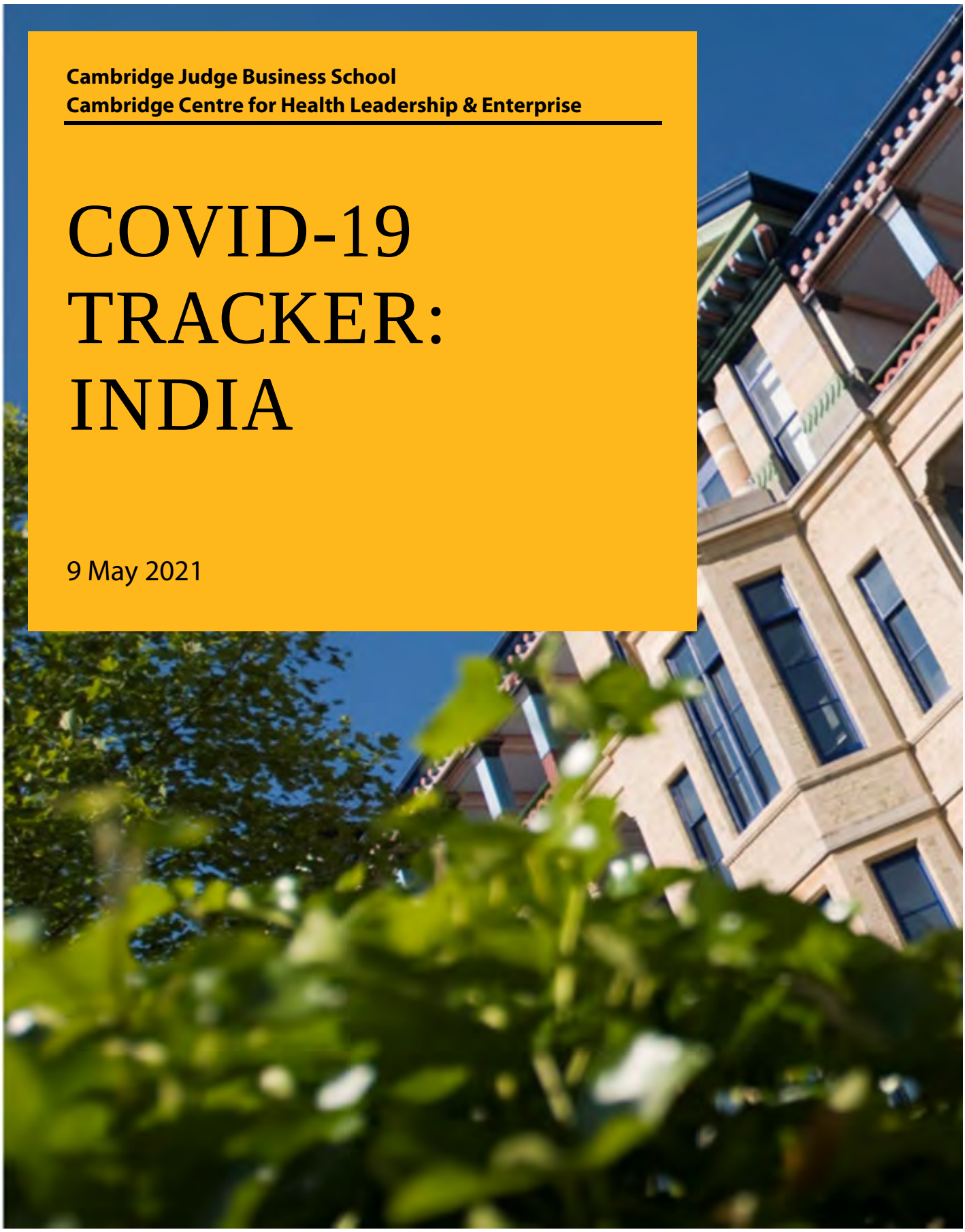
Cambridge Judge Business School
Cambridge Centre for Health Leadership & Enterprise

COVID-19 TRACKER: INDIA

9 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 near 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 the recently published paper by Andrew Harvey, Emeritus Professor of Econometrics at the Faculty of Economics of the University of Cambridge, and Paul Kattuman, Reader in Economics at Cambridge Judge Business School, entitled "Time series models based on growth curves with applications to forecasting coronavirus". *Harvard Data Science Review*, Special issue 1 - COVID -19.

Indian states and union territories vary considerably in near term trajectories of COVID-19 cases.

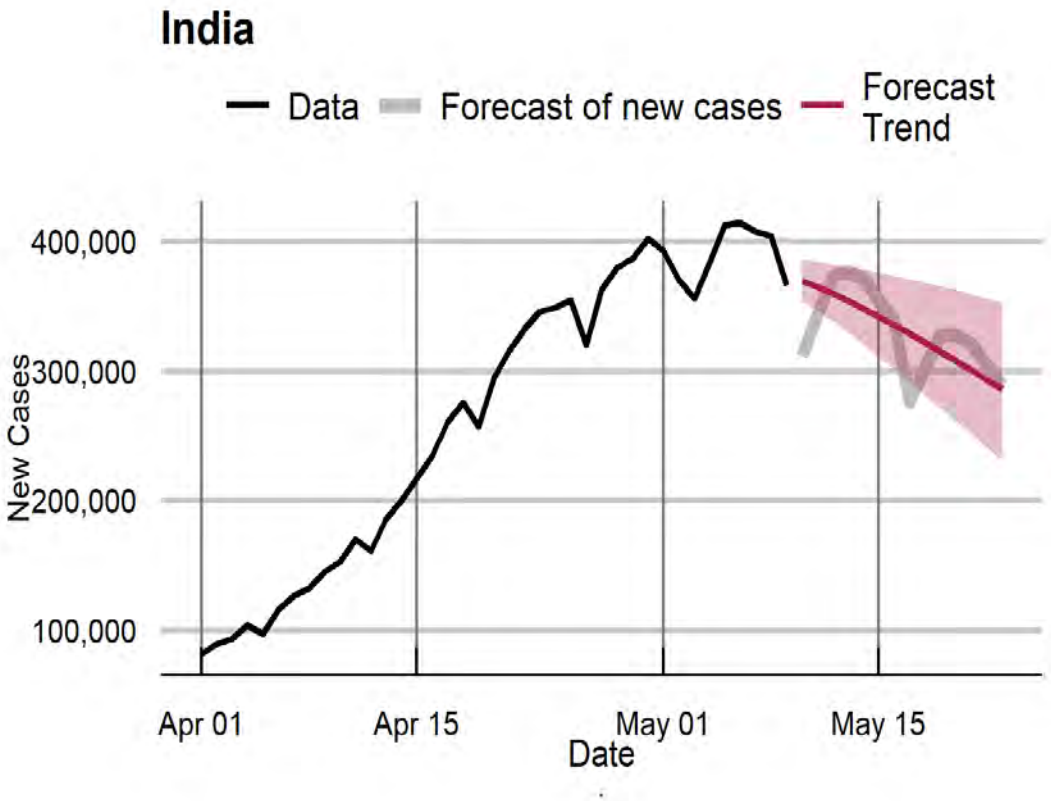
Trend values of daily new cases are forecast to continue to increase over the next two weeks for: Tripura, Himachal Pradesh, Meghalaya, Manipur, Tamil Nadu, Jammu and Kashmir, Mizoram, Puducherry, Punjab, Nagaland, Assam and Odisha.

The filtered daily growth rates at the end of the observation period on 9 May exceeded 5% for: Tripura (implying a doubling time of 8 days), Manipur (doubling time of 11 days), Himachal Pradesh (12 days) and Meghalaya (14 days).

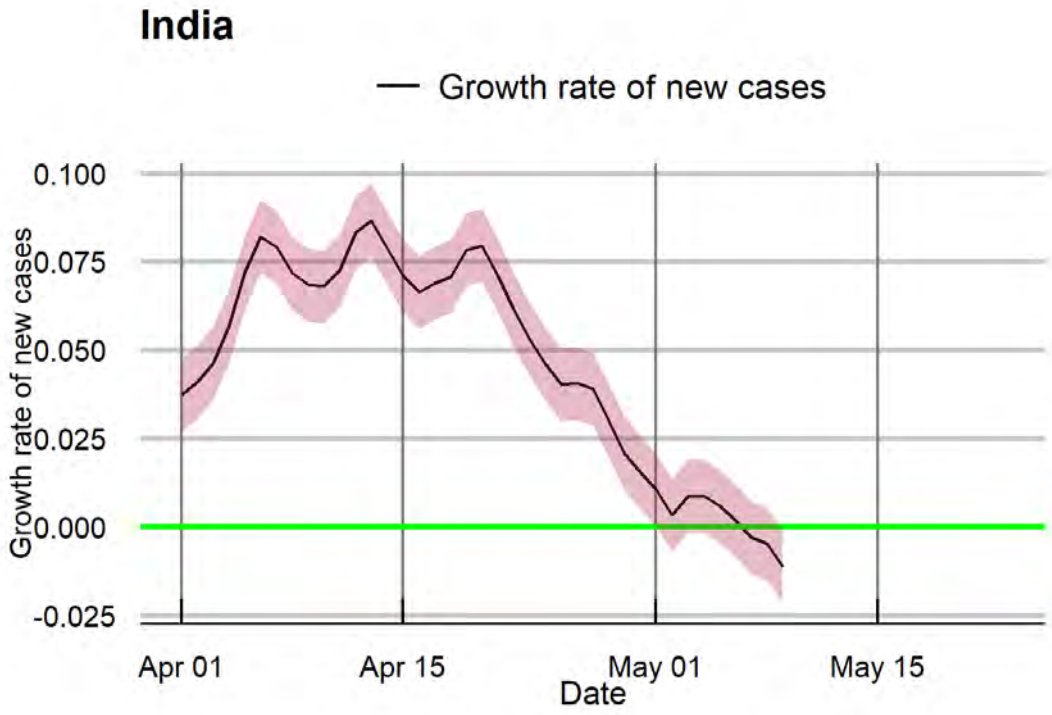
The quality of forecasts rely on the quality of the published data. Further, near term changes in government pandemic policies, as well as transmission relevant social behaviour will realised numbers to depart from forecasts.

[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>

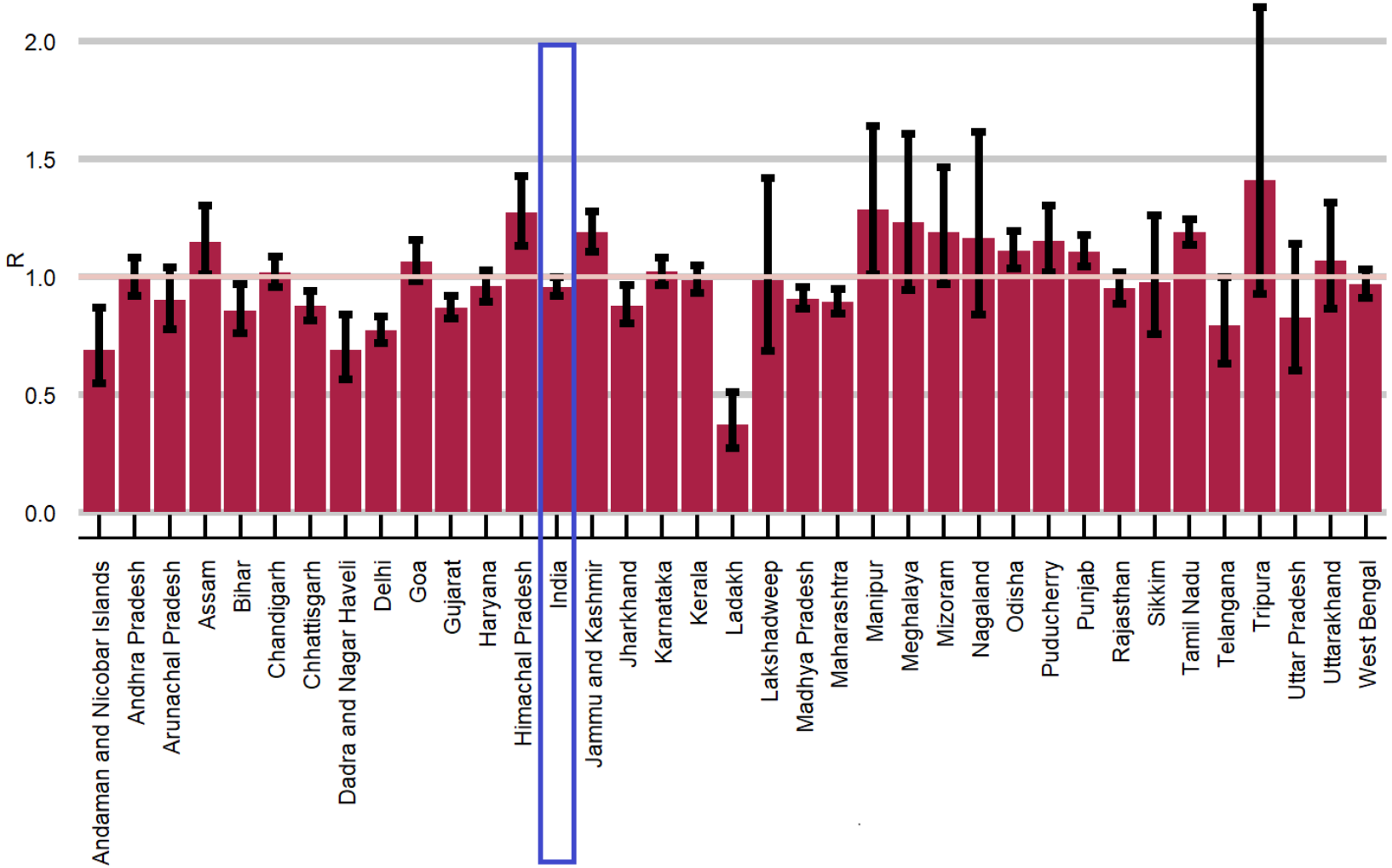


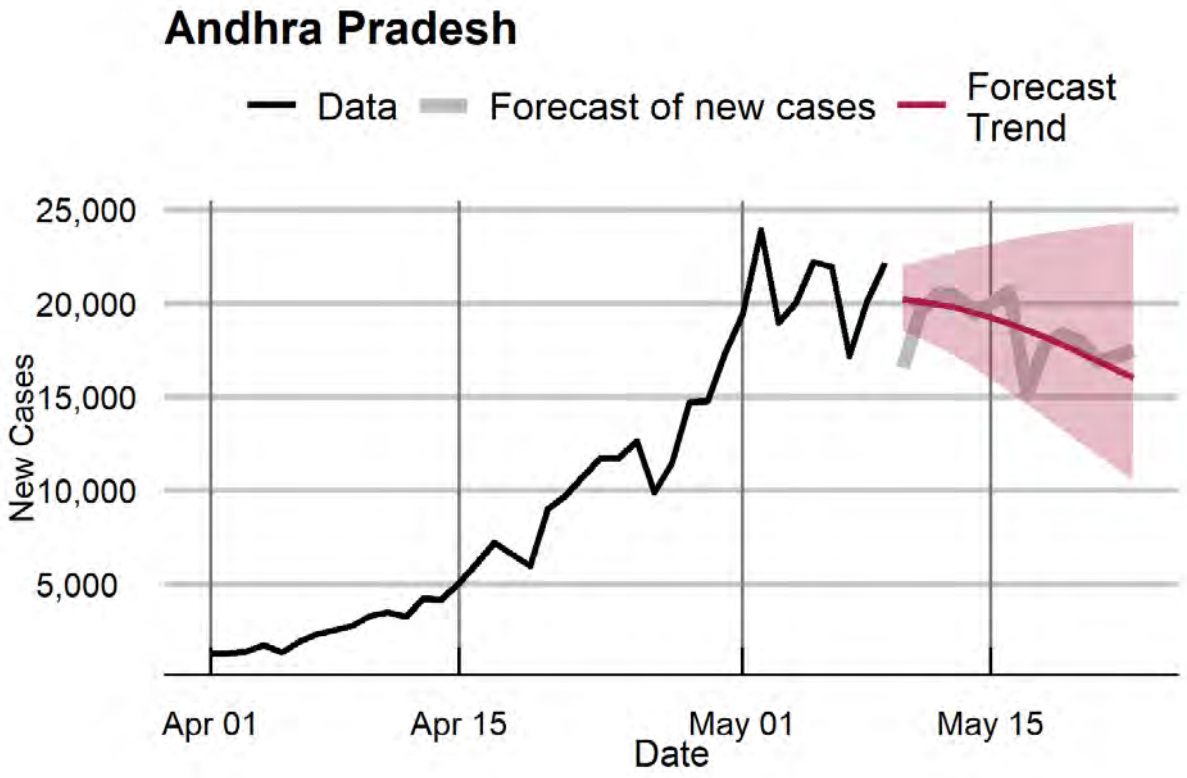
Forecasts of daily new cases are for the period May 10 to 22 , 2021, based on data till 9 May 2021.

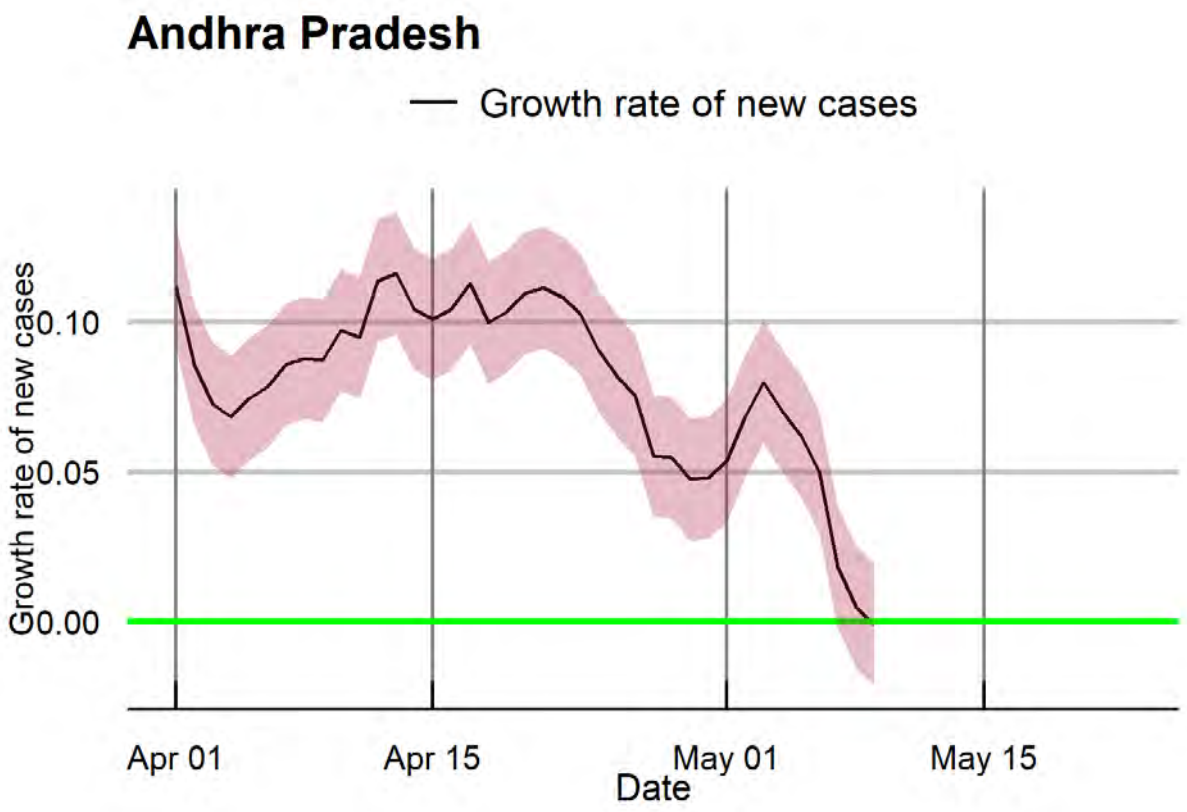


The filtered trend in the growth rate of daily new cases. Final date: 9 May 2021.

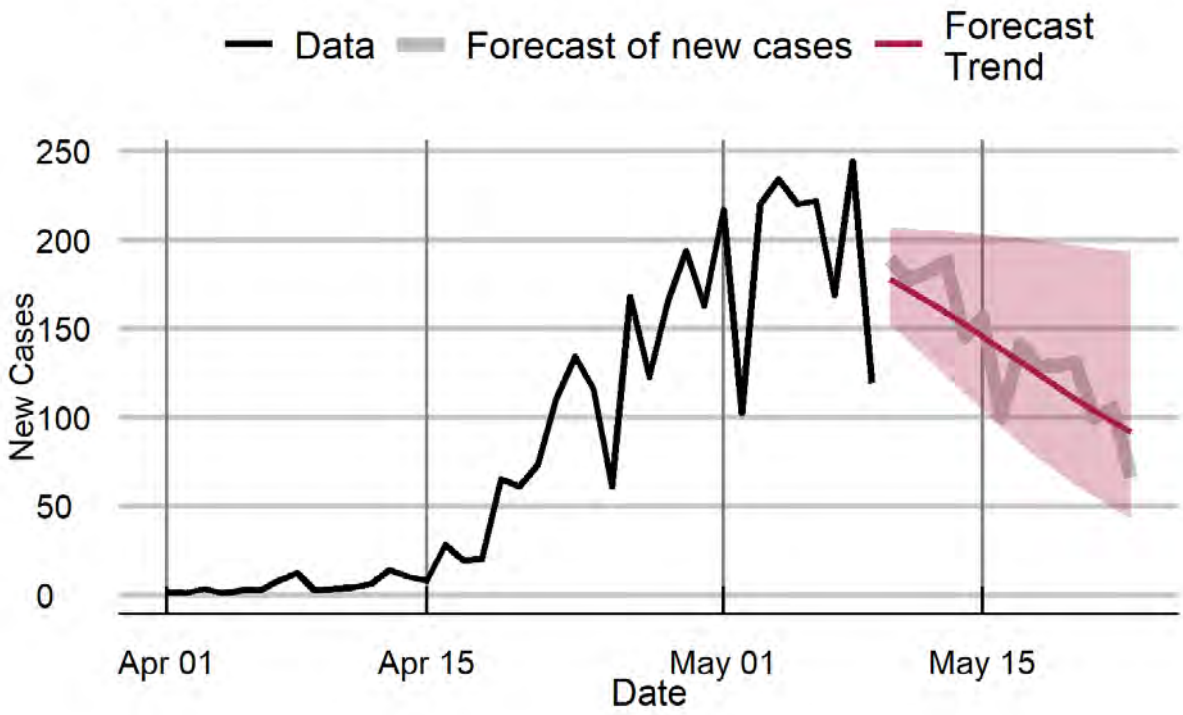
R_t : as on 9 May 2021



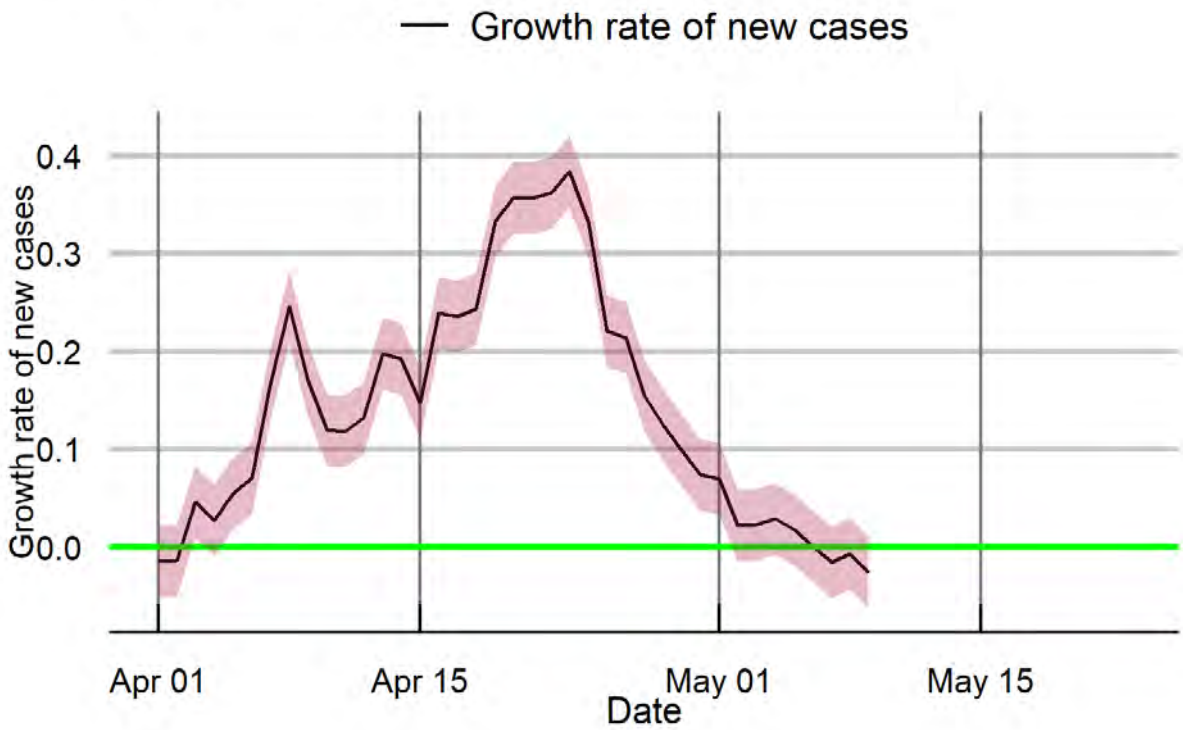

Andhra Pradesh
Data
Forecast of new cases
Forecast Trend
25,000
20,000
15,000
10,000
5,000
New Cases
Apr 01
Apr 15
May 01
May 15
Date

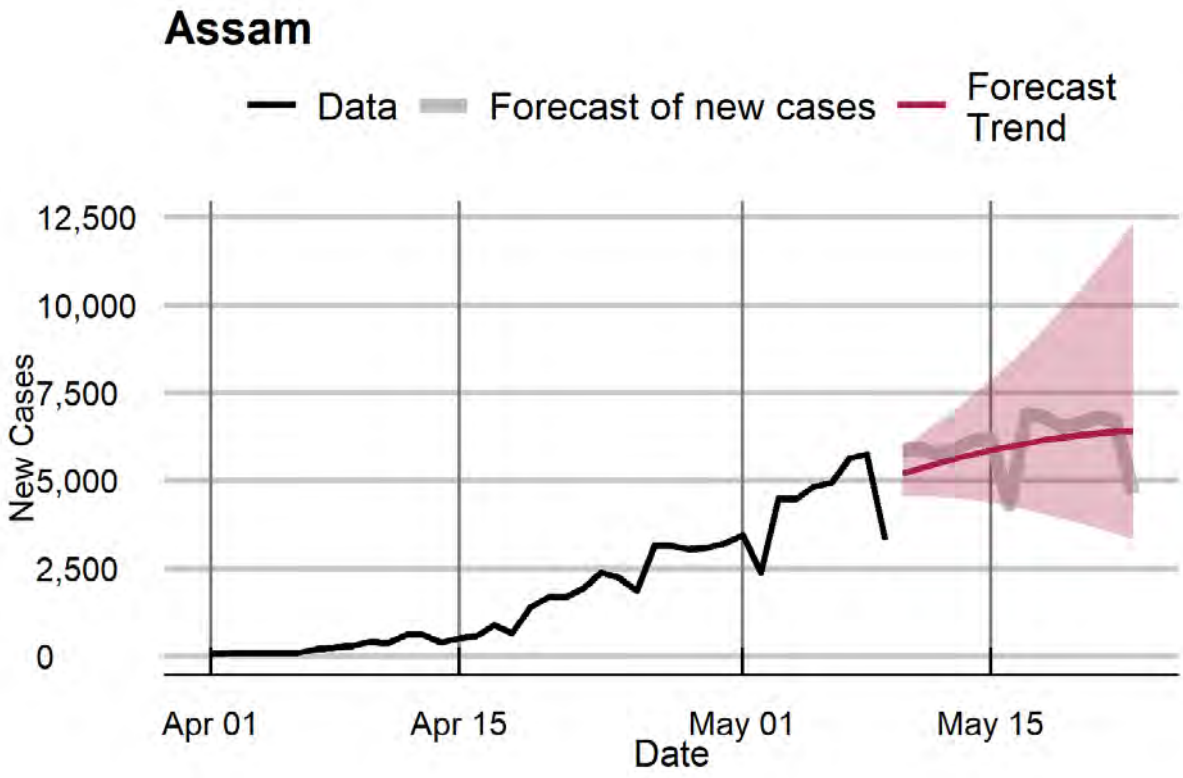

Andhra Pradesh
Growth rate of new cases
0.10
0.05
0.00
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

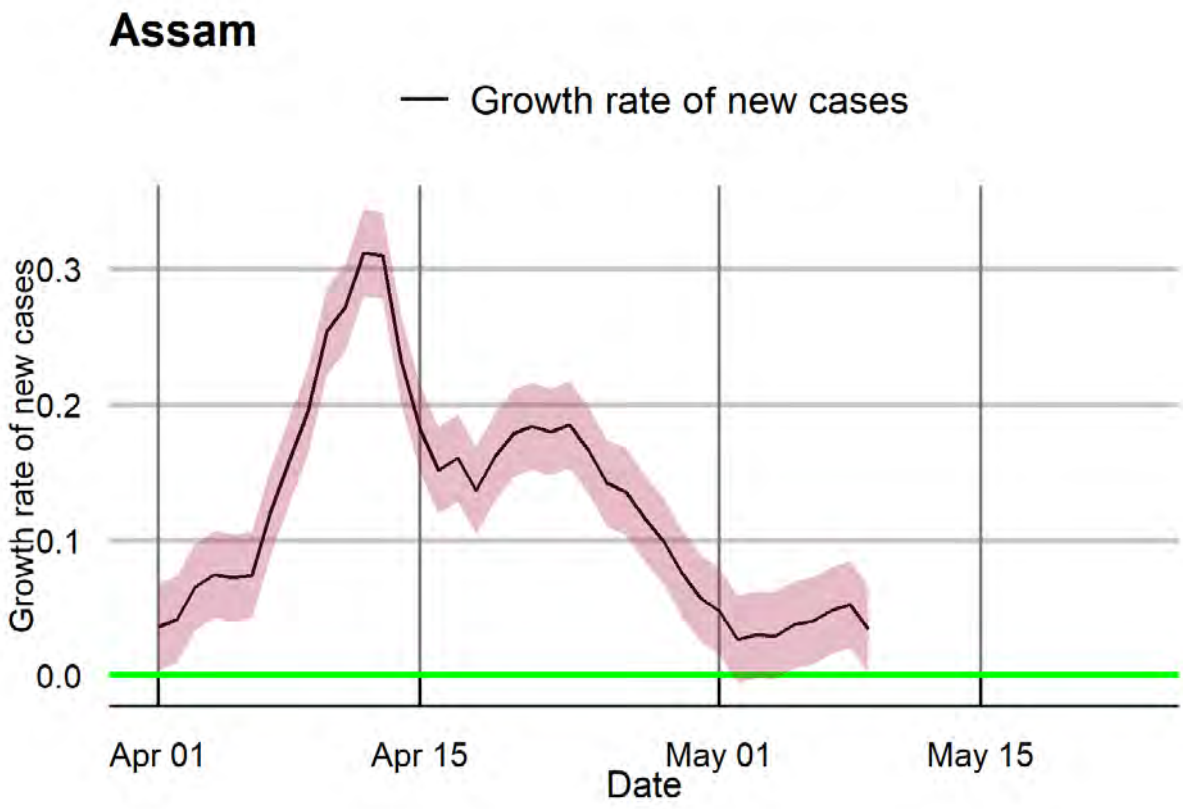
Arunachal Pradesh

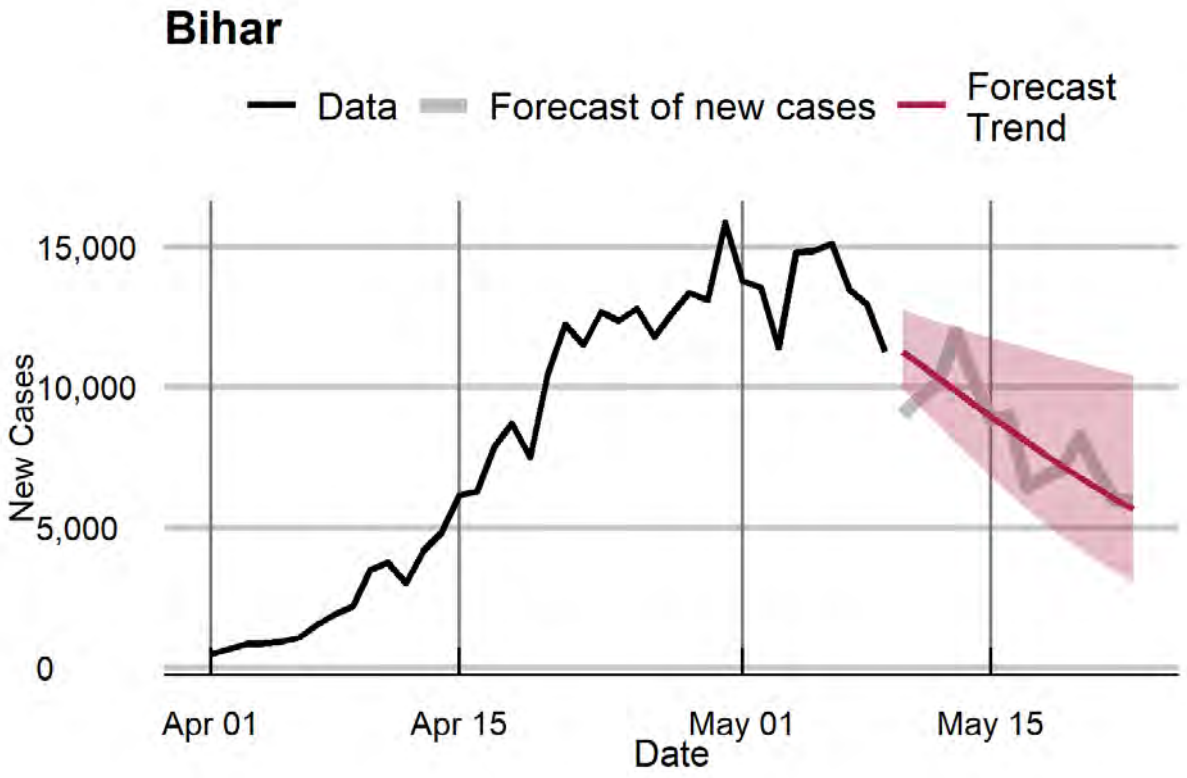


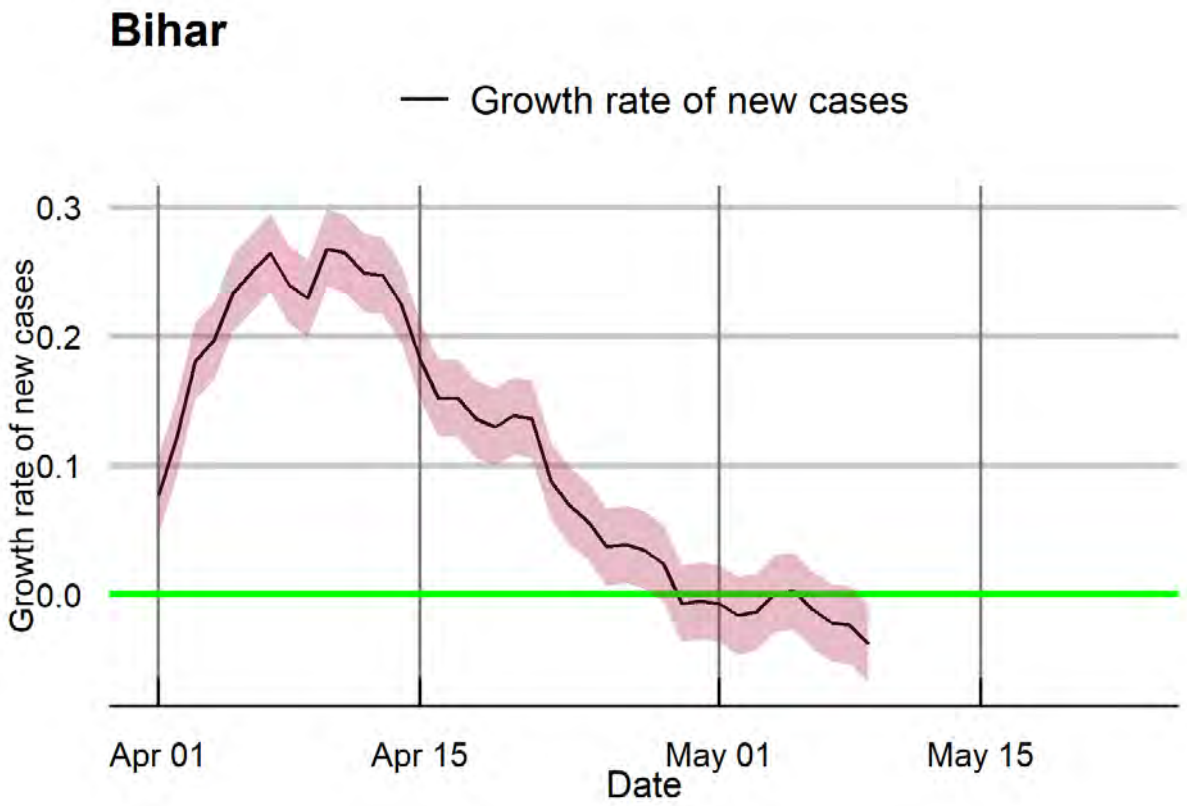
Arunachal Pradesh

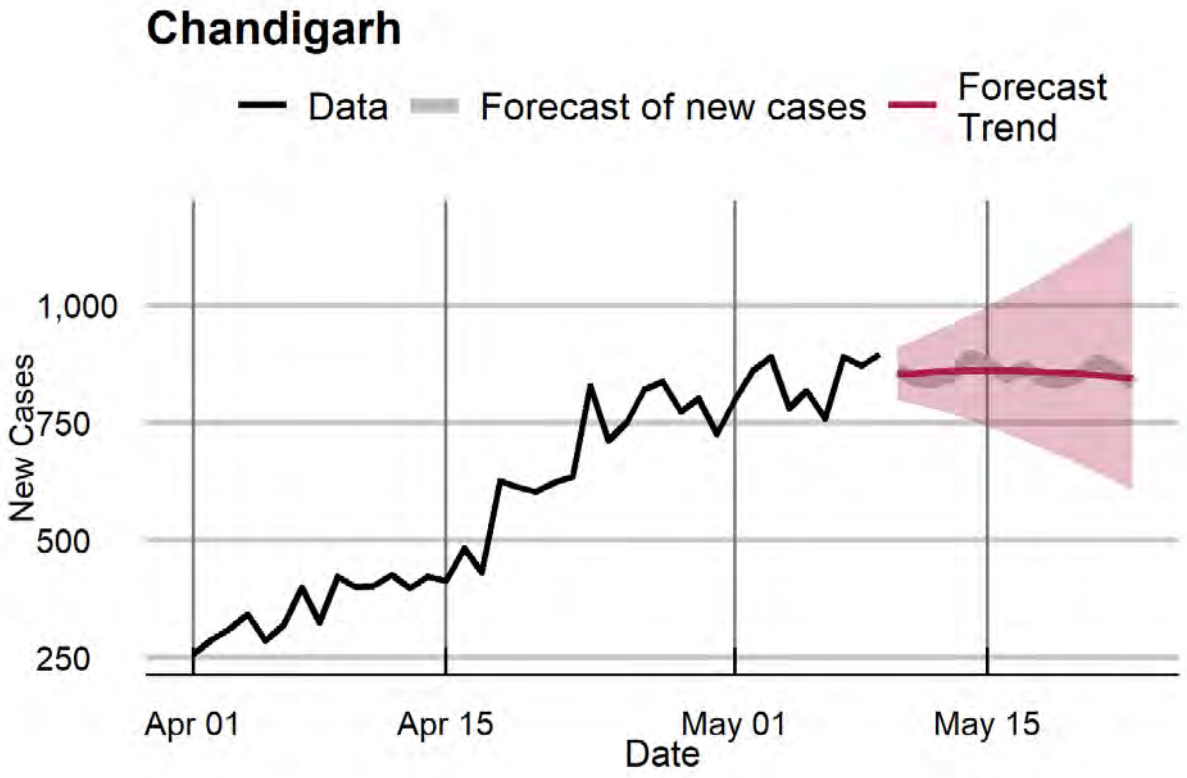


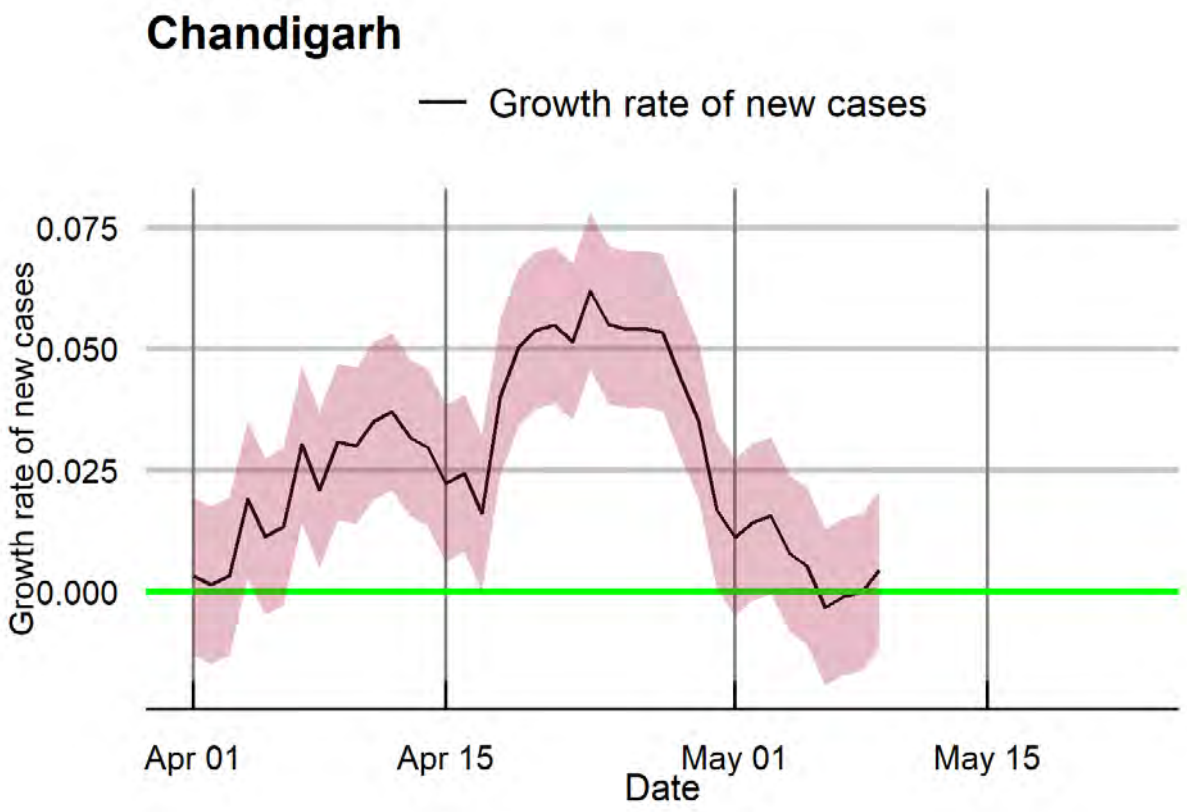

Assam
Data
Forecast of new cases
Forecast Trend
12,500
10,000
7,500
5,000
2,500
0
New Cases
Apr 01
Apr 15
May 01
May 15
Date

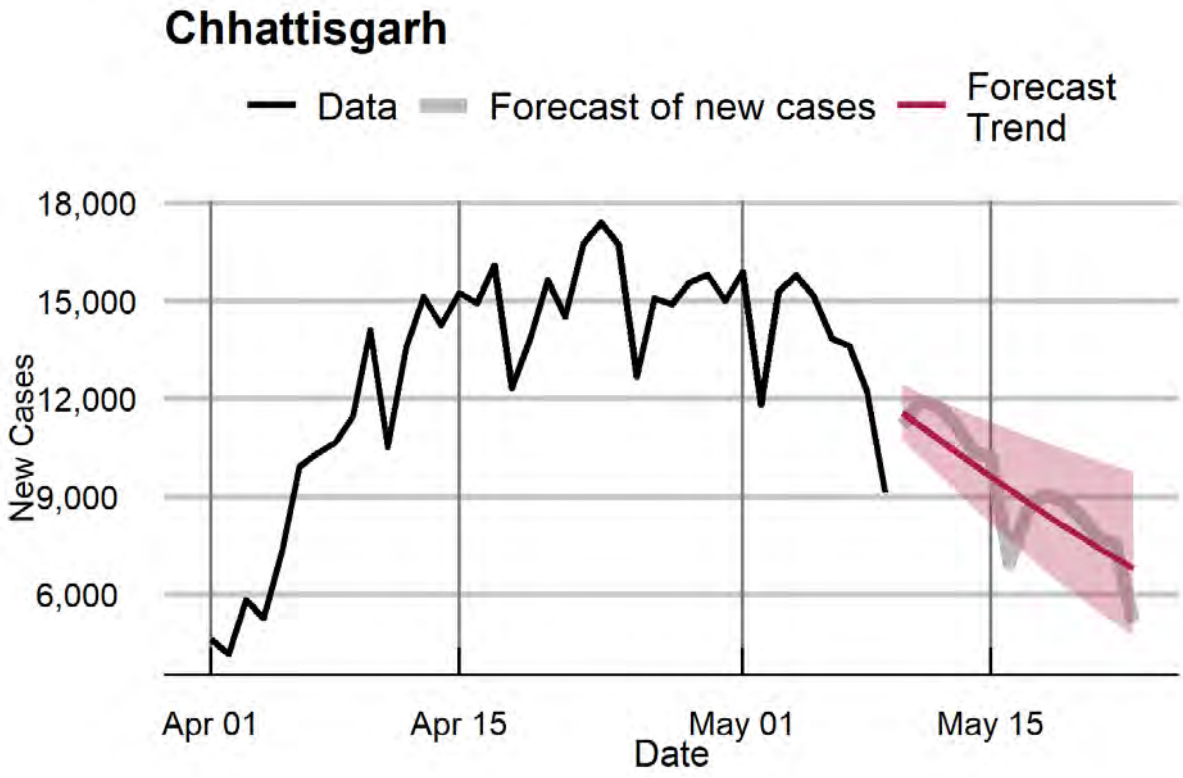

Assam
Growth rate of new cases
0.3
0.2
0.1
0.0
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

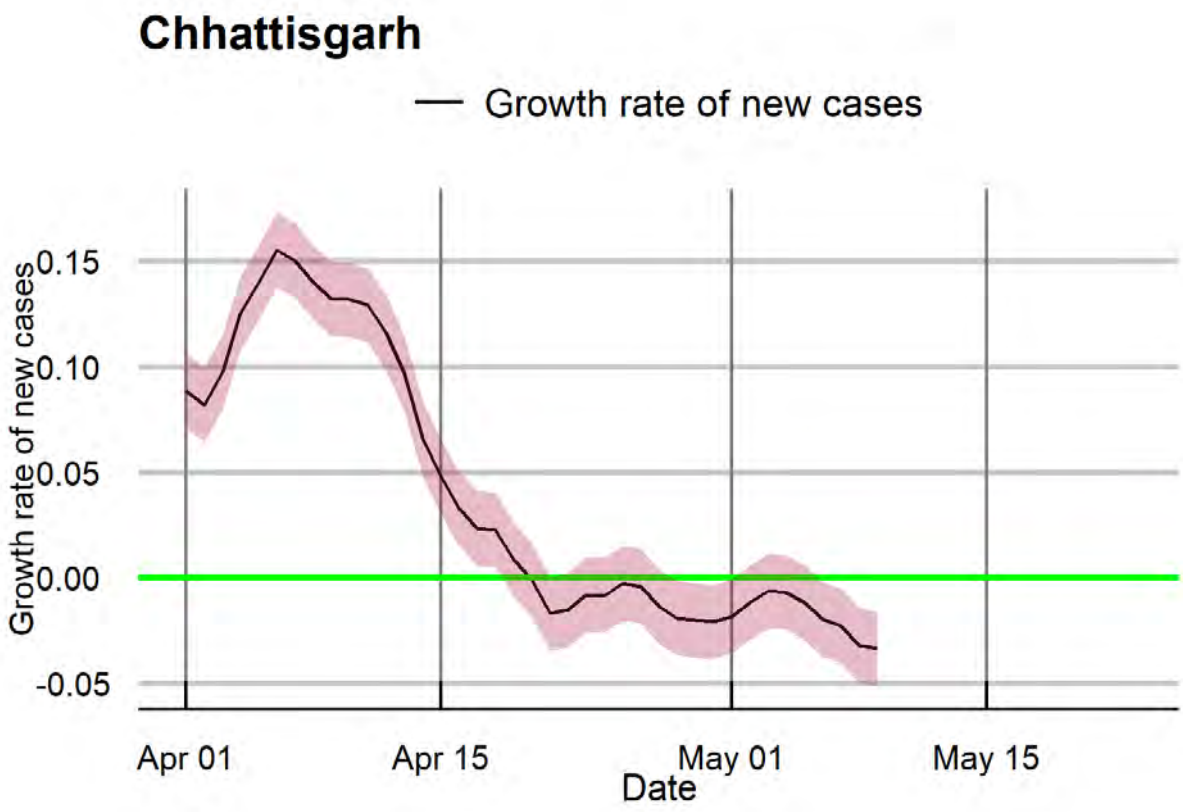

Bihar
Data
Forecast of new cases
Forecast Trend
15,000
10,000
5,000
0
New Cases
Apr 01
Apr 15
May 01
May 15
Date

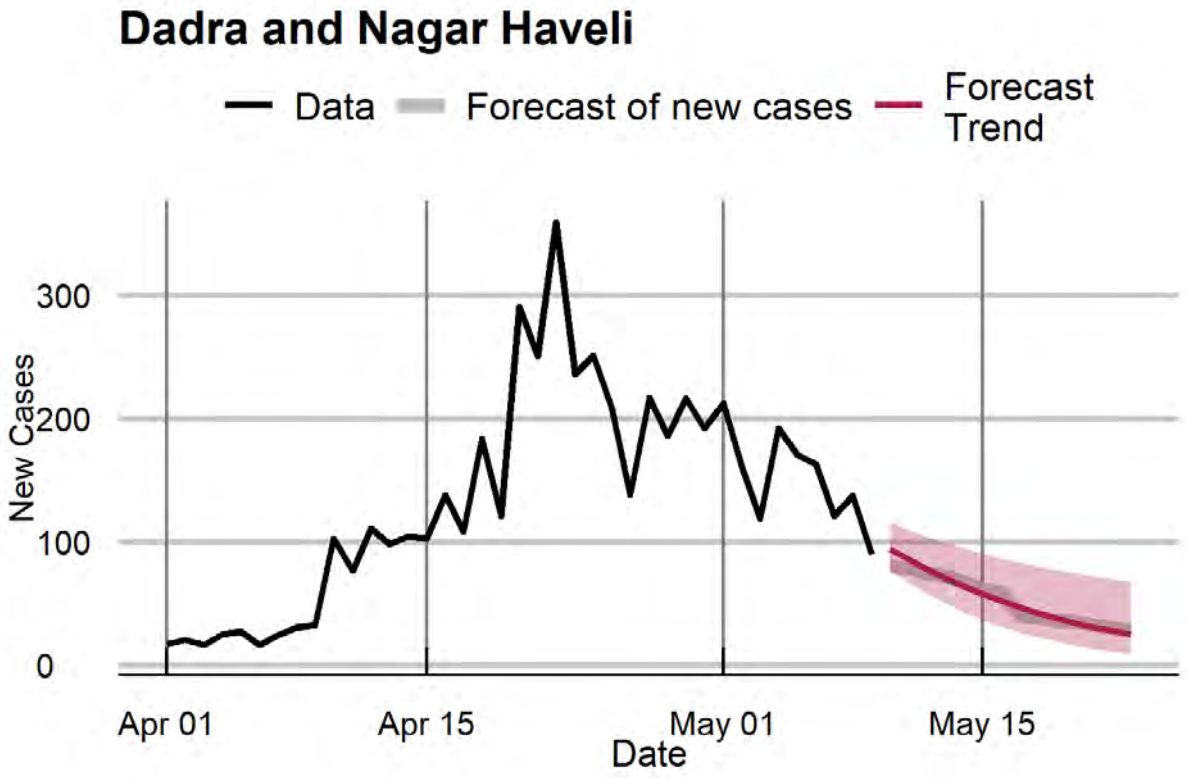

Bihar
Growth rate of new cases
0.3
0.2
0.1
0.0
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

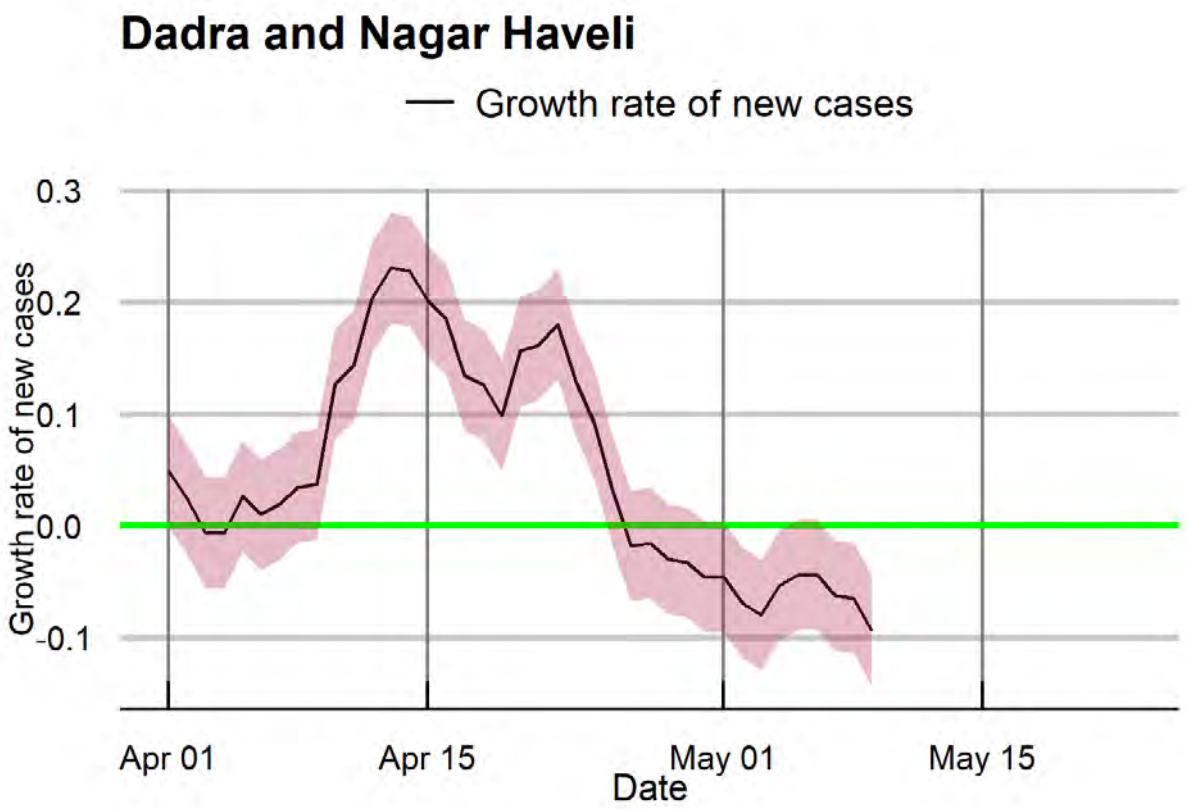

Chandigarh
Data
Forecast of new cases
Forecast Trend
1,000
750
500
250
New Cases
Apr 01
Apr 15
May 01
May 15
Date

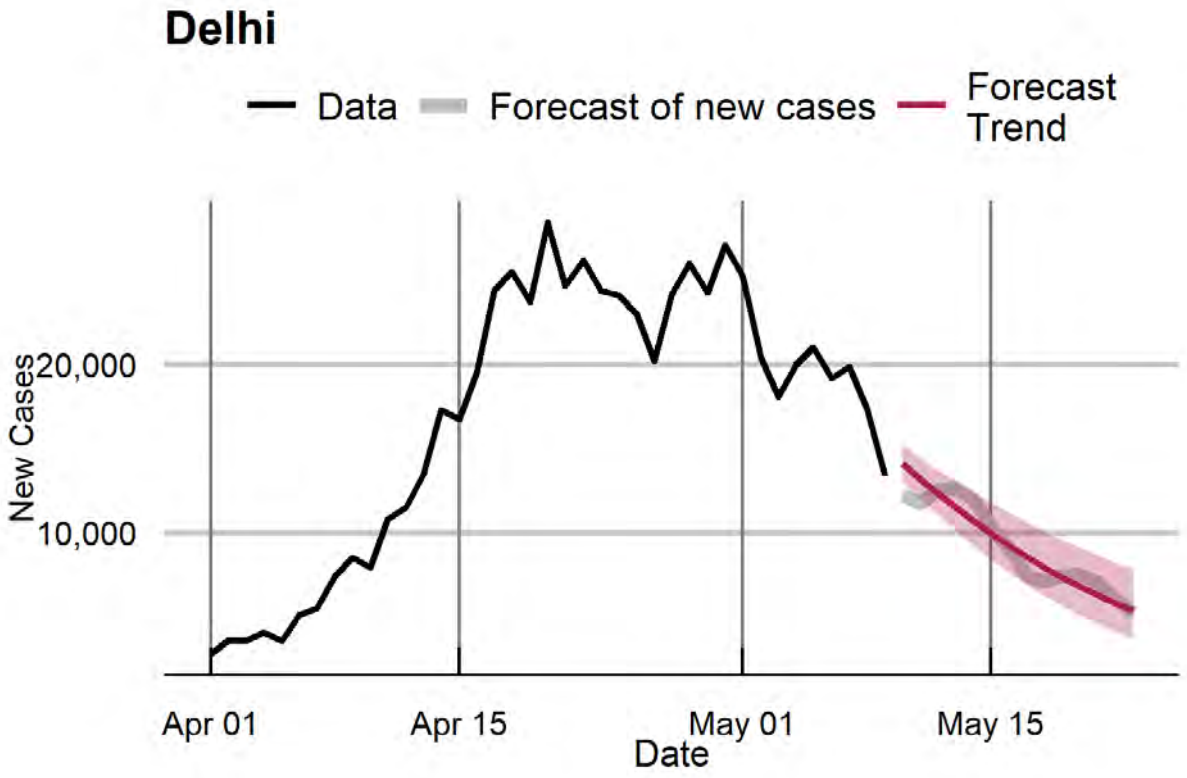

Chandigarh
Growth rate of new cases
0.075
0.050
0.025
0.000
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

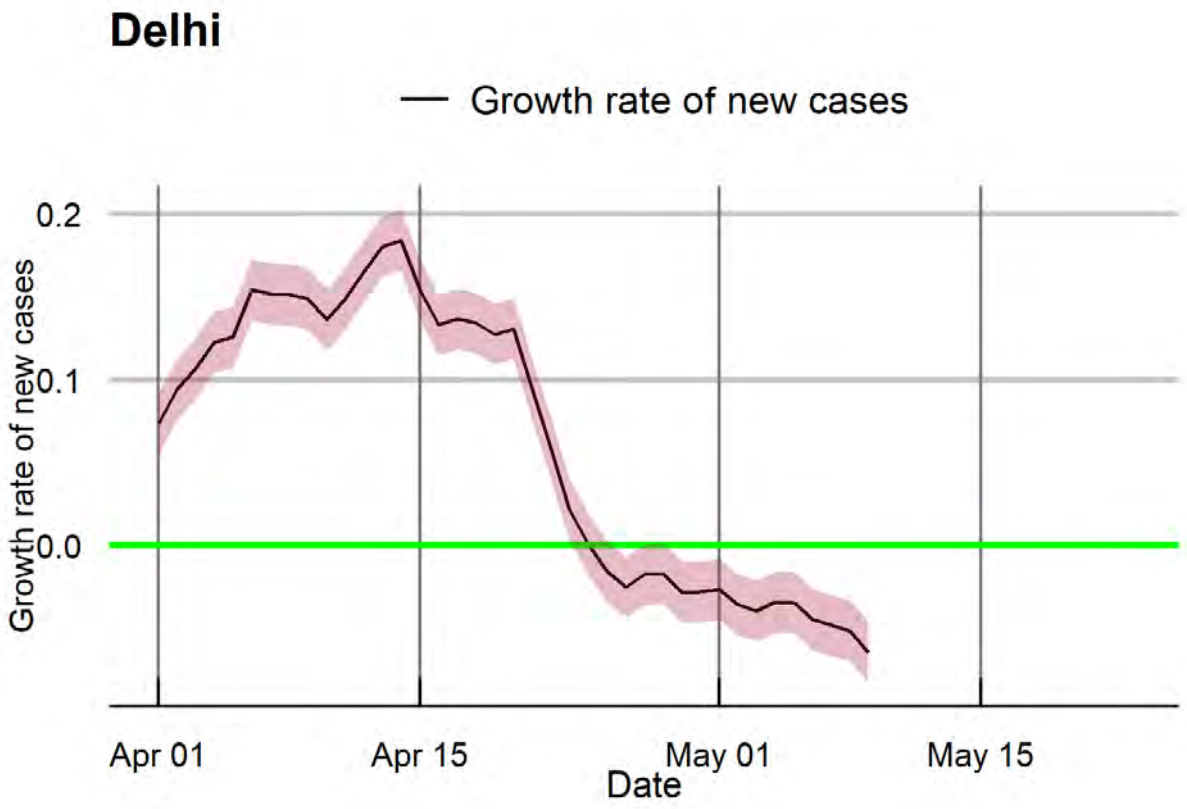

Chhattisgarh
Data
Forecast of new cases
Forecast Trend
18,000
15,000
12,000
9,000
6,000
New Cases
Apr 01
Apr 15
May 01
May 15
Date

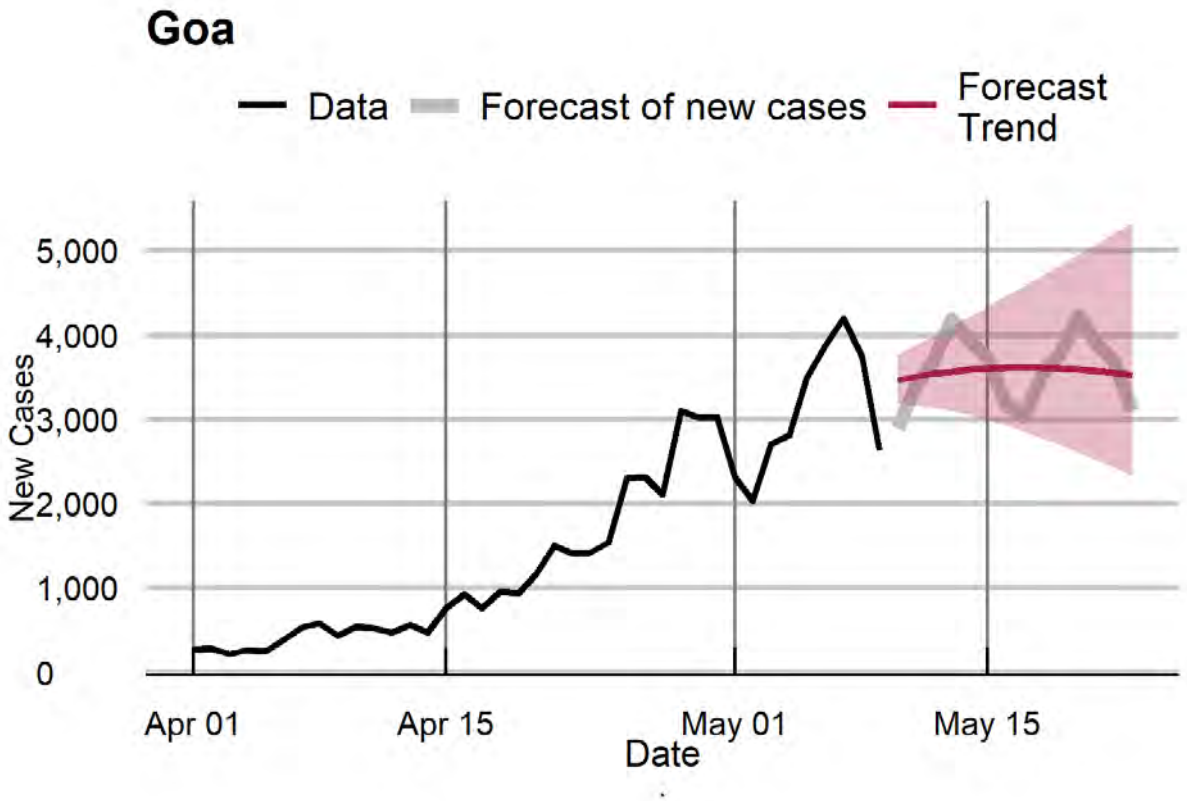

Chhattisgarh
Growth rate of new cases
0.15
0.10
0.05
0.00
-0.05
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

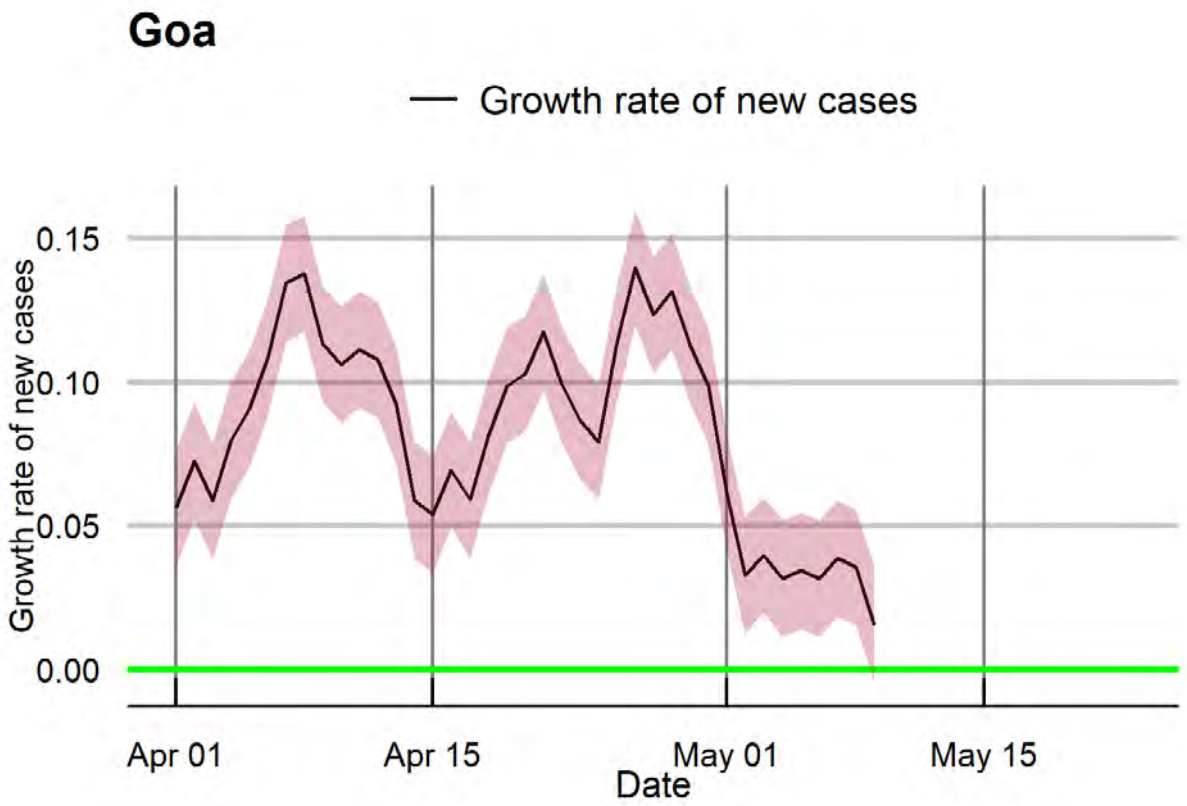

Dadra and Nagar Haveli
Data
Forecast of new cases
Forecast Trend
New Cases
300
200
100
0
Apr 01
Apr 15
May 01
May 15
Date

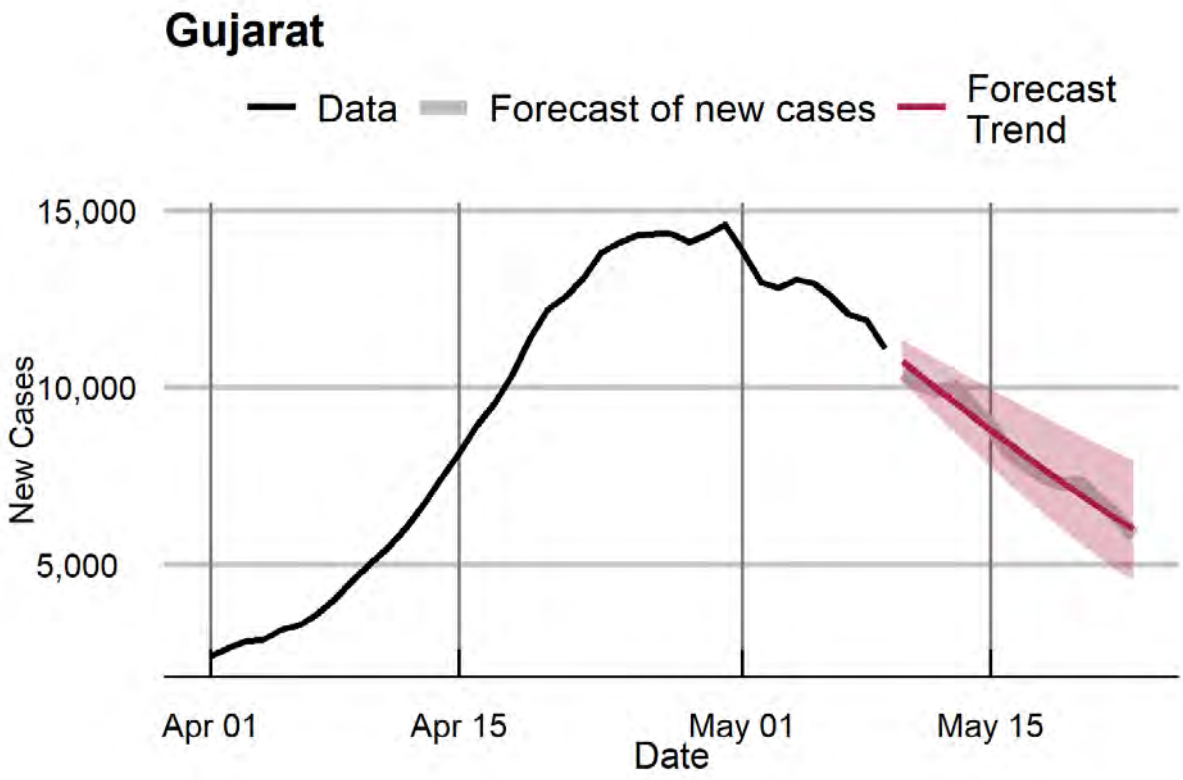

Dadra and Nagar Haveli
Growth rate of new cases
Growth rate of new cases
0.3
0.2
0.1
0.0
-0.1
Apr 01
Apr 15
May 01
May 15
Date

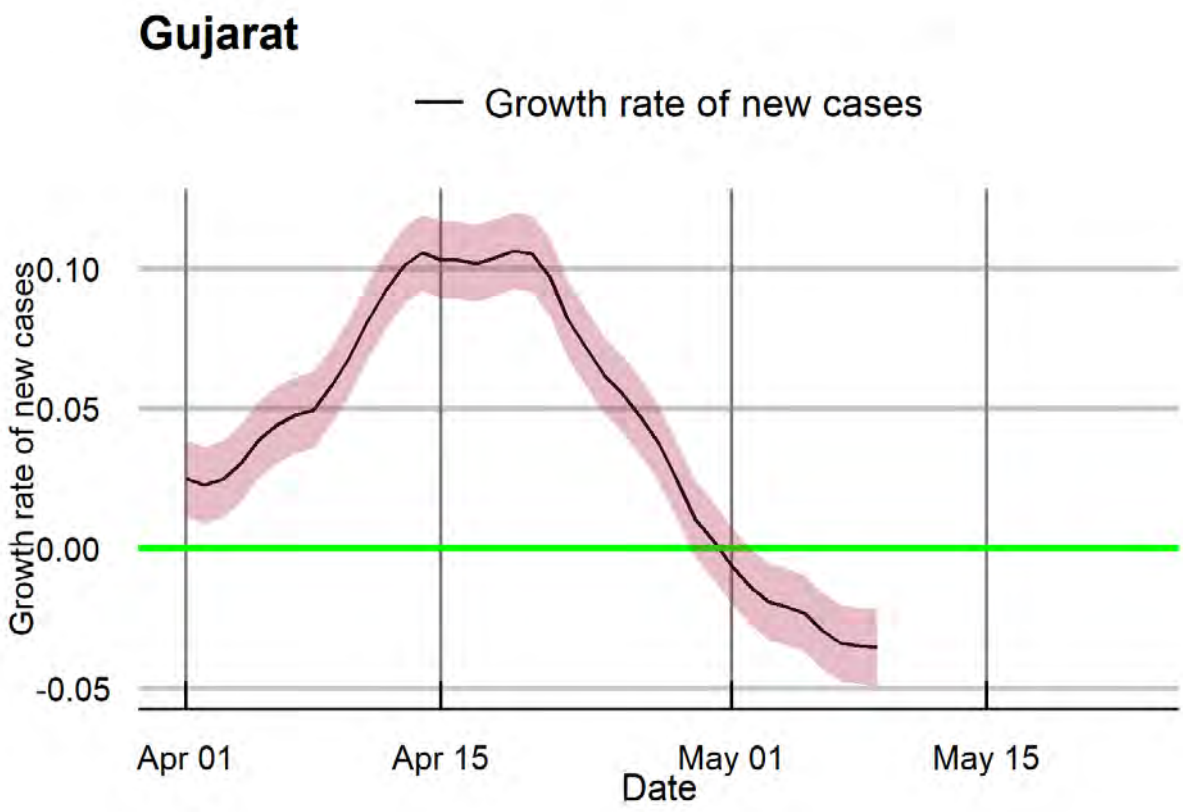

Delhi
Data
Forecast of new cases
Forecast Trend
New Cases
20,000
10,000
Apr 01
Apr 15
May 01
May 15
Date


Delhi
Growth rate of new cases
Growth rate of new cases
0.2
0.1
0.0
Apr 01
Apr 15
May 01
May 15
Date

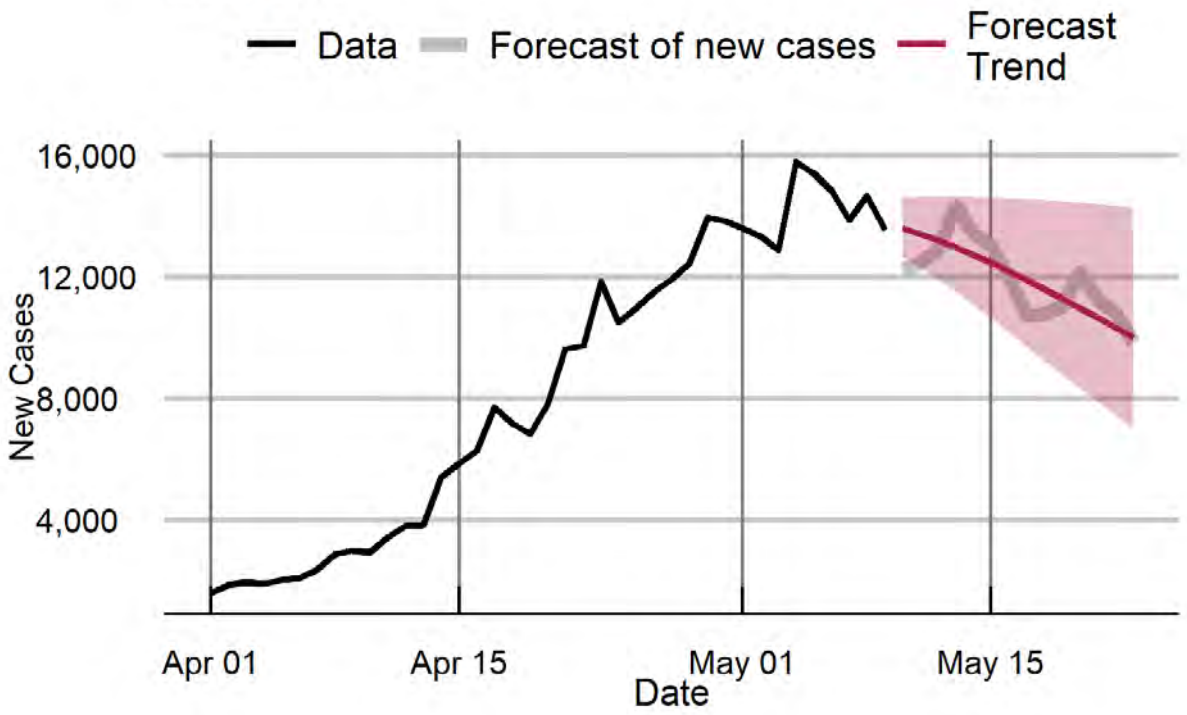

Goa
Data
Forecast of new cases
Forecast Trend
5,000
4,000
3,000
2,000
1,000
0
New Cases
Apr 01
Apr 15
May 01
May 15
Date


Goa
Growth rate of new cases
0.15
0.10
0.05
0.00
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

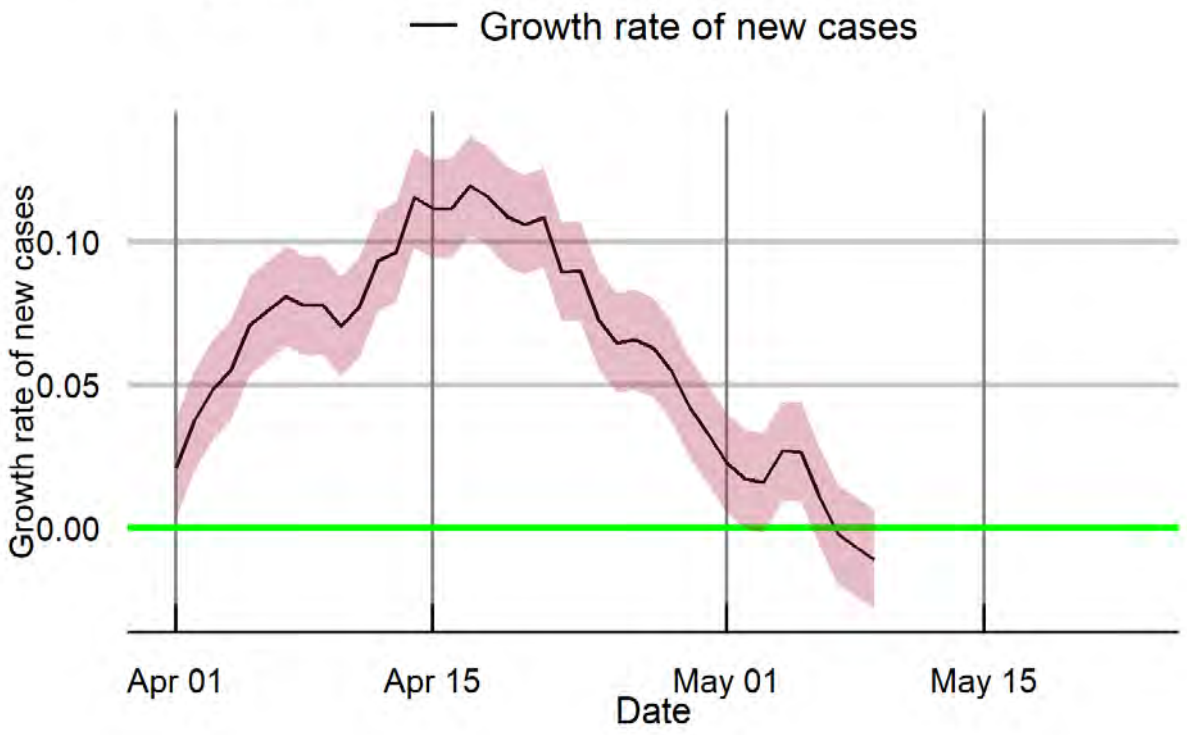

Gujarat
Data
Forecast of new cases
Forecast Trend
15,000
10,000
5,000
New Cases
Apr 01
Apr 15
May 01
May 15
Date

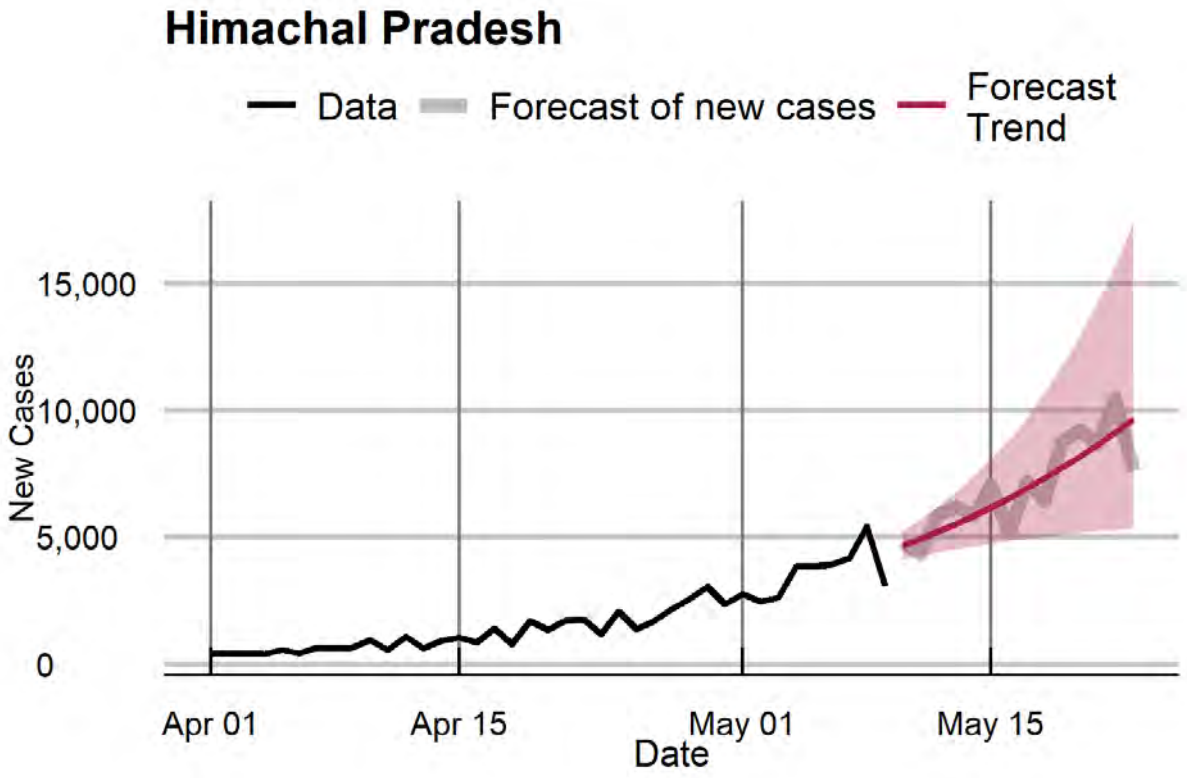

Gujarat
Growth rate of new cases
0.10
0.05
0.00
-0.05
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

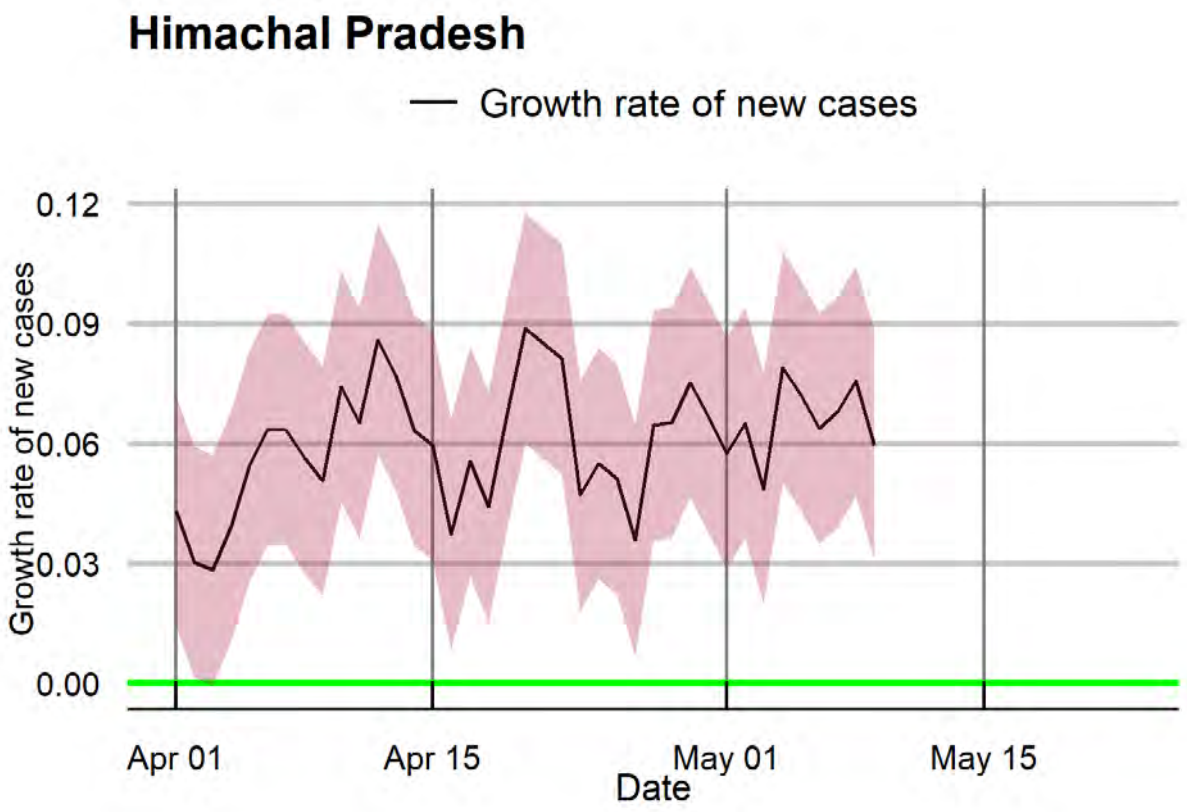
Haryana

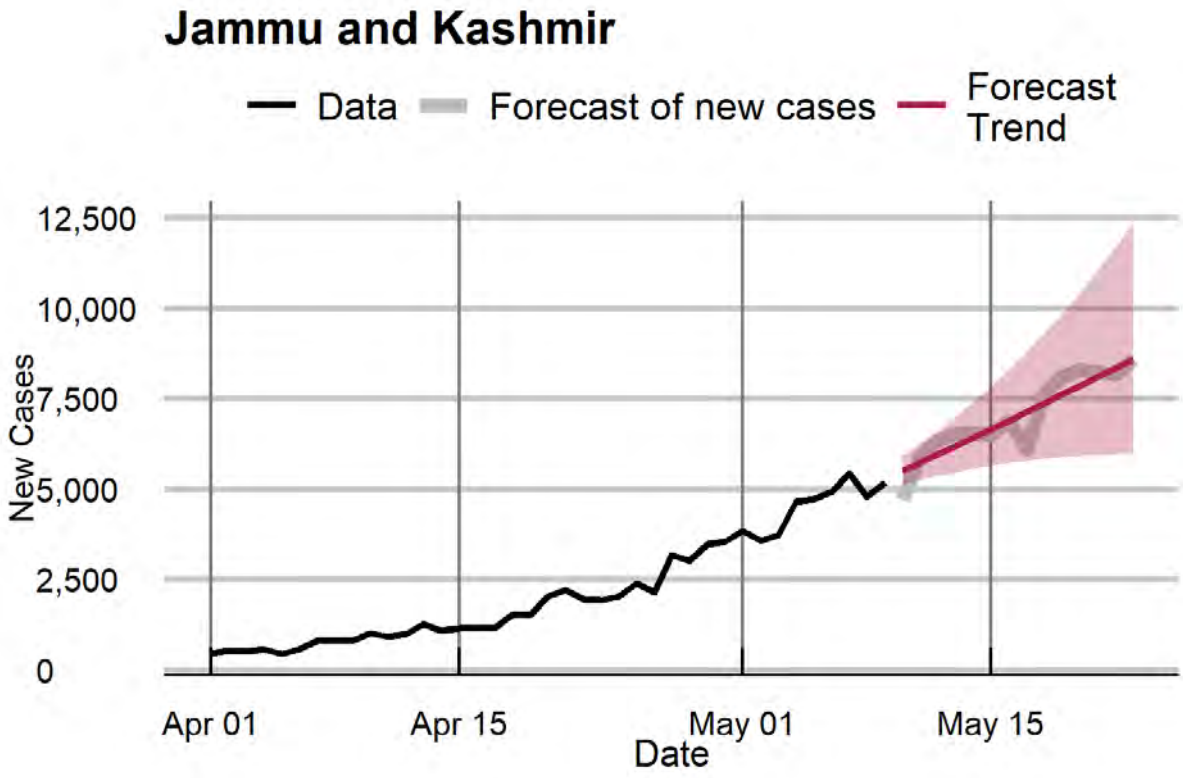


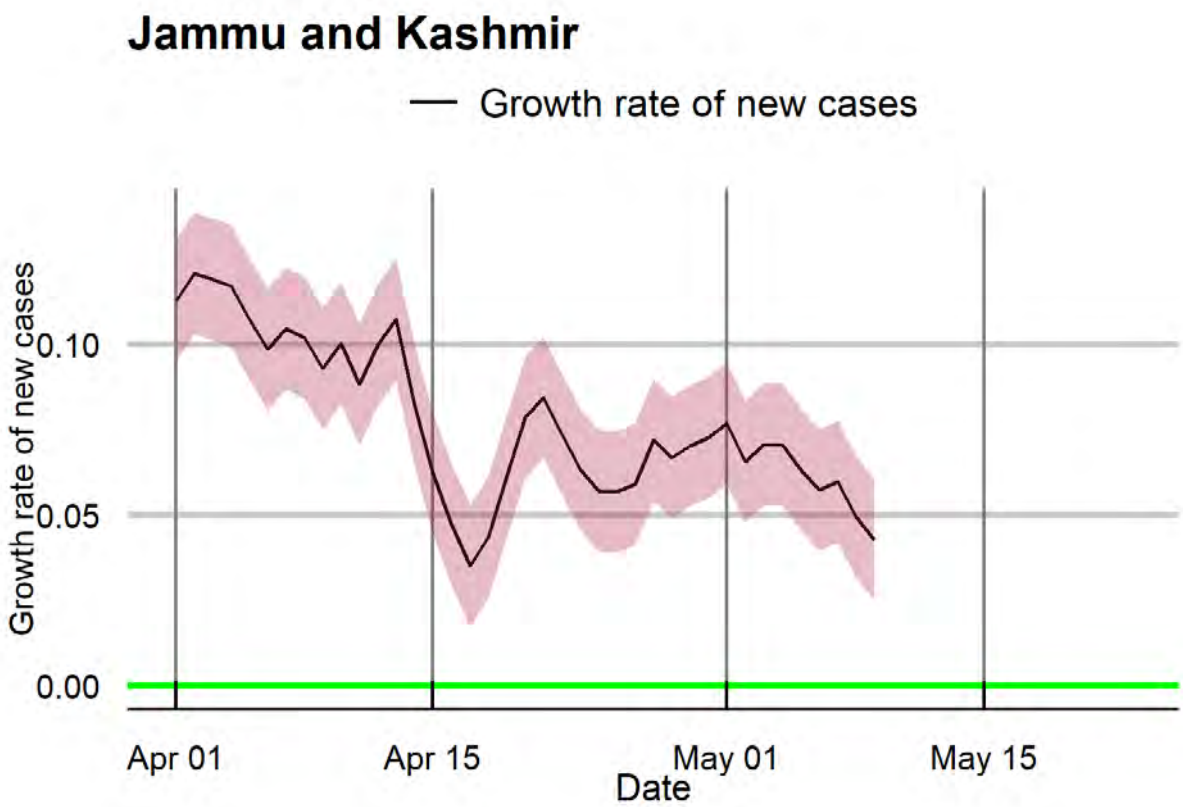
Haryana

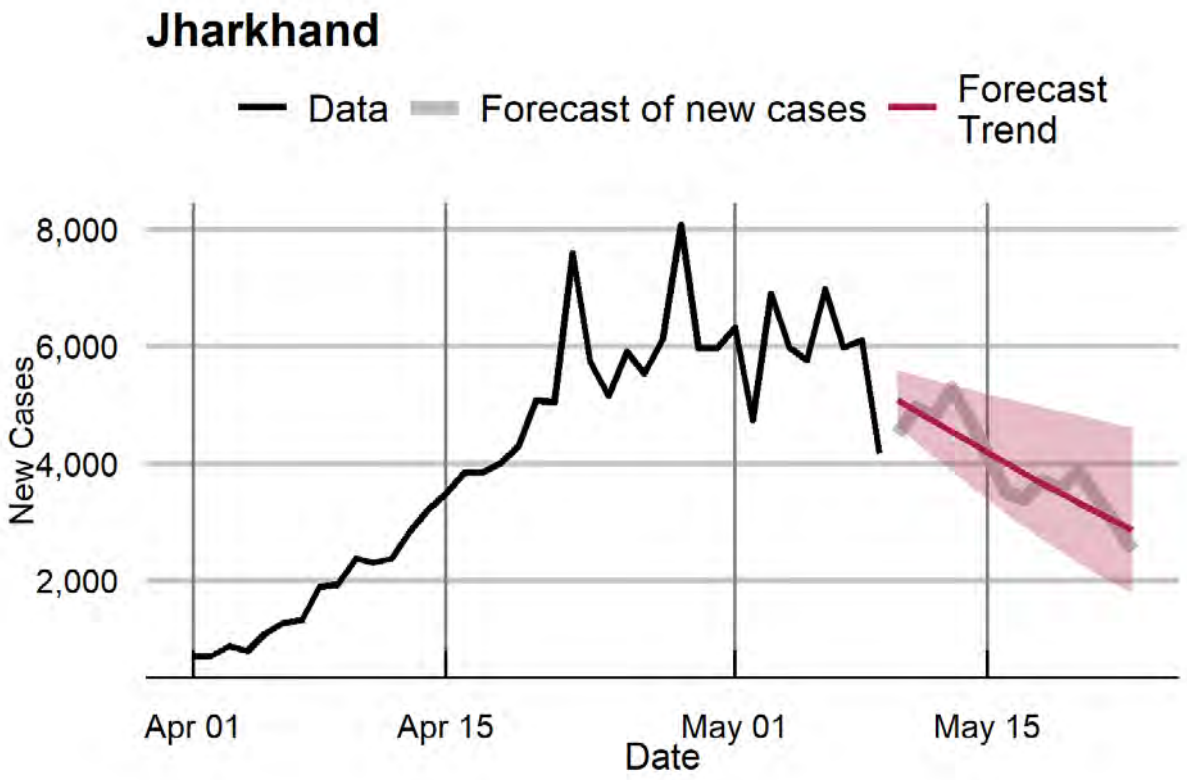


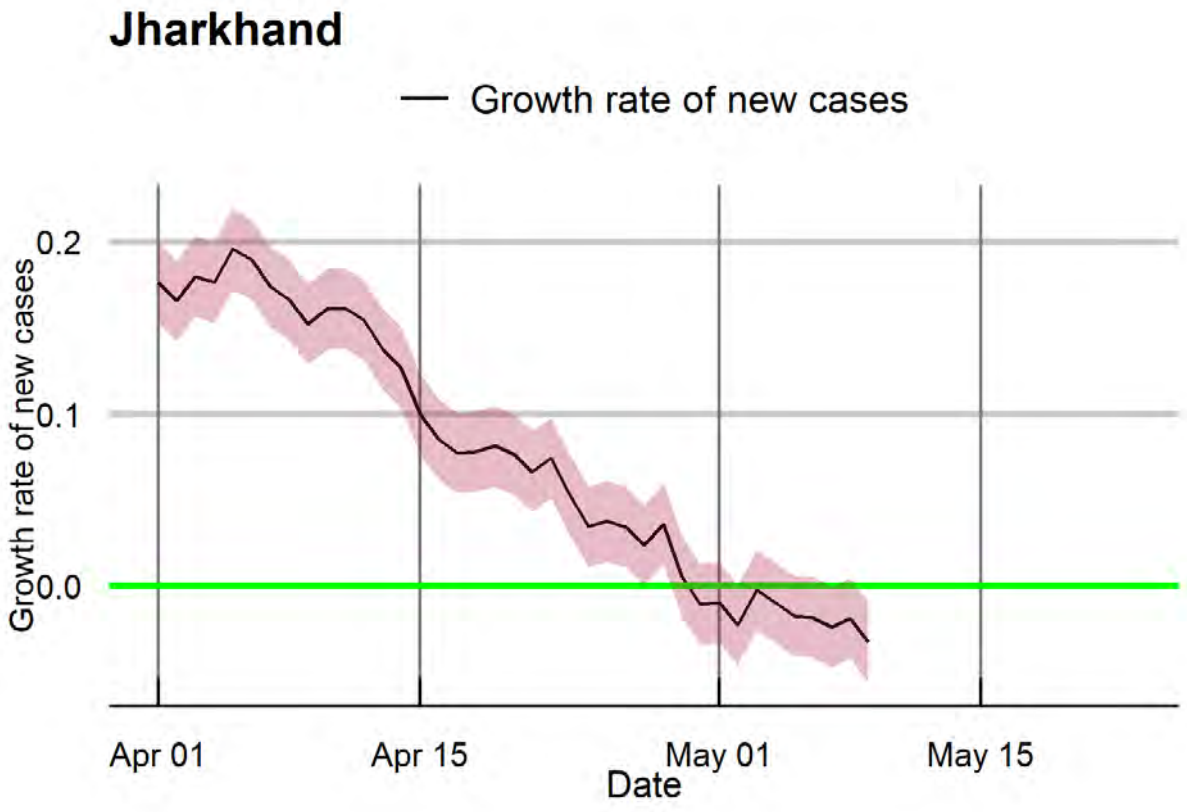

Himachal Pradesh
Data
Forecast of new cases
Forecast Trend
15,000
10,000
5,000
0
New Cases
Apr 01
Apr 15
May 01
May 15
Date

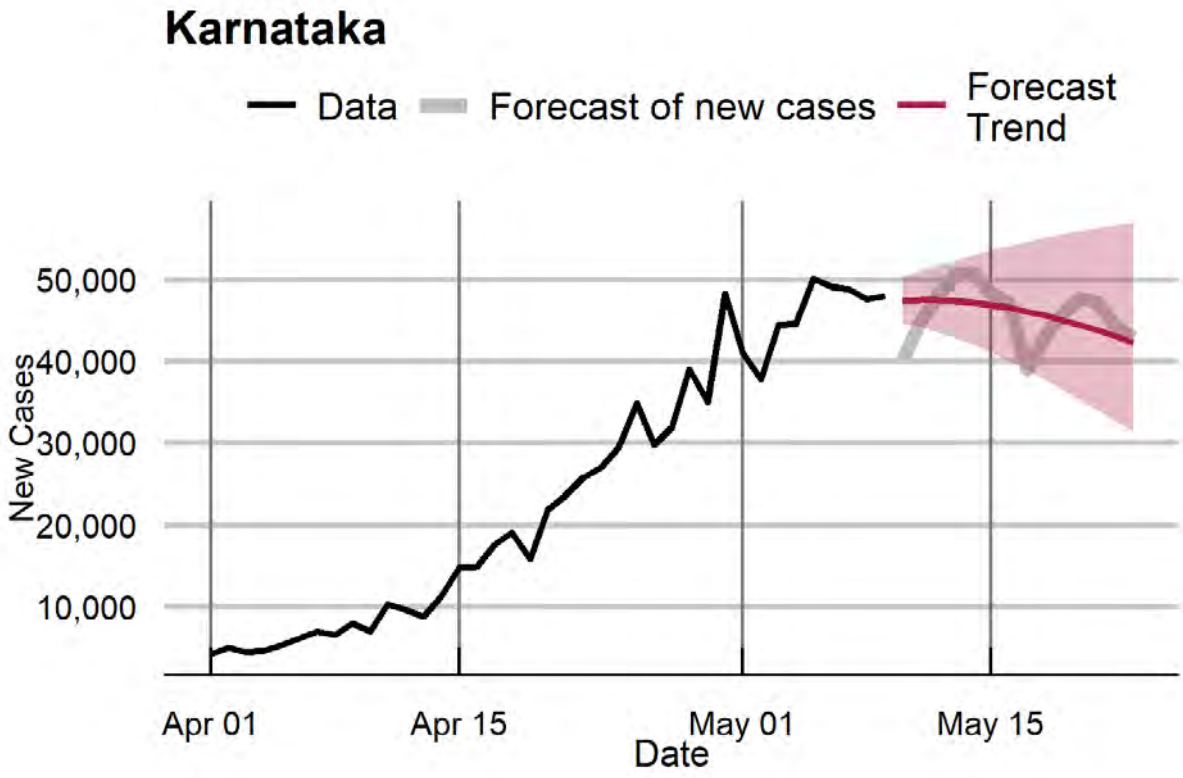

Himachal Pradesh
Growth rate of new cases
0.12
0.09
0.06
0.03
0.00
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

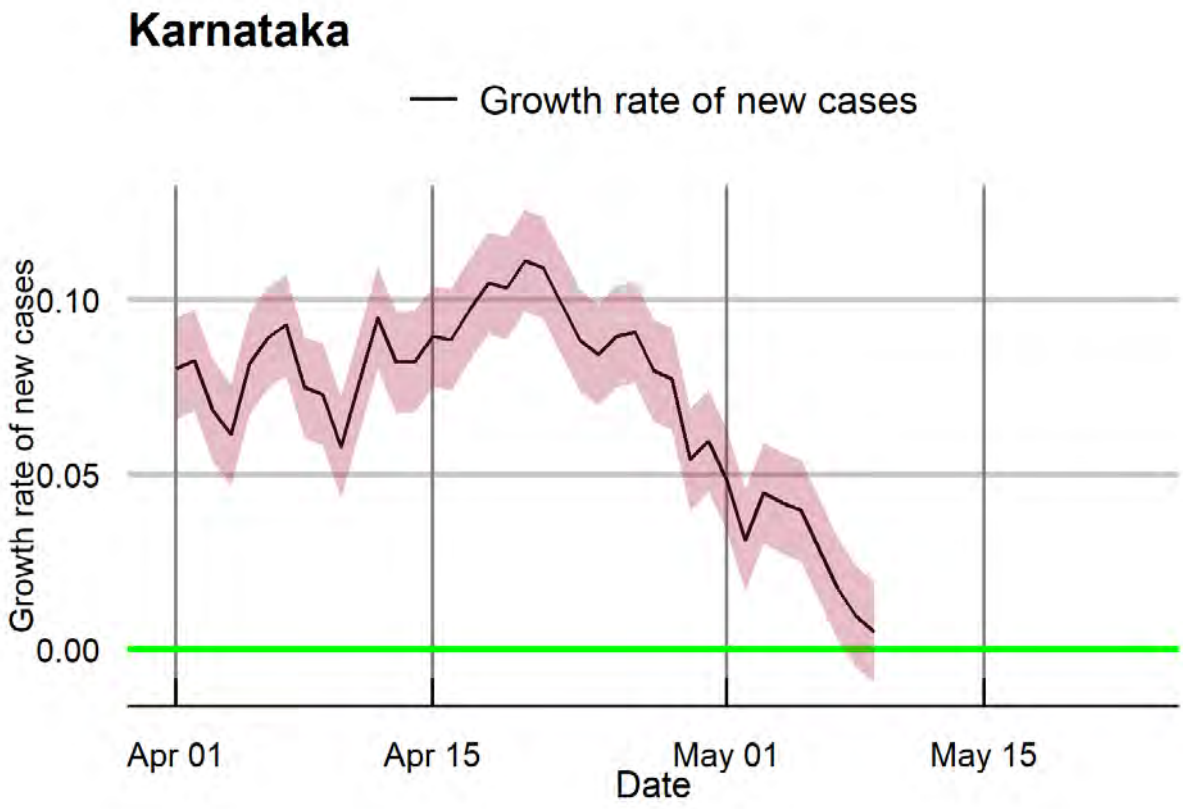

Jammu and Kashmir
Data
Forecast of new cases
Forecast Trend
12,500
10,000
7,500
5,000
2,500
0
New Cases
Apr 01
Apr 15
May 01
May 15
Date

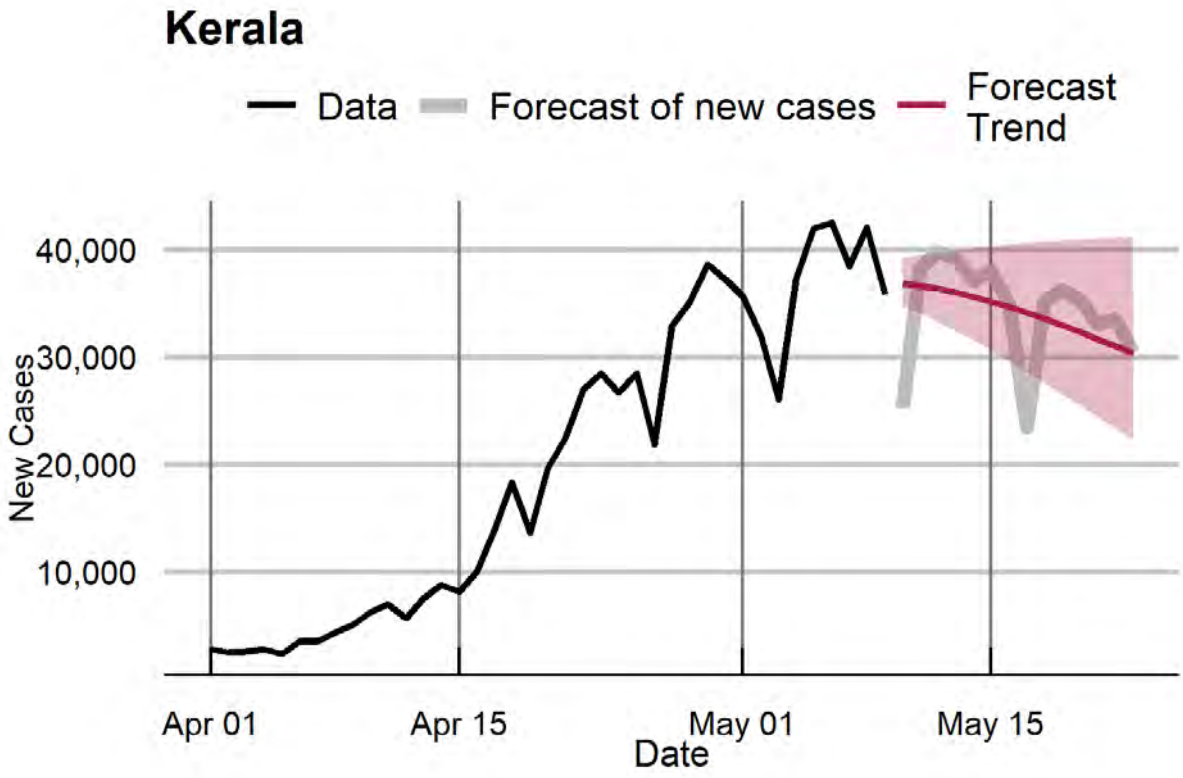

Jammu and Kashmir
Growth rate of new cases
0.10
0.05
0.00
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

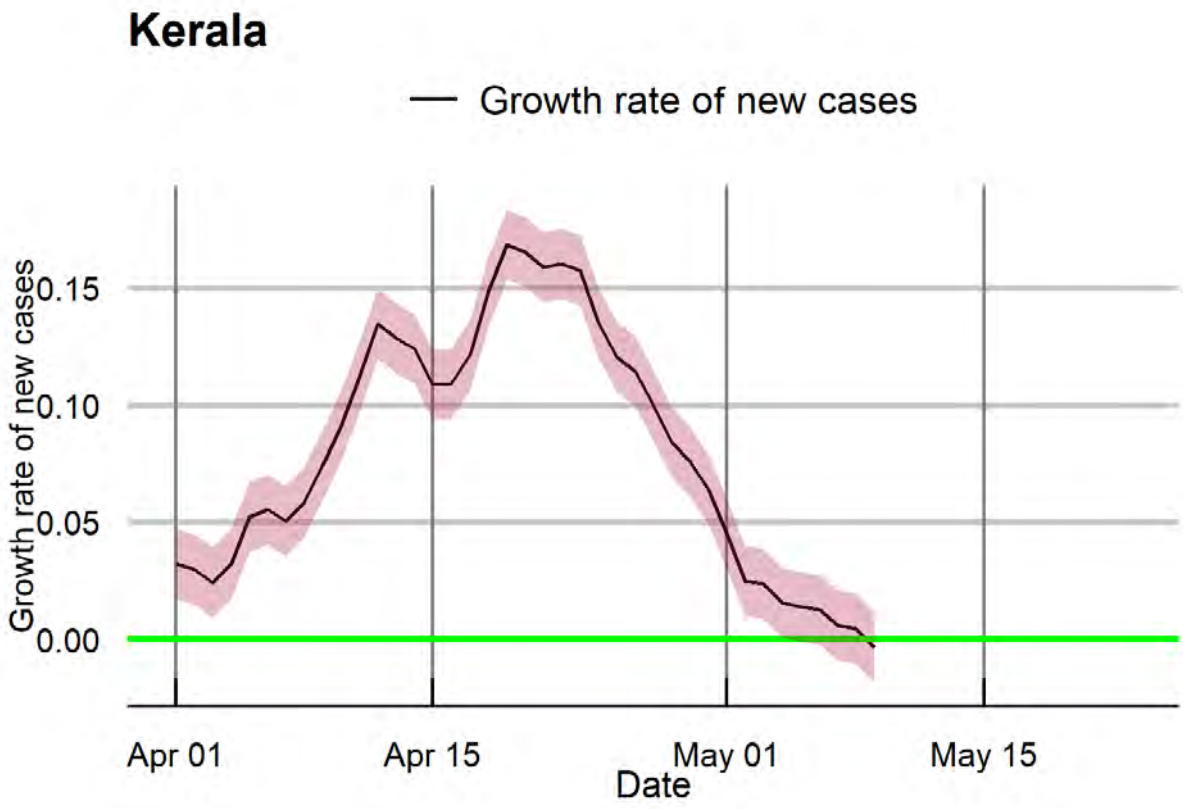

Jharkhand
Data
Forecast of new cases
Forecast Trend
8,000
6,000
4,000
2,000
New Cases
Apr 01
Apr 15
May 01
May 15
Date

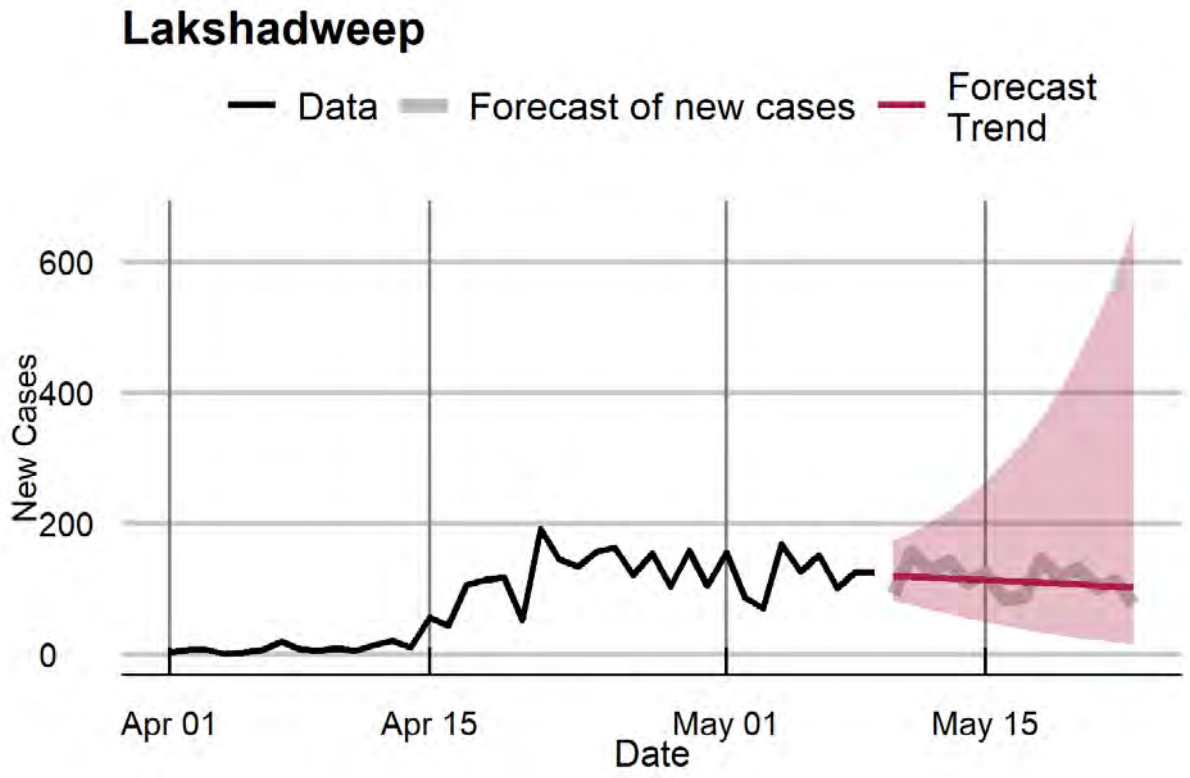

Jharkhand
Growth rate of new cases
0.2
0.1
0.0
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

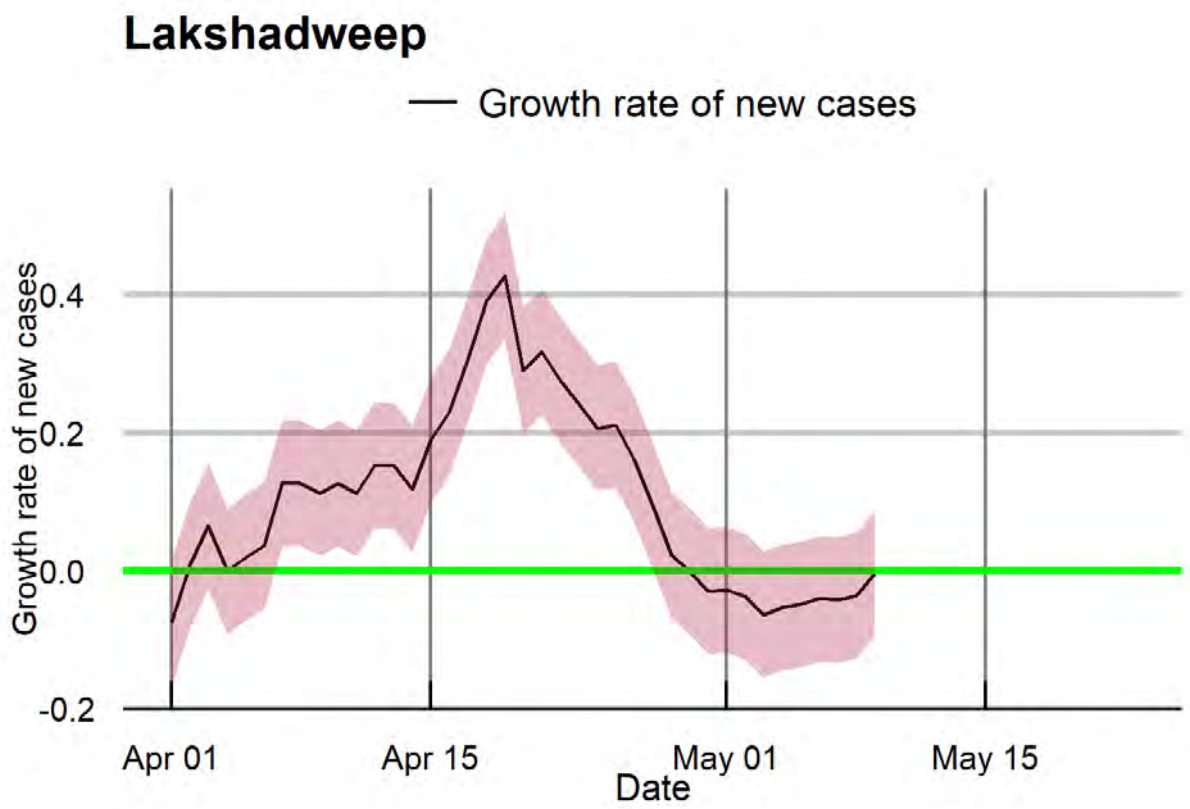

Karnataka
Data
Forecast of new cases
Forecast Trend
50,000
40,000
30,000
20,000
10,000
New Cases
Apr 01
Apr 15
May 01
May 15
Date

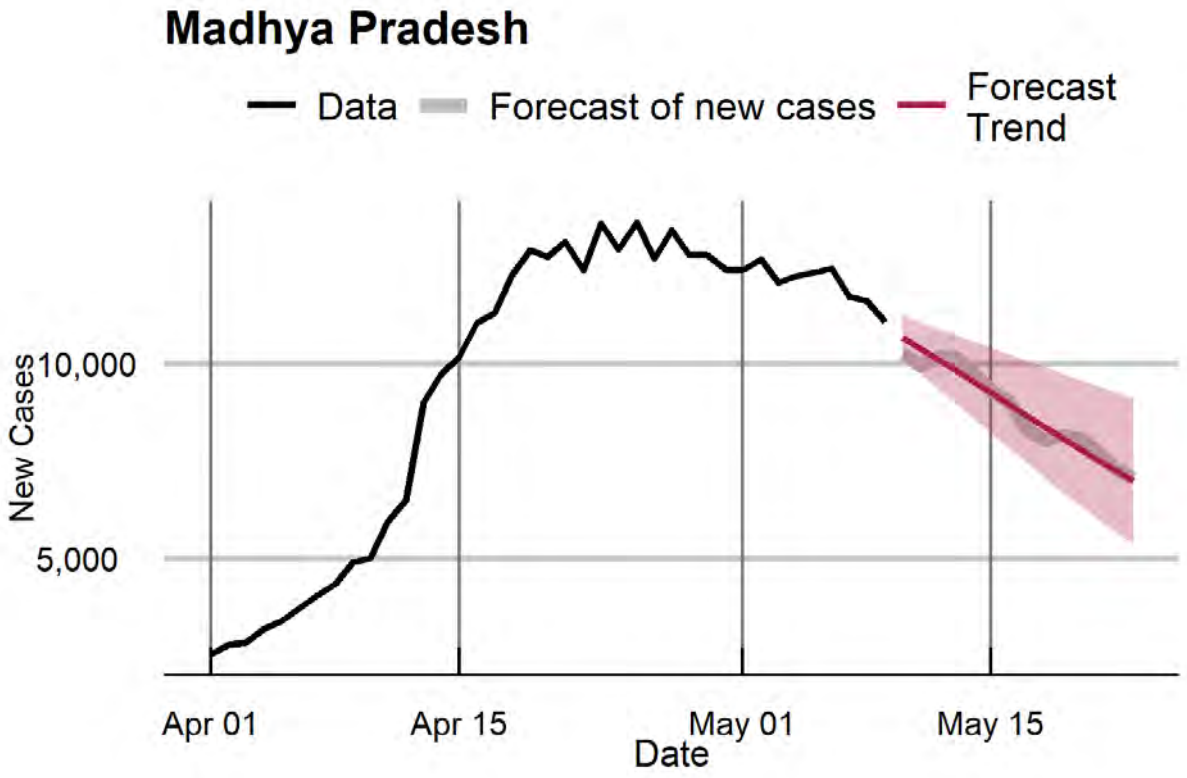

Karnataka
Growth rate of new cases
0.10
0.05
0.00
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

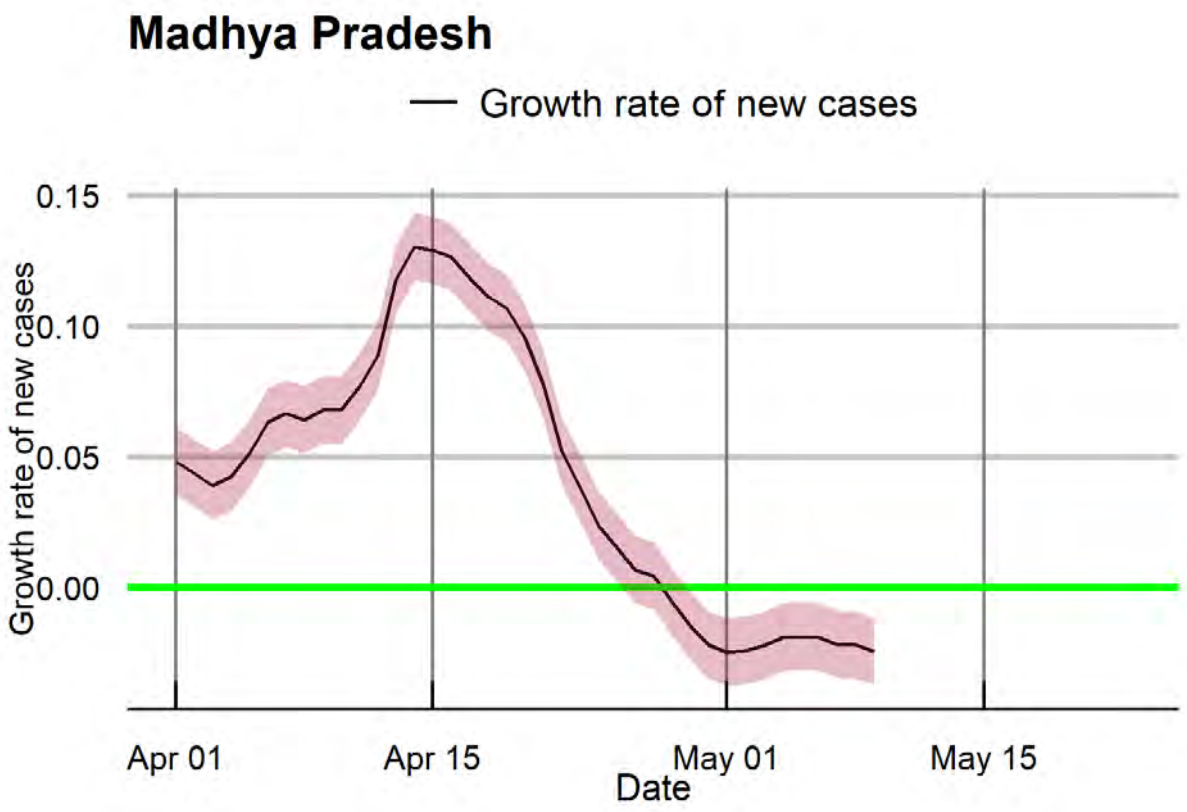

Kerala
Data
Forecast of new cases
Forecast Trend
40,000
30,000
20,000
10,000
New Cases
Apr 01
Apr 15
May 01
May 15
Date

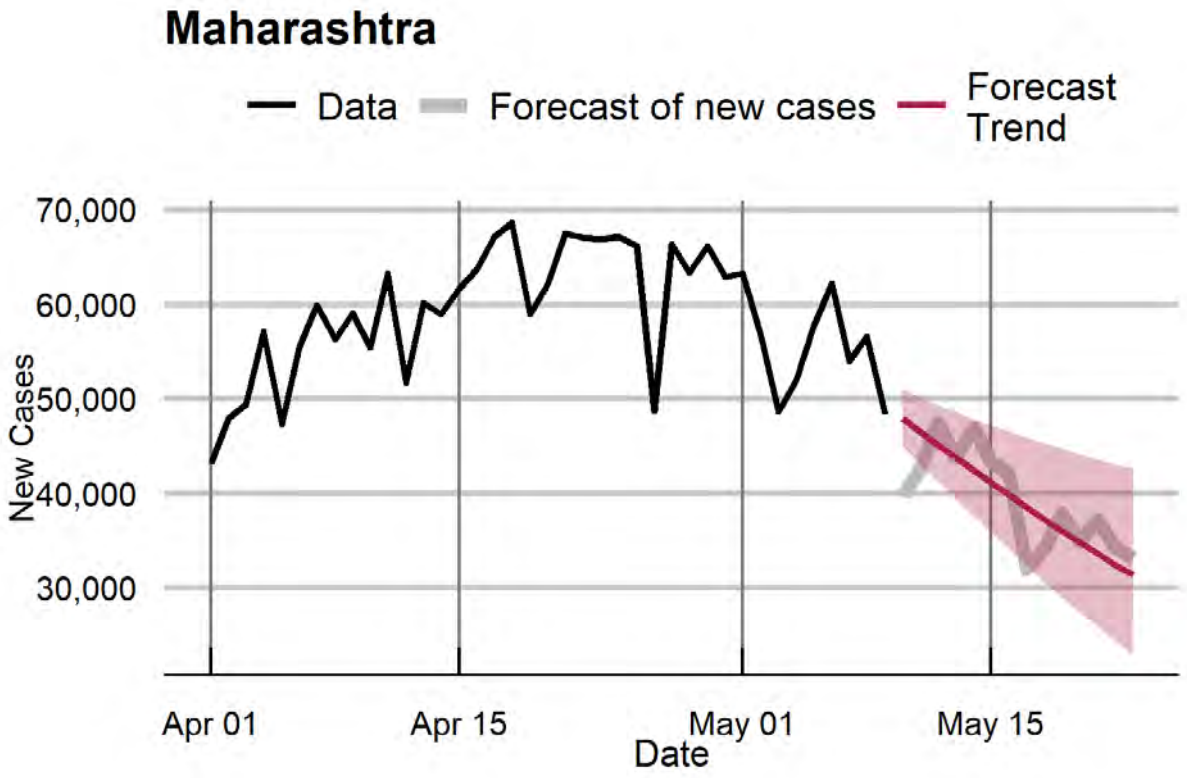

Kerala
Growth rate of new cases
0.15
0.10
0.05
0.00
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

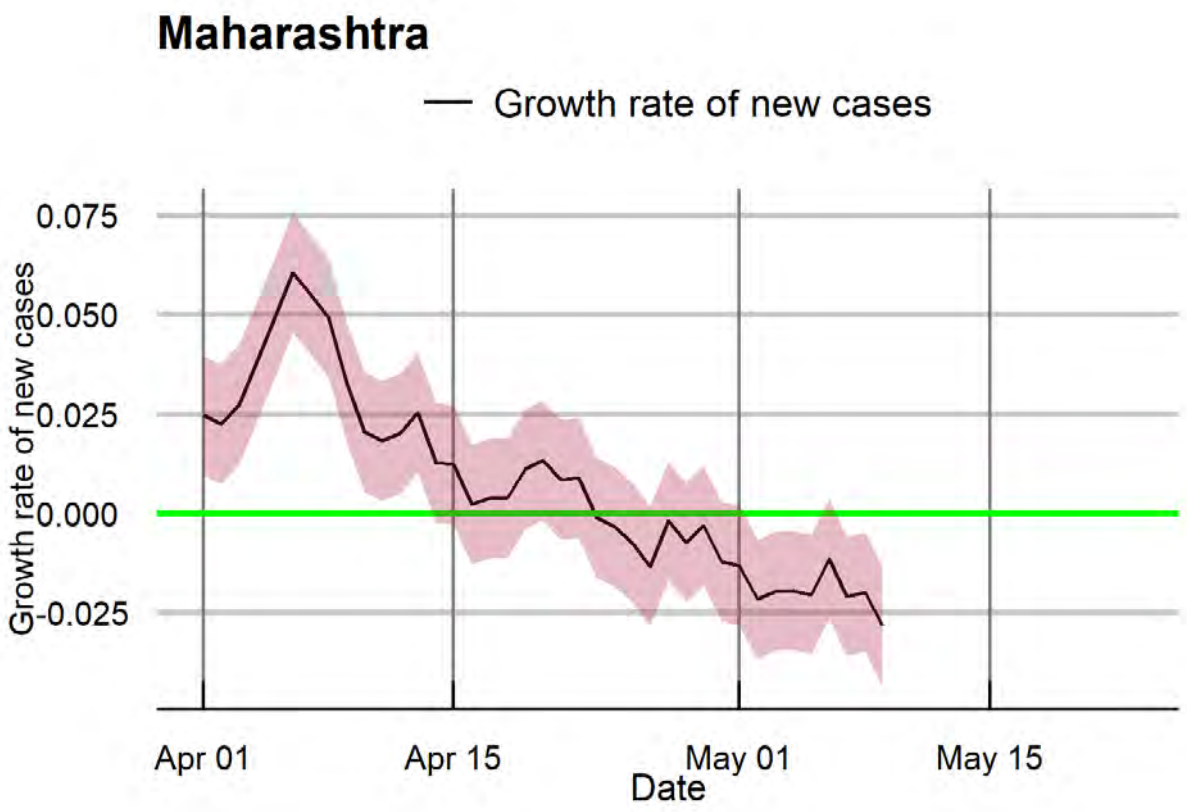

Lakshadweep
Data
Forecast of new cases
Forecast Trend
600
400
200
0
New Cases
Apr 01
Apr 15
May 01
May 15
Date

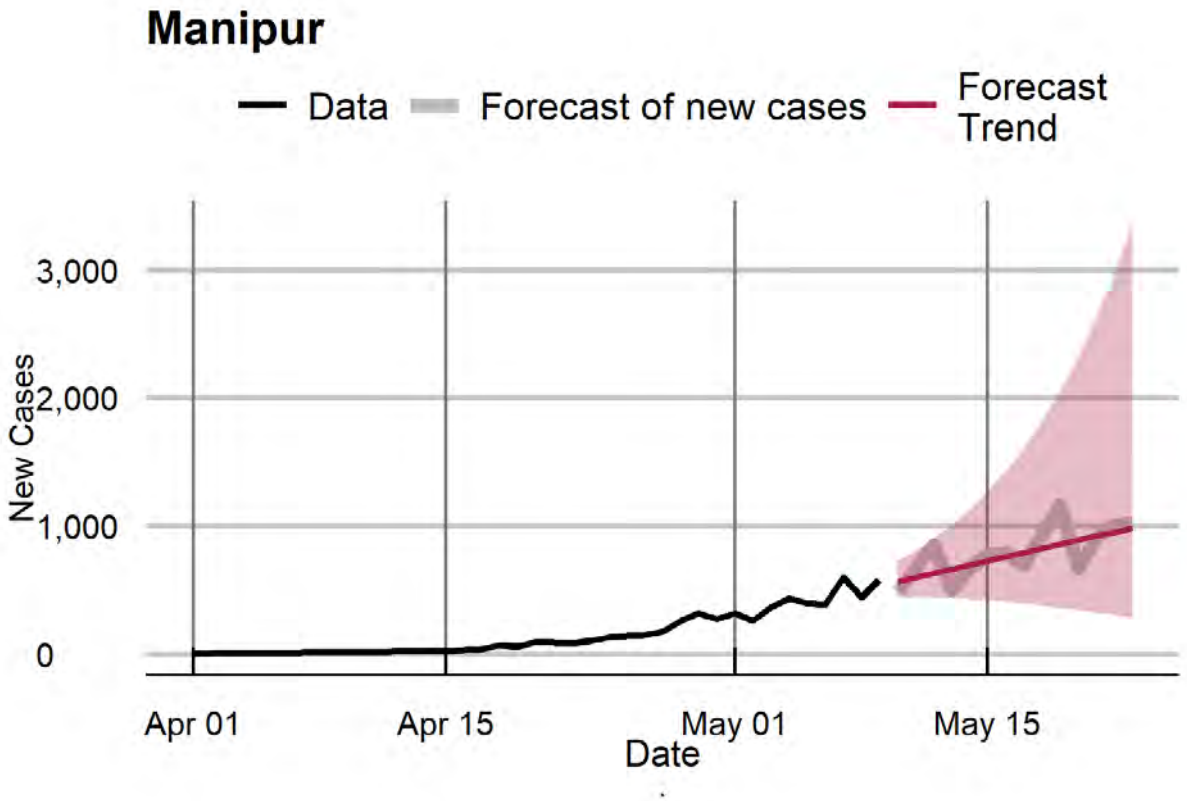

Lakshadweep
Growth rate of new cases
0.4
0.2
0.0
-0.2
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

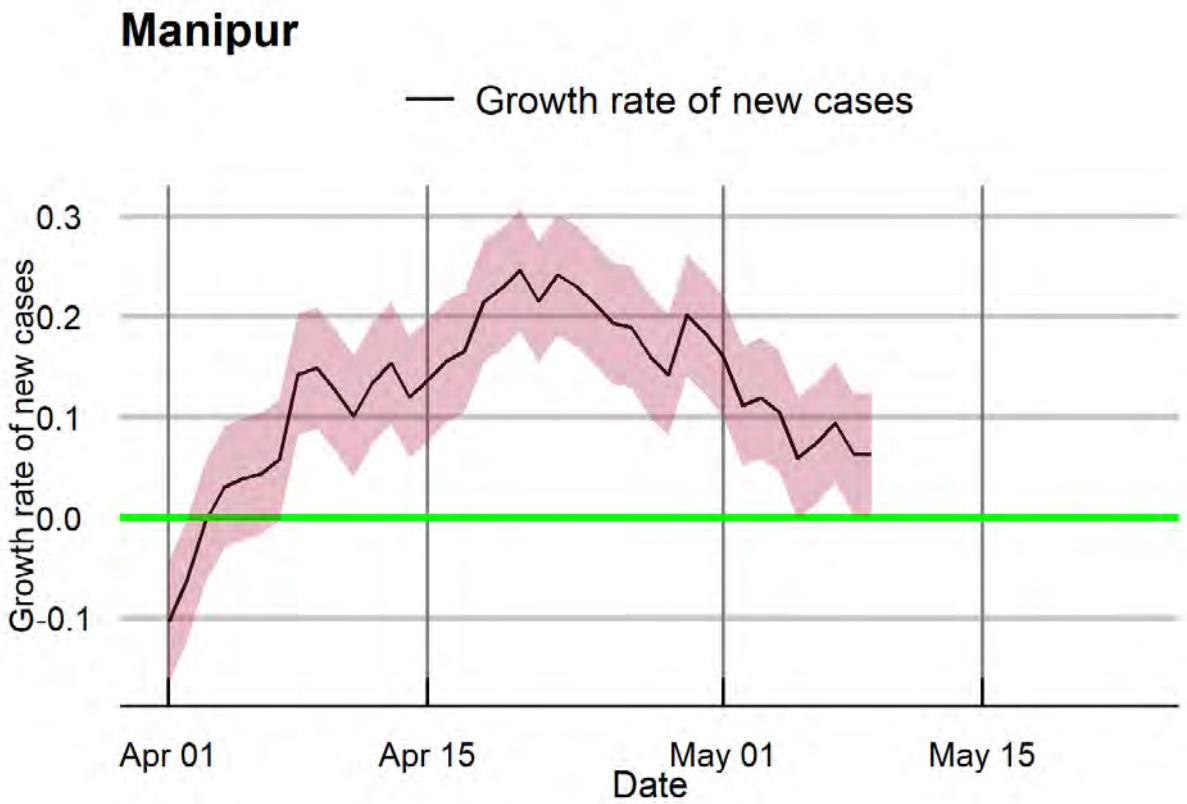

Madhya Pradesh
Data
Forecast of new cases
Forecast Trend
New Cases
10,000
5,000
Apr 01
Apr 15
May 01
May 15
Date

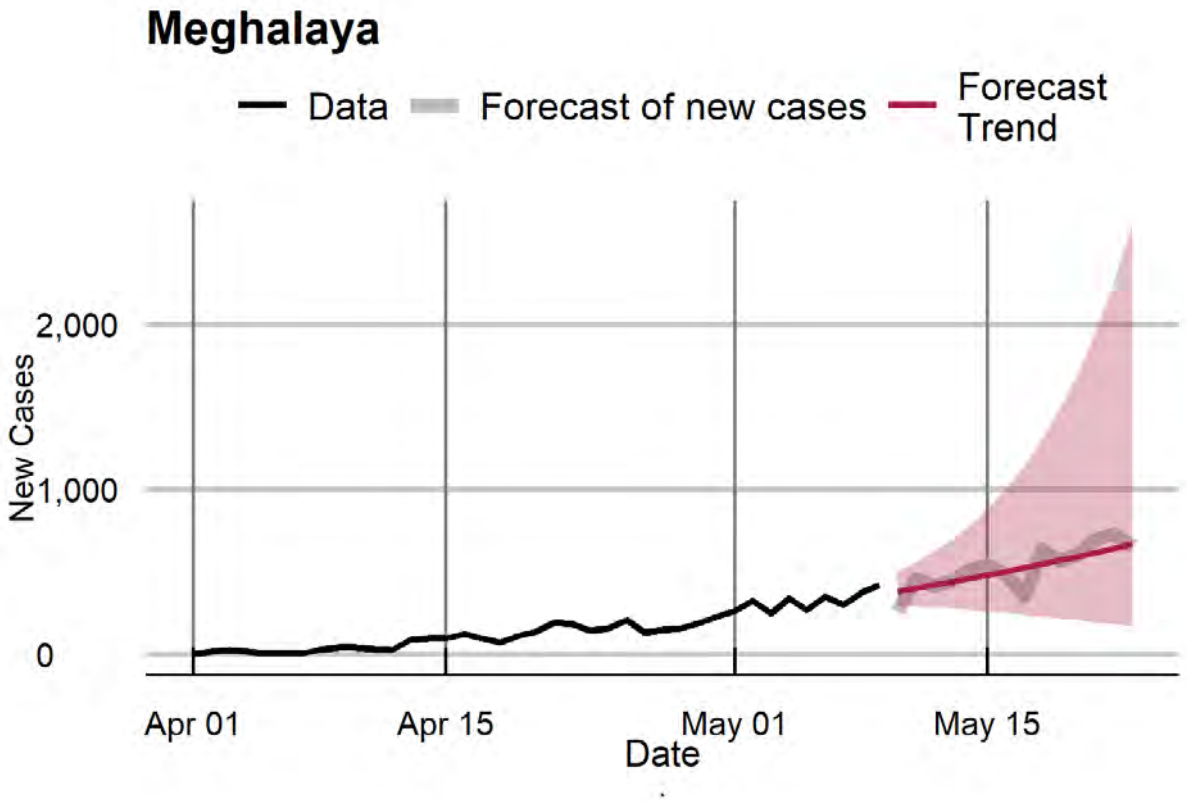

Madhya Pradesh
Growth rate of new cases
Growth rate of new cases
0.15
0.10
0.05
0.00
Apr 01
Apr 15
May 01
May 15
Date

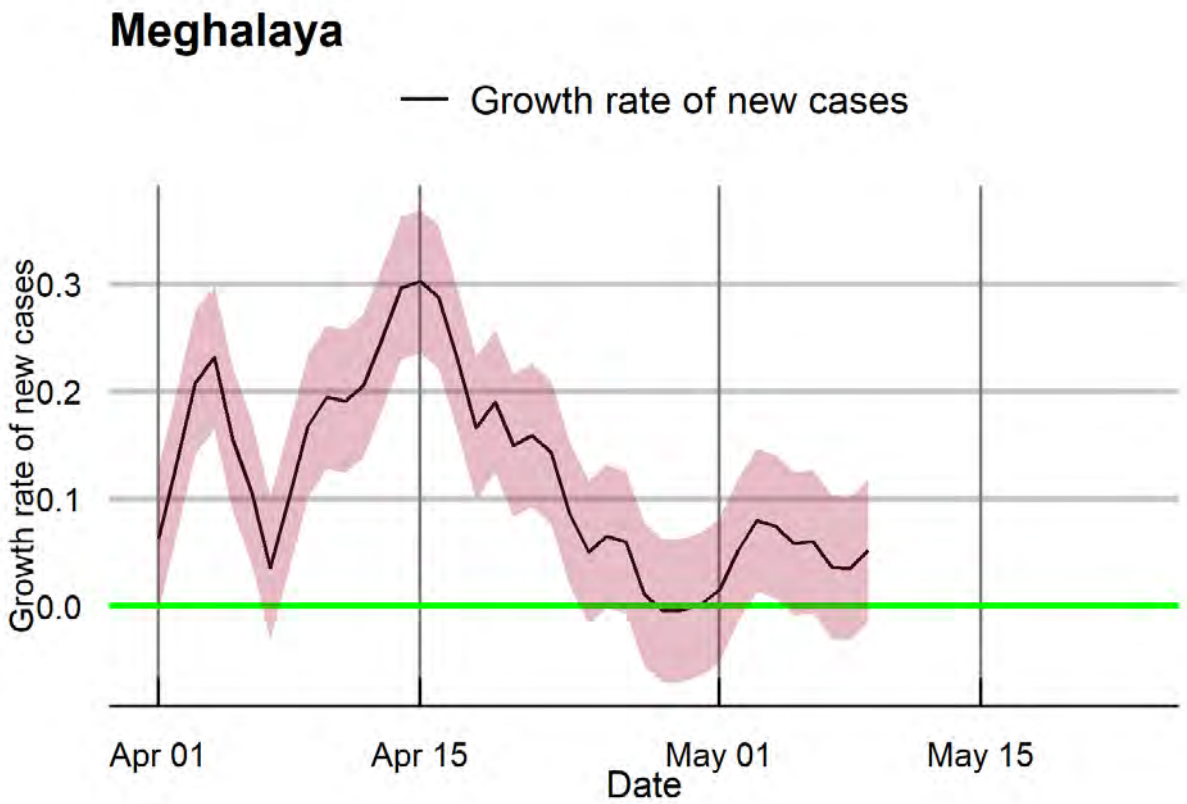

Maharashtra
Data
Forecast of new cases
Forecast Trend
70,000
60,000
50,000
40,000
30,000
New Cases
Apr 01
Apr 15
May 01
May 15
Date

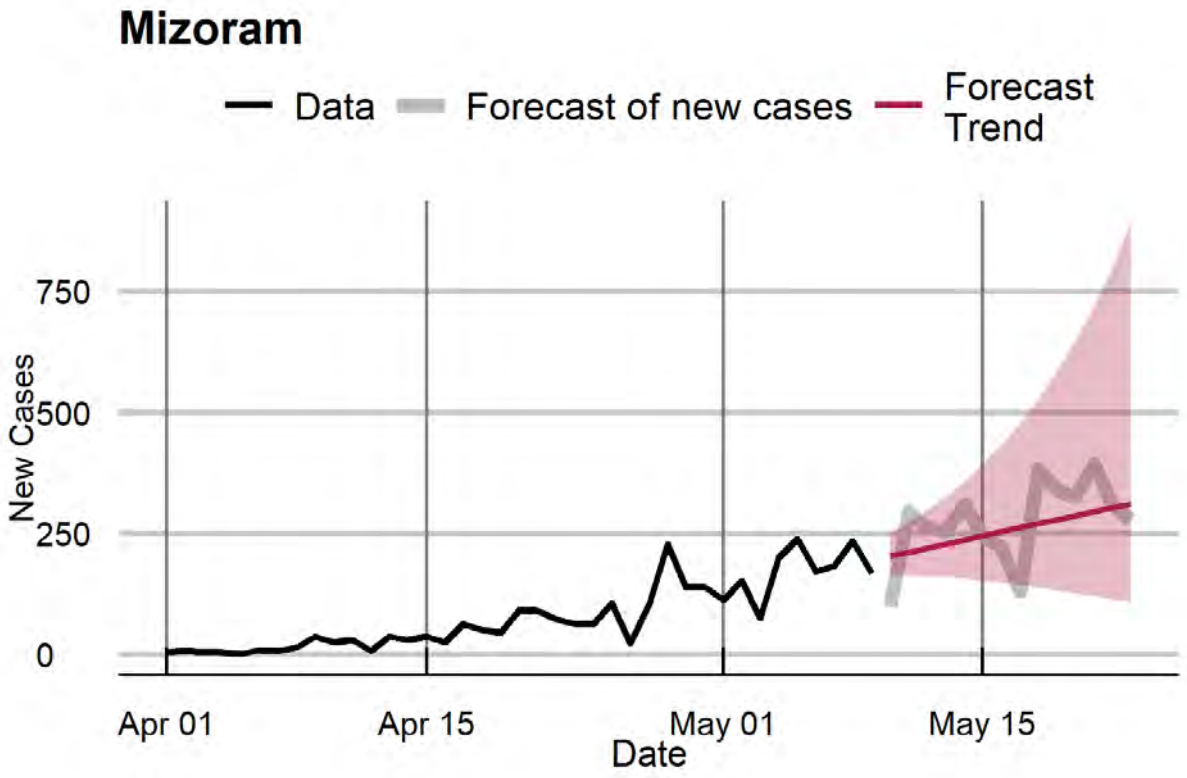

Maharashtra
Growth rate of new cases
0.075
0.050
0.025
0.000
-0.025
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

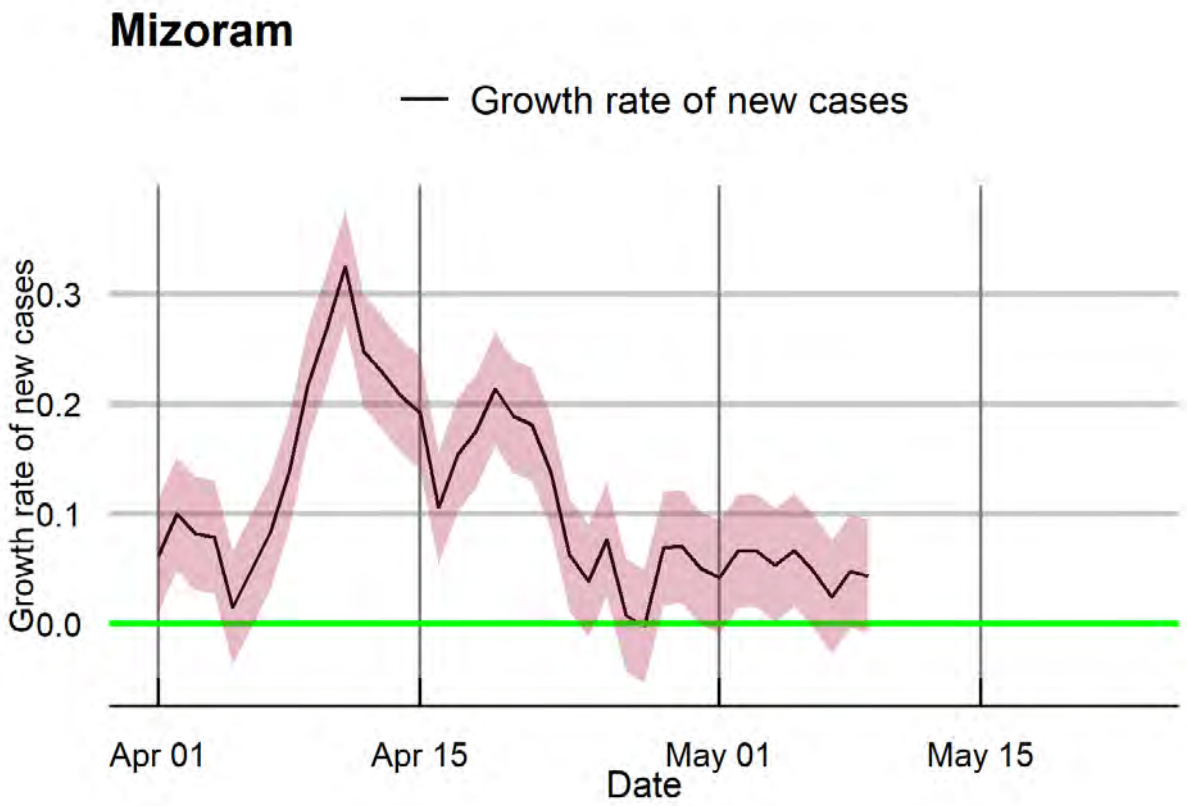

Manipur
Data
Forecast of new cases
Forecast Trend
3,000
2,000
1,000
0
New Cases
Apr 01
Apr 15
May 01
May 15
Date

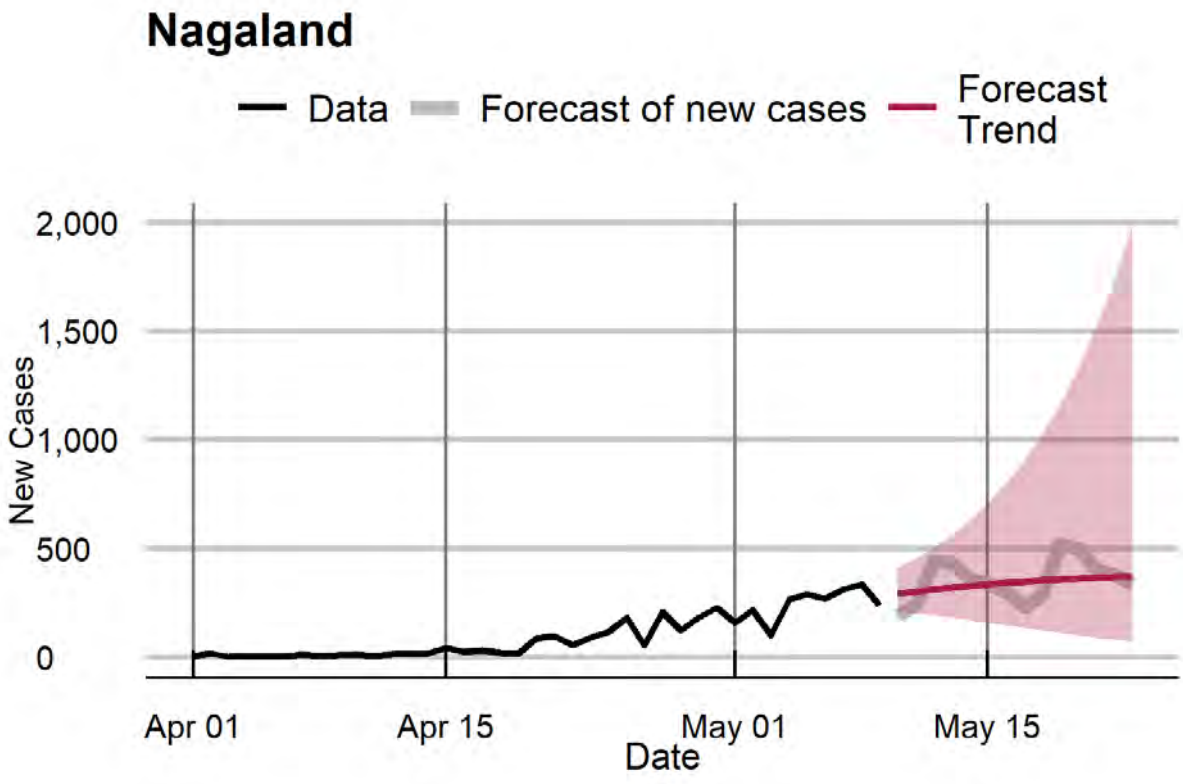

Manipur
Growth rate of new cases
0.3
0.2
0.1
0.0
-0.1
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

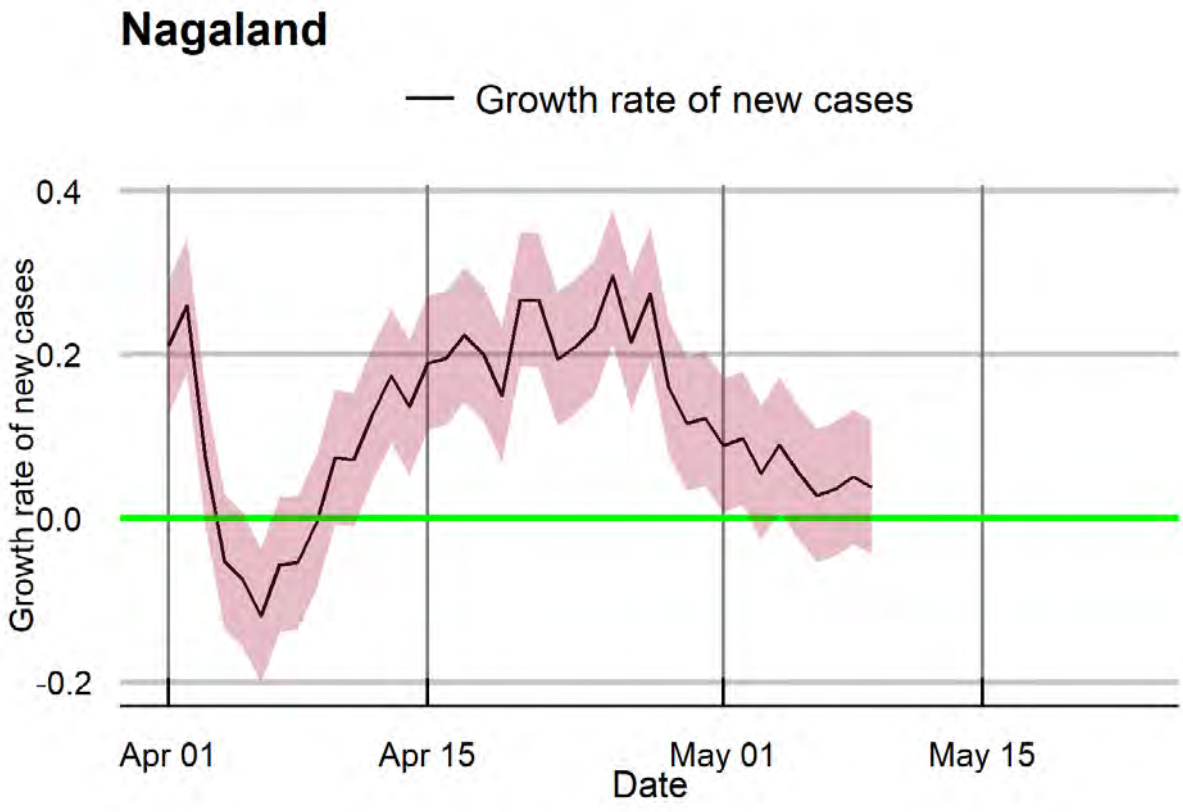

Meghalaya
Data
Forecast of new cases
Forecast Trend
New Cases
2,000
1,000
0
Apr 01
Apr 15
May 01
May 15
Date

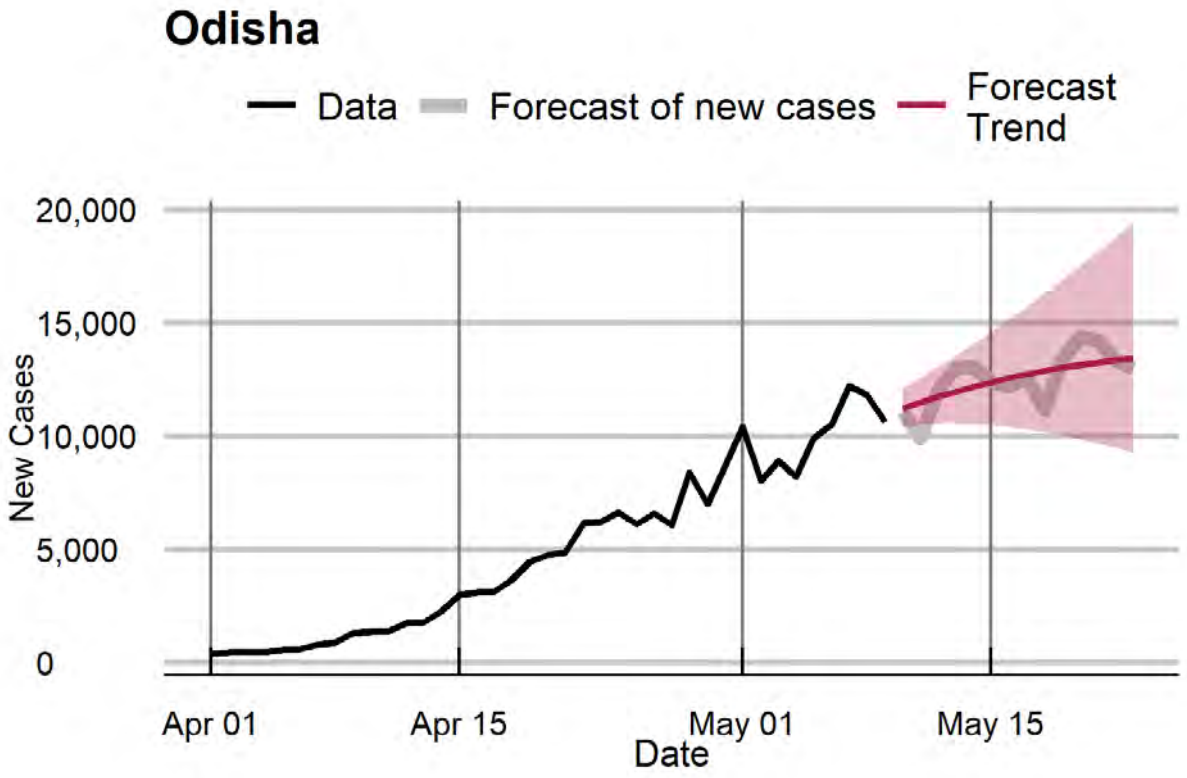

Meghalaya
Growth rate of new cases
Growth rate of new cases
0.3
0.2
0.1
0.0
Apr 01
Apr 15
May 01
May 15
Date

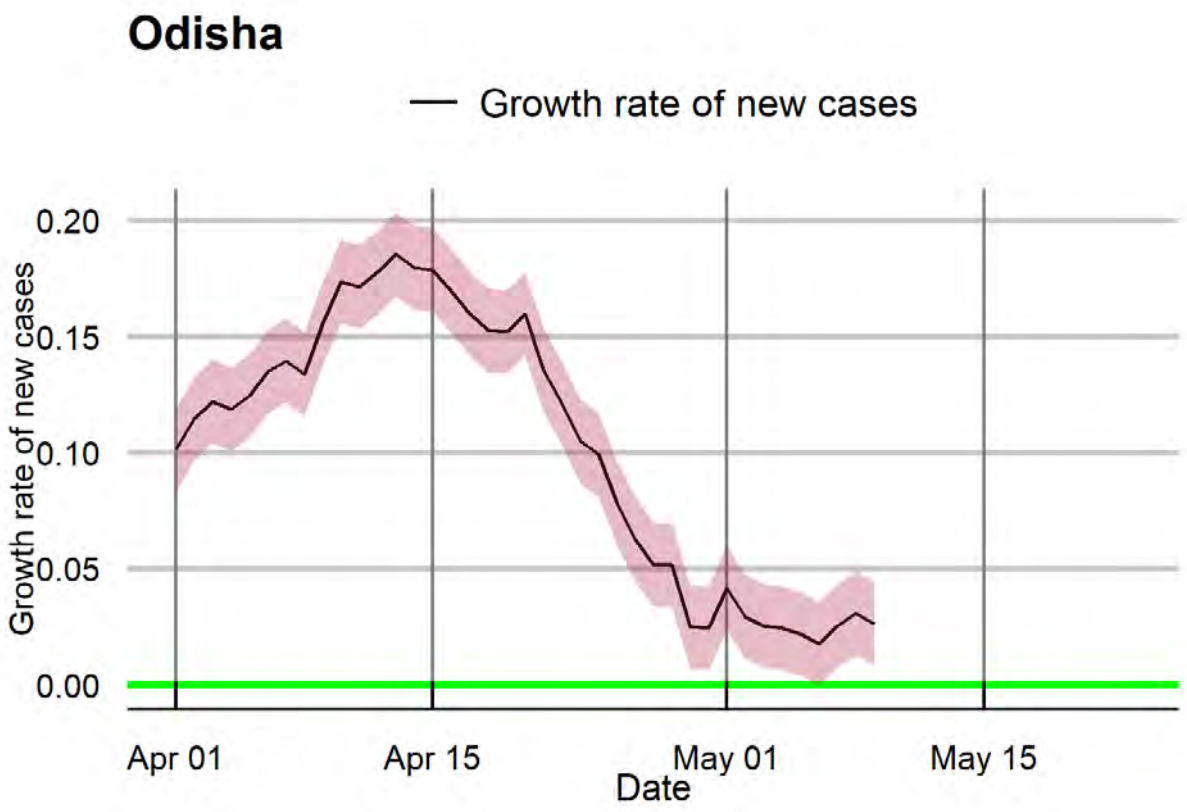

Mizoram
Data
Forecast of new cases
Forecast Trend
New Cases
750
500
250
0
Apr 01
Apr 15
May 01
May 15
Date

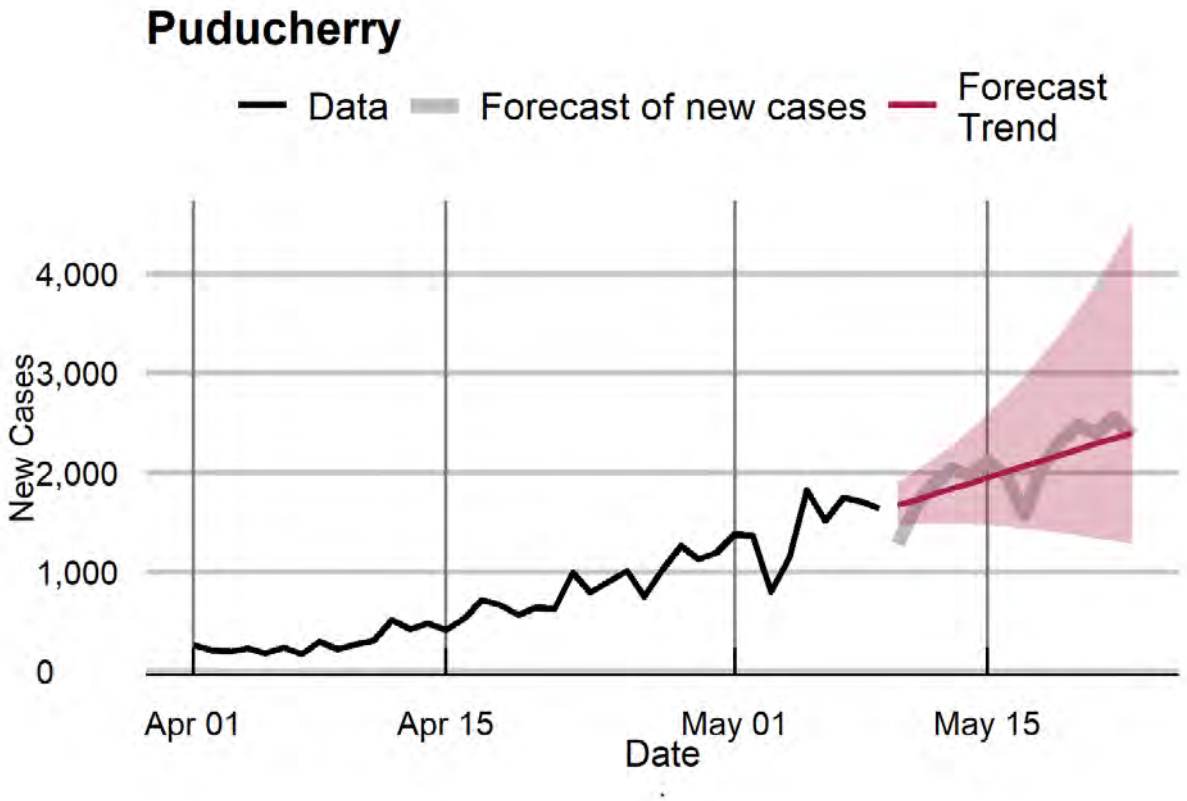

Mizoram
Growth rate of new cases
Growth rate of new cases
0.3
0.2
0.1
0.0
Apr 01
Apr 15
May 01
May 15
Date

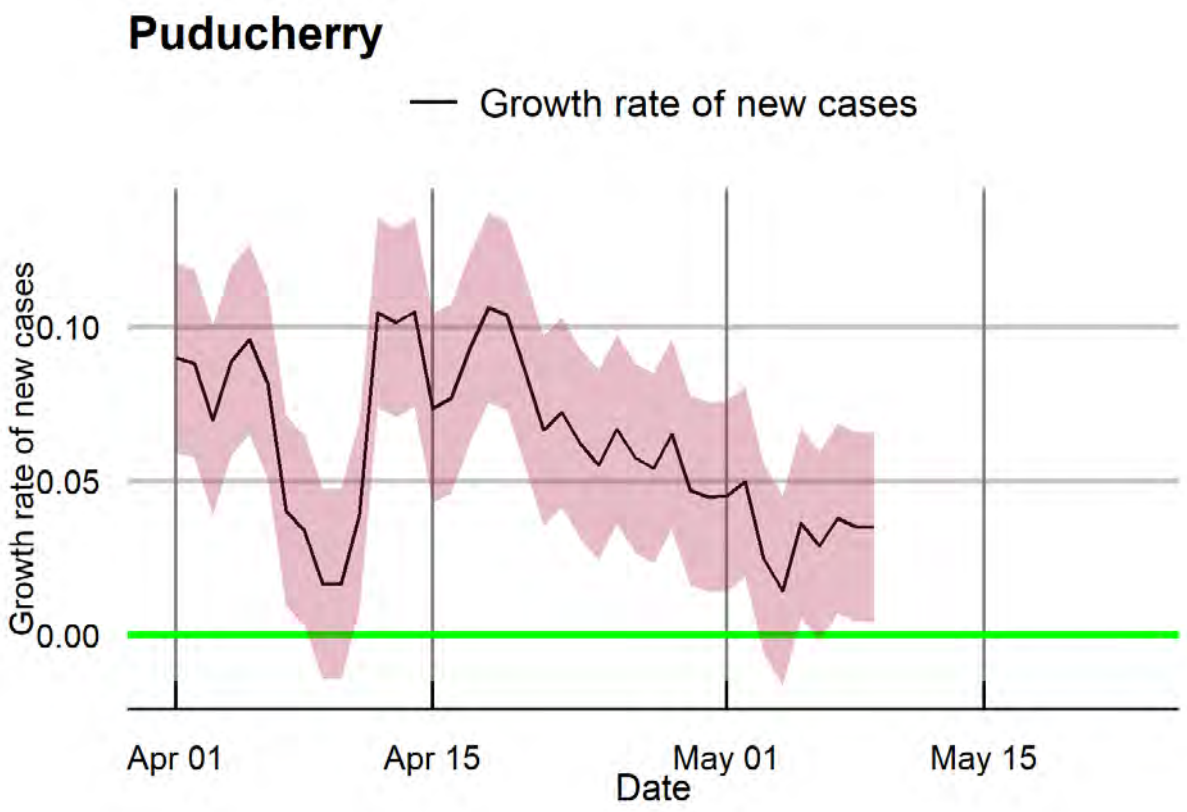

Nagaland
Data
Forecast of new cases
Forecast Trend
2,000
1,500
1,000
500
0
New Cases
Apr 01
Apr 15
May 01
May 15
Date

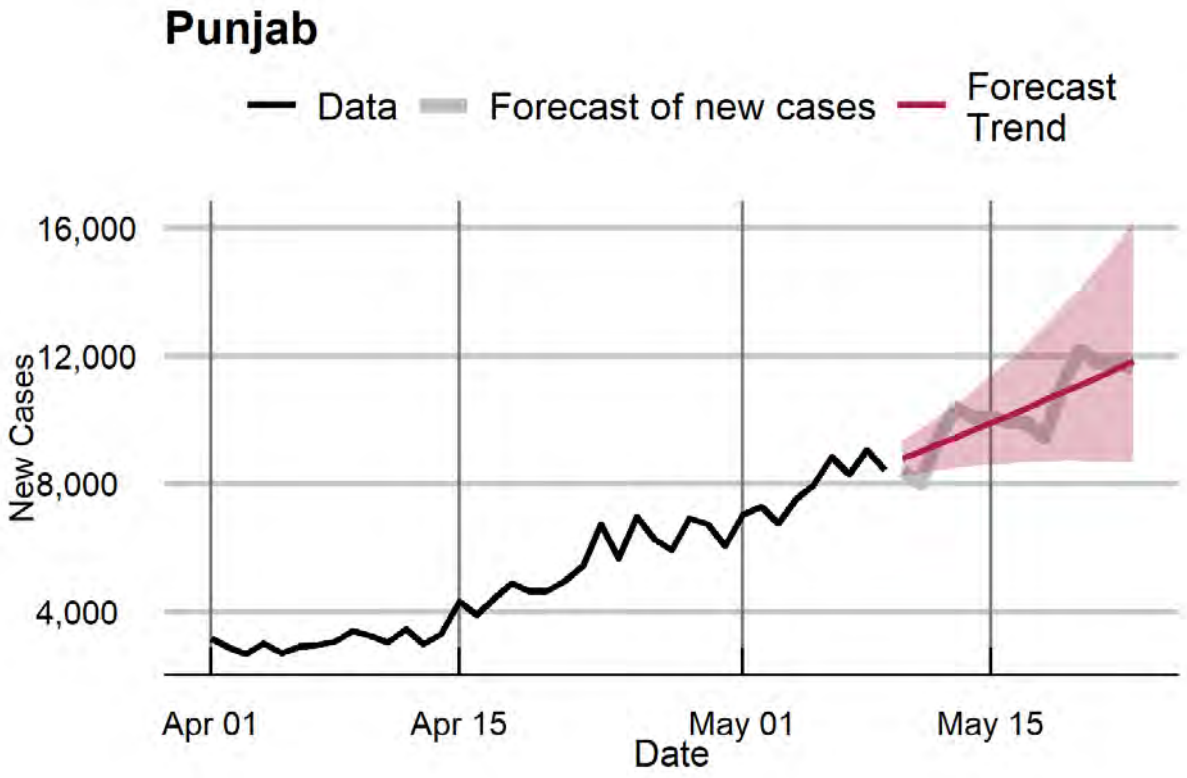

Nagaland
Growth rate of new cases
0.4
0.2
0.0
-0.2
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

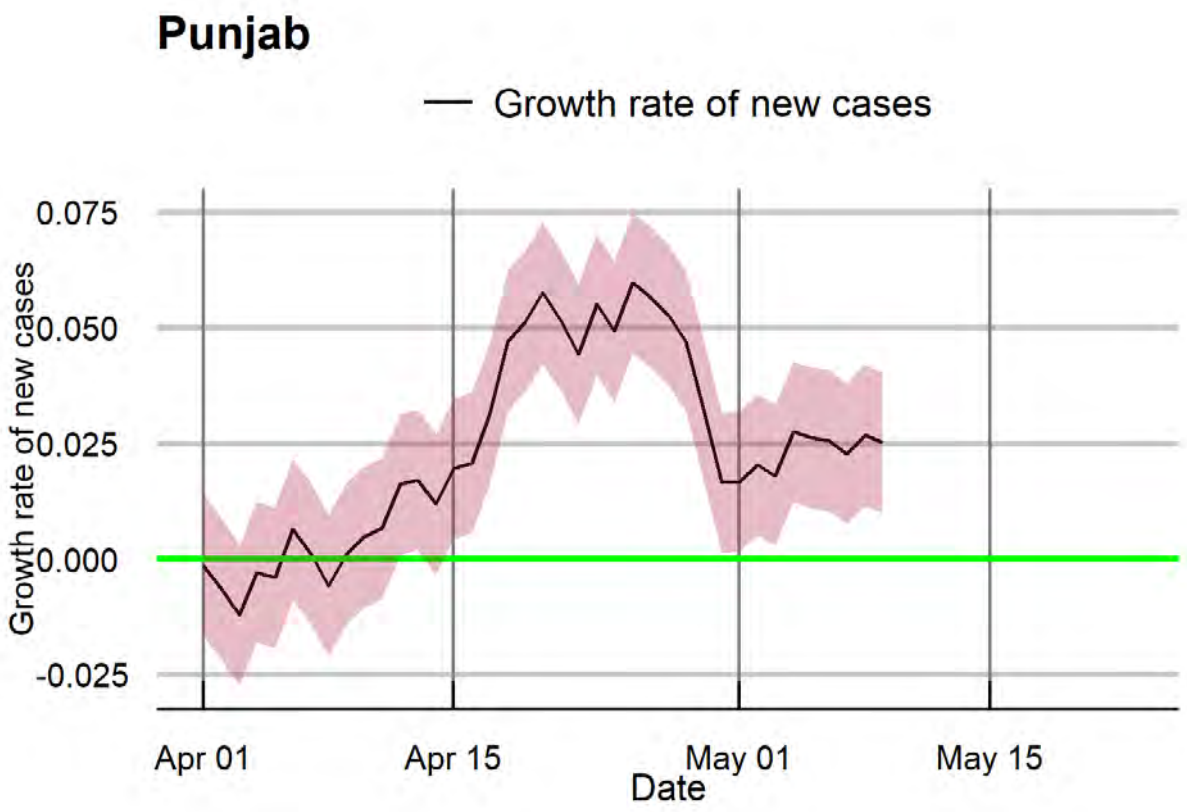

Odisha
Data
Forecast of new cases
Forecast Trend
20,000
15,000
10,000
5,000
0
New Cases
Apr 01
Apr 15
May 01
May 15
Date

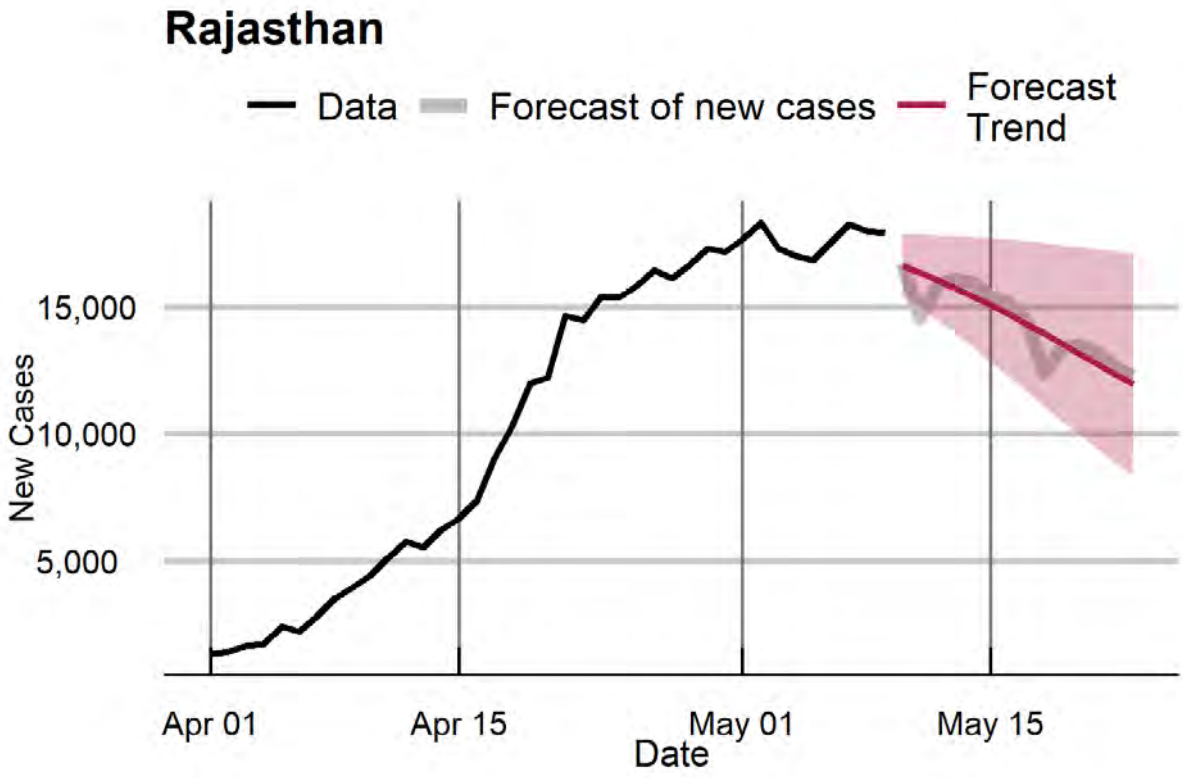

Odisha
Growth rate of new cases
0.20
0.15
0.10
0.05
0.00
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

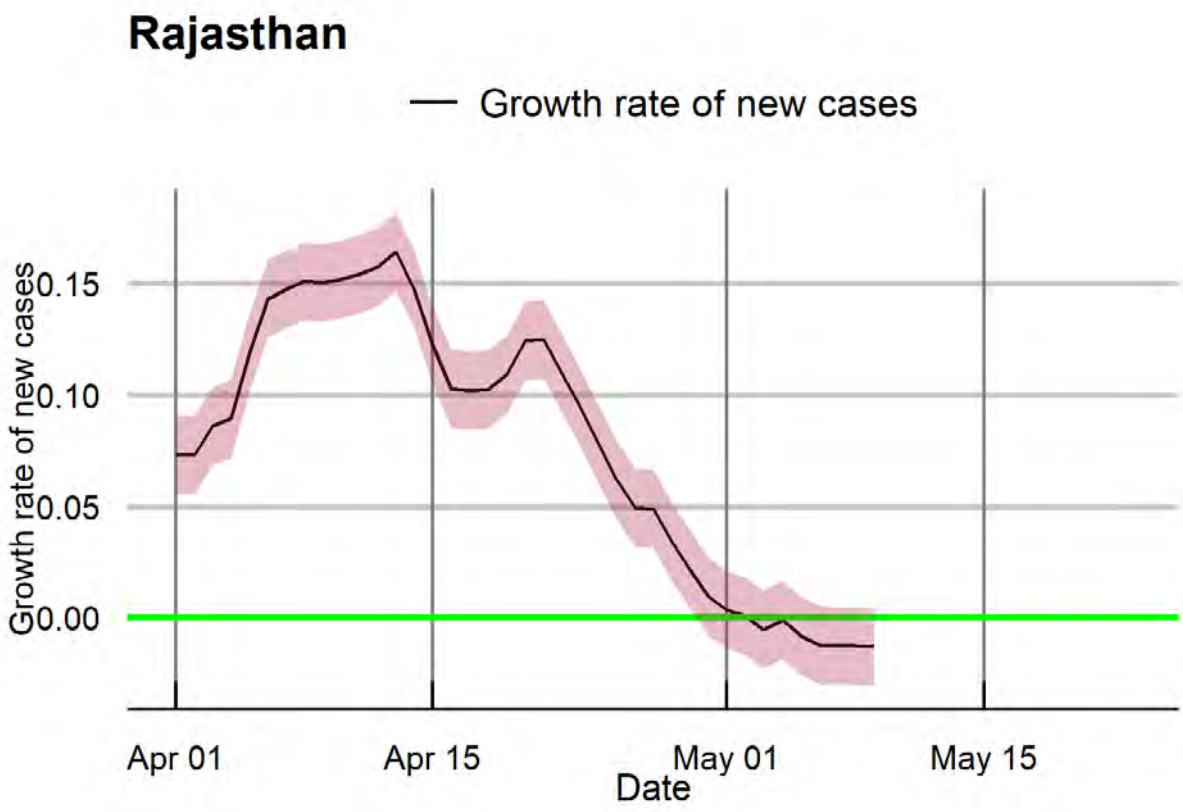

Puducherry
Data
Forecast of new cases
Forecast Trend
4,000
3,000
2,000
1,000
0
New Cases
Apr 01
Apr 15
May 01
May 15
Date

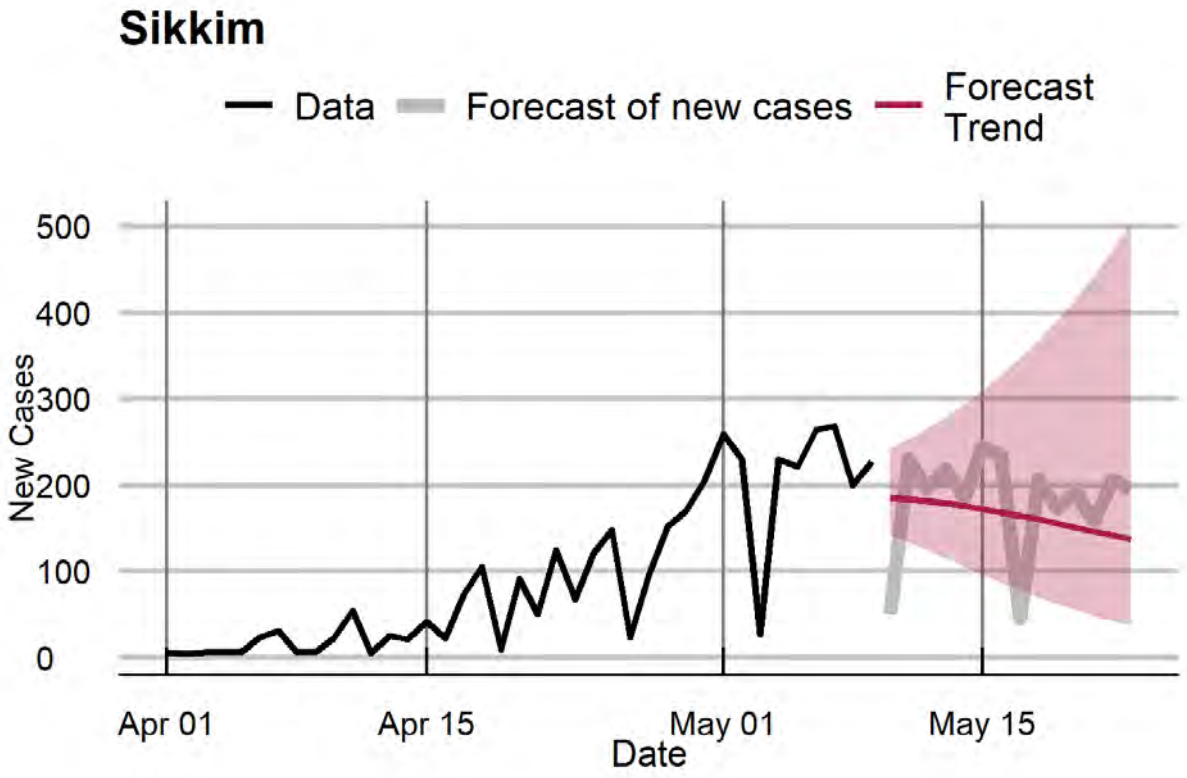

Puducherry
Growth rate of new cases
0.10
0.05
0.00
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

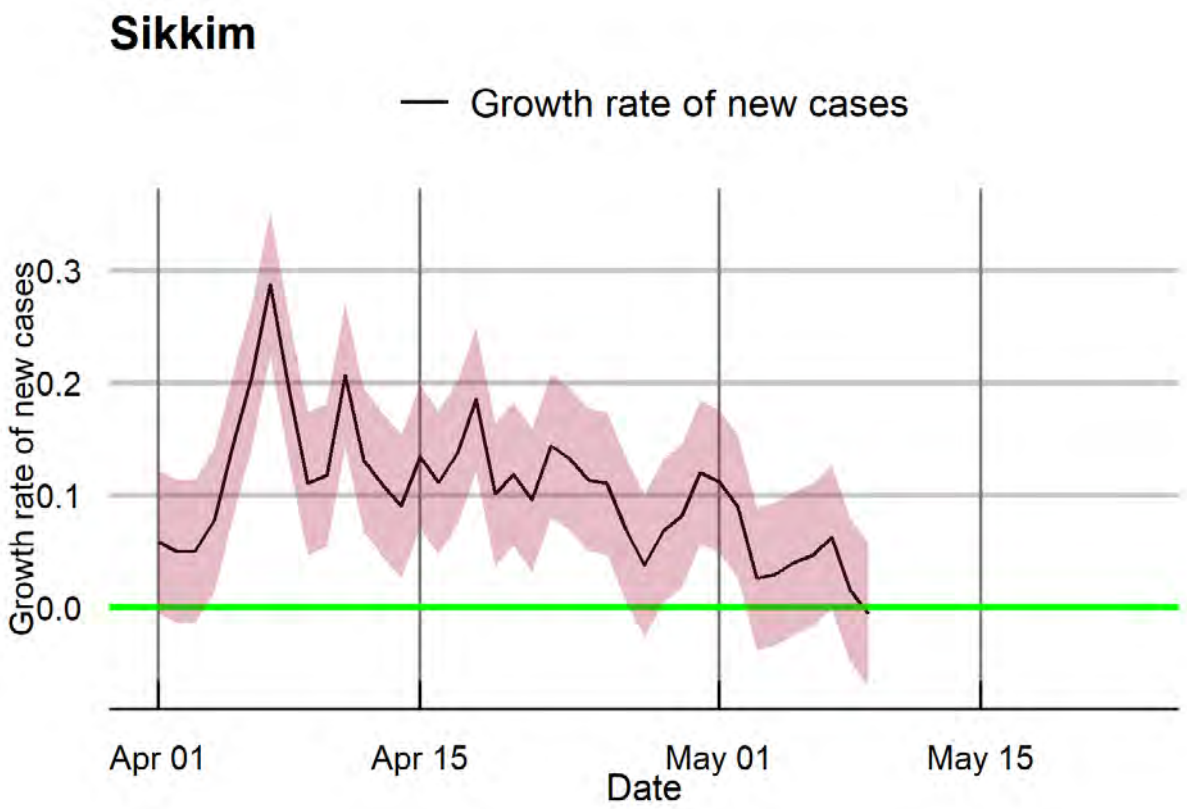

Punjab
Data
Forecast of new cases
Forecast Trend
16,000
12,000
8,000
4,000
New Cases
Apr 01
Apr 15
May 01
May 15
Date

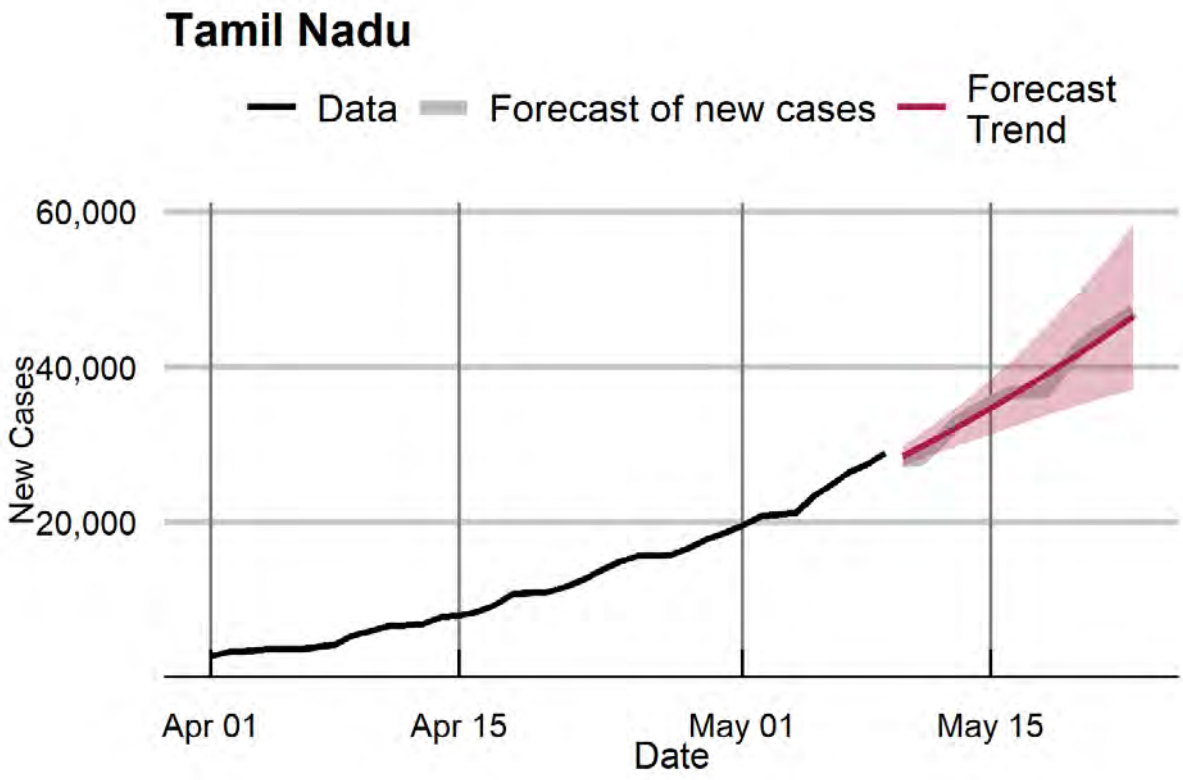

Punjab
Growth rate of new cases
0.075
0.050
0.025
0.000
-0.025
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

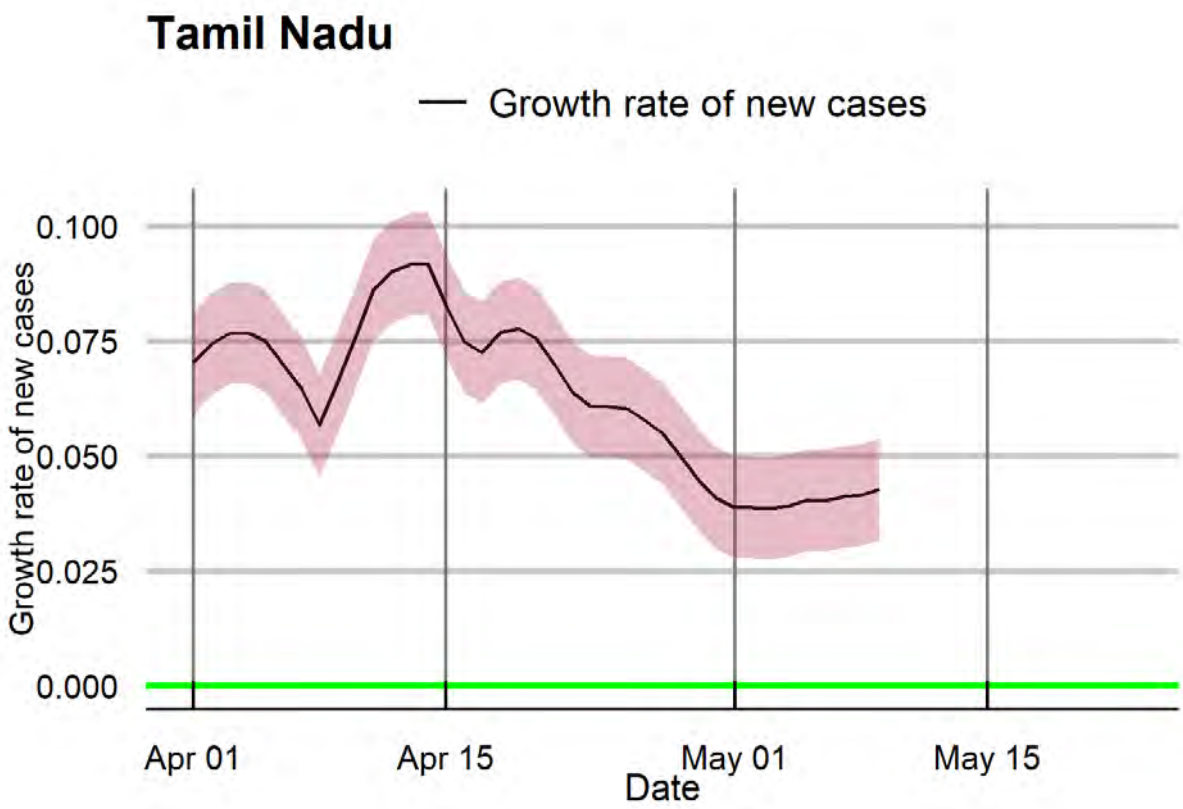

Rajasthan
Data
Forecast of new cases
Forecast Trend
15,000
10,000
5,000
New Cases
Apr 01
Apr 15
May 01
May 15
Date

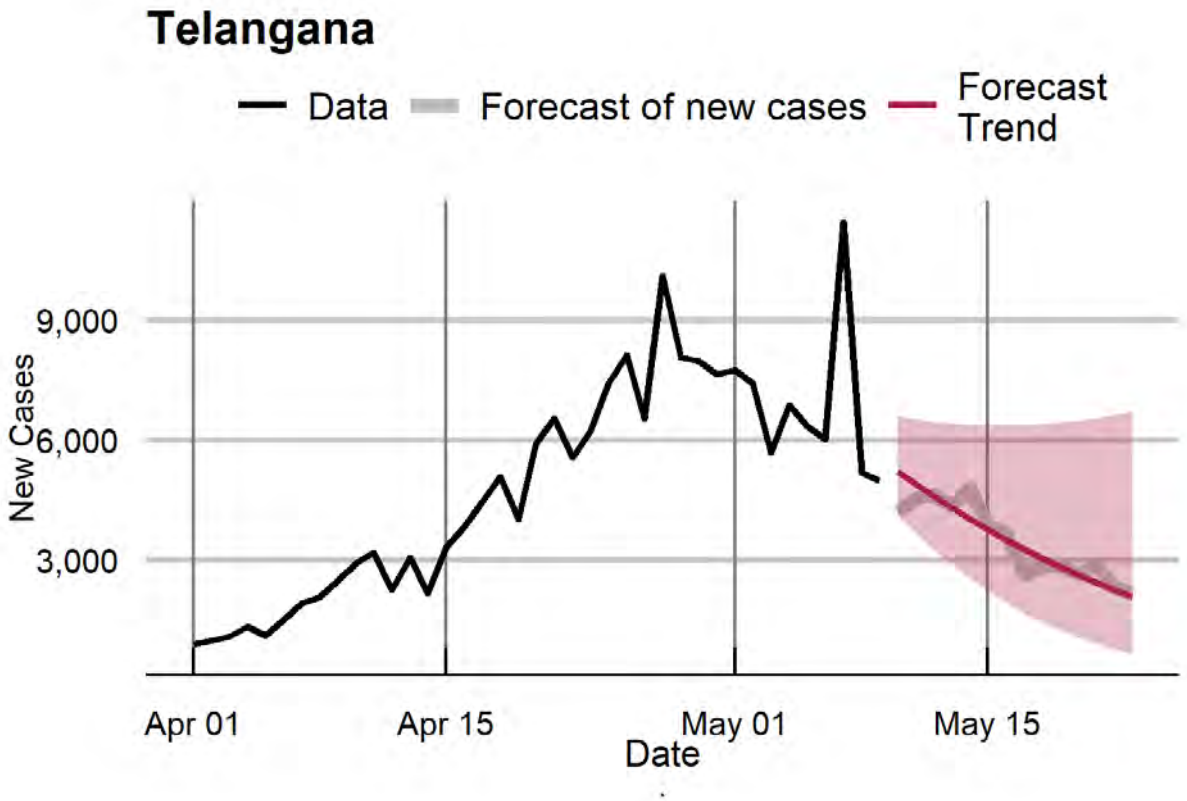

Rajasthan
Growth rate of new cases
0.15
0.10
0.05
0.00
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

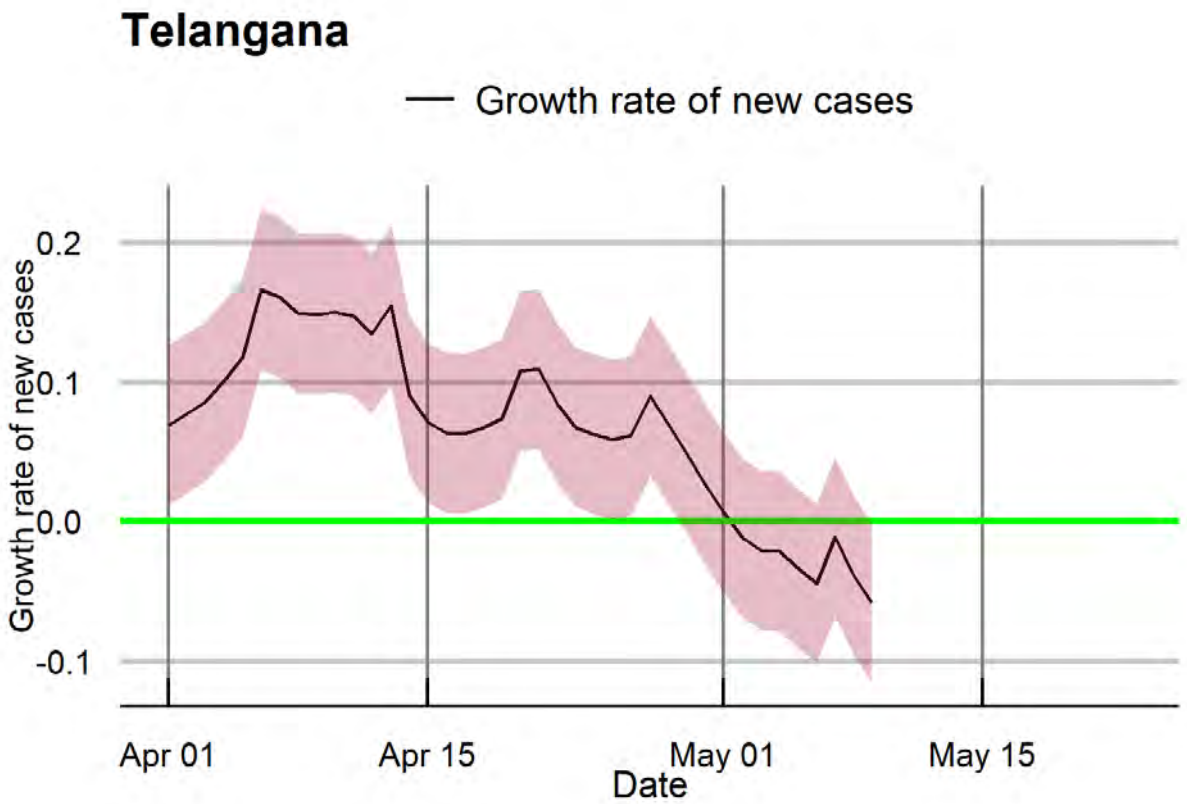

Sikkim
Data
Forecast of new cases
Forecast Trend
500
400
300
200
100
0
New Cases
Apr 01
Apr 15
May 01
May 15
Date

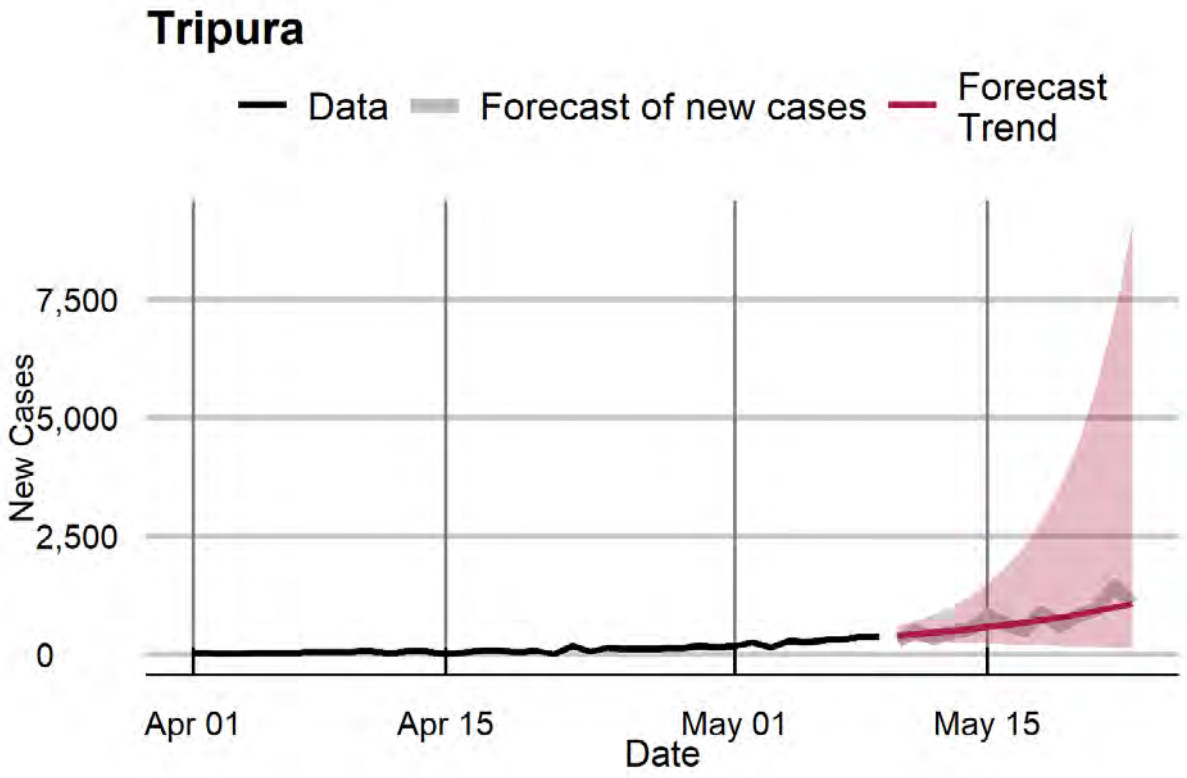

Sikkim
Growth rate of new cases
0.3
0.2
0.1
0.0
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

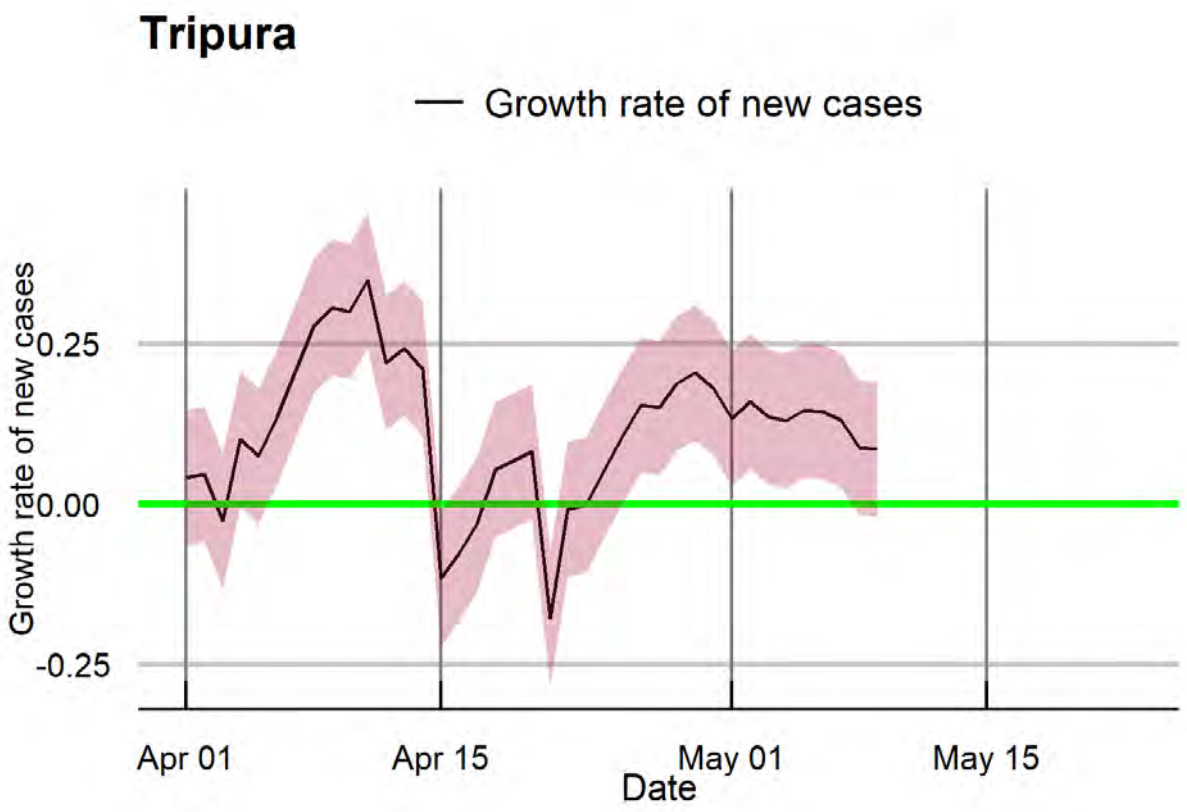

Tamil Nadu
Data
Forecast of new cases
Forecast Trend
60,000
40,000
20,000
New Cases
Apr 01
Apr 15
May 01
May 15
Date

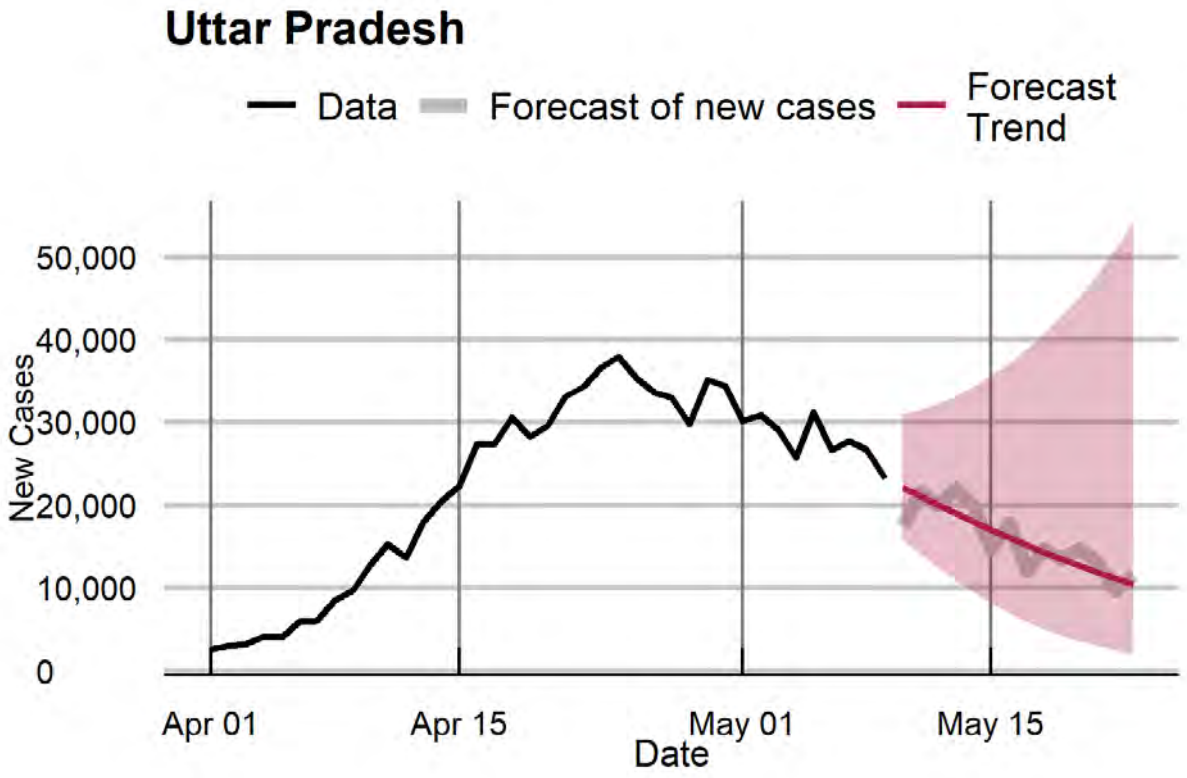

Tamil Nadu
Growth rate of new cases
0.100
0.075
0.050
0.025
0.000
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

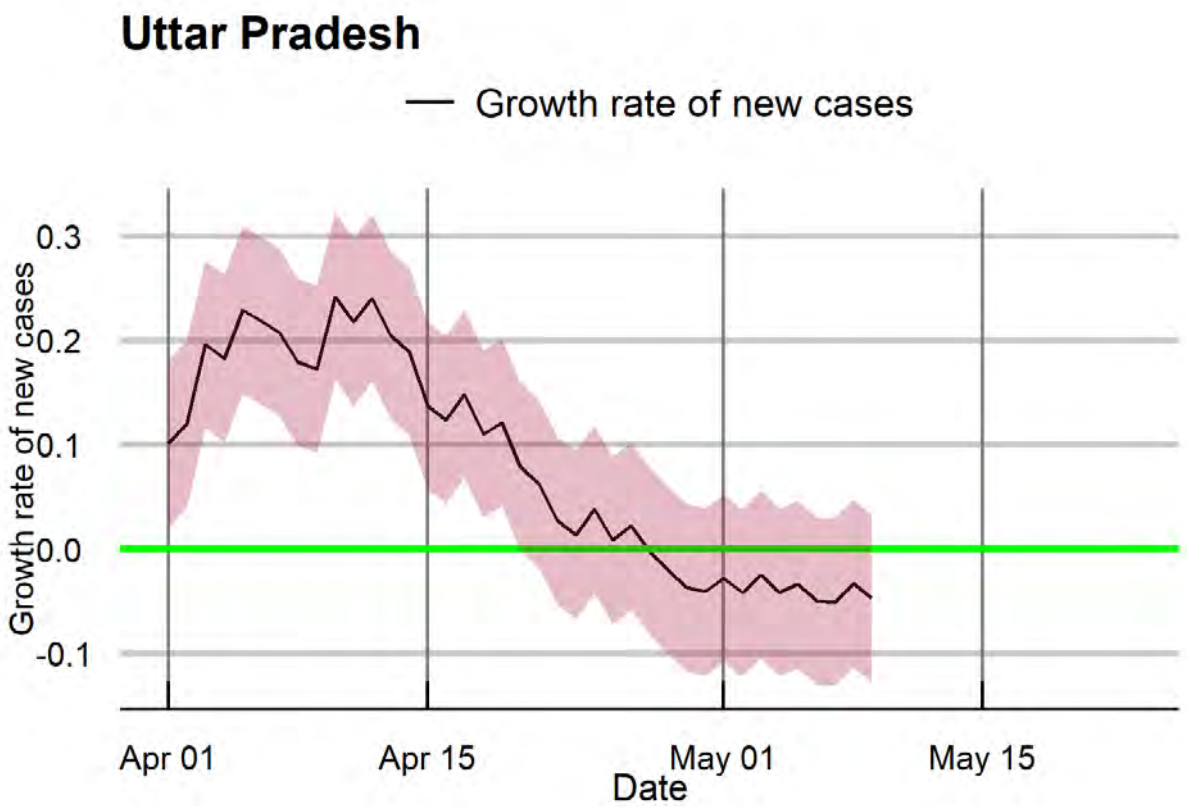

Telangana
Data
Forecast of new cases
Forecast Trend
9,000
6,000
3,000
New Cases
Apr 01
Apr 15
May 01
May 15
Date

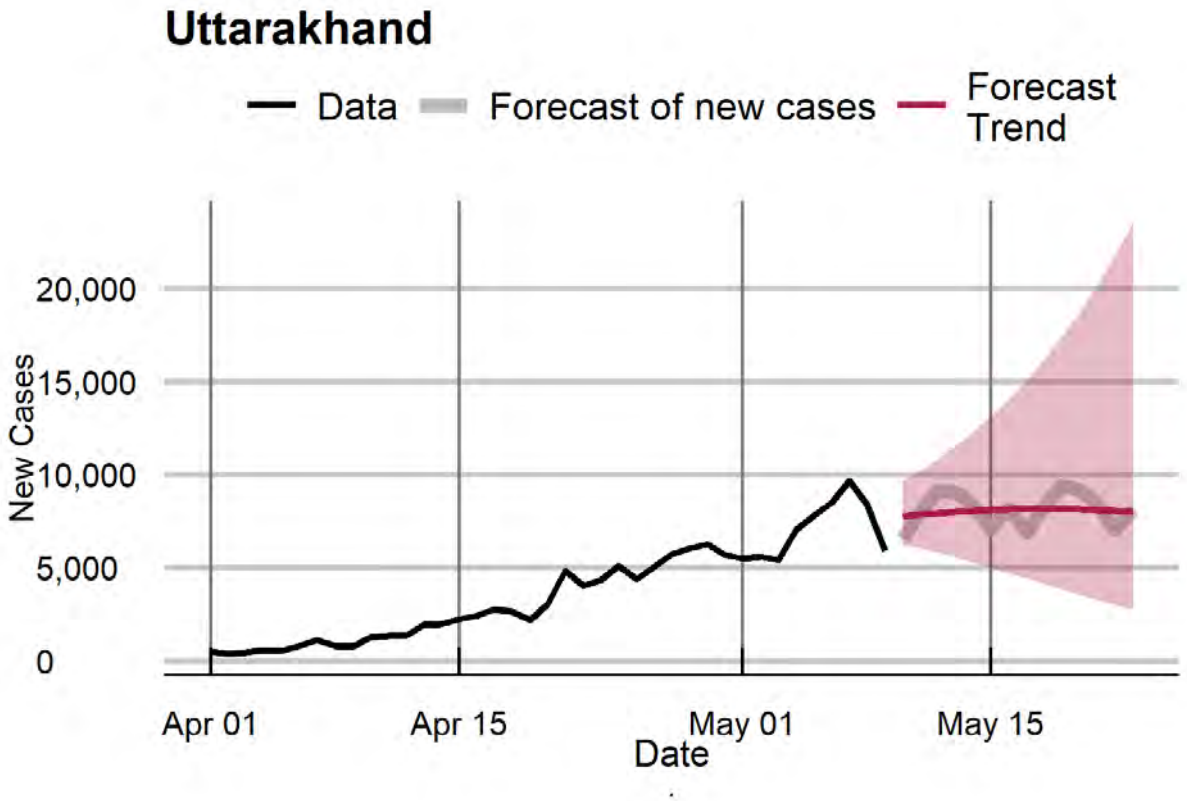

Telangana
Growth rate of new cases
0.2
0.1
0.0
-0.1
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

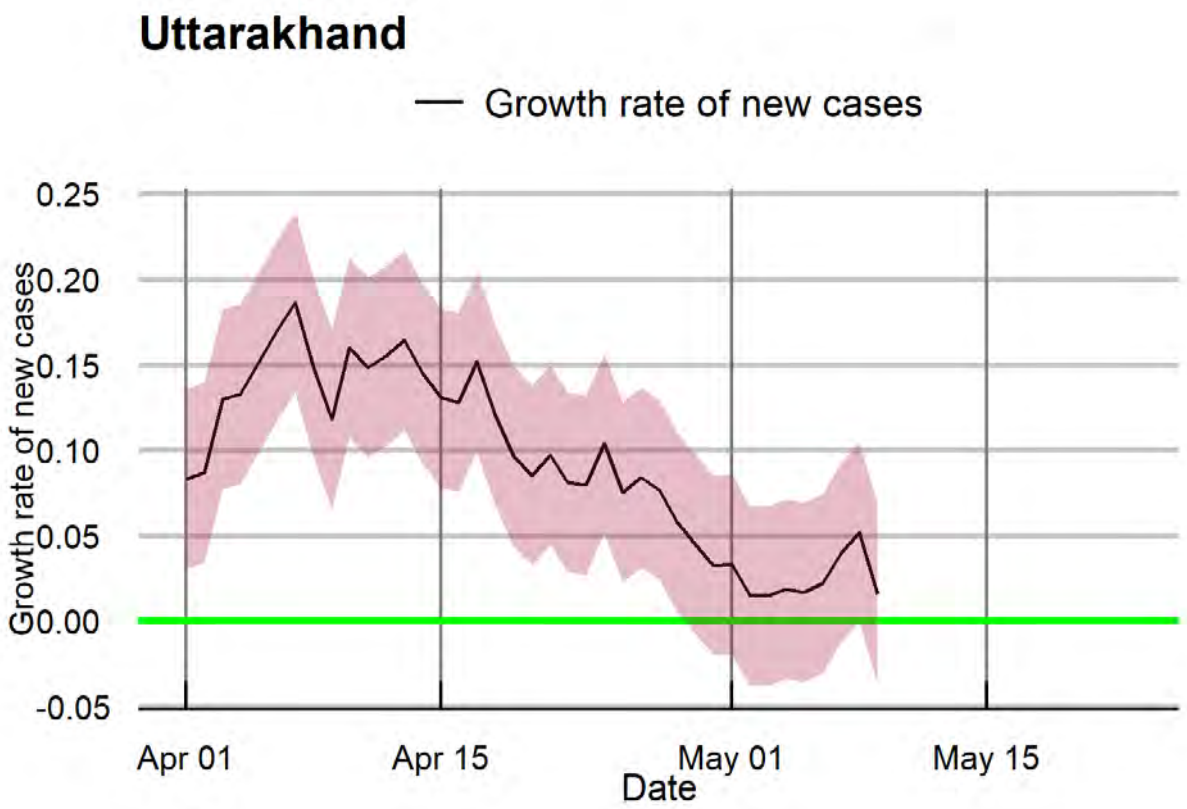

Tripura
Data
Forecast of new cases
Forecast Trend
7,500
5,000
2,500
0
New Cases
Apr 01
Apr 15
May 01
May 15
Date

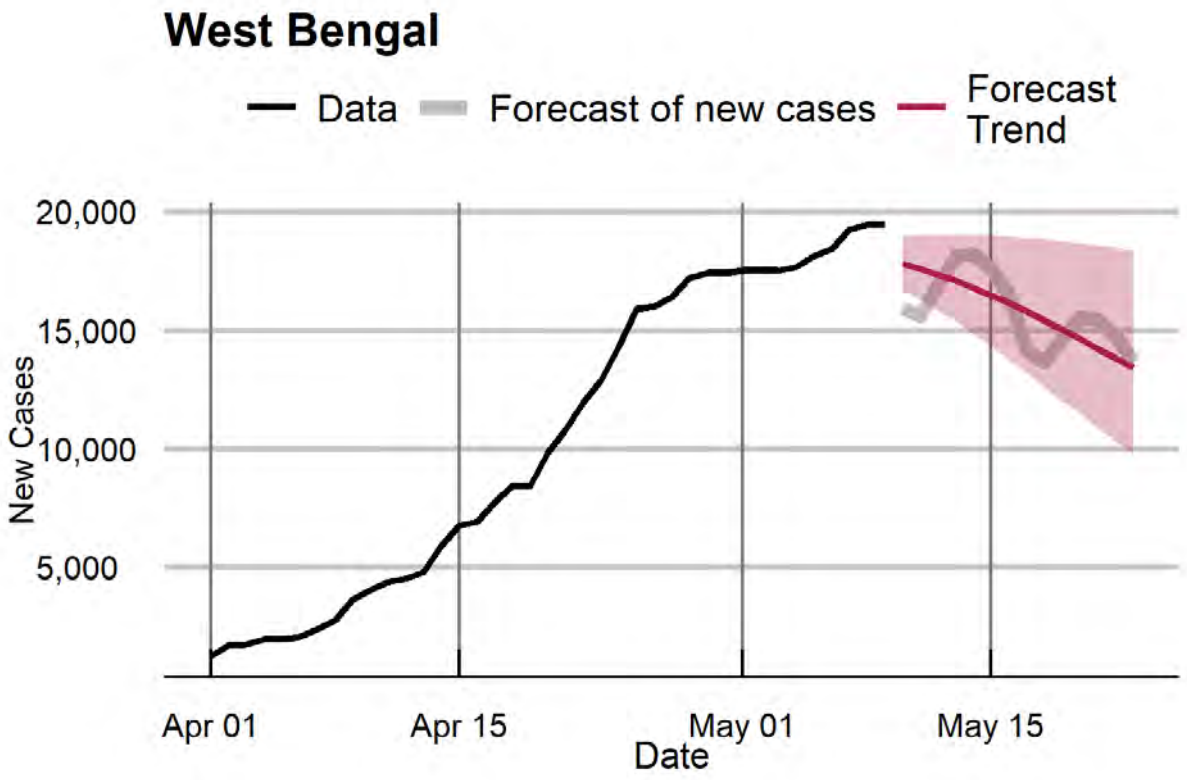

Tripura
Growth rate of new cases
0.25
0.00
-0.25
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date

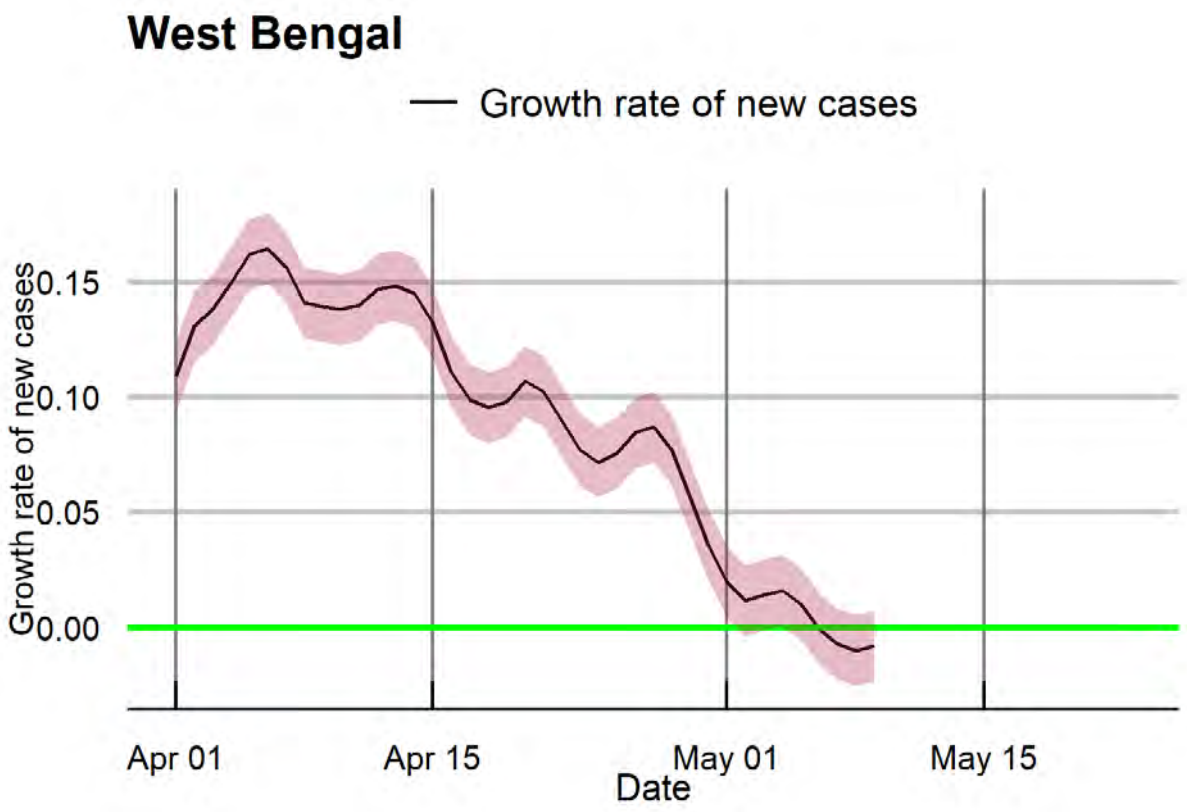

Uttar Pradesh
Data
Forecast of new cases
Forecast Trend
50,000
40,000
30,000
20,000
10,000
0
New Cases
Apr 01
Apr 15
May 01
May 15
Date


Uttar Pradesh
Growth rate of new cases
0.3
0.2
0.1
0.0
-0.1
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date


Uttarakhand
Data
Forecast of new cases
Forecast Trend
20,000
15,000
10,000
5,000
0
New Cases
Apr 01
Apr 15
May 01
May 15
Date


Uttarakhand
Growth rate of new cases
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
Date


West Bengal
Data
Forecast of new cases
Forecast Trend
20,000
15,000
10,000
5,000
New Cases
Apr 01
Apr 15
May 01
May 15
Date


West Bengal
Growth rate of new cases
0.15
0.10
0.05
0.00
Growth rate of new cases
Apr 01
Apr 15
May 01
May 15
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 2, the mean absolute percentage error of the forecasts for the 7 day period, May 3-9, is 6.1%. Forecast accuracy will in general be lower for the smaller states / union territories. It is important to pay attention to the confidence interval around the forecasts. The coverage of the interval presented is 50% implying there is 25% 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 1 std. deviation, with coverage of 68%.

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

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