

Supplementary Materials

Table S1. Parameters and diagnostics of the selected $ARIMA(2, 0, 1)(1, 0, 0)_{12}$ model (full data and reduced datasets).

Parameter/Metric	Full Dataset	Without June 2020	Without 4 Extremes
φ_1 (AR1)	1.243	1.282	1.307
$SE(\varphi_1)$	0.085	0.112	0.110
φ_2 (AR2)	−0.257	−0.298	−0.324
$SE(\varphi_2)$	0.071	0.099	0.096
θ_1 (MA1)	−0.914	−0.907	−0.903
$SE(\theta_1)$	0.070	0.065	0.073
Φ (SAR1)	0.150	0.311	0.272
$SE(\Phi)$	0.074	0.078	0.075
LogLik	−825.5	−768.9	−744.9
AIC	1663.0	1549.8	1501.7
BIC	1682.1	1568.9	1520.8
Ljung–Box p (lag 24)	0.001	< 0.001	0.005

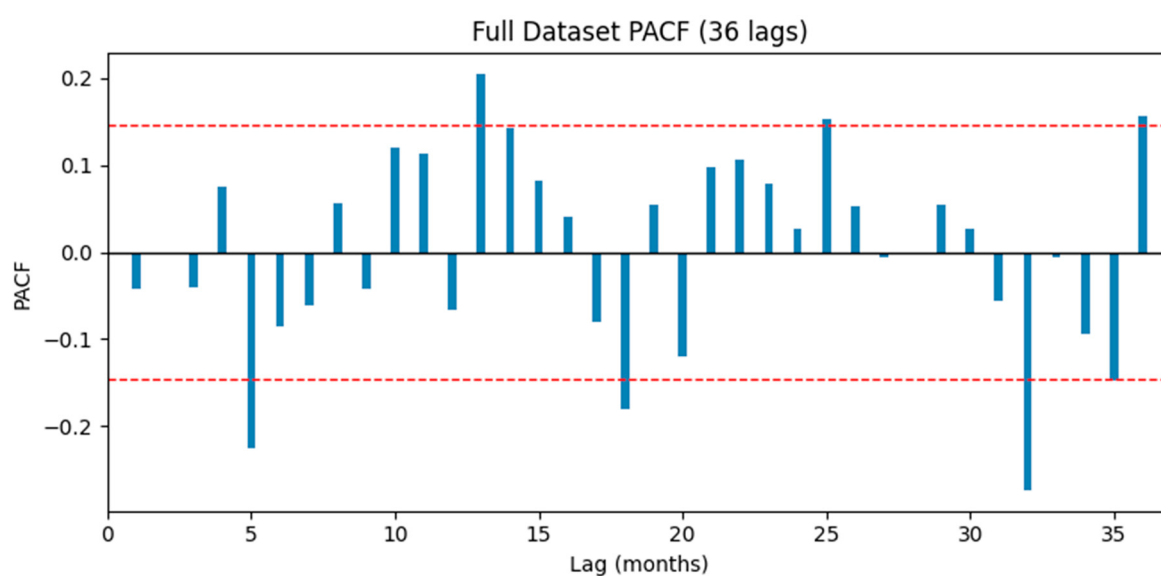


Figure S1. Partial Autocorrelation Function (PACF) of ARIMA residuals for the full dataset, with $\pm 2/\sqrt{n}$ confidence limits.

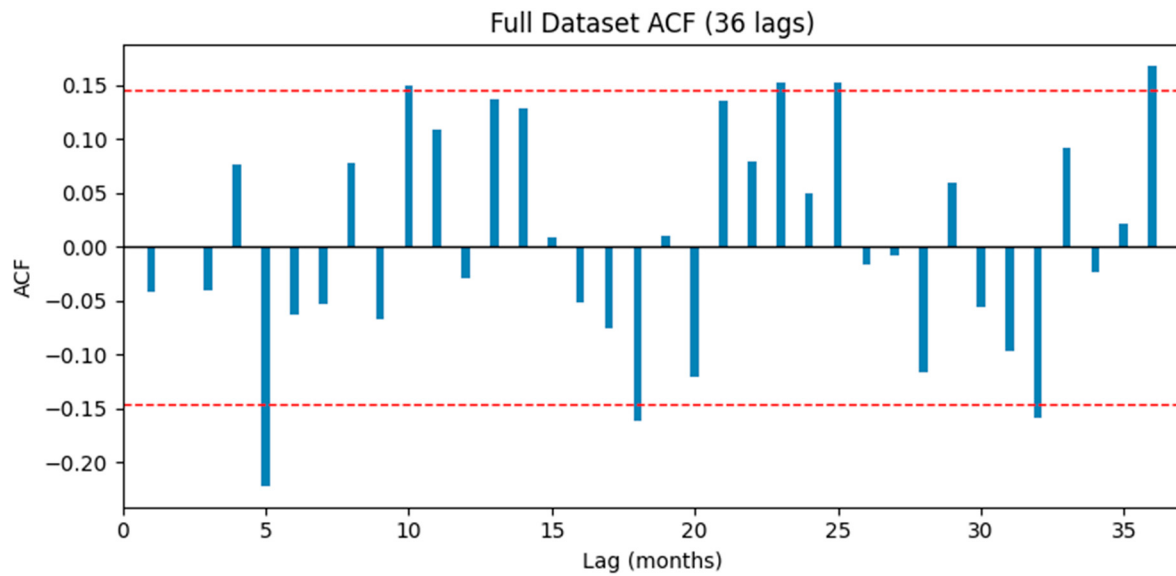


Figure S2. Autocorrelation Function (ACF) of ARIMA residuals for the full dataset, with $\pm 2/\sqrt{n}$ confidence limits.

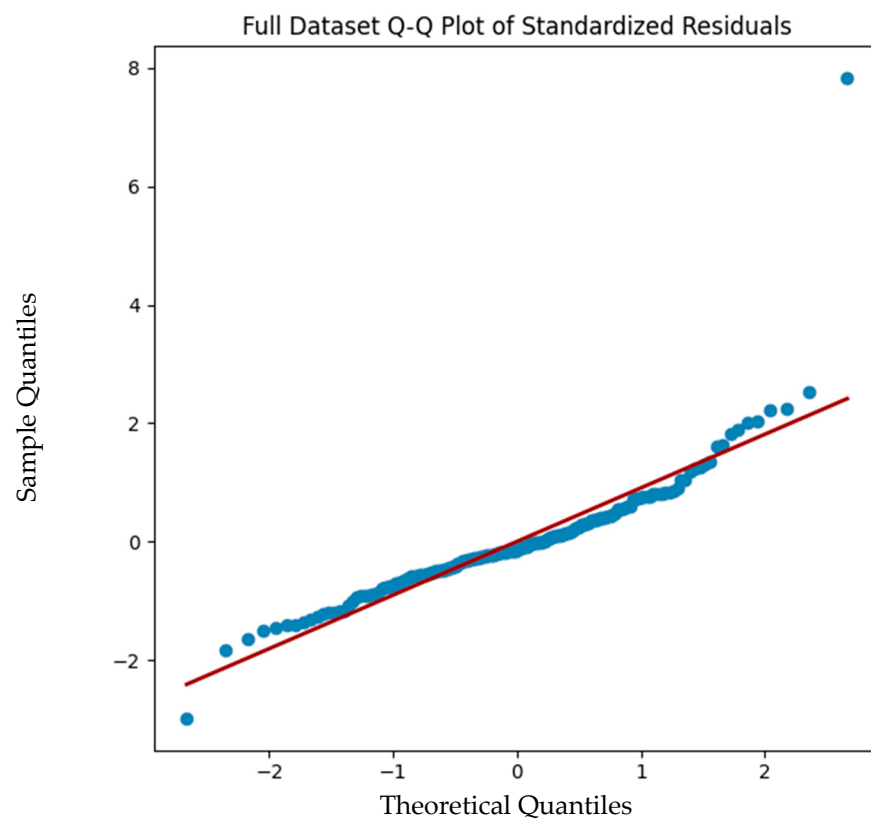


Figure S3. Normal Q–Q Plot of Standardized Residuals for full dataset.

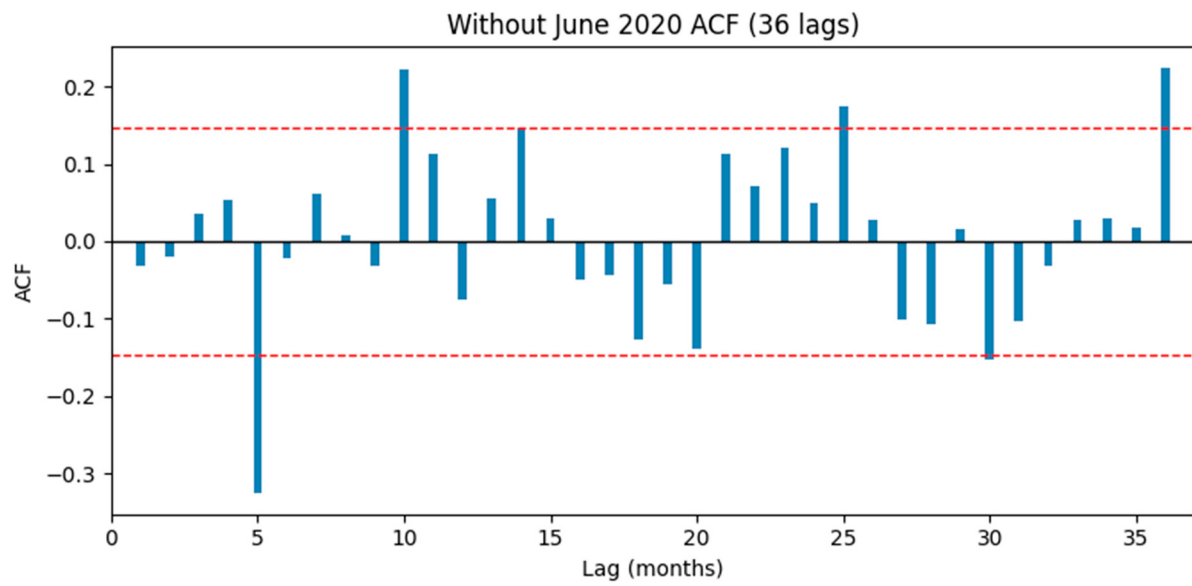


Figure S4. Autocorrelation Function (ACF) of ARIMA residuals without June 2020, with $\pm 2/\sqrt{n}$ confidence limits.

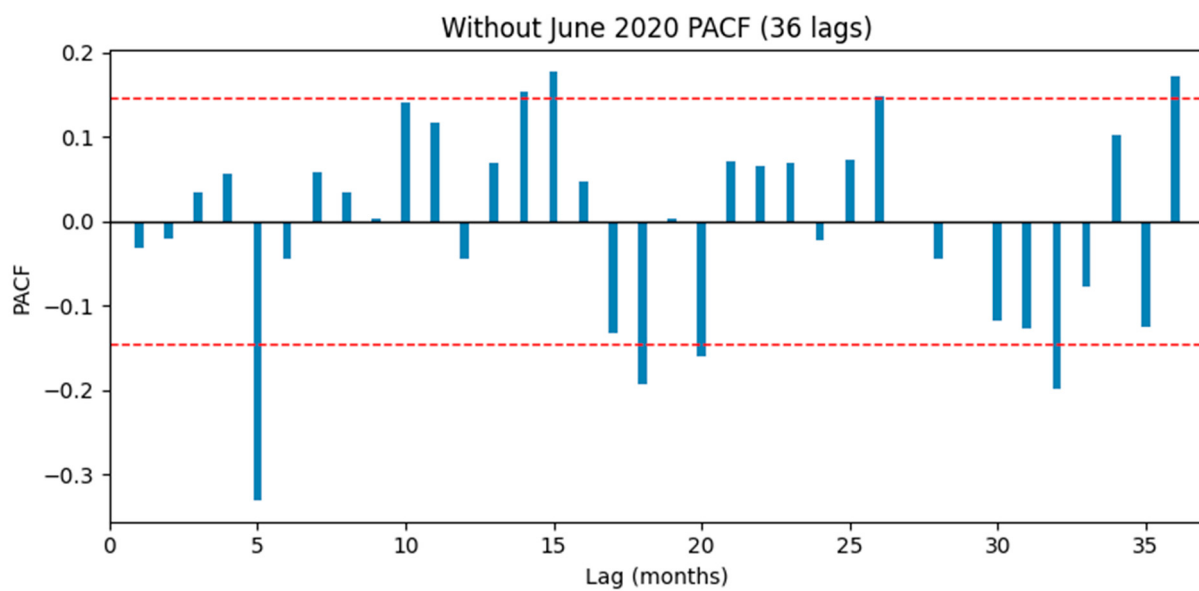


Figure S5. Partial Autocorrelation Function (PACF) of ARIMA residuals without June 2020, with $\pm 2/\sqrt{n}$ confidence limits.

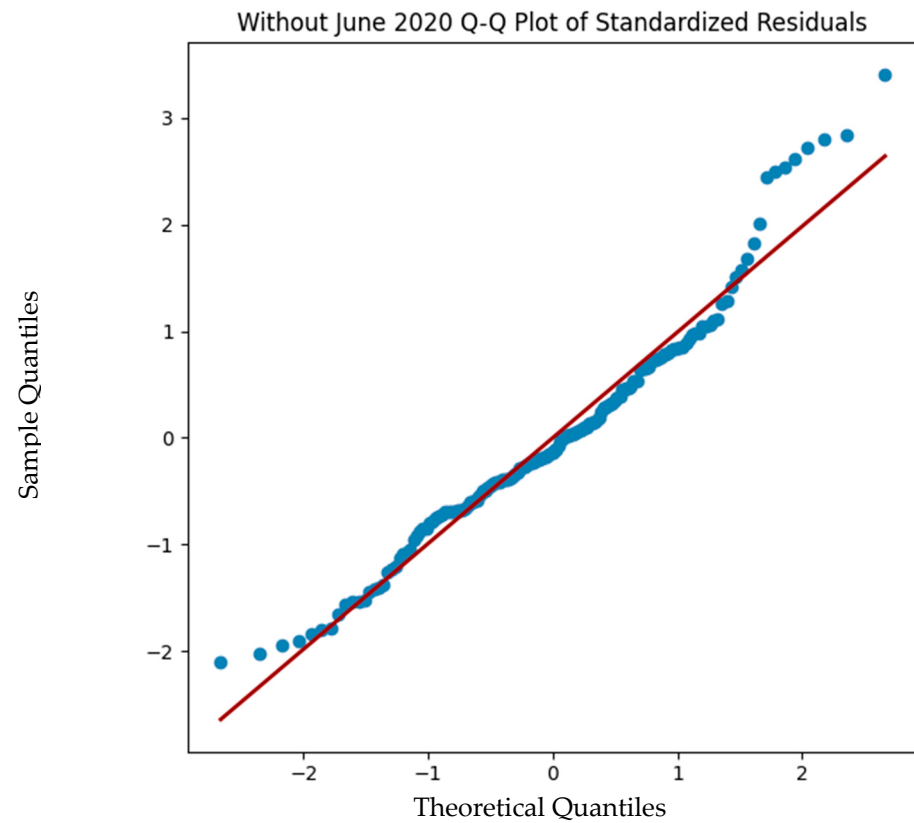


Figure S6. Normal Q-Q Plot of Standardized Residuals after removing June 2020.

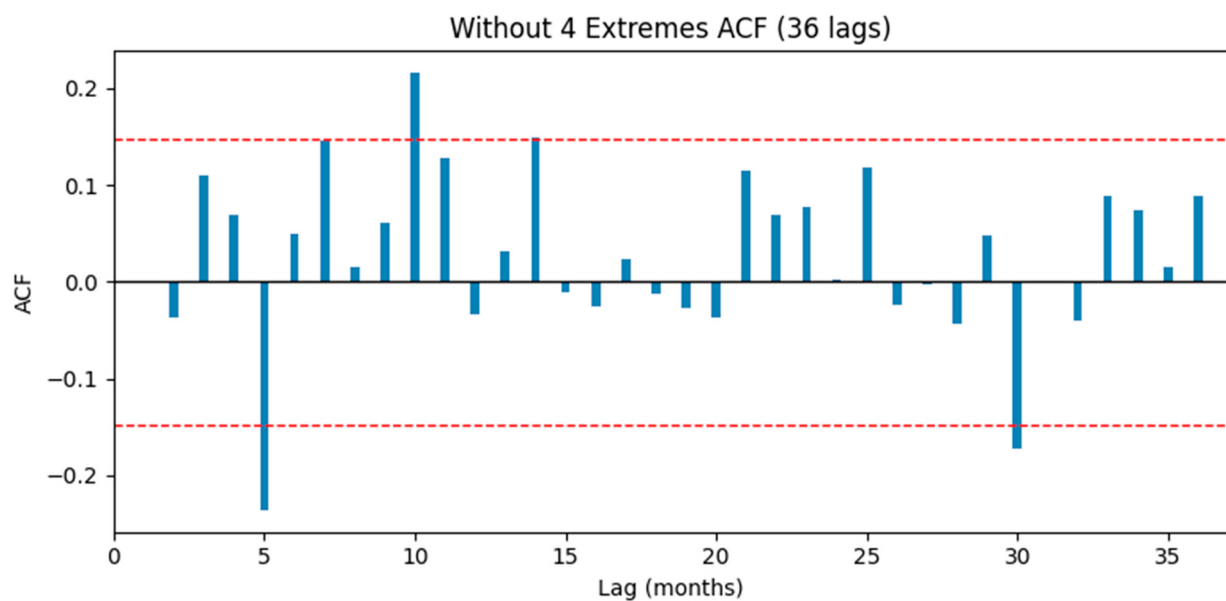


Figure S7. Autocorrelation Function (ACF) of ARIMA residuals after removing four extreme months, with $\pm 2/\sqrt{n}$ confidence limits.

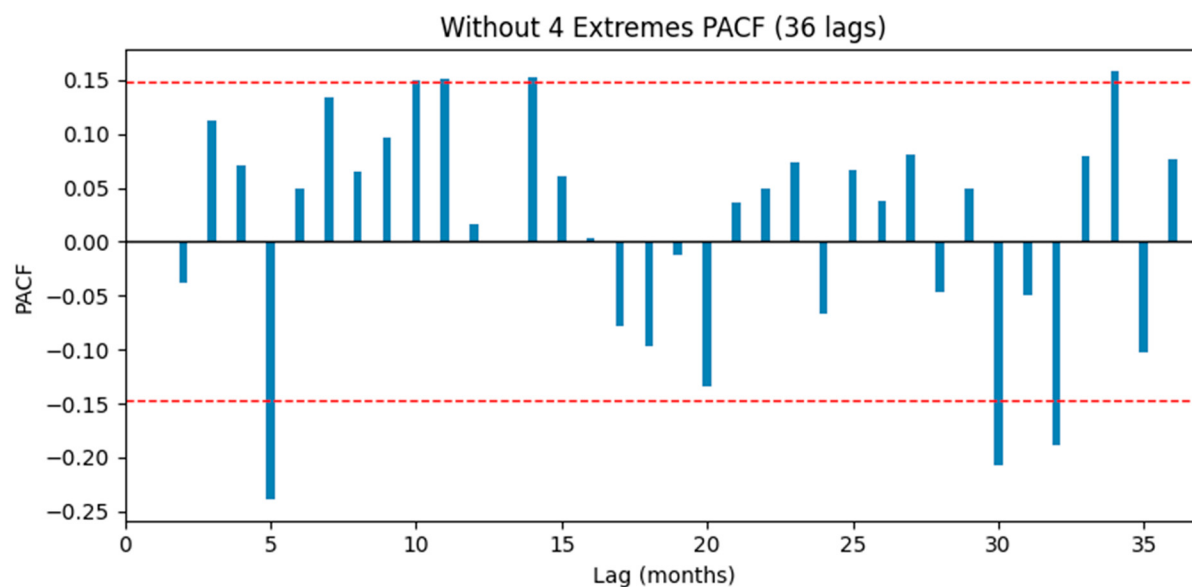


Figure S8. Partial Autocorrelation Function (PACF) of ARIMA residuals after removing four extreme months, with $\pm 2/\sqrt{n}$ confidence limits.

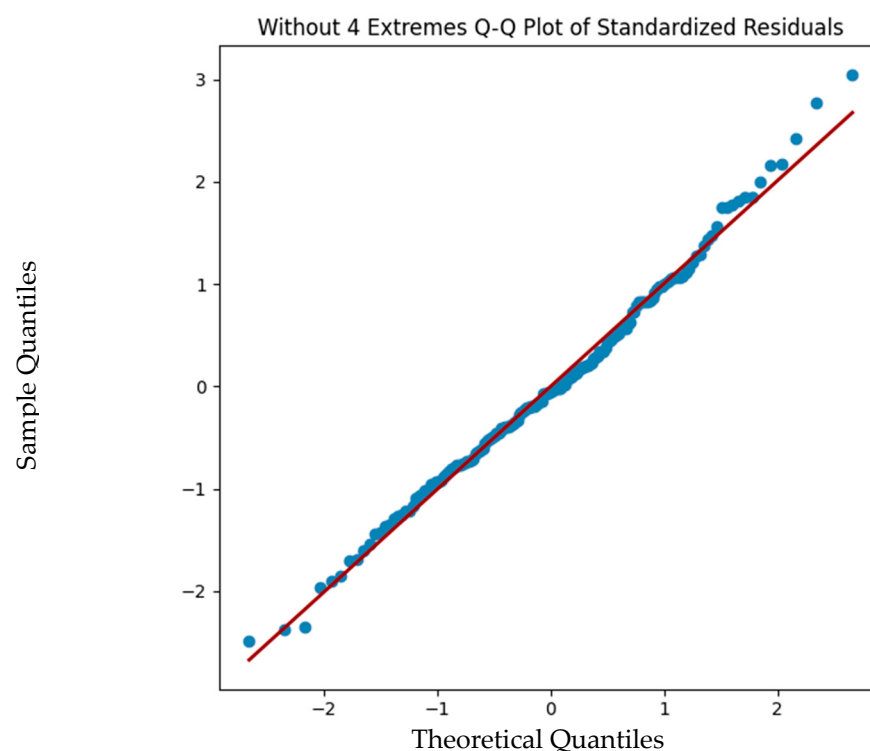


Figure S9. Normal Q–Q Plot of Standardized Residuals after removing four extreme months (>137 Failures).

Table S2. Influence of the June-2020 outlier and four extreme months on STL amplitude and WSI.

Metric	Full Dataset	Without June-2020	Without 4 Extremes
June-2020 value	292		
Z-score	7.25		
STL seasonal amplitude	61.03	60.64	64.44
Amplitude change (%)		−0.64%	+5.59%
WSI (June)	1.02	1.09	1.05
WSI change (%)		+6.59%	+2.42%

Table S3. Comparison of candidate ARIMA models and residual diagnostics.

Model	Data	AIC	BIC	Ljung–Box <i>p</i> -Value	Comment
ARIMA(2,0,1)(1,0,0) _{\12}	raw	1663.00	1682.16	0.001	Original model; residual autocorrelation present
ARIMA(2,0,1)(1,0,1) _{\12}	log	38.72	57.39	0.044	Log transform; seasonal MA reduces AIC but residual independence borderline
ARIMA(3,0,1)(1,0,1) _{\12}	log	40.42	62.17	0.081	Log transform; extra AR improves residual independence ($p > 0.05$)
ARIMA(2,0,1)(0,1,1) _{\12}	raw	1432.64	1447.82	0.249	Seasonal differencing; residuals independent ($p > 0.05$)
ARIMA(1,0,1)(0,1,1) _{\12}	raw	1432.87	1445.02	0.185	Simpler; similar AIC but seasonal MA parameter unstable

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