{re} P_{rs} (C7)</i>								
XGBoost7	0.921	2.492	1.675	0.001	0.905	2.654	1.899	0.070
Catboost7	0.926	2.414	1.606	0.000	0.907	2.611	1.862	0.056
LightGBM7	0.949	1.991	1.373	0.000	0.901	2.711	1.935	0.073
CART7	0.888	2.981	2.080	0.000	0.881	3.009	2.206	0.066
ET7	0.893	2.911	2.012	0.000	0.893	2.808	2.069	0.079
RF7	0.982	1.191	0.773	-0.017	0.887	2.932	2.110	0.049
GBDT7	0.922	2.482	1.671	0.000	0.904	2.664	1.906	0.063
MLP7	0.899	2.815	1.923	0.010	0.901	2.701	1.964	0.064
SVM-RBF7	0.894	2.893	1.945	0.053	0.900	2.738	1.990	0.122

Table S17 Same as Table S4 but for all stations on average.

Input/Model	Training				Testing			
	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻²)	R ²	RMSE(MJm ⁻² d ⁻¹)	MAE(MJm ⁻² d ⁻¹)	MBE(MJm ⁻² d ⁻¹)
<i>R_a n/N (C1)</i>								
XGBoost1	0.916	1.979	1.464	0.000	0.897	2.159	1.622	-0.011
Catboost1	0.913	2.015	1.488	0.000	0.898	2.144	1.606	-0.013
LightGBM1	0.924	1.876	1.390	0.000	0.893	2.195	1.646	-0.011
CART1	0.895	2.223	1.683	0.000	0.877	2.380	1.820	-0.013
ET1	0.894	2.233	1.692	0.000	0.884	2.306	1.768	-0.013
RF1	0.979	0.992	0.683	0.000	0.866	2.469	1.842	-0.007
GBDT1	0.916	1.971	1.460	0.000	0.897	2.161	1.623	-0.012
MLP1	0.901	2.153	1.608	0.004	0.892	2.213	1.673	-0.011
SVM-RBF1	0.900	2.153	1.587	-0.052	0.891	2.212	1.663	-0.067
Mean	0.915	1.955	1.451	-0.005	0.888	2.249	1.696	-0.017
<i>R_a n/N T_{max} T_{min} (C2)</i>								
XGBoost2	0.926	1.857	1.372	0.000	0.904	2.081	1.561	0.009
Catboost2	0.929	1.824	1.345	0.000	0.907	2.044	1.526	0.014
LightGBM2	0.946	1.594	1.184	0.000	0.904	2.085	1.556	0.013
CART2	0.897	2.203	1.669	0.000	0.877	2.378	1.817	-0.003
ET2	0.896	2.214	1.686	0.000	0.885	2.291	1.762	-0.012
RF2	0.983	0.889	0.610	0.002	0.891	2.224	1.661	0.015
GBDT2	0.927	1.850	1.368	0.000	0.904	2.080	1.560	0.009
MLP2	0.909	2.073	1.537	0.014	0.900	2.135	1.604	0.013
SVM-RBF2	0.907	2.090	1.530	-0.069	0.897	2.156	1.612	-0.070
Mean	0.924	1.844	1.367	-0.006	0.896	2.164	1.629	-0.001
<i>R_a n/N H₀ U₀ (C3)</i>								
XGBoost3	0.927	1.848	1.365	0.000	0.902	2.090	1.573	0.031
Catboost3	0.926	1.851	1.364	0.000	0.902	2.077	1.560	0.039
LightGBM3	0.944	1.615	1.201	0.000	0.899	2.123	1.590	0.030
CART3	0.899	2.182	1.650	0.000	0.878	2.367	1.806	0.006
ET3	0.898	2.186	1.658	0.000	0.887	2.266	1.739	-0.006
RF3	0.983	0.894	0.617	-0.001	0.885	2.275	1.705	0.026
GBDT3	0.927	1.842	1.362	0.000	0.902	2.091	1.574	0.031
MLP3	0.909	2.063	1.534	0.013	0.898	2.149	1.627	0.032
SVM-RBF	0.908	2.072	1.526	-0.051	0.896	2.153	1.623	-0.032
Mean	0.925	1.839	1.364	-0.004	0.894	2.177	1.644	0.018
<i>R_a n/N P_{re} P_{rs} (C4)</i>								
XGBoost4	0.928	1.836	1.362	0.000	0.905	2.056	1.548	0.019
Catboost4	0.927	1.842	1.364	0.000	0.906	2.040	1.532	0.023
LightGBM4	0.944	1.620	1.212	0.000	0.902	2.089	1.567	0.020
CART4	0.901	2.158	1.632	0.000	0.881	2.335	1.783	0.001
ET4	0.897	2.206	1.676	0.000	0.886	2.284	1.752	-0.003
RF4	0.983	0.892	0.618	0.000	0.889	2.240	1.684	0.019
GBDT4	0.928	1.829	1.359	0.000	0.905	2.058	1.550	0.019
MLP4	0.908	2.075	1.549	-0.008	0.896	2.159	1.634	0.009
SVM-RBF4	0.905	2.098	1.548	-0.058	0.894	2.174	1.638	-0.040
Mean	0.925	1.840	1.369	-0.007	0.896	2.159	1.632	0.007
<i>R_a n/N T_{max} T_{min} H₀ U₀ (C5)</i>								
XGBoost5	0.933	1.772	1.310	0.000	0.907	2.033	1.528	0.033
Catboost5	0.937	1.723	1.270	0.000	0.911	1.996	1.496	0.046
LightGBM5	0.955	1.449	1.081	0.000	0.909	2.021	1.510	0.030
CART5	0.900	2.181	1.652	0.000	0.877	2.377	1.814	0.010
ET5	0.900	2.175	1.656	0.000	0.887	2.266	1.743	-0.002
RF5	0.985	0.846	0.582	0.001	0.897	2.152	1.612	0.035
GBDT5	0.933	1.767	1.307	0.000	0.907	2.034	1.528	0.032
MLP5	0.915	1.992	1.472	-0.005	0.903	2.086	1.570	0.020
SVM-RBF5	0.910	2.050	1.503	-0.068	0.900	2.125	1.595	-0.049
Mean	0.930	1.773	1.315	-0.008	0.900	2.121	1.600	0.017
<i>R_a n/N T_{max} T_{min} P_{re} P_{rs} (C6)</i>								
XGBoost6	0.934	1.755	1.301	0.000	0.911	1.996	1.503	0.025
Catboost6	0.937	1.714	1.269	0.000	0.914	1.958	1.468	0.033
LightGBM6	0.955	1.451	1.086	0.000	0.912	1.992	1.492	0.028
CART6	0.901	2.159	1.635	0.000	0.880	2.346	1.792	0.006
ET6	0.897	2.202	1.680	0.000	0.886	2.286	1.761	-0.005
RF6	0.985	0.840	0.580	0.001	0.900	2.123	1.593	0.026
GBDT6	0.935	1.748	1.299	0.000	0.911	1.997	1.504	0.024
MLP6	0.914	2.005	1.488	0.002	0.904	2.089	1.572	0.022
SVM-RBF6	0.909	2.069	1.522	-0.069	0.898	2.145	1.611	-0.049
Mean	0.930	1.771	1.318	-0.007	0.902	2.104	1.589	0.012
<i>R_a n/N T_{max} T_{min} H₀ U₀ P_{re} P_{rs} (C7)</i>								
XGBoost7	0.937	1.720	1.275	0.000	0.912	1.986	1.495	0.031
Catboost7	0.941	1.664	1.230	0.000	0.916	1.943	1.457	0.041
LightGBM7	0.960	1.370	1.027	0.000	0.914	1.967	1.472	0.030
CART7	0.901	2.160	1.637	0.000	0.879	2.354	1.798	0.005
ET7	0.899	2.182	1.663	0.000	0.887	2.273	1.749	0.003
RF7	0.986	0.824	0.569	0.001	0.902	2.103	1.578	0.031
GBDT7	0.937	1.715	1.273	0.000	0.912	1.987	1.496	0.029
MLP7	0.917	1.974	1.463	-0.008	0.906	2.063	1.552	0.018
SVM-RBF7	0.910	2.058	1.517	-0.066	0.899	2.141	1.614	-0.040
Mean	0.932	1.741	1.295	-0.008	0.903	2.091	1.579	0.016

