

Situational awareness and forecasting for Norway

FHI COVID-19 modelling team

Week 49, 8 December 2021

Main results:

This week, the regional predictions are from the regional SMC model.

- **National epidemiological situation:**

The most recent reproduction numbers:

Model	Median	5%	95%	Prob>1	period/day	More info
Changepoint	1.07	0.94	1.19	0.76	Since 2. Nov	Table 1
SMC	1.12	0.91	1.35	0.84	30 Nov	Fig. 4
EpiEstim	1.24	1.21	1.26		30 Nov	Table 16, Fig. 27

- **National forecasting:**

One-week-ahead national forecasts from changepoint model:

Indicator	Median/Mean 95% PI	day	Info 2-3 weeks forecasts
Hospital beds	338/335 (235-453)	12 Dec	Table 2
Ventilator beds	55/55 (37-76)	12 Dec	Table 2

* Age-specific hospital prevalence predictions are provided in Figures 6 and 7.

- **Regional epidemiological situation:**

The newest regional reproduction numbers for Oslo:

Model	Median	5%	95%	Prob>1	period/day	Info other counties
Changepoint	1.54	1.42	1.66	1	Since 1 Nov	Table 4
SMC	1.51	1.23	1.92	1	15-25 Nov	Fig. 11
EpiEstim	1.20	1.19	1.27		30 Nov	Table 16, Fig. 27

- **Telenor mobility data and the number of foreign visitors:** The most recent mobility development is found in Figures 21 and 22 for the largest municipality in each county and for each county, respectively. Figure 23 shows the total number of roamers per day per county.

1 Estimated national reproduction numbers

Calibration of our national changepoint model to hospitalisation incidence data leads to the following estimates provided in table 1. Figure 2 shows the estimated daily number of COVID-19 patients admitted to hospital (1), with blue medians and interquantile bands, which are compared to the actual true data, provided in red. The uncertainty captures the uncertainty in the calibrated parameters in addition to the stochastic elements of our model and the variability of other model parameters.

Table 1: Calibration results

Reff	Period
2.14/2.14(1.61-2.66)	From Feb 17 to Mar 14
0.59/0.59(0.52-0.66)	From Mar 15 to Apr 19
0.96/0.94(0.49-1.34)	From Apr 20 to May 10
0.47/0.46(0.04-0.89)	From May 11 to Jun 30
0.74/0.74(0.13-1.4)	From Jul 01 to Jul 31
1.05/1.04(0.74-1.31)	From Aug 01 to Aug 31
0.93/0.92(0.67-1.12)	From Sep 01 to Sep 30
1.1/1.1(0.9-1.3)	From Oct 01 to Oct 25
1.18/1.18(0.86-1.52)	From Oct 26 to Nov 04
0.86/0.86(0.75-0.96)	From Nov 05 to Nov 30
0.99/0.99(0.9-1.08)	From Dec 01 to Jan 03
0.71/0.71(0.57-0.86)	From Jan 04 to Jan 21
0.76/0.77(0.6-0.95)	From Jan 22 to Feb 07
1.3/1.3(1.15-1.44)	From Feb 08 to Mar 01
1.09/1.09(0.98-1.19)	From Mar 02 to Mar 24
0.82/0.82(0.69-0.94)	From Mar 25 to Apr 12
0.82/0.82(0.7-0.96)	From Apr 13 to May 05
0.96/0.97(0.8-1.18)	From May 06 to May 26
0.89/0.88(0.65-1.06)	From May 27 to Jun 20
0.87/0.88(0.73-1.03)	From Jun 21 to Aug 04
1.09/1.09(0.95-1.23)	From Aug 05 to Aug 31
0.77/0.77(0.68-0.87)	From Sep 01 to Sep 24
1.06/1.06(1-1.12)	From Sep 25 to Nov 01
1.07/1.07(0.94-1.19)	From Nov 02
Median/Mean (95% credible intervals)	

Sykehus insidens

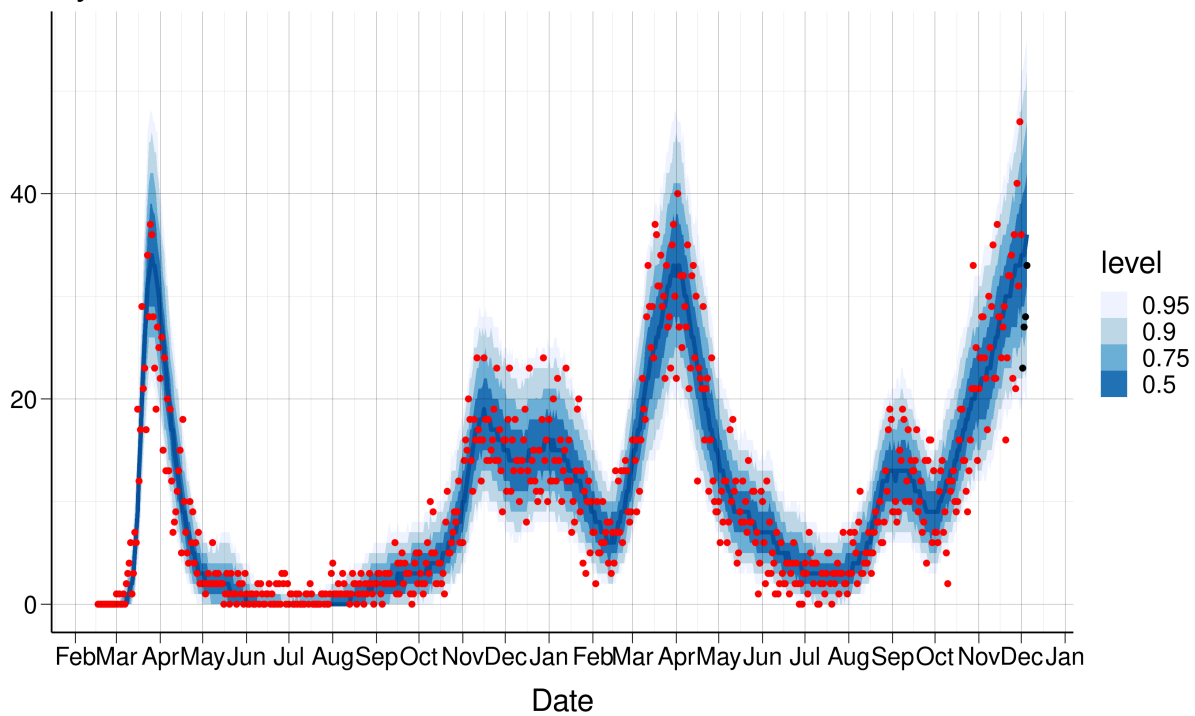


Figure 1: Hospital admissions

Figure 2: A comparison of true data (red) and predicted values (blue) for hospital admissions. The last four data points (black) are assumed to be affected by reporting delay. The uncertainty captures the uncertainty in the calibrated parameters, in addition to the stochastic elements of our model and the variability of other model parameters.

In figure 3, we show how our national model fits the national hospital prevalence data (3a) and the daily number of patients receiving ventilator treatment (3b). Those data sources are not used to estimate the parameters, and can therefore be seen as a validation of the model assumptions.

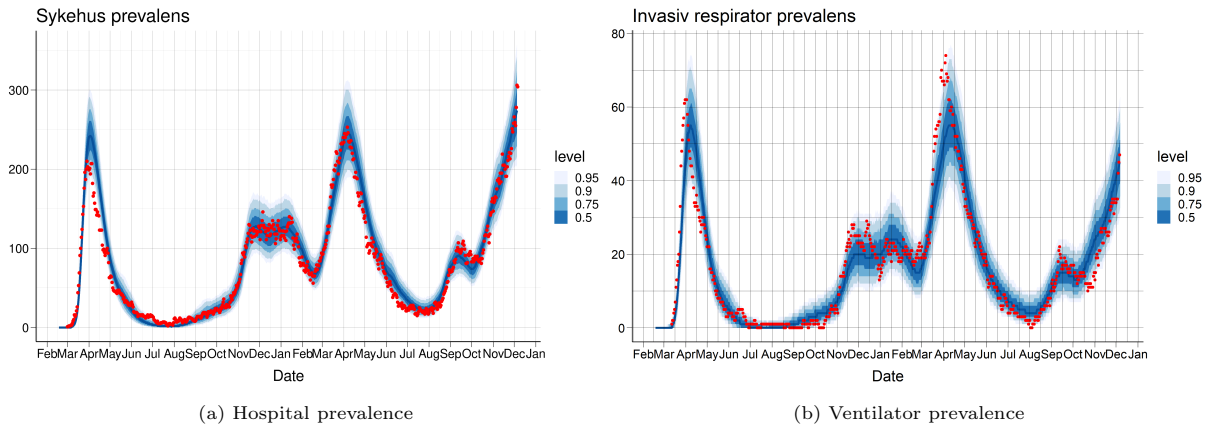


Figure 3: A comparison of true data (red) and predicted values (blue) for hospital and respirator prevalence. Prevalence data is based on NIPaR and may be different to the data from Helsedirektoratet.

1.1 National SMC-model: Estimated daily reproduction numbers

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Figure 4 shows the SMC estimate of the 7-day-average daily reproduction number $R(t)$ from the start of the epidemic in Norway and until today. In the figure we plot the 95% credibility interval and quantiles of the estimated posterior distribution of $R(t)$.

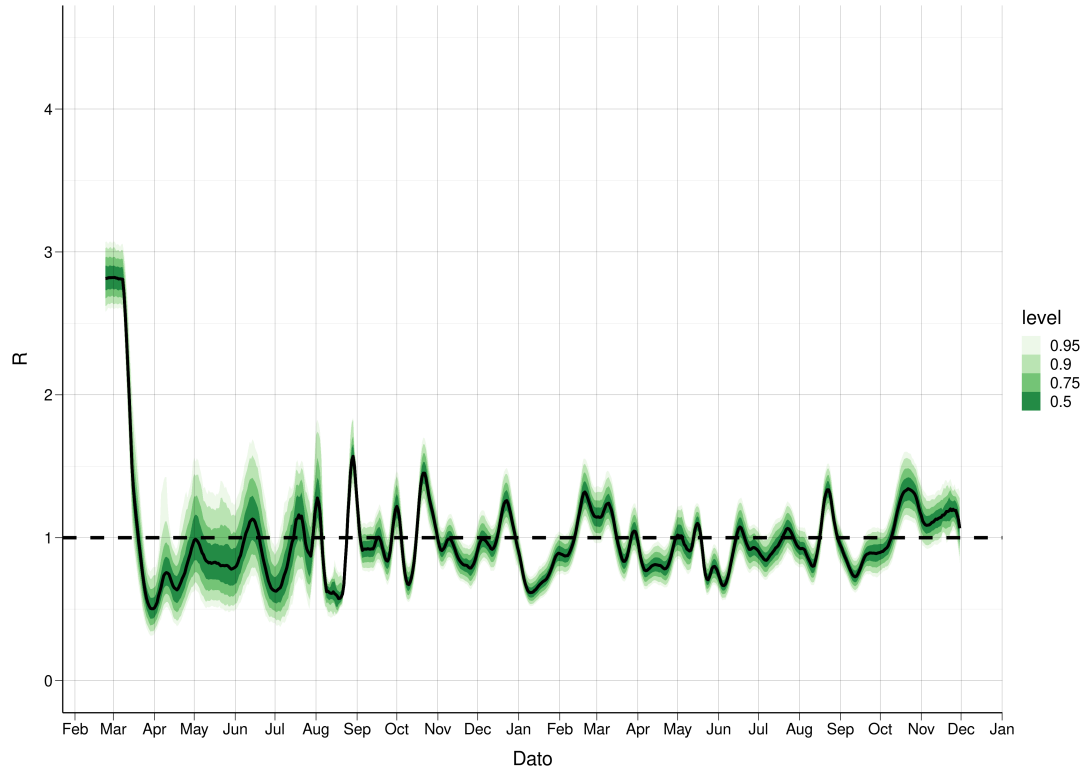


Figure 4: $R(t)$ estimates using a Sequential Monte Carlo approach calibrated to hospitalisation incidence and test data. The large uncertainty during the last 7 days reflects the lack of available data due to the transmission delay, test delay, time between symptoms onset and hospitalisation. The green band shows the 95% posterior credibility interval. As we use test data only from 1 August, the credibility interval becomes more narrow thereafter.

2 National 3-week predictions: Hospital beds and Ventilator beds

The national changepoint model estimates the projected national prevalence of hospitalised patients (hospital beds) and prevalence of patients receiving ventilator treatment (ventilator beds). The projected epidemic and healthcare burden are illustrated in figure 5.

Table 2: Estimated national hospital beds and ventilator beds. Median/Mean (CI)

	1 week prediction (Dec 12)	2 week prediction (Dec 19)	3 week prediction (Dec 26)
Hospital beds	338/335 (235-453)	372/368 (236-548)	406/397 (225-647)
Ventilator beds	55/55 (37-76)	63/62 (39-90)	70/69 (40-108)

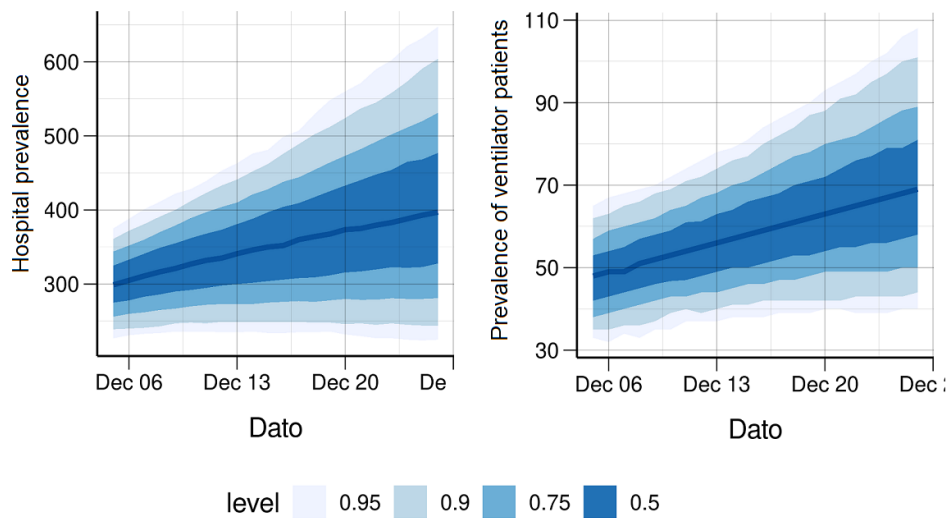


Figure 5: National 3 week predictions for hospital beds (left) and ventilator beds (right)

2.1 Hospital and Ventilator prevalence by age

2.1 Hospital and Ventilator prevalence by age

In Figures 6 and 7 we show the hospital prevalence by age group obtained from the simulations of the national model, including a 3 week forecast period. The real number of patients in each age group is also included (black dots). In the forecast period, we assume that the age distribution of the cases in hospital and respirator beds will remain the same as today. Specific values for these projections are shown in table 3.

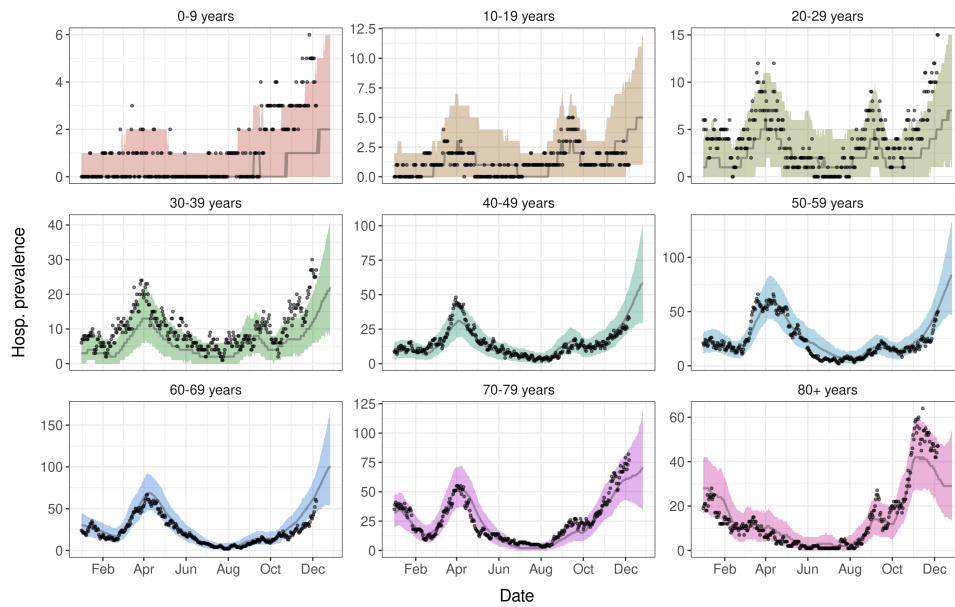


Figure 6: Simulated hospital prevalence by age group. Real data is shown as black dots

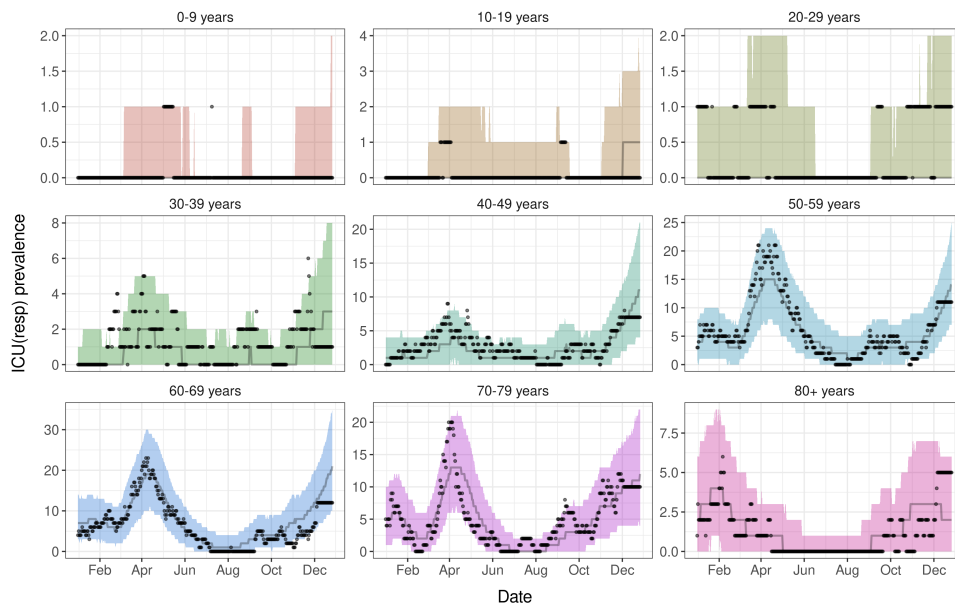


Figure 7: Simulated respirator prevalence by age group. Real data is shown as black dots

2.1 Hospital and Ventilator prevalence by age

Table 3: Hospital and Respirator prevalence per age group: 3 week prediction (2021-12-26). Mean and 95 perc. CI

Age group	Hosp	Resp
0-9 years	2 (0-6)	0 (0-2)
10-19 years	6 (1-12)	1 (0-4)
20-29 years	8 (2-16)	1 (0-2)
30-39 years	23 (10-43)	4 (0-9)
40-49 years	63 (32-104)	12 (4-22)
50-59 years	90 (52-139)	16 (8-25)
60-69 years	108 (55-179)	22 (10-37)
70-79 years	75 (40-127)	13 (5-22)
+80 years	31 (14-54)	2 (0-6)

3 Estimated regional reproduction numbers

Calibration of our regional changepoint model to hospitalisation incidence data and test data leads to the following estimates for current regional reproduction numbers by county (Table 4). A full list of all regional reproduction numbers can be found at the end of the report.

Below we show the estimated daily number of COVID-19 patients admitted to hospital and the estimated daily number of laboratory-confirmed SARS-CoV-2 cases for each county. Model estimates are shown with blue medians and interquantile bands, which are compared to the actual true data, provided in red. The blue bands describe the uncertainty in the calibrated parameters, in addition to the stochastic elements of our model. Last four data points are shown in black as they may be affected by reporting delay.

Table 4: Estimated current regional reproduction numbers

R	Parameter	County	From	Pr(R>1)
1.54 (1.42-1.66)	R19	Oslo	2021-11-01	1
1.21 (0.87-1.48)	R18	Rogaland	2021-11-01	0.9
1.3 (0.92-1.68)	R16	Møre og Romsdal	2021-11-01	0.94
0.96 (0.71-1.22)	R16	Nordland	2021-11-01	0.37
1.32 (1.25-1.4)	R17	Viken	2021-11-01	1
1.1 (0.66-1.45)	R19	Innlandet	2021-11-01	0.71
1.4 (1.14-1.65)	R18	Vestfold og Telemark	2021-11-01	1
1.41 (0.98-1.81)	R17	Agder	2021-11-01	0.97
1.29 (1.07-1.5)	R20	Vestland	2021-11-01	1
1.1 (0.94-1.25)	R18	Trøndelag	2021-11-01	0.87
0.99 (0.81-1.15)	R19	Troms og Finnmark	2021-11-01	0.46

Mean and 95% credible intervals

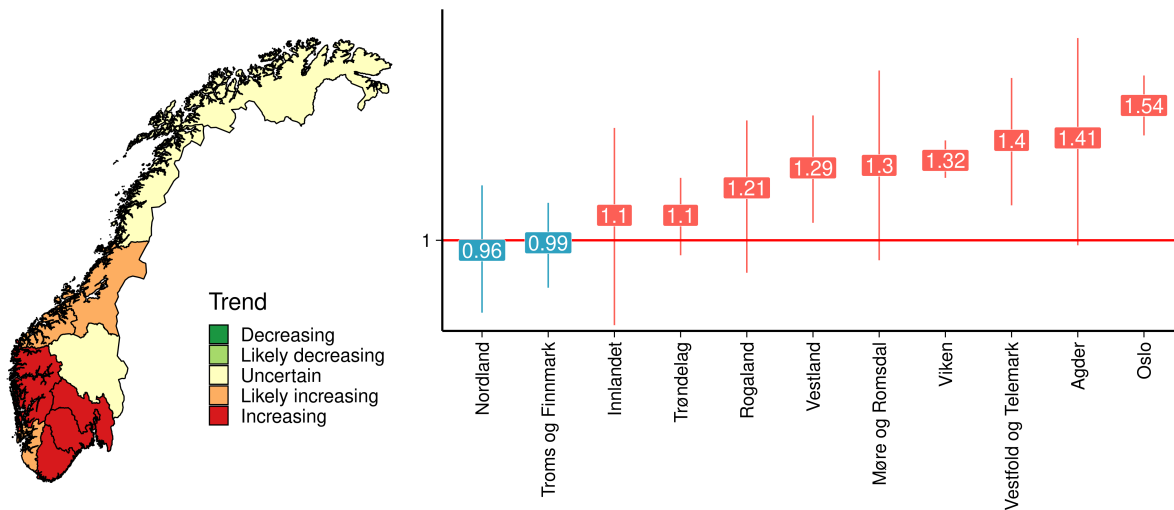
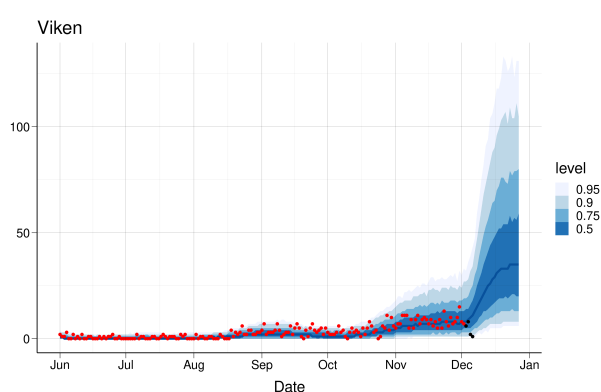
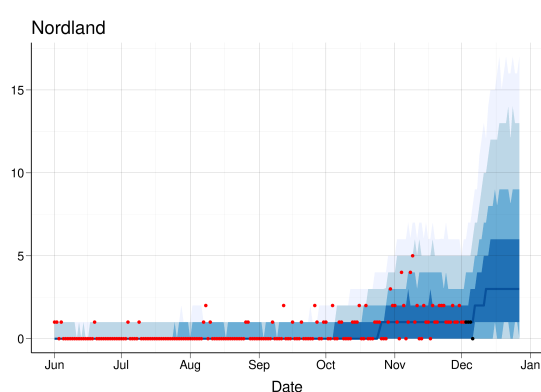
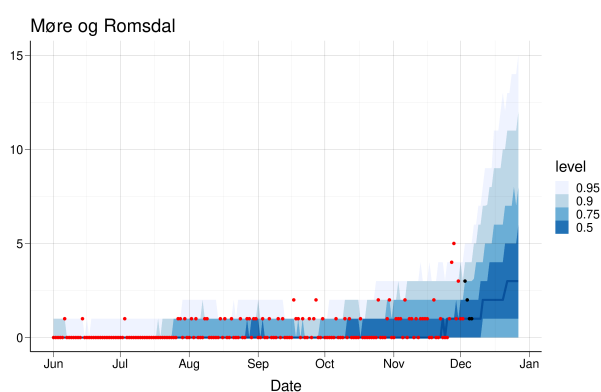
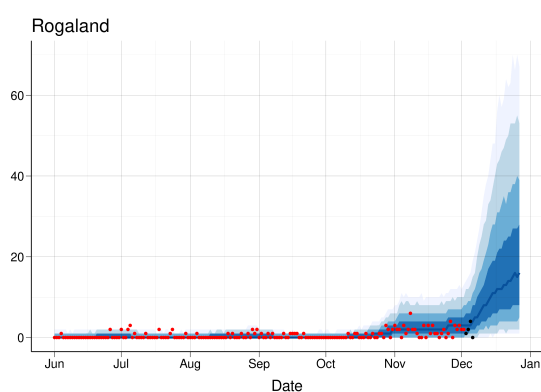
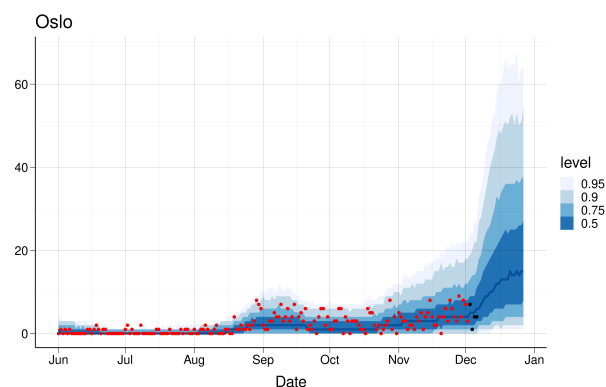
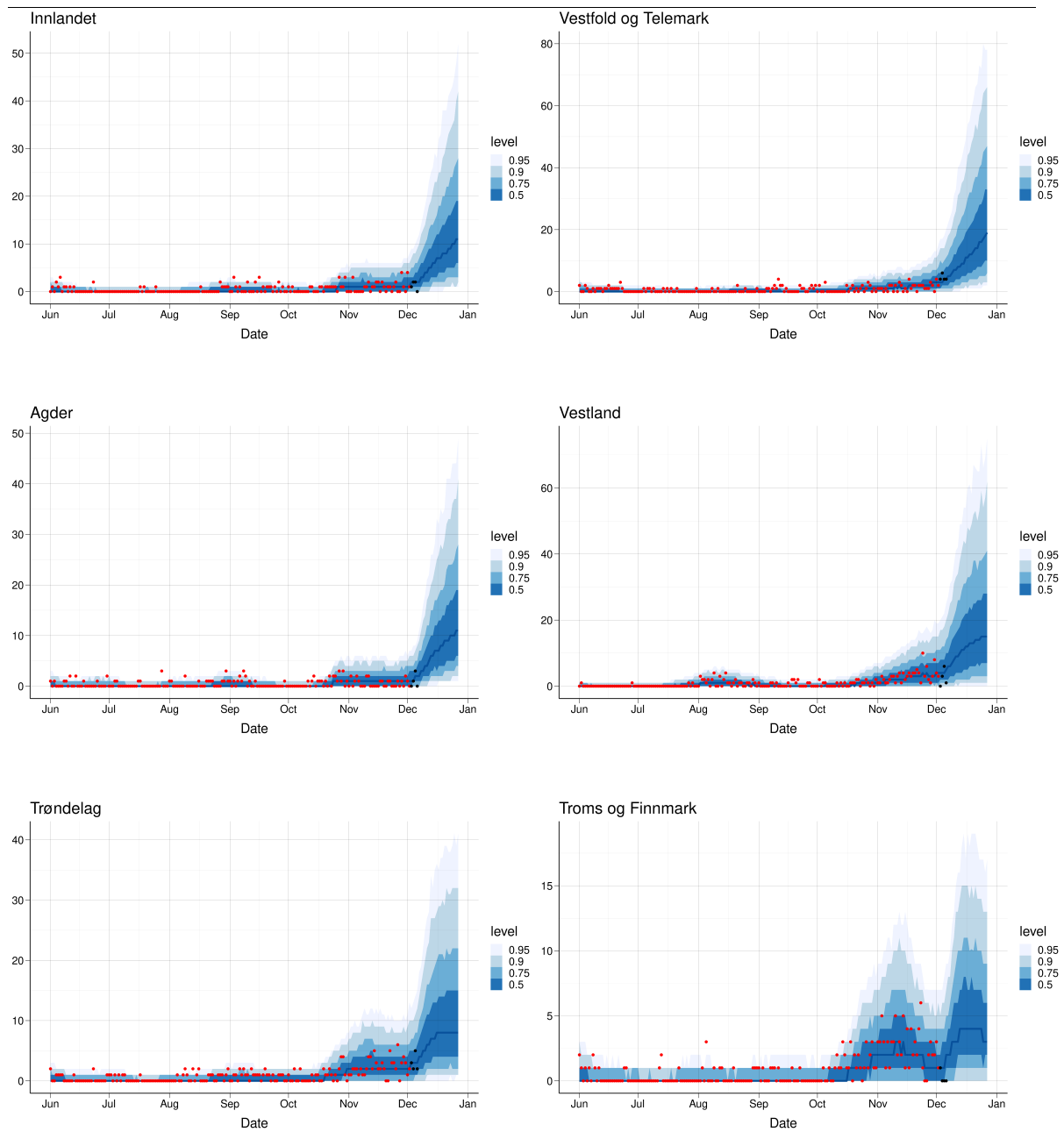


Figure 8: The map shows the direction of the trend in incidence in the counties based on the latest reproduction numbers shown in the other chart. The trend is increasing if the probability that the latest reproduction number is above one is above 95%, the trend is likely increasing if this probability is between 80% and 95%, the trend is uncertain if the probability is between 20% and 80%, the trend is likely decreasing if the probability is between 5% and 20% and is decreasing if the probability that the latest R is above one is less than 5%.

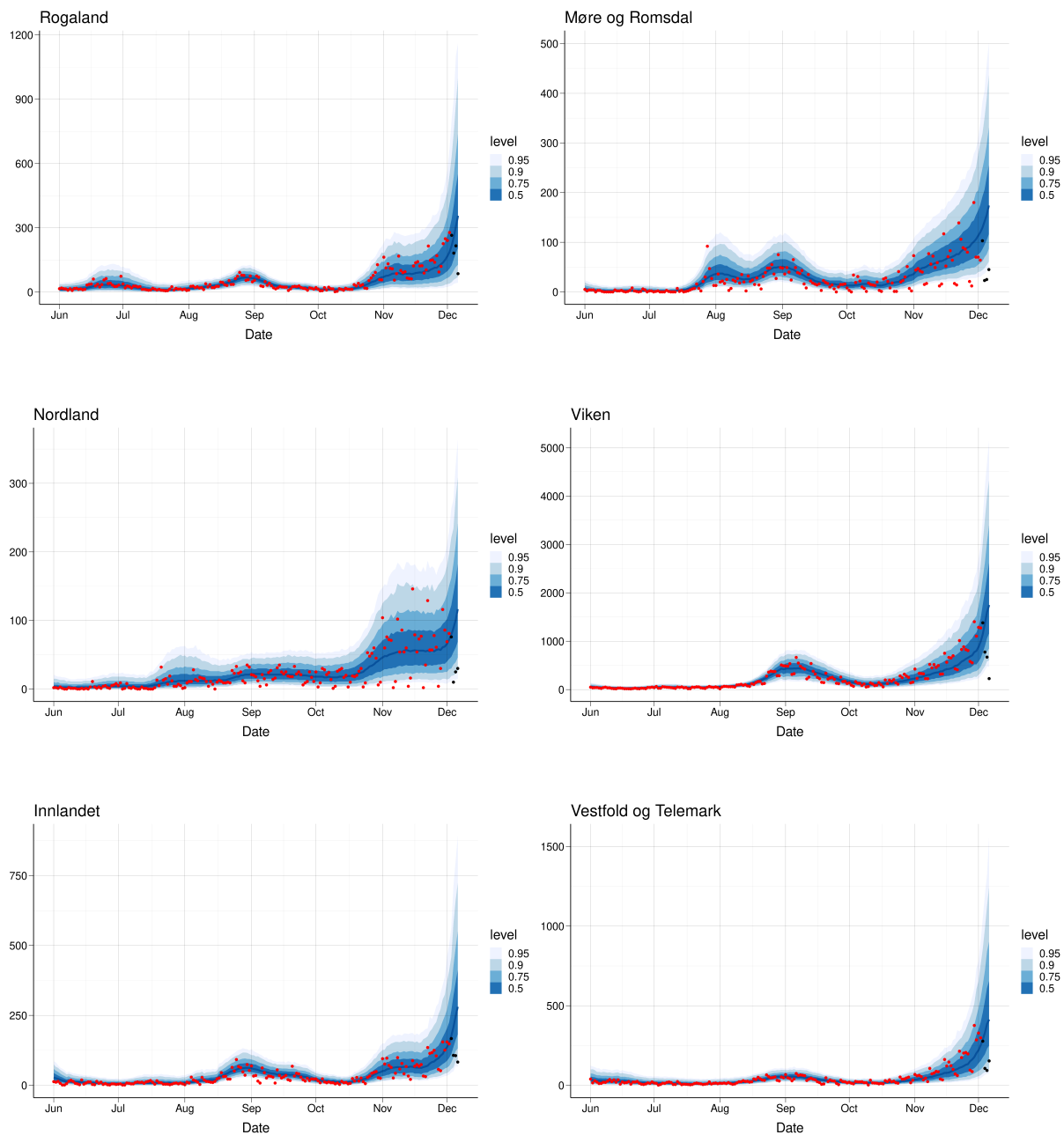
Estimated vs observed hospital incidence and 3 weeks forecast by county:

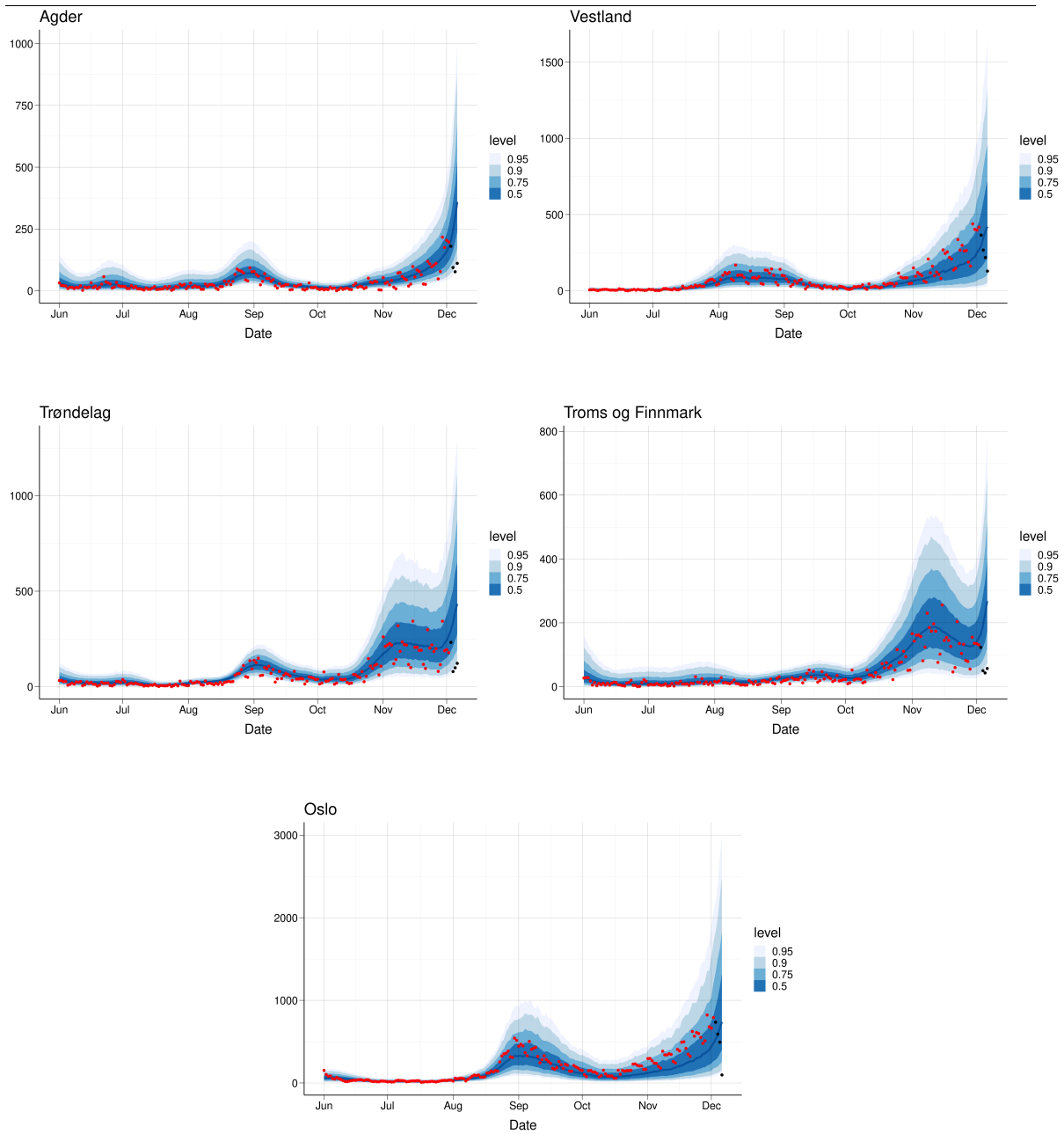
Forecasts are now based on the estimated reproduction numbers obtained by our regional SMC model, for each county. In the forecasted period of three weeks, we use the mean daily reproduction number during the period today - 21 days until today - 10 days.





Estimated and observed lab-confirmed test data by county:





4 Regional 3-week predictions: Cumulative (total) incidence and Prevalence

Below is shown the estimated short-term forecasting of total incidence of infected individuals since 1st of June (2021) (table 5), daily incidence (table 6) and prevalence (table 7) for each county.

Table 5: Estimated cumulative number of infections, 2021-12-06

Region	Total	No. confirmed	Fraction reported	Min. fraction
Oslo	61744 (16173; 142315)	33482	54%	24%
Rogaland	19093 (4384; 41627)	8075	42%	19%
Møre og Romsdal	6752 (2577; 13923)	4207	62%	30%
Nordland	6446 (1545; 14467)	3868	60%	27%
Viken	74710 (35314; 144643)	42327	57%	29%
Innlandet	10130 (4165; 21378)	5524	55%	26%
Vestfold og Telemark	17712 (5473; 38756)	7398	42%	19%
Agder	9010 (3430; 19158)	5300	59%	28%
Vestland	28543 (3959; 66694)	12773	45%	19%
Trøndelag	19840 (6391; 42824)	11633	59%	27%
Troms og Finnmark	11494 (3358; 24981)	7345	64%	29%

Fraction reported=Number confirmed/number predicted; Minimal fraction reported=number confirmed/upper CI

Table 6: Predicted incidence per day: Median/Mean (CI)

Region	1 week prediction (13 Dec)	2 weeks prediction (20 Dec)	3 weeks prediction (27 Dec)
Agder	979/1133 (256-2755)	1269/1450 (312-3552)	1544/1745 (363-4202)
Innlandet	866/1027 (249-2713)	1160/1402 (297-3949)	1489/1818 (346-5074)
Møre og Romsdal	318/377 (76-1078)	385/458 (85-1331)	445/548 (86-1695)
Nordland	251/293 (34-779)	250/292 (30-803)	242/292 (25-832)
Oslo	2876/3334 (470-8652)	3195/3539 (507-8226)	3274/3503 (538-7930)
Rogaland	1726/1995 (193-5265)	2085/2385 (193-6168)	2377/2663 (220-6729)
Troms og Finnmark	447/502 (84-1203)	362/413 (66-1043)	292/341 (46-909)
Trøndelag	914/1085 (200-2935)	916/1092 (192-3023)	903/1082 (173-3127)
Vestfold og Telemark	1849/2205 (351-6179)	2623/3072 (469-7890)	3419/3769 (597-8335)
Vestland	2188/2474 (138-6745)	2526/2826 (154-7346)	2779/3037 (157-7633)
Viken	5376/5967 (1660-13665)	5736/6424 (1737-14450)	5886/6509 (1778-14030)

Table 7: Predicted prevalence. Number of infectious individuals (asymptomatic plus pre-symptomatic plus symptomatic) per day. Median/Mean and 95 perc. CI for three weeks prediction.

Region	13 Dec	20 Dec	27 Dec	low CI, 27 Dec	high CI, 27 Dec
Agder	4020/4669	5330/6057	6577/7384	1570	18115
Innlandet	3548/4197	4847/5783	6183/7580	1466	21328
Møre og Romsdal	1343/1587	1612/1930	1917/2318	381	7078
Nordland	1099/1282	1097/1283	1071/1283	121	3615
Oslo	12172/14223	13693/15373	14478/15470	2301	34940
Rogaland	7223/8322	8798/10098	10177/11452	926	28981
Troms og Finnmark	2037/2281	1681/1900	1375/1572	232	4071
Trøndelag	3994/4719	4081/4794	3976/4772	775	13714
Vestfold og Telemark	7431/8899	10757/12647	14265/15917	2476	35913
Vestland	9218/10430	10797/12082	11951/13167	685	33136
Viken	22843/25389	24929/27813	25740/28588	7847	61798

5 Regional 3-week predictions: Hospital beds and ventilator beds

Below is shown the estimated short-term forecasting of expected hospital prevalence (table 8) and patients on ventilator treatment for each county (table 9).

Table 8: Number of hospitalisation beds occupied by Covid-19 patients: Median/Mean (CI)

Region	1 week prediction (13 Dec)	2 weeks prediction (20 Dec)	3 weeks prediction (27 Dec)
Agder	30/34 (7-90)	54/62 (12-153)	80/91 (17-231)
Innlandet	30/35 (7-96)	52/61 (13-175)	77/90 (17-255)
Møre og Romsdal	11/14 (2-37)	17/20 (3-60)	22/27 (4-77)
Nordland	19/22 (2-58)	26/30 (3-84)	30/35 (3-97)
Oslo	68/82 (10-228)	100/120 (16-330)	123/143 (19-367)
Rogaland	54/62 (7-159)	91/104 (11-277)	121/139 (14-374)
Troms og Finnmark	25/29 (4-73)	34/39 (5-98)	35/40 (5-104)
Trøndelag	41/49 (8-128)	62/73 (12-192)	73/86 (14-243)
Vestfold og Telemark	49/59 (9-164)	83/100 (15-282)	127/150 (23-379)
Vestland	66/73 (4-198)	99/112 (6-307)	127/143 (7-392)
Viken	144/162 (46-380)	230/258 (71-592)	284/319 (86-730)

Table 9: Number of ICU beds occupied by Covid-19 patients: Median/Mean (CI)

Region	1 week prediction (13 Dec)	2 weeks prediction (20 Dec)	3 weeks prediction (27 Dec)
Agder	3/3 (0-9)	5/5 (0-14)	8/9 (1-24)
Innlandet	3/3 (0-9)	5/5 (0-16)	8/9 (1-25)
Møre og Romsdal	1/1 (0-5)	2/2 (0-7)	2/3 (0-9)
Nordland	2/3 (0-8)	3/3 (0-10)	4/4 (0-13)
Oslo	10/13 (1-36)	15/18 (2-52)	21/24 (3-65)
Rogaland	5/6 (0-15)	9/10 (1-26)	13/15 (1-38)
Troms og Finnmark	3/4 (0-11)	4/5 (0-13)	5/6 (0-15)
Trøndelag	4/5 (0-14)	7/8 (1-21)	9/10 (1-28)
Vestfold og Telemark	5/5 (0-15)	8/9 (1-25)	12/15 (2-40)
Vestland	7/7 (0-21)	10/11 (0-31)	14/16 (0-43)
Viken	15/16 (4-38)	23/25 (7-60)	33/36 (9-82)

6 14-day trend analysis of confirmed cases and hospitalisations by county

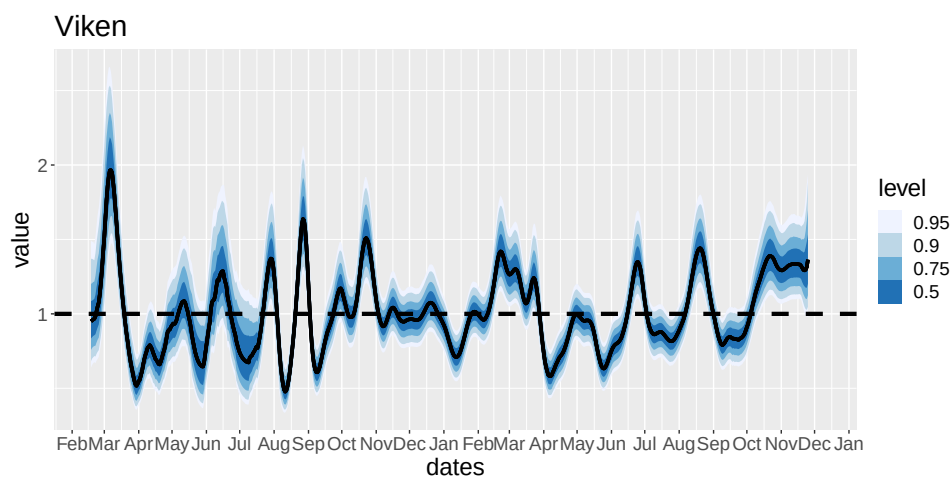
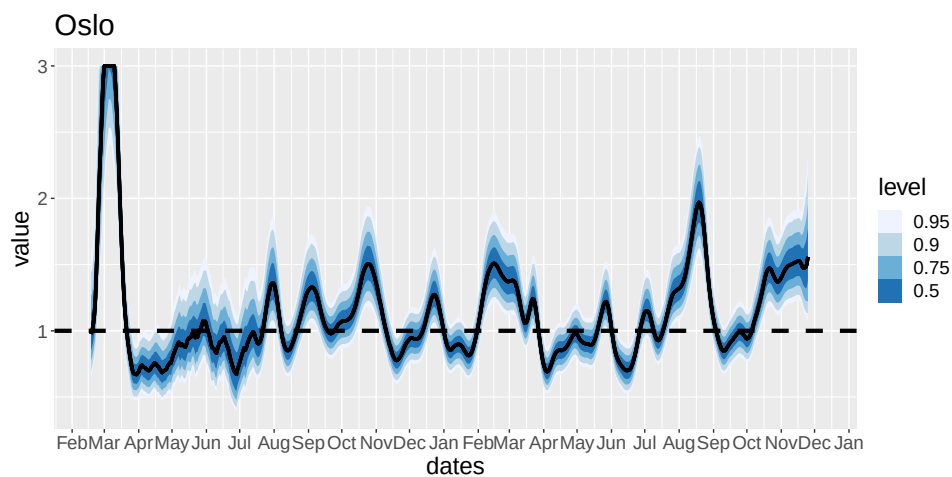
To estimate recent trends in hospitalisation and number of positive tests, we present results in table 10 based on a negative binomial regression where we account for weekend effects. We exclude the last three days to avoid problems of reporting delay and fit the model using data from 17 days to 3 days before the current date. We fit a separate trend model for confirmed cases and for hospital incidence. We only fit a trend model if there has been more than 5 cases or hospitalisations in the 14-day period.

Table 10: Trend analysis for the last 14 days

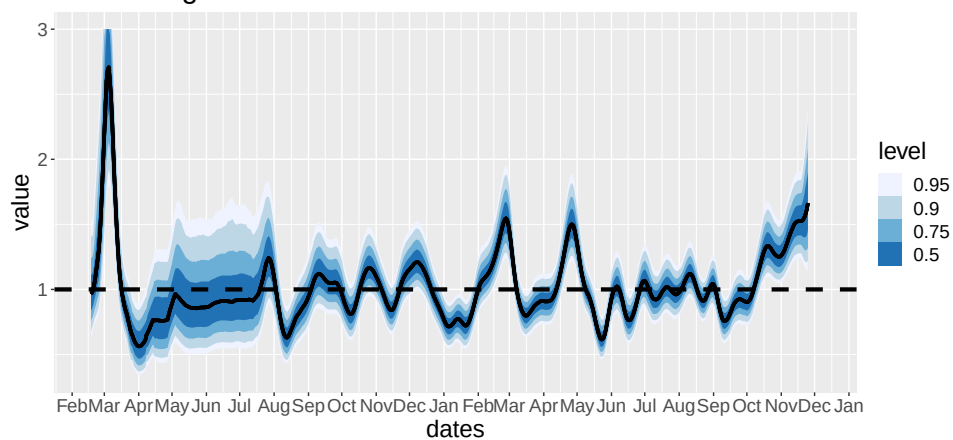
County	Average daily increase last 14 days		Doubling Time (days)	
	Hospitalisations	Cases	Hospitalisations	Cases
Agder	Not enough data	1.3 (-6.2, 9.4) %	Not enough data	54.2 (-10.8, 7.7)
Innlandet	Not enough data	-5.5 (-9.9, -0.9) %	Not enough data	-12.2 (-6.6, -72.8)
Møre og Romsdal	Not enough data	-7.3 (-11.6, -2.7) %	Not enough data	-9.2 (-5.6, -24.9)
Nordland	Not enough data	-1.7 (-5.1, 1.8) %	Not enough data	-40.5 (-13.2, 38.5)
Norge	-3.5 (-8.1, 1.4) %	-2.6 (-4.3, -0.9) %	-19.7 (-8.2, 50.4)	-26.4 (-15.9, -78.1)
Oslo	-10 (-18.3, -1.4) %	-3.6 (-5.8, -1.4) %	-6.6 (-3.4, -48.2)	-18.8 (-11.6, -48.8)
Rogaland	Not enough data	-4.3 (-7.9, -0.7) %	Not enough data	-15.7 (-8.5, -99.2)
Troms og Finnmark	8 (-10.4, 32.9) %	2.4 (-1.7, 6.6) %	9 (-6.3, 2.4)	29.6 (-40.2, 10.8)
Trøndelag	Not enough data	-2.5 (-6.7, 1.9) %	Not enough data	-27.7 (-10, 36.1)
Vestfold og Telemark	Not enough data	-6.3 (-10.6, -1.8) %	Not enough data	-10.7 (-6.2, -38)
Vestland	Not enough data	0.2 (-2.7, 3.2) %	Not enough data	310.3 (-25.5, 21.9)
Viken	-1.2 (-9.5, 7.9) %	-2.4 (-4.8, 0.2) %	-58.4 (-6.9, 9.2)	-29 (-14, 368.6)

7 Regional SMC-model: Estimated daily reproduction numbers

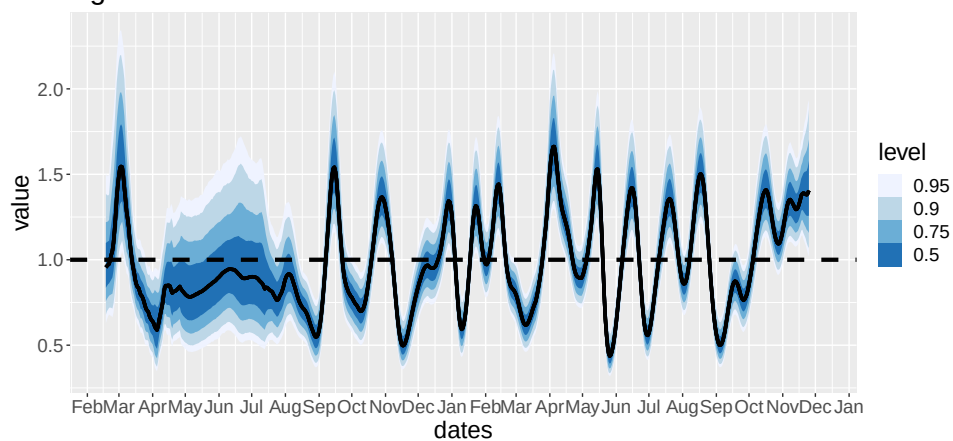
In the figures below we plot the 95% credibility interval and quantiles of the estimated posterior distribution of the regional, daily reproduction numbers. For some counties, uncertainty is large towards the most recent time, because there are very few data and possibly reporting delays which are different in each county.



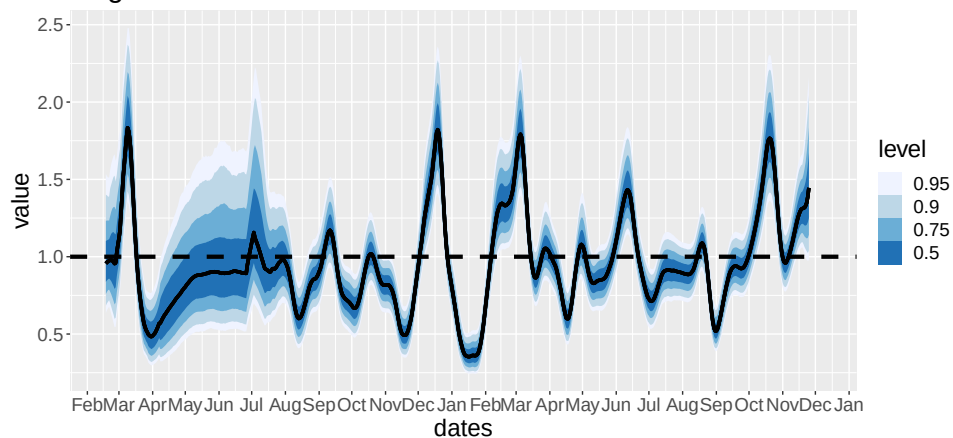
Vestfold og Telemark

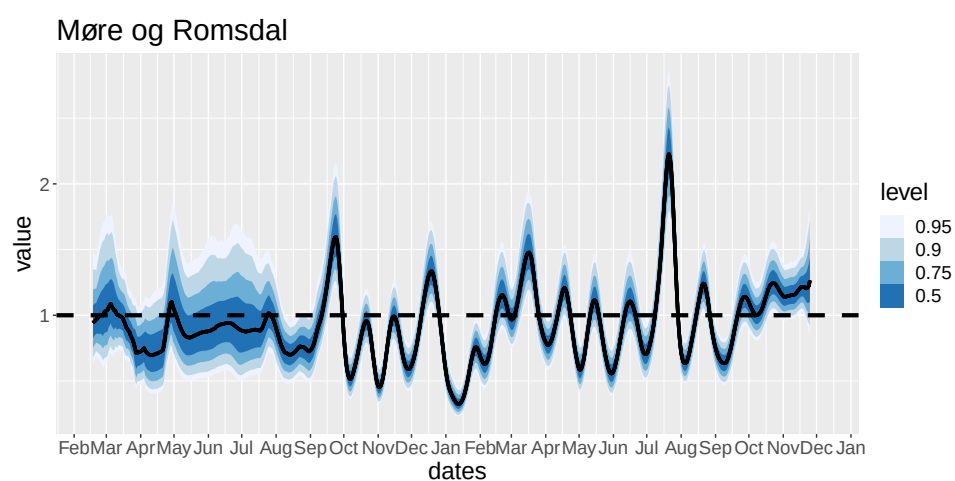
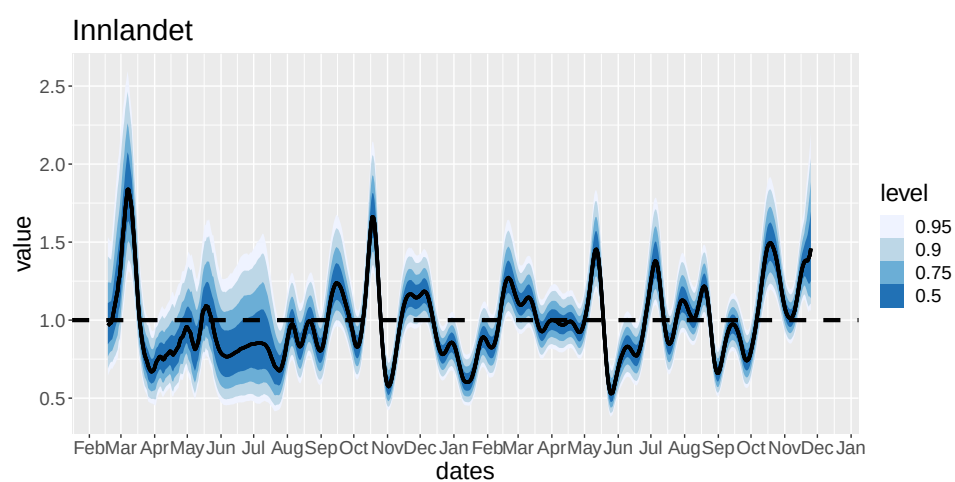
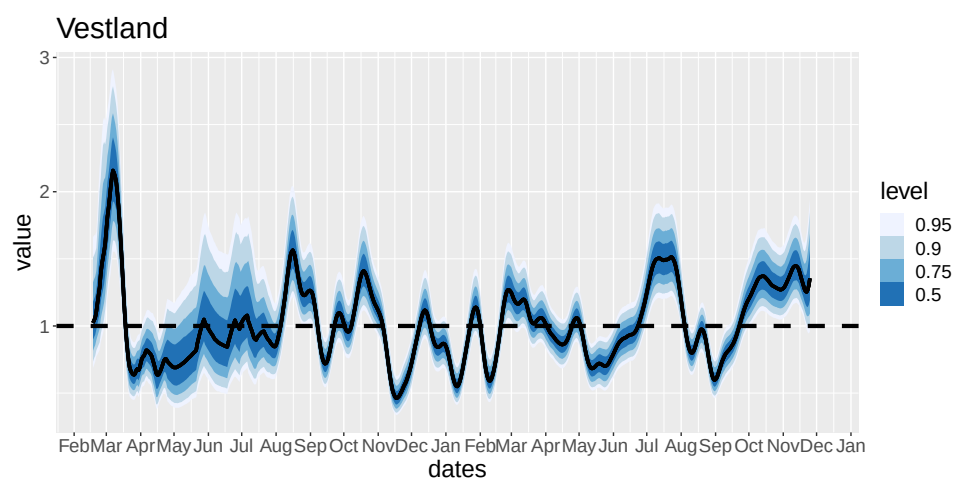


Agder

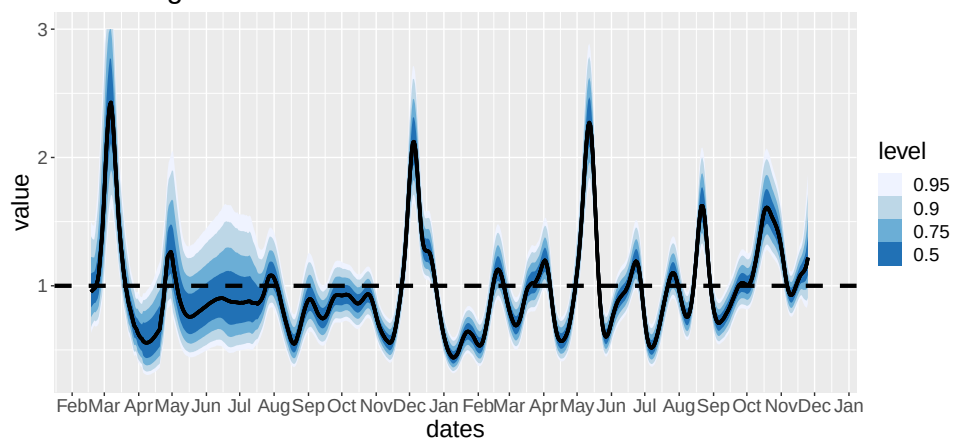


Rogaland

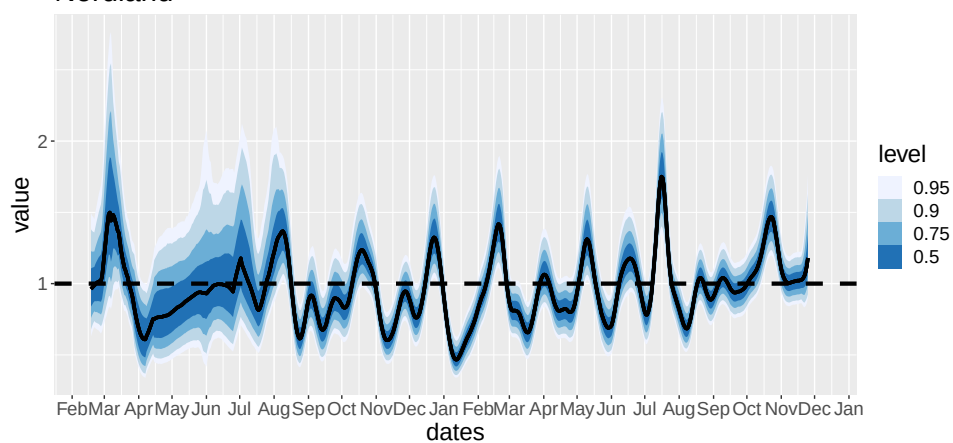




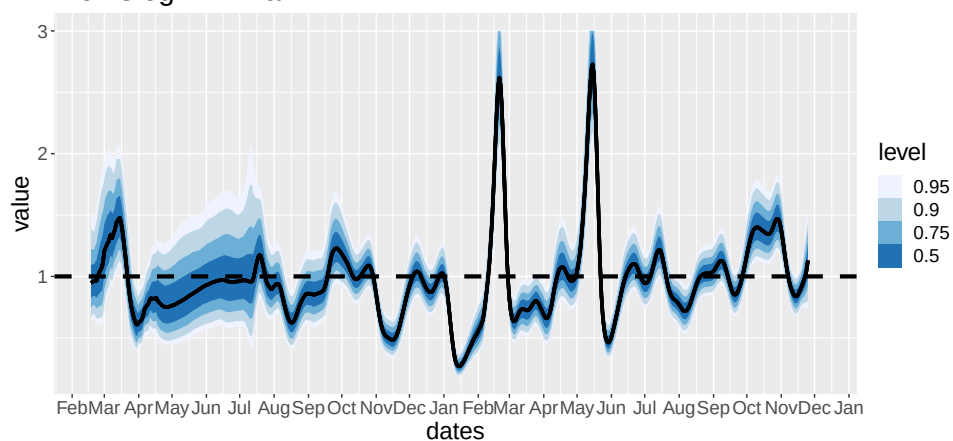
Trøndelag



Nordland



Troms og Finnmark



	Median	5%	95%	Prob>1
Oslo	1.51	1.23	1.92	1
Rogaland	1.34	1.08	1.72	0.996
Møre og Romsdal	1.22	1.01	1.54	0.980
Nordland	1.06	0.89	1.32	0.748
Viken	1.32	1.09	1.64	0.999
Innlandet	1.38	1.13	1.76	1
Vestfold og Telemark	1.57	1.26	1.97	1
Agder	1.37	1.14	1.68	1
Vestland	1.32	1.09	1.64	0.997
Trøndelag	1.11	0.91	1.41	0.860
Troms og Finnmark	0.95	0.77	1.19	0.316

Table 11: Regional estimates, 15-26 Nov

8 Mobility

Number of trips out from each municipality during each day is based on Telenor mobility data. The reference level is set to 100 on March 2nd 2020 for all the figures in this section, and we plot the seven-day, moving average of the daily mobility. Figure 19 shows an overview of the mobility since March 2020 for the largest municipalities in each county, and Figure 20 shows the total mobility out from all municipalities in each county, including Oslo. Figure 21 and 22, zooms in on mobility from August 16 2021, for municipalities and counties, respectively.

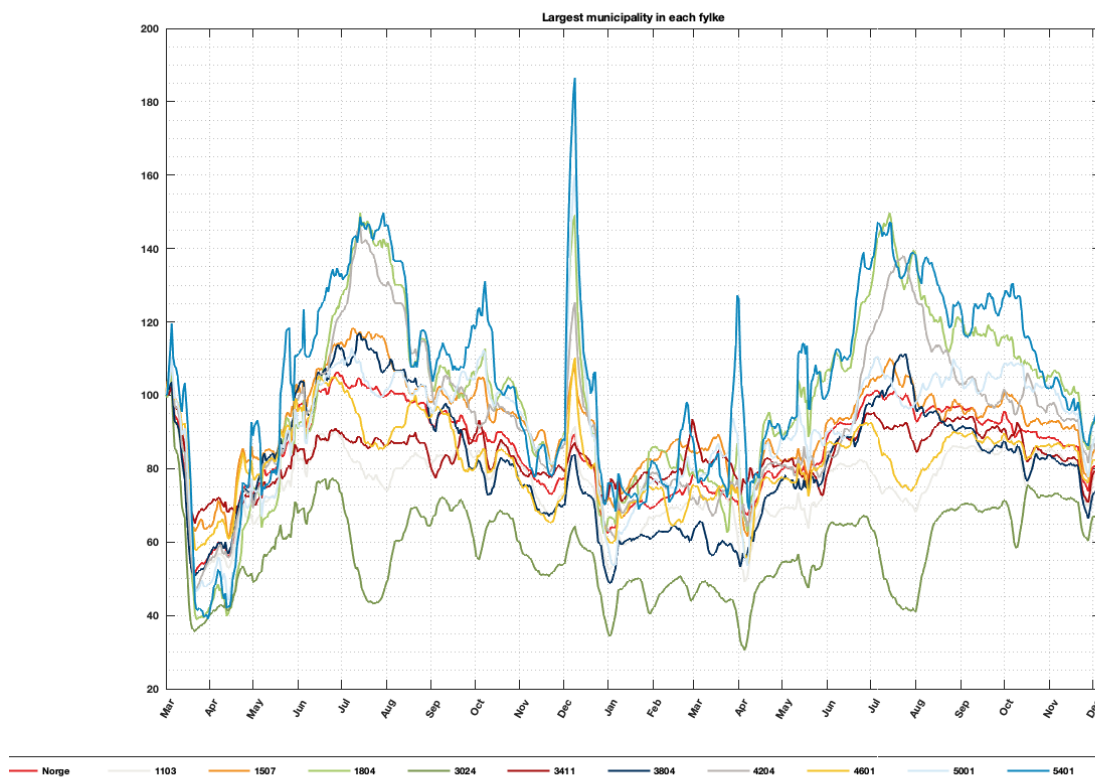


Figure 19: Mobility for selected municipalities since March 2020: Nationally (Norge), Stavanger (1103), Ålesund (1507), Bodø (1804), Bærum (3024), Ringsaker (3411), Sandefjord (3804), Kristiansand (4204), Bergen (4601), Trondheim (5001), Tromsø (5401).

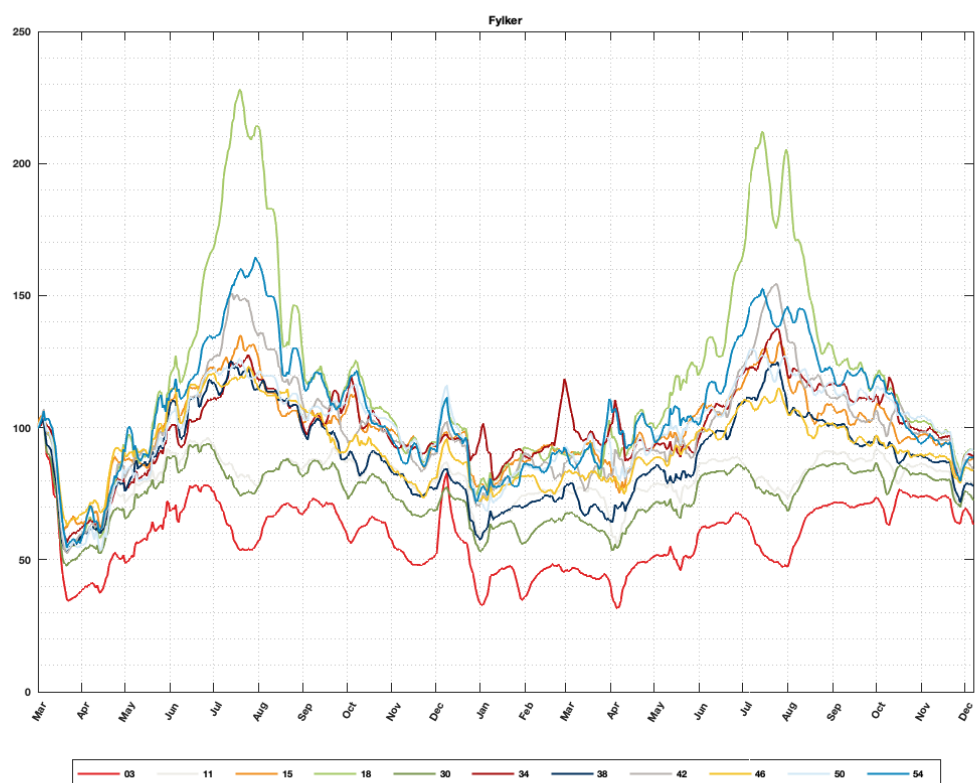


Figure 20: Mobility for fylker since March 2020: Oslo (03), Rogaland (11), Møre og Romsdal (15), Nordland (18), Viken (30), Innlandet (34), Vestfold og Telemark (38), Agder (42), Vestland (46), Trøndelag (50), Troms og Finmark (54).

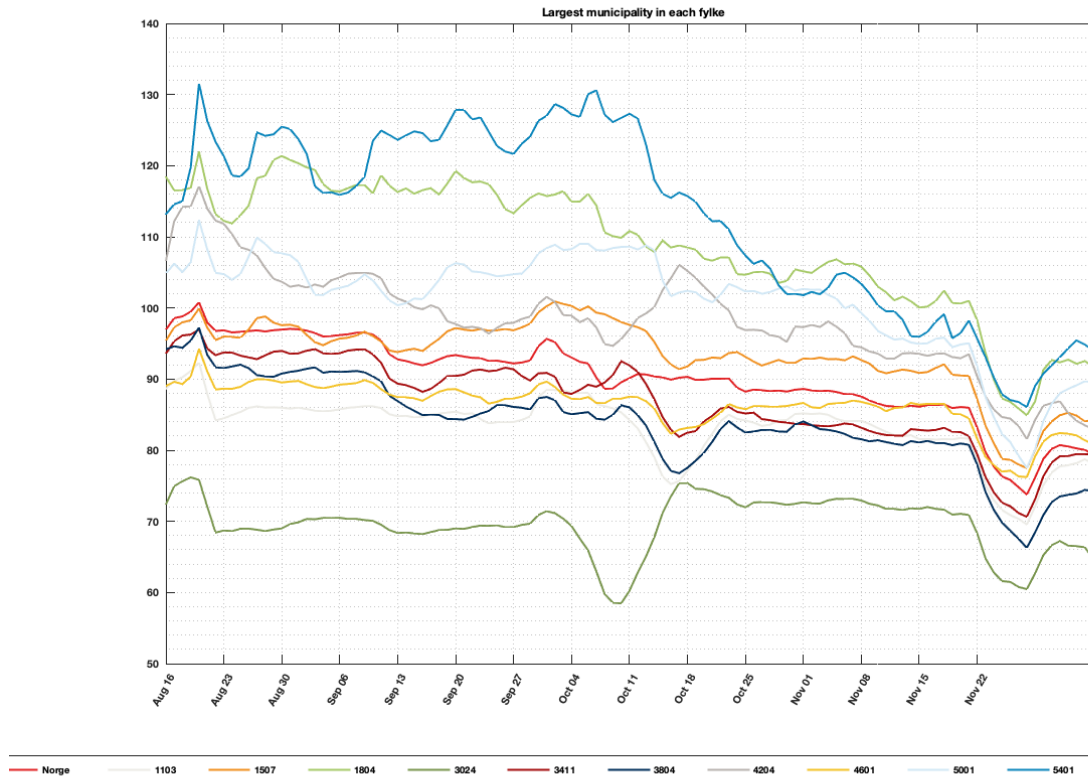


Figure 21: Zoom: Mobility from August 16, 2021 and onwards: Nationally (Norge), Stavanger (1103), Ålesund (1507), Bodø (1804), Bærum (3024), Ringsaker (3411), Sandefjord (3804), Kristiansand (4204), Bergen (4601), Trondheim (5001), Tromsø (5401).

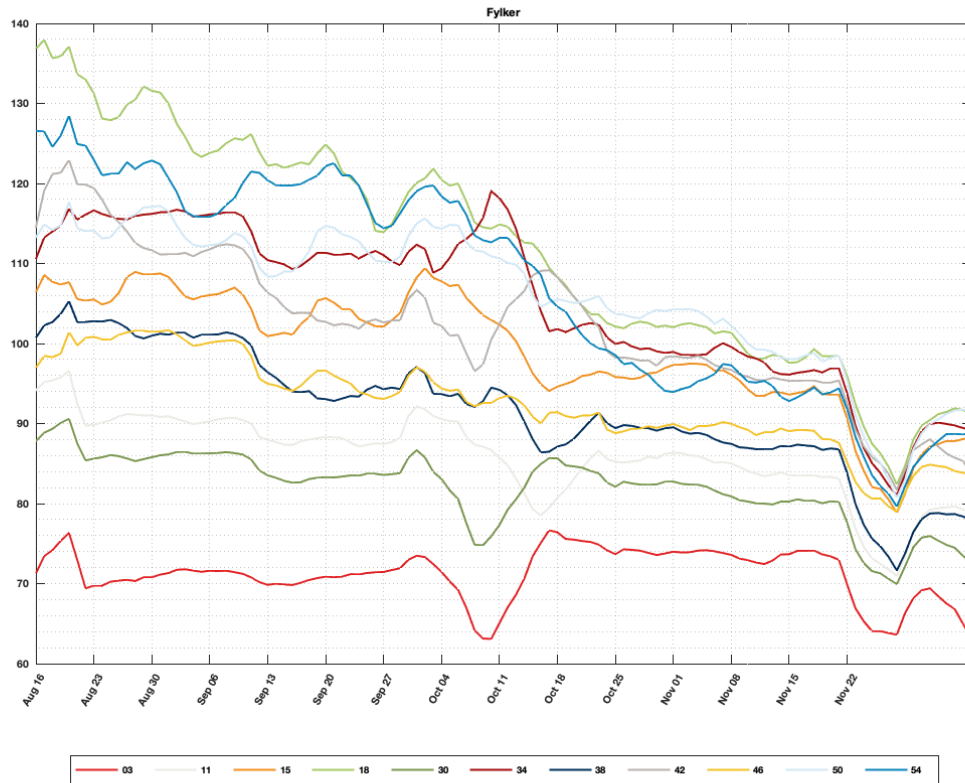


Figure 22: Zoom: Mobility from August 16, 2021 and onwards, per fylker: Oslo (03), Rogaland (11), Møre og Romsdal (15), Nordland (18), Viken (30), Innlandet (34), Vestfold og Telemark (38), Agder (42), Vestland (46), Trøndelag (50), Troms og Finnmark (54).

	46	47	48	49	50
Norge	87.5	86.1	83.2	76.2	79.4
Stavanger	84.1	81.5	78.7	72.1	78.1
Ålesund	92.7	90.9	87.2	80.0	84.2
Bodø	105.8	100.0	98.3	86.9	91.8
Bærum	72.9	71.7	68.3	62.7	64.8
Ringsaker	83.2	82.8	79.4	73.1	79.4
Sandefjord	81.5	81.1	78.0	68.5	74.3
Kristiansand	94.5	93.5	90.4	84.3	83.0
Bergen	86.8	86.4	81.6	79.1	80.9
Trondheim	99.2	94.9	91.8	80.1	89.6
Tromsø	103.4	95.9	95.7	89.0	94.0

Table 12: Municipalities

	46	47	48	49	50
Oslo	73.6	73.7	69.9	66.3	65.0
Rogaland	85.0	83.6	80.3	73.4	79.3
Møre og Romsdal	96.1	93.6	90.6	81.2	88.0
Nordland	101.4	97.6	95.9	84.7	91.7
Viken	80.9	80.2	77.6	72.2	73.5
Innlandet	99.6	96.1	93.7	83.7	89.4
Vestfold og Telemark	87.5	87.1	83.8	73.8	78.4
Agder	96.7	95.3	92.4	84.3	85.3
Vestlandet	90.0	89.0	85.1	81.4	83.8
Trøndelag	102.2	98.0	95.3	83.0	91.7
Troms og Finnmark	97.3	92.8	91.8	82.2	88.6

Table 13: Counties

Weekly mobility for Norway and selected municipalities is displayed in Table 12 and mobility for counties is displayed in Table 13. The percentages in the tables are to be interpreted towards the reference level of 100 for week 10 in March 2020. The color-coding encodes the following: 'Green' monotonic decrease in mobility, 'Yellow' almost monotonic decrease or flat mobility trend, 'Red' increasing mobility.

8.1 Foreign roamers on Telenor's network in Norway

8.1 Foreign roamers on Telenor's network in Norway

An analysis of foreign roamers in Norway from January 2020 has been carried out, to better understand the potential virus importation. In Figure 23 the total number of roamers per day per county are displayed.

Figure 24 shows the levels of roamers from the following countries: Poland, Lithuania, Sweden, Netherlands, Denmark, Latvia, Germany, Spain, Finland and the rest of the world. These levels represent the total number of foreign, visiting roamers from each of the countries per day in Norway, since July 5 2021.

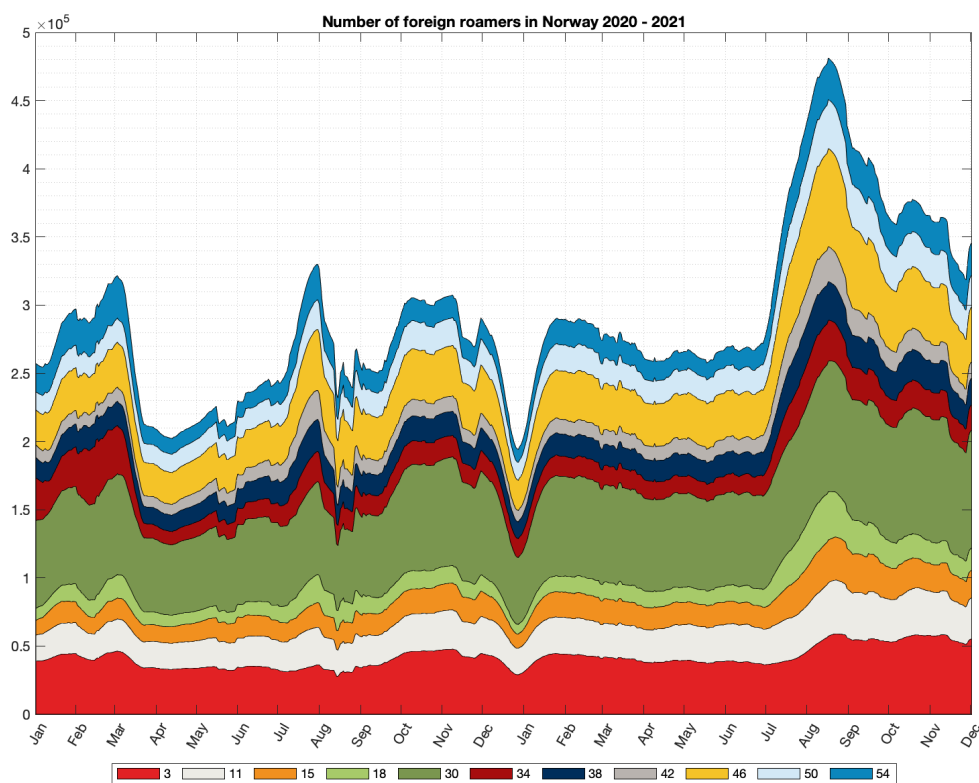


Figure 23: The total number of foreign roamers in Norway broken down on different fylker: Oslo (3), Rogaland (11), Møre og Romsdal (15), Nordland (18), Viken (30), Innlandet (34), Vestfold og Telemark (38), Agder (42), Vestland (46), Trøndelag (50), Troms og Finnmark (54).

8.1 Foreign roamers on Telenor's network in Norway

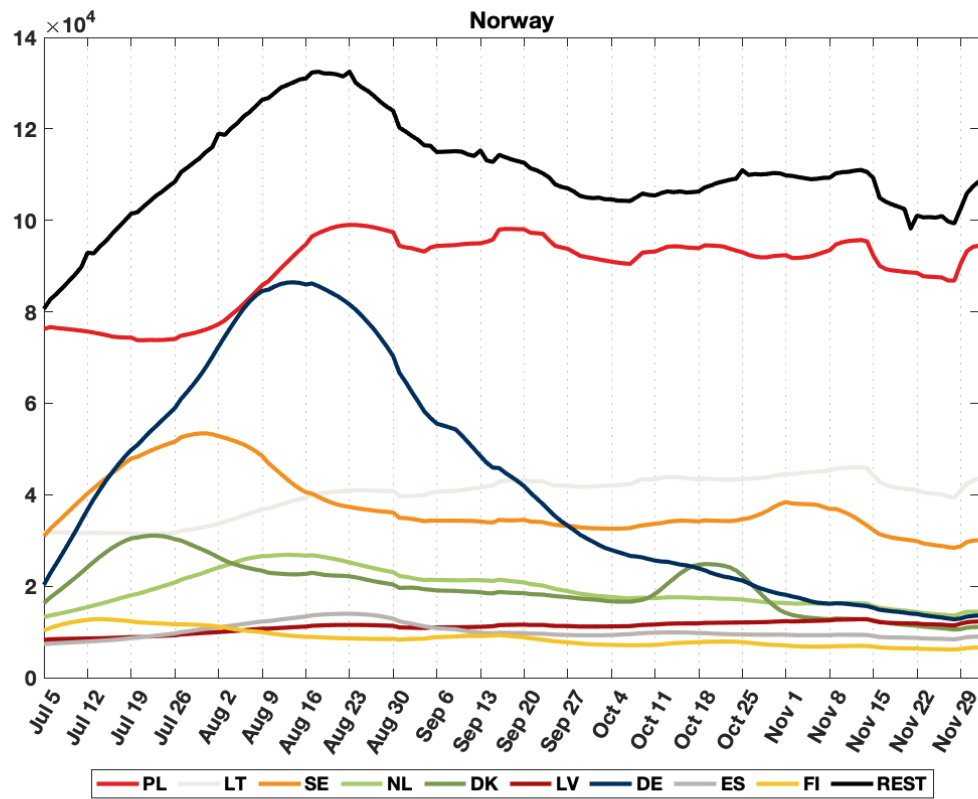
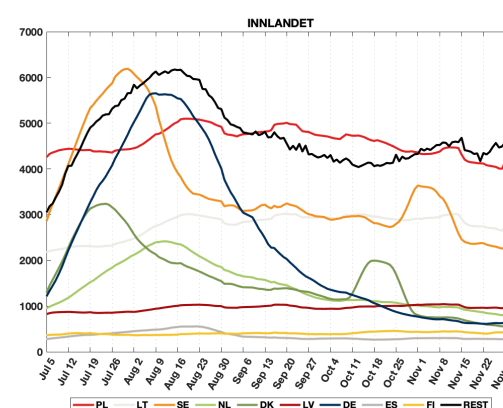
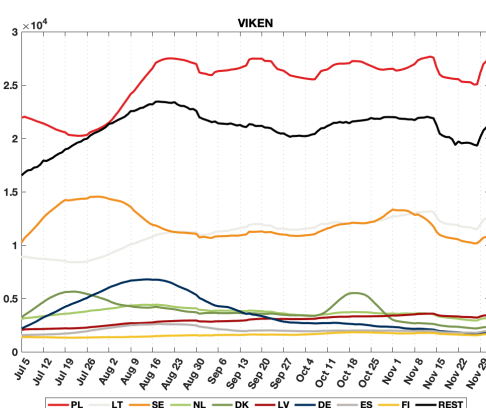
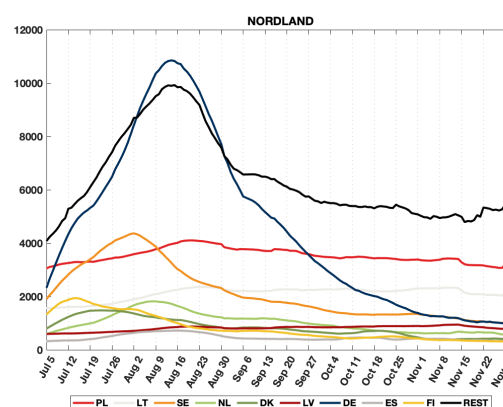
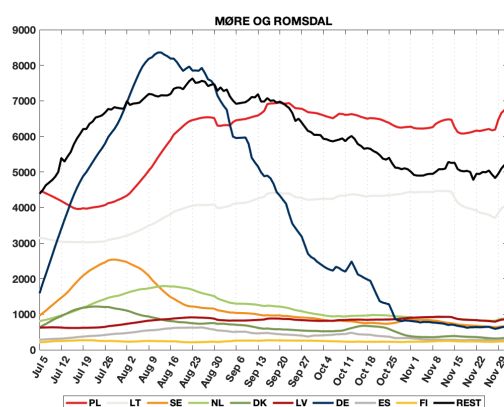
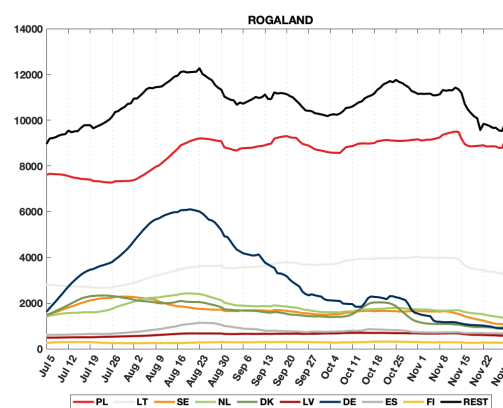
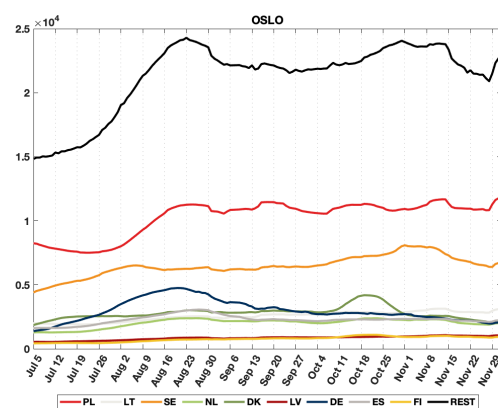


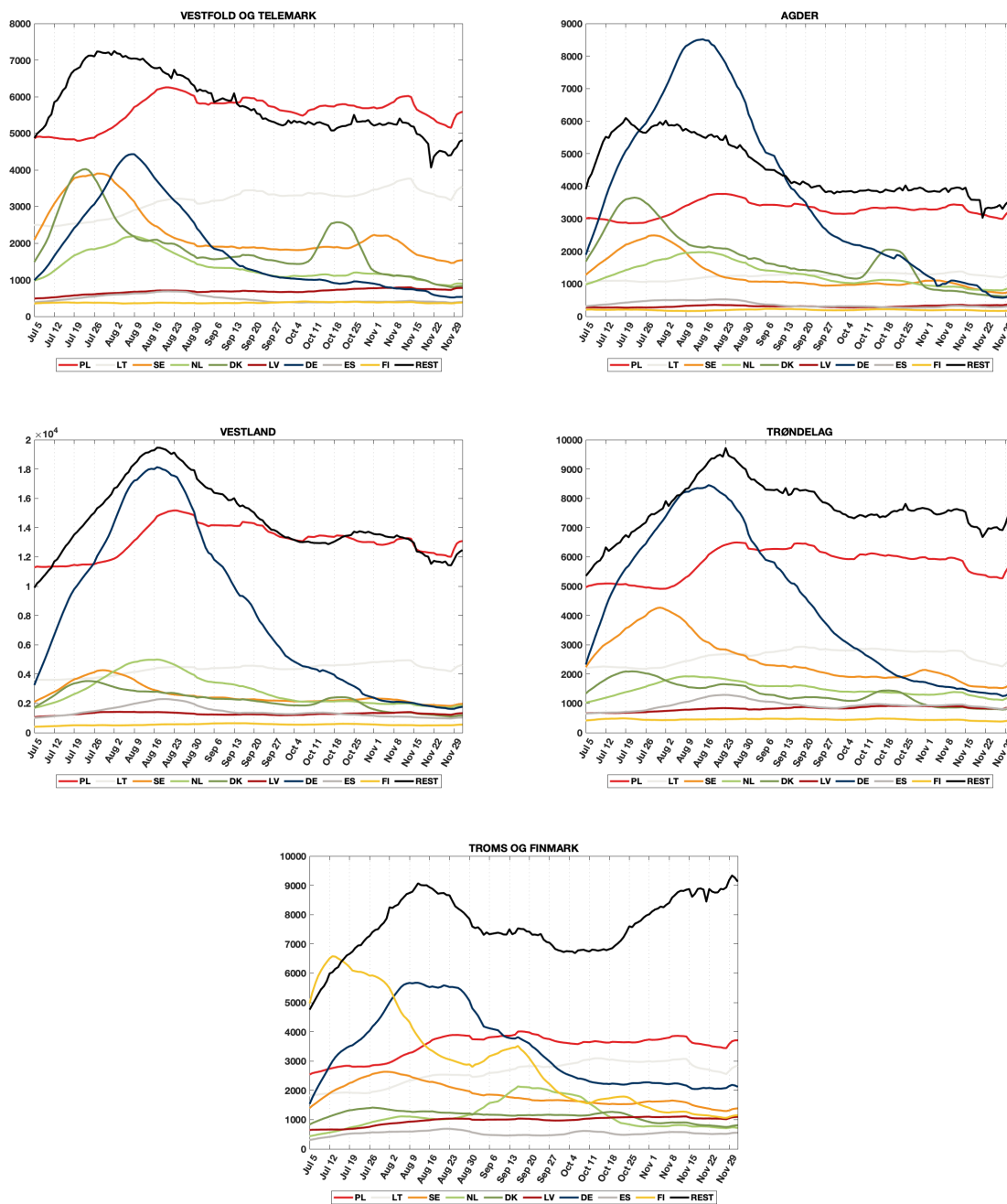
Figure 24: National overview of total number of foreign, visiting roamers from Poland, Lithuania, Sweden, Netherlands, Denmark, Latvia, Germany, Spain, Finland and the rest of the world.

8.2 Foreign roamers per county (fylke) in Norway

8.2 Foreign roamers per county (fylke) in Norway



8.2 Foreign roamers per county (fylke) in Norway



9 Estimated parameters

Table 14: Estimated parameters

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	Period
R0s	1.388	1.958	2.143	2.144	2.336	2.9	Until March 14
R1s	0.474	0.565	0.587	0.587	0.612	0.696	From 15 March to 19 April
R2s	0.338	0.784	0.964	0.943	1.116	1.628	From 20 April to 10 May
R3s	0.004	0.289	0.468	0.463	0.634	1.17	From 11 May to 30 June
R4s	0.001	0.521	0.744	0.744	0.971	1.768	From 01 July to 31 July
R5s	0.614	0.958	1.05	1.044	1.143	1.422	From 01 August to 31 August
R6s	0.594	0.859	0.931	0.923	0.998	1.223	From 01 September to 30 September
R7s	0.825	1.028	1.104	1.104	1.178	1.377	From 01 October to 25 October
R8s	0.679	1.046	1.178	1.179	1.314	1.697	From 26 October to 04 November
R9s	0.686	0.819	0.861	0.859	0.9	1.012	From 05 November to 30 November
R10s	0.843	0.956	0.986	0.987	1.018	1.118	From 01 December to 03 January
R11s	0.365	0.66	0.711	0.711	0.761	0.938	From 04 January to 21 January
R12s	0.484	0.707	0.763	0.769	0.831	1.056	From 22 January to 07 February
R13s	1.036	1.254	1.302	1.299	1.349	1.549	From 08 February to 01 March
R14s	0.907	1.051	1.092	1.088	1.126	1.242	From 02 March to 24 March
R15s	0.611	0.776	0.82	0.822	0.871	1.021	From 25 March to 12 April
R16s	0.632	0.772	0.817	0.82	0.866	1.048	From 13 April to 05 May
R17s	0.73	0.9	0.959	0.967	1.021	1.304	From 06 May to 26 May
R18s	0.504	0.816	0.894	0.882	0.959	1.148	From 27 May to 20 June
R19s	0.64	0.825	0.871	0.877	0.929	1.127	From 21 June to 04 August
R20s	0.845	1.035	1.086	1.086	1.136	1.286	From 05 August to 31 August
R21s	0.622	0.735	0.77	0.771	0.805	0.924	From 01 September to 24 September
R22s	0.962	1.034	1.056	1.056	1.078	1.165	From 25 September to 01 November
R23s	0.894	1.027	1.069	1.067	1.111	1.234	From 02 November
AMPs	1.002	1.716	2.131	2.143	2.543	3.819	-

Table 15: Assumptions

Assumptions	Mean	Distribution	Reference
Mobile Mobility Data			
Telenor coverage	48%		https://ekomstatistikken.nkom.no/
Data updated	August 29		
Data used in the predictions	August 27th	Fixed	Corrected to preserve population
Model parameters			
Exposed period ($1/\lambda_1$)	2 days	Exponential	changed from Feretti et al 2020
Pre-symptomatic period ($1/\lambda_2$)	2 days	Exponential	Feretti et al 2020
Symptomatic infectious period ($1/\gamma$)	3 days	Exponential	changed from Feretti et al 2020
Asymptomatic, infectious period ($1/\gamma$)	3 days	Exponential	changed from Feretti et al 2020
Infectiousness asympt. (r_{I_a})	0.1	Fixed	Feretti et al 2020
Infectiousness presymp (r_{E_2})	1.3	Fixed	guided by Feretti et al 2020
Prob. asymptomatic infection (p_a)	0.4		Feretti et al 2020
Healthcare			
Fraction asymptomatic infections	40%	Fixed	Mizumoto et al 2020 20% for the old population, Diamond Princess
% symptomatic and asymptomatic infections requiring hospitalization:			Salje et al 2020 corrected for: % of elderly living in elderly homes in Norway (last two age groups) and corrected for presence among positive tested since May 1.
0-9 years	0.1%	Fixed	
10 - 19 years	0.1%		
20 - 29 years	0.5%		
30 - 39 years	1.1%		
40 - 49 years	1.4%		
50 - 59 years	2.9%		
60 - 69 years	5.8%		
70 - 79 years	9.3%		
80+ years	22.3%		
Probability that an admission has been reported on Monday			
From Sunday	32%	Fixed	Estimated from "Beredskapsregistret BeredtC19"
From Saturday	49%		
From Friday	68%		
From Thursday	86%		
Probability that an admission has been reported			
From one day before	53%	Fixed	Estimated from "Beredskapsregistret BeredtC19"
From two days before	77%		
From three days before	82%		
From four days before	91%		
Probability that a positive laboratory test has been reported			
From one day before	6.7%	Fixed	Estimated from MSIS
From two days before	59%		
From three days before	90%		
From four days before	97%		
Probability that a negative laboratory test has been reported			
From one day before	16%	Fixed	Estimated from MSIS
From two days before	74%		
From three days before	92%		
From four days before	98%		

Supplementary analysis: EpiEstim estimation of reproduction number based on laboratory-confirmed cases

To complement the results of the metapopulation model, we present estimates of the temporal evolution of the reproduction number in Norway based on an analysis of laboratory-confirmed cases. The primary purpose of this analysis is to provide a more comprehensive perspective on the epidemic situation, taking into account several data sources.

Table 16: Estimated reproduction numbers 7 days ago

Location	Reff
National	1.24(1.21 - 1.26)
Oslo	1.23(1.19 - 1.27)
Rogaland	1.28(1.2 - 1.36)
Møre og Romsdal	0.94(0.85 - 1.03)
Nordland	1.02(0.92 - 1.12)
Viken	1.21(1.18 - 1.24)
Innlandet	1.19(1.11 - 1.28)
Vestfold og Telemark	1.25(1.18 - 1.32)
Agder	1.38(1.29 - 1.48)
Vestland	1.19(1.14 - 1.25)
Trøndelag	0.96(0.91 - 1.02)
Troms og Finnmark	0.96(0.89 - 1.03)

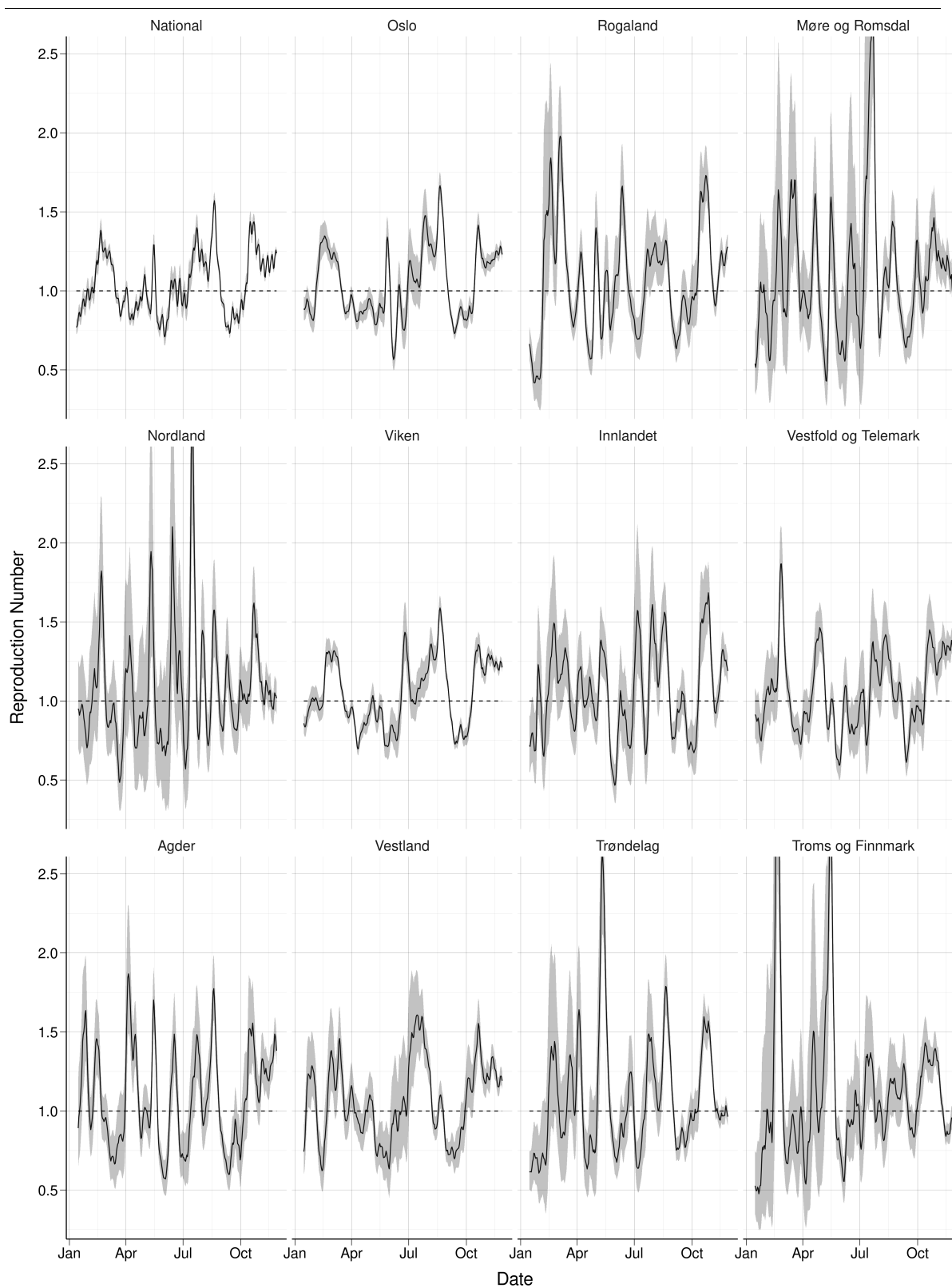


Figure 27: Reproduction number estimated using the R package EpiEstim.

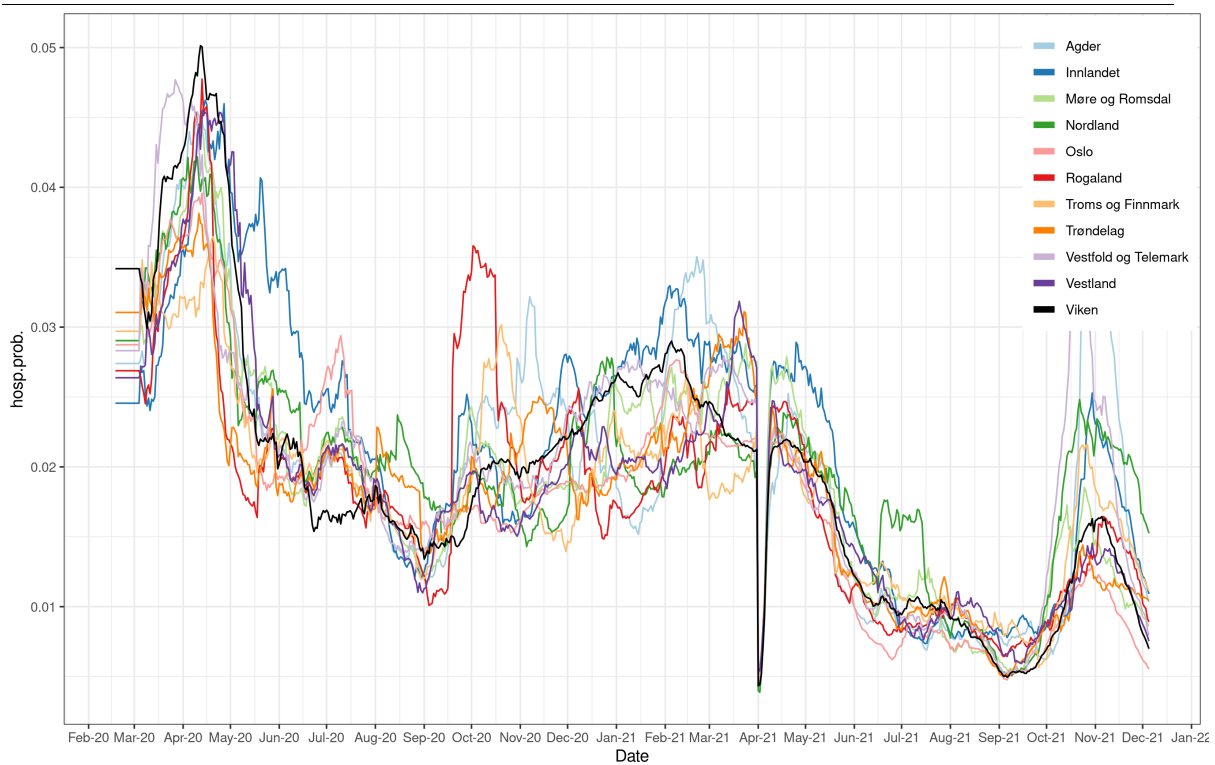


Figure 28: Regional hospitalisation probabilities per infection. The estimates are based on Salje et al., and regional data on the age distribution in the test data and the empirical case-hospitalisation rates.

Models and materials:

This report presents results based on a mathematical infectious disease model describing the geographical spread of COVID-19 in Norway. We use a metapopulation model for situational awareness and short-term forecasting and an individual-based model for long-term predictions. This report does not contain the long-term prediction results. Reproduction numbers of the metapopulation model are estimated in two ways: SMC-ABC is used to estimate a step-function in the transmissibility through prespecified changepoints, and SMC is used to estimate a daily varying reproduction number. We also provide estimates based on EpiEstim and a simple trend analysis. The models are described in previous reports and will not be explained here.

The metapopulation model takes daily varying Telenor mobility data as input. We also provide plots of the recent mobility for situational awareness.

How you should interpret the results: 3-week-ahead predictions and long-term scenarios

We provide both 3-week-ahead predictions and long-term scenarios. These are simulations of the disease spread into the future, under specific assumptions.

In the 3-week-ahead predictions, we assume that all parameters are as today, and simulate disease spread 3-weeks-ahead in time. Hence, these predictions are conditional on the current situation, and specifically on the most recently estimated reproduction number. The 3-week-ahead predictions thus do not take into account changes in transmissibility that are not yet captured by the available data, for example due to the delay between transmission and hospitalisation. Hence one of the conditions for the predictions to be valid is that the intervention policies do not change significantly in the next weeks. Hence, it does not make sense to evaluate or use the predictions if there are big changes in factors like

- new interventions
- relaxation of interventions
- a combination of new interventions and relaxations
- a significant change in vaccination coverage
- new variants with new properties
- a significant change in the contact behaviour of individuals.

As these factors are not likely to stay constant in the long-term future, we do not produce predictions for longer than three weeks ahead in time. Hence, our 3-week-ahead predictions are predictions of what may happen in the future, if there were no significant changes in the assumptions.

In addition to the short-term predictions, we also produce different long-term scenarios. Scenarios are not predictions of how we think the future pandemic will evolve. The scenarios are based on different hypothetical assumptions, and hence cannot be validated against what we later actually observe in the data. They are not meant to be, and hence should not be interpreted as, what we believe to be the most probable future outcome.

The purpose of the scenarios is manifold. Scenarios can contribute to situational awareness, and as information in decision making and future preparedness planning. Scenarios can be used to provide a better understanding of possible future disease spread, under specific assumptions. The assumptions of the scenarios may also sometimes be unrealistic. For example, scenarios can contribute in understanding the current situation, should we not change intervention policies in the future. This does however not mean that we believe that the intervention policies will stay constant. Scenarios can also be used to compare different intervention strategies, like comparing different vaccination strategies.

In this report, the term patient in ventilator treatment includes only those patients that require either invasive mechanical ventilation or ECMO (Extracorporeal membrane oxygenation).

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