Supplementary information

A River Water Quality Prediction Method Based on Dual Signal Decomposition and Deep Learning

Yifan Bai[1,2], Menghang Peng[1], Mei Wang[1*]

1. School of Water Conservancy and transportation, Zhengzhou University, Zhengzhou, 450001, China

*2. Yellow River Engineering Consulting Corporation Limited, Zhengzhou 450003, China*

_____

* Corresponding author, email: maywang226@163.com

Table S1 Comparison of model accuracy for different water quality indicators across various forecast periods.

Predictive indicators	Forecast period	Model accuracy	RF-TVSV-SCL	TVSV-SCL	RF-SCL	RF-TV-SCL	RF-SV-SCL	RF-CE-SCL
TP	1	R^2	0.949	0.848	0.881	0.931	0.919	0.907
		MAE	0.004	0.007	0.006	0.005	0.005	0.006
		RMSE	0.005	0.008	0.007	0.006	0.006	0.007
	3	R^2	0.848	0.673	0.758	0.833	0.793	0.782
		MAE	0.007	0.010	0.008	0.007	0.008	0.008
		RMSE	0.008	0.012	0.011	0.009	0.010	0.010
	5	R^2	0.671	0.565	0.533	0.648	0.653	0.569
		MAE	0.010	0.011	0.012	0.011	0.011	0.011
		RMSE	0.012	0.014	0.015	0.013	0.013	0.014
	7	R^2	0.621	0.519	0.427	0.526	0.507	0.437
		MAE	0.010	0.012	0.016	0.012	0.012	0.012
		RMSE	0.013	0.015	0.013	0.015	0.015	0.016
TN	1	R^2	0.951	0.819	0.871	0.931	0.922	0.917
		MAE	0.062	0.109	0.119	0.070	0.072	0.077
		RMSE	0.073	0.141	0.092	0.087	0.093	0.096
	3	R^2	0.810	0.716	0.735	0.809	0.800	0.780
		MAE	0.115	0.137	0.171	0.130	0.117	0.128
		RMSE	0.145	0.165	0.132	0.145	0.149	0.156
	5	R^2	0.712	0.600	0.617	0.680	0.664	0.647
		MAE	0.130	0.165	0.205	0.135	0.166	0.144
		RMSE	0.178	0.210	0.160	0.188	0.192	0.197
	7	R^2	0.622	0.540	0.529	0.586	0.599	0.567
		MAE	0.158	0.177	0.228	0.165	0.175	0.187
		RMSE	0.204	0.225	0.192	0.214	0.210	0.218
NH$_3$-N	1	R^2	0.957	0.729	0.864	0.927	0.918	0.909
		MAE	0.044	0.092	0.096	0.056	0.051	0.059
		RMSE	0.054	0.136	0.067	0.070	0.075	0.079
	3	R^2	0.798	0.626	0.721	0.767	0.769	0.733
		MAE	0.084	0.130	0.138	0.101	0.099	0.097
		RMSE	0.117	0.159	0.115	0.126	0.125	0.135
	5	R^2	0.710	0.525	0.596	0.674	0.662	0.611
		MAE	0.099	0.141	0.166	0.104	0.118	0.125
		RMSE	0.140	0.180	0.129	0.149	0.152	0.163

	7	R^2	0.621	0.505	0.453	0.626	0.566	0.472
		MAE	0.130	0.147	0.193	0.139	0.131	0.160
		RMSE	0.160	0.188	0.167	0.159	0.172	0.189
DO	1	R^2	0.949	0.811	0.850	0.928	0.913	0.899
		MAE	0.335	0.619	0.534	0.398	0.423	0.500
		RMSE	0.437	0.841	0.748	0.519	0.570	0.613
	3	R^2	0.836	0.682	0.707	0.817	0.798	0.745
		MAE	0.587	0.895	0.800	0.638	0.687	0.798
		RMSE	0.782	1.090	1.047	0.826	0.869	0.976
	5	R^2	0.684	0.584	0.565	0.649	0.601	0.584
		MAE	0.912	1.016	1.013	0.966	0.990	1.020
		RMSE	1.085	1.246	1.274	1.144	1.220	1.246
	7	R^2	0.593	0.522	0.476	0.573	0.532	0.485
		MAE	1.032	1.075	1.066	1.051	1.049	1.142
		RMSE	1.232	1.336	1.399	1.263	1.322	1.387
COD_{Mn}	1	R^2	0.953	0.787	0.847	0.926	0.904	0.883
		MAE	0.107	0.213	0.231	0.129	0.141	0.167
		RMSE	0.128	0.272	0.164	0.161	0.183	0.202
	3	R^2	0.820	0.724	0.674	0.780	0.792	0.718
		MAE	0.201	0.244	0.337	0.210	0.195	0.216
		RMSE	0.250	0.310	0.265	0.277	0.269	0.314
	5	R^2	0.710	0.642	0.599	0.688	0.627	0.622
		MAE	0.261	0.281	0.374	0.271	0.312	0.278
		RMSE	0.318	0.353	0.297	0.330	0.361	0.363
	7	R^2	0.640	0.520	0.507	0.604	0.576	0.544
		MAE	0.272	0.325	0.415	0.283	0.274	0.317
		RMSE	0.354	0.409	0.325	0.372	0.384	0.399
EC	1	R^2	0.930	0.767	0.833	0.907	0.886	0.874
		MAE	8.409	15.661	14.055	9.361	9.667	9.786
		RMSE	11.806	20.135	17.054	12.734	14.101	14.850
	3	R^2	0.786	0.607	0.672	0.743	0.719	0.737
		MAE	13.281	20.818	18.543	16.469	15.005	15.124
		RMSE	19.306	26.172	23.919	21.178	22.145	21.430
	5	R^2	0.631	0.521	0.531	0.612	0.591	0.562
		MAE	18.779	24.510	20.534	19.662	20.316	21.624
		RMSE	25.365	28.903	28.587	26.016	26.707	27.630
	7	R^2	0.555	0.421	0.460	0.522	0.497	0.491

		MAE	21.255	27.206	25.917	22.995	23.391	25.254
		RMSE	27.843	31.758	30.671	28.858	29.608	29.791
TB	1	R^2	0.941	0.794	0.837	0.912	0.897	0.865
		MAE	3.016	5.257	4.756	3.621	4.179	4.657
		RMSE	3.995	7.454	6.618	4.864	5.281	6.040
	3	R^2	0.870	0.627	0.656	0.849	0.790	0.736
		MAE	4.578	7.531	7.987	4.903	6.551	6.380
		RMSE	5.922	10.022	9.634	6.388	7.515	8.435
	5	R^2	0.717	0.543	0.535	0.696	0.696	0.630
		MAE	7.048	7.974	8.288	7.458	6.330	7.117
		RMSE	8.737	11.101	11.193	9.052	9.053	9.987
	7	R^2	0.638	0.494	0.529	0.605	0.596	0.561
		MAE	7.159	8.691	7.831	7.582	7.786	7.946
		RMSE	9.875	11.676	11.268	10.314	10.432	10.877
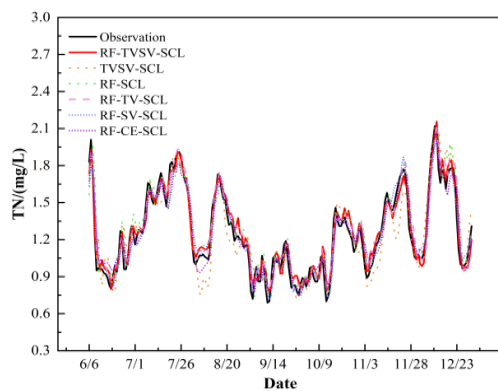
（a）1-d ahead   （b）3-d ahead
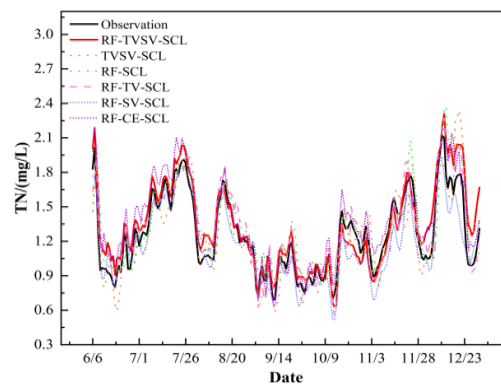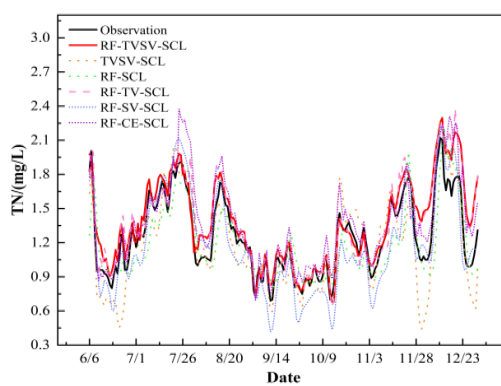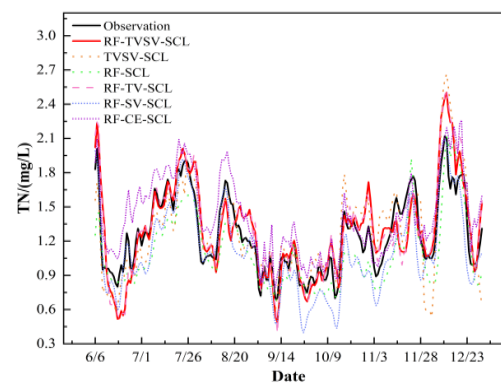
（c）5-d ahead   （d）7-d ahead

Figure S1 Comparison of different models' prediction performance for **TN**
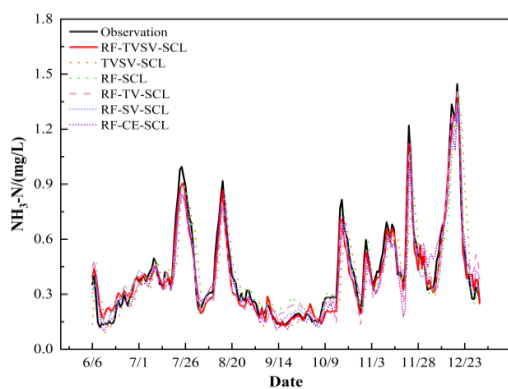
（a）1-d ahead
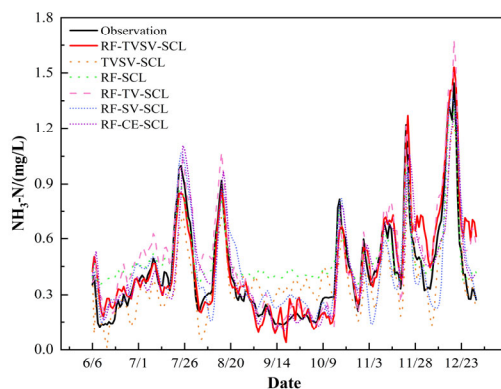
（b）3-d ahead
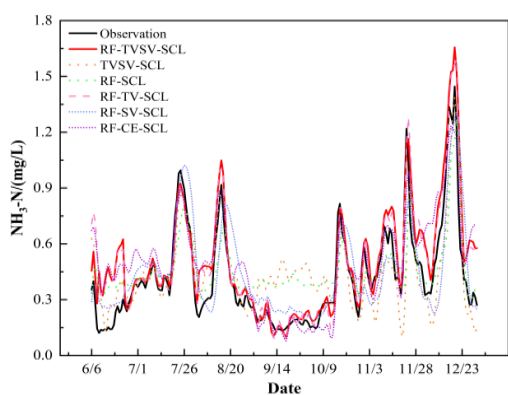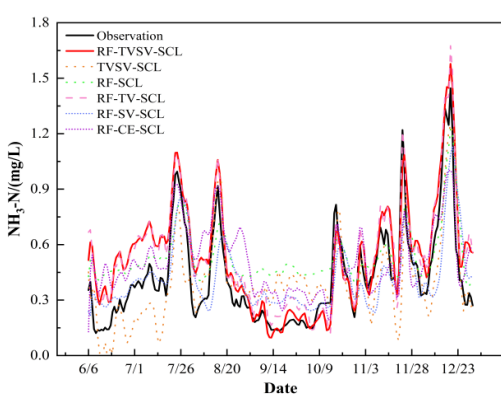
（c）5-d ahead

（d）7-d ahead

Figure S2 Comparison of different models' prediction performance for $NH_3\text{-}N$
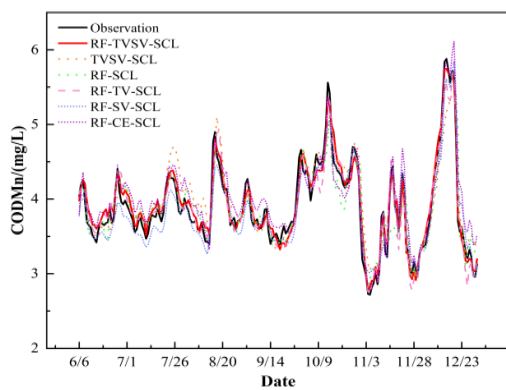
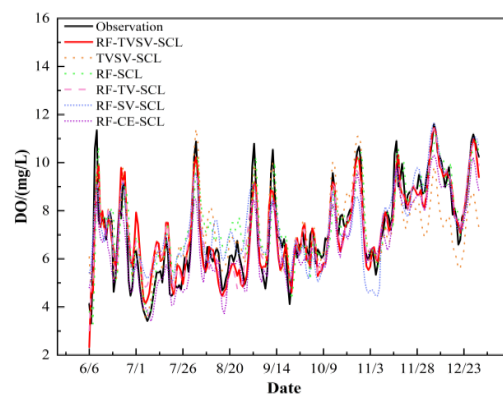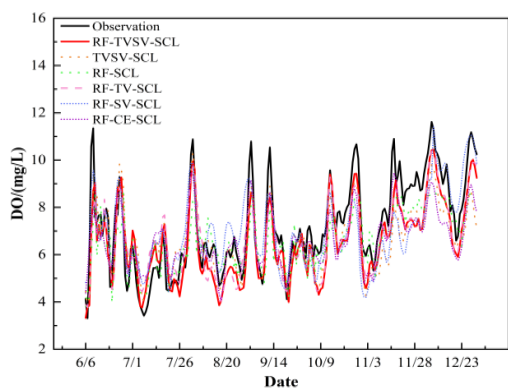（a）1-d ahead   （b）3-d ahead
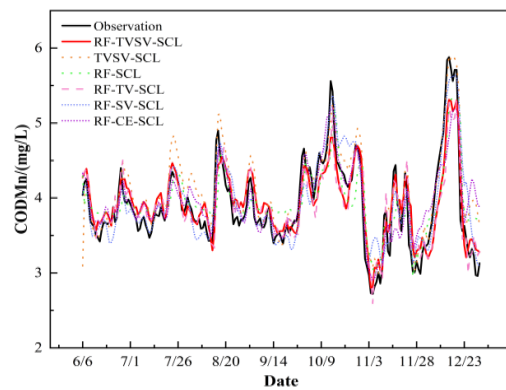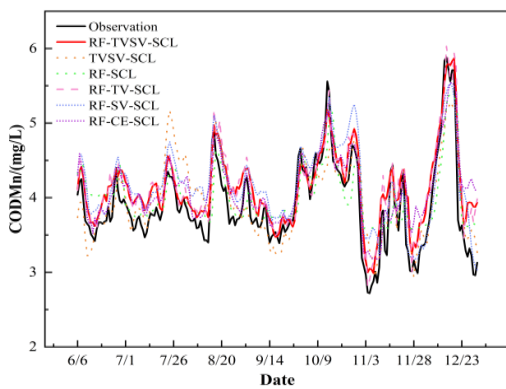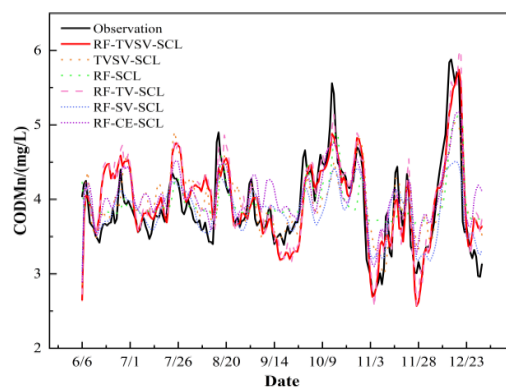
（c）5-d ahead   （d）7-d ahead

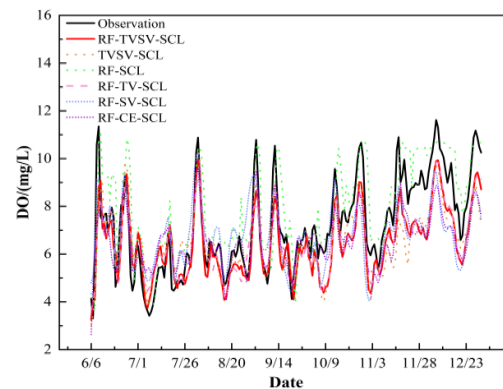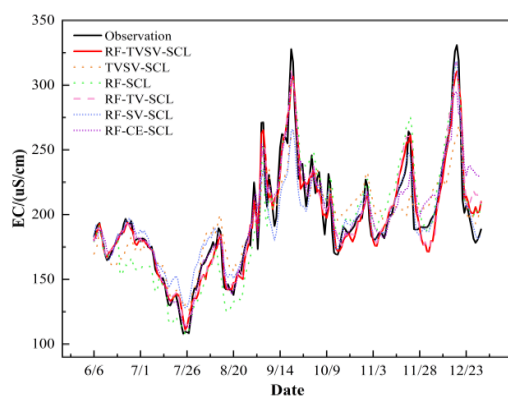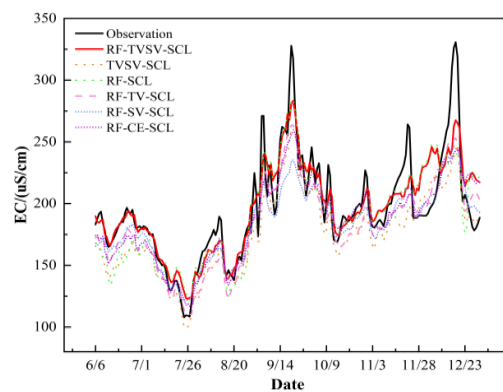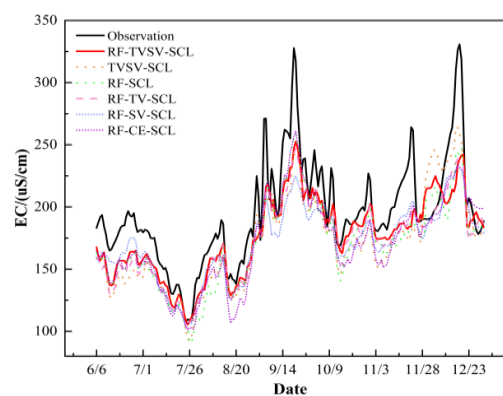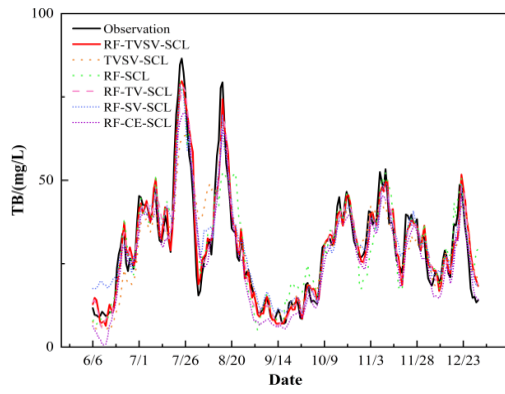Figure S3 Comparison of different models' prediction performance for COD_{Mn}
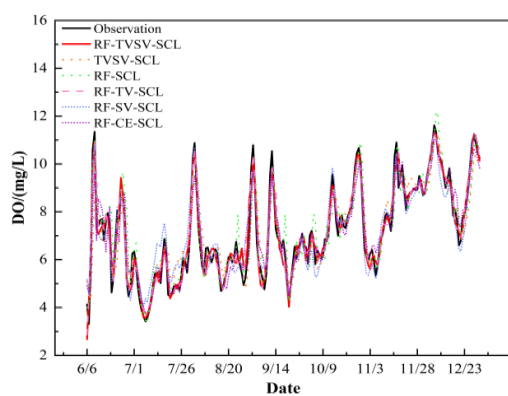
（a）1-d ahead

（b）3-d ahead

（c）5-d ahead

（d）7-d ahead

Figure S4 Comparison of different models' prediction performance for **DO**
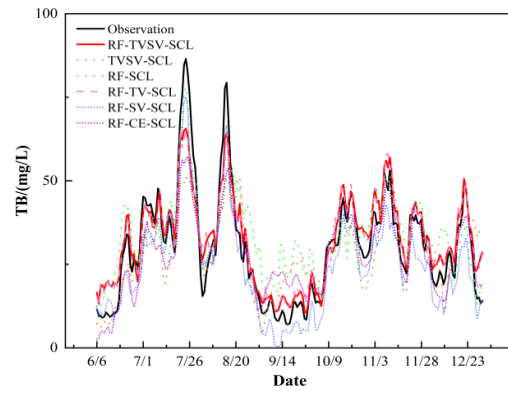
（a）1-d ahead

（b）3-d ahead
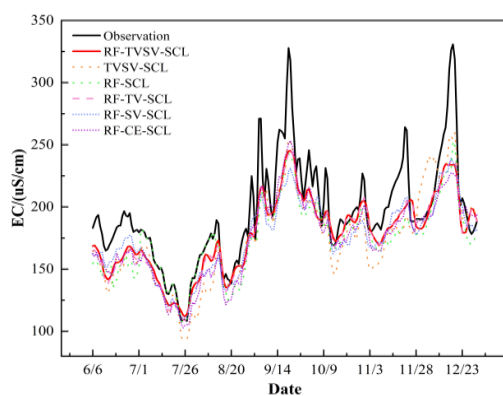
（c）5-d ahead
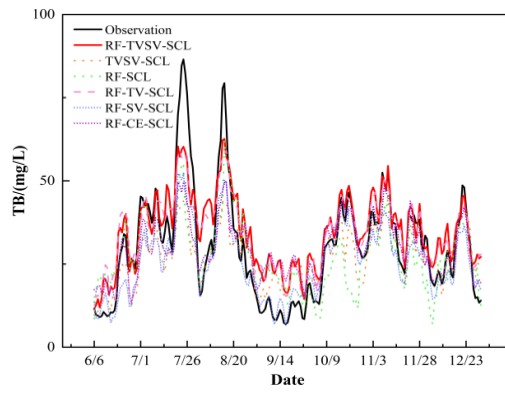
（d）7-d ahead

Figure S5 Comparison of different models' prediction performance for **EC**

（a）1-d ahead　　　　　　　　　　　（b）3-d ahead
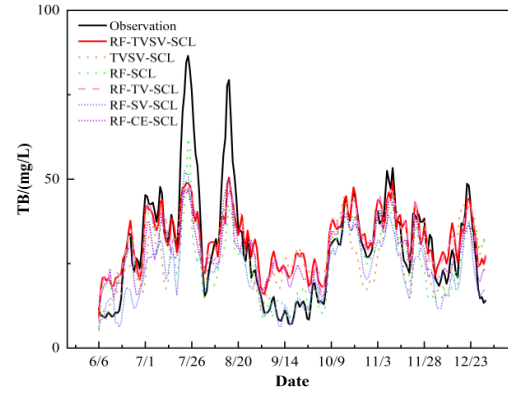
（c）5-d ahead　　　　　　　　　　　（d）7-d ahead

Figure S6 Comparison of different models' prediction performance for **TB**