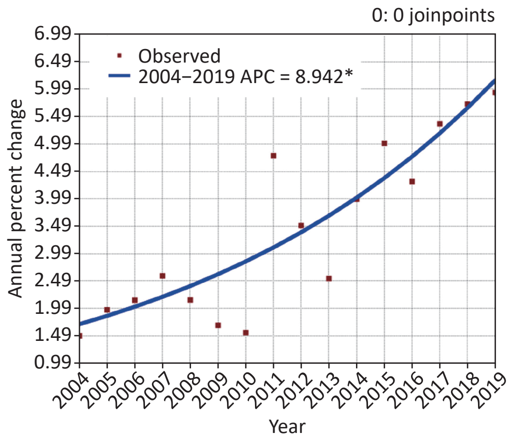
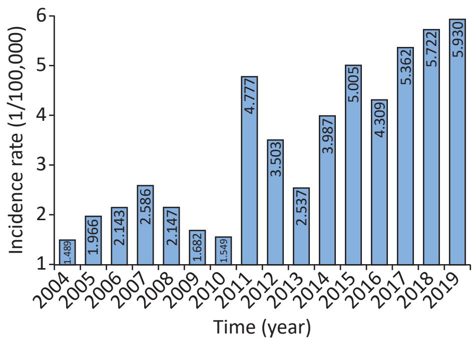
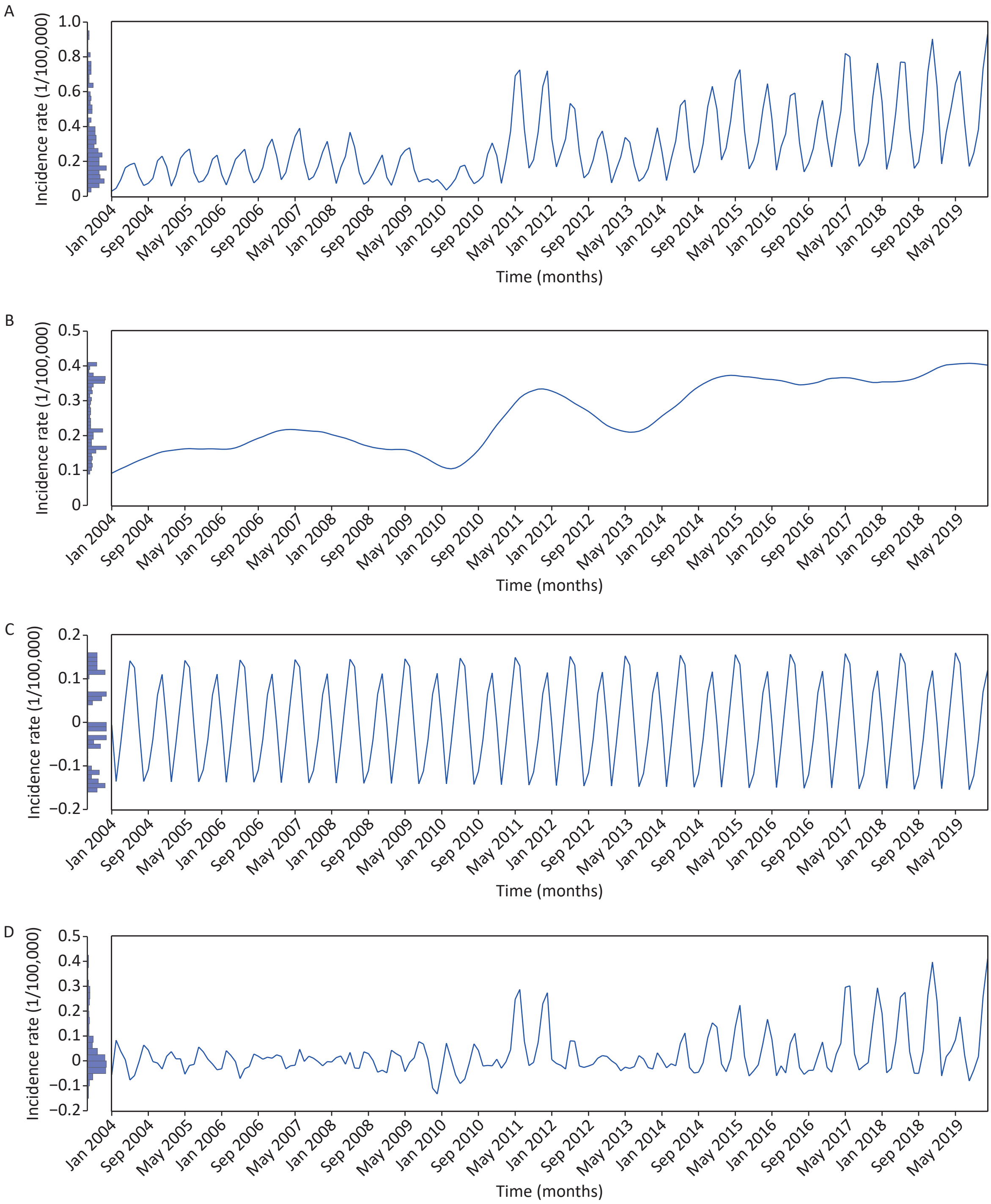


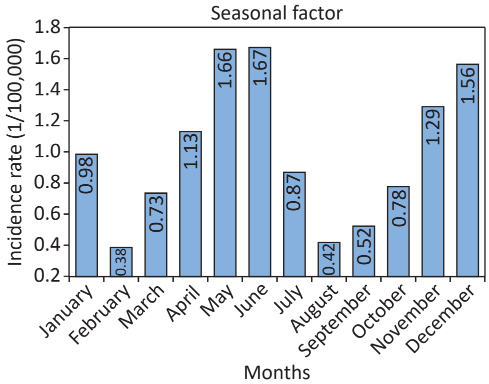
Supplementary Figure S1. Joinpoint regression showing the scarlet fever epidemic trends in the period 2004–2019. *Showed that the annual percent change (APC) is significantly different from zero at the significance level. This plot was plotted using Joinpoint regression program (Version 4.8.0.1). Joinpoint is a statistical tool for the description and analysis of trends with the Joinpoint methods. This Joinpoint Regression Program is designed as a Windows-based statistical software package to analyze Joinpoint methods. Users can use this software to investigate whether there is a statistically notable change in trend (Available from https://surveillance.cancer.gov/joinpoint/. Accessed on 16 May 2022).



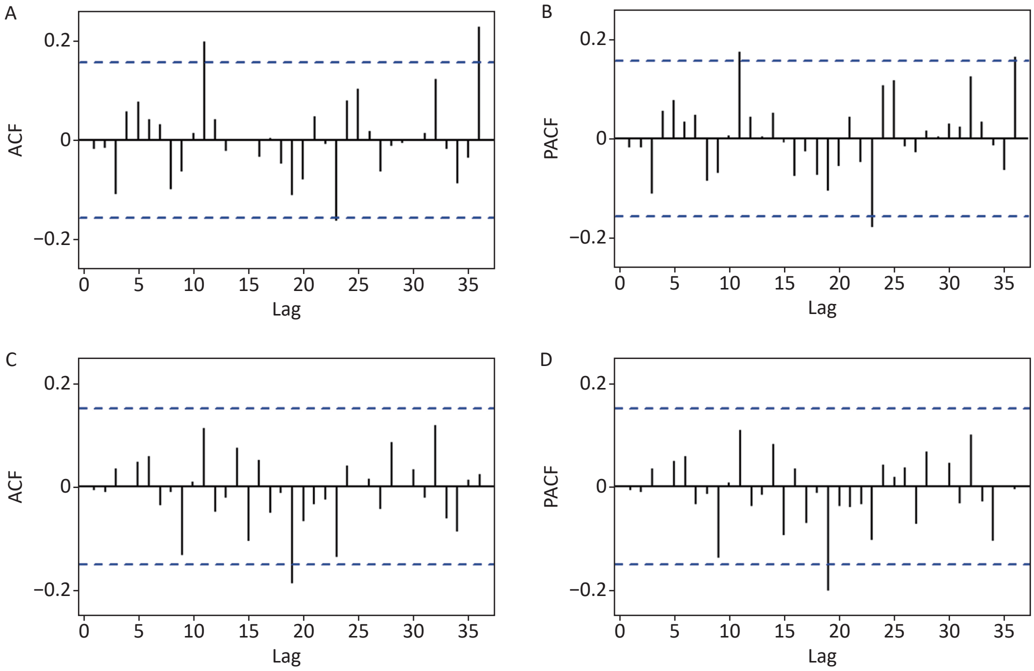
Supplementary Figure S2. The yearly incidence of SF from 2004 to 2019. It was seen that SF had the lowest incidence in 2004 (1.489 per 100,000 population) and the highest morbidity in 2019 (5.930 per 100,000 persons).



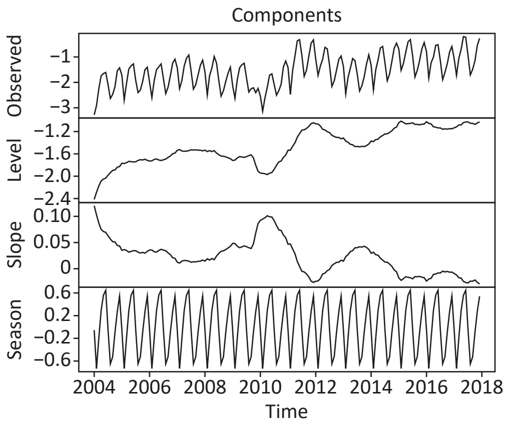
Supplementary Figure S3. Time series plot showing the monthly SF incidence rate and the decomposed seasonal, trend, and irregular components based on the STL technique. (A) Original monthly SF morbidity series. (B) Decomposed trend component. (C) Decomposed seasonal component. (D) Decomposed random component. As illustrated, overall the SF morbidity showed a rising tendency, with a sudden increase in 2011, and having notable seasonal patterns.



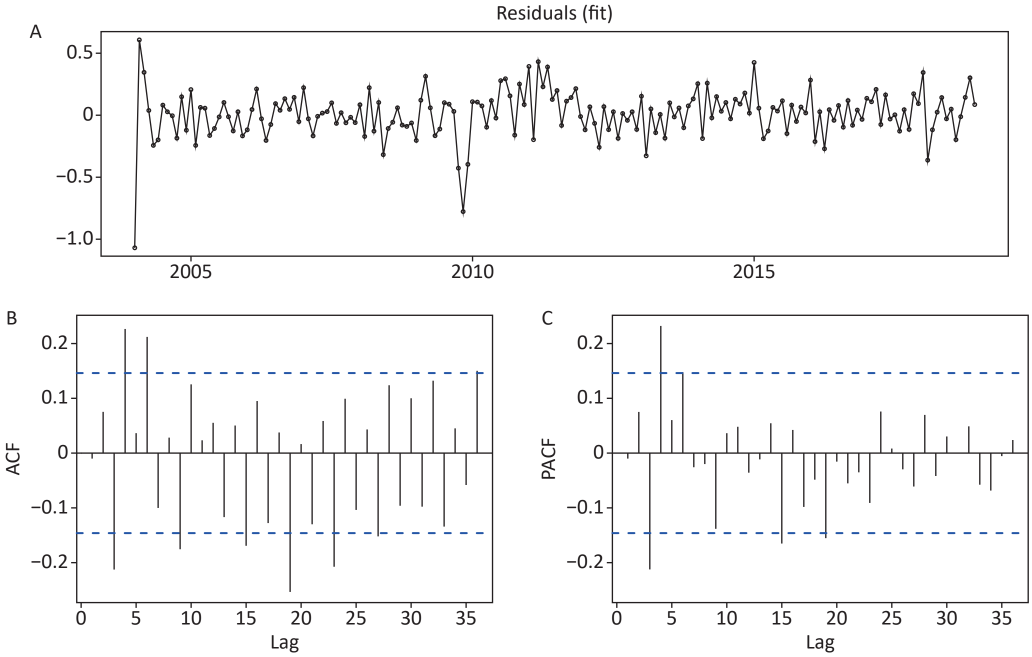
Supplementary Figure S4. The decomposed seasonal factors for the scarlet fever morbidity series using the multiplicative decomposition method (The classical Seasonal Decomposition technique can be applied to decompose a time series into a seasonal pattern, a trend component, and a random fluctuation component. This technique is implemented based on the ratio-to-moving-average method. The Seasonal Decomposition technique can be divided into two types including a multiplicative and an additive method. For a multiplicative decomposition method, the seasonal component is a factor by which the seasonally adjusted series is multiplied to produce original observed values. For a time series without seasonal variation, the seasonal pattern is deemed as one. For an additive decomposition method, the seasonal adjustments are added to the seasonally adjusted series to yield the original series. For the morbidity series of infectious diseases, the multiplicative decomposition method typically produces a more reliable decomposed result in application. By employing a multiplicative decomposition method to an object series, the seasonal pattern or seasonal factors included in the object series can be obtained. Such a decomposition is very helpful in removing the seasonal effect from a series so that we can visibly look into the other characteristics of interest in the series that may be masked by the seasonal trait[7,8]).



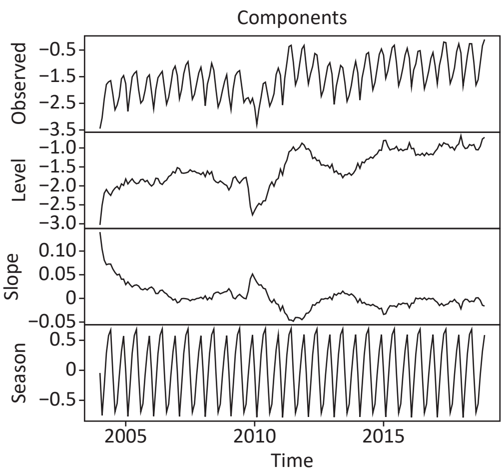
Supplementary Figure S5. Estimated autocorrelation function (ACF) and partial ACF (PACF) plots to display the statistical checking for the residual series of the SARIMA and TBATS models. (A) ACF plot for the SARIMA model. (B) PACF plot for the SARIMA model. (C) ACF plot for the TBATS model. (D) PACF plot for the TBATS model. We can see that the correlation coefficients at lags 11, 23, and 36 in Figure 2A and 2B, and at lag 19 in Figure 2C and 2D touched the confidence levels (this is reasonable as the correlation coefficients at higher-order may exceed the significance bounds by chance alone), but all other correlation coefficients at different lags failed to touch the confidence levels, seemingly suggesting effective and sufficient models.



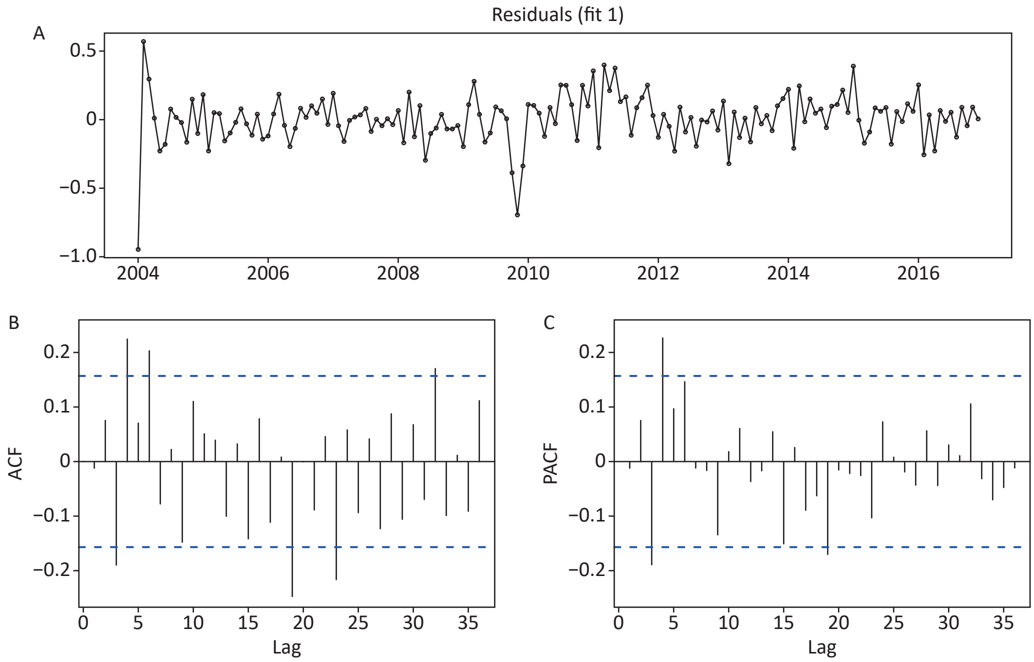
Supplementary Figure S6. The extracted level, slope, and seasonal components of the best TBATS method developed on the basis of the data from January 2004 to December 2017.



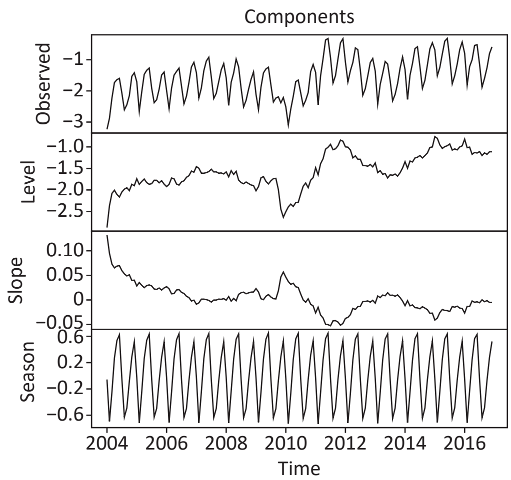
Supplementary Figure S7. Statistical checking for the residual series of the TBATS model developed on the basis of the data from January 2004 to December 2018. (A) Time series plot showing the residual series. (B) Autocorrelation function (ACF) plot. (C) Partial autocorrelation function (PACF) plot. The correlogram shows that although there are some residual ACF and PACF for the forecast errors that exceed the significance bounds, this is the best model used to estimate the upcoming 12-month epidemics of scarlet fever.



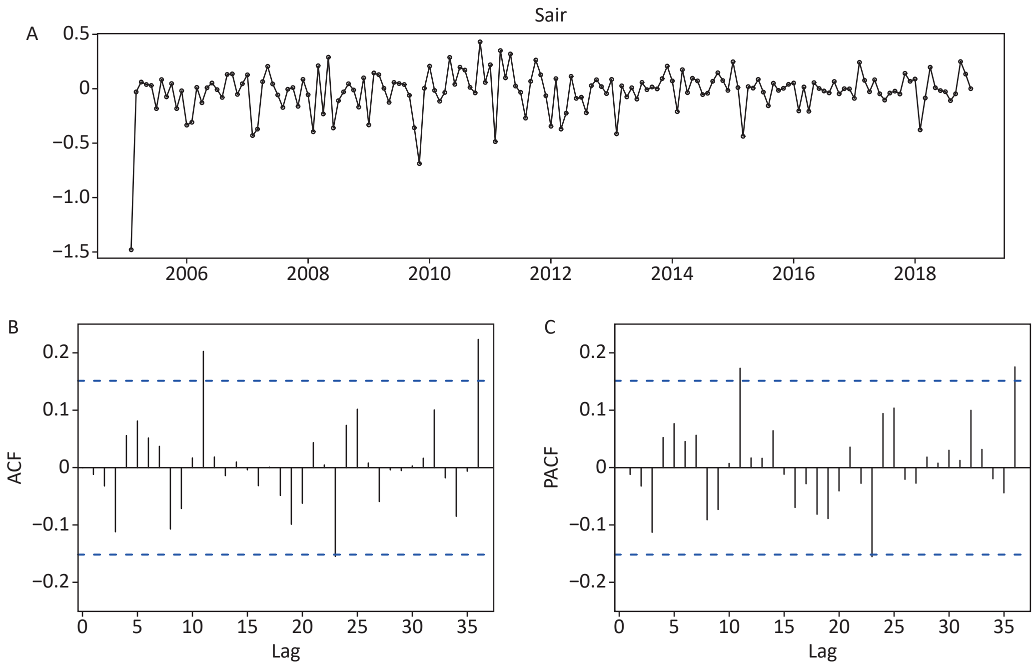
Supplementary Figure S8. The extracted level, slope, and seasonal components of the best TBATS method developed on the basis of the data from January 2004 to December 2018.



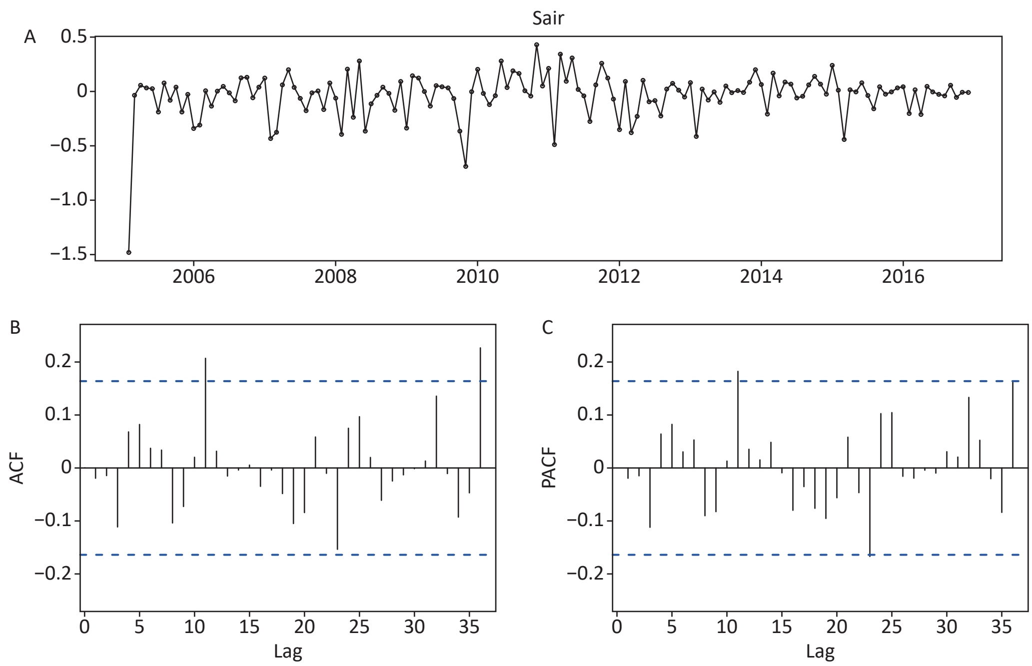
Supplementary Figure S9. Statistical checking for the residual series of the TBATS model developed on the basis of the data from January 2004 to December 2016. (A) Time series plot showing the residual series. (B) Autocorrelation function (ACF) plot. (C) Partial autocorrelation function (PACF) plot. The correlogram shows that although there are some residual ACF and PACF for the forecast errors that exceed the significance bounds, this is the best model used to estimate the upcoming 36-month epidemics of scarlet fever.



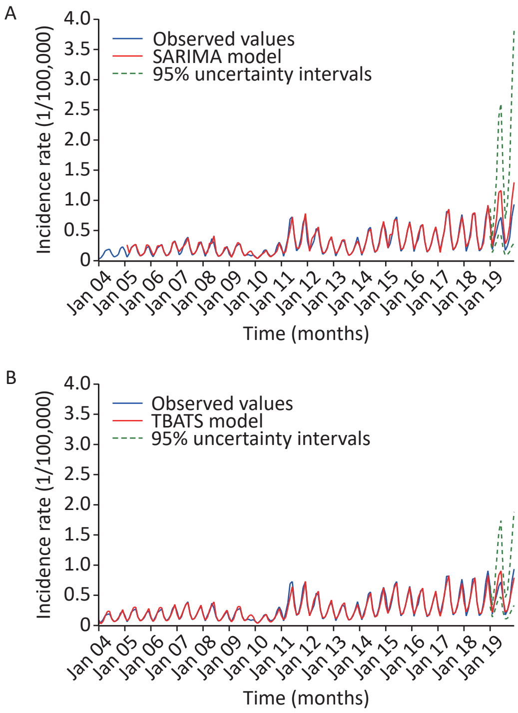
Supplementary Figure S10. The extracted level, slope, and seasonal components of the best TBATS method developed on the basis of the data from January 2004 to December 2016.



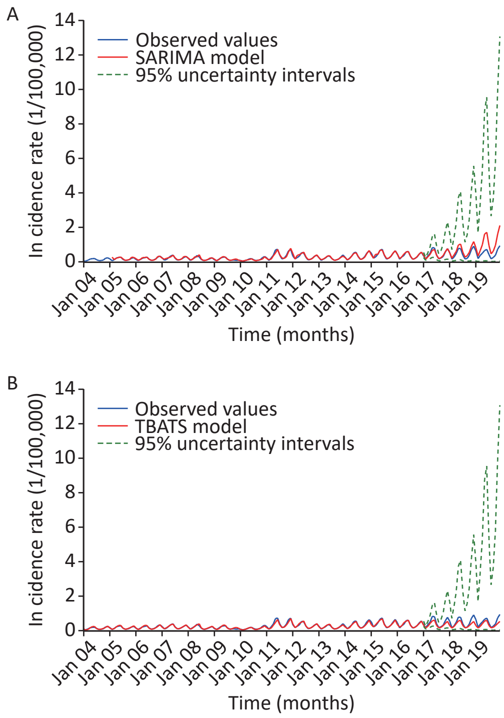
Supplementary Figure S11. Statistical checking for the residual series of the SSARIMA model developed on the basis of the data from January 2004 to December 2018. (A) Time series plot showing the residual series. (B) Autocorrelation function (ACF) plot. (C) Partial autocorrelation function (PACF) plot. The correlogram shows that the ACF and PACF for the forecast errors do not exceed the significance bounds except for lags 11, 23, and 36, indicating that there is little evidence of non-zero autocorrelations at lags 1–36.



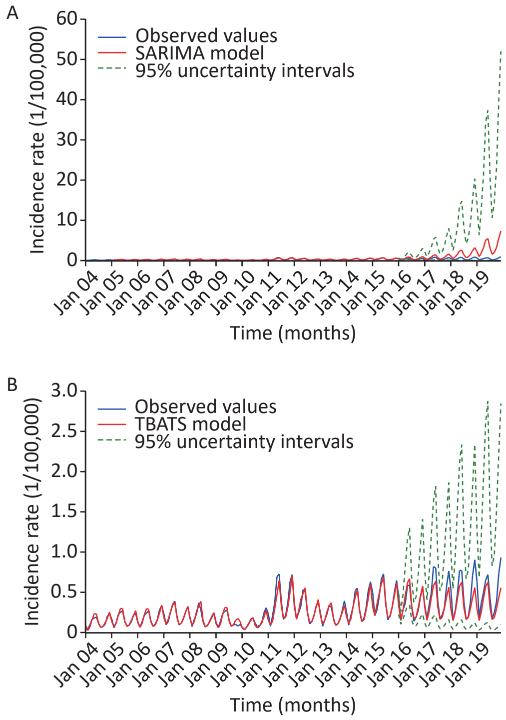
Supplementary Figure S12. Statistical checking for the residual series of the SARIMA model developed on the basis of the data from January 2004 to December 2016. (A) Time series plot showing the residual series. (B) Autocorrelation function (ACF) plot. (C) Partial autocorrelation function (PACF) plot. The correlogram shows that the ACF and PACF for the forecast errors do not exceed the significance bounds except for lags 11 and 36, indicating that there is little evidence of non-zero autocorrelations at lags 1–36.



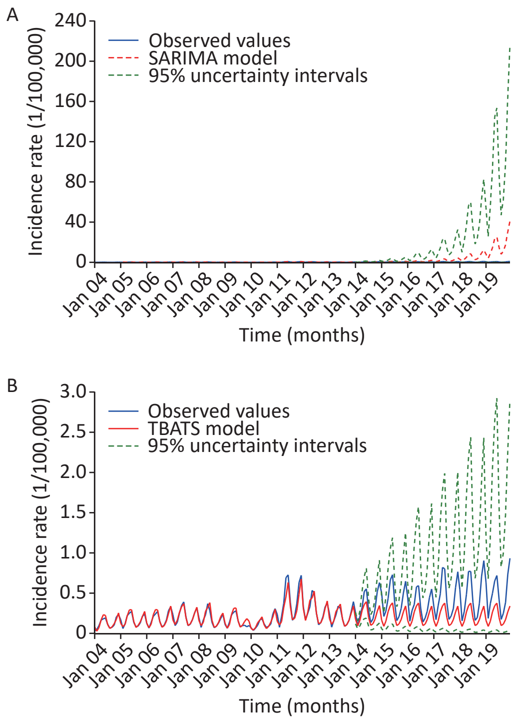
Supplementary Figure S13. Comparative results of the forecasts based on the SARIMA and TBATS models. (A) The comparison between the 12-step ahead forecasts of the SARIMA model and the observed values. (B) The comparison between the 12-step ahead forecasts of the TBATS model and the observed values.



Supplementary Figure S14. Comparative results of the forecasts based on the SARIMA and TBATS models. (A) The comparison between the 36-step ahead forecasts of the SARIMA model and the observed values. (B) The comparison between the 36-step ahead forecasts of the TBATS model and the observed values.



Supplementary Figure S15. Comparative results of the forecasts based on the SARIMA and TBATS models. (A) The comparison between the 48-step ahead forecasts of the SARIMA model and the observed values. (B) The comparison between the 48-step ahead forecasts of the TBATS model and the observed values.



Supplementary Figure S16. Comparative results of the forecasts based on the SARIMA and TBATS models. (A) The comparison between the 72-step ahead forecasts of the SARIMA model and the observed values. (B) The comparison between the 72-step ahead forecasts of the TBATS model and the observed values.

Supplementary Table S1. The best TBATS models obtained on the basis of different datasets and their key parameters

Parameters	24-step ahead forecasting	12-step ahead forecasting	36-step ahead forecasting
	TBATS (0.04, {4,0}, 0.882, {<12,5>}) model	TBATS (0.01, {0,0}, 0.898, {<12,5>}) model	TBATS (0.048, {0,0}, 0.902, {<12,5>}) model
Lambda	0.0401	0.0105	0.0480
Alpha	0.1652	0.6489	0.6795
Beta	−0.0252	−0.0362	−0.0432
Damping Parameter	0.8818	0.8982	0.9024
Gamma-1 Values	0.0002	−0.0046	−0.0048
Gamma-2 Values	−1.2682	0.0050	0.0072
AR coefficients	AR1 = 0.4772, AR2 = 0.2318, AR3 = −0.1894, AR4 = 0.3222	–	–
Seed states			
1	−2.3530	−2.4373	−2.3215
2	0.1089	0.1130	0.1015
3	−0.0246	−0.0185	−0.0251
4	−0.0748	−0.0757	−0.0731
5	−0.0069	−0.0077	−0.0065
6	0.0213	0.0266	0.0207
7	0.0296	0.0312	0.0279
8	−0.1547	0.1489	0.1353
9	−0.5953	−0.6307	−0.5756
10	−0.0602	−0.0649	−0.0598
11	0.1463	−0.1521	−0.1404
12	−0.0231	−0.0248	−0.0218
13	0.0000	–	–
14	0.0000	–	–
15	0.0000	–	–
16	0.0000	–	–
Sigma	0.1686	0.1909	0.1797
AIC	−197.9650	−175.3322	−198.4532
Parameters	48-step ahead forecasting	72-step ahead forecasting	Future 36-step ahead forecasting
	TBATS (0.037, {0,0}, 0.901,{<12,5>})	TBATS (0.029, {0,0}, 0.87,{<12,4>})	TBATS (0.023, {0,0}, 0.895, {<12,5>})
Lambda	0.0368	0.0292	0.0225
Alpha	0.6900	0.7253	0.6444
Beta	−0.0410	−0.1128	−0.0378
Damping Parameter	0.9013	0.8702	0.8955
Gamma-1 Values	−0.0069	−0.0115	−0.0050
Gamma-2 Values	0.0052	0.0035	0.0037
AR coefficients	–	–	–

Continued

Parameters	48-step ahead forecasting	72-step ahead forecasting	Future 36-step ahead forecasting
	TBATS (0.037, {0,0}, 0.901, {<12,5>})	TBATS (0.029, {0,0}, 0.87, {<12,4>})	TBATS (0.023, {0,0}, 0.895, {<12,5>})
Seed states			
1	−2.3577	−2.3794	−2.3993
2	0.1062	0.1064	0.1117
3	−0.0314	−0.0546	−0.0067
4	−0.0815	−0.1004	−0.0690
5	−0.0103	−0.0196	−0.0068
6	0.0220	0.0160	0.0300
7	0.0268	0.1411	0.0336
8	0.1425	−0.5940	0.1460
9	−0.5902	−0.0762	−0.6235
10	−0.0647	−0.1476	−0.0634
11	−0.1437	–	−0.1522
12	−0.0212	–	−0.0232
Sigma	0.1868	0.1947	0.1871
AIC	−197.7402	−203.9513	−160.8382

Note. TBATS, an advanced innovation state-space modelling framework by combining Box-Cox transformations, Fourier series with time-varying coefficients and autoregressive moving average (ARMA) error correction, AR autoregressive method, AIC Akaike's Information Criterion.

Supplementary Table S2. Box-Ljung Q and LM tests for the residual series of the SARIMA and TBATS models

Lags	SARIMA model				TBATS model			
	Box-Ljung Q	*P*	LM-test	*P*	Box-Ljung Q	*P*	LM-test	*P*
1	0.044	0.833	0.001	0.979	0.005	0.943	52.651	< 0.001
3	1.944	0.584	2.364	0.500	0.235	0.972	22.234	< 0.001
6	3.720	0.715	4.223	0.647	1.246	0.975	23.555	0.001
9	6.093	0.731	5.981	0.742	4.538	0.873	23.624	0.005
12	13.021	0.368	9.427	0.666	7.320	0.836	23.416	0.024
15	13.094	0.595	12.379	0.650	10.456	0.790	23.533	0.073
18	13.663	0.751	19.872	0.340	11.442	0.875	24.550	0.138
21	17.313	0.692	20.262	0.505	19.031	0.583	23.808	0.302
24	23.237	0.506	29.352	0.207	23.061	0.516	24.015	0.461
27	26.060	0.515	25.492	0.547	23.466	0.660	23.924	0.635
30	26.082	0.671	26.422	0.653	25.230	0.714	24.918	0.729
33	29.133	0.660	29.863	0.624	29.004	0.667	24.941	0.842
36	41.417	0.246	37.230	0.412	30.707	0.718	24.391	0.929

Note. SARIMA seasonal autoregressive integrated moving average method, TBATS an advanced innovation state-space modelling framework by combining Box-Cox transformations, Fourier series with time-varying coefficients, and autoregressive moving average (ARMA) error correction.

Supplementary Table S3. The Box-Ljung Q and LM tests for the best SARIMA $(0,1,0)(0,1,1)_{12}$ model and TBATS (0.01, {0,0}, 0.898, {<12,5>}) model built based on the date from January 2004 to December 2018

Lags	SARIMA $(0,1,0)(0,1,1)_{12}$ model				TBATS(0.01, {0,0}, 0.898, {<12,5>}) model			
	Box-Ljung Q	*P*	LM-test	*P*	Box-Ljung Q	*P*	LM-test	*P*
1	0.024	0.878	0.000	0.993	0.018	0.892	44.923	< 0.001
3	2.353	0.503	2.196	0.533	9.428	0.024	17.323	< 0.001
6	4.529	0.605	4.287	0.638	27.713	< 0.001	18.742	0.005
9	7.720	0.563	6.063	0.734	35.665	< 0.001	22.380	0.008
12	15.292	0.226	9.747	0.638	39.404	< 0.001	22.715	0.030
15	15.349	0.427	13.651	0.552	48.268	< 0.001	22.695	0.091
18	15.980	0.594	21.290	0.265	53.640	< 0.001	25.463	0.113
21	18.952	0.588	21.569	0.425	70.249	< 0.001	24.902	0.251
24	24.734	0.420	30.292	0.175	82.013	< 0.001	24.863	0.413
27	27.525	0.436	26.218	0.507	89.634	< 0.001	26.398	0.497
30	27.536	0.595	27.588	0.592	97.136	< 0.001	27.268	0.609
33	29.788	0.628	31.192	0.557	107.120	< 0.001	29.080	0.663
36	42.128	0.223	37.860	0.384	113.480	< 0.001	29.872	0.754

Note. SARIMA seasonal autoregressive integrated moving average method, TBATS an advanced innovation state-space modelling framework by combining Box-Cox transformations, Fourier series with time-varying coefficients and autoregressive moving average (ARMA) error correction.

Supplementary Table S4. The Box-Ljung Q and LM tests for the best SARIMA $(0,1,0)(0,1,1)_{12}$ model and TBATS (0.048, {0,0}, 0.902, {<12,5>}) model built based on the date from January 2004 to December 2016

Lags	SARIMA $(0,1,0)(0,1,1)_{12}$ model				TBATS (0.048, {0,0}, 0.902, {<12,5>}) model			
	Box-Ljung Q	*P*	LM-test	*P*	Box-Ljung Q	*P*	LM-test	*P*
1	0.055	0.815	0.001	0.975	0.023	0.879	41.160	< 0.001
3	1.921	0.589	2.011	0.570	6.733	0.081	14.042	0.003
6	3.835	0.699	3.951	0.683	22.488	0.001	15.202	0.019
9	6.482	0.691	5.727	0.767	27.233	0.001	18.045	0.035
12	13.434	0.338	8.305	0.761	29.988	0.003	18.208	0.110
15	13.478	0.565	11.083	0.747	35.413	0.002	18.302	0.247
18	14.064	0.725	17.475	0.491	38.712	0.003	21.100	0.274
21	17.679	0.669	17.610	0.674	51.174	0.002	20.863	0.467
24	22.746	0.535	25.236	0.393	60.873	< 0.001	20.972	0.640
27	25.130	0.567	21.988	0.738	65.748	< 0.001	22.446	0.714
30	25.270	0.712	22.799	0.823	70.290	< 0.001	23.178	0.808
33	28.759	0.678	25.691	0.814	78.981	< 0.001	24.382	0.861
36	40.773	0.269	32.064	0.656	83.260	< 0.001	24.538	0.926

Note. SARIMA seasonal autoregressive integrated moving average method, TBATS, an advanced innovation state-space modelling framework by combining Box-Cox transformations, Fourier series with time-varying coefficients and autoregressive moving average (ARMA) error correction.

Supplementary Table S5. The obtained best SARIMA models with their key parameters on the basis of different datasets

Variables	Estimate	S.E.	t	*P*	Stationary R^2	R^2	AIC	BIC	Ljung-Box Q $_{(18)}$	
									Statistics	*P*
SARIMA $(0,1,0)(0,1,1)_{12}$method developed on the basis of the data from January 2004 to December 2018										
SMA1	0.782	0.072	10.873	< 0.001	0.300	0.944	−6.159	−6.146	15.980	0.525
SARIMA $(0,1,0)(0,1,1)_{12}$ method developed on the basis of the data from January 2004 to December 2017										
SMA1	0.795	0.075	10.600	< 0.001	0.292	0.935	−6.166	−6.152	13.663	0.691
SARIMA $(0,1,0)(0,1,1)_{12}$ method developed on the basis of the data from January 2004 to December 2016										
SMA1	0.771	0.084	9.230	< 0.001	0.288	0.922	−6.162	−6.127	14.064	0.663

Note. SARIMA seasonal autoregressive integrated moving average method, S.E. standard error, AIC Akaike's Information Criterion, BIC Schwarz's Bayesian Information Criterion, SMA1 seasonal moving average method at lag 1.

Supplementary Table S6. The obtained best SARIMA methods with their key parameters on the basis of different datasets

Variables	Estimate	S.E.	t	*P*	Stationary R^2	R^2	AIC	BIC	Ljung-Box Q (18)	
									Statistics	*P*
SARIMA $(0,1,0)(0,1,1)_{12}$ method developed on the basis of the data from January 2004 to December 2015										
SMA1	0.790	0.094	8.394	< 0.001	0.277	0.915	−6.086	−6.072	12.564	0.765
SARIMA $(0,1,0)(0,1,1)_{12}$ method developed on the basis of the data from January 2004 to December 2013										
SMA1	0.813	0.135	6.025	< 0.001	0.276	0.883	−6.055	−6.032	12.510	0.768

Note. SARIMA seasonal autoregressive integrated moving average method, S.E. standard error, AIC Akaike's Information Criterion, BIC Schwarz's Bayesian Information Criterion, SMA1 seasonal moving average method at lag 1.

Supplementary Table S7. The comparisons of the predicted results between the SARIMA model and the TBATS model on different testing datasets

Models	Testing horizons				
	MAD	MAPE	RMSE	MER	RMSPE
48-step ahead predictions					
SARIMA	1.186	252.348	1.850	2.670	3.440
TBATS	0.098	18.307	0.139	0.220	0.222
Reduced percentage (%)					
SARIMA *vs.* TBATS	91.737	92.745	92.486	91.760	93.547
72-step ahead predictions					
SARIMA	0.800	171.381	1.511	1.901	2.810
TBATS	0.207	46.042	0.248	0.491	0.477
Reduced percentage (%)					
SARIMA *vs.* TBATS	74.125	73.135	83.587	74.171	83.025

Note. SARIMA seasonal autoregressive integrated moving average method, TBATS an advanced innovation state-space modelling framework by combining Box-Cox transformations, Fourier series with time-varying coefficients and autoregressive moving average (ARMA) error correction, MAD mean absolute deviation, MAPE mean absolute percentage error, RMSE root mean square error, MER mean error rate, RMSPE root mean square percentage error.

Supplementary Table S8. The comparisons of the predicted results between the SARIMA model and the TBATS model on different testing datasets

Sites	Models	Testing horizons			
		MAD	MAPE	RMSE	MER
Liaoning province	12-step-ahead forecast				
	SARIMA $(0,1,0)(0,1,1)_{12}$	0.681	8.983	0.858	0.697
	TBATS (0.073, {4,0}, 0.888, {<12,4>})	0.358	5.830	0.432	0.367
	Percentage reductions (%)				
	TBATS *vs*. SARIMA	47.430	35.100	49.650	47.346
	24-step-ahead forecast				
	SARIMA $(0,1,0)(0,1,1)_{12}$	0.330	42.453	0.509	0.326
	TBATS(0.121, {0,0}, 0.868, {<12,4>})	0.262	25.144	0.372	0.259
	Percentage reductions (%)				
	TBATS *vs*. SARIMA	20.606	40.772	26.916	20.552
	36-step-ahead forecast				
	SARIMA $(0,1,0)(0,1,1)_{12}$	2.303	275.181	3.207	2.393
	TBATS (0.052, {0,0}, 0.875, {<12,5>})	0.224	26.448	0.305	0.233
	Percentage reductions (%)				
	TBATS *vs*. SARIMA	90.274	90.389	90.490	90.263

Continued

Sites	Models	Testing horizons			
		MAD	MAPE	RMSE	MER
Heilongjiang province	12-step-ahead forecast				
	SARIMA $(0,1,0)(0,1,1)_{12}$	0.227	51.808	0.262	0.383
	TBATS (0.151, {0,0}, 0.889, {<12,5>})	0.130	32.657	0.167	0.219
	Percentage reductions (%)				
	TBATS *vs*. SARIMA	42.731	36.965	36.260	42.820
	24-step-ahead forecast				
	SARIMA $(0,1,0)(0,1,1)_{12}$	0.402	74.176	0.562	0.655
	TBATS (0.17, {0,0}, 0.889, {<12,5>})	0.119	25.819	0.162	0.194
	Percentage reductions (%)				
	TBATS *vs*. SARIMA	70.398	65.192	71.174	70.382
	36-step-ahead forecast				
	SARIMA $(0,1,0)(0,1,1)_{12}$	1.448	253.072	2.114	2.357
	TBATS(0.161, {0,0}, 0.894, {<12,4>})	0.155	20.235	0.252	0.446
	Percentage reductions (%)				
	TBATS vs. SARIMA	89.296	92.004	88.079	81.078
Shandong province	12-step-ahead forecast				
	SARIMA $(0,1,1)(0,1,1)_{12}$	0.236	39.823	0.282	0.319
	TBATS(0, {0,0}, 0.932, {<12,5>})	0.175	19.390	0.280	0.237
	Percentage reductions (%)				
	TBATS *vs*. SARIMA	25.847	51.310	0.709	25.705
	24-step-ahead forecast				
	SARIMA $(0,1,1)(0,1,1)_{12}$	0.509	76.930	0.670	0.717
	TBATS (0, {0,0}, 0.932, {<12,5>})	0.168	19.222	0.268	0.237
	Percentage reductions (%)				
	TBATS *vs*. SARIMA	66.994	75.014	60.000	66.946
	36-step-ahead forecast				
	SARIMA $(0,1,1)(0,1,1)_{12}$	1.683	246.865	2.376	2.491
	TBATS (0, {0,0}, 0.926, {<12,5>})	0.312	43.277	0.401	0.461
	Percentage reductions (%)				
	TBATS vs. SARIMA	81.462	82.469	83.123	81.493
Inner Mongolia	12-step-ahead forecast				
	SARIMA $(1,0,2)(0,1,1)_{12}$	0.401	51.026	0.496	0.397
	TBATS (0.232, {0,0}, -, {<12,4>})	0.130	32.657	0.167	0.219
	Percentage reductions (%)				
	TBATS *vs*. SARIMA	67.581	35.999	66.331	44.836
	24-step-ahead forecast				
	SARIMA $(1,0,2)(0,1,1)_{12}$	0.319	38.984	0.418	0.308
	TBATS (0.232, {0,0}, -, {<12,4>})	0.166	16.508	0.236	0.161
	Percentage reductions (%)				
	TBATS *vs*. SARIMA	47.962	57.654	43.541	47.727
	36-step-ahead forecast				
	SARIMA $(1,0,2)(0,1,1)_{12}$	0.484	56.502	0.573	0.494
	TBATS (0.21, {0,0}, -, {<12,4>})	0.158	17.002	0.224	0.161
	Percentage reductions (%)				
	TBATS *vs*. SARIMA	67.355	69.909	60.908	67.409

Note. SARIMA seasonal autoregressive integrated moving average method, TBATS an advanced innovation state-space modelling framework by combining Box-Cox transformations, Fourier series with time-varying coefficients and autoregressive moving average (ARMA) error correction, MAD mean absolute deviation, MAPE mean absolute percentage error, RMSE root mean square error, MER mean error rate.

Supplementary Table S9. Comparisons of the out-of-sample forecasting powers between TBATS models and SARIMA models, along with ETS models

Models	Testing power				
	MAD	MAPE	RMSE	MER	RMSPE
12-data ahead forecasting					
SARIMA	144.734	25.049	161.671	0.203	0.296
TBATS	91.799	14.772	123.653	0.129	0.193
ETS	148.635	25.835	177.092	0.209	0.325
Decreased percentage (%)					
TBATS *vs.* SARIMA	36.574	41.028	23.516	36.453	34.797
TBATS *vs.* ETS	38.239	42.822	30.176	38.278	40.615
24-data ahead forecasting					
SARIMA	357.734	53.753	406.278	0.460	0.625
TBATS	260.619	38.407	301.441	0.335	0.469
ETS	279.014	44.604	307.731	0.359	0.536
Decreased percentage (%)					
TBATS *vs.* SARIMA	27.147	28.549	25.804	27.174	24.960
TBATS *vs.* ETS	6.593	13.893	2.044	6.685	12.500
36-data ahead forecasting					
SARIMA	290.782	42.156	365.570	0.334	0.560
TBATS	204.151	28.685	254.418	0.235	0.387
ETS	297.359	44.118	347.689	0.342	0.564
Decreased percentage (%)					
TBATS *vs.* SARIMA	29.792	31.955	30.405	29.641	30.893
TBATS *vs.* ETS	31.345	34.981	26.826	31.287	31.383
60-data ahead forecasting					
SARIMA	224.931	28.874	310.043	0.258	0.424
TBATS	183.780	21.558	235.665	0.211	0.250
ETS	146.437	16.449	212.028	0.168	0.223
Decreased percentage (%)					
TBATS *vs.* SARIMA	18.295	25.338	23.990	18.217	41.038
TBATS *vs.* ETS	-20.319	-23.699	-10.030	-20.379	-10.800
84-data ahead forecasting					
SARIMA	931.622	134.915	1016.813	1.040	1.679
TBATS	167.432	20.081	204.172	0.187	0.240
ETS	183.777	21.010	227.113	0.205	0.250
Decreased percentage (%)					
TBATS *vs.* SARIMA	82.028	85.116	79.920	82.019	85.706
TBATS *vs.* ETS	8.894	4.422	10.101	8.780	4.000
108-data ahead forecasting					
SARIMA	1483.868	202.729	1588.876	1.560	2.500
TBATS	208.775	22.849	287.536	0.220	0.310
ETS	268.726	30.177	354.045	0.283	0.386
Decreased percentage (%)					
TBATS *vs.* SARIMA	85.930	88.729	81.903	85.897	87.600
TBATS *vs.* ETS	22.309	24.283	18.785	22.261	19.689

Note. SARIMA seasonal autoregressive integrated moving average method, TBATS an advanced innovation state-space modeling framework by combining Box-Cox transformations, Fourier series with time-varying coefficients and autoregressive moving average error correction, ETS Error-Trend-Seasonal framework, MAD mean absolute deviation, MAPE mean absolute percentage error, RMSE root mean square error, MER mean error rate, RMSPE root mean square percentage error.

Supplementary Table S10. Projection into the future 36 months from January 2020 to December 2022 using the best TBATS (0.023, {0,0}, 0.895, {<12,5>}) model

Time	Forecasts	Lower 95% *CI*	Upper 95% *CI*	Time	Forecasts	Lower 95% *CI*	Upper 95% *CI*
Jan-20	0.479	0.330	0.695	Jul-21	0.426	0.147	1.204
Feb-20	0.224	0.143	0.349	Aug-21	0.220	0.073	0.647
Mar-20	0.380	0.229	0.627	Sep-21	0.250	0.081	0.751
Apr-20	0.627	0.360	1.085	Oct-21	0.412	0.132	1.249
May-20	0.843	0.463	1.521	Nov-21	0.616	0.195	1.890
Jun-20	0.930	0.489	1.750	Dec-21	0.816	0.254	2.543
Jul-20	0.443	0.221	0.879	Jan-22	0.434	0.130	1.400
Aug-20	0.228	0.108	0.474	Feb-22	0.204	0.059	0.686
Sep-20	0.259	0.119	0.557	Mar-22	0.351	0.100	1.186
Oct-20	0.424	0.190	0.935	Apr-22	0.584	0.166	1.988
Nov-20	0.632	0.275	1.429	May-22	0.791	0.222	2.722
Dec-20	0.835	0.354	1.938	Jun-22	0.878	0.242	3.073
Jan-21	0.443	0.180	1.069	Jul-22	0.421	0.111	1.533
Feb-21	0.208	0.081	0.524	Aug-22	0.218	0.055	0.823
Mar-21	0.357	0.137	0.914	Sep-22	0.248	0.062	0.953
Apr-21	0.593	0.223	1.543	Oct-22	0.409	0.102	1.574
May-21	0.801	0.296	2.126	Nov-22	0.612	0.151	2.369
Jun-21	0.889	0.320	2.412	Dec-22	0.811	0.199	3.172

Note. TBATS an advanced innovation state-space modelling framework by combining Box-Cox transformations, Fourier series with time-varying coefficients and autoregressive moving average (ARMA) error correction, CI, confidence interval.

Supplementary Table 11. The SF incidence time series data from January 2004 to December 2019

Date	Incidence	Date	Incidence	Date	Incidence	Date	Incidence	Date	Incidence	Date	Incidence
01-2004	0.0298	09-2006	0.101	05-2009	0.2623	01-2012	0.3294	09-2014	0.1772	05-2017	0.8192
02-2004	0.0452	10-2006	0.1647	06-2009	0.2782	02-2012	0.1675	10-2014	0.3011	06-2017	0.8006
03-2004	0.0945	11-2006	0.2809	07-2009	0.1508	03-2012	0.2466	11-2014	0.5149	07-2017	0.3811
04-2004	0.1639	12-2006	0.3291	08-2009	0.0821	04-2012	0.3281	12-2014	0.6298	08-2017	0.1711
05-2004	0.1809	01-2007	0.231	09-2009	0.0946	05-2012	0.5325	01-2015	0.499	09-2017	0.2162
06-2004	0.1896	02-2007	0.095	10-2009	0.0988	06-2012	0.5018	02-2015	0.2079	10-2017	0.3078
07-2004	0.113	03-2007	0.1356	11-2009	0.0798	07-2012	0.2523	03-2015	0.2756	11-2017	0.5717
08-2004	0.0619	04-2007	0.2474	12-2009	0.0961	08-2012	0.1047	04-2015	0.4342	12-2017	0.7641
09-2004	0.0742	05-2007	0.3435	01-2010	0.069	09-2012	0.1323	05-2015	0.6642	01-2018	0.5421
10-2004	0.103	06-2007	0.39	02-2010	0.0353	10-2012	0.2071	06-2015	0.7269	02-2018	0.1547
11-2004	0.2033	07-2007	0.1992	03-2010	0.0636	11-2012	0.3264	07-2015	0.3765	03-2018	0.2705
12-2004	0.2299	08-2007	0.0932	04-2010	0.1008	12-2012	0.3741	08-2015	0.1568	04-2018	0.4862
01-2005	0.1686	09-2007	0.1122	05-2010	0.1692	01-2013	0.2437	09-2015	0.2076	05-2018	0.7702
02-2005	0.0582	10-2007	0.1695	06-2010	0.1788	02-2013	0.0762	10-2015	0.3096	06-2018	0.768
03-2005	0.1182	11-2007	0.2543	07-2010	0.1138	03-2013	0.1536	11-2015	0.5007	07-2018	0.3859
04-2005	0.2182	12-2007	0.3153	08-2010	0.0714	04-2013	0.2258	12-2015	0.6459	08-2018	0.1602
05-2005	0.2504	01-2008	0.193	09-2010	0.0872	05-2013	0.3381	01-2016	0.4449	09-2018	0.1967
06-2005	0.2707	02-2008	0.0724	10-2010	0.1149	06-2013	0.3106	02-2016	0.15	10-2018	0.3738
07-2005	0.1344	03-2008	0.1655	11-2010	0.2399	07-2013	0.1756	03-2016	0.2843	11-2018	0.7114
08-2005	0.0801	04-2008	0.2286	12-2010	0.3053	08-2013	0.0858	04-2016	0.3584	12-2018	0.9025
09-2005	0.0891	05-2008	0.367	01-2011	0.2333	09-2013	0.1077	05-2016	0.5771	01-2019	0.6313
10-2005	0.1296	06-2008	0.2816	02-2011	0.0742	10-2013	0.158	06-2016	0.5923	02-2019	0.1851
11-2005	0.2129	07-2008	0.1343	03-2011	0.2074	11-2013	0.2689	07-2016	0.3078	03-2019	0.3657
12-2005	0.2361	08-2008	0.0688	04-2011	0.3728	12-2013	0.3929	08-2016	0.1396	04-2019	0.4974
01-2006	0.1239	09-2008	0.087	05-2011	0.6908	01-2014	0.2568	09-2016	0.1898	05-2019	0.649
02-2006	0.0645	10-2008	0.129	06-2011	0.7253	02-2014	0.0899	10-2016	0.2734	06-2019	0.718
03-2006	0.1345	11-2008	0.1831	07-2011	0.3839	03-2014	0.2113	11-2016	0.4409	07-2019	0.4188
04-2006	0.2117	12-2008	0.2363	08-2011	0.1614	04-2014	0.3171	12-2016	0.5504	08-2019	0.1711
05-2006	0.2406	01-2009	0.1079	09-2011	0.2088	05-2014	0.52	01-2017	0.3333	09-2019	0.2481
06-2006	0.2701	02-2009	0.0625	10-2011	0.369	06-2014	0.5525	02-2017	0.168	10-2019	0.3839
07-2006	0.1454	03-2009	0.1393	11-2011	0.63	07-2014	0.2832	03-2017	0.3394	11-2019	0.7296
08-2006	0.0768	04-2009	0.2292	12-2011	0.7196	08-2014	0.1336	04-2017	0.4895	12-2019	0.9323