

1 **Table 1.** Flood characteristics statistics during test period.

Event No.	Total rainfall(mm)	Rain duration(h)	Rising flow(mm)	Rainfall gravity center of
980622	25.20	35	2.44	宁化堡
980630	40.42	26	3.70	杜家村
980711	33.27	33	17.00	圪洞子
990710	28.37	24	1.20	东马坊
990719	7.48	8	3.00	堂儿
990817	20.07	20	1.47	静乐
000811	6.95	9.00	3.54	圪洞子
000827	15.49	16	9.70	杜家村
020626	49.23	15.00	21.40	宋家崖
030729	76.95	30	4.71	杜家村

2 **Table 2.** Calibrated parameters of the EIES model during model set up.

Variable	Description	Value
WM	Average catchment storage capacity	129.4
cke	Water area evaporation conversion	0.884
c	Deep evaporation coefficient	0.635
fc	Steady infiltration rate	8.366
k	Soil permeability coefficient	0.531
ckg	Extinction coefficient of underground runoff	0.995
EX	Index of free water storage capacity curve	1.884
SM	Free water storage capacity	23.541
CKI	Extinction coefficient of flow in soil	0.998
CI	Outflow coefficient of soil	0.347
CG	Underground runoff coefficient	0.361

Table 3. Performance of the EIES-standalone model and the error updating model variants for lead-time streamflow forecasting.

[illegible]

$r(-)$	0.93	0.92	0.91	0.89	0.88	0.87
$NSE(-)$	0.87	0.83	0.81	0.79	0.77	0.75
$MAE(m^3/s)$	11.34	12.47	11.62	13.58	13.96	14.25
$Evolution(\%)$	-5.65	-8.88	-8.54	-9.32	-9.05	-10.88

5 **Table 4.** Qualified rate of AR model calibration results.

Lead-Time	period	Qualified rate $\alpha(\%)$		
		Flood peak	Flood peak occurrence time	Mean value
1h	training	78.3	85.4	81.85
	test	80.1	88.6	84.35
2h	training	70.0	81.3	76.1
	test	74.6	84.9	79.75
3h	training	65.4	78.7	72.05
	test	67.2	79.6	73.4
4h	training	62.5	74.2	68.35
	test	64.6	76.3	70.45
5h	training	56.7	75.1	65.9
	test	60.3	75.2	67.75
6h	training	55.7	63.9	59.8
	test	58.0	66.5	62.25

6 **Table 5.** Qualified rate of ARMAX model calibration results.

Lead-Time	period	Qualified rate $\alpha(\%)$		
		Flood peak	Flood peak occurrence time	Mean value
1h	training	75.2	85.1	80.15
	test	78.6	85.4	81
2h	training	66.8	80.2	73.5
	test	70.2	81.6	75.9
3h	training	61.5	74.3	67.9
	test	61.9	74.5	68.2
4h	training	58.3	72.2	65.25
	test	55.7	73.1	64.4
5h	training	54.4	72.5	63.45
	test	53.1	70.2	61.65
6h	training	51.5	65.7	58.6
	test	50.20	67.4	58.8

7 **Table 6.** Qualified rate of LSTM model calibration results.

Lead-Time	period	Qualified rate $\alpha(\%)$		
		Flood peak	Occurrence time of flood peak	Mean value
1h	training	92.4	96.3	94.35
	test	94.5	98.2	96.35
2h	training	90.6	93.5	92.05
	test	92.7	94.1	93.4
3h	training	87.2	94.7	90.95
	test	88.6	92.6	90.6
4h	training	85.4	90.1	87.75
	test	87.3	91.5	89.4
5h	training	80.1	87.4	83.75
	test	82.5	88.3	85.4
6h	training	77.3	85.9	81.6
	test	80.8	86.7	82.75

8 **Table 7.** Forecasting Results of Case that occurred during the July 30 to August 1, 2003 at 1, 3
9 and 6-hour lead-times

Model	Correlation			Nash Sutcliffe			Error of Peak			Error of Time to		
	Coefficient (r)			Efficiency (E)			Discharge (EQ_{peak})(%)			Peak (ET_{peak})		
	1h	3h	6h	1h	3h	6h	1h	3h	6h	1h	3h	6h
EIES-standalone	0.922	0.895	0.870	0.782	0.721	0.547	-48.3	-61.4	-75.6	2	0	1
EIES-AR	0.958	0.944	0.921	0.826	0.771	0.665	-36.9	-41.5	-58.6	0	0	0
EIES-ARMAX	0.913	0.904	0.882	0.796	0.714	0.619	-46.8	-52.3	-70.6	1	1	0
EIES-LSTM	0.992	0.981	0.976	0.991	0.885	0.822	-8.2	-14.8	-18.3	0	0	0

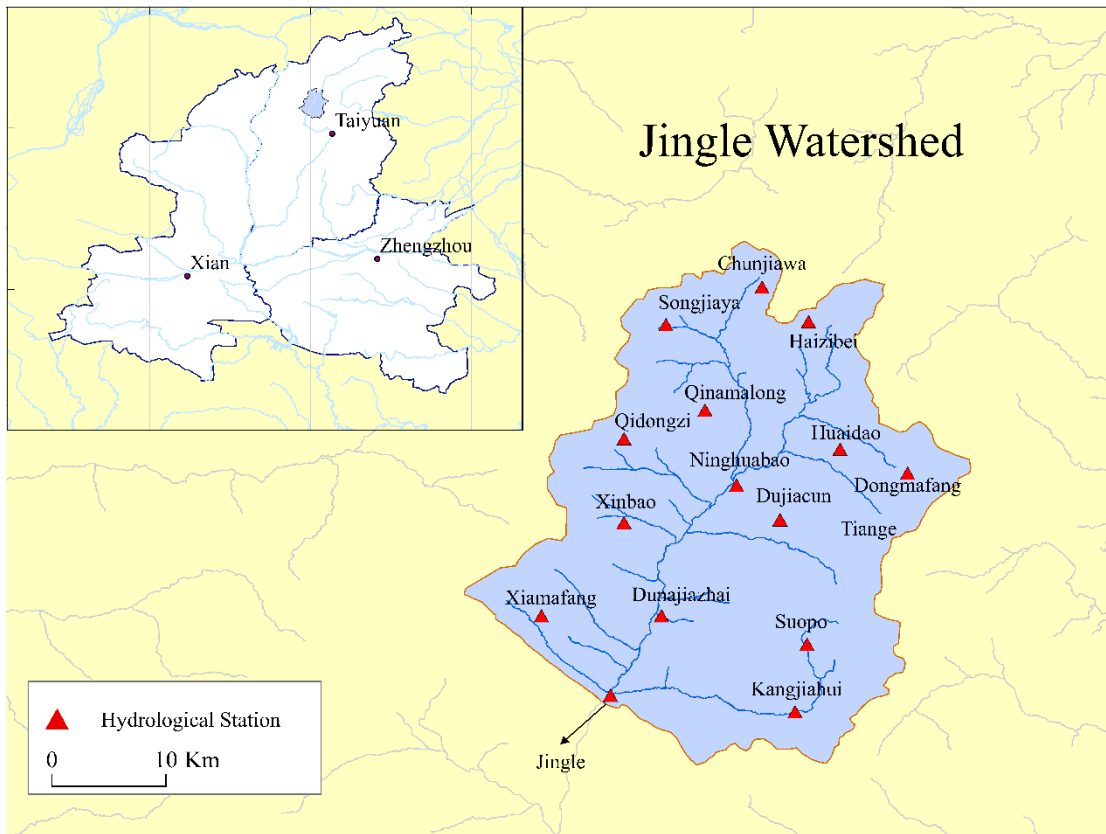


Figure 1. Locations of jingle sub-basin and Fen River basin.

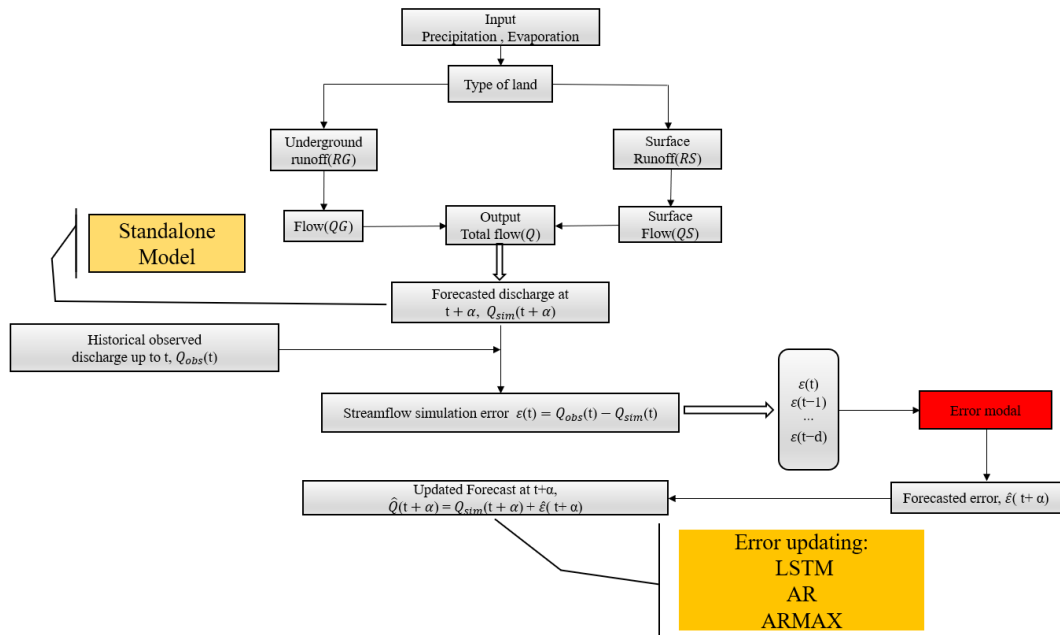


Figure 2. Framework of the standalone EIES model for flood forecasting and error-updating models.

Figure 3. Structure of the saturated storage and excess infiltration model.

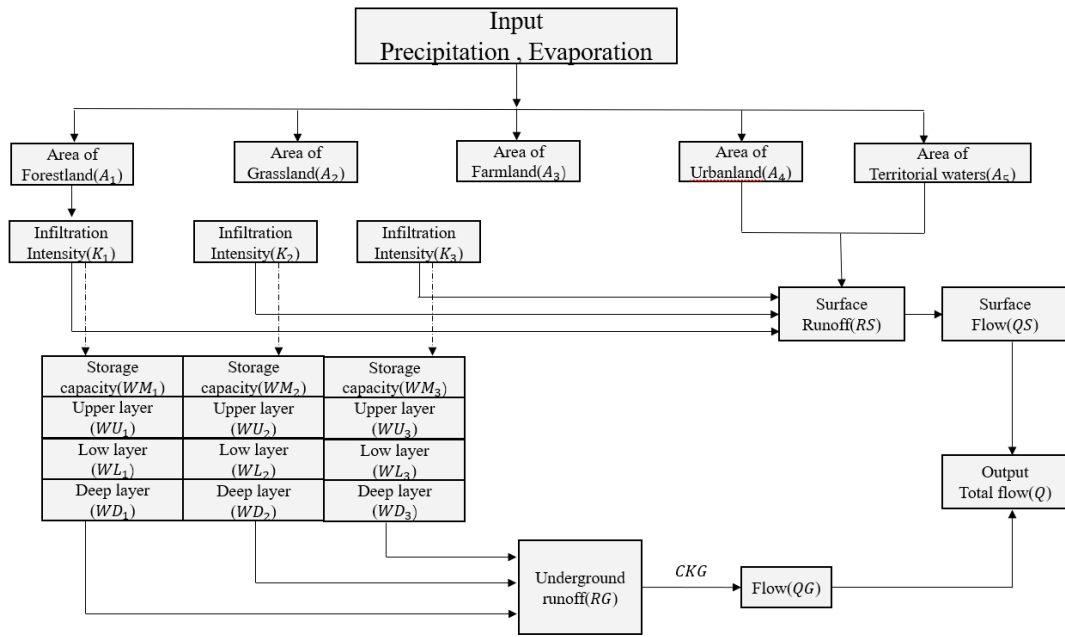


Figure 4. Basic flow of the modified model.

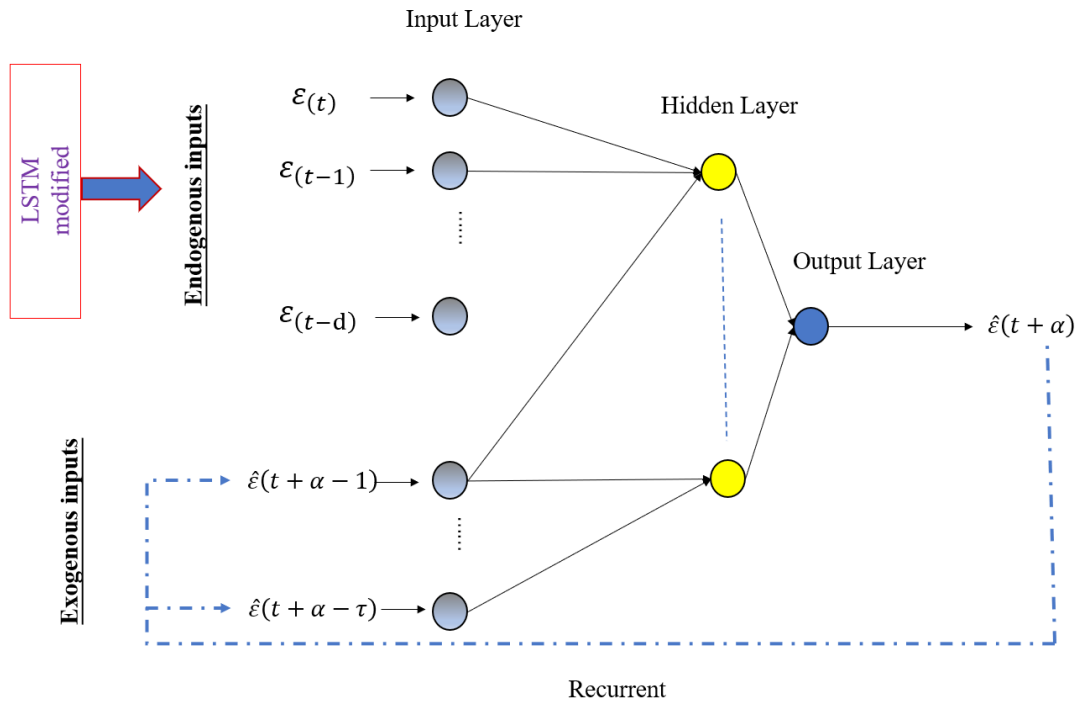


Figure 5. LSTM error forecasting model.

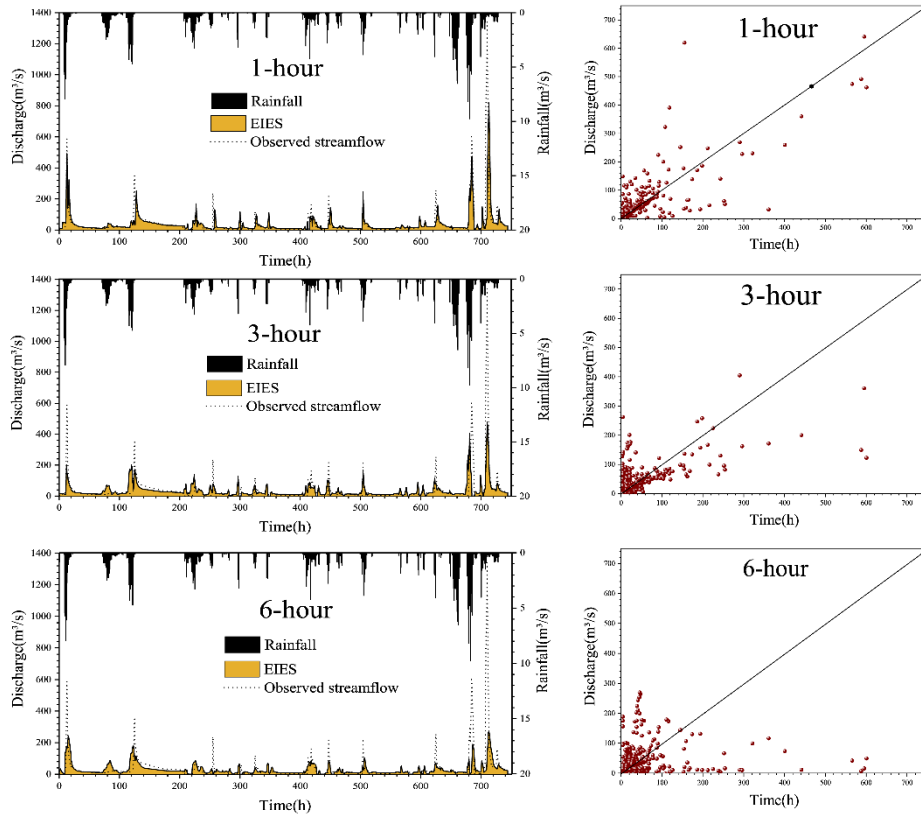


Figure 6. Forecasting of streamflow by the standalone EIES model.

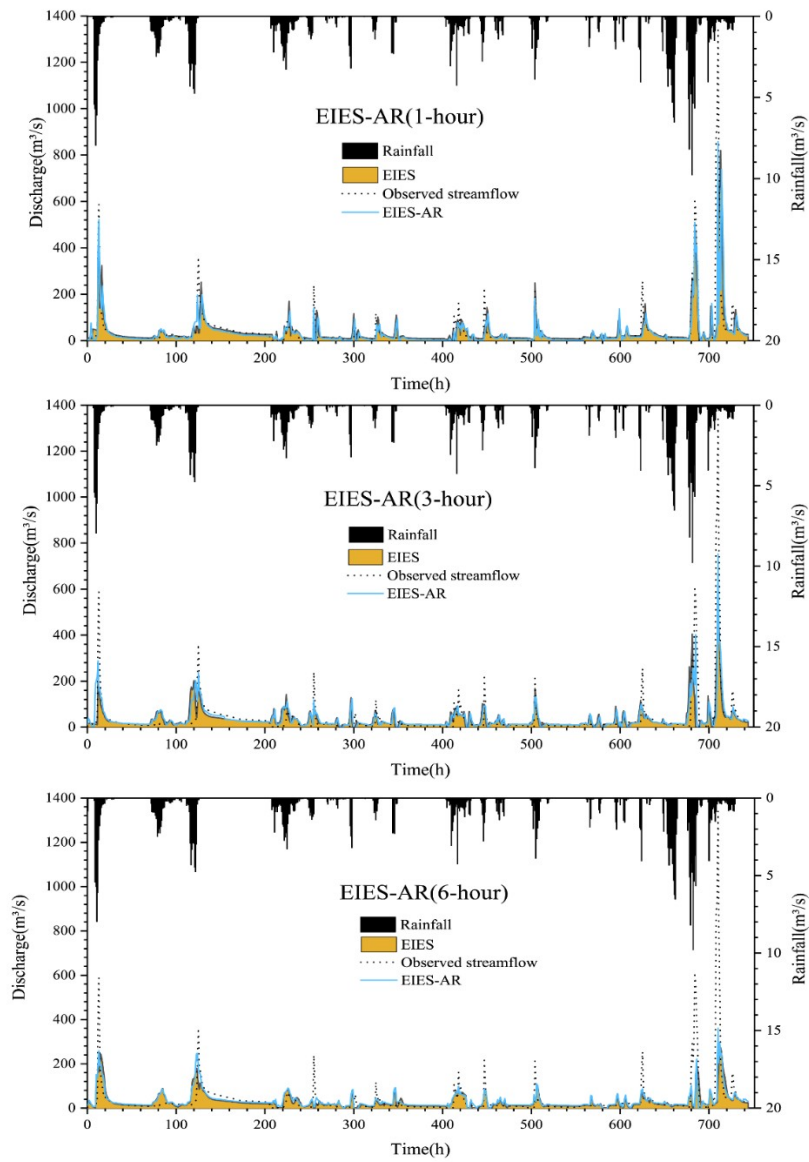
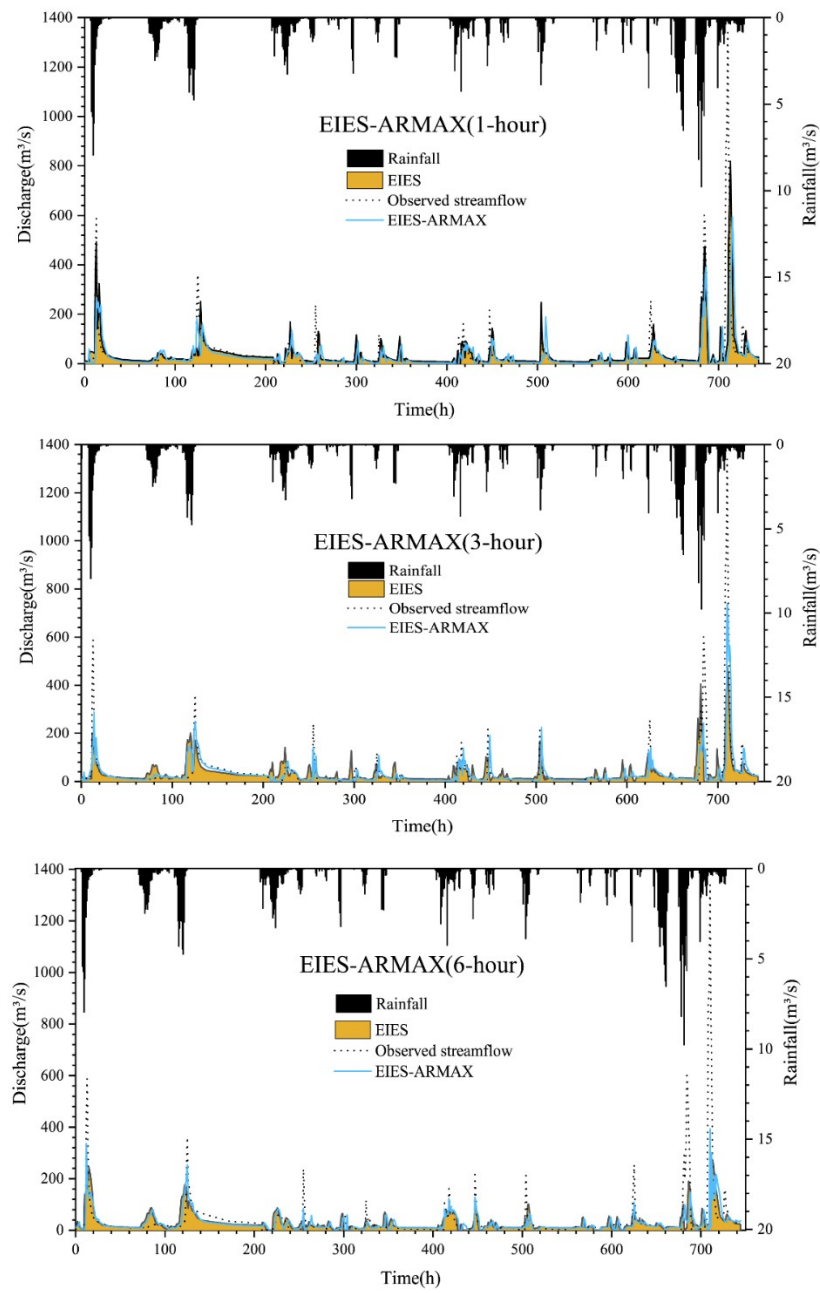


Figure 7. Reproduction of observed streamflow forecasts by the EIES-standalone and EIES-AR error-updating models at different lead-times



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Figure 8. Reproduction of observed streamflow forecasts by the EIES-standalone and

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EIES-ARMAX error-updating models at different lead-times

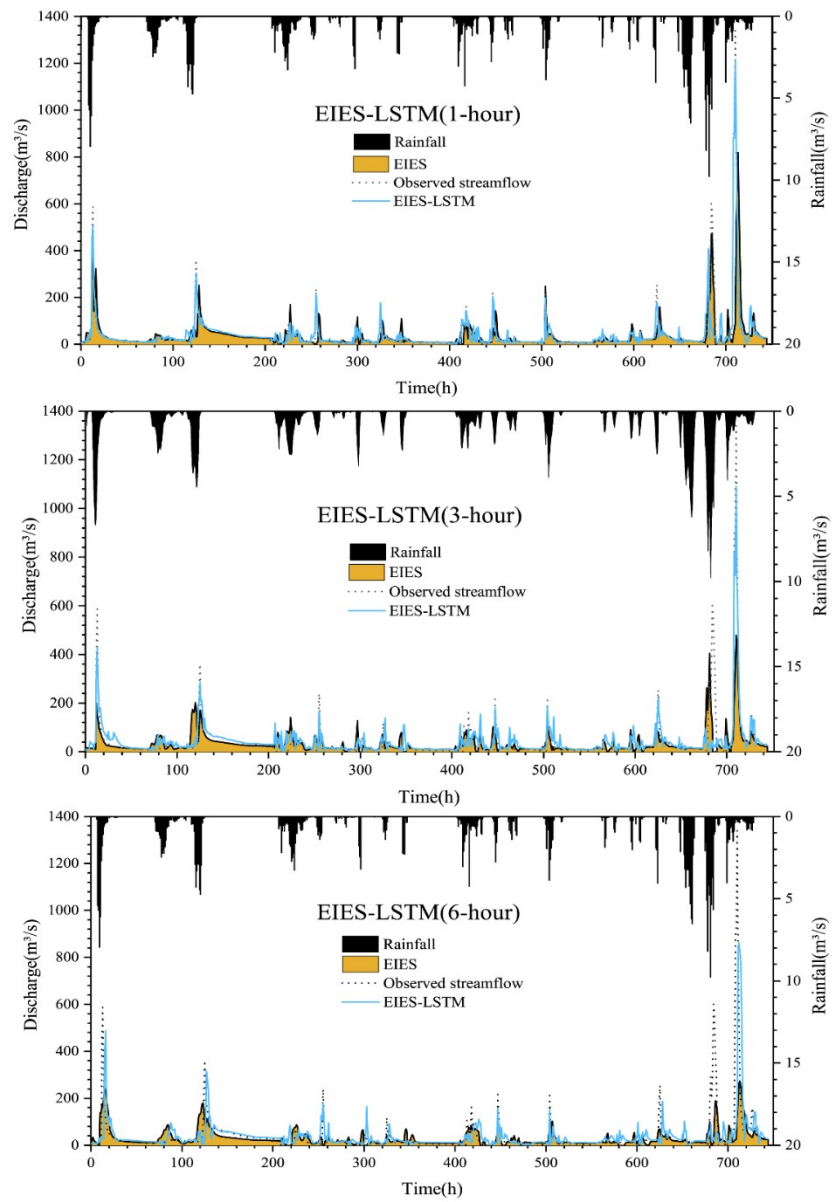


Figure 9. Reproduction of observed streamflow forecasts by the EIES-standalone and EIES-LSTM error-updating models at different lead-times

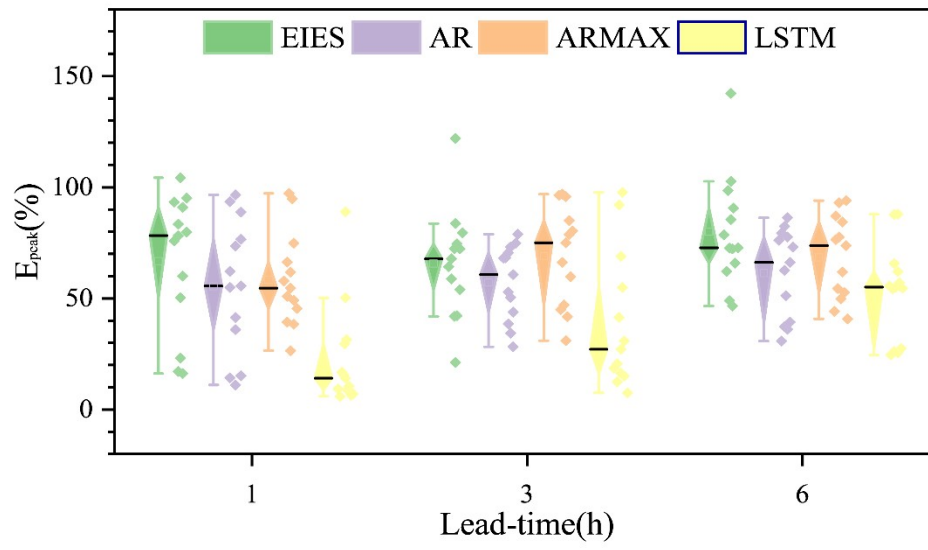
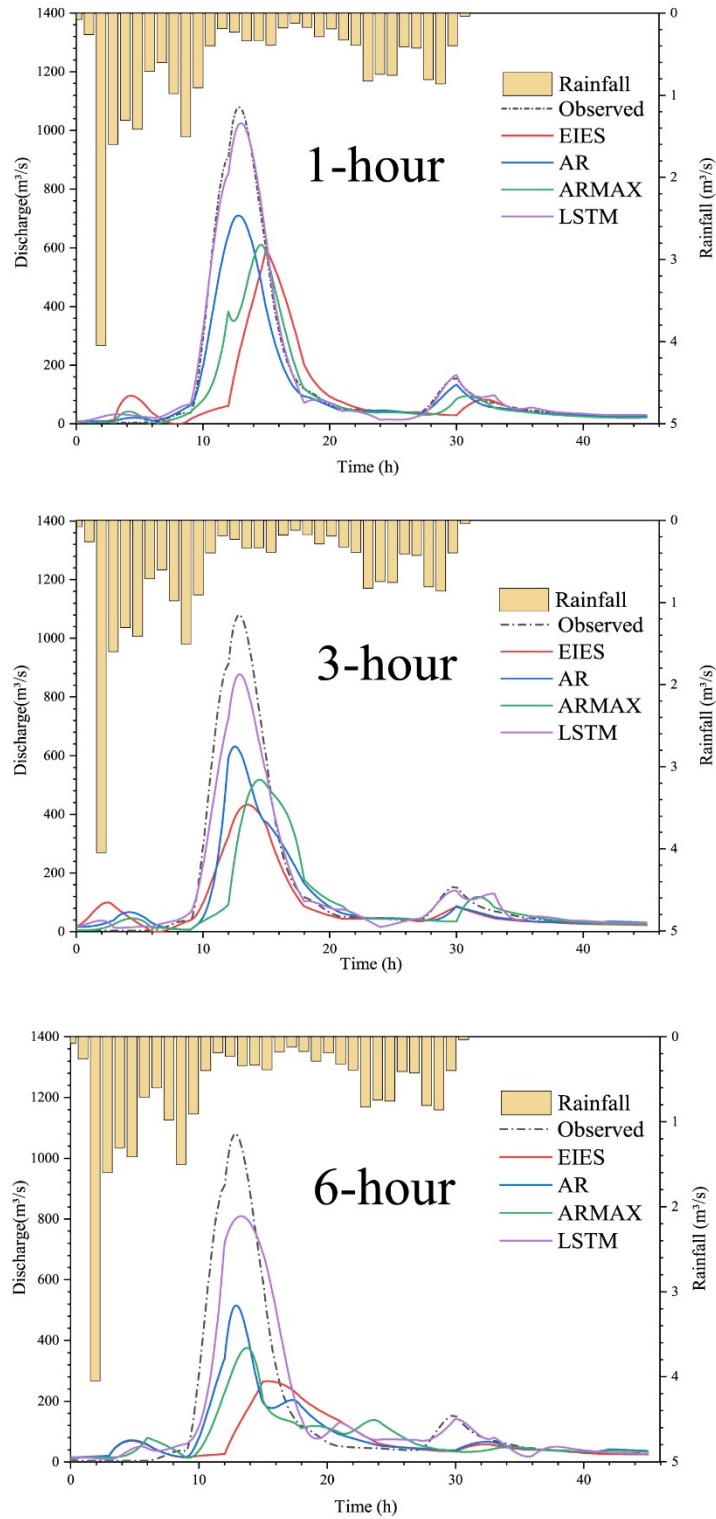


Figure 10. Comparison of model accuracy during calibration and verification.



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34 **Figure. 11.** Comparison of the forecasting model variants for reproducing the typical peak

35 flow event that occurred during the July 30 to August 1, 2003 at 1, 3 and 6-hour lead-times

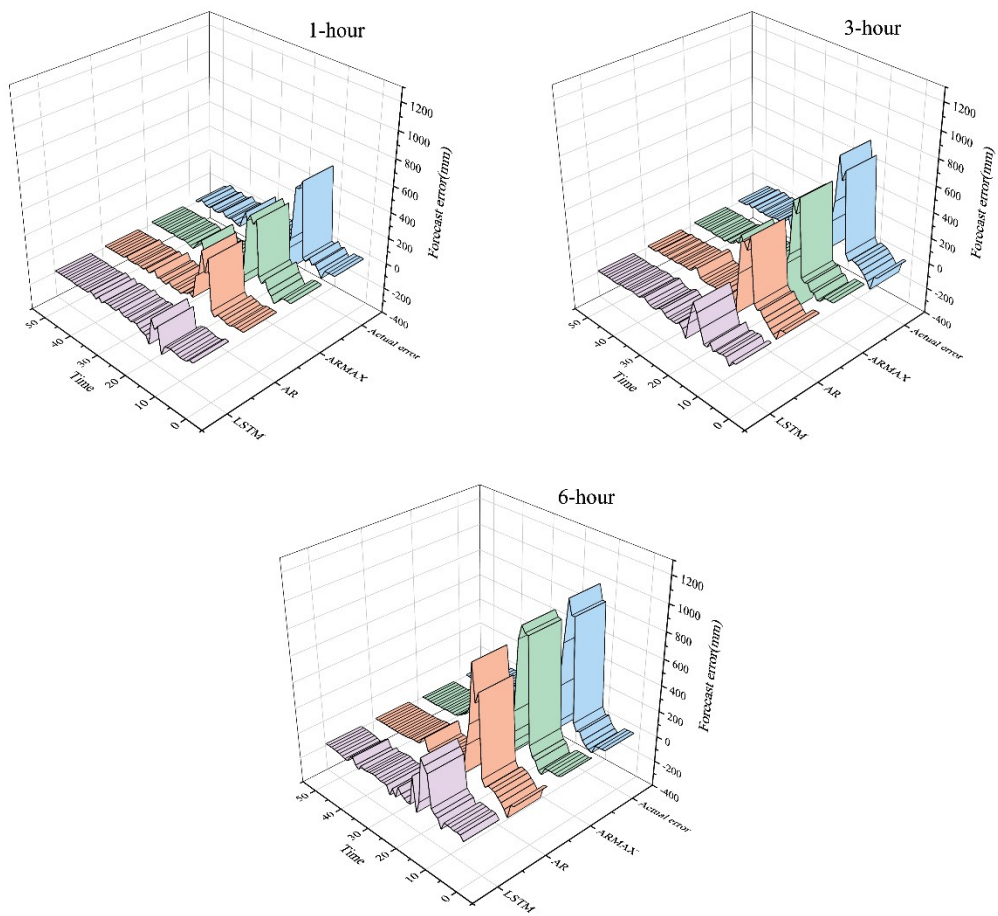


Figure 12. Comparison of forecasting error of the three model.