NIPH
Norwegian Institute of Public Health

Situational awareness and forecasting for Norway

FHI COVID-19 modelling team

Week 5, 2 February 2022

Main results:

This week we report the the estimated reproduction numbers obtained using only omicron confirmed and predicted hospitalisations, because the reporting of test data is unstable. There is also a more unstable reporting delay of the new hospitalised patients because of covid, which makes the last 4 data points very uncertain. There is also evidence that patients hospitalised because of Omicron have a shorter stay in hospital compared to delta patients, though there are still many delta patients in the hospitals. All this complicates our short term predictions of the incidence and prevalence. We estimate the reproduction number to be around 1.5 on average during January. One-two-tree weeks ahead predictions of hospital prevalence due to covid are uncertain, and it appears that we overestimate hospital incidence, which is in any case clearly increasing, while the number of occupied ventilator beds is clearly decreasing.

- **National epidemiological situation:**

  The most recent reproduction numbers:

Model	Median	5%	95%	Prob>1	period/day	More info
Changepoint - Omicron only	1.49	1.45	1.53	0.99	Since 1 Jan	Section 1.2

- **National forecasting:**

  One-week-ahead national forecasts from changepoint model:

Indicator	Median/Mean 95% PI	day	Info 2-3 weeks forecasts
Hospital beds	293/292 (248-342)	7 Feb	Table 2
Ventilator beds	22/21 (13-22)	7 Feb	Table 2

  * Age-specific hospital prevalence predictions are provided in Figures 5 and 6.

- **Regional epidemiological situation:**

  The newest regional reproduction numbers for Oslo:

Model	Median	5%	95%	Prob>1	period/day	Info other counties
SMC	1.31	0.81	2.16	0.9	11 Jan - 18 Jan	Fig. 3

- **Telenor mobility data and the number of foreign visitors:** The most recent mobility development is found in Figures 16 and 17 for the largest municipality in each county and for each county, respectively. Figure 18 shows the total number of roamers per day per county.

1 Estimated national reproduction numbers

In the results of our national changepoint model, we combine two independent calibrations: One against the non-omicron cases (mainly Delta) and another with a focus on Omicron. Table 1 shows the estimated reproductive number of the non-omicron cases.

Figure 1 shows the estimated daily number of COVID-19 patients admitted to hospital (all variants), 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. Delta variant

Reff	Period
2.63/2.62(2.16-3.03)	From Feb 17 to Mar 14
0.57/0.57(0.46-0.66)	From Mar 15 to Apr 19
0.78/0.75(0.12-1.25)	From Apr 20 to May 10
0.87/0.84(0.3-1.25)	From May 11 to Jun 30
0.86/0.8(0.06-1.44)	From Jul 01 to Jul 31
1.06/1.07(0.74-1.43)	From Aug 01 to Aug 31
0.87/0.87(0.65-1.09)	From Sep 01 to Sep 30
1.2/1.21(0.98-1.5)	From Oct 01 to Oct 25
1.25/1.24(0.72-1.62)	From Oct 26 to Nov 04
0.88/0.88(0.77-1)	From Nov 05 to Nov 30
0.97/0.97(0.9-1.05)	From Dec 01 to Jan 03
0.75/0.75(0.59-0.93)	From Jan 04 to Jan 21
0.85/0.85(0.63-1.08)	From Jan 22 to Feb 07
1.33/1.33(1.15-1.49)	From Feb 08 to Mar 01
1.1/1.1(1-1.21)	From Mar 02 to Mar 24
0.81/0.81(0.69-0.91)	From Mar 25 to Apr 12
0.82/0.82(0.69-0.96)	From Apr 13 to May 05
1.08/1.07(0.81-1.27)	From May 06 to May 26
0.7/0.72(0.49-1.04)	From May 27 to Jun 20
0.94/0.94(0.75-1.09)	From Jun 21 to Aug 04
1.21/1.2(1.04-1.36)	From Aug 05 to Aug 31
0.77/0.77(0.69-0.85)	From Sep 01 to Sep 24
1.1/1.1(1.06-1.13)	From Sep 25 to Dec 12
0.57/0.57(0.47-0.65)	From Dec 13

Median/Mean (95% credible intervals)

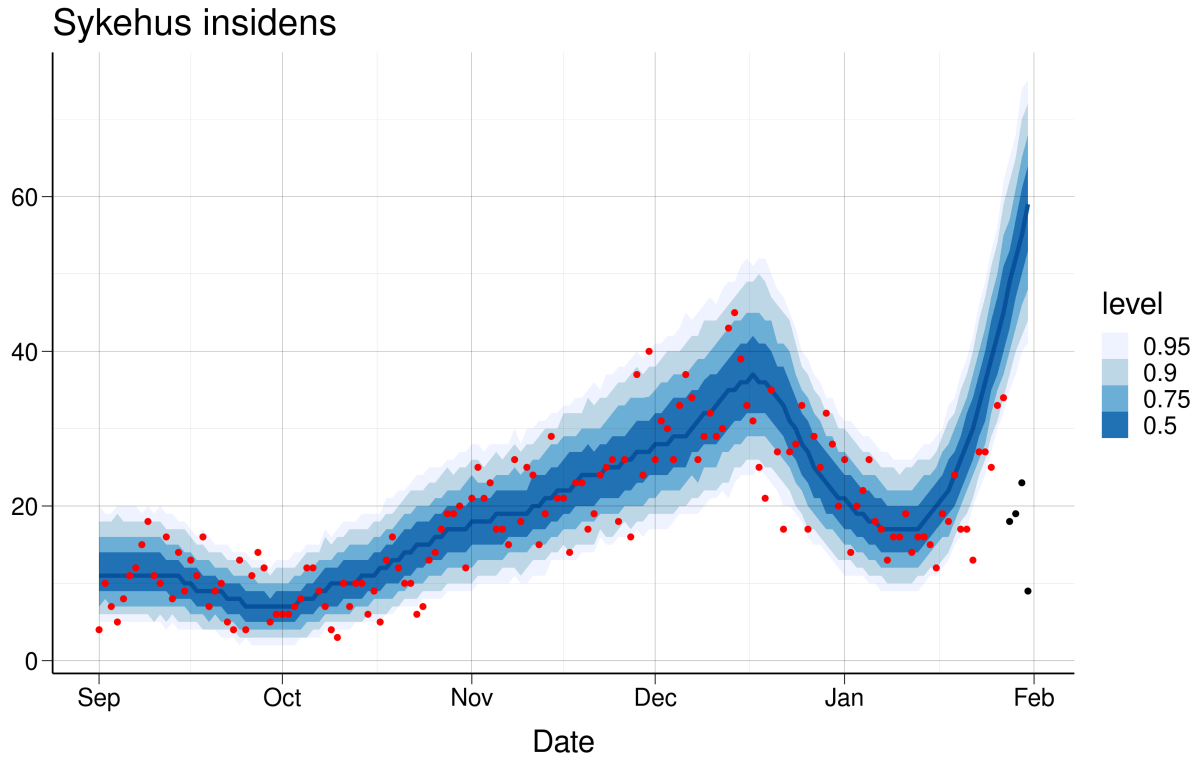
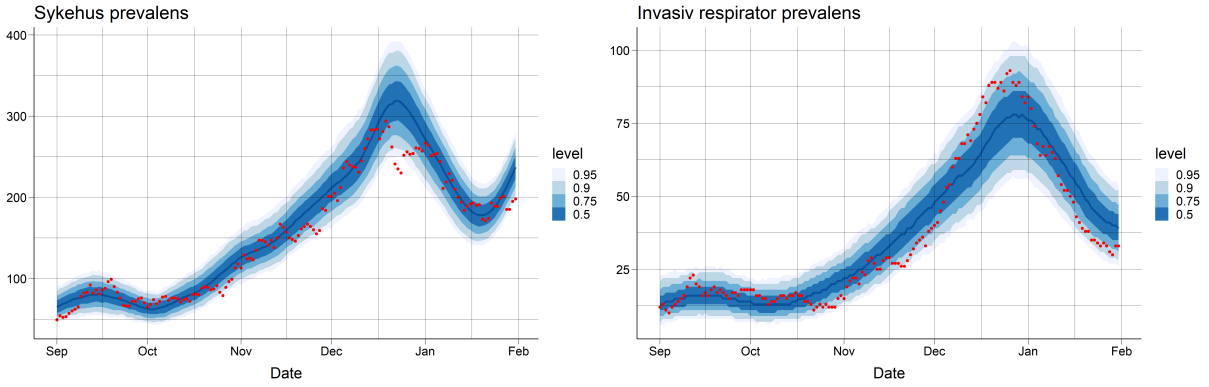


Figure 1: A comparison of true data (red) and predicted values (blue) for hospital admissions (all variants). The last four data points (black) are assumed to be affected by reporting delay. The uncertainty captures the uncertainty in the calibrated parameters, in addition to the stochastic elements 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 (2a) and the daily number of patients receiving ventilator treatment (2b). Those data sources are not used to estimate the parameters, and can therefore be seen as a validation of the model assumptions.



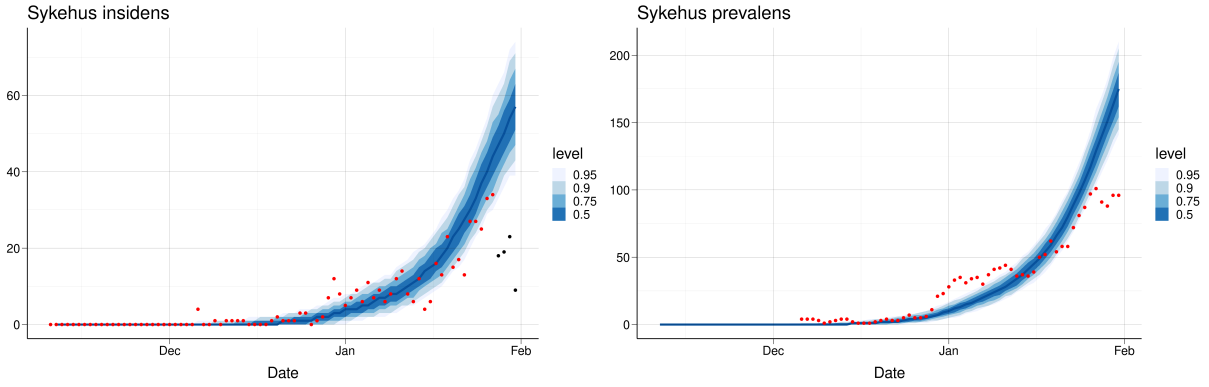
(a) Hospital prevalence

(b) Ventilator prevalence

Figure 2: A comparison of true data (red) and predicted values (blue) for hospital and respirator prevalence (all variants). Prevalence data is based on NIPaR and may be different to the data from Helsedirektoratet.

1.1 Focus on Omicron

This week, we calibrate our national changepoint model separately on only the omicron hospitalisation data. This calibration starts on the day of the first confirmed omicron case in Norway, and seeds with all known imported cases of omicron from abroad. We calibrate to the known hospitalised cases with omicron. As not all cases are screened to determine the variant, we scale up the omicron imported cases and the omicron hospitalisations with the factor of screened cases that were attributed to omicron. We assume an amplification factor of 1.9, and that the probability to be hospitalised if infected by omicron is 70% smaller than if infected by delta. This calibration results in an **estimated reproduction number for omicron of 1.49 (1.45, 1.53)**. Note that since the amplification factor is here fixed, the uncertainty is likely underestimated.



(a) Hospital incidence

(b) Hospital prevalence

Figure 3: A comparison of true data (red) and predicted values (blue) for hospital and incidence and prevalence. Prevalence data is scaled up from data based on NIPaR according to the proportion of Omicron cases screened. The last four data points (black) are assumed to be affected by reporting delay.

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

In this section we show the three-week-ahead trajectories of the combined analyses including both non-omicron and omicron simulations from our two independent calibrations.

The table of hospital beds and ventilator beds is provided in Table 2. The corresponding figures are provided in Figure 4. Age-specific hospital prevalence predictions are provided in Figures 5 and 6.

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

	1 week prediction (Feb 07)	2 week prediction (Feb 14)	3 week prediction (Feb 21)
Hospital beds	293/292 (248-342)	320/319 (271-376)	344/342 (293-402)
Ventilator beds	22/21 (13-33)	15/15 (8-24)	10/10 (5-18)

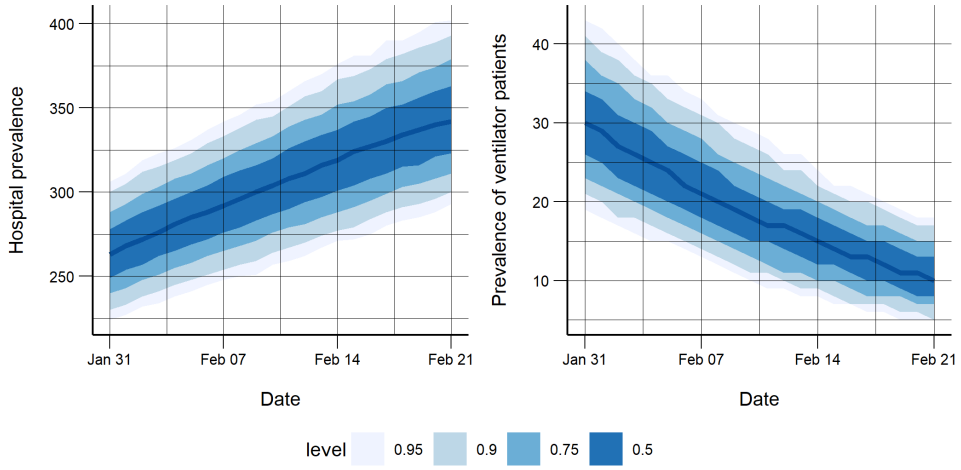


Figure 4: National 3 week predictions for hospital beds (left) and ventilator beds (right) taking into account the omicron takeover.

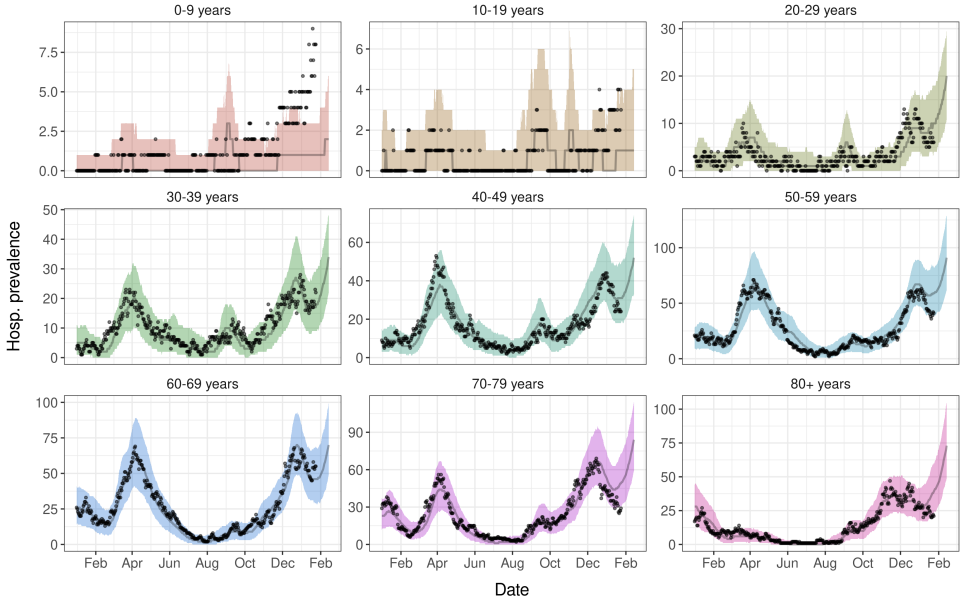


Figure 5: Simulated hospital prevalence by age group taking into account the omicron takeover. Real data is shown as black dots.

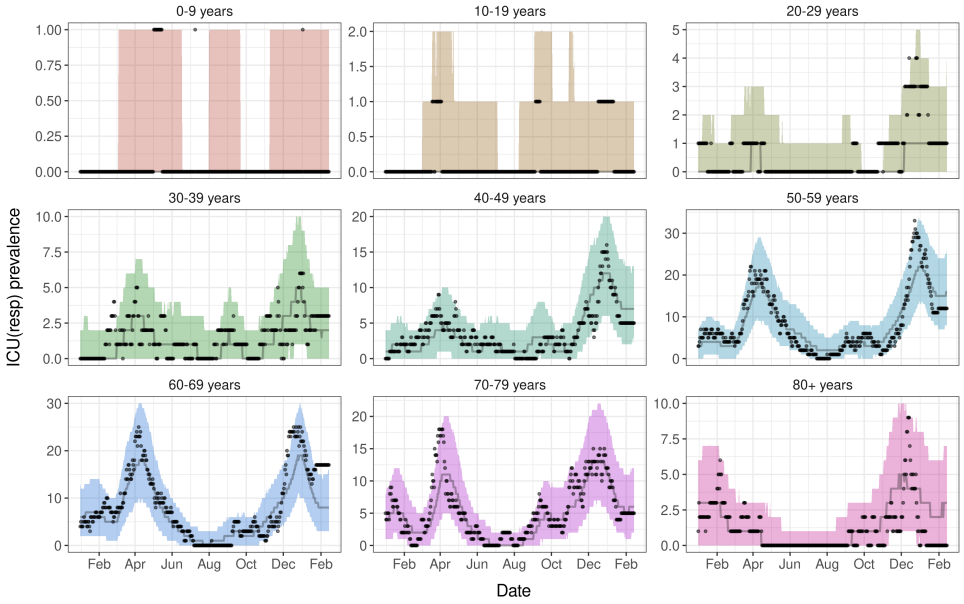


Figure 6: Simulated respirator prevalence by age group taking into account the omicron takeover. Real data is shown as black dots.

3 Estimated regional reproduction numbers

Calibration of our regional SMC model to hospitalisation incidence data leads to the following estimates for current regional reproduction numbers by county (Table 3).
Below we show the estimated daily number of COVID-19 patients admitted to hospital in 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 3: Regional estimates, 11 Jan-18 Jan

County	Median	95CI	Prob>1
Oslo	1.31	0.81-2.16	0.86
Rogaland	1.40	0.85-2.37	0.9
Møre og Romsdal	0.86	0.43-1.69	0.3
Nordland	1.10	0.64-1.92	0.64
Viken	1.82	1.11-3.11	0.99
Innlandet	1.25	0.73-2.26	0.78
Vestfold og Telemark	1.17	0.71-2.05	0.74
Agder	1.21	0.72-2.21	0.77
Vestland	1.32	0.76-2.42	0.84
Trøndelag	1.06	0.61-1.94	0.58
Troms og Finnmark	0.94	0.49-1.69	0.41

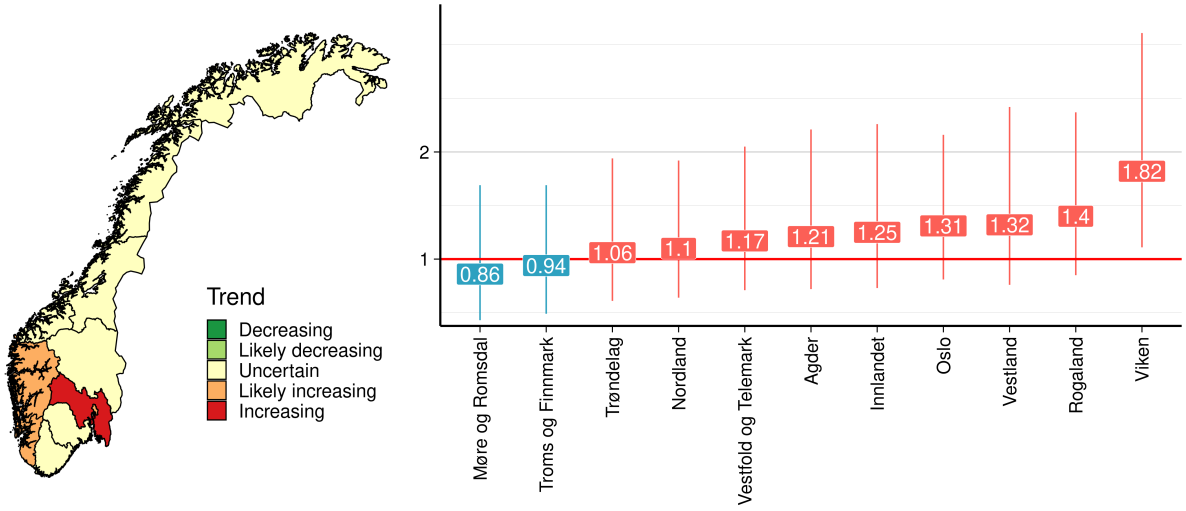
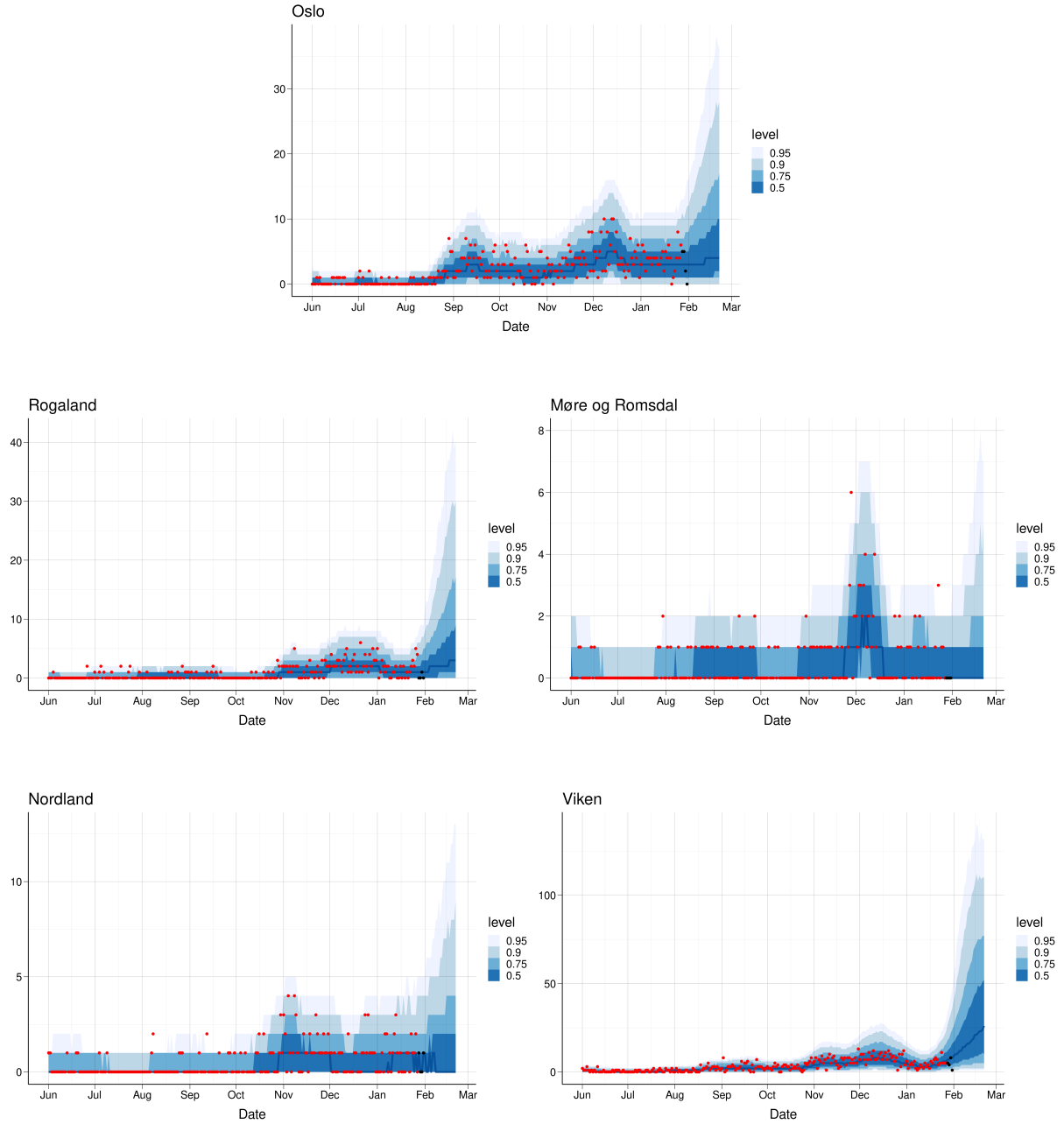
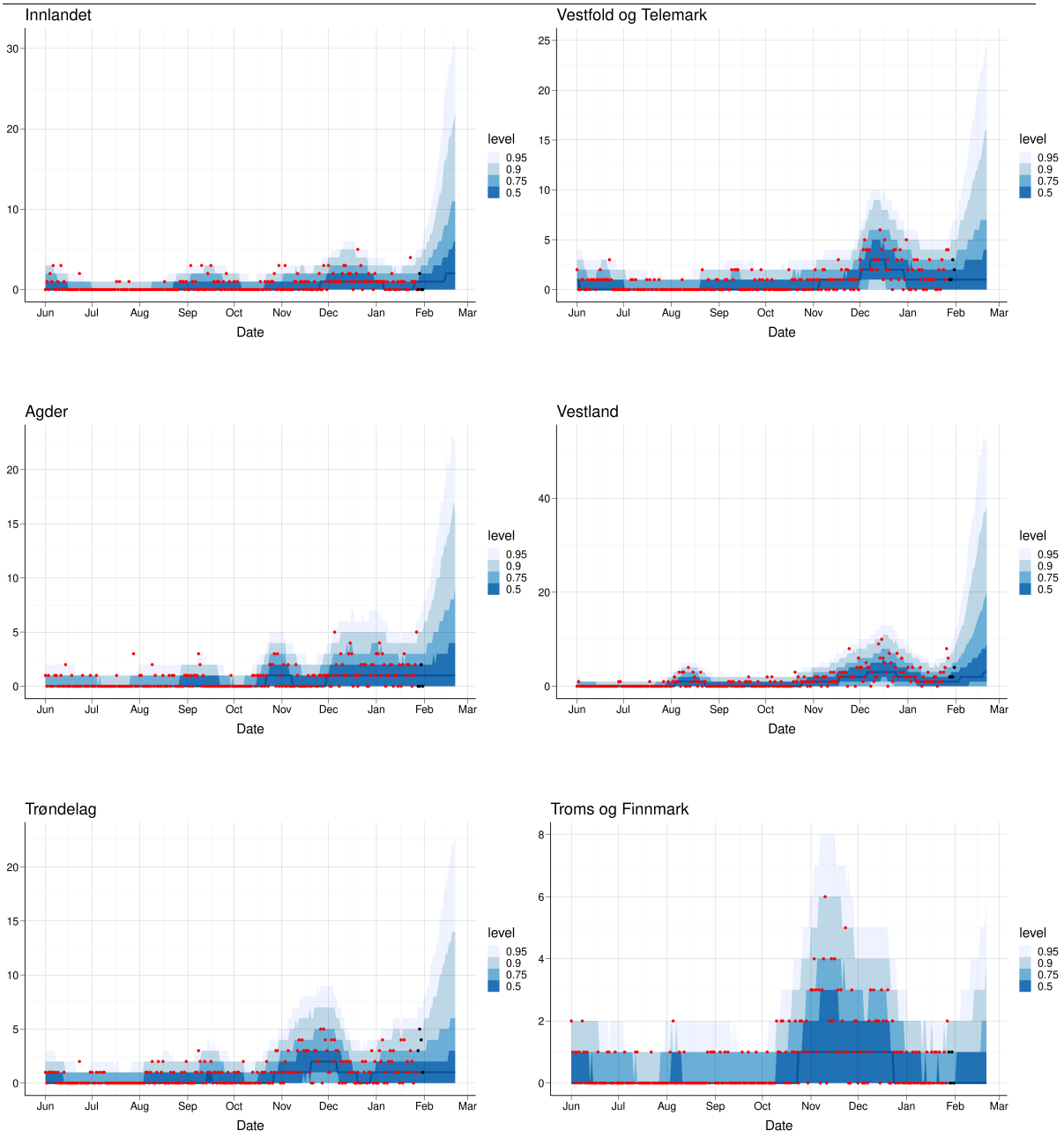


Figure 7: The map shows the direction of the trend in incidence in the counties based on the latest reproduction numbers shown in the other chart. The trend is increasing if the probability that the latest reproduction number is above one is above 95%, the trend is likely increasing if this probability 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 reproductive numbers showed on Table 3.

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

Below is shown the daily incidence (table 4) and prevalence (table 5) for each county.

Table 4: Predicted incidence per day: Median/Mean (CI)

Region	1 week prediction (07 Feb)	2 weeks prediction (14 Feb)	3 weeks prediction (21 Feb)
Agder	403/928 (49-5330)	491/1184 (42-6700)	587/1295 (37-6050)
Innlandet	453/973 (49-5617)	612/1420 (45-8418)	753/1698 (37-8243)
Møre og Romsdal	86/211 (9-1327)	103/307 (7-2199)	127/384 (6-3037)
Nordland	180/425 (19-2434)	176/509 (14-3326)	173/557 (10-3719)
Oslo	1195/1924 (217-7908)	1394/2321 (187-9766)	1587/2507 (167-8904)
Rogaland	811/1834 (73-10246)	1052/2437 (62-12311)	1308/2695 (52-10661)
Troms og Finnmark	70/153 (8-854)	76/210 (6-1362)	81/264 (5-1899)
Trøndelag	309/845 (27-5576)	293/1024 (17-7849)	287/1093 (10-7985)
Vestfold og Telemark	378/833 (53-4965)	420/1064 (41-7529)	455/1187 (34-7519)
Vestland	782/2028 (76-13277)	946/2742 (60-17187)	1130/3037 (46-14750)
Viken	6636/10044 (887-37051)	9189/11593 (865-30483)	10533/11010 (837-23752)

Table 5: 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	07 Feb	14 Feb	21 Feb	low CI, 21 Feb	high CI, 21 Feb
Agder	1712/3788	2065/4967	2485/5599	173	27026
Innlandet	1861/3851	2518/5812	3170/7211	165	36687
Møre og Romsdal	359/852	439/1256	537/1617	29	12700
Nordland	800/1780	769/2158	763/2407	48	15944
Oslo	5116/8029	5915/9829	6803/10870	764	40358
Rogaland	3357/7377	4377/10143	5482/11632	238	48033
Troms og Finnmark	304/628	328/867	353/1108	25	7788
Trøndelag	1370/3511	1311/4336	1272/4752	54	35069
Vestfold og Telemark	1605/3401	1789/4459	1974/5109	157	33306
Vestland	3272/8099	4002/11391	4761/13105	214	66305
Viken	26887/40956	37844/49690	45946/49148	3713	107776

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

Below is shown the estimated short-term forecasting of expected hospital prevalence (table 6) and patients on ventilator treatment for each county (table 7).

Table 6: Number of hospitalisation beds occupied by Covid-19 patients: Median/Mean (CI)

Region	1 week prediction (07 Feb)	2 weeks prediction (14 Feb)	3 weeks prediction (21 Feb)
Agder	7/11 (0-45)	8/14 (0-75)	9/19 (0-104)
Innlandet	7/10 (0-43)	8/16 (0-87)	11/24 (0-137)
Møre og Romsdal	2/3 (0-13)	2/4 (0-20)	2/5 (0-35)
Nordland	4/7 (0-29)	4/8 (0-45)	4/10 (0-61)
Oslo	21/27 (4-84)	22/32 (3-119)	24/38 (3-150)
Rogaland	10/17 (1-70)	13/26 (1-132)	16/35 (1-185)
Troms og Finnmark	2/3 (0-11)	2/3 (0-17)	2/4 (0-25)
Trøndelag	7/10 (0-47)	6/13 (0-72)	6/15 (0-110)
Vestfold og Telemark	8/12 (1-46)	8/15 (1-78)	9/19 (0-121)
Vestland	12/19 (2-84)	14/29 (1-165)	16/40 (1-249)
Viken	70/96 (16-347)	99/145 (16-523)	138/186 (15-554)

Table 7: Number of ICU beds occupied by Covid-19 patients: Median/Mean (CI)

Region	1 week prediction (07 Feb)	2 weeks prediction (14 Feb)	3 weeks prediction (21 Feb)
Agder	1/1 (0-5)	1/1 (0-6)	1/1 (0-7)
Innlandet	1/1 (0-4)	1/1 (0-6)	1/2 (0-9)
Møre og Romsdal	0/1 (0-2)	0/0 (0-2)	0/0 (0-3)
Nordland	0/1 (0-3)	0/1 (0-4)	0/1 (0-5)
Oslo	4/4 (0-10)	3/4 (0-10)	3/4 (0-12)
Rogaland	1/2 (0-6)	1/2 (0-9)	1/3 (0-13)
Troms og Finnmark	0/0 (0-2)	0/0 (0-2)	0/0 (0-2)
Trøndelag	1/1 (0-4)	1/1 (0-5)	1/1 (0-7)
Vestfold og Telemark	1/2 (0-5)	1/1 (0-6)	1/2 (0-8)
Vestland	2/2 (0-7)	2/2 (0-11)	2/3 (0-17)
Viken	7/8 (1-22)	8/10 (1-33)	10/14 (1-44)

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

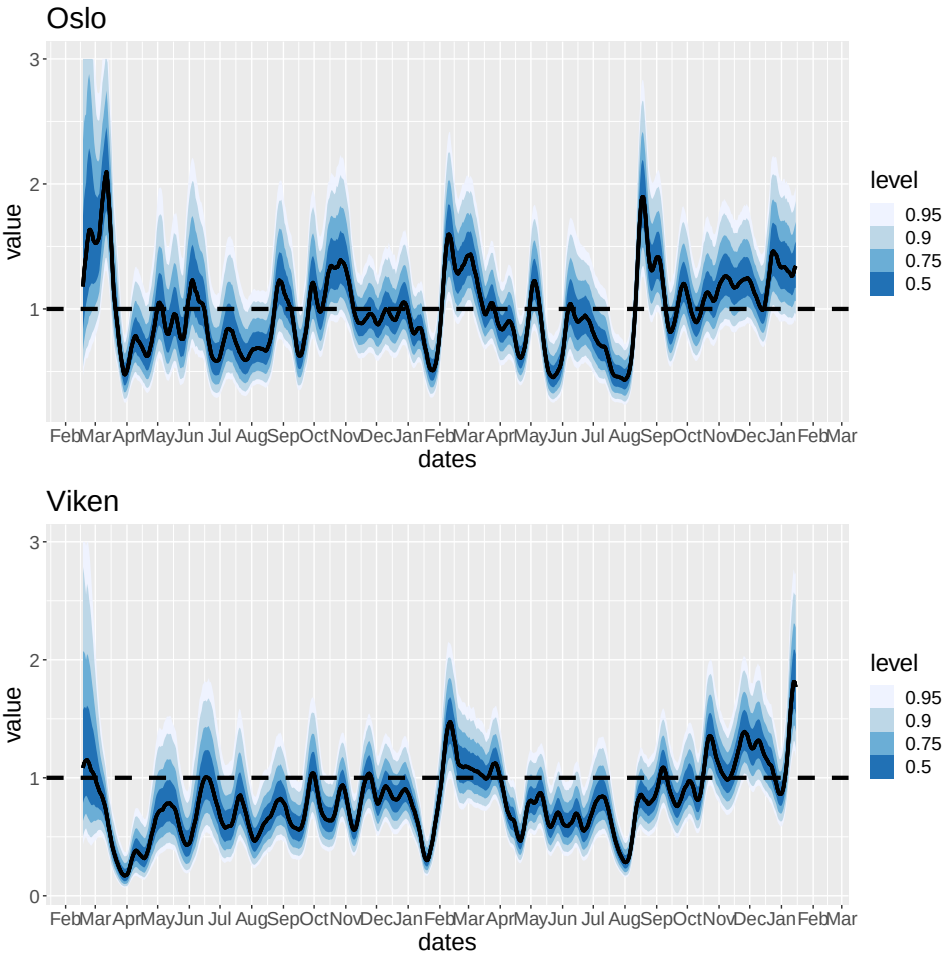
To estimate recent trends in hospitalisation and number of positive tests, we present results in table 8 based on a negative binomial regression where we account for weekend effects. We exclude the last three days to avoid problems of reporting delay and fit the model using data from 17 days to 3 days 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.

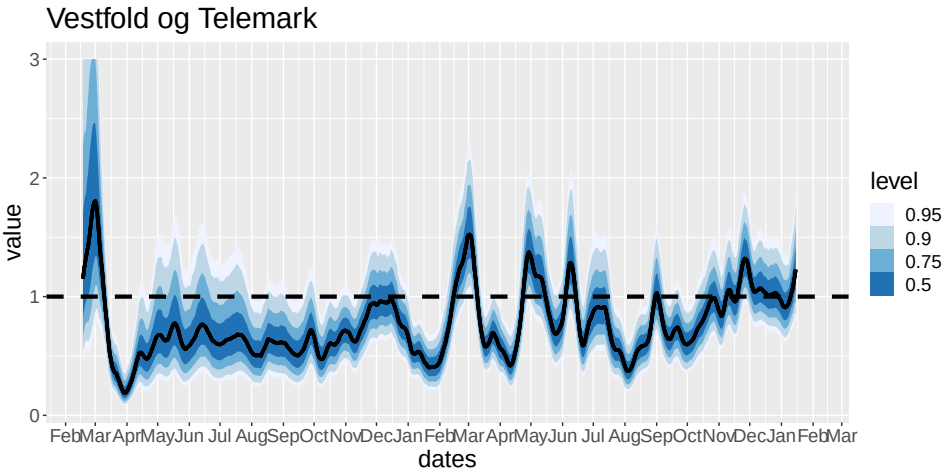
Table 8: Trend analysis for the last 14 days

	Average daily increase last 14 days		Doubling Time (days)	
County	Hospitalisations	Cases	Hospitalisations	Cases
Agder	4.3 (-6, 16) %	1.6 (-2.7, 6) %	16.6 (-11.2, 4.7)	44.6 (-25.6, 11.9)
Innlandet	1 (-12.4, 16.8) %	8.7 (3.8, 13.9) %	66.5 (-5.2, 4.5)	8.3 (18.6, 5.3)
Møre og Romsdal	-3.5 (-17, 11.6) %	5.7 (0.6, 11) %	-19.6 (-3.7, 6.3)	12.5 (111.2, 6.6)
Nordland	-5.8 (-18.3, 7.9) %	3.9 (-1.6, 9.8) %	-11.7 (-3.4, 9.2)	17.9 (-41.7, 7.4)
Norge	-3.1 (-5.7, -0.4) %	5.7 (2.5, 9) %	-22.2 (-11.8, -181.7)	12.6 (28.5, 8.1)
Oslo	0.3 (-5.5, 6.5) %	7.5 (4.8, 10.2) %	215.4 (-12.3, 11)	9.6 (14.7, 7.1)
Rogaland	-3.5 (-11.9, 5.4) %	5.5 (2.2, 9) %	-19.3 (-5.5, 13.1)	12.9 (32.4, 8)
Troms og Finnmark	Not enough data	6.2 (1.6, 11) %	Not enough data	11.6 (44.3, 6.6)
Trøndelag	Not enough data	9.7 (5.4, 14.1) %	Not enough data	7.5 (13.2, 5.2)
Vestfold og Telemark	-0.2 (-11, 12) %	4.1 (1.4, 6.9) %	-434.6 (-6, 6.1)	17.2 (49, 10.4)
Vestland	-5.9 (-14.3, 2.9) %	4.2 (0.5, 8.1) %	-11.4 (-4.5, 23.9)	16.9 (153.9, 8.9)
Viken	-7.2 (-13, -1.3) %	4.8 (1.5, 8.2) %	-9.2 (-5, -55)	14.8 (45.8, 8.8)

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.

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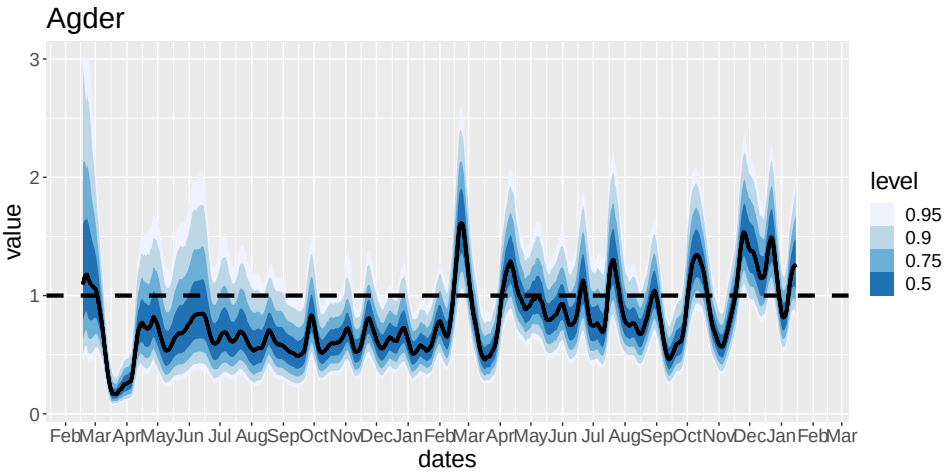
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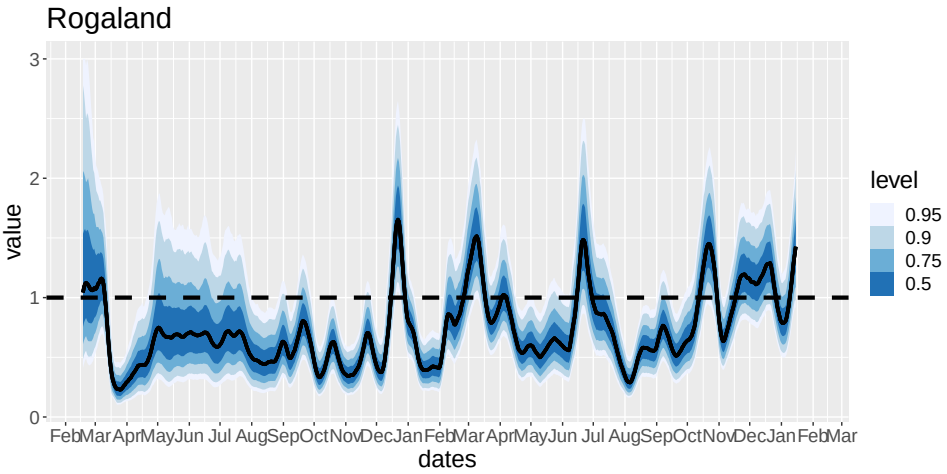
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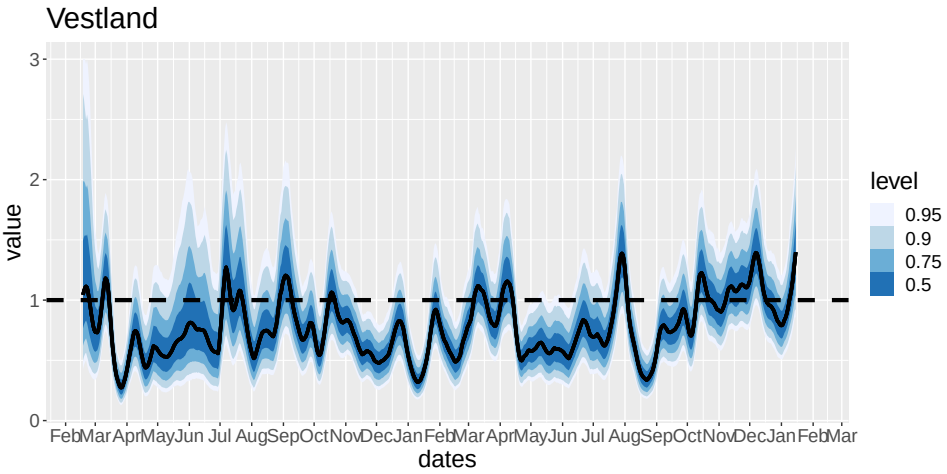
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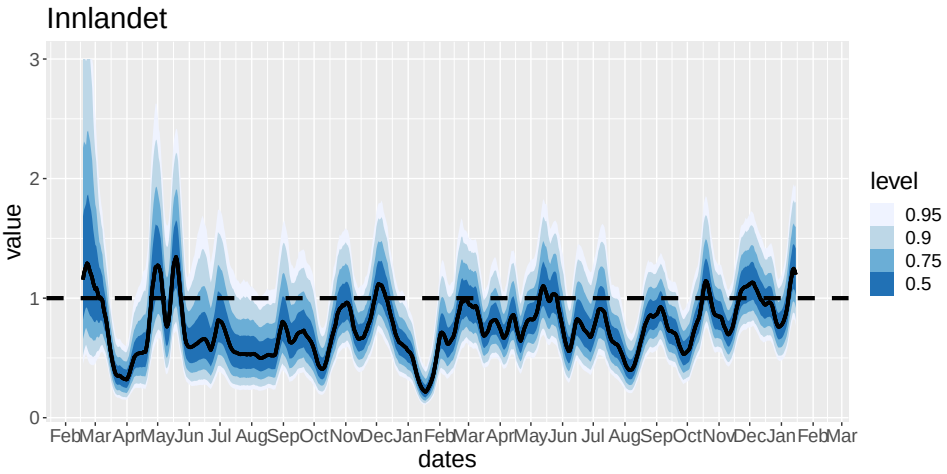
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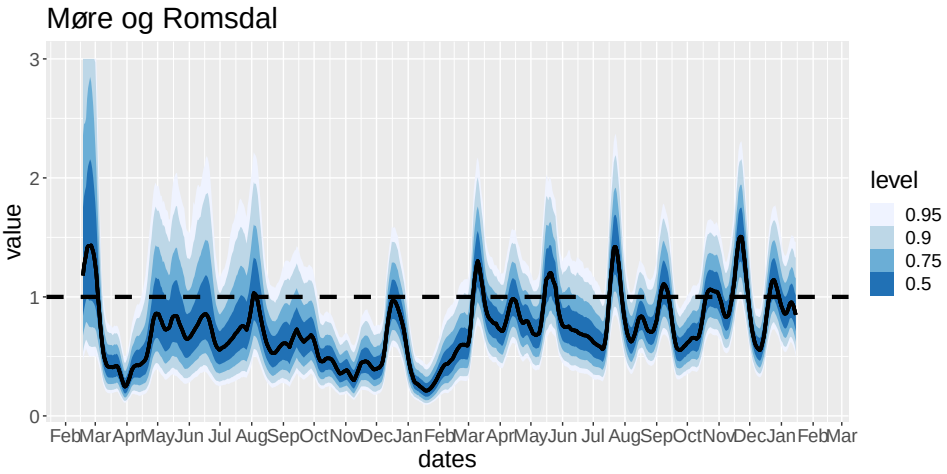
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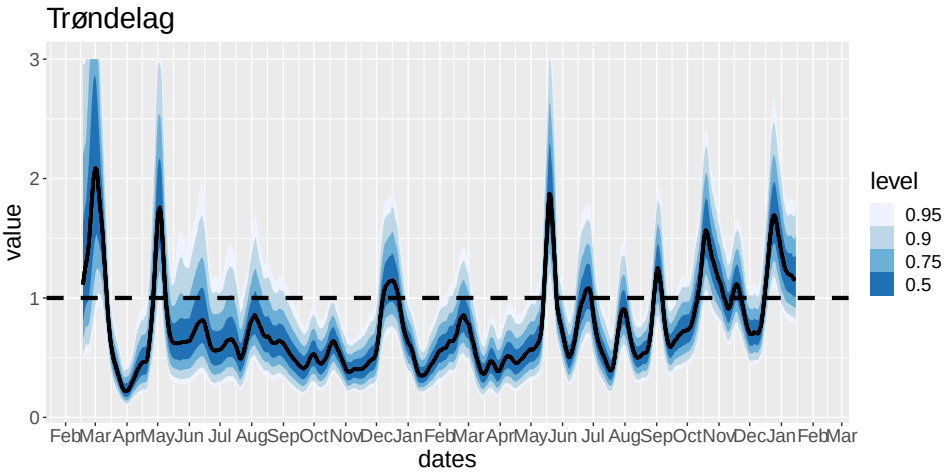
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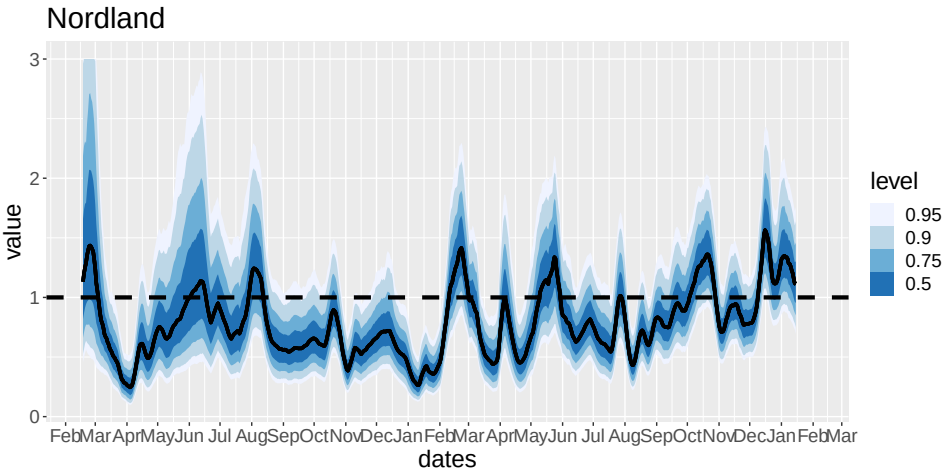
Nordland
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level
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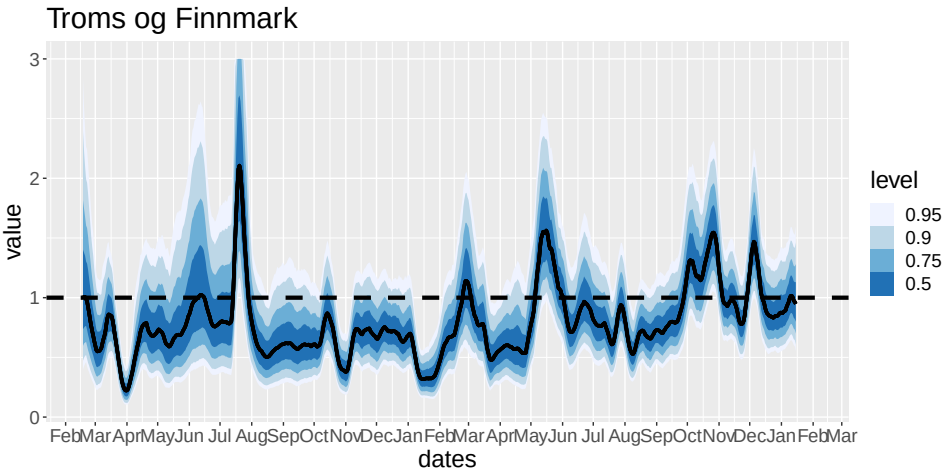
Troms og Finnmark
value
dates
level
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1
2
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Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar

8 Short-term predictions per health trust ("helseforetak"): number of occupied covid-19 beds and number of patients receiving ventilator treatment

In the table below we distribute our short-term predictions to the Norwegian health trusts ("helseforetak"), on the basis of their areas of responsibility.

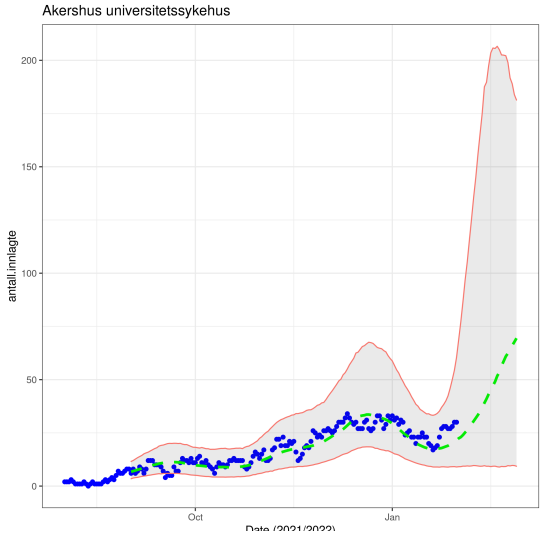
Table 9: Number of hospitalisation beds occupied by Covid-19 patients: Median/Mean (CI)

Helseforetak	1 week prediction (07 Feb)	2 weeks prediction (14 Feb)	3 weeks prediction (21 Feb)
Akershus universitetssykehus	29/38 (9-125)	41/57 (9-190)	56/73 (9-203)
Finnmarksykehuset	1/1 (0-3)	1/1 (0-5)	1/1 (0-8)
Helse Bergen	9/14 (1-59)	9/20 (1-118)	11/29 (1-177)
Helse Fonna	4/6 (1-21)	6/9 (1-39)	7/13 (1-52)
Helse Førde	2/3 (0-14)	2/5 (0-28)	3/7 (0-42)
Helse Møre og Romsdal	2/3 (0-12)	2/4 (0-19)	2/5 (0-33)
Helse Nord Trøndelag	2/3 (0-14)	2/4 (0-23)	2/5 (0-35)
Helse Stavanger	9/13 (2-53)	10/20 (1-101)	12/27 (1-142)
Nordlandssykehuset	3/4 (0-16)	2/5 (0-25)	2/6 (0-34)
Oslo universitetssykehus	18/22 (5-68)	18/27 (4-98)	21/32 (3-125)
St. Olavs hospital	5/7 (1-31)	4/9 (0-48)	3/10 (0-74)
Sykehuset Innlandet	7/10 (1-38)	8/15 (1-76)	11/23 (1-124)
Sykehuset Telemark	3/5 (0-18)	3/6 (0-31)	4/8 (0-49)
Sykehuset i Vestfold	5/7 (1-26)	5/9 (1-44)	5/11 (1-70)
Sykehuset Østfold	18/25 (5-89)	25/37 (5-134)	35/48 (4-141)
Sørlandet sykehus	7/11 (1-43)	8/14 (0-74)	9/19 (0-104)
Universitetssykehuset i Nord-Norge	2/3 (0-9)	2/3 (0-13)	2/4 (0-21)
Vestre Viken	27/38 (7-136)	39/57 (7-206)	54/73 (6-217)

Table 10: Number of respirator beds occupied by Covid-19 patients: Median/Mean (CI)

Helseforetak	1 week prediction (07 Feb)	2 weeks prediction (14 Feb)	3 weeks prediction (21 Feb)
Akershus universitetssykehus	3/3 (1-8)	4/4 (1-12)	4/6 (1-16)
Finnmarksykehuset	0/0 (0-1)	0/0 (0-1)	0/0 (0-1)
Helgelandssykehuset	0/0 (0-1)	0/0 (0-1)	0/0 (0-2)
Helse Bergen	1/1 (0-5)	1/2 (0-8)	1/2 (0-12)
Helse Fonna	1/1 (0-2)	1/1 (0-3)	1/1 (0-4)
Helse Førde	0/0 (0-1)	0/0 (0-2)	0/1 (0-3)
Helse Møre og Romsdal	0/1 (0-2)	0/0 (0-2)	0/0 (0-3)
Helse Nord Trøndelag	0/0 (0-1)	0/0 (0-2)	0/0 (0-2)
Helse Stavanger	1/1 (0-5)	1/2 (0-7)	1/2 (0-10)
Nordlandssykehuset	0/0 (0-2)	0/0 (0-2)	0/0 (0-3)
Oslo universitetssykehus	3/3 (0-8)	3/3 (0-8)	3/3 (0-10)
St. Olavs hospital	1/1 (0-3)	1/1 (0-3)	1/1 (0-5)
Sykehuset Innlandet	1/1 (0-4)	1/1 (0-5)	1/2 (0-8)
Sykehuset Telemark	0/1 (0-2)	0/1 (0-2)	0/1 (0-3)
Sykehuset i Vestfold	1/1 (0-3)	1/1 (0-4)	1/1 (0-5)
Sykehuset Østfold	2/2 (0-6)	2/3 (0-8)	3/4 (0-11)
Sørlandet sykehus	1/1 (0-5)	1/1 (0-6)	1/1 (0-7)
Universitetssykehuset i Nord-Norge	0/0 (0-2)	0/0 (0-2)	0/0 (0-2)
Vestre Viken	3/3 (0-9)	3/4 (0-13)	4/5 (0-17)

In the figures below, we plot the 95% credibility interval and quantiles of the estimated posterior distribution of the daily number of occupied covid-19 beds and the number of patients receiving ventilator treatment for a few health trusts. The others are available on request. In blue are actual data, in green our median prediction and in gray the 95% credibility interval. For some counties, uncertainty is considerable towards the most recent time because there is little data and possibly reporting delays that are different in each county.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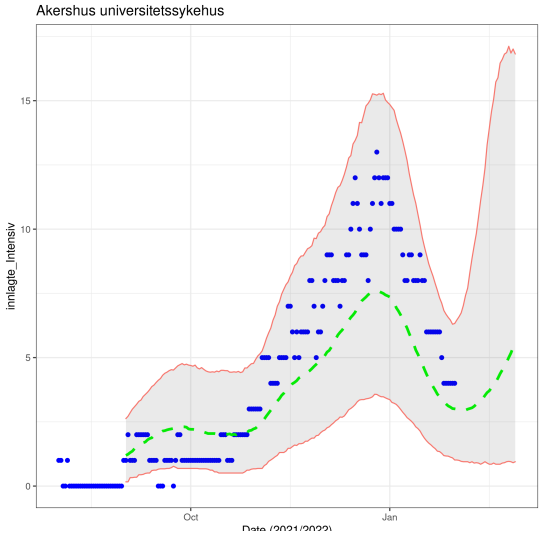
200
150
100
50
0
Oct
Jan


Akershus universitetssykehus
innlagte_Intensiv
15
10
5
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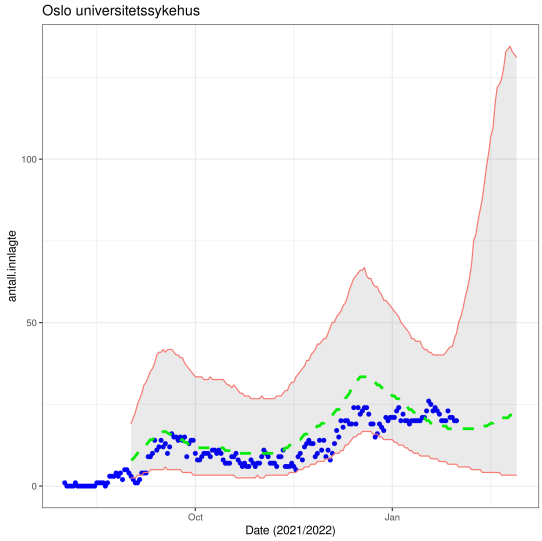
Oct
Jan


Oslo universitetssykehus
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100
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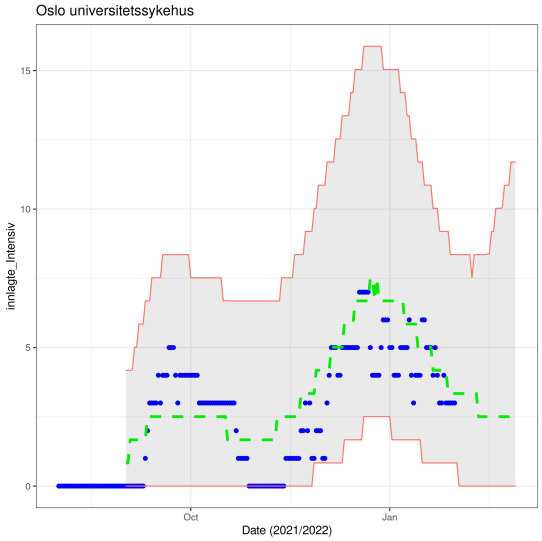
Oct
Jan
Date (2021/2022)


Oslo universitetssykehus
innlagte_Intensiv
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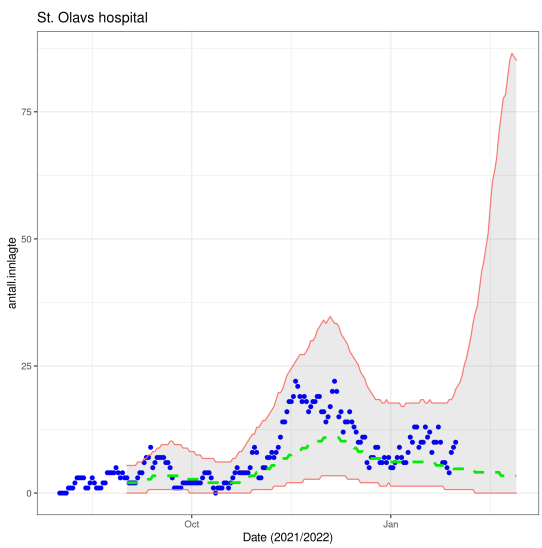
Jan
Date (2021/2022)


St. Olavs hospital
antall.innlagte
75
50
25
0
Oct
Jan
Date (2021/2022)


St. Olavs hospital
innlagte_Intensiv
7.5
5.0
2.5
0.0
Oct
Jan
Date (2021/2022)

9 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 14 shows an overview of the mobility since March 2020 for the largest municipalities in each county, and Figure 15 shows the total mobility out from all municipalities in each county, including Oslo. Figure 16 and 17, zooms in on mobility from August 16 2021, for municipalities and counties, respectively.

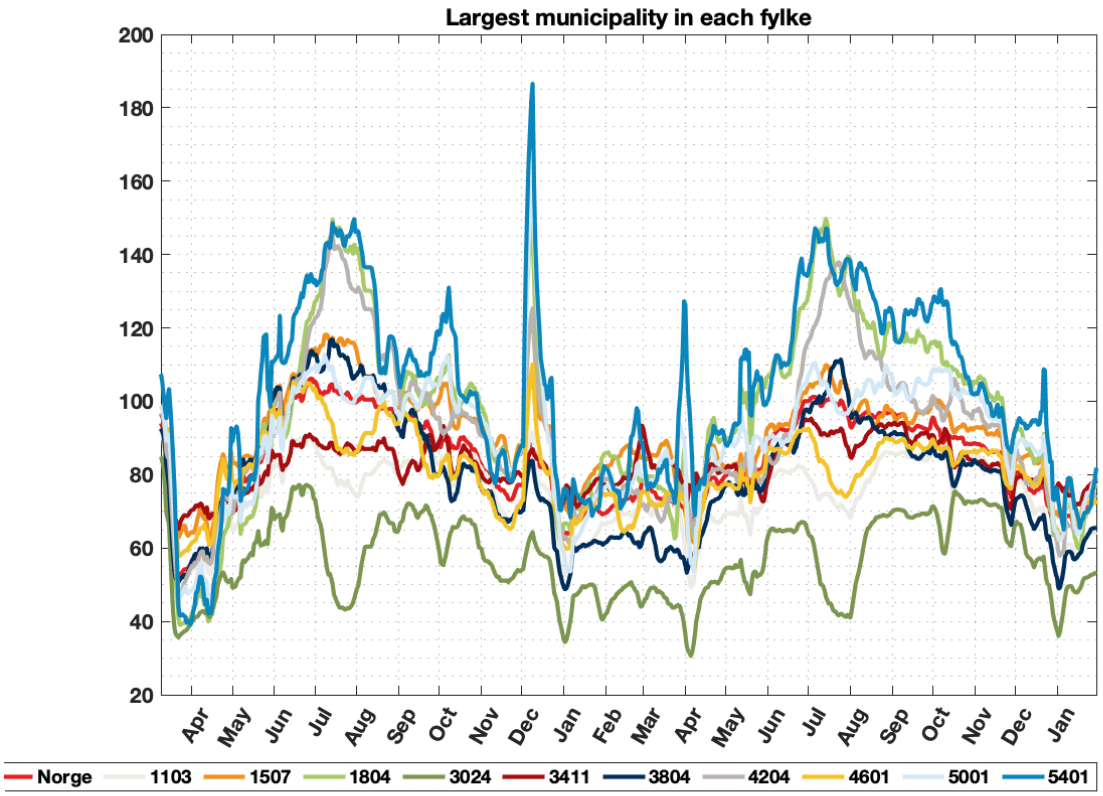


Figure 14: Mobility for selected municipalities since March 2020: Nationally (Norge), Stavanger (1103), Ålesund (1507), Bodø (1804), Bærum (3024), Ringsaker (3411), Sandefjord (3804), Kristiansand (4204), Bergen (4601), Trondheim (5001), Tromsø (5401).

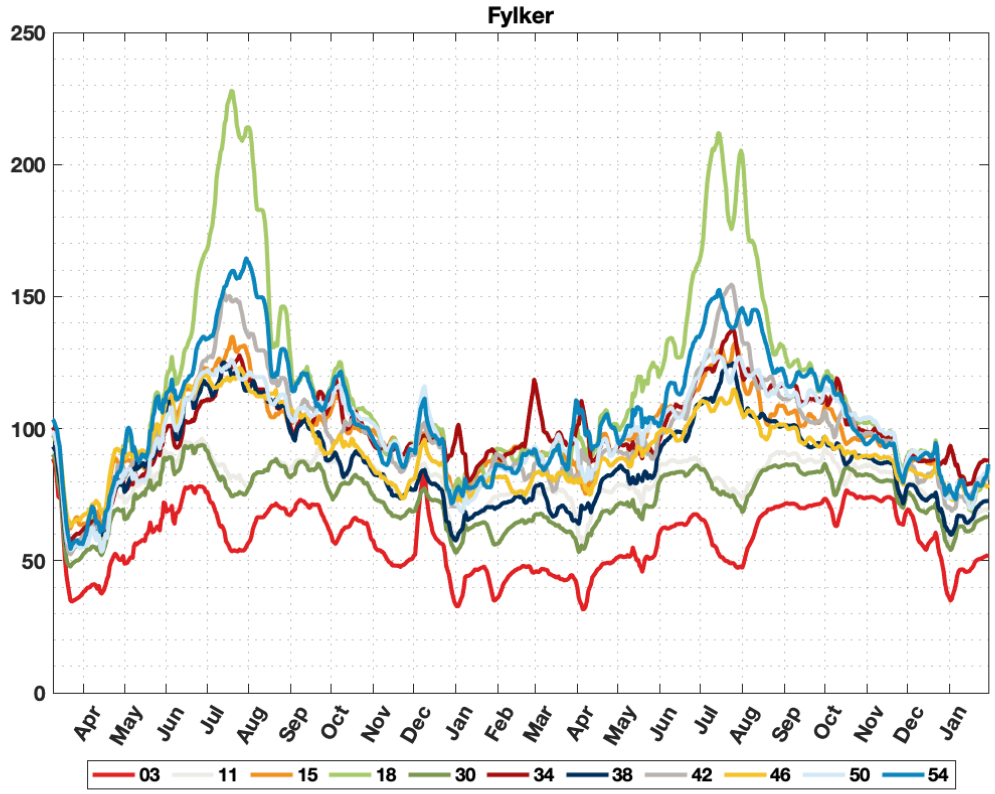


Figure 15: Mobility for fylker since March 2020: Oslo (03), Rogaland (11), Møre og Romsdal (15), Nordland (18), Viken (30), Innlandet (34), Vestfold og Telemark (38), Agder (42), Vestland (46), Trøndelag (50), Troms og Finmark (54).

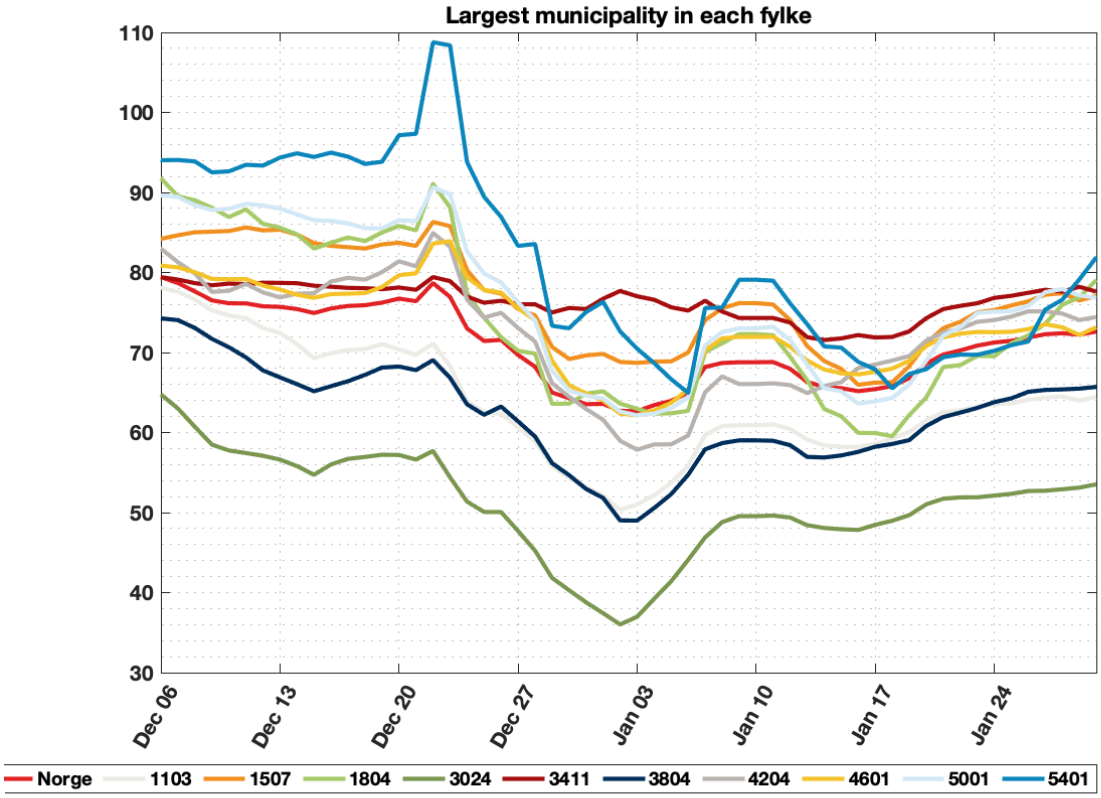


Figure 16: Zoom: Mobility from August 16, 2021 and onwards: Nationally (Norge), Stavanger (1103), Ålesund (1507), Bodø (1804), Bærum (3024), Ringsaker (3411), Sandefjord (3804), Kristiansand (4204), Bergen (4601), Trondheim (5001), Tromsø (5401).

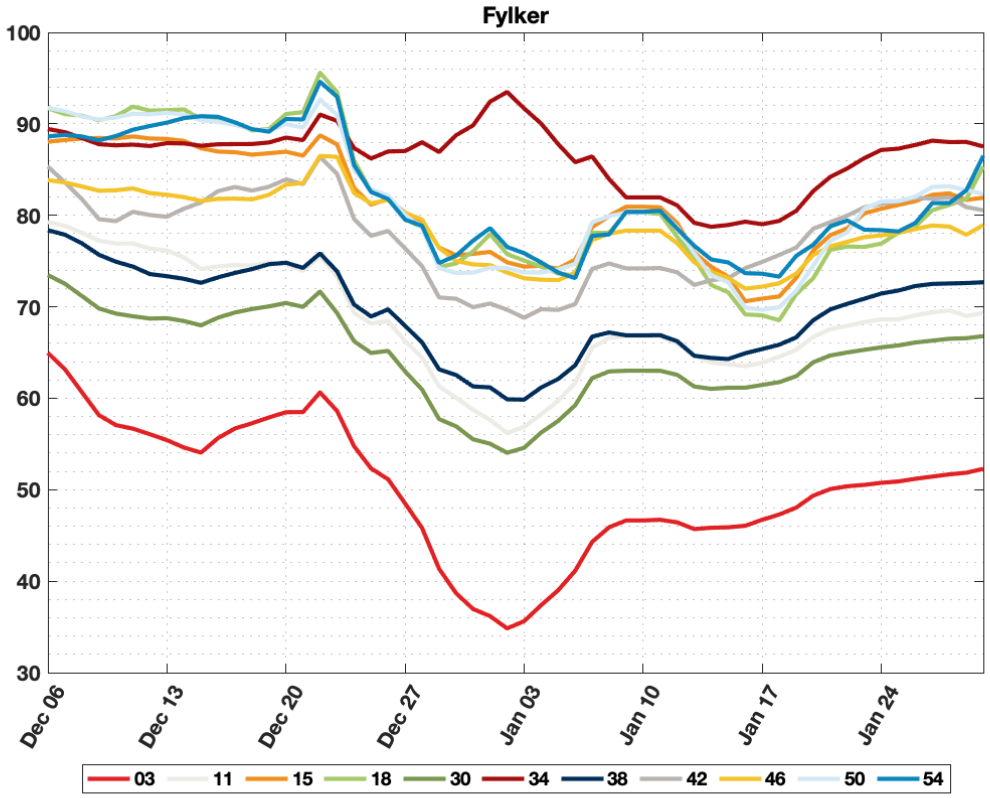


Figure 17: Zoom: Mobility from August 16, 2021 and onwards, per fylker: Oslo (03), Rogaland (11), Møre og Romsdal (15), Nordland (18), Viken (30), Innlandet (34), Vestfold og Telemark (38), Agder (42), Vestland (46), Trøndelag (50), Troms og Finnmark (54).

	53	2	3	4	5
Norge	69.7	62.7	68.8	65.4	71.2
Stavanger	60.6	51.0	60.9	58.6	63.5
Ålesund	75.4	68.7	76.2	66.2	75.3
Bodø	70.2	63.0	72.3	59.9	69.5
Bærum	47.7	37.0	49.5	48.5	52.1
Ringsaker	76.0	77.0	74.3	71.9	76.8
Sandefjord	61.4	49.0	59.0	58.2	63.8
Kristiansand	73.1	57.9	66.1	68.5	74.1
Bergen	75.5	62.1	72.0	67.6	72.5
Trondheim	76.3	62.2	73.0	63.9	75.1
Tromsø	83.3	70.5	79.1	67.9	70.2

Table 11: Municipalities

	53	2	3	4	5
Oslo	48.5	35.6	46.6	46.7	50.8
Rogaland	66.2	56.9	66.8	63.9	68.6
Møre og Romsdal	80.3	74.4	80.9	70.9	80.7
Nordland	79.6	75.1	80.3	69.1	76.9
Viken	62.9	54.6	63.0	61.5	65.6
Innlandet	87.0	91.7	82.0	79.0	87.2
Vestfold og Telemark	67.9	59.9	66.9	65.4	71.5
Agder	76.4	68.8	74.2	74.9	81.3
Vestlandet	80.3	73.1	78.3	72.2	77.8
Trøndelag	80.0	73.7	80.3	69.7	81.5
Troms og Finnmark	79.5	75.8	80.4	73.6	78.4

Table 12: Counties

Weekly mobility for Norway and selected municipalities is displayed in Table 11 and mobility for counties is displayed in Table 12. 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.

9.1 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 18 the total number of roamers per day per county are displayed.

Figure 19 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.

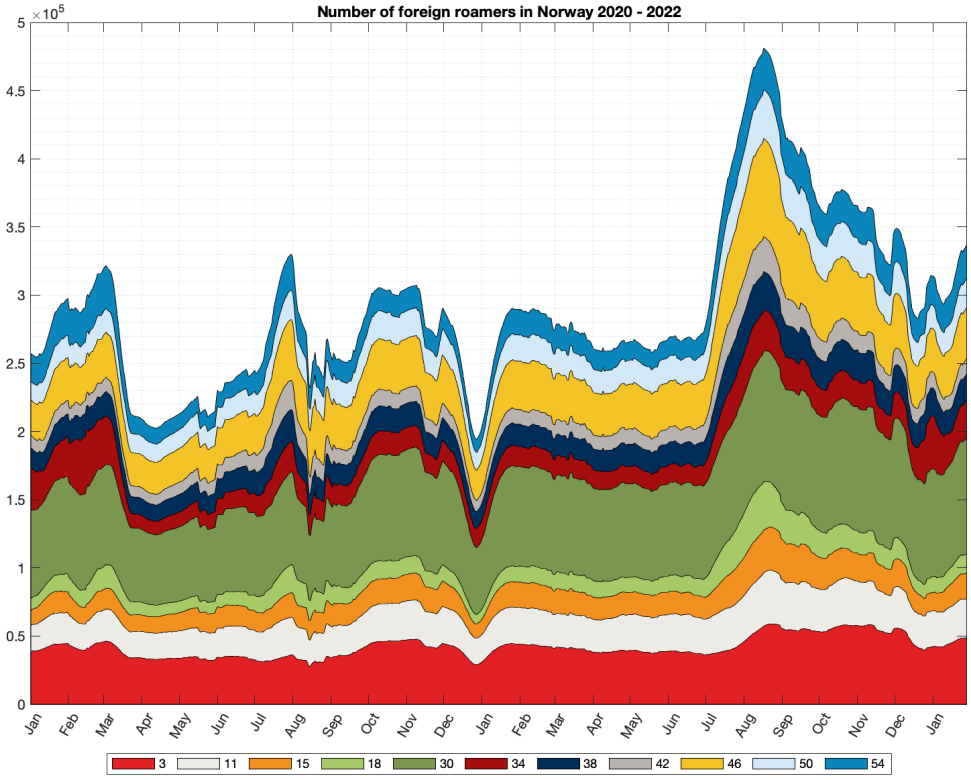


Figure 18: The total number of foreign roamers in Norway broken down on different fylker: Oslo (3), Rogaland (11), Møre og Romsdal (15), Nordland (18), Viken (30), Innlandet (34), Vestfold og Telemark (38), Agder (42), Vestland (46), Trøndelag (50), Troms og Finnmark (54).

9.1 Foreign roamers on Telenor's network in Norway

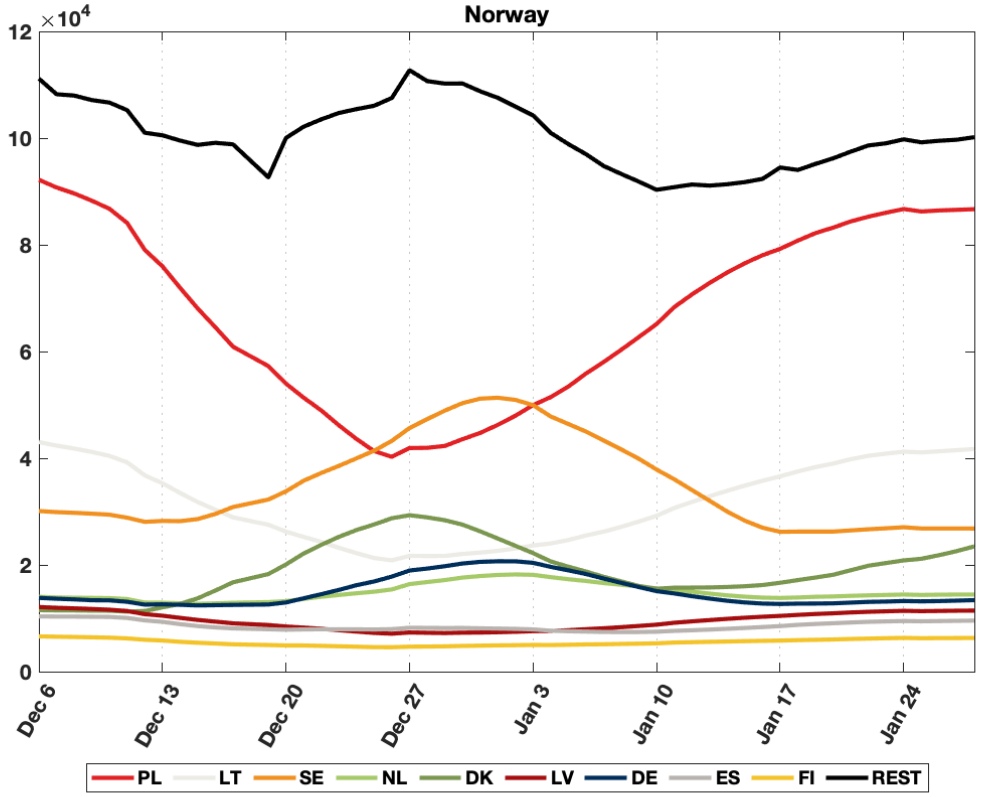
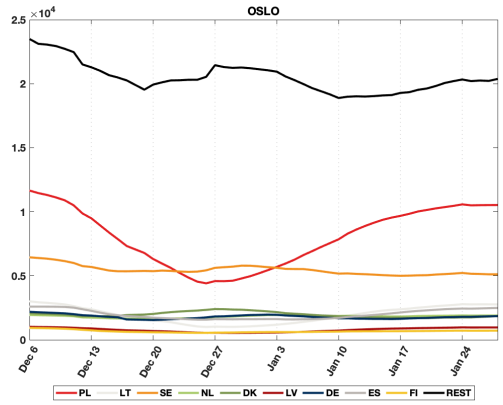
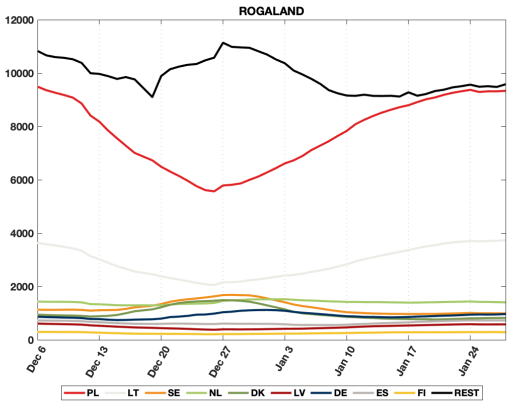
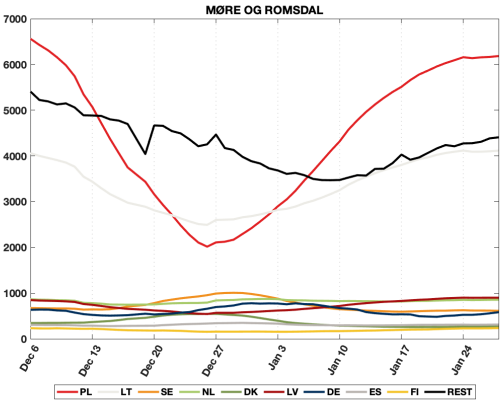


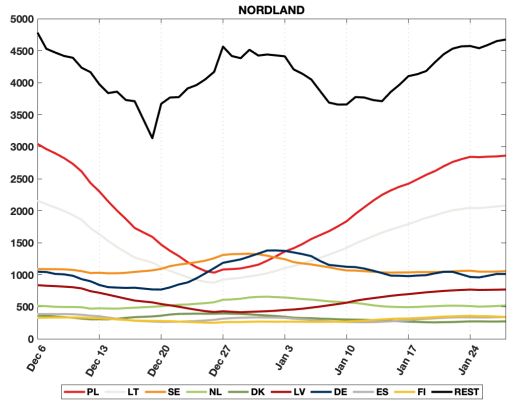
Figure 19: National overview of total number of foreign, visiting roamers from Poland, Lithuania, Sweden, Netherlands, Denmark, Latvia, Germany, Spain, Finland and the rest of the world.

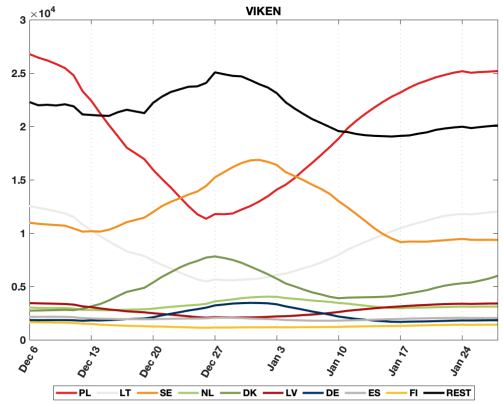
9.2 Foreign roamers per county (fylke) in Norway

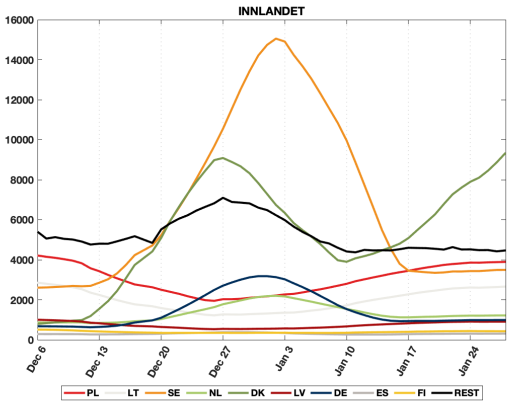




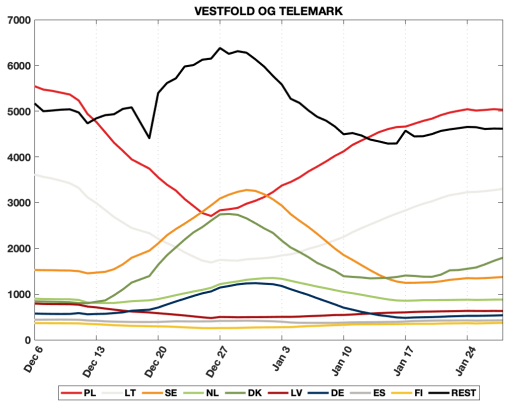


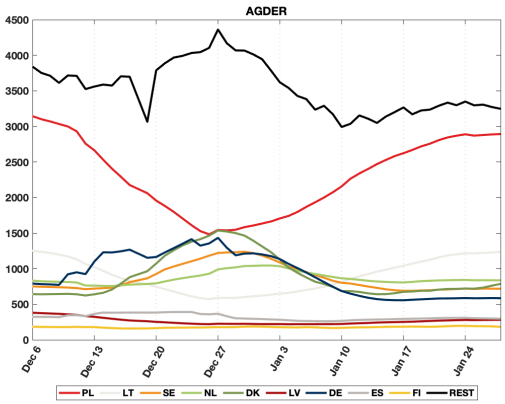


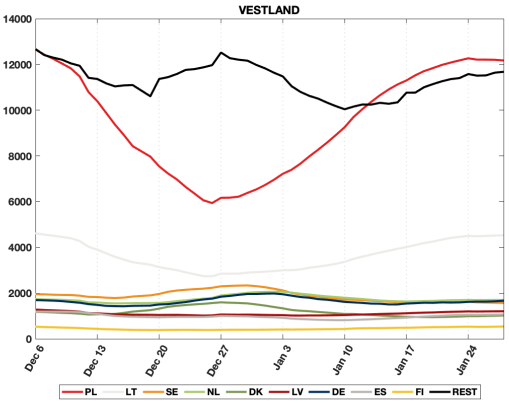


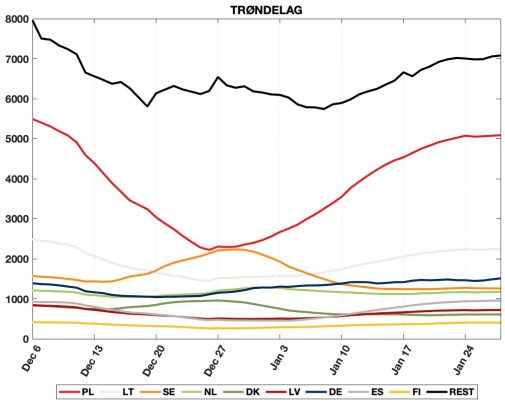


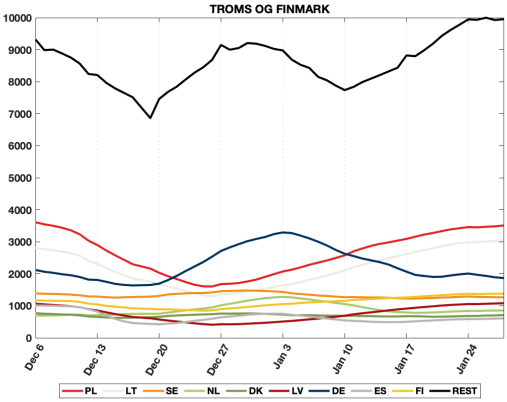
9.2 *Foreign roamers per county (fylke) in Norway*











10 Estimated parameters

Table 13: Estimated parameters

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	Period
R0s	1.893	2.449	2.632	2.622	2.806	3.185	Until March 14
R1s	0.415	0.538	0.566	0.567	0.598	0.705	From 15 March to 19 April
R2s	0.002	0.563	0.775	0.748	0.95	1.718	From 20 April to 10 May
R3s	0.013	0.687	0.869	0.84	1.023	1.658	From 11 May to 30 June
R4s	0.005	0.518	0.86	0.804	1.087	1.728	From 01 July to 31 July
R5s	0.567	0.951	1.064	1.066	1.178	1.598	From 01 August to 31 August
R6s	0.549	0.788	0.869	0.87	0.948	1.234	From 01 September to 30 September
R7s	0.82	1.126	1.199	1.213	1.289	1.65	From 01 October to 25 October
R8s	0.417	1.102	1.255	1.24	1.407	1.784	From 26 October to 04 November
R9s	0.676	0.842	0.883	0.88	0.916	1.065	From 05 November to 30 November
R10s	0.853	0.948	0.974	0.973	0.997	1.095	From 01 December to 03 January
R11s	0.477	0.687	0.749	0.752	0.809	0.989	From 04 January to 21 January
R12s	0.516	0.779	0.847	0.848	0.918	1.159	From 22 January to 07 February
R13s	1.015	1.269	1.331	1.326	1.388	1.594	From 08 February to 01 March
R14s	0.955	1.069	1.102	1.103	1.139	1.319	From 02 March to 24 March
R15s	0.55	0.774	0.812	0.809	0.848	0.975	From 25 March to 12 April
R16s	0.641	0.772	0.815	0.817	0.858	1.061	From 13 April to 05 May
R17s	0.659	1.001	1.085	1.072	1.158	1.38	From 06 May to 26 May
R18s	0.412	0.616	0.699	0.725	0.815	1.142	From 27 May to 20 June
R19s	0.653	0.888	0.943	0.938	0.996	1.18	From 21 June to 04 August
R20s	0.92	1.151	1.208	1.203	1.258	1.402	From 05 August to 31 August
R21s	0.612	0.741	0.769	0.771	0.799	0.908	From 01 September to 24 September
R22s	1.044	1.087	1.098	1.097	1.108	1.148	From 25 September to 12 December
R23s	0.342	0.534	0.57	0.566	0.599	0.685	From 13 December

Table 14: Assumptions

Assumptions	Mean	Distribution	Reference
Mobile Mobility Data			
Telenor coverage	48%		https://ekomstatistikken.nkom.no/
Data updated	January 31th		
Data used in the predictions	January 29	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:		Fixed	Saljie 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%		
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		Fixed	Estimated from "Beredskapsregistret BeredtC19"
From Sunday	32%		
From Saturday	49%		
From Friday	68%		
From Thursday	86%		
Probability that an admission has been reported		Fixed	Estimated from "Beredskapsregistret BeredtC19"
From one day before	53%		
From two days before	77%		
From three days before	82%		
From four days before	91%		
Probability that a positive laboratory test has been reported		Fixed	Estimated from MSIS
From one day before	6.7%		
From two days before	59%		
From three days before	90%		
From four days before	97%		
Probability that a negative laboratory test has been reported		Fixed	Estimated from MSIS
From one day before	16%		
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 15: Estimated reproduction numbers 7 days ago

Location	Reff
National	1.06(1.05 - 1.07)
Oslo	1(0.99 - 1.02)
Rogaland	1.14(1.12 - 1.16)
Møre og Romsdal	1.24(1.2 - 1.29)
Nordland	1.08(1.04 - 1.12)
Viken	1.07(1.06 - 1.08)
Innlandet	1.18(1.15 - 1.21)
Vestfold og Telemark	0.94(0.92 - 0.97)
Agder	1.15(1.12 - 1.18)
Vestland	1.18(1.16 - 1.2)
Trøndelag	1.11(1.09 - 1.14)
Troms og Finnmark	1.16(1.11 - 1.2)

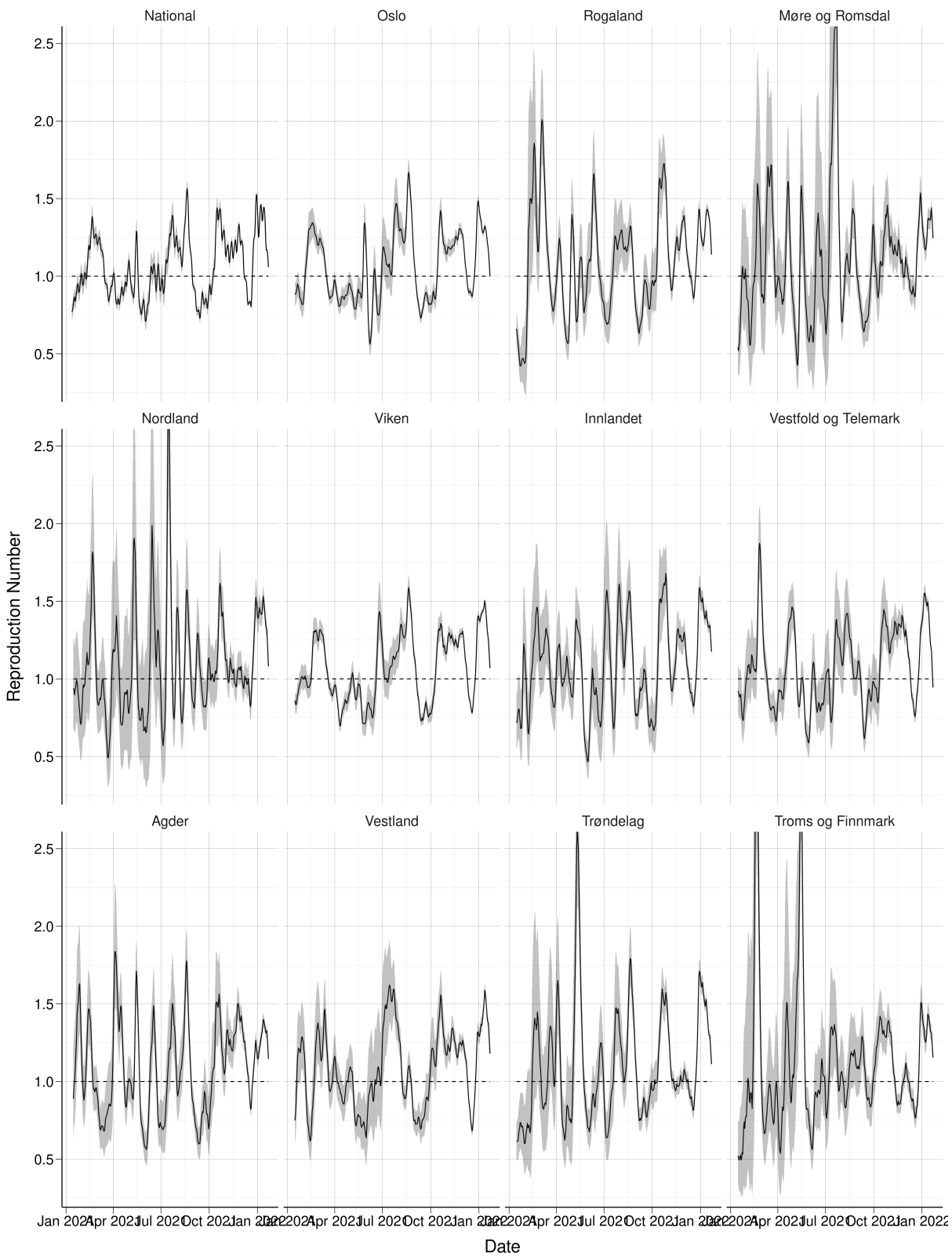


Figure 22: Reproduction number estimated using the R package EpiEstim.

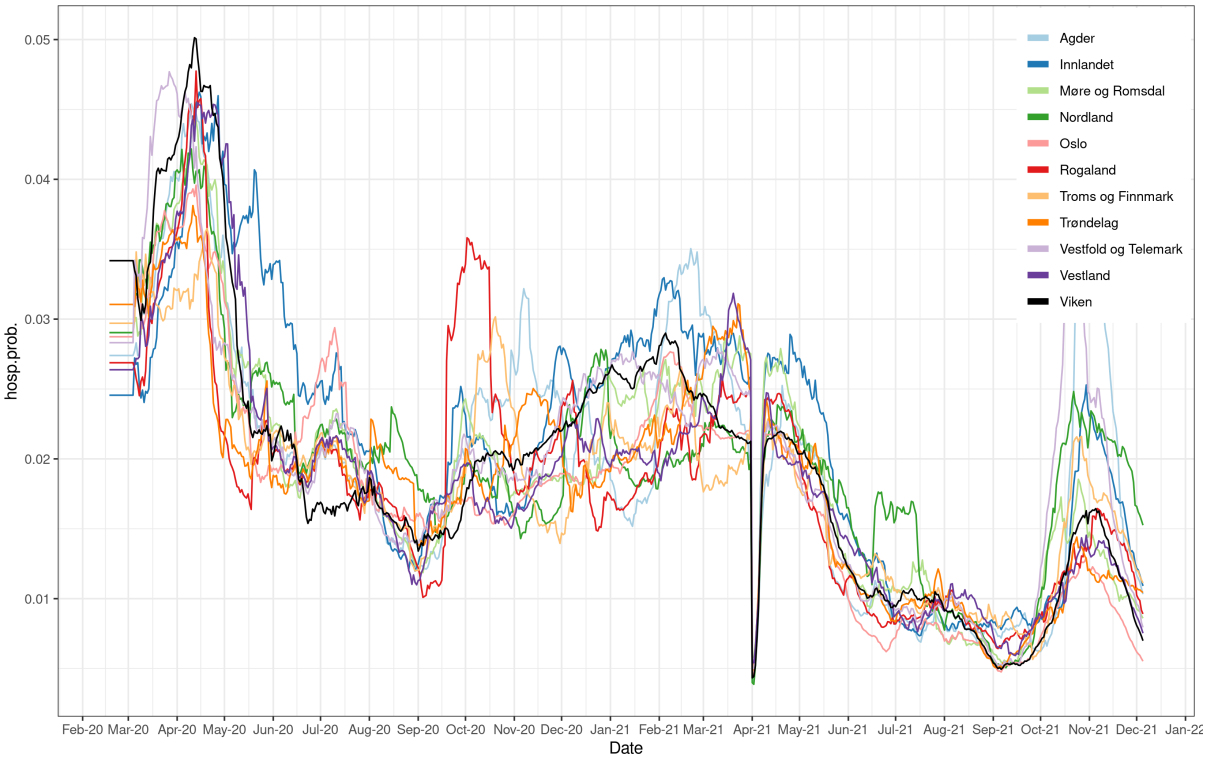


Figure 23: Regional hospitalisation probabilities per infection. The estimates are based on Salje et al., and regional data on the age distribution in the test data and the empirical case-hospitalisation rates.

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

FHI COVID-19 modelling team:

- **Birgitte Freiesleben de Blasio** - Department of Method Development and Analytics. Norwegian Institute of Public Health and Oslo Centre for Biostatistics and Epidemiology, University of Oslo.
- **Francesco Di Ruscio** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Gunnar Øyvind Isaksson Rø** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Solveig Engebretsen** - Norsk Regnesentral.
- **Arnoldo Frigessi** - Oslo Centre for Biostatistics and Epidemiology, University of Oslo and Oslo University Hospital.
- **Alfonso Diz-Lois Palomares** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Magnus Nygård Osnes** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Anja Bråthen Kristoffersen** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Kenth Engø-Monsen** - Telenor Research.
- **Louis Yat Hin Chan** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Jonas Christoffer Lindstrøm** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Richard White** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Gry Marysol Grøneng** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Chi Zhang** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Jørgen Eriksson Midtbø** - Department of Method Development and Analytics. Norwegian Institute of Public Health.
- **Geir Storvik** - Department of Mathematics. University of Oslo.