Cambridge Judge Business School
Cambridge Centre for Health Leadership & Enterprise

COVID-19 TRACKER: INDIA

23 May 2021

Centre for Health Leadership & Enterprise
UNIVERSITY OF CAMBRIDGE Judge Business School
HSTP Health Systems Transformation Platform
National Institute of Economic and Social Research

This tracker[1] has been developed by researchers at Cambridge Judge Business School and National Institute of Economic and Social Research, working with Health Systems Transformation Platform in India, as part of a pandemic monitoring series devoted to India and its states and union territories. It provides short term forecasts of the trajectory of the pandemic, identifying states and union territories that are at high risk of increases in infection incidence.

The forecasts are based on a structural time series model that uses historical data in estimation but adapts to the trend emerging in the most recent period. The model is described in Harvey and Kattuman (2021) "Time series models based on growth curves with applications to forecasting coronavirus". *Harvard Data Science Review*, Special issue 1 - COVID -19.

Newly reported COVID-19 cases in India are likely to decline to about 110,000 per day by 6 June 2021.

Almost all Indian states and union territories are on clear downward paths, but daily cases are forecast to increase in the North Eastern states of Manipur, Meghalaya, Mizoram, and Tripura. The filtered daily growth rates at the end of the observation period on 23 May imply new cases doubling times of 13 days for Meghalaya, 19 days for Tripura, 21 days for Mizoram and 41 days for Manipur. Odisha is likely to hold steady in the number of cases over the next two weeks. Tamil Nadu is likely to edge into a declining trend by early June.

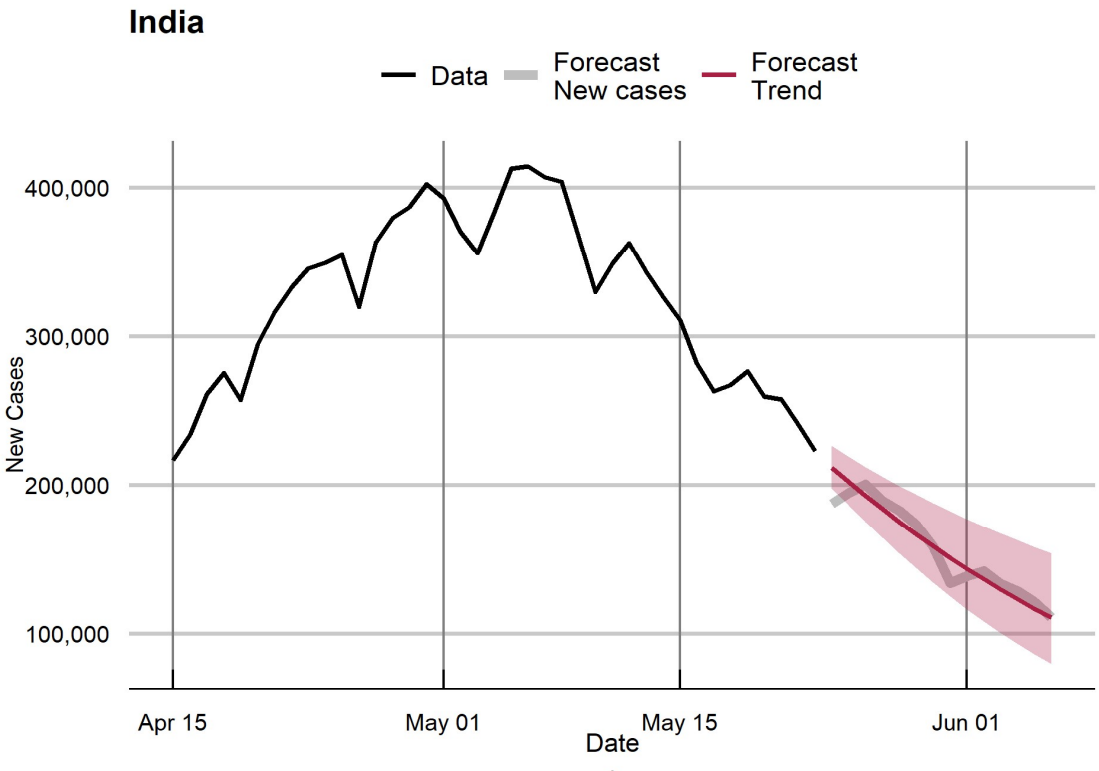
Daily deaths attributed to COVID-19 in India are in gradual decline. The trend value of reported daily deaths is likely to be about 3,500 per day by 6 June 2021.

Mean absolute percentage error of the forecasts of daily cases in India given in the 16 May tracker, for the week beginning 17 May 2021, is 6.5%. The accuracy of forecasts rely on the quality of the reported data. Changes in government pandemic policies and in transmission relevant social behaviour may cause realised numbers to depart from forecasts. Data have been volatile for Chandigarh, Delhi and Gujarat as well as for some smaller states and union territories, making their forecasts less accurate.

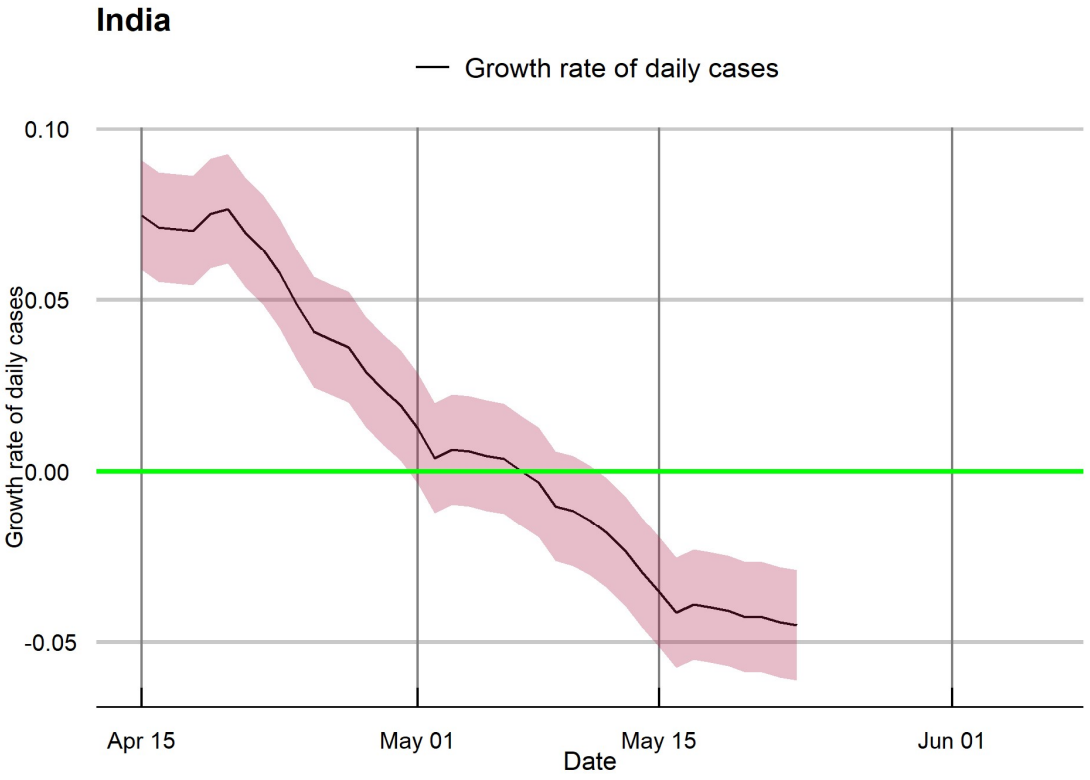
[1] CJBS COVID-19 Tracker for India can be accessed at: www.jbs.cam.ac.uk/covid-india
The companion spreadsheet contains all the estimates and forecasts.

Contact: Paul Kattuman <p.kattuman@jbs.cam.ac.uk>

Daily Covid-19 cases in India: Forecast

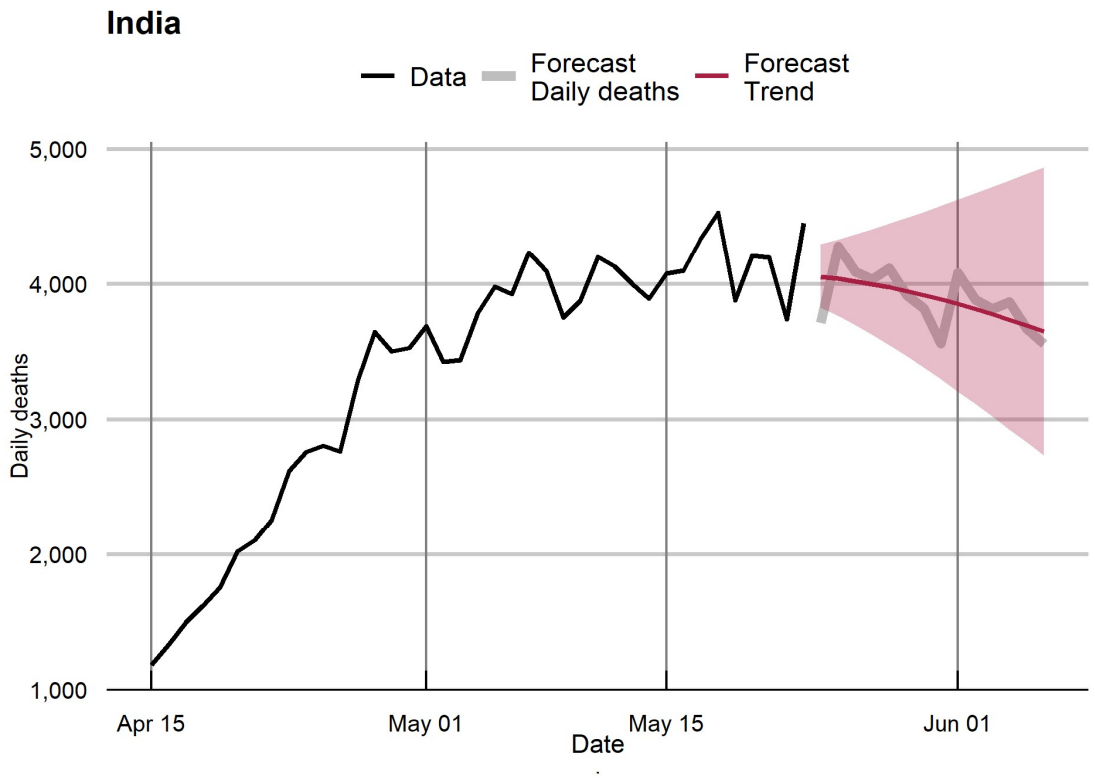


Forecasts of daily new cases for the period 24 May 24 to 6 June, 2021, based on data till 23 May 2021.

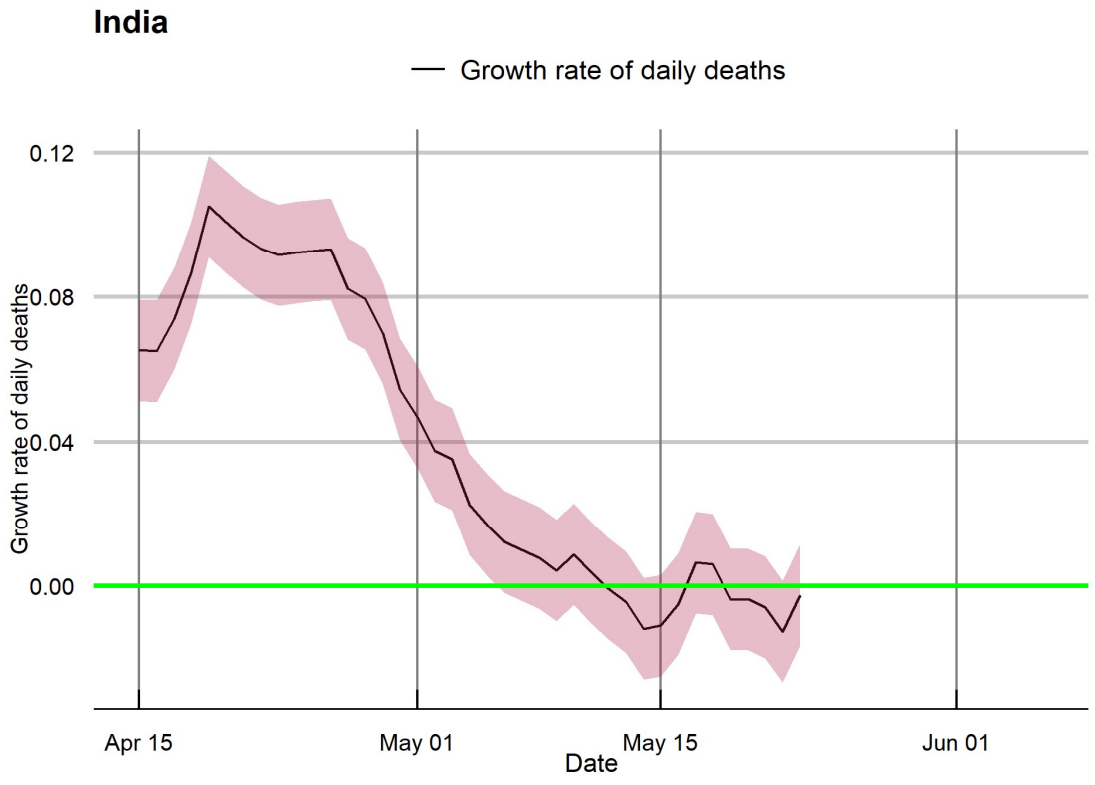


The filtered trend in the growth rate of daily new cases. Final date: 23 May 2021.

Daily Covid-19 deaths in India: Forecast

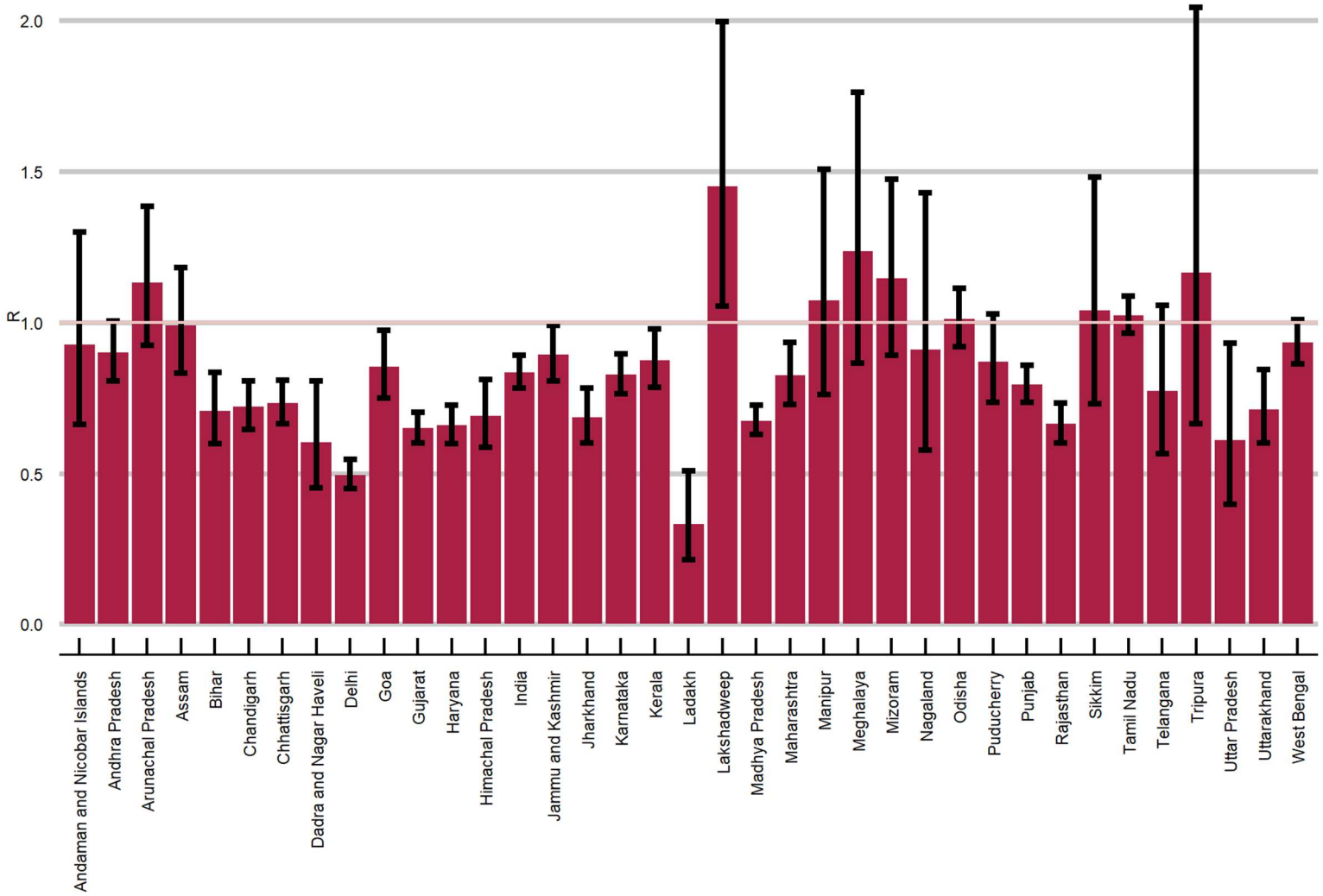


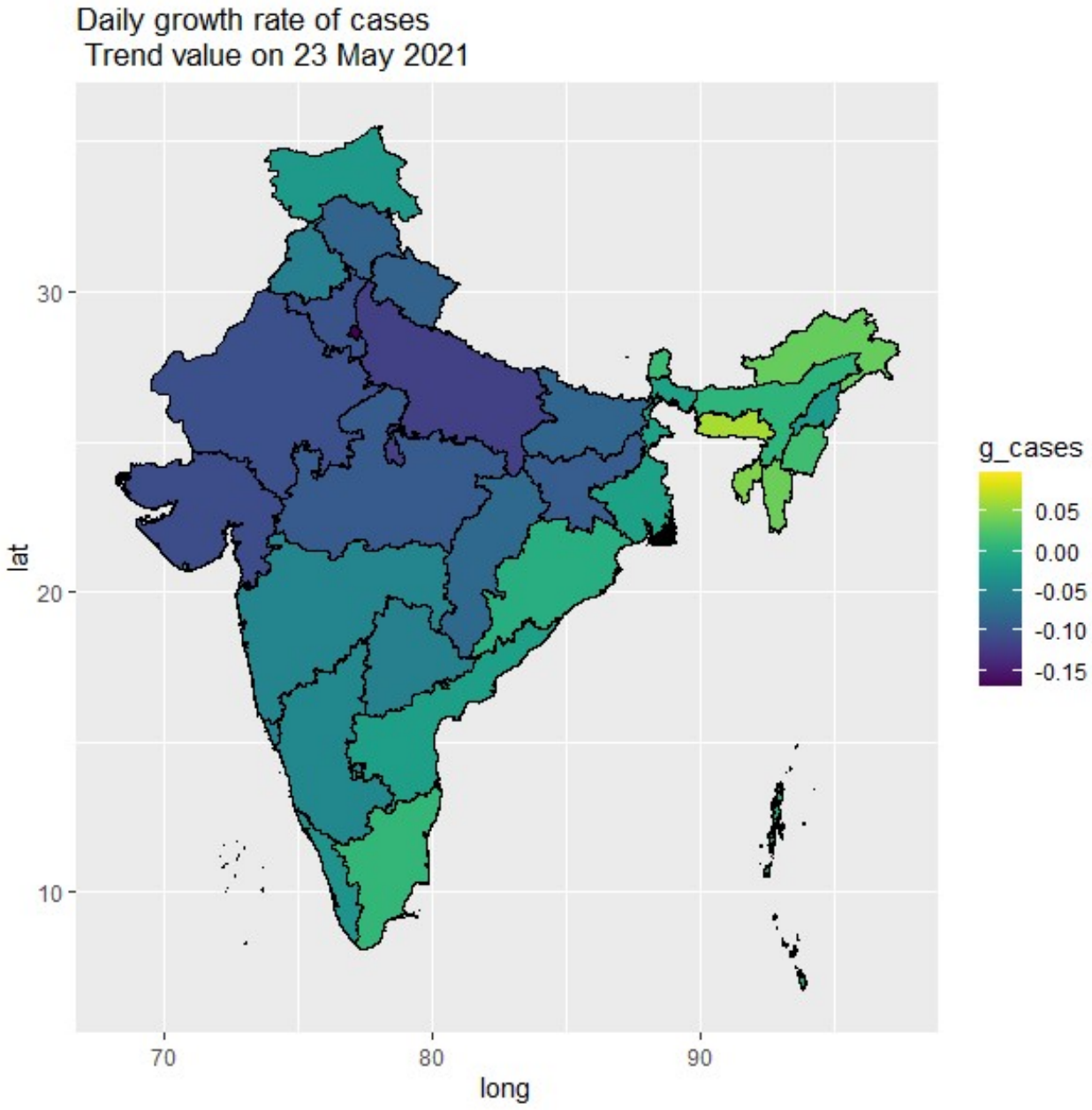
Forecasts of daily deaths over the period 24 May 24 to 6 June, 2021, based on data till 23 May 2021.

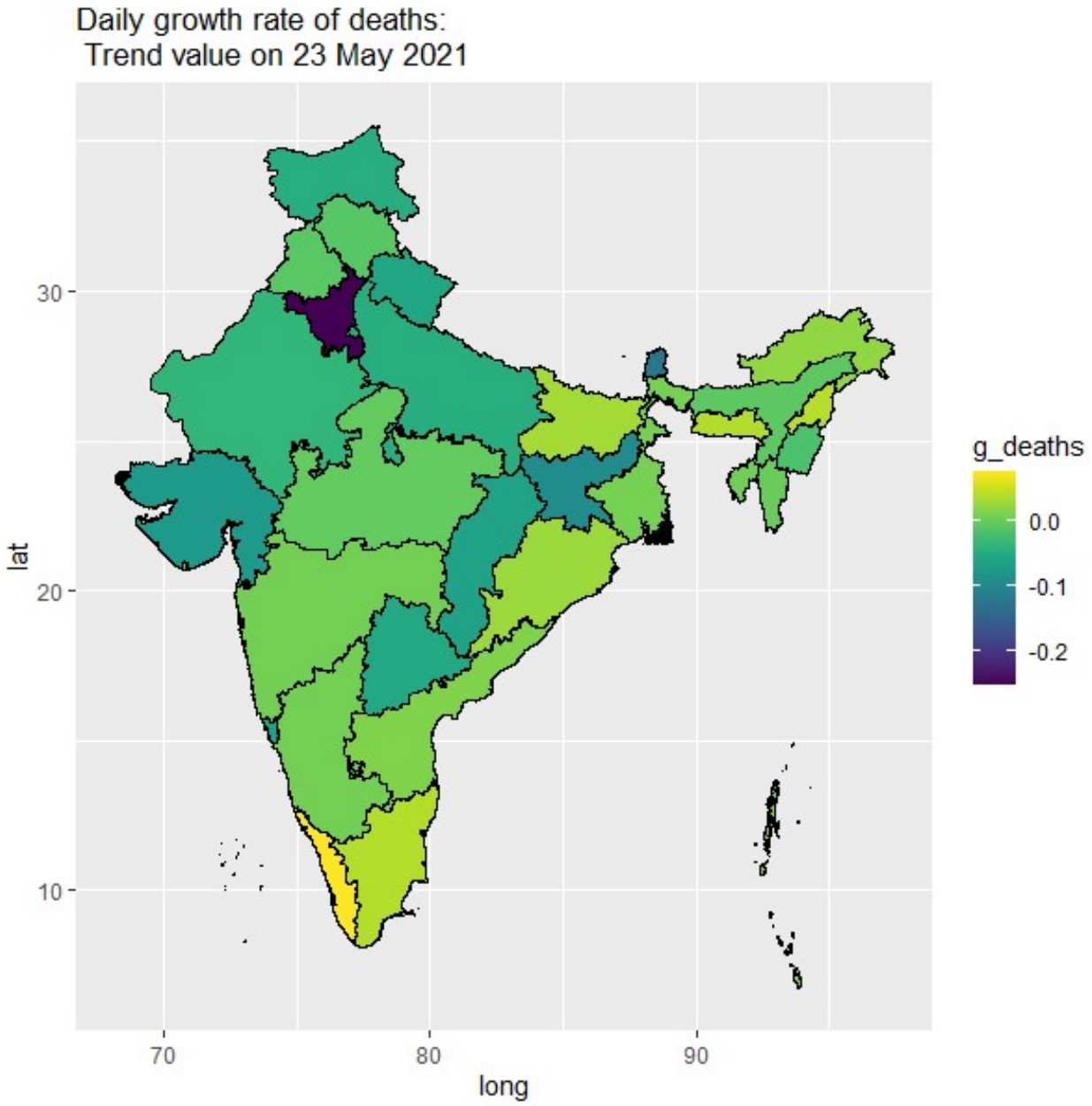


The filtered trend in the growth rate of daily deaths. Final date: 23 May 2021.

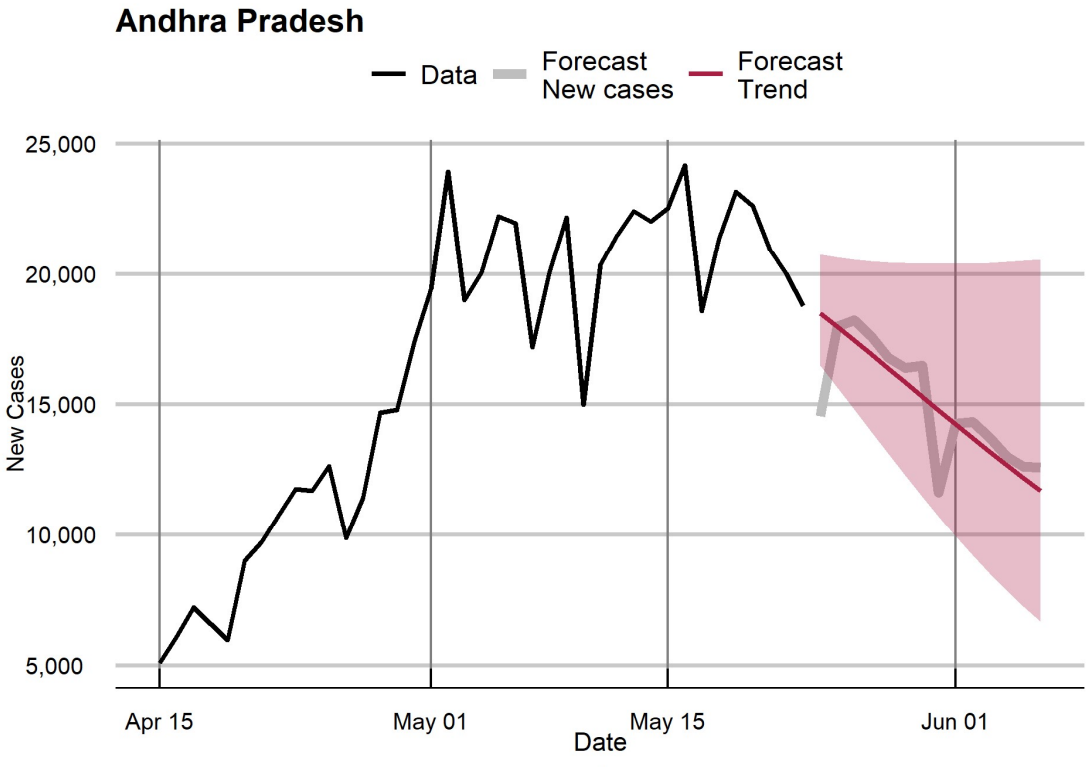
R_t: 23 May 2021

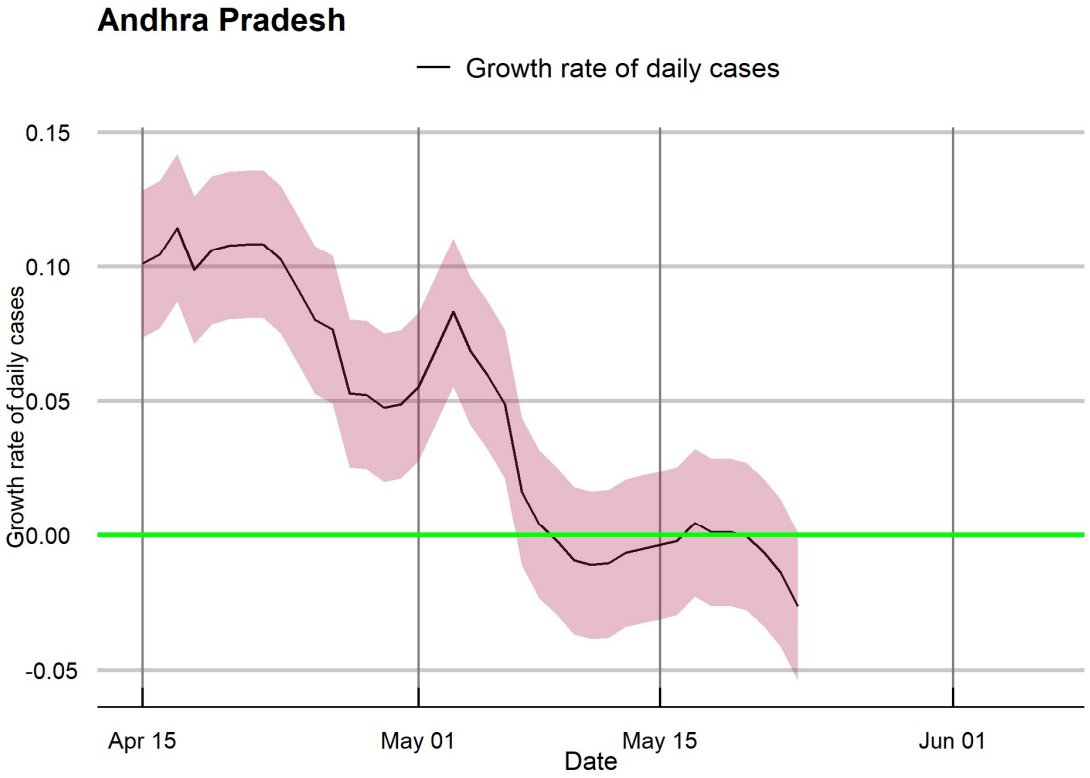


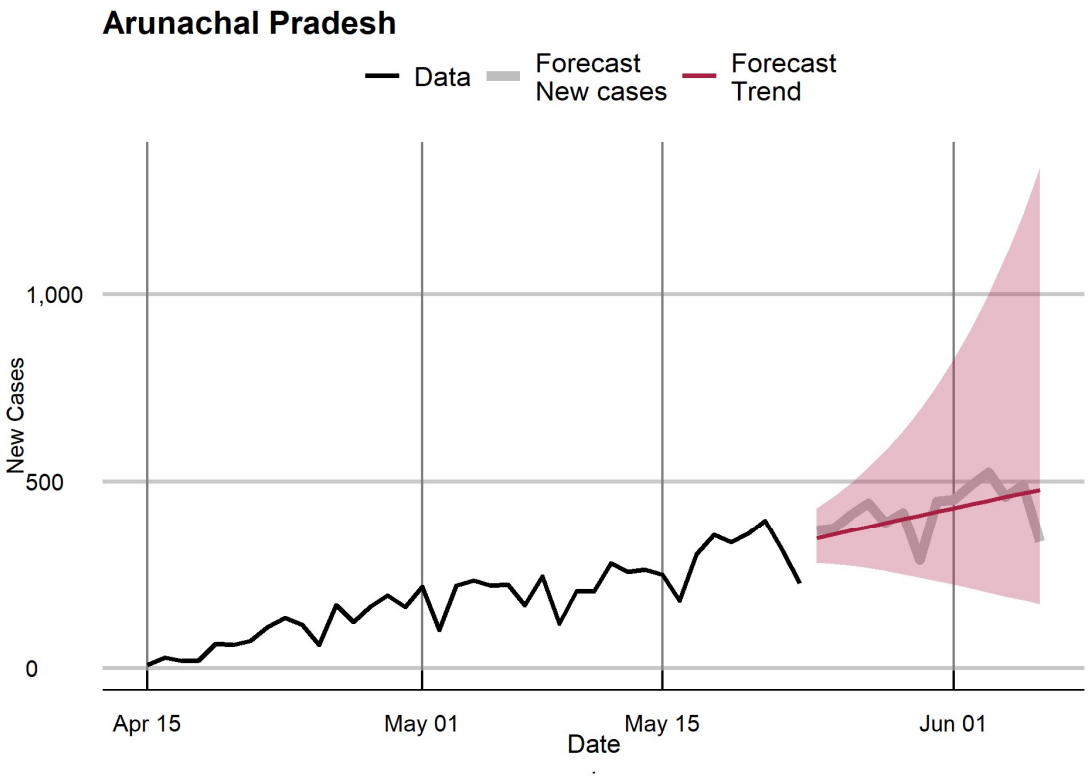

Daily growth rate of cases
Trend value on 23 May 2021
lat
30
20
10
70
80
90
long
g_cases
0.05
0.00
-0.05
-0.10
-0.15

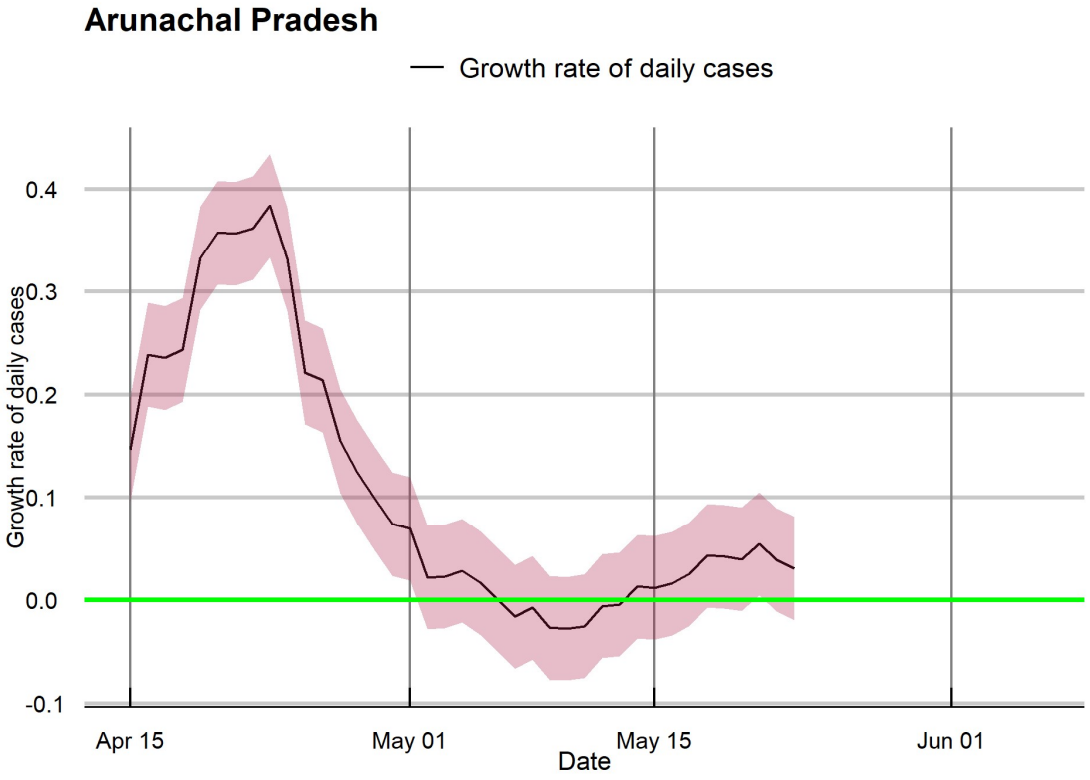

Daily growth rate of deaths:
Trend value on 23 May 2021
30
20
10
lat
70
80
90
long
g_deaths
0.0
-0.1
-0.2

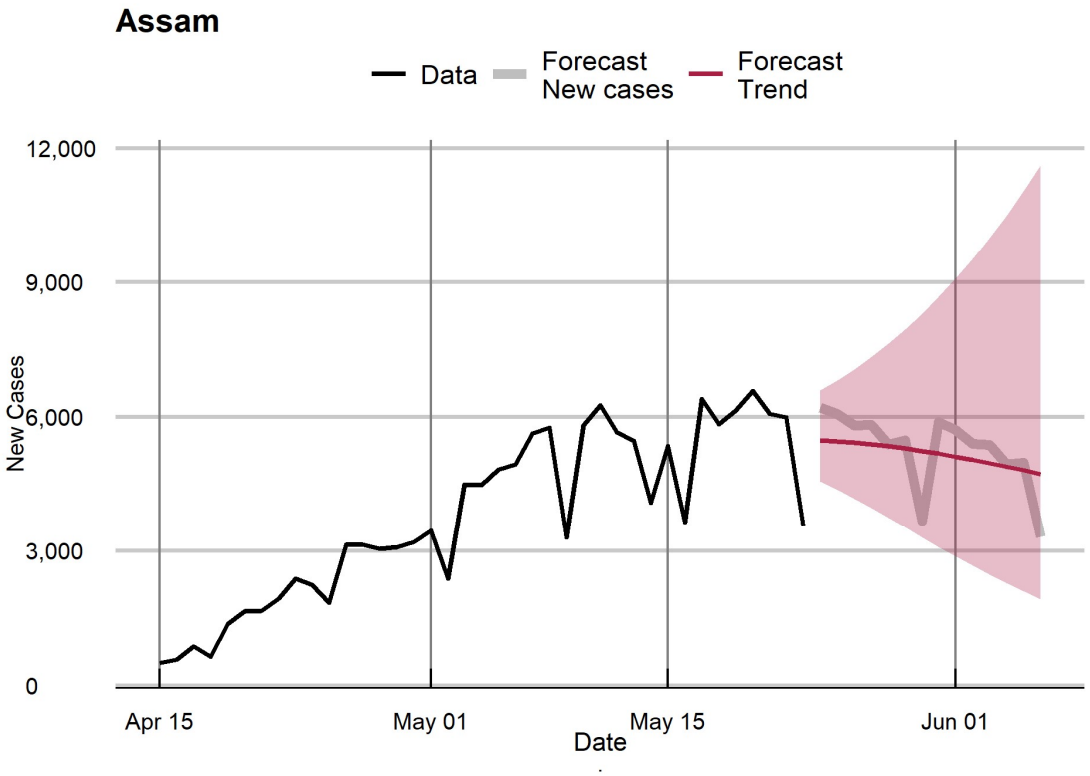
Daily Cases forecast: States and Union territories

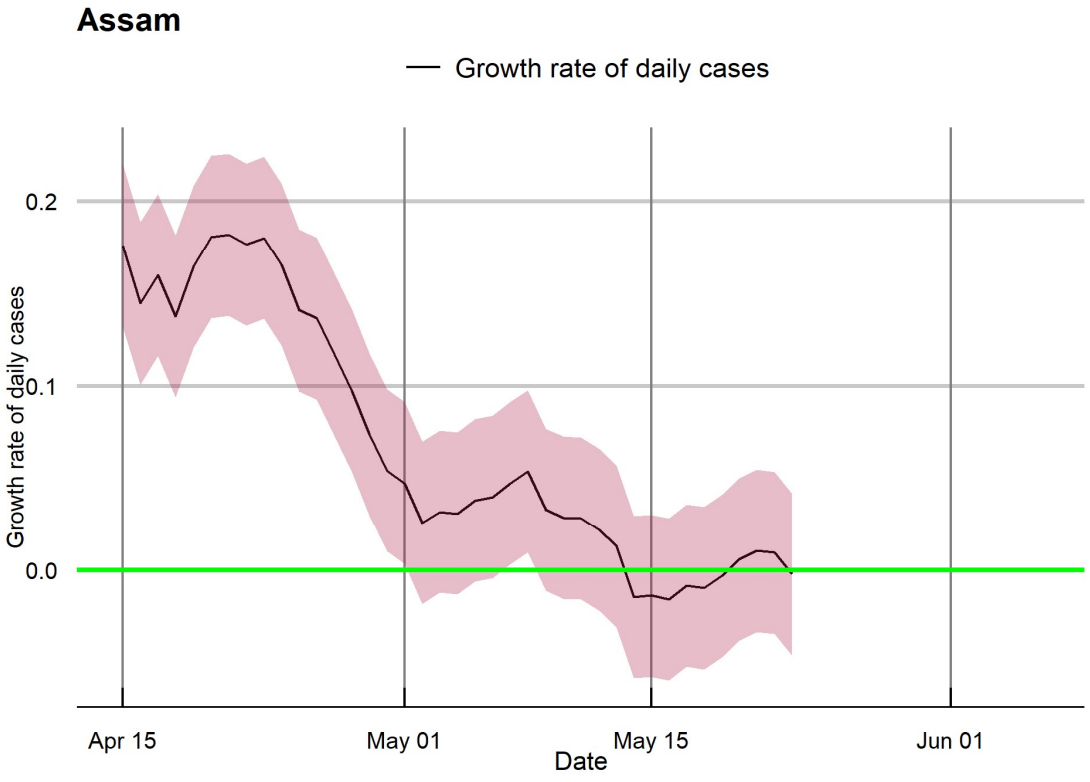


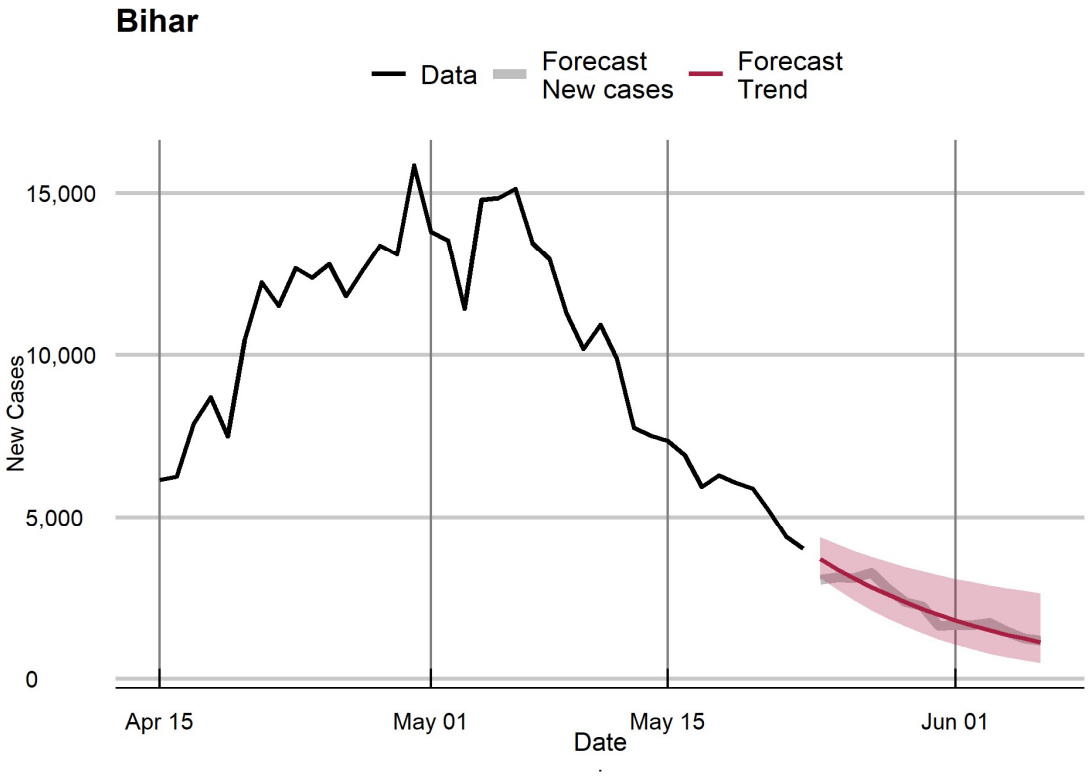


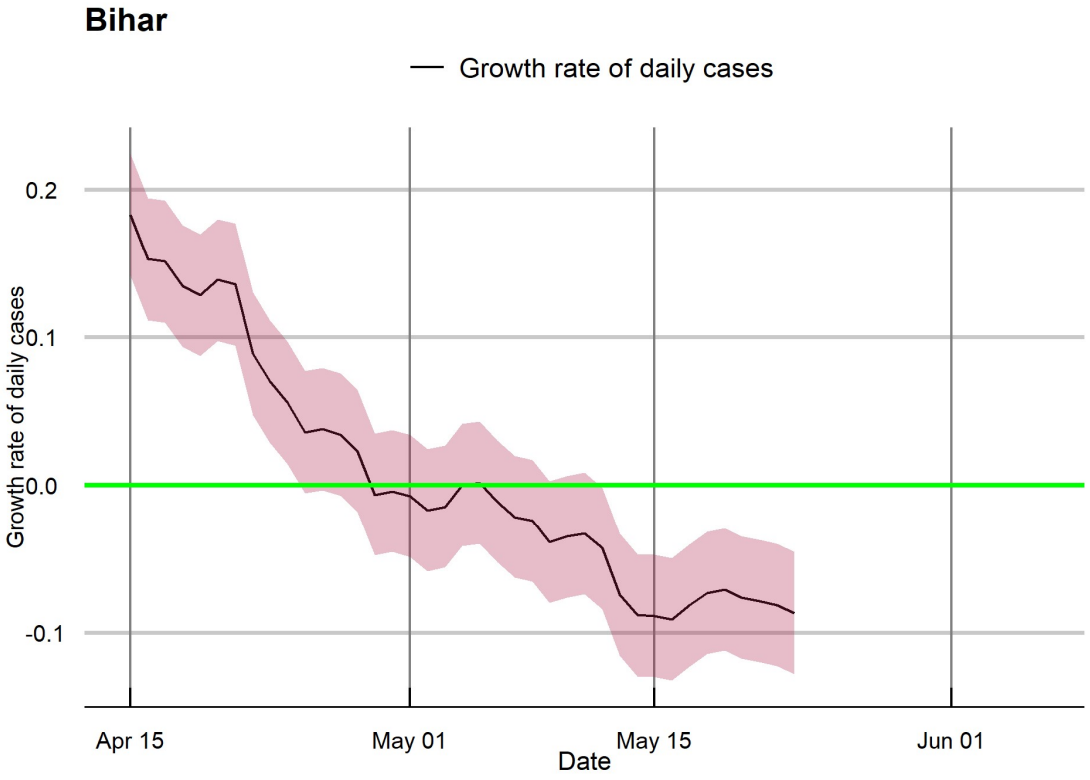

Arunachal Pradesh
Data
Forecast
New cases
Forecast
Trend
1,000
500
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date

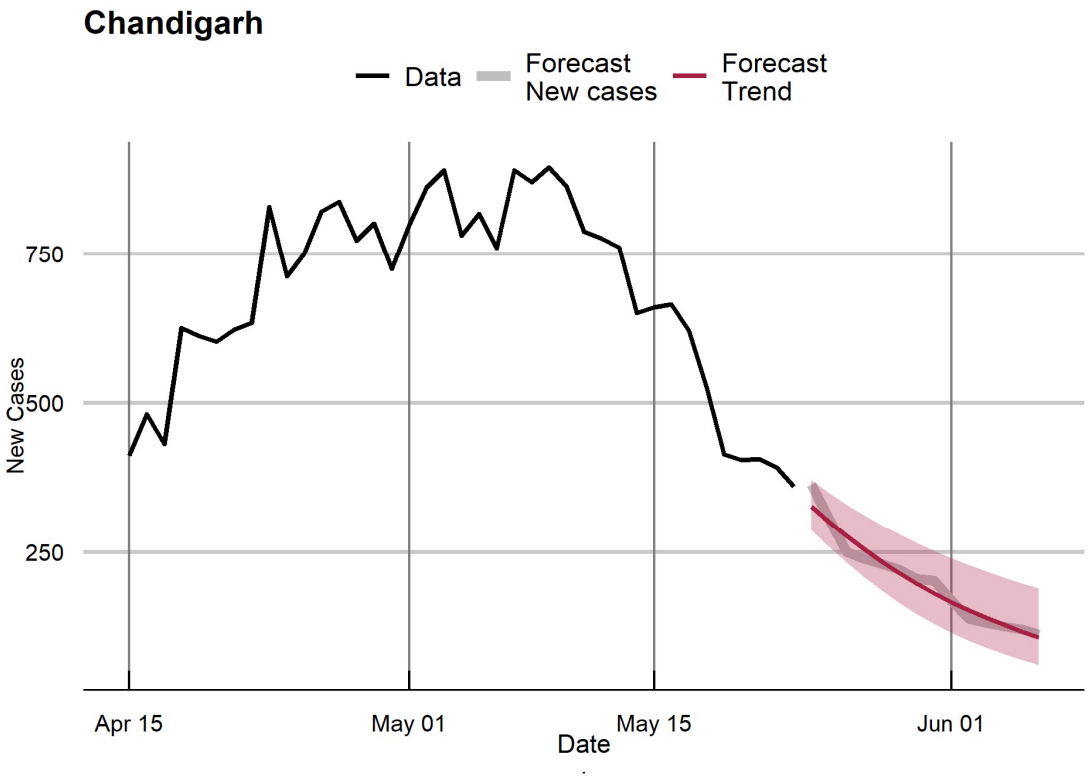

Arunachal Pradesh
Growth rate of daily cases
0.4
0.3
0.2
0.1
0.0
-0.1
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

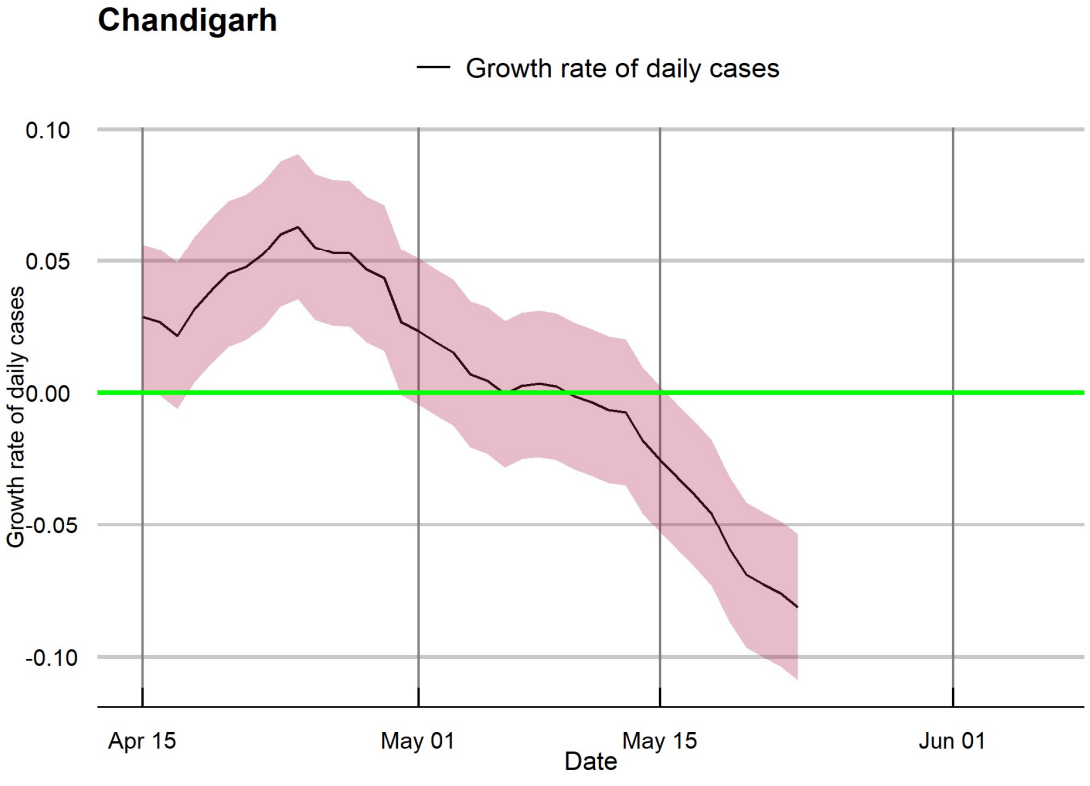

Assam
Data
Forecast
New cases
Forecast
Trend
12,000
9,000
6,000
3,000
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date

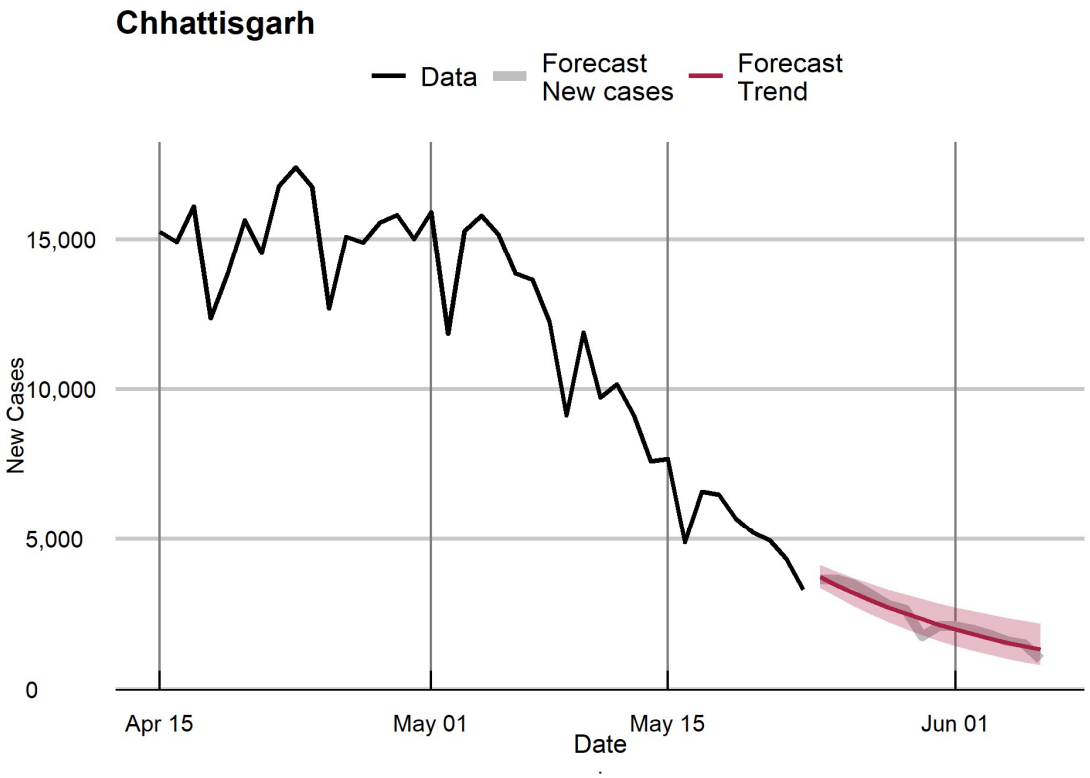

Assam
Growth rate of daily cases
0.2
0.1
0.0
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

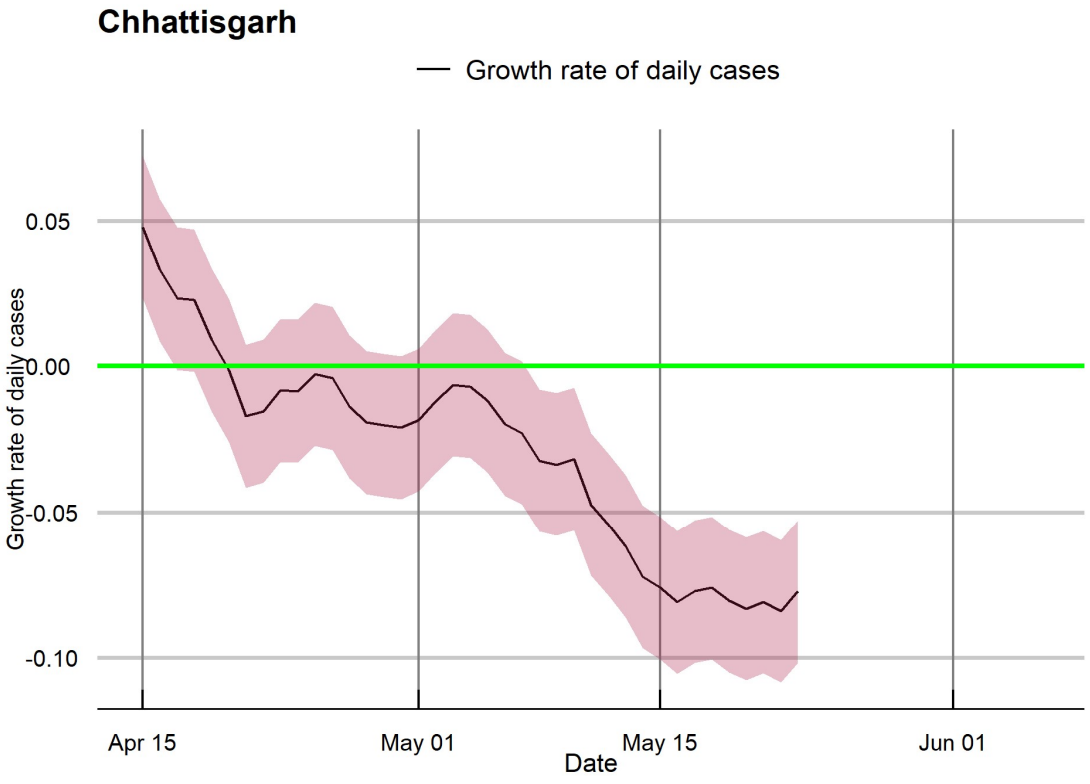

Bihar
Data
Forecast
New cases
Forecast
Trend
15,000
10,000
5,000
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date

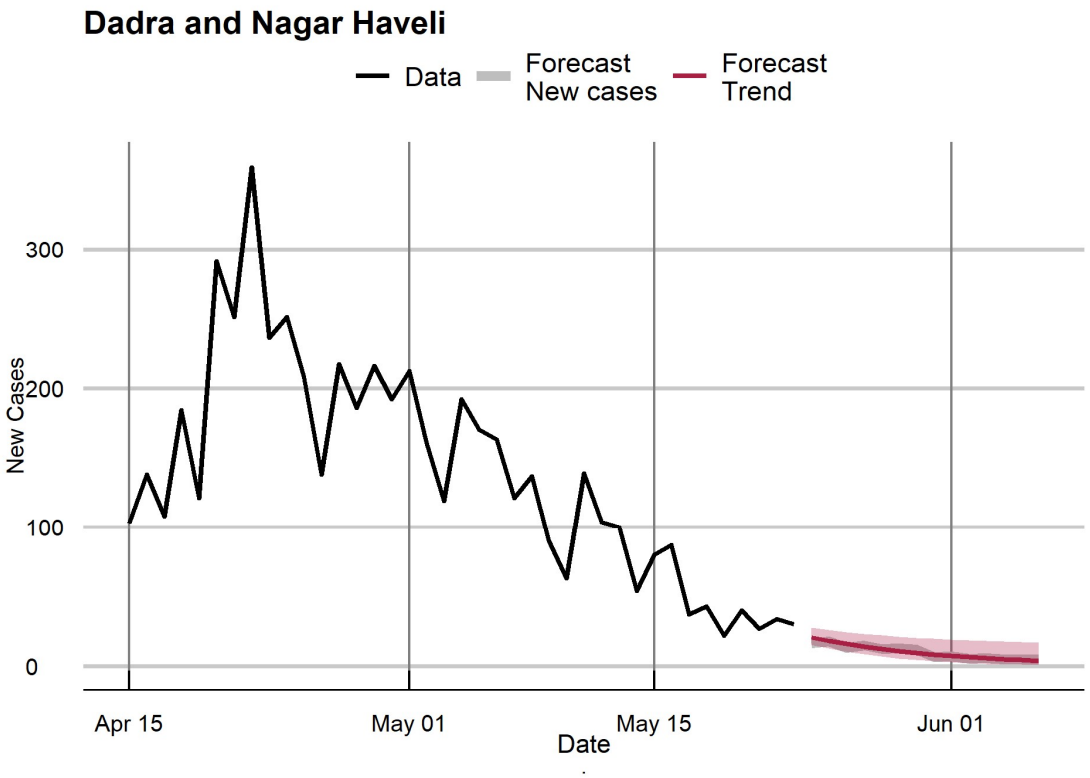

Bihar
Growth rate of daily cases
0.2
0.1
0.0
-0.1
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

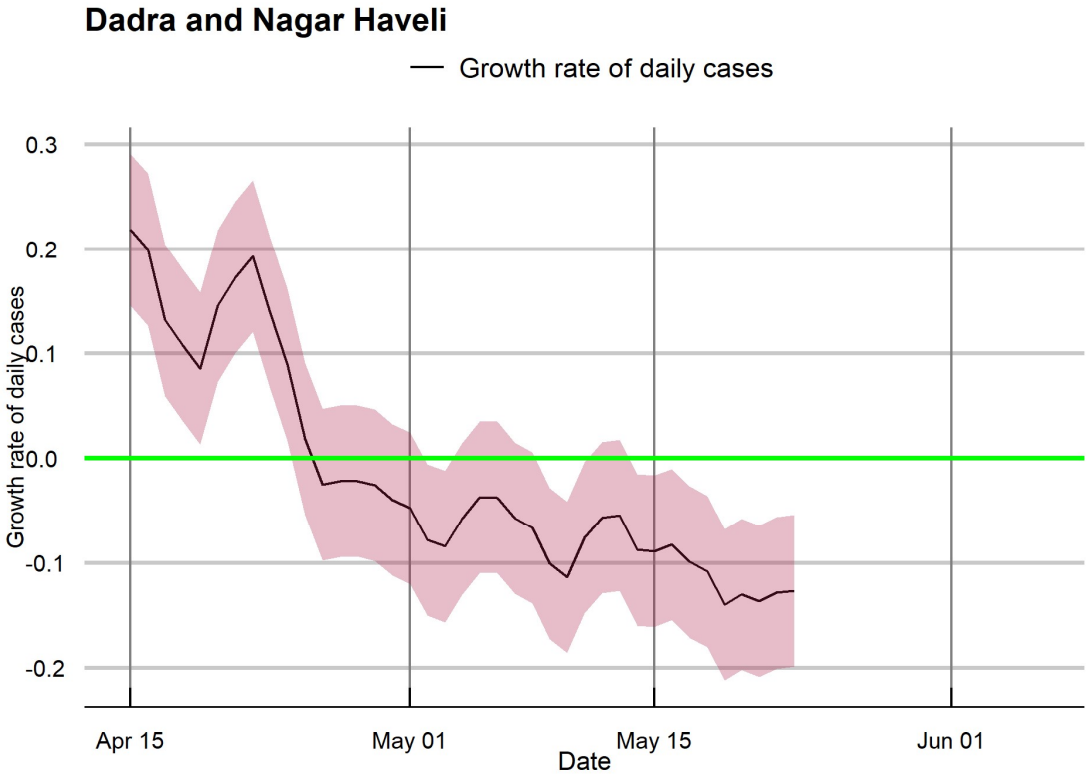

Chandigarh
Data
Forecast
New cases
Forecast
Trend
750
500
250
New Cases
Apr 15
May 01
May 15
Jun 01
Date

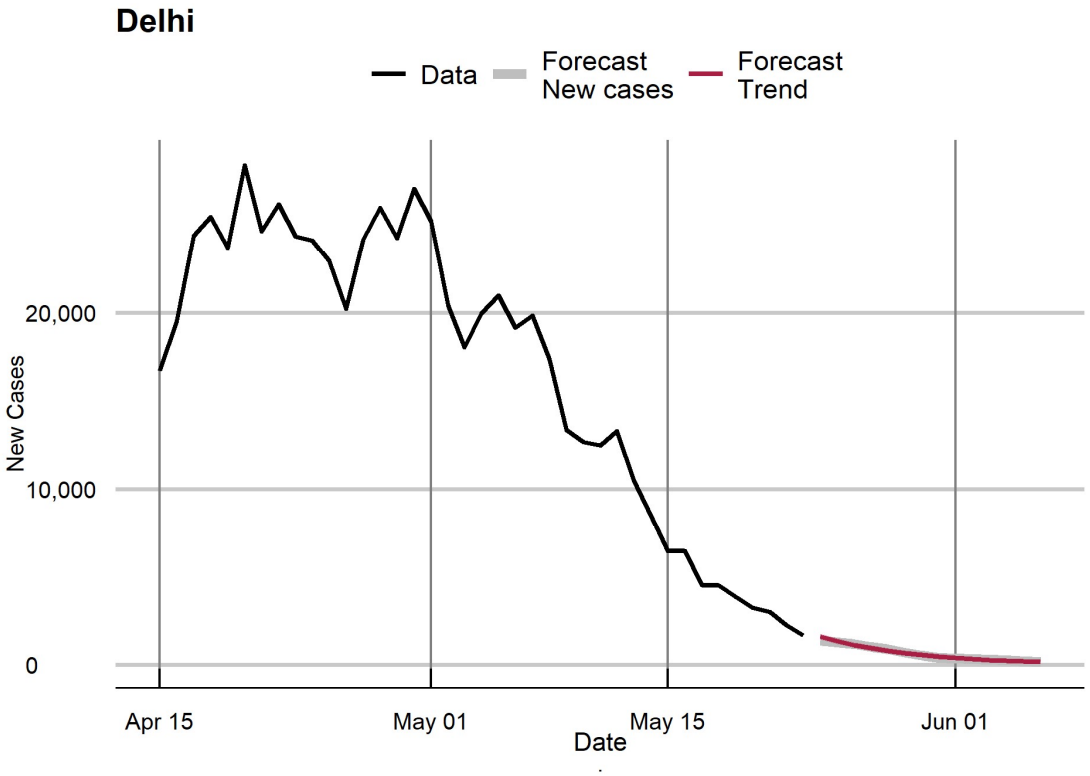

Chandigarh
Growth rate of daily cases
0.10
0.05
0.00
-0.05
-0.10
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

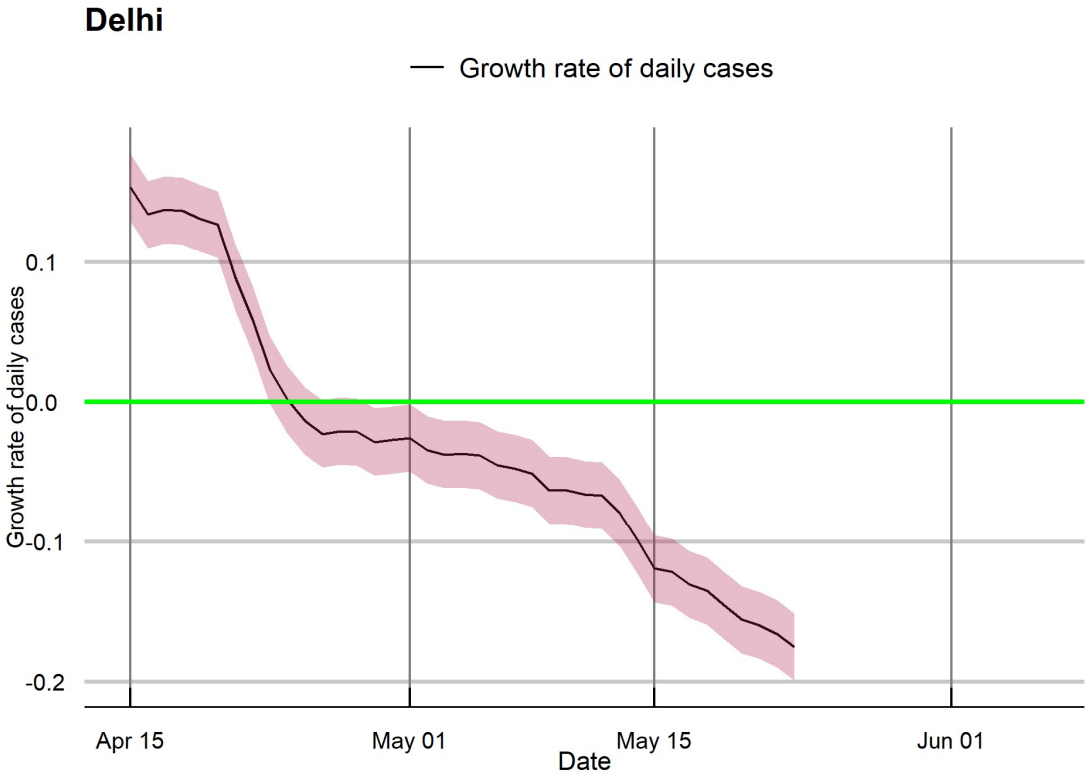

Chhattisgarh
Data
Forecast
New cases
Forecast
Trend
15,000
10,000
5,000
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date

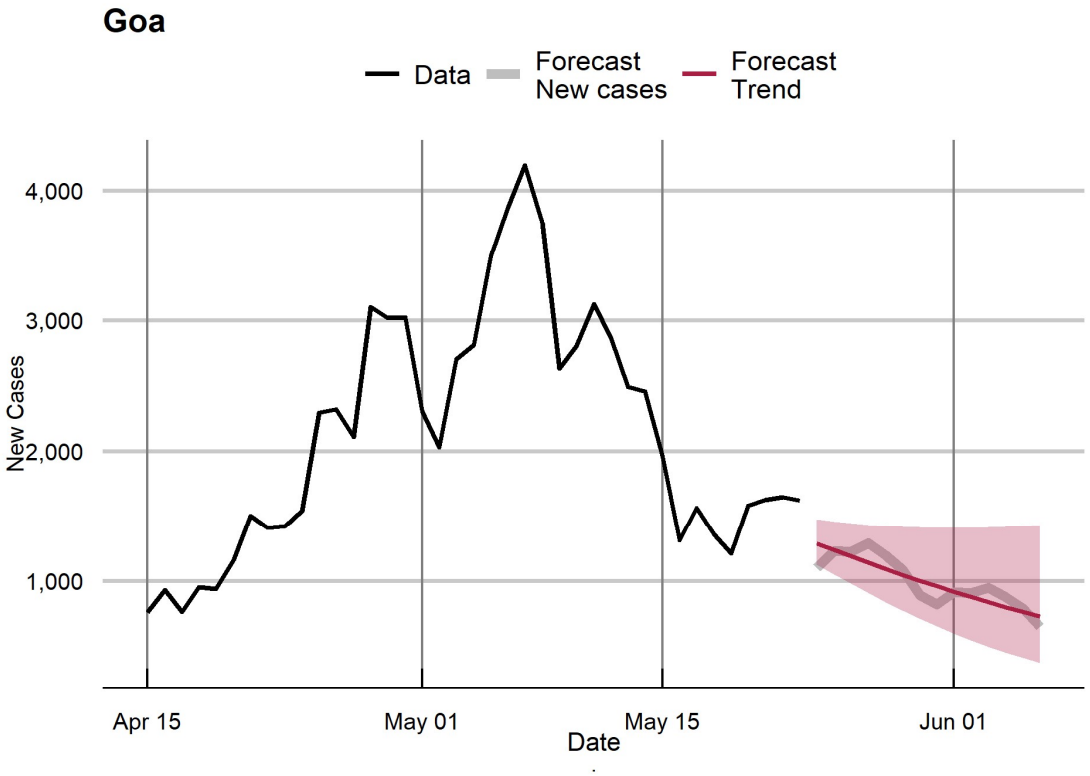

Chhattisgarh
Growth rate of daily cases
0.05
0.00
-0.05
-0.10
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

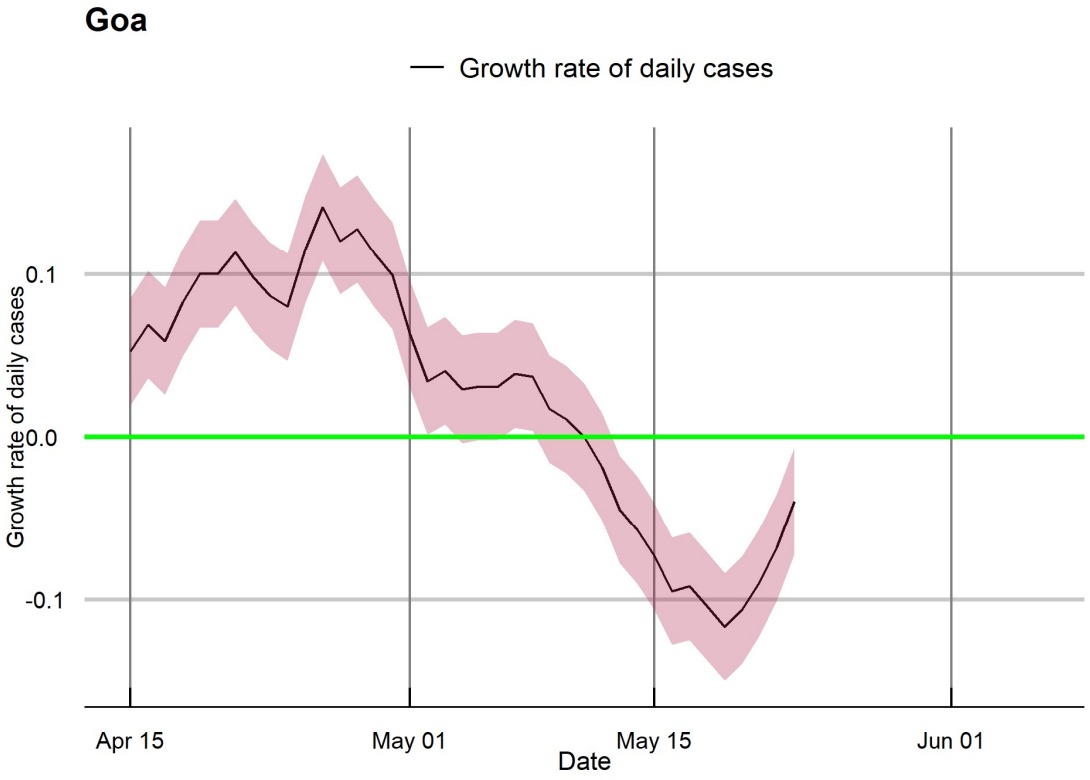

Dadra and Nagar Haveli
Data
Forecast
New cases
Forecast
Trend
300
200
100
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date

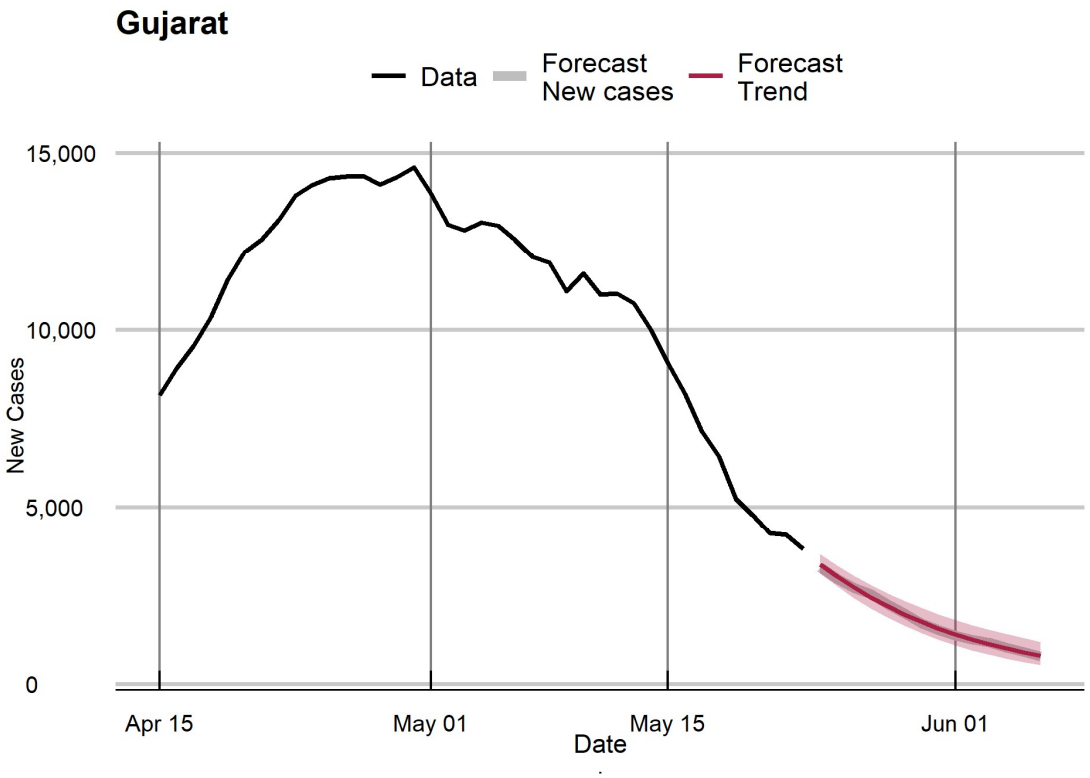

Dadra and Nagar Haveli
Growth rate of daily cases
0.3
0.2
0.1
0.0
-0.1
-0.2
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

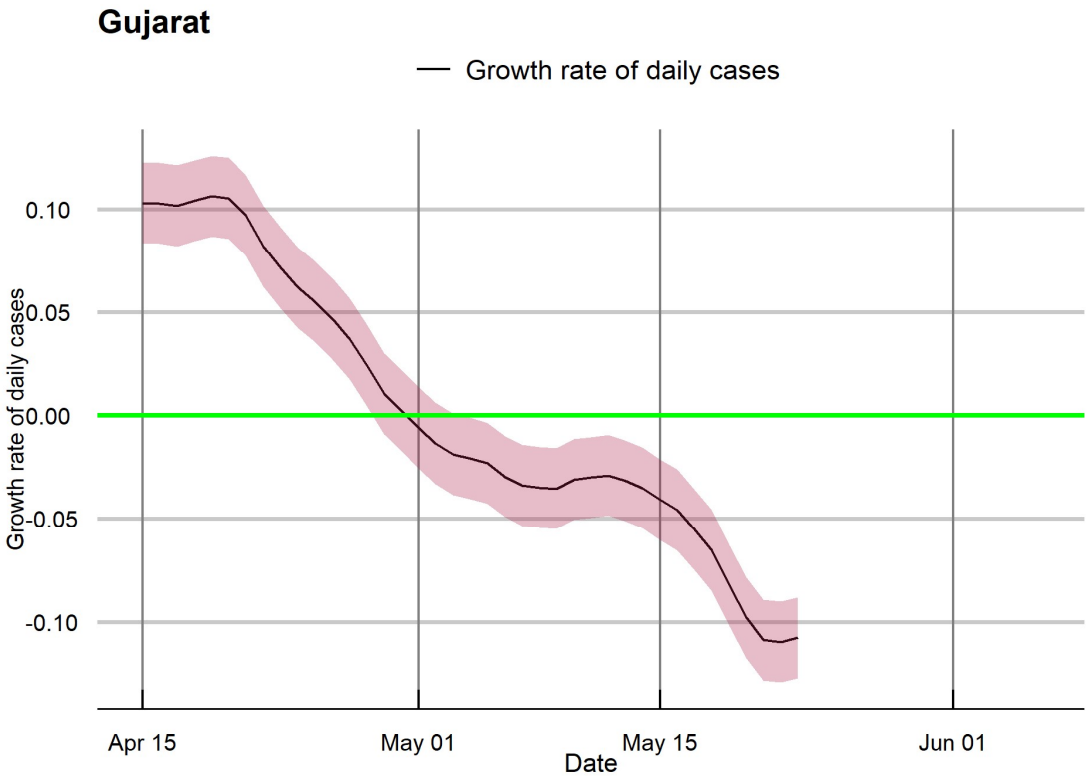

Delhi
Data
Forecast
New cases
Forecast
Trend
20,000
10,000
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date

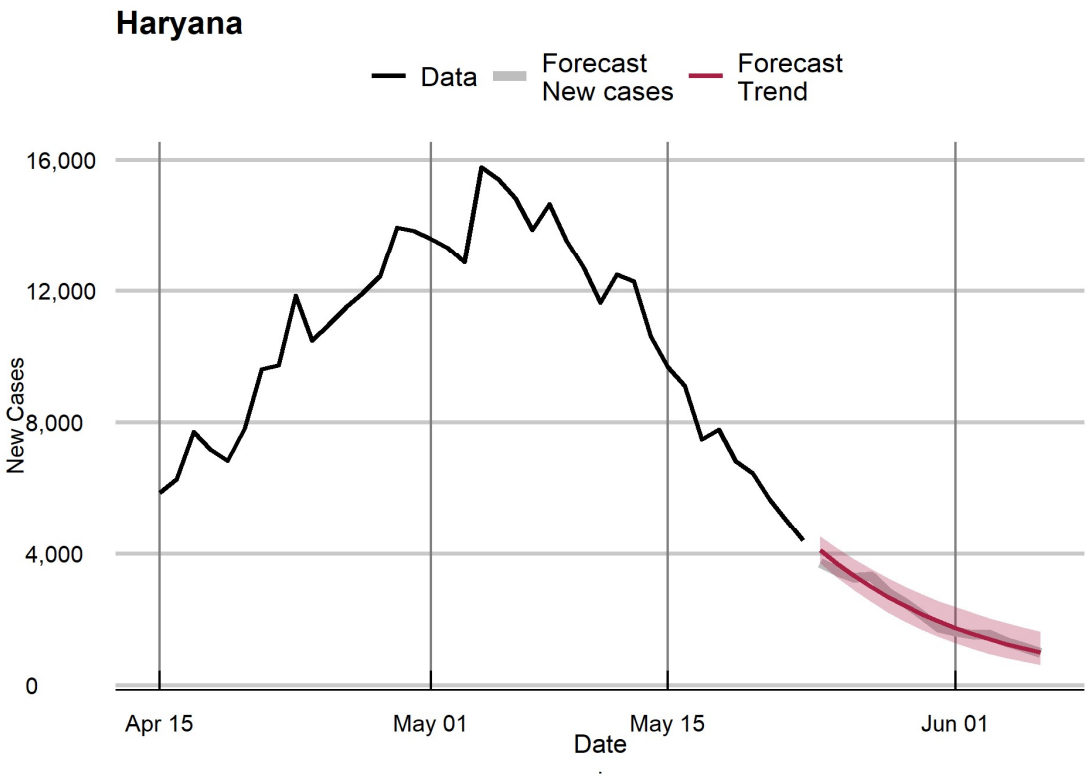

Delhi
Growth rate of daily cases
0.1
0.0
-0.1
-0.2
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

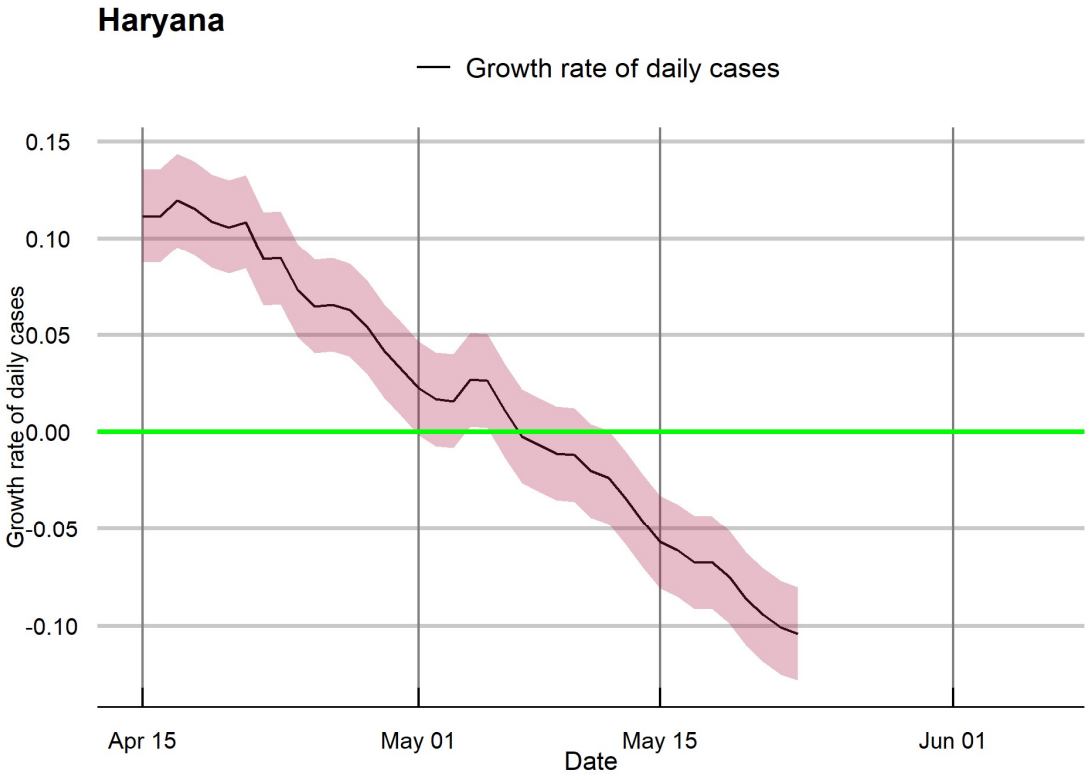

Goa
Data
Forecast
New cases
Forecast
Trend
4,000
3,000
2,000
1,000
New Cases
Apr 15
May 01
May 15
Jun 01
Date

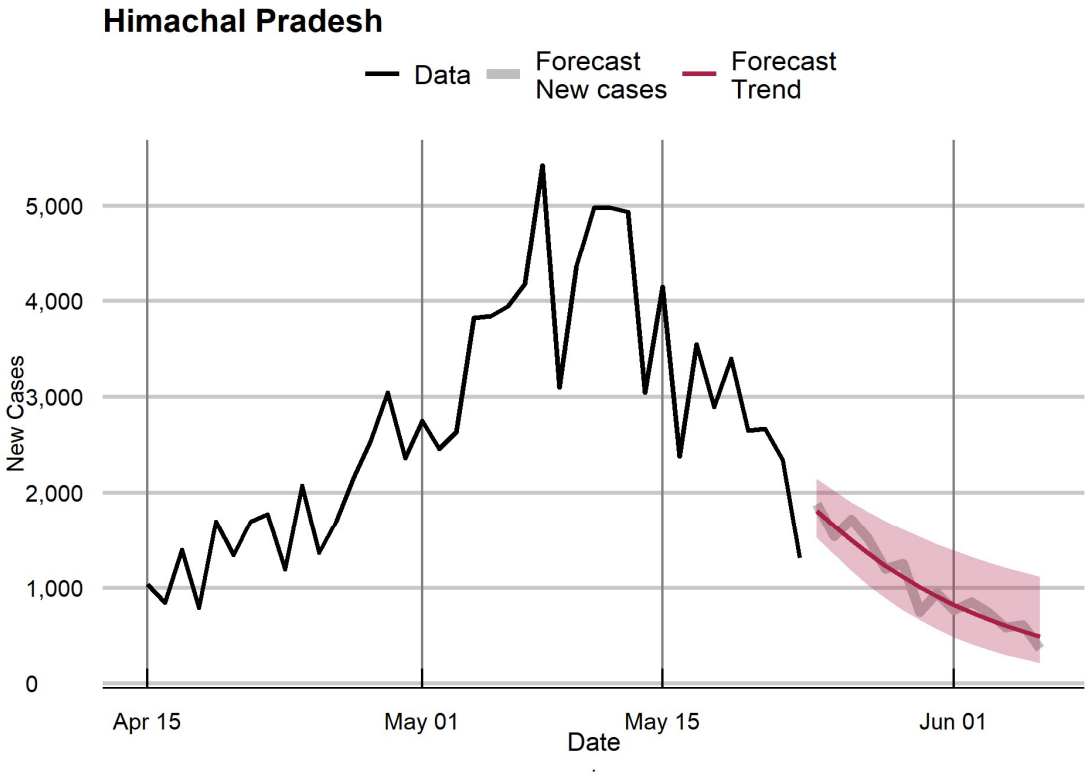

Goa
Growth rate of daily cases
0.1
0.0
-0.1
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

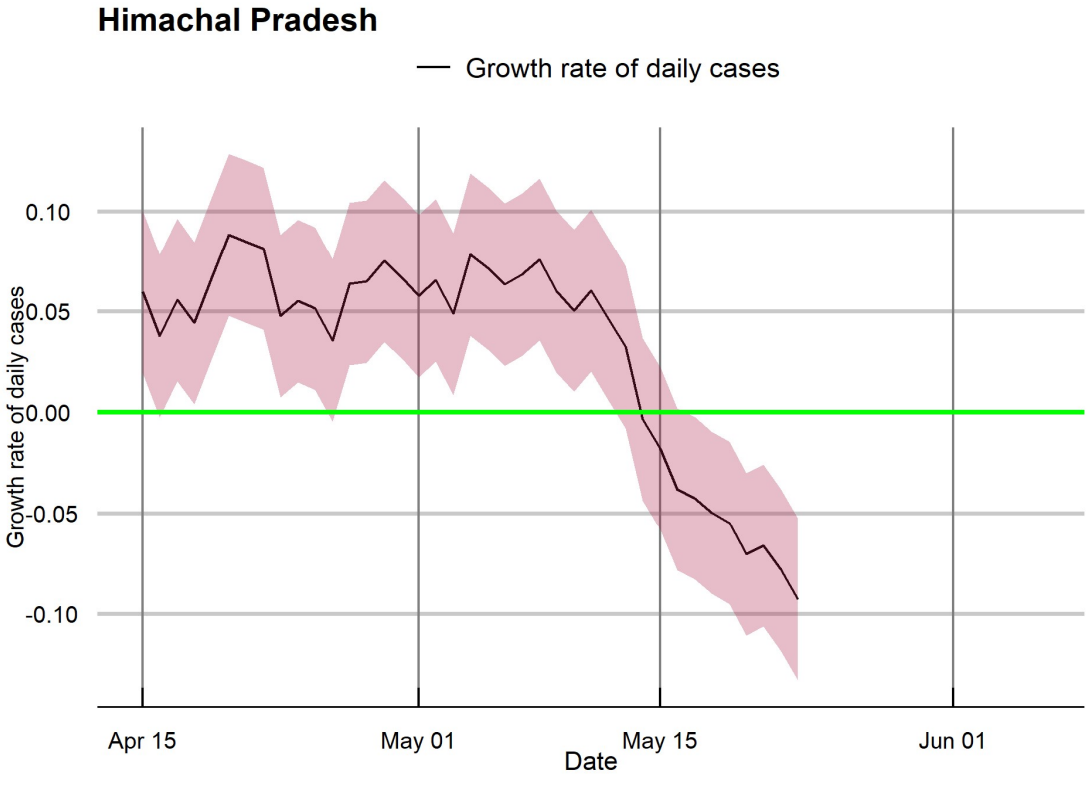

Gujarat
Data
Forecast
New cases
Forecast
Trend
15,000
10,000
5,000
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date

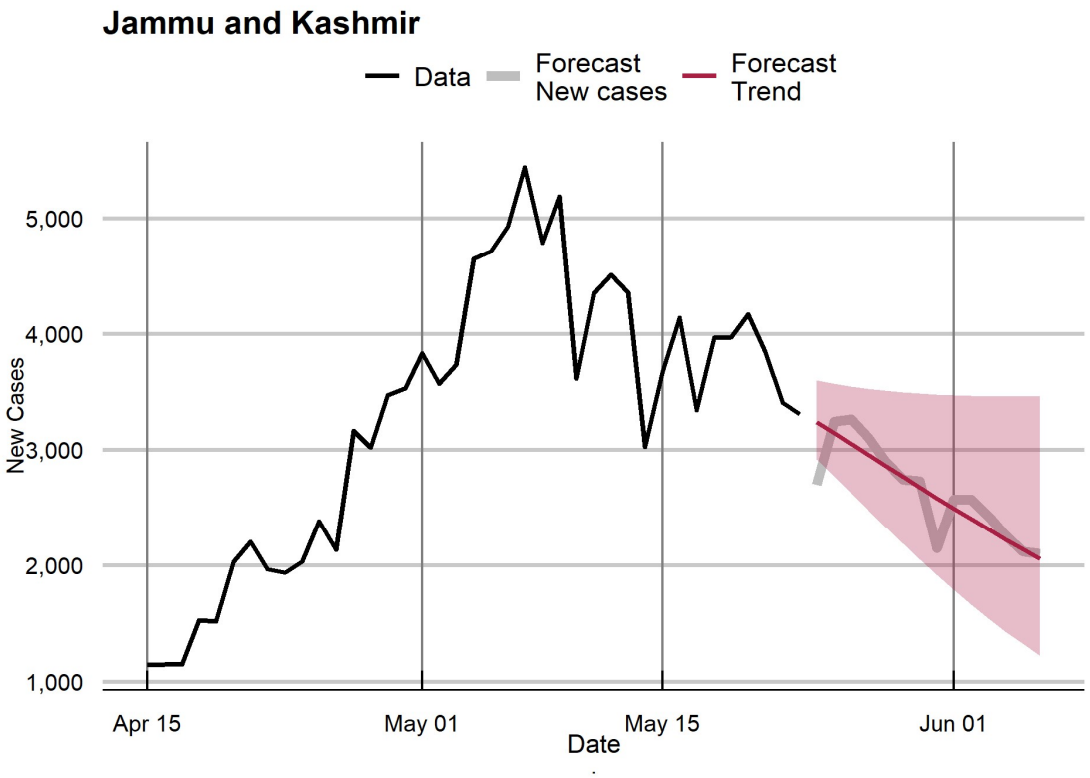

Gujarat
Growth rate of daily cases
0.10
0.05
0.00
-0.05
-0.10
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

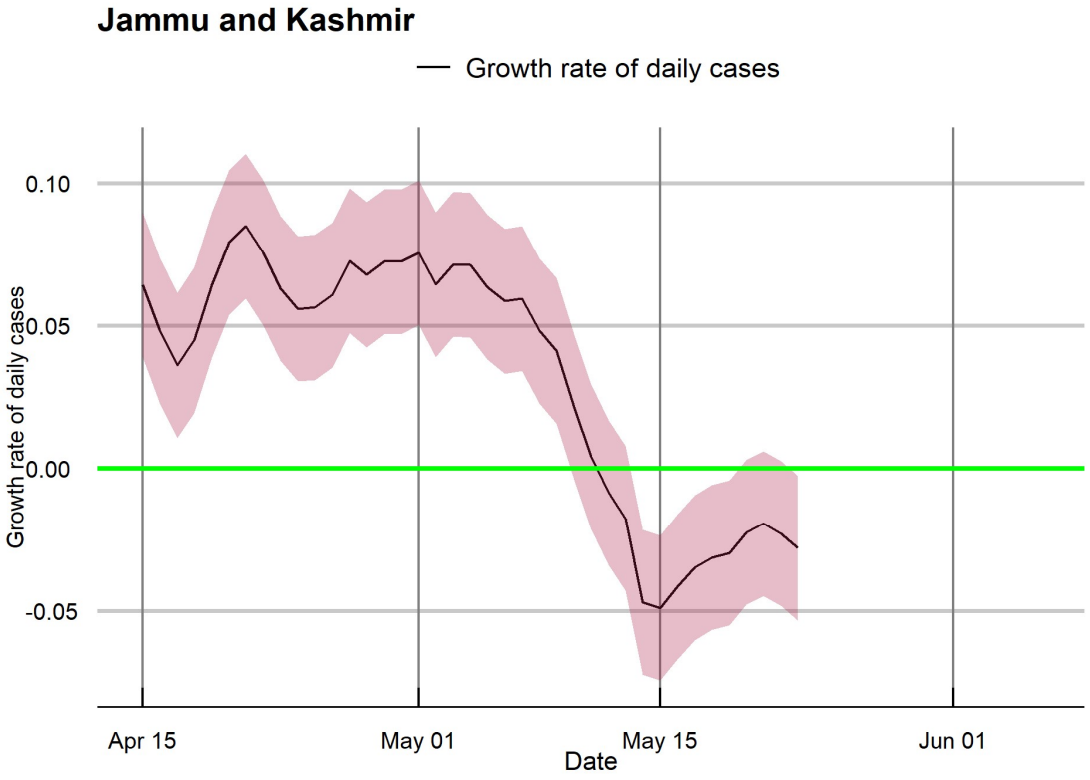

Haryana
Data
Forecast
New cases
Forecast
Trend
16,000
12,000
8,000
4,000
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date

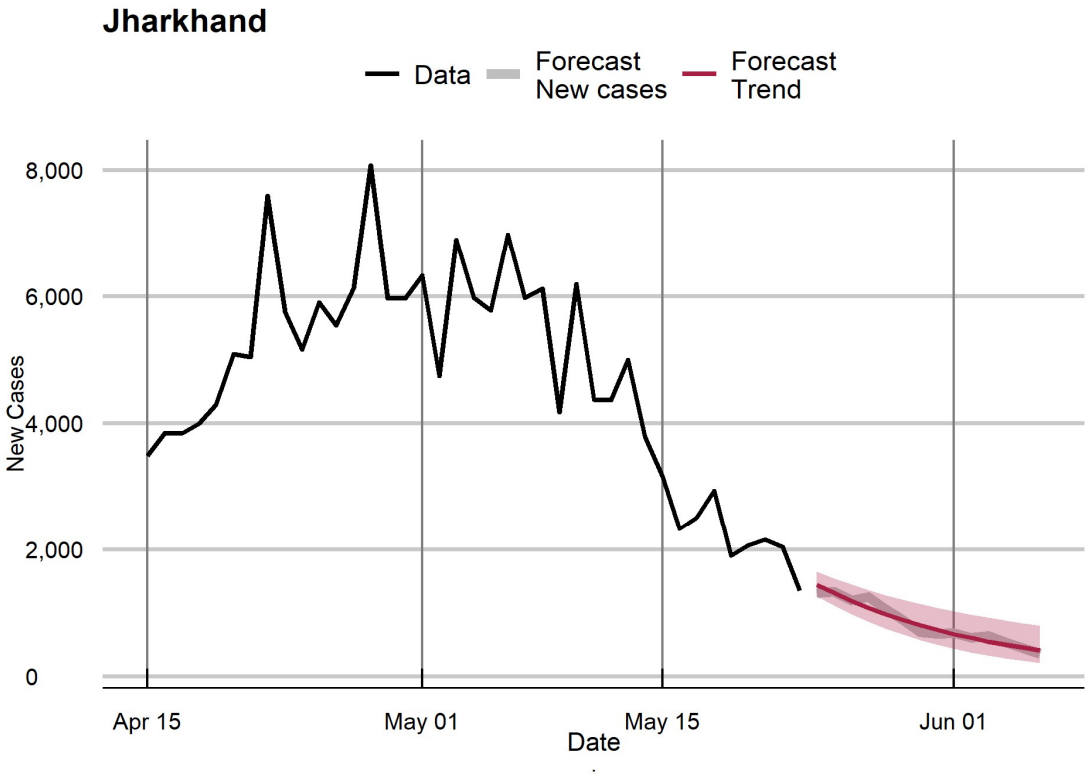

Haryana
Growth rate of daily cases
0.15
0.10
0.05
0.00
-0.05
-0.10
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

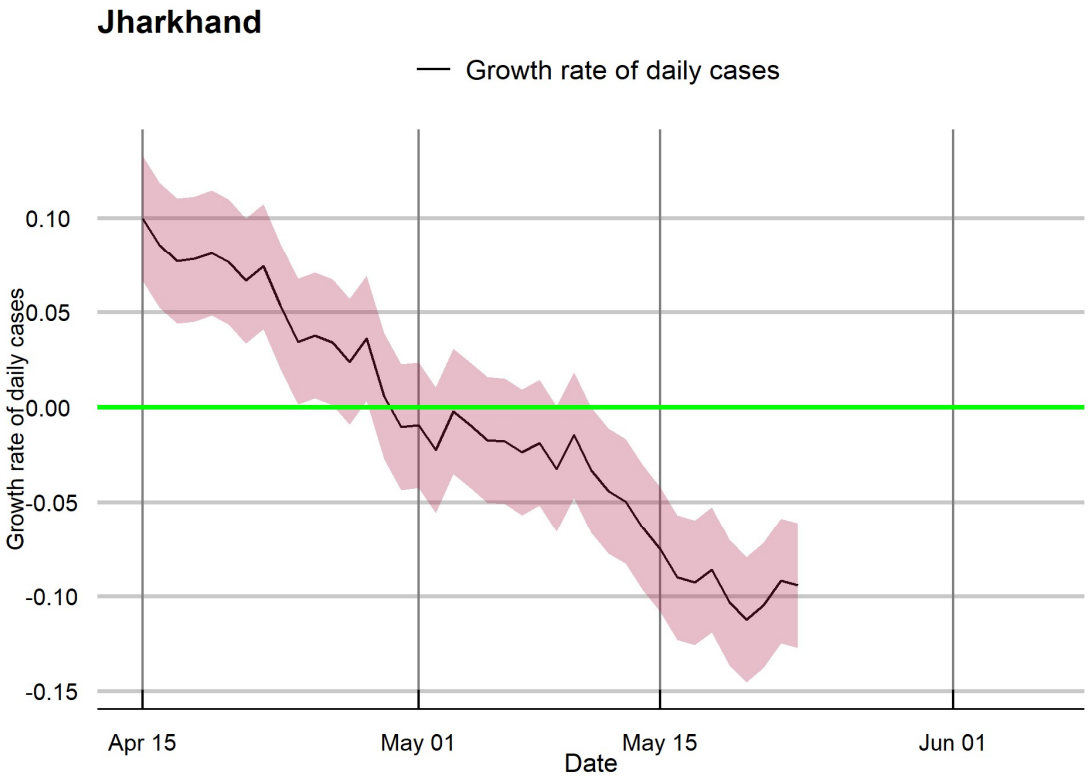

Himachal Pradesh
Data
Forecast
New cases
Forecast
Trend
5,000
4,000
3,000
2,000
1,000
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date

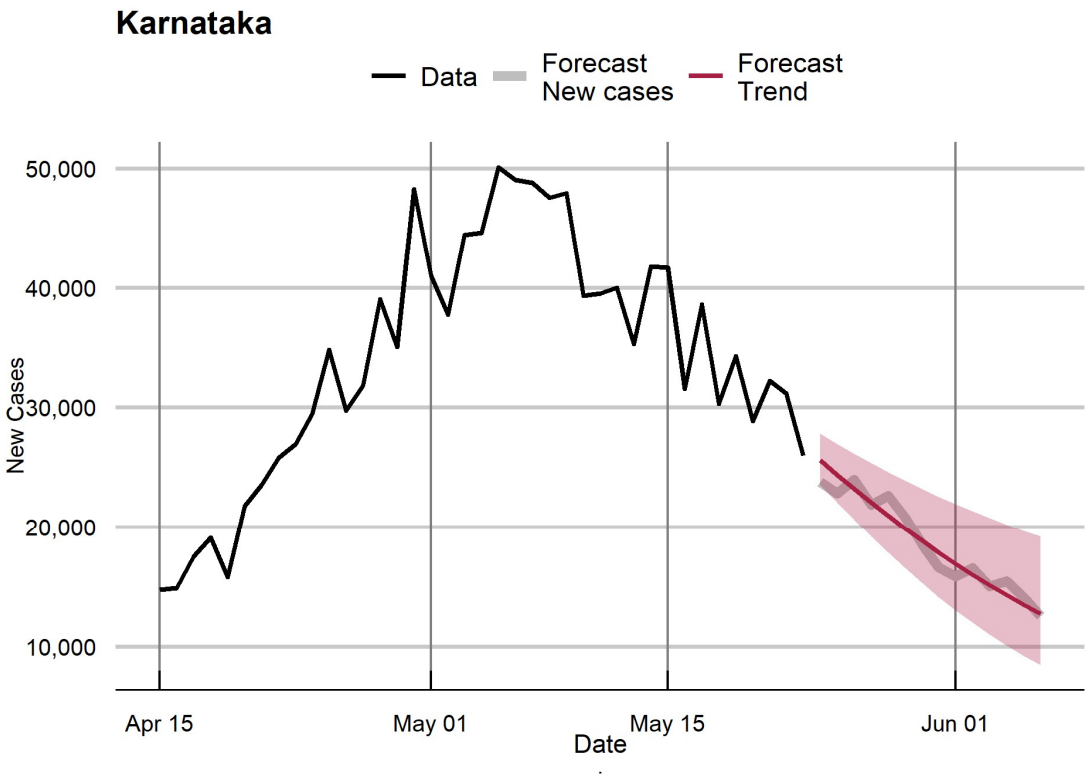

Himachal Pradesh
Growth rate of daily cases
0.10
0.05
0.00
-0.05
-0.10
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

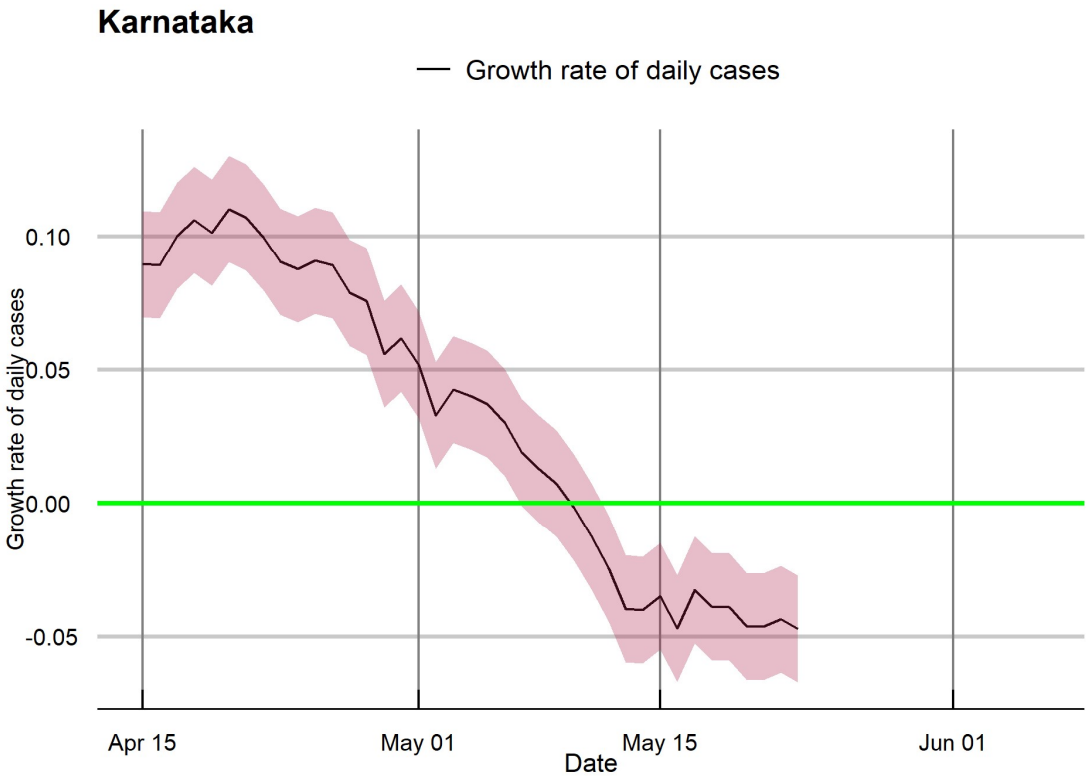

Jammu and Kashmir
Data
Forecast
New cases
Forecast
Trend
5,000
4,000
3,000
2,000
1,000
New Cases
Apr 15
May 01
May 15
Jun 01
Date

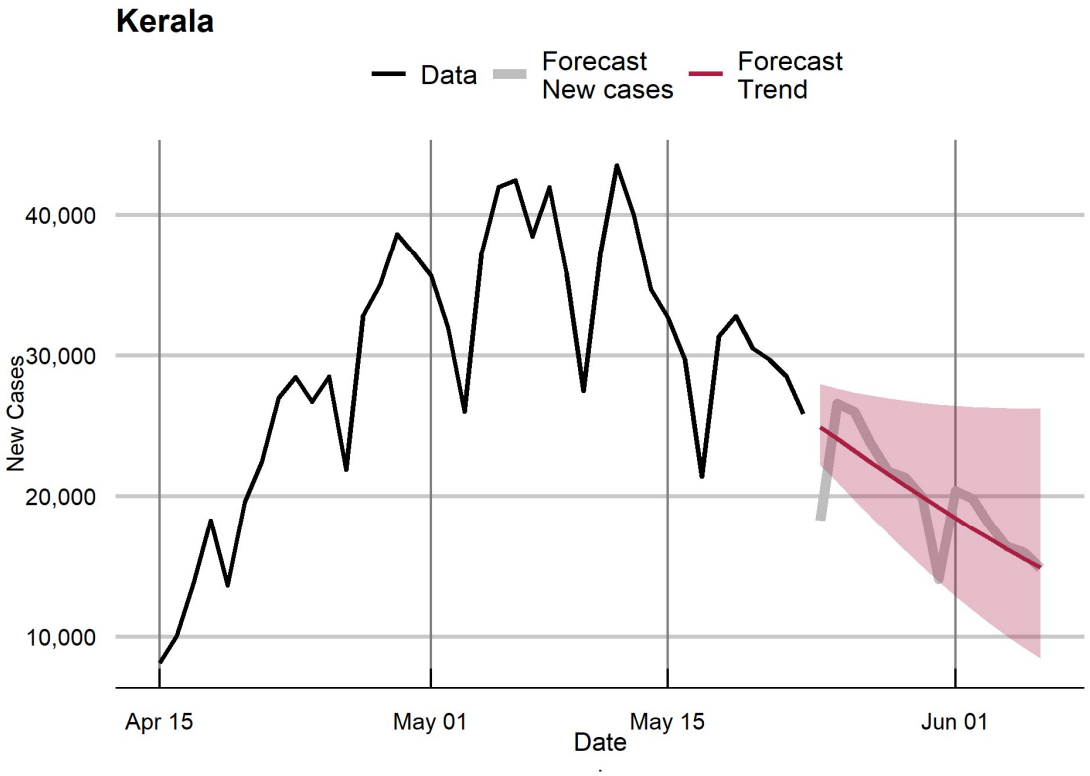

Jammu and Kashmir
Growth rate of daily cases
0.10
0.05
0.00
-0.05
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

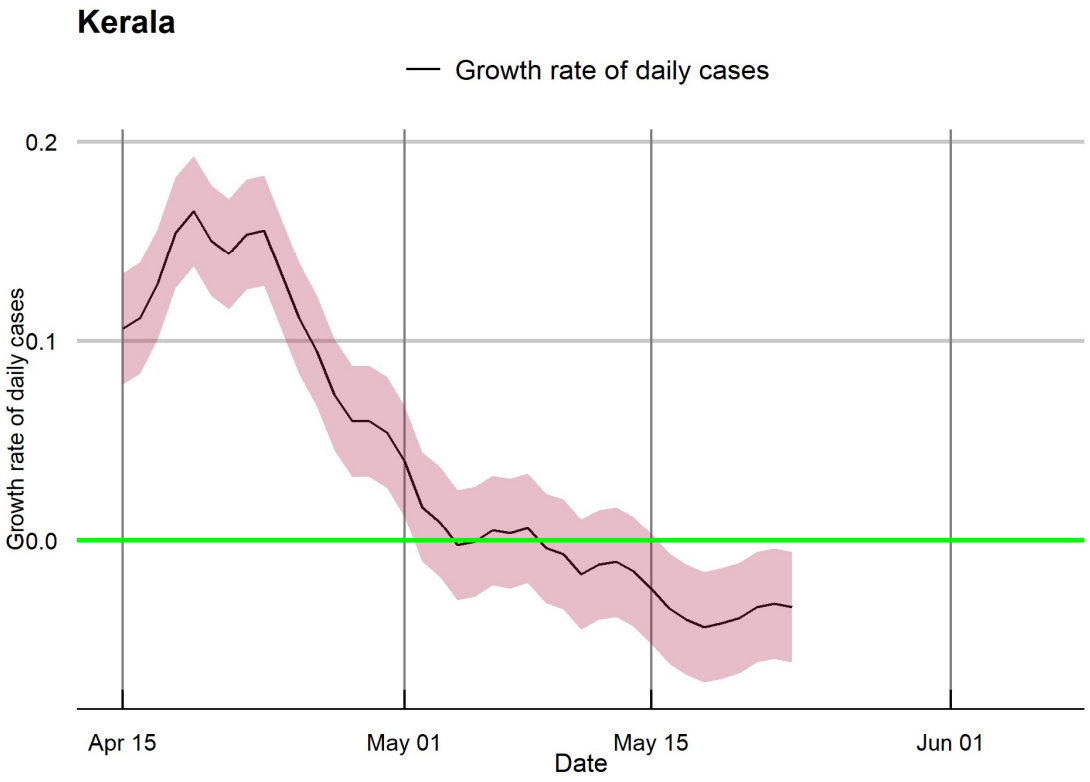

Jharkhand
Data
Forecast
New cases
Forecast
Trend
8,000
6,000
4,000
2,000
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date

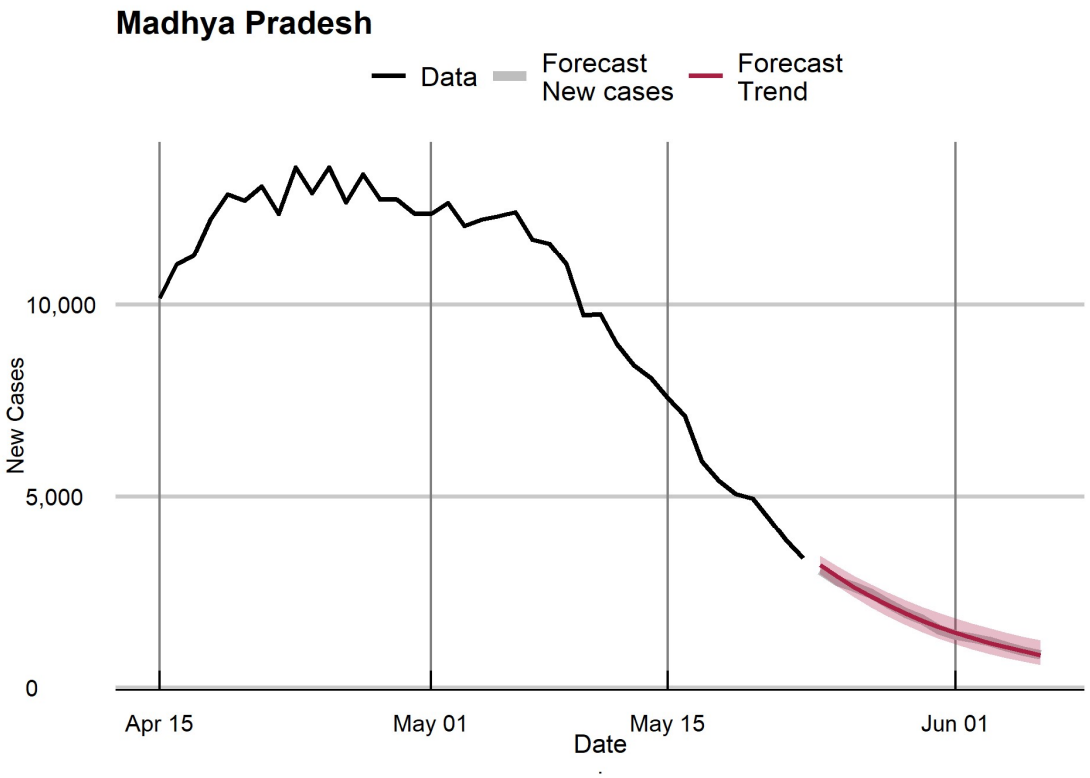

Jharkhand
Growth rate of daily cases
0.10
0.05
0.00
-0.05
-0.10
-0.15
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

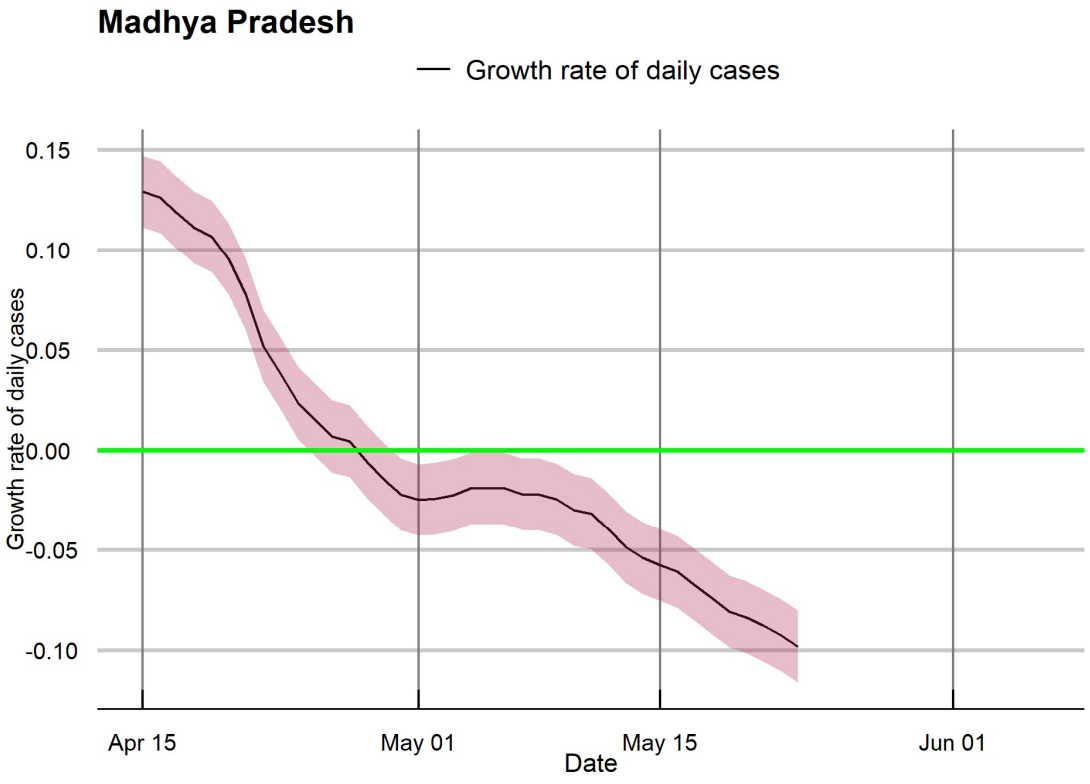

Karnataka
Data
Forecast
New cases
Forecast
Trend
50,000
40,000
30,000
20,000
10,000
New Cases
Apr 15
May 01
May 15
Jun 01
Date

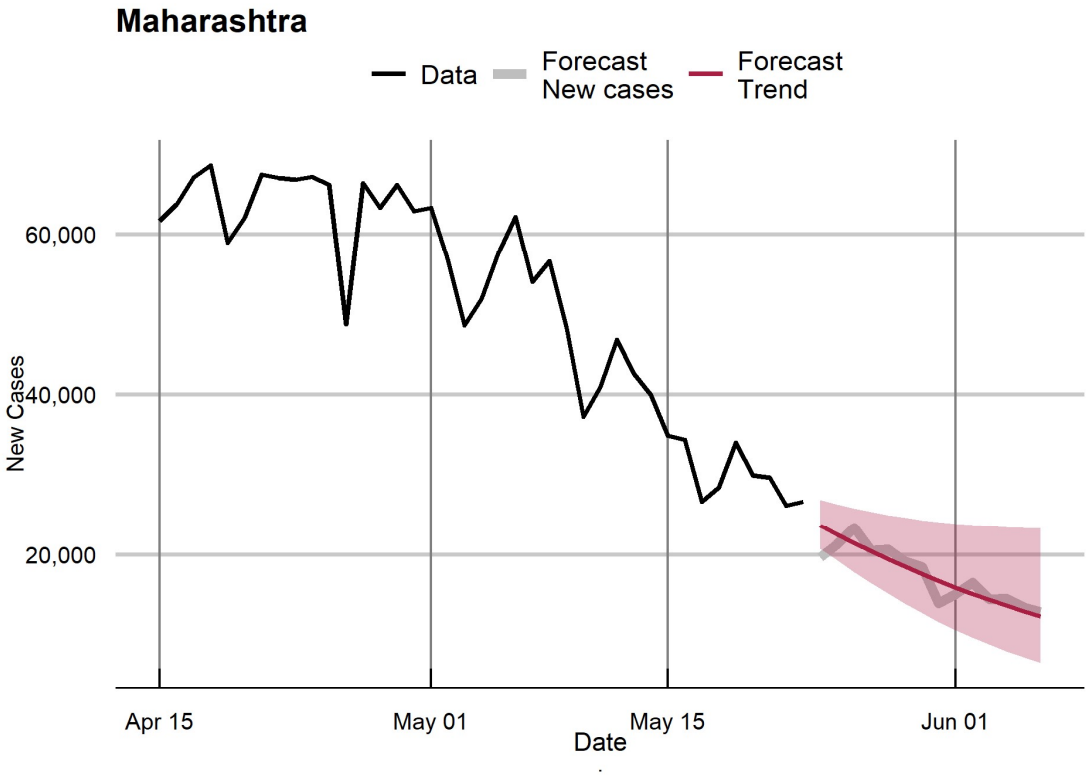

Karnataka
Growth rate of daily cases
0.10
0.05
0.00
-0.05
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

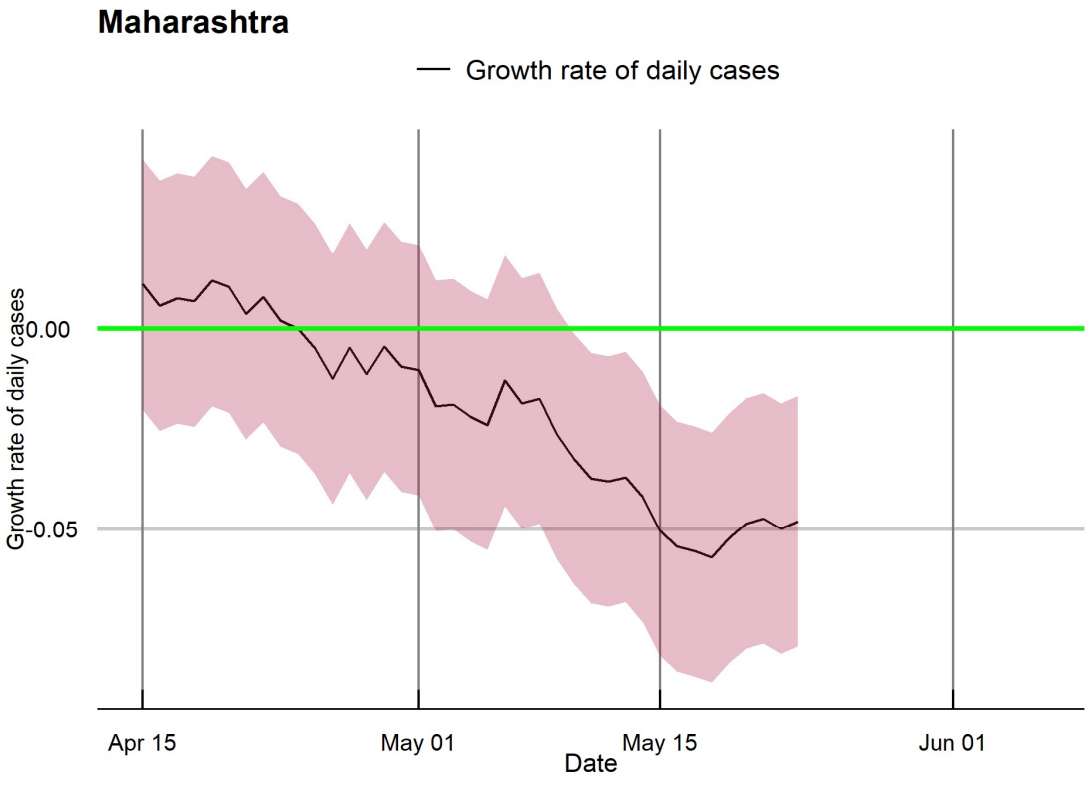

Kerala
Data
Forecast
New cases
Forecast
Trend
40,000
30,000
20,000
10,000
New Cases
Apr 15
May 01
May 15
Jun 01
Date

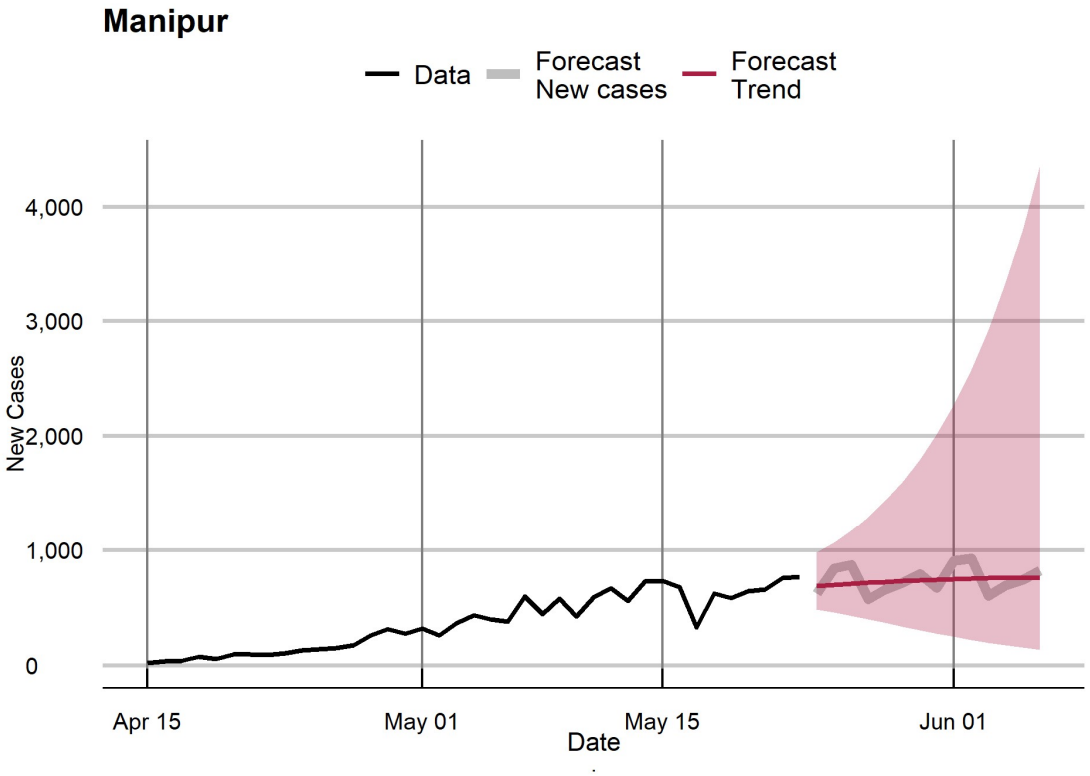

Kerala
Growth rate of daily cases
0.2
0.1
0.0
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

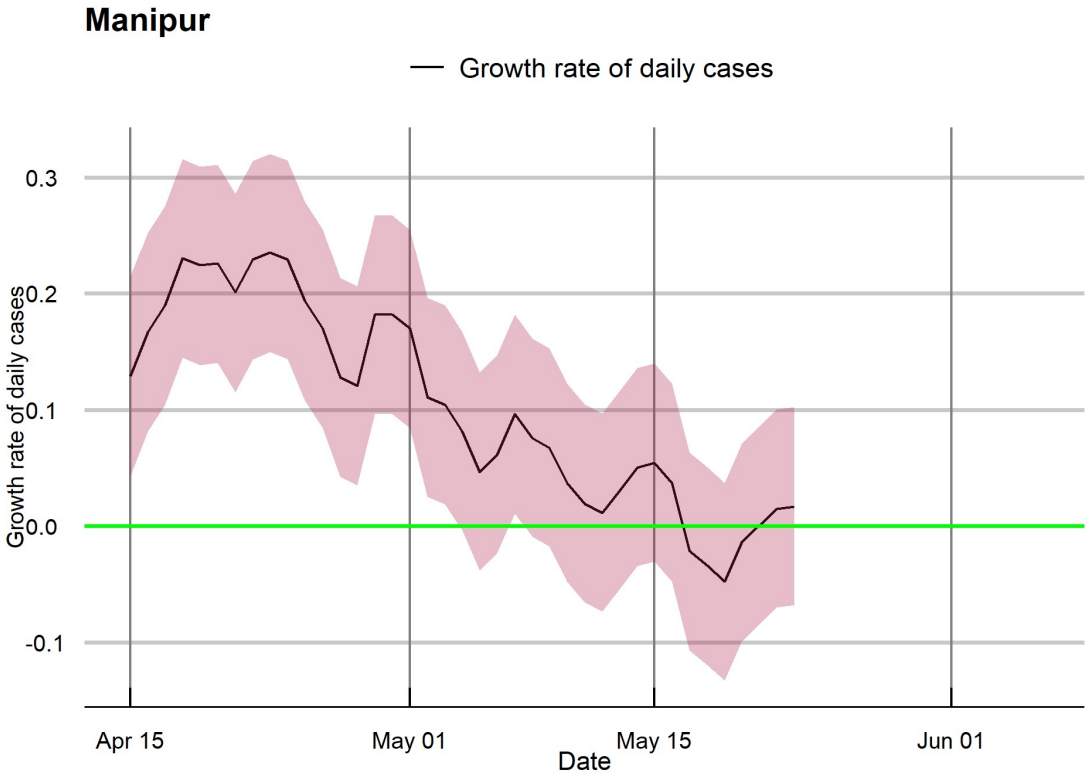

Madhya Pradesh
Data
Forecast
New cases
Forecast
Trend
10,000
5,000
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date

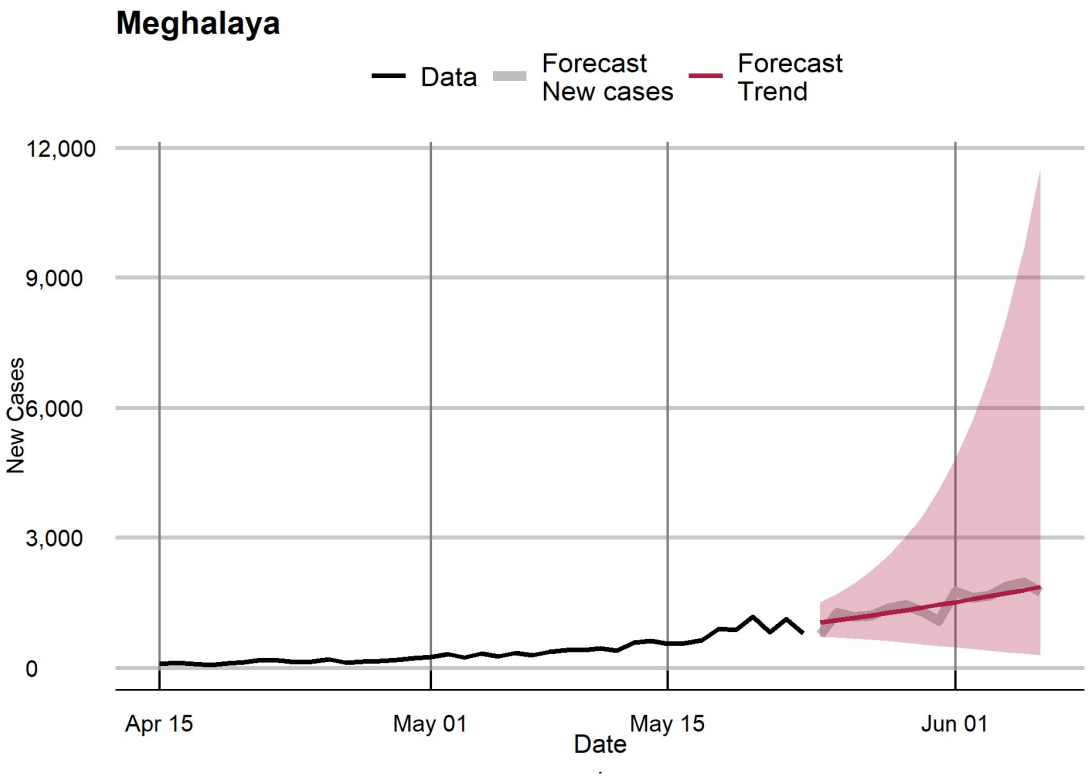

Madhya Pradesh
Growth rate of daily cases
0.15
0.10
0.05
0.00
-0.05
-0.10
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

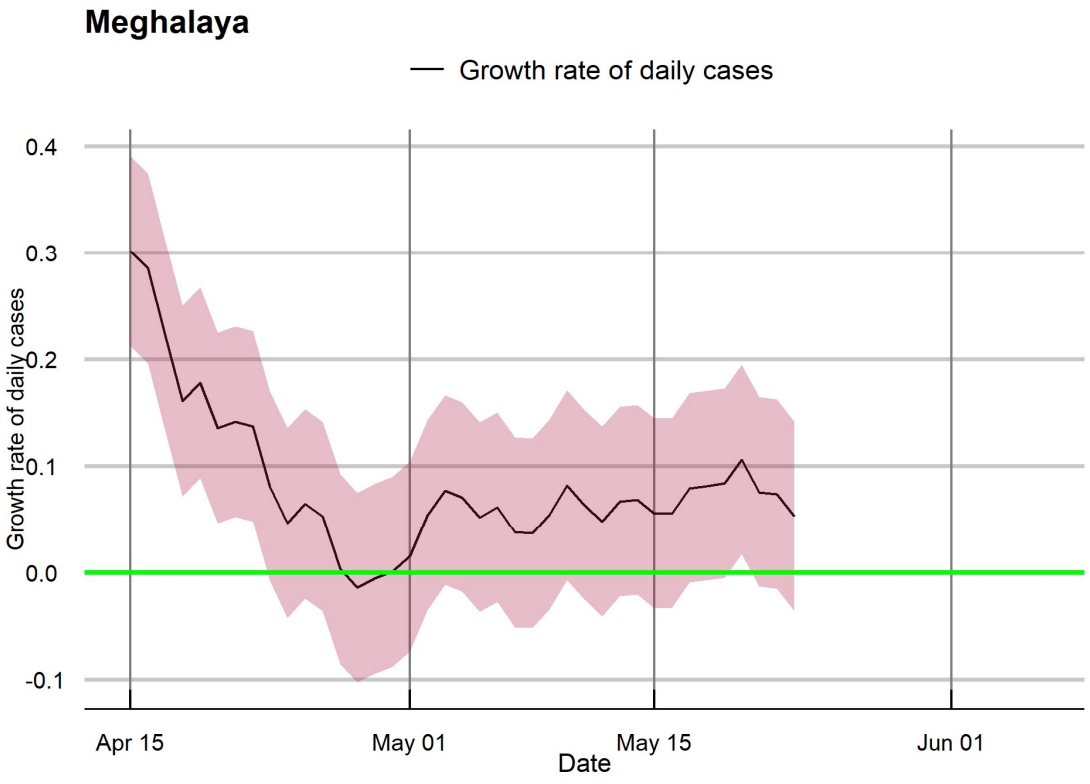

Maharashtra
Data
Forecast
New cases
Forecast
Trend
60,000
40,000
20,000
New Cases
Apr 15
May 01
May 15
Jun 01
Date

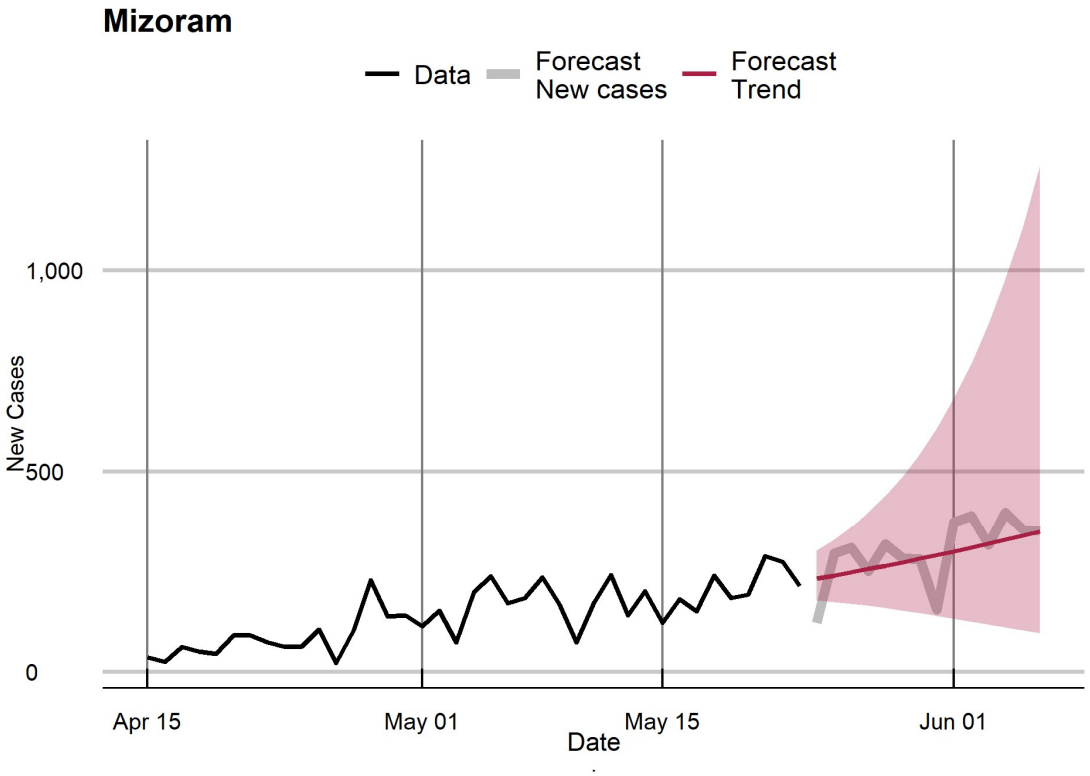

Maharashtra
Growth rate of daily cases
0.00
-0.05
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

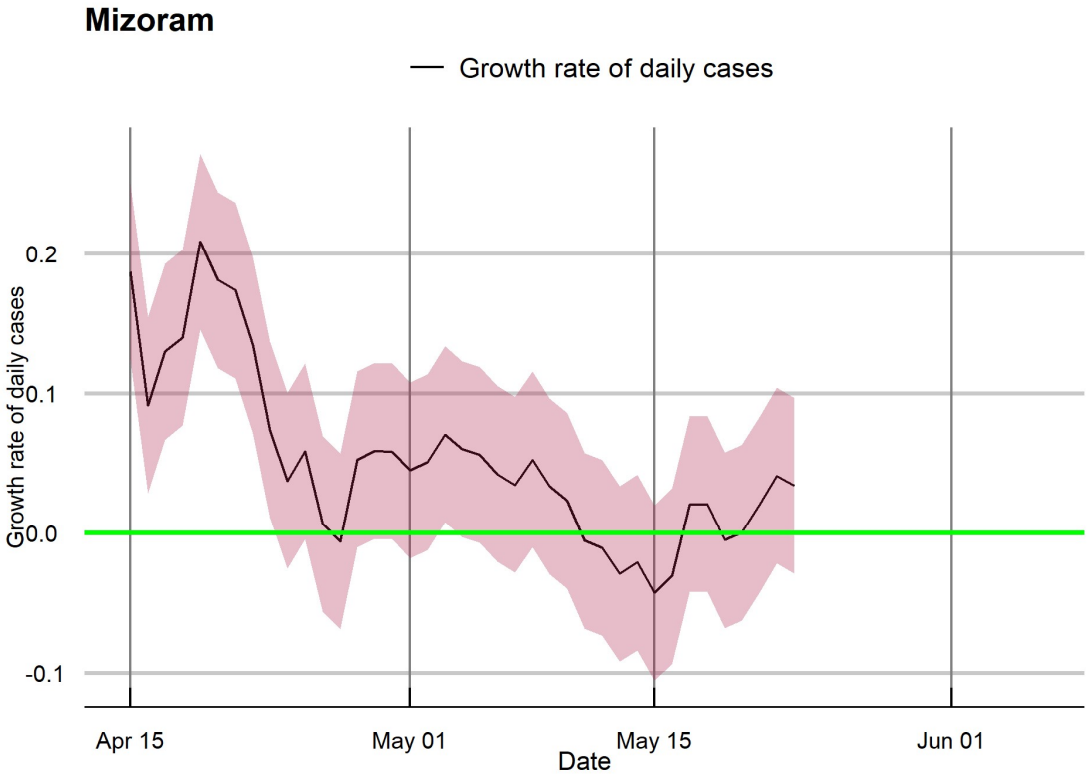

Manipur
Data
Forecast
New cases
Forecast
Trend
4,000
3,000
2,000
1,000
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date

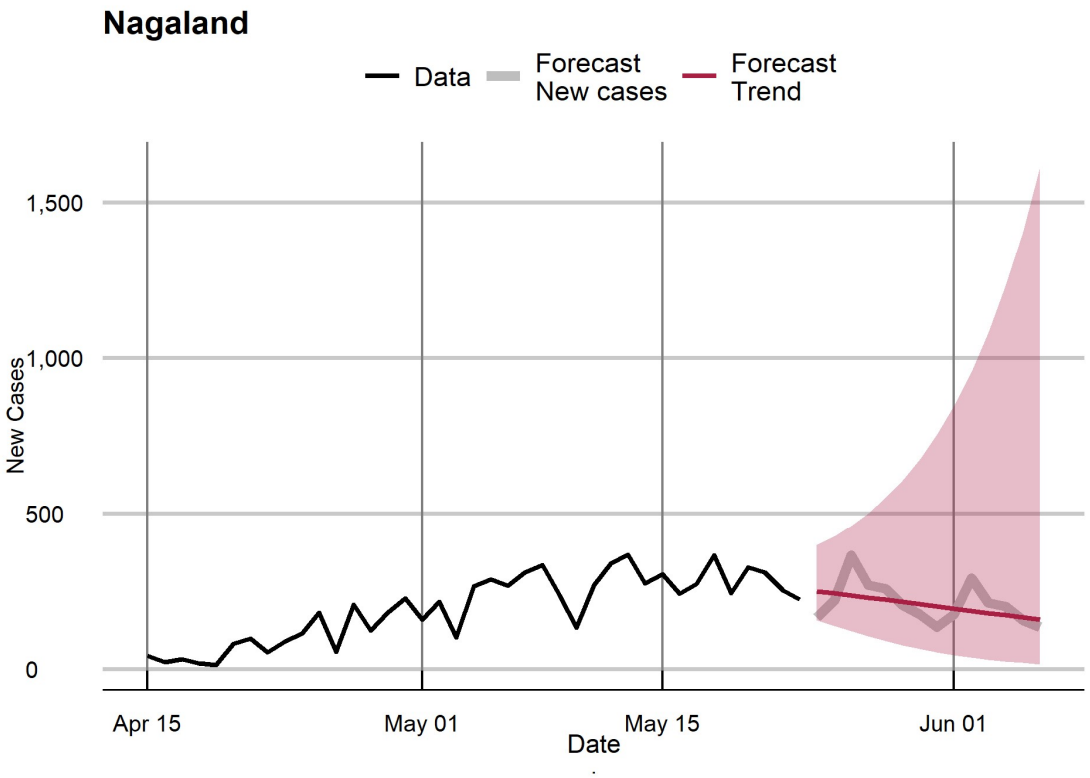

Manipur
Growth rate of daily cases
0.3
0.2
0.1
0.0
-0.1
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

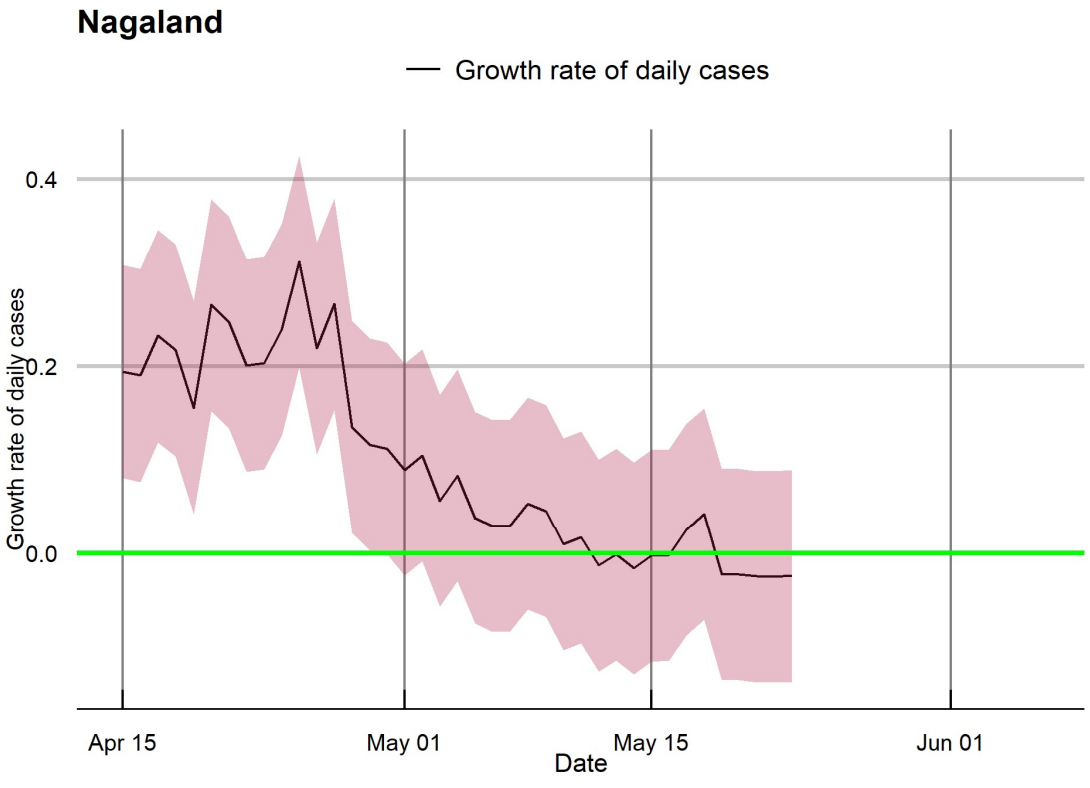

Meghalaya
Data
Forecast
New cases
Forecast
Trend
12,000
9,000
6,000
3,000
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date

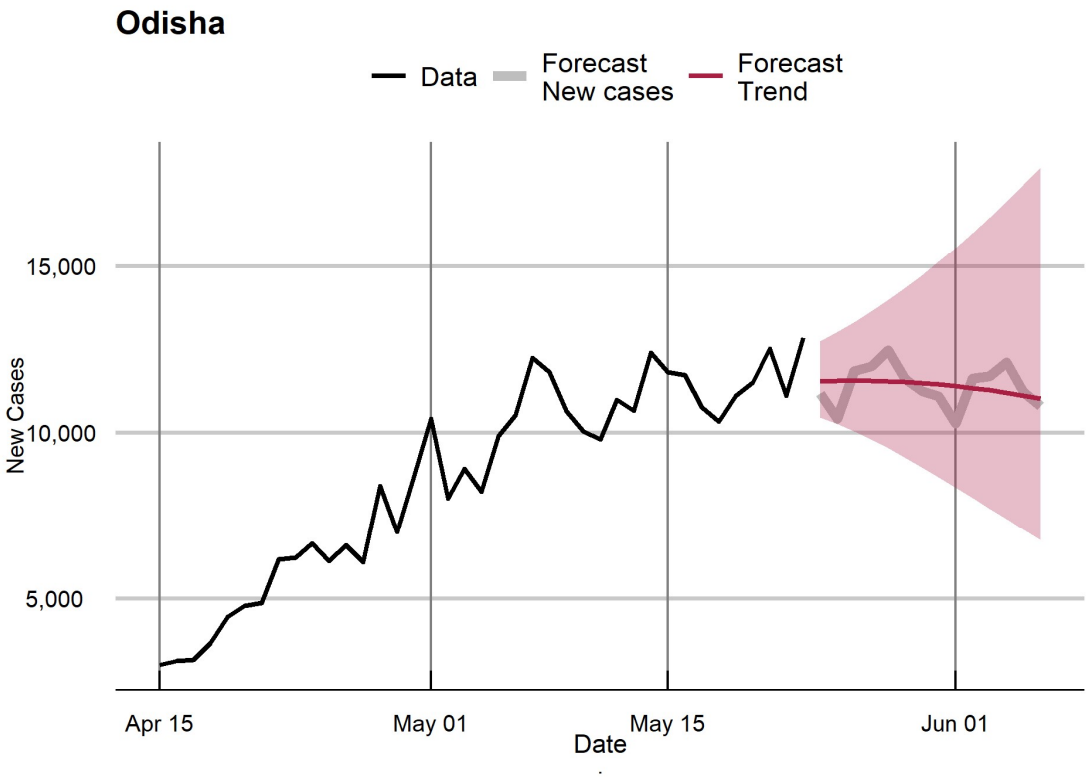

Meghalaya
Growth rate of daily cases
0.4
0.3
0.2
0.1
0.0
-0.1
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

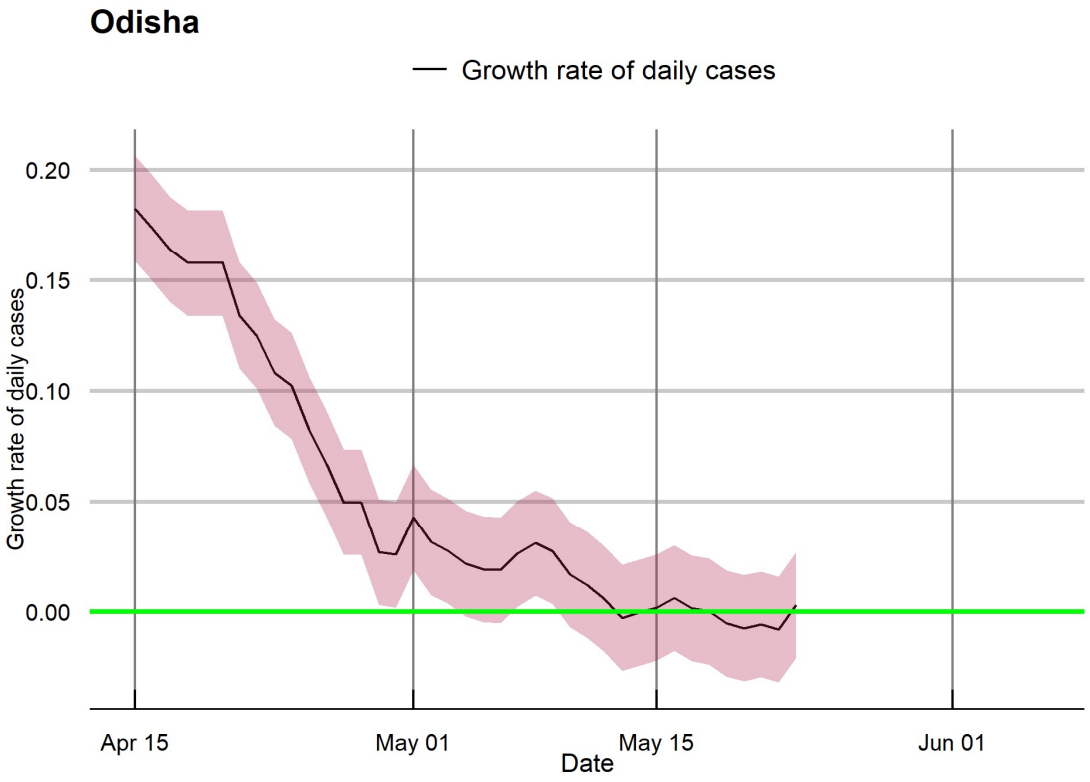

Mizoram
Data
Forecast
New cases
Forecast
Trend
1,000
500
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date

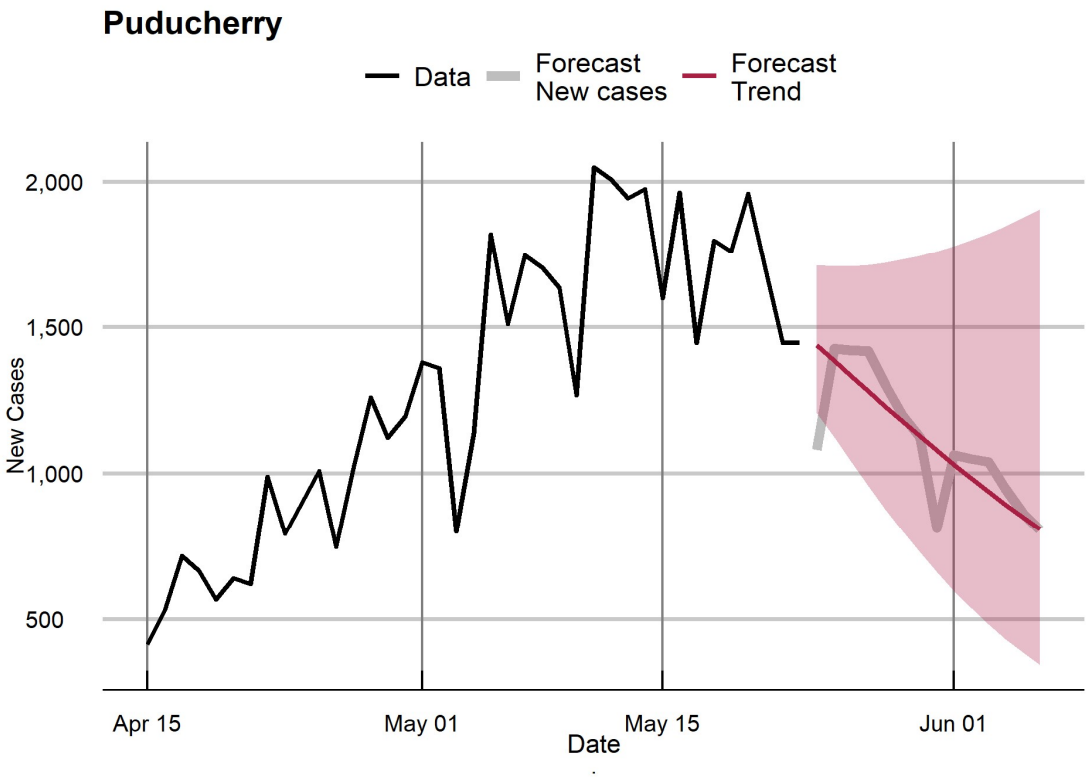

Mizoram
Growth rate of daily cases
0.2
0.1
0.0
-0.1
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

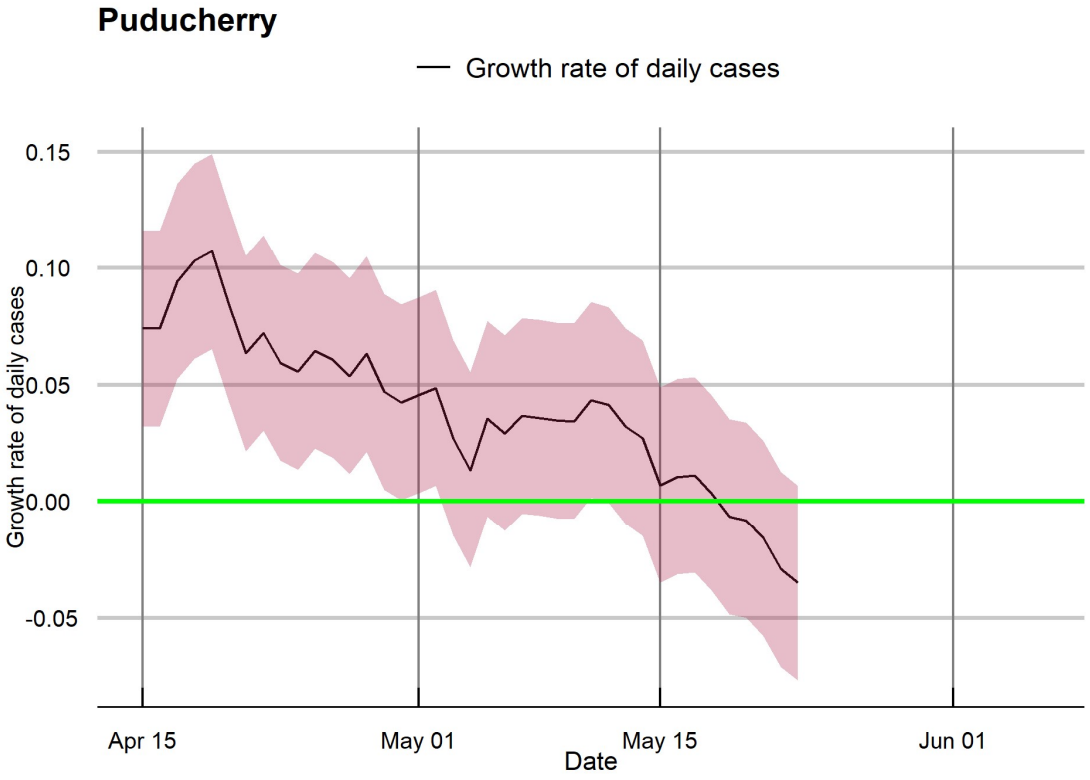

Nagaland
Data
Forecast
New cases
Forecast
Trend
1,500
1,000
500
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date

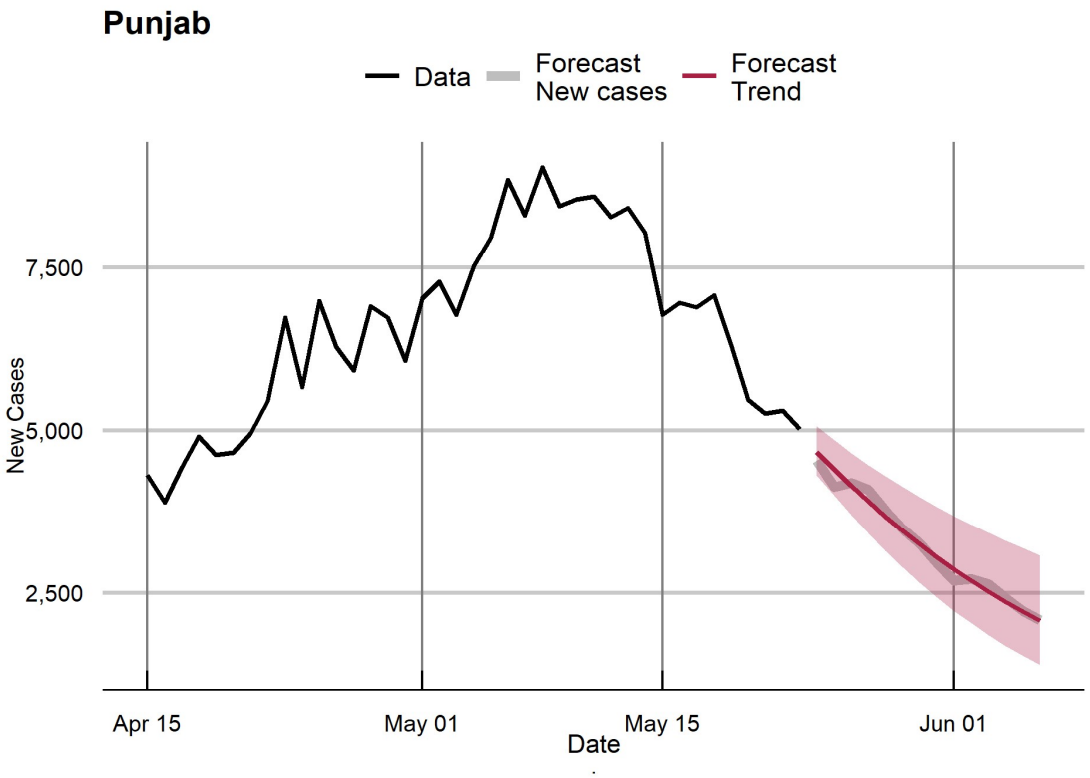

Nagaland
Growth rate of daily cases
0.4
0.2
0.0
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

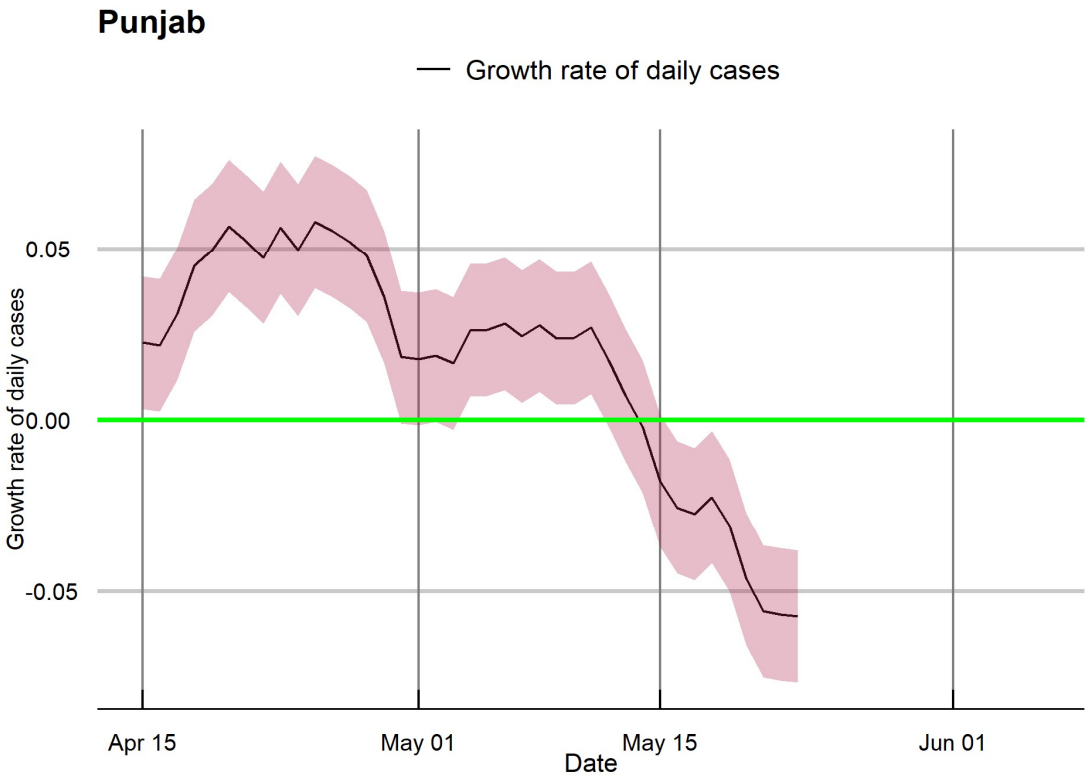

Odisha
Data
Forecast
New cases
Forecast
Trend
15,000
10,000
5,000
New Cases
Apr 15
May 01
May 15
Jun 01
Date

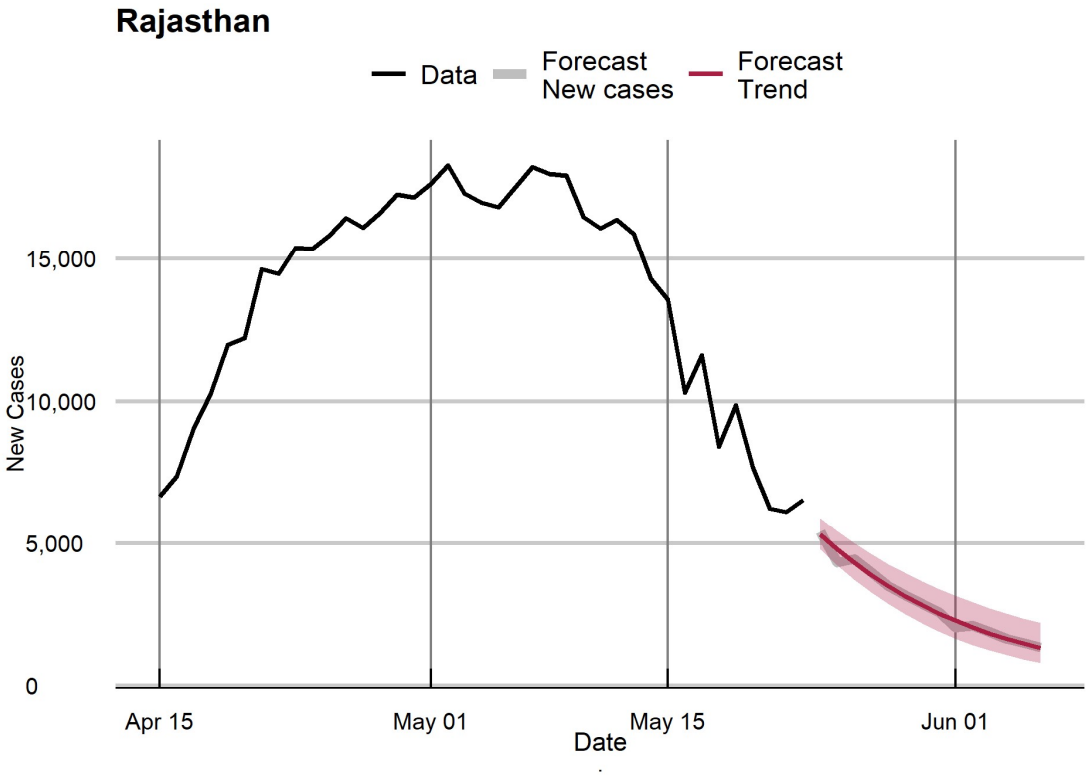

Odisha
Growth rate of daily cases
0.20
0.15
0.10
0.05
0.00
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

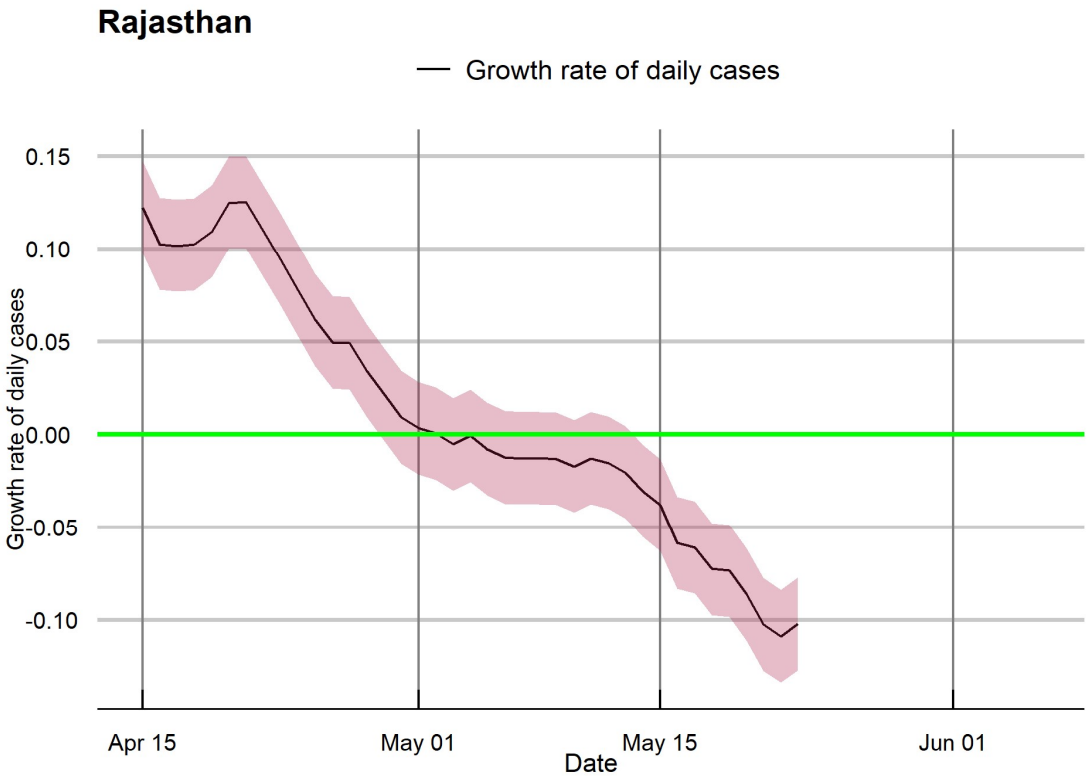

Puducherry
Data
Forecast
New cases
Forecast
Trend
2,000
1,500
1,000
500
New Cases
Apr 15
May 01
May 15
Jun 01
Date

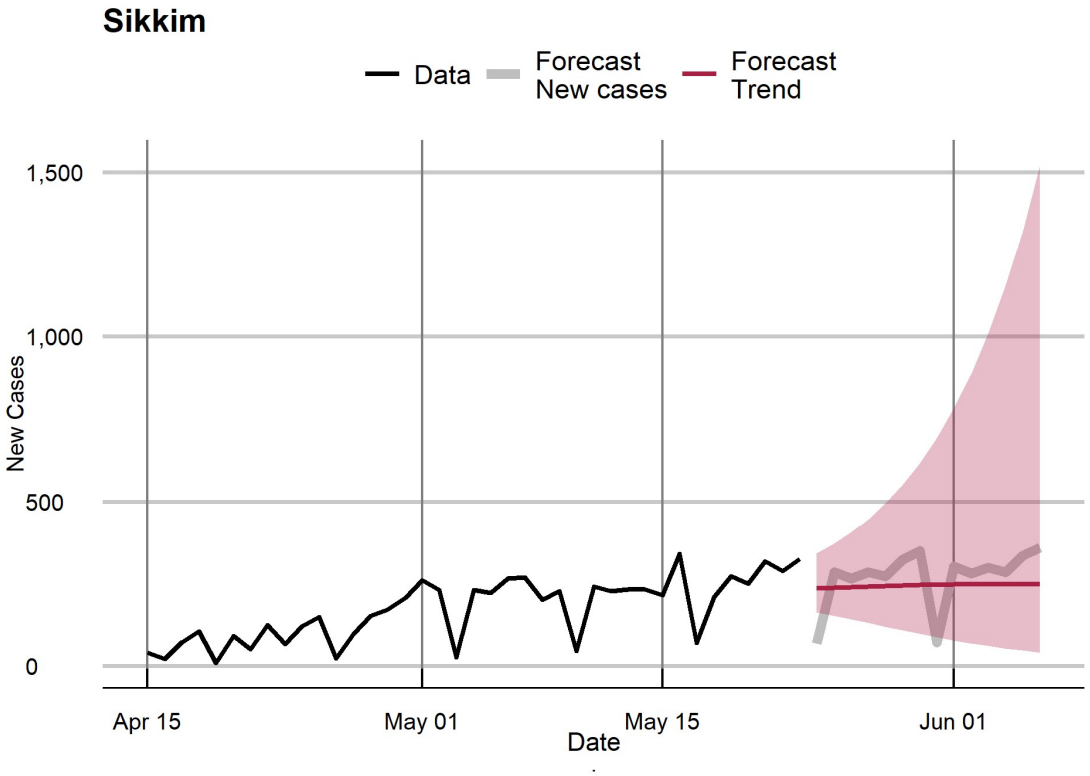

Puducherry
Growth rate of daily cases
0.15
0.10
0.05
0.00
-0.05
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

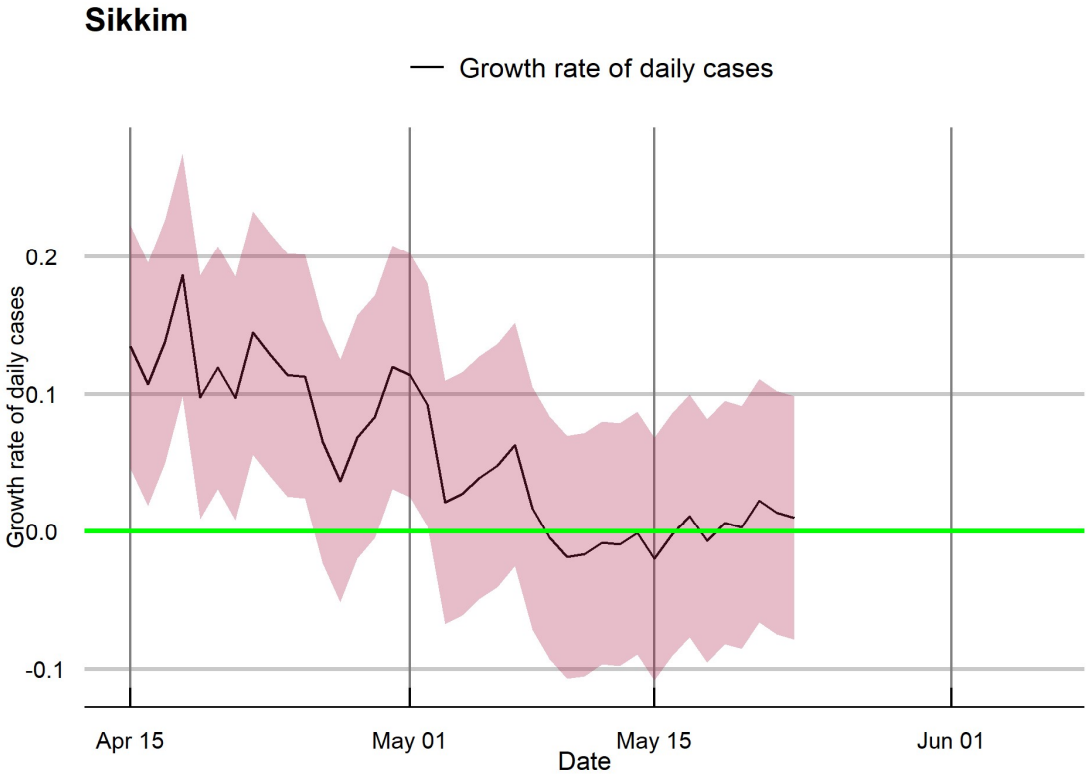

Punjab
Data
Forecast
New cases
Forecast
Trend
7,500
5,000
2,500
New Cases
Apr 15
May 01
May 15
Jun 01
Date

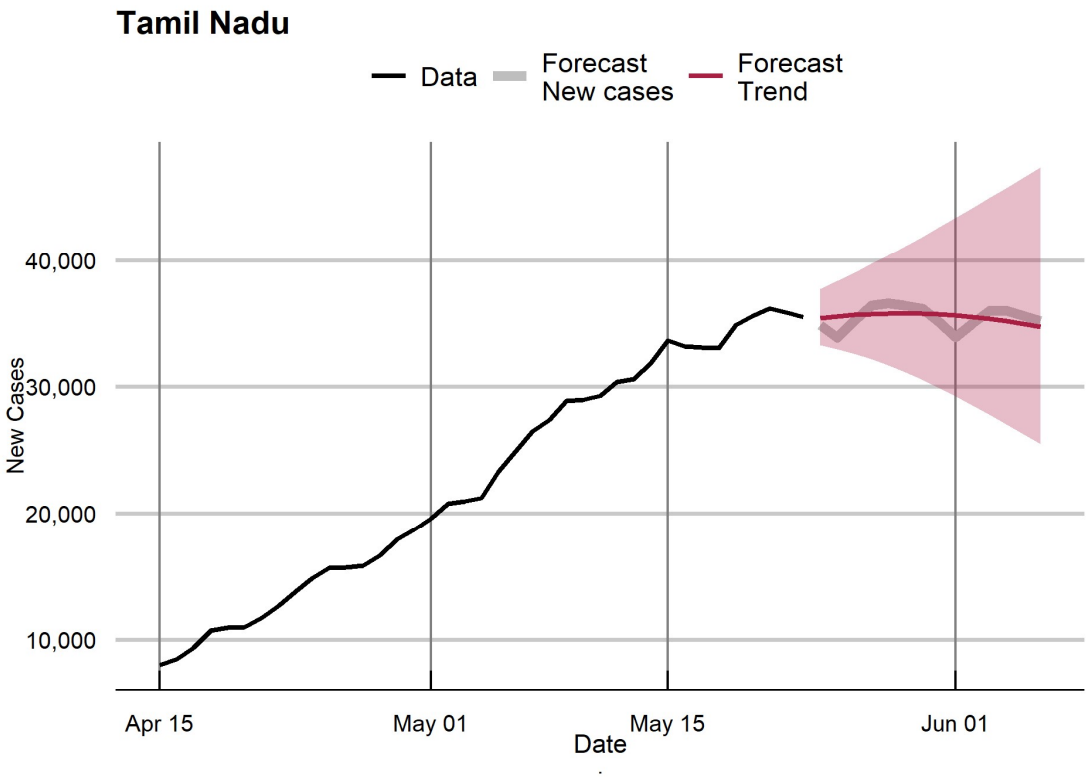

Punjab
Growth rate of daily cases
0.05
0.00
-0.05
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

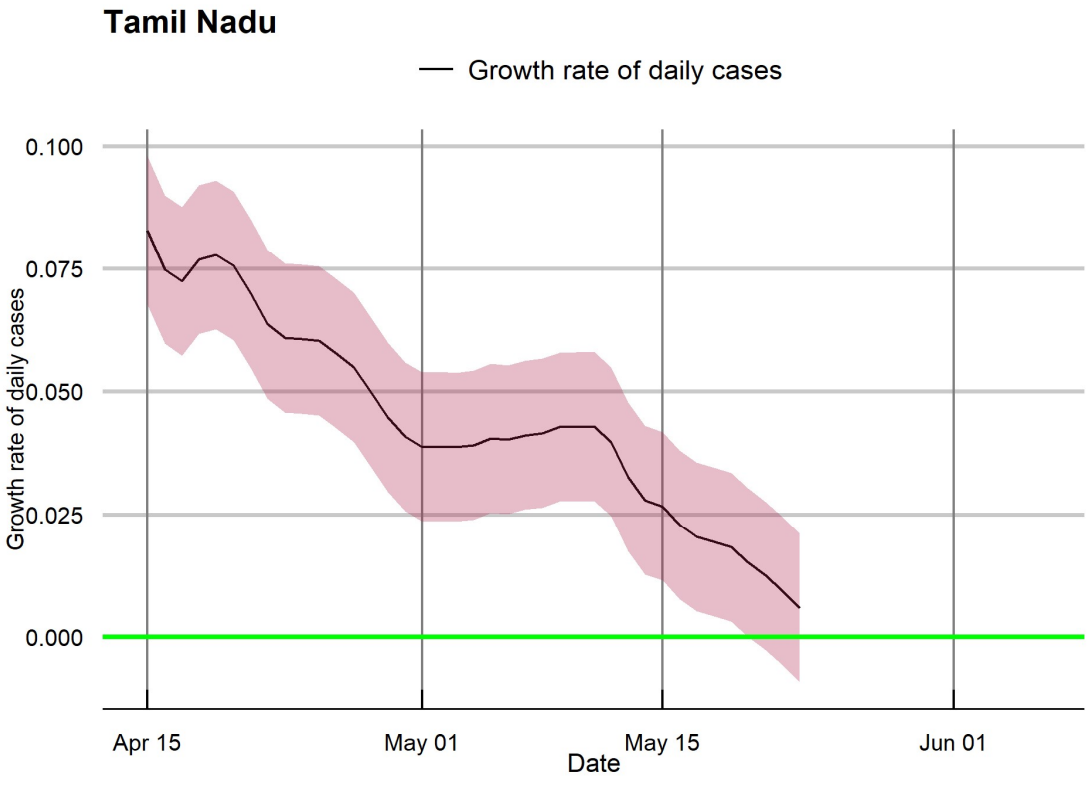

Rajasthan
Data
Forecast
New cases
Forecast
Trend
15,000
10,000
5,000
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date

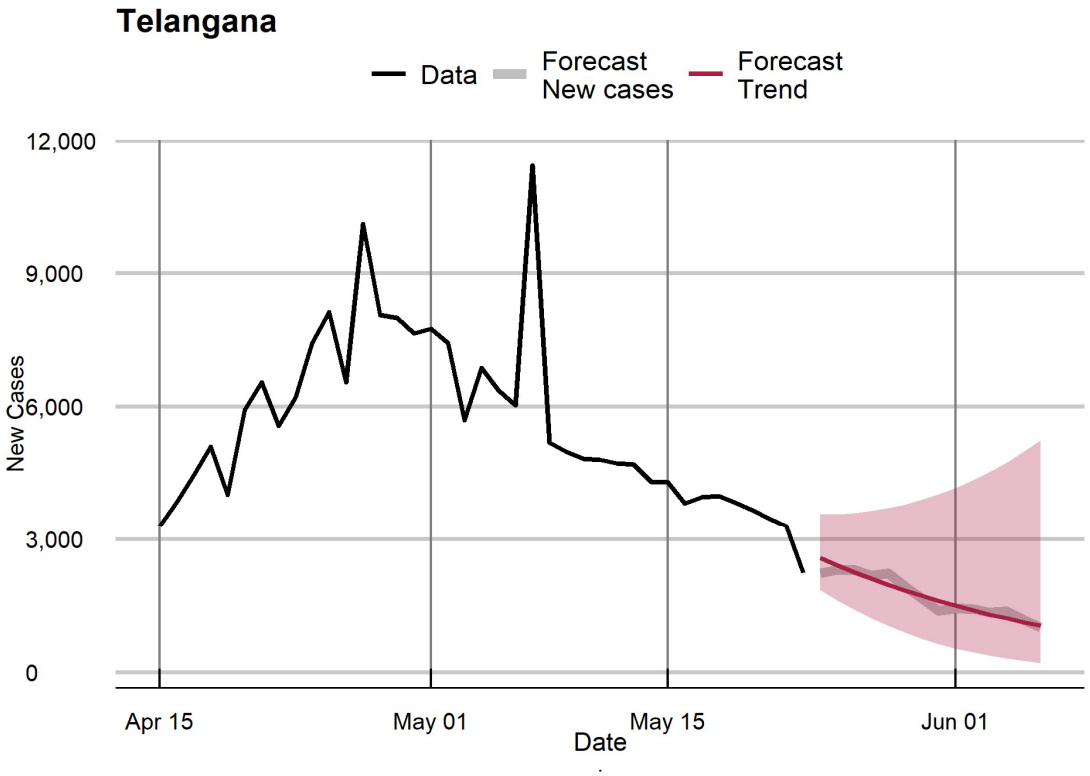

Rajasthan
Growth rate of daily cases
0.15
0.10
0.05
0.00
-0.05
-0.10
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

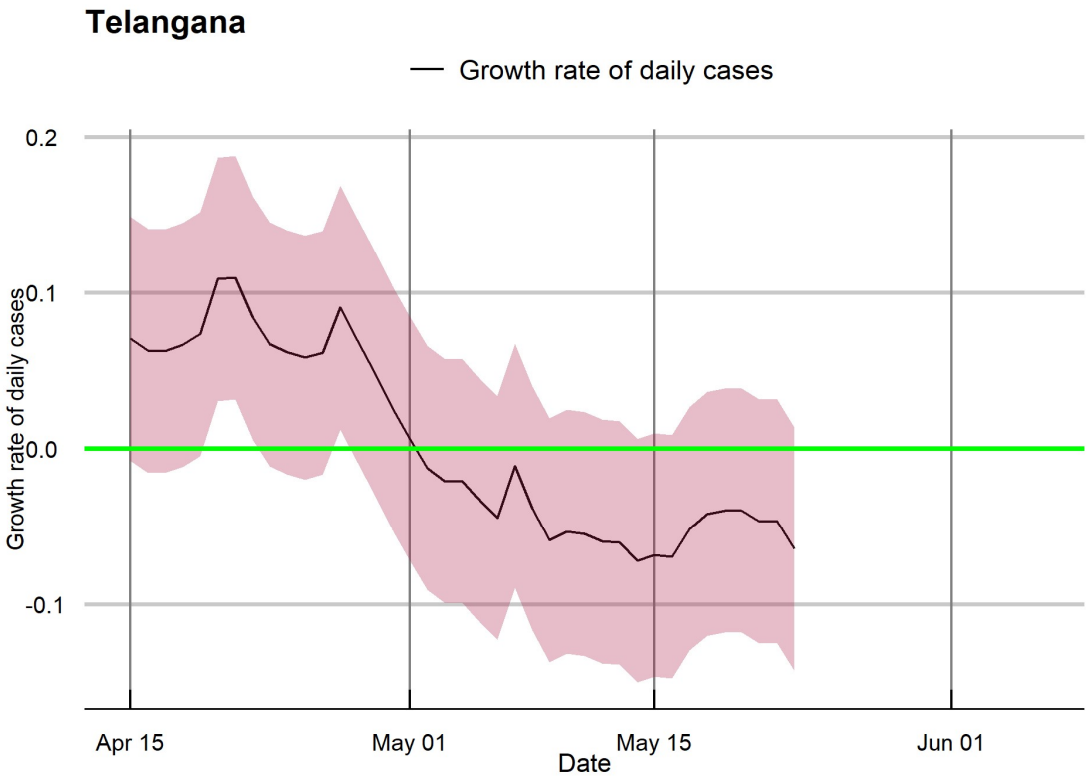

Sikkim
Data
Forecast
New cases
Forecast
Trend
1,500
1,000
500
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date

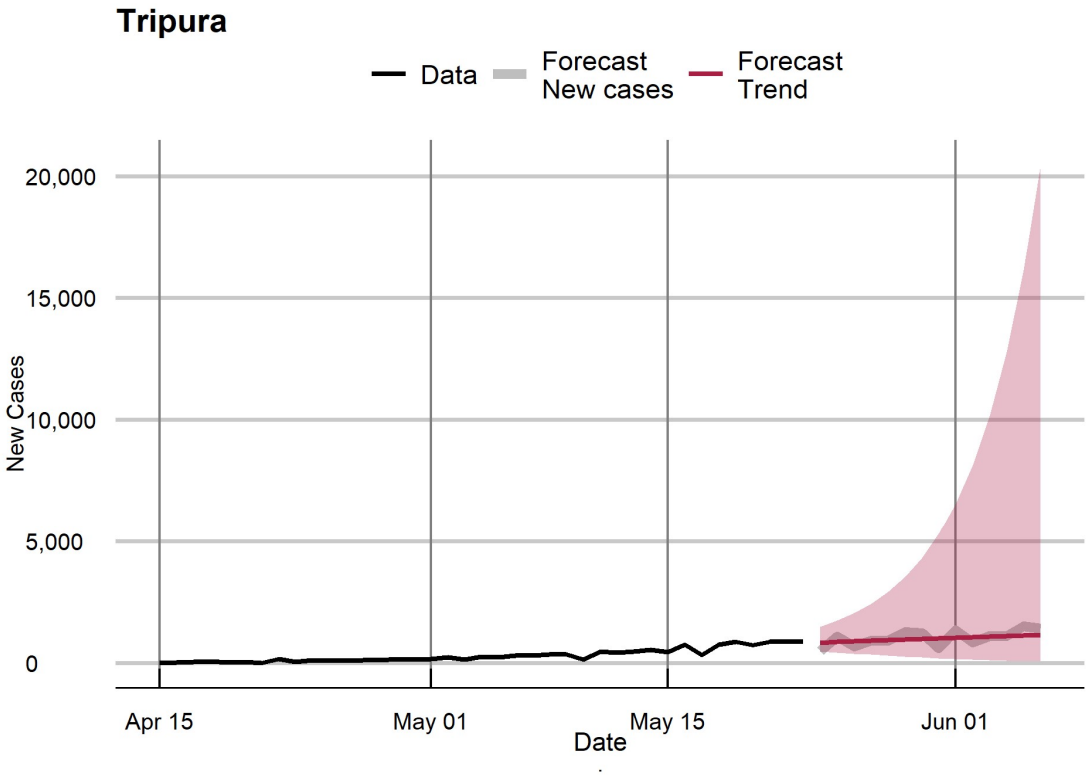

Sikkim
Growth rate of daily cases
0.2
0.1
0.0
-0.1
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

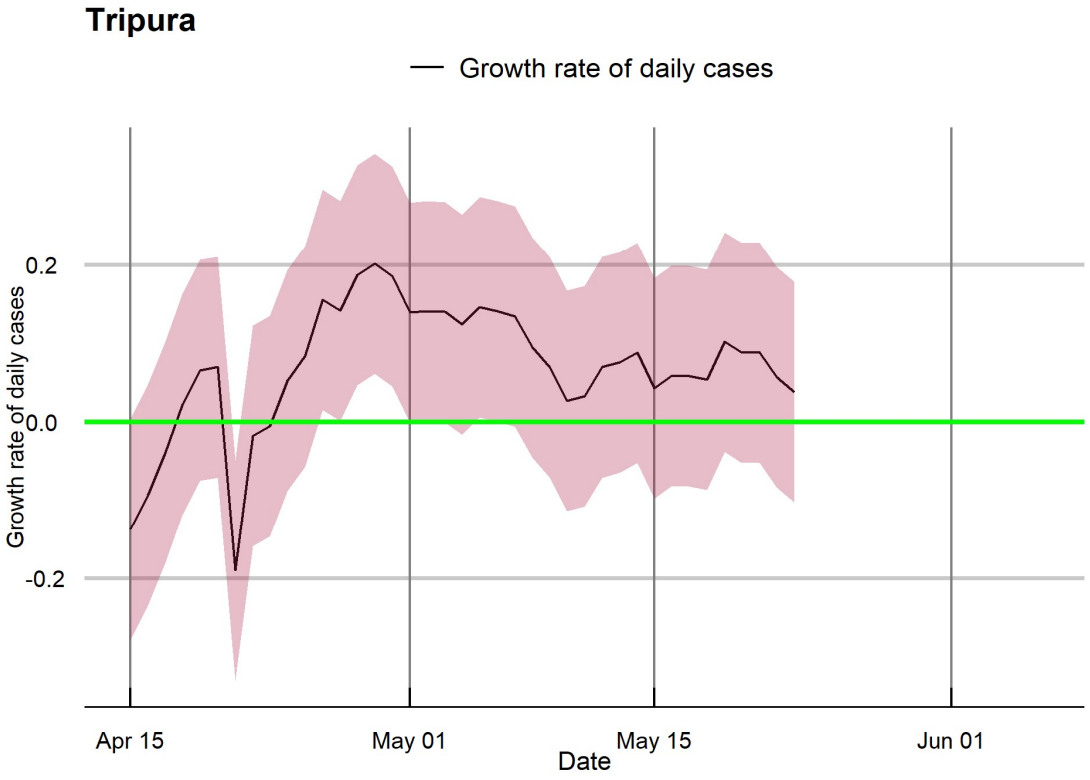

Tamil Nadu
Data
Forecast
New cases
Forecast
Trend
40,000
30,000
20,000
10,000
New Cases
Apr 15
May 01
May 15
Jun 01
Date

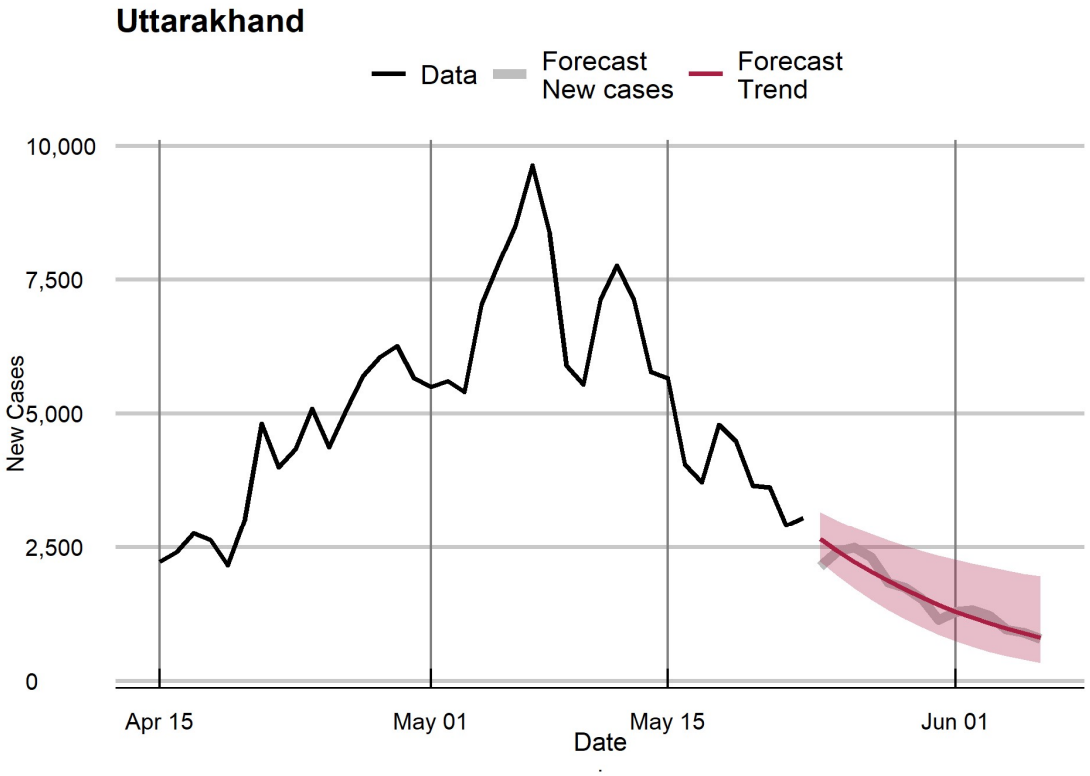

Tamil Nadu
Growth rate of daily cases
0.100
0.075
0.050
0.025
0.000
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

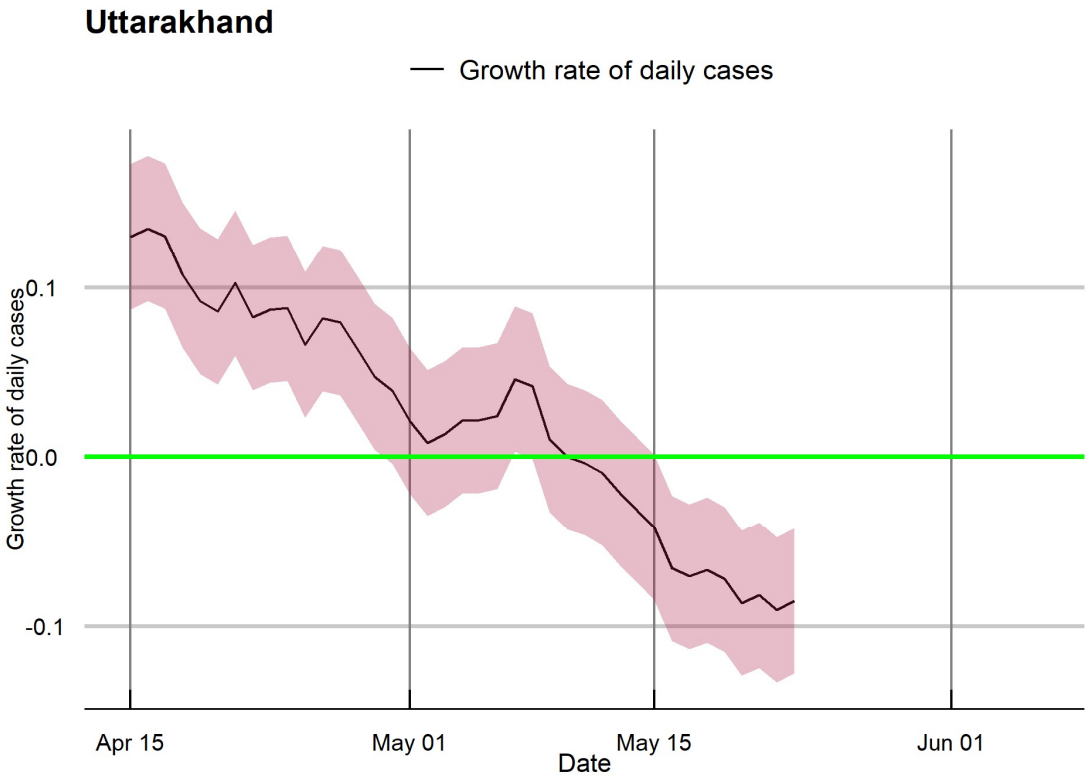

Telangana
Data
Forecast
New cases
Forecast
Trend
12,000
9,000
6,000
3,000
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date

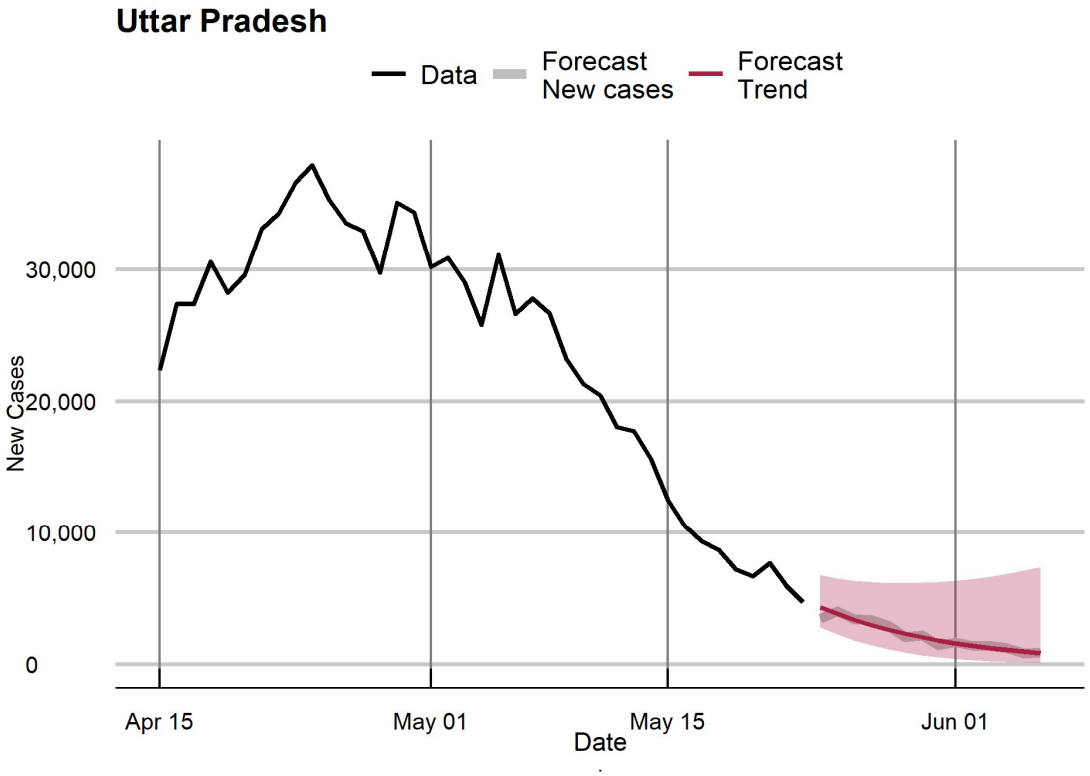

Telangana
Growth rate of daily cases
0.2
0.1
0.0
-0.1
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

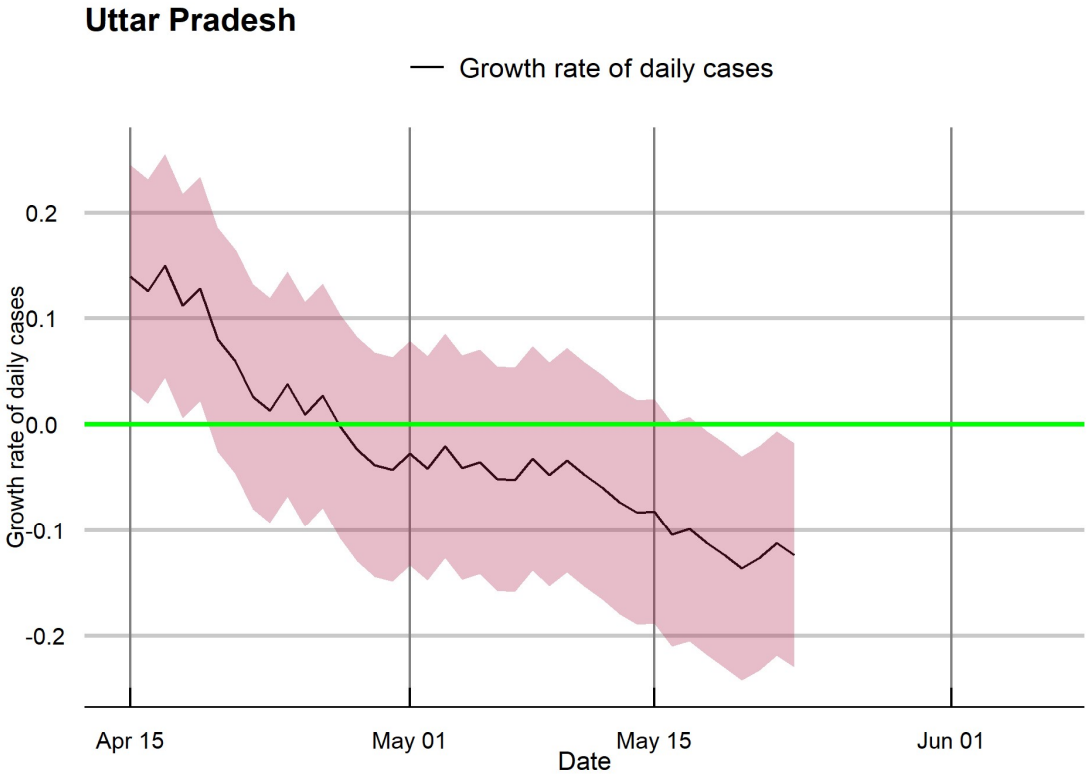

Tripura
Data
Forecast
New cases
Forecast
Trend
20,000
15,000
10,000
5,000
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date

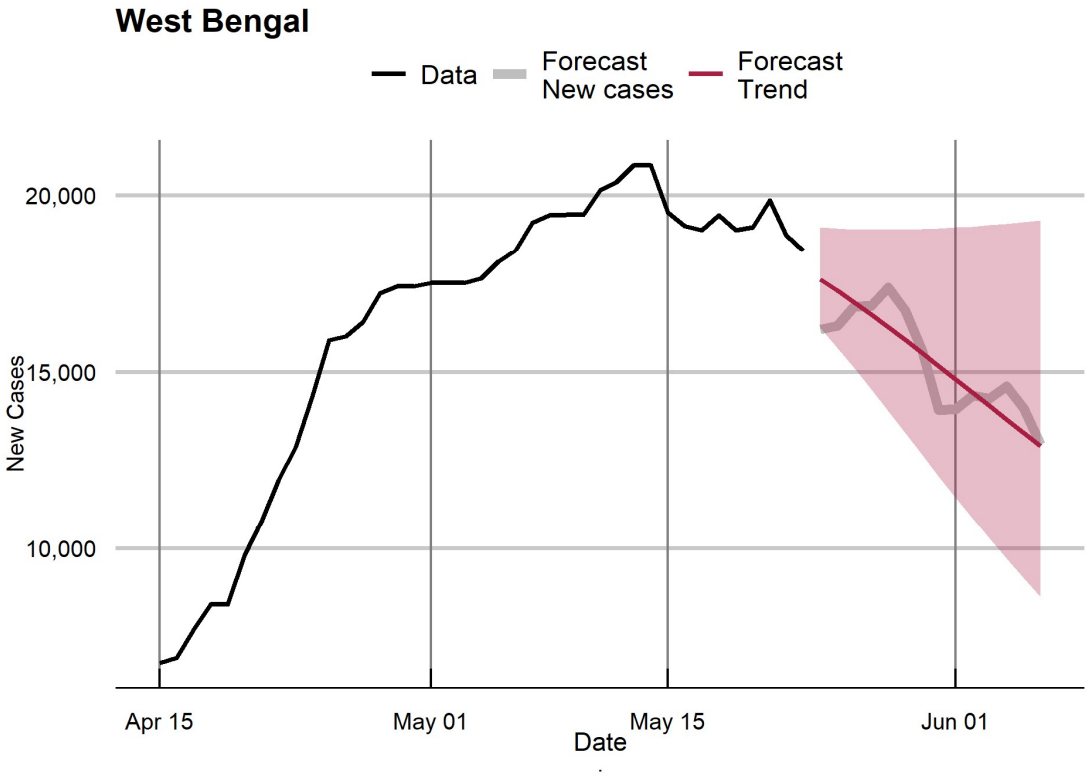

Tripura
Growth rate of daily cases
0.2
0.0
-0.2
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

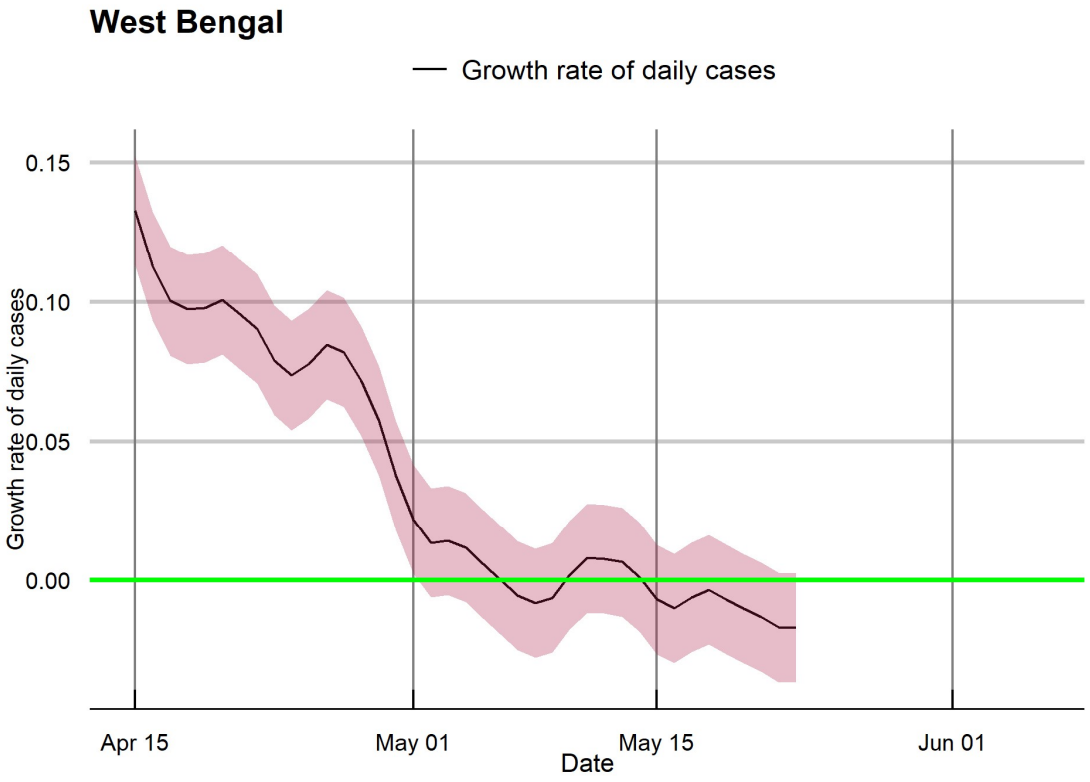

Uttarakhand
Data
Forecast
New cases
Forecast
Trend
10,000
7,500
5,000
2,500
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date


Uttarakhand
Growth rate of daily cases
0.1
0.0
-0.1
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date


Uttar Pradesh
Data
Forecast
New cases
Forecast
Trend
30,000
20,000
10,000
0
New Cases
Apr 15
May 01
May 15
Jun 01
Date


Uttar Pradesh
Growth rate of daily cases
0.2
0.1
0.0
-0.1
-0.2
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date


West Bengal
Data
Forecast
New cases
Forecast
Trend
20,000
15,000
10,000
New Cases
Apr 15
May 01
May 15
Jun 01
Date


West Bengal
Growth rate of daily cases
0.15
0.10
0.05
0.00
Growth rate of daily cases
Apr 15
May 01
May 15
Jun 01
Date

Notes

Data: COVID-19 confirmed cases and deaths data are sourced from COVID19-India API: https://api.covid19india.org/

New cases: forecasts. Forecasts above are based on a structural time series model that uses all the data in estimation but adapts to the trend emerging in the most recent period. The method is described in: Harvey, A. and P. Kattuman (2020). Time series models based on growth curves with applications to forecasting coronavirus. *Harvard Data Science Review*, Special issue 1 - COVID -19. https://hdsr.mitpress.mit.edu/pub/ozgjx0yn/release/2 , and Harvey, A., P. Kattuman, and C. Thamotheram (2021). Tracking the mutant: forecasting and nowcasting COVID-19 in the UK in 2021. *National Institute Economic Review*. Forthcoming.

Forecast accuracy: When estimated with data up to May 16, the mean absolute percentage error of the forecasts of cases for India over the 7 day period, May 17-23, is 6.6%. Forecast accuracy will in general be lower for the smaller states / union territories. It is important to pay attention to the confidence intervals around the forecasts. The coverage of the confidence intervals presented is 68%, implying there is 16% probability of the upper bound being exceeded.

New cases: growth rate. The filtered trends presented for daily growth rates of cases are estimated using the Kalman filter, applied to the observed series. The method filters out day of the week effects and random noise to reveal the underlying signal. Unlike methods such as the moving average, this method adapts the trend to changes in real time and characterises underlying patterns of surges or attenuations that are hidden in the volatile series. The method is described in the papers listed above.

***R*:** The *R*-estimation approach is described in Harvey, A. and P. Kattuman (2020b). A farewell to R: Time series models for tracking and forecasting epidemics. *Center for Economic Policy Research* (CEPR) working paper, 51. https://cepr.org/content/covid-economics. The confidence interval is based on one standard deviation, with coverage of 68%.

The accuracy of forecasts rely on the quality of the published data. Further, changes in government pandemic policies and in transmission relevant social behaviour will realised numbers to depart from forecasts.

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