

SUPPLEMENTARY MATERIAL

Dynamics of contagion and submerged infections during the second wave of the SARS-CoV-2 epidemic in the Italian regions

**GIULIA CEREDA, CECILIA VISCARDI, LUCA GHERARDINI,
FABRIZIA MEALLI, MICHELA BACCINI**

FIGURES

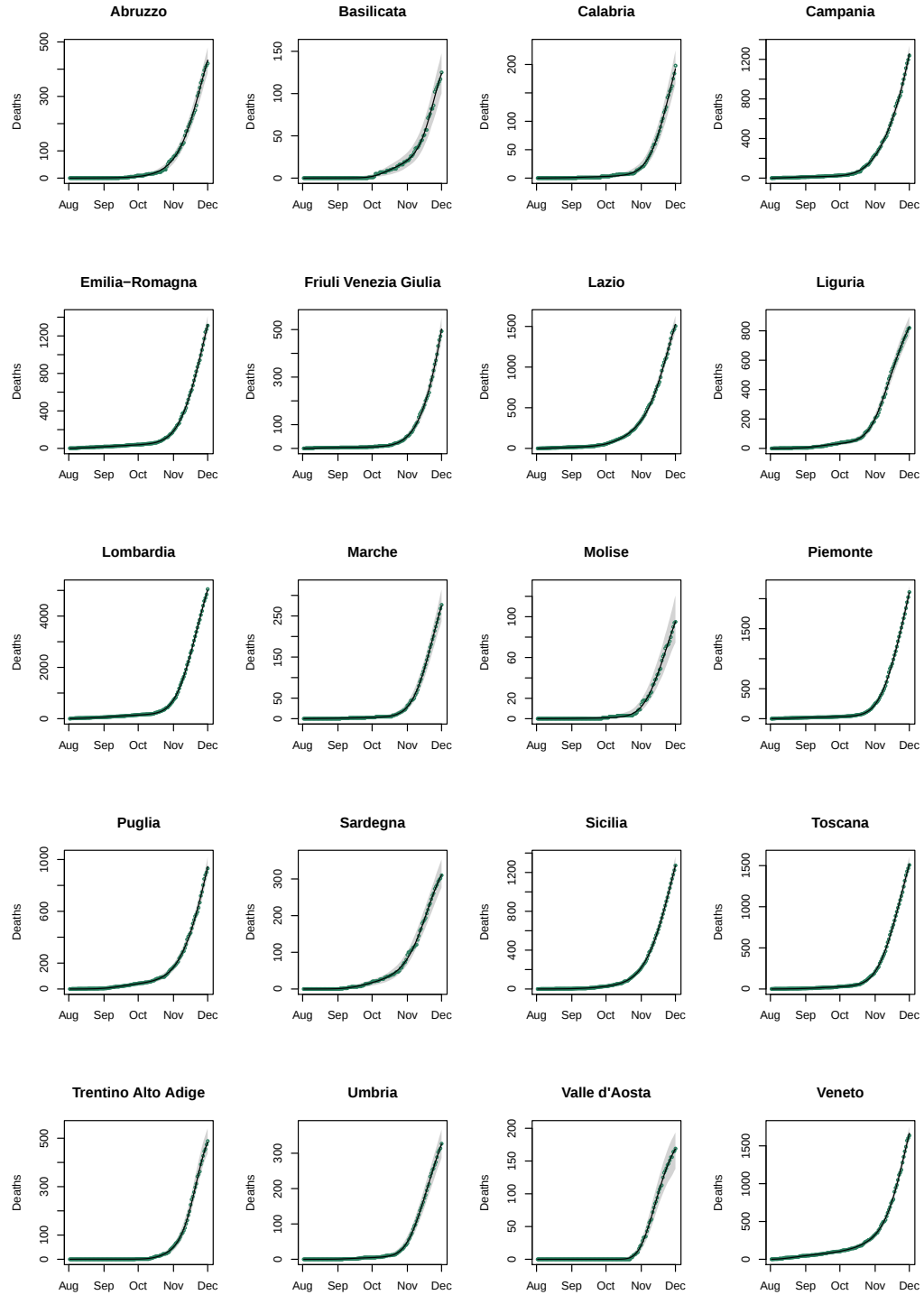


Fig. S1. Estimated number of deaths with pointwise 90% confidence bands from the SIRD model which assumes an infection fatality rate equal to 0.5% (black line) and observed number of deaths (green points), by region.

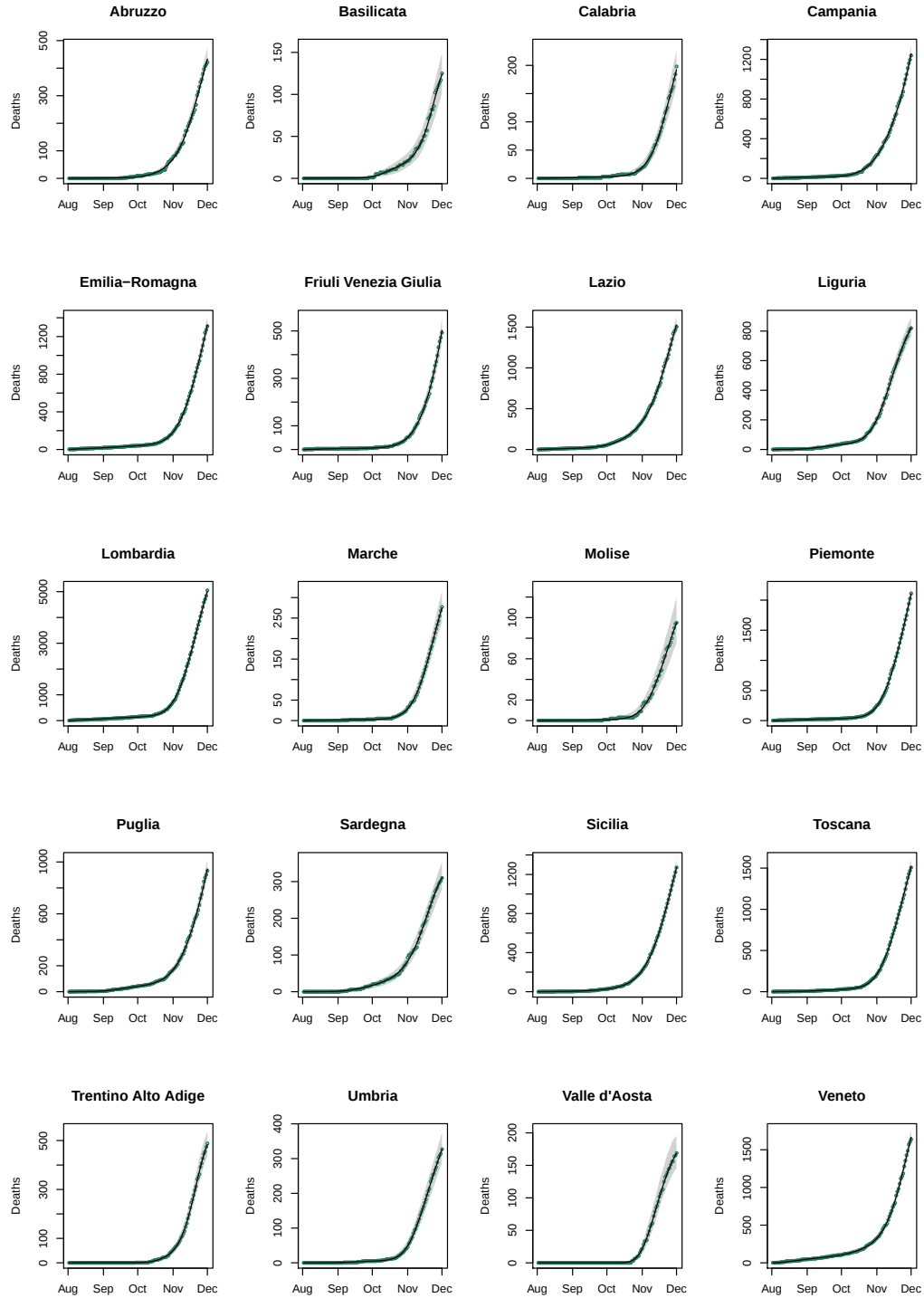


Fig. S2. Estimated number of deaths with pointwise 90% confidence bands from the SIRD model which assumes an infection fatality rate equal to 0.78% (black line) and observed number of deaths (green points), by region.

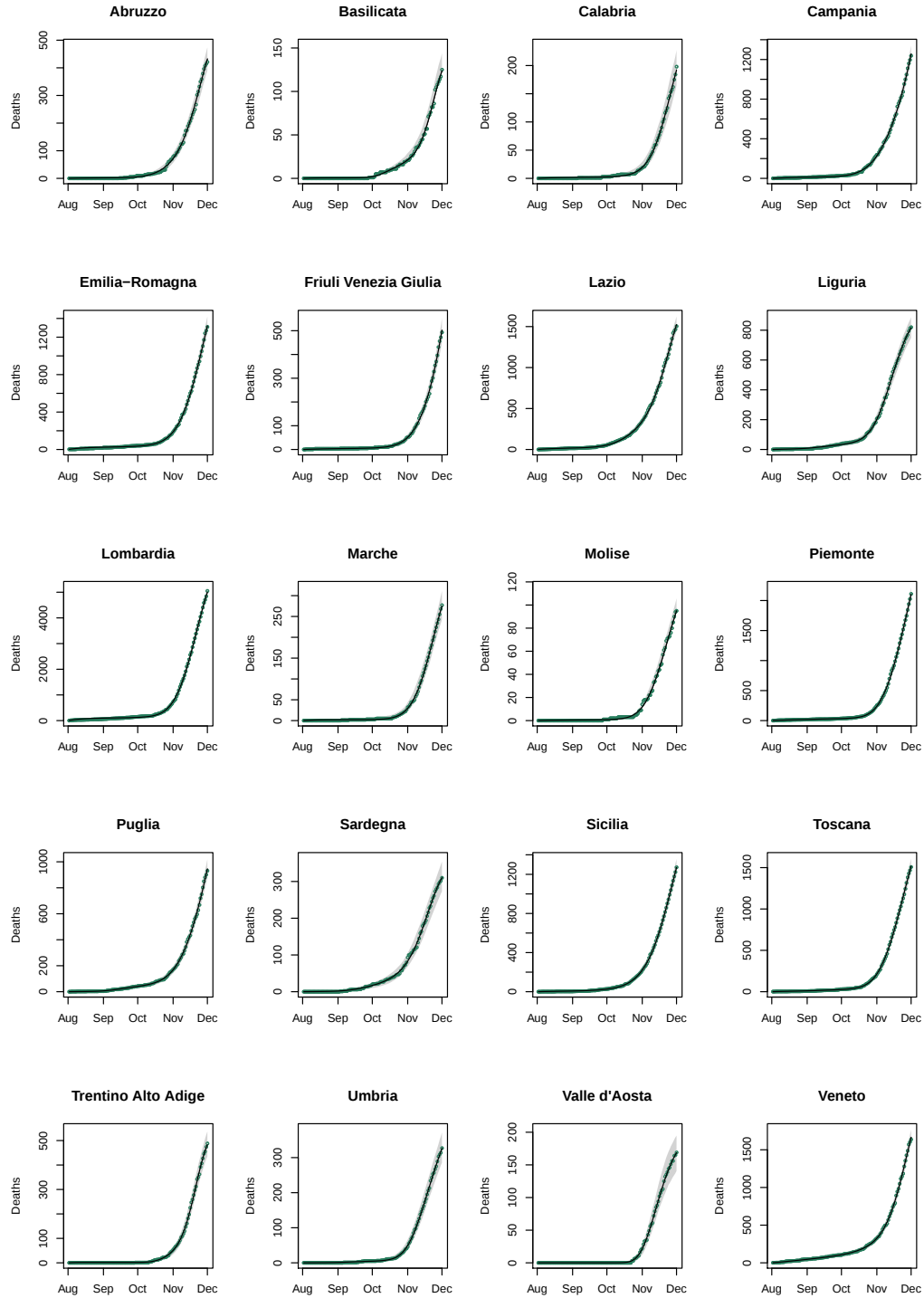


Fig. S3. Estimated number of deaths with pointwise 90% confidence bands from the SIRD model which assumes an infection fatality rate equal to 1.79% (black line) and observed number of deaths (green points), by region.

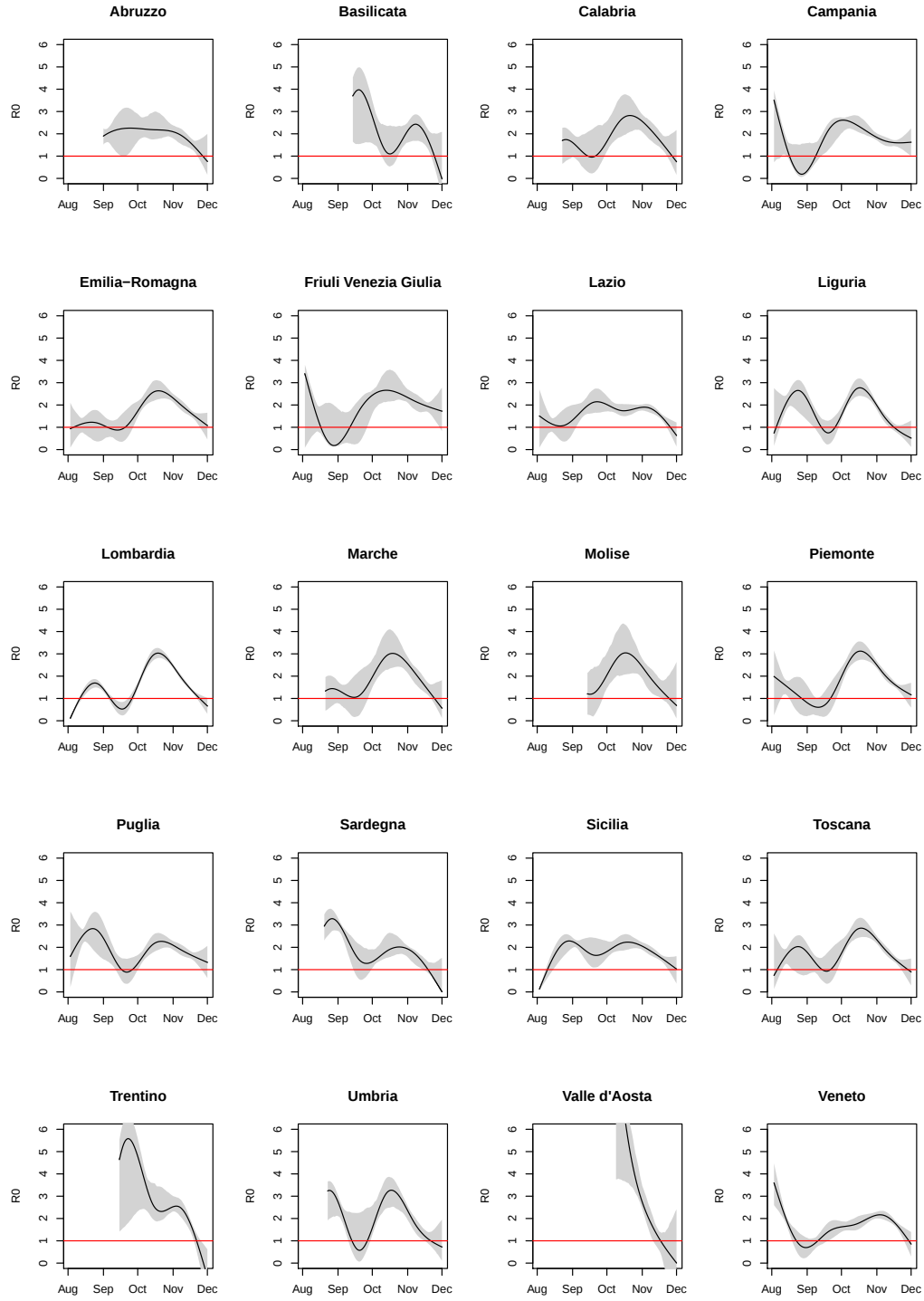


Fig. S4. Estimated $R_0(t)$ with pointwise 90% confidence bands assuming an infection fatality rate equal to 0.5%, by region.

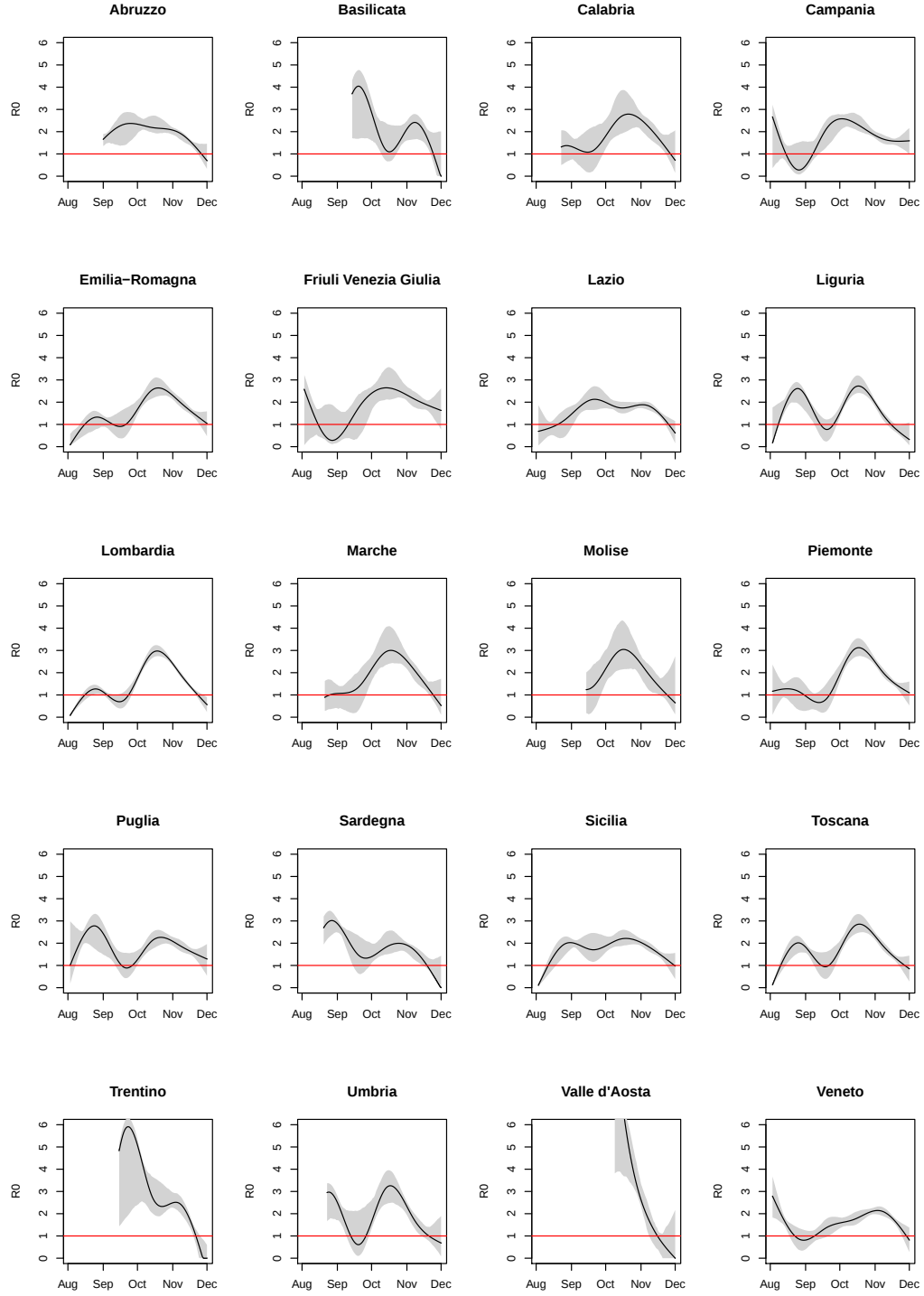


Fig. S5. Estimated $R_0(t)$ with pointwise 90% confidence bands assuming an infection fatality rate equal to 0.78%, by region.

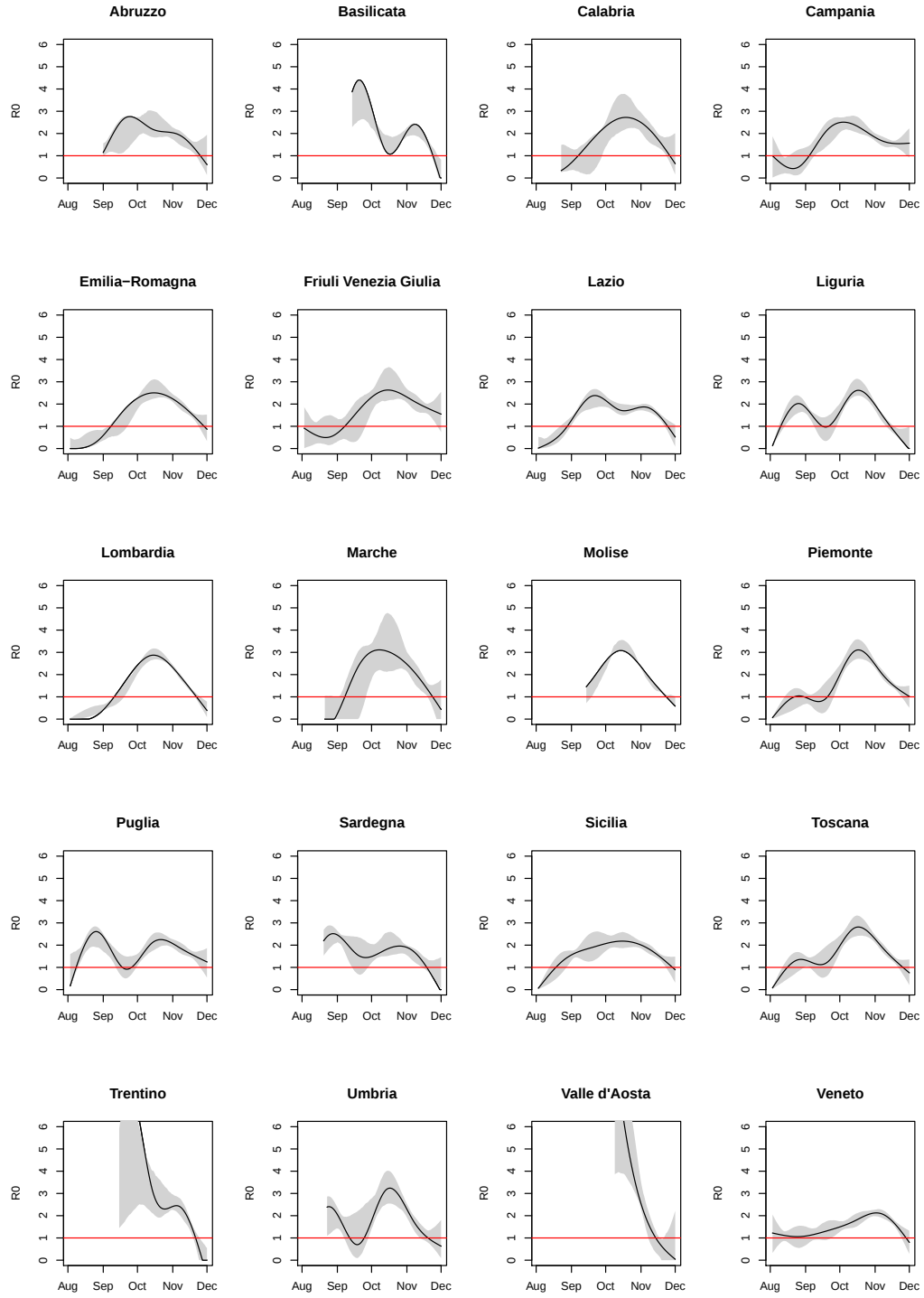


Fig. S6. Estimated $R_0(t)$ with pointwise 90% confidence bands assuming an infection fatality rate equal to 1.79%, by region.

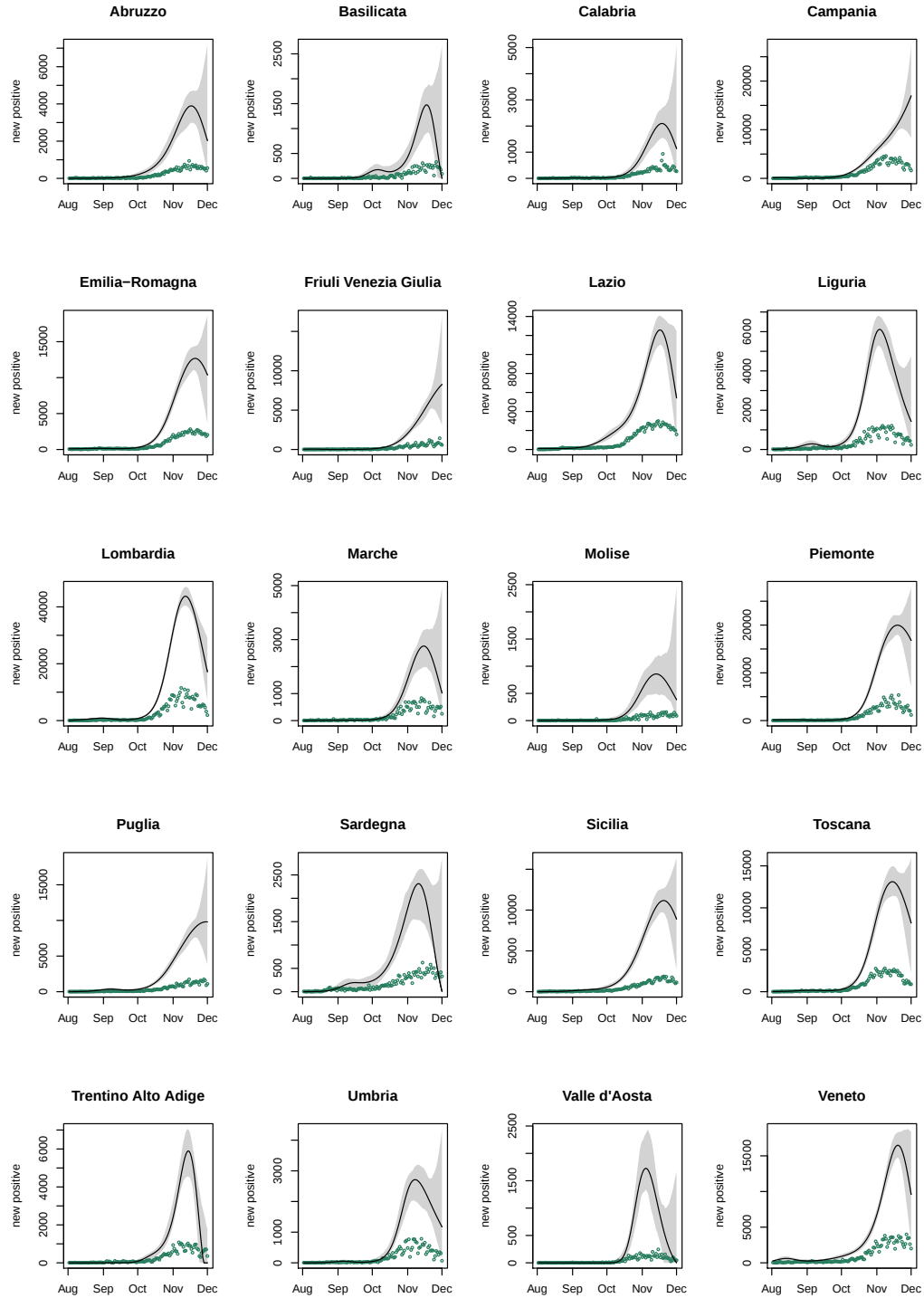


Fig. S7. Estimated number of new infections with pointwise 90% confidence bands assuming an infection fatality rate equal to 0.5% (black line) and observed number of new infections (green points), by region.

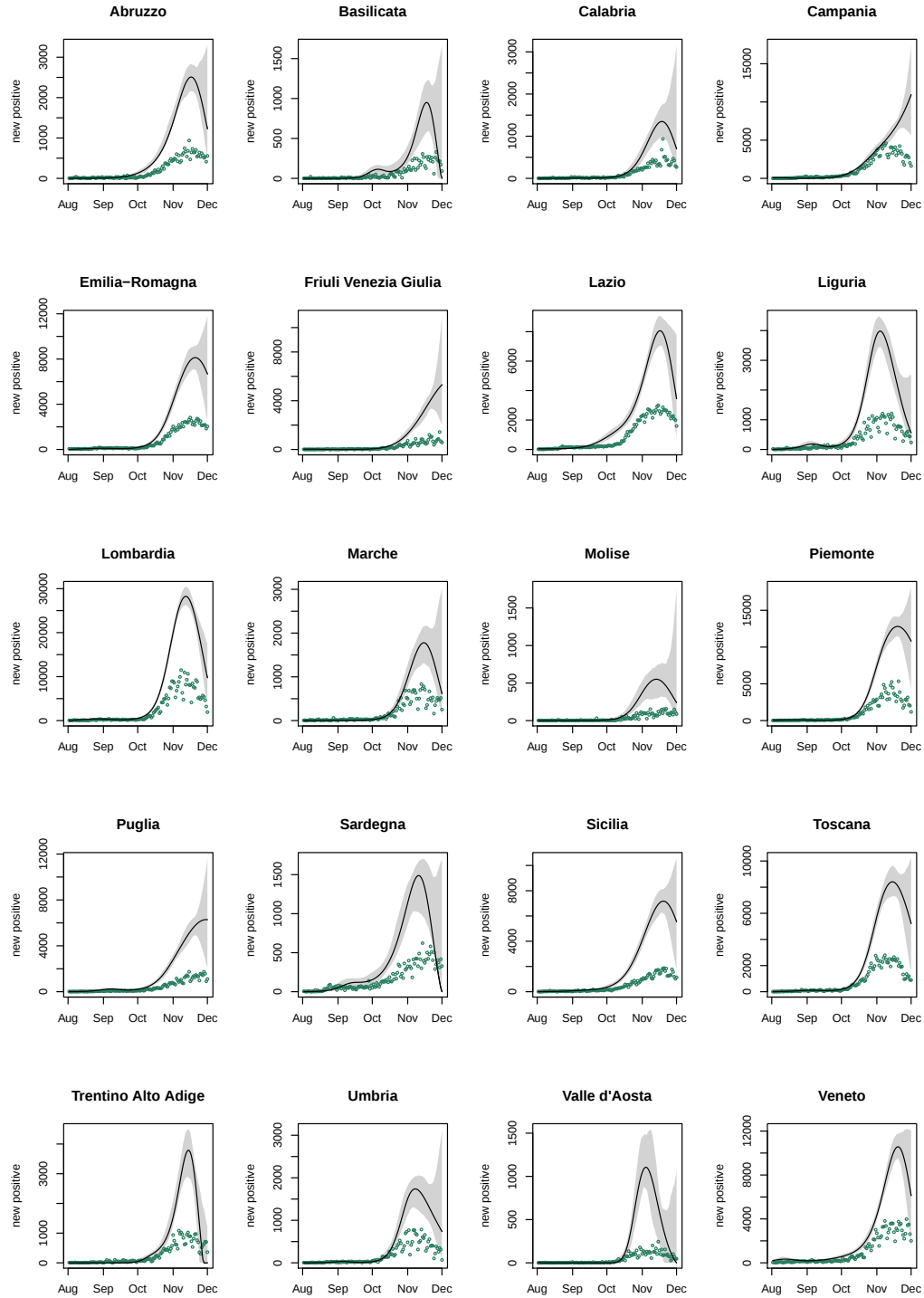


Fig. S8. Estimated number of new infections with pointwise 90% confidence bands assuming an infection fatality rate equal to 0.78% (black line) and observed number of new infections (green points), by region.

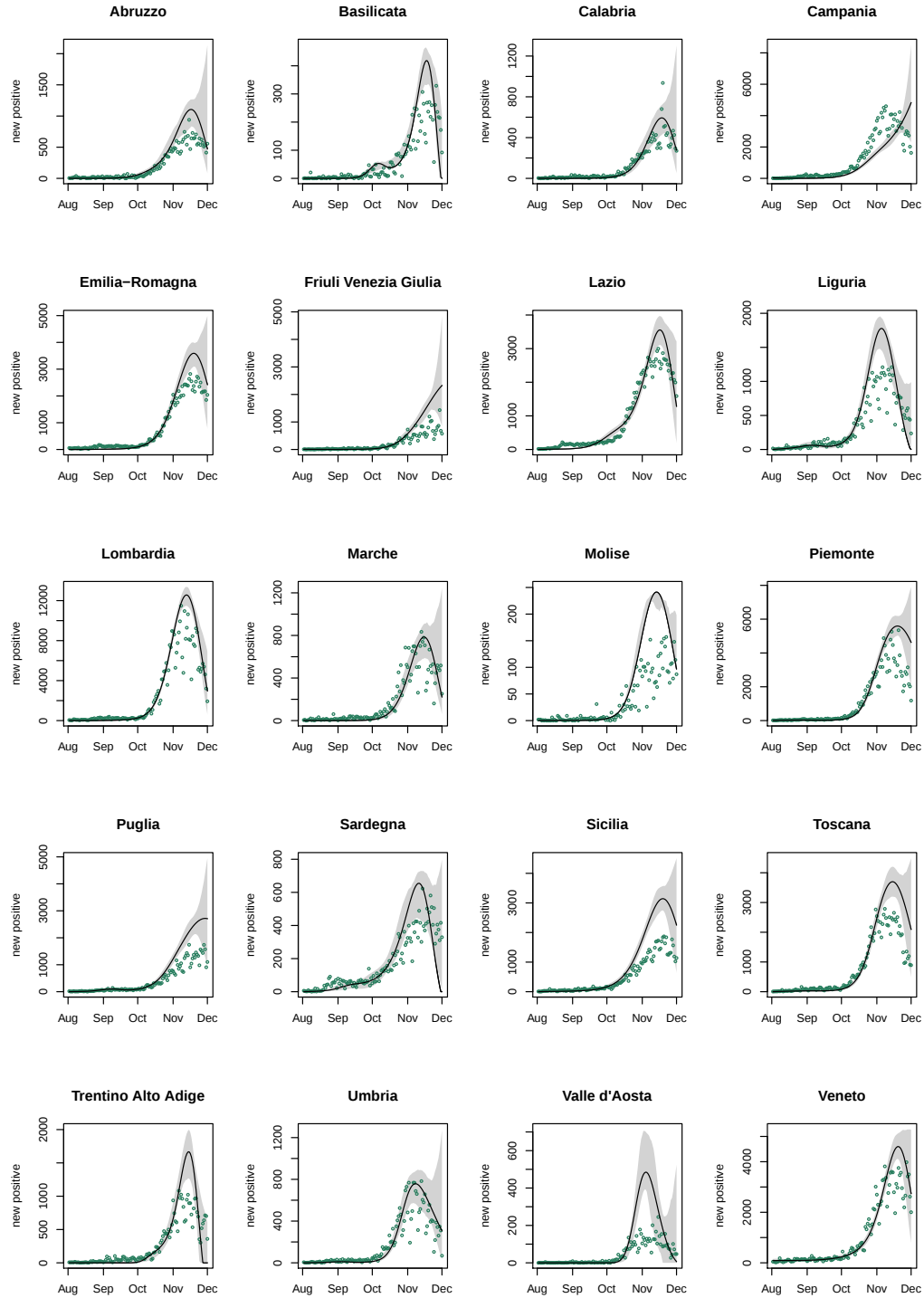


Fig. S9. Estimated number of new infections with pointwise 90% confidence bands assuming an infection fatality rate equal to 1.79% (black line) and observed number of new infections (green points), by region.

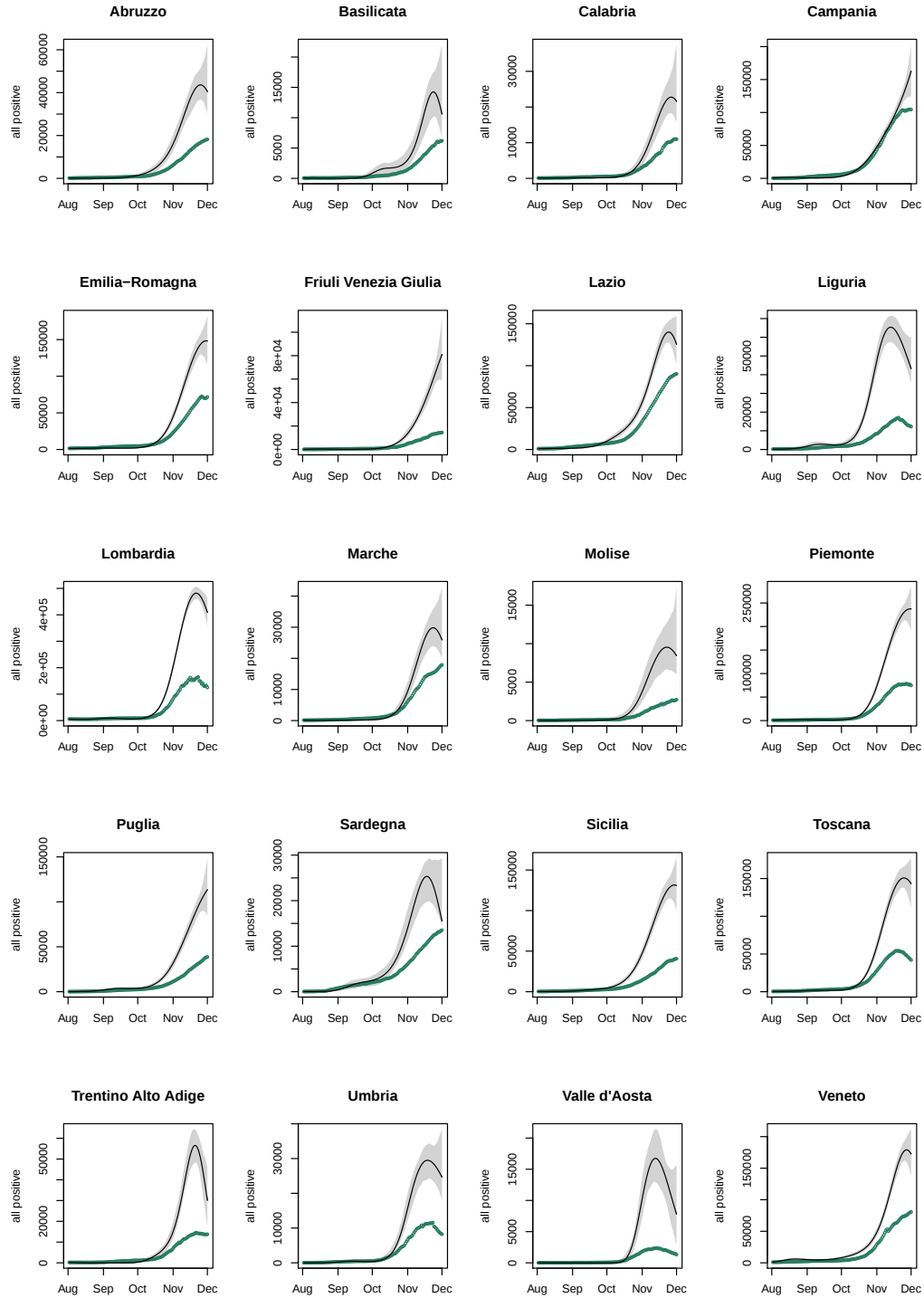


Fig. S10. Estimated number of circulating infections with pointwise 90% confidence bands assuming an infection fatality rate equal to 0.5% (black line) and observed number of circulating infections (green points), by region.

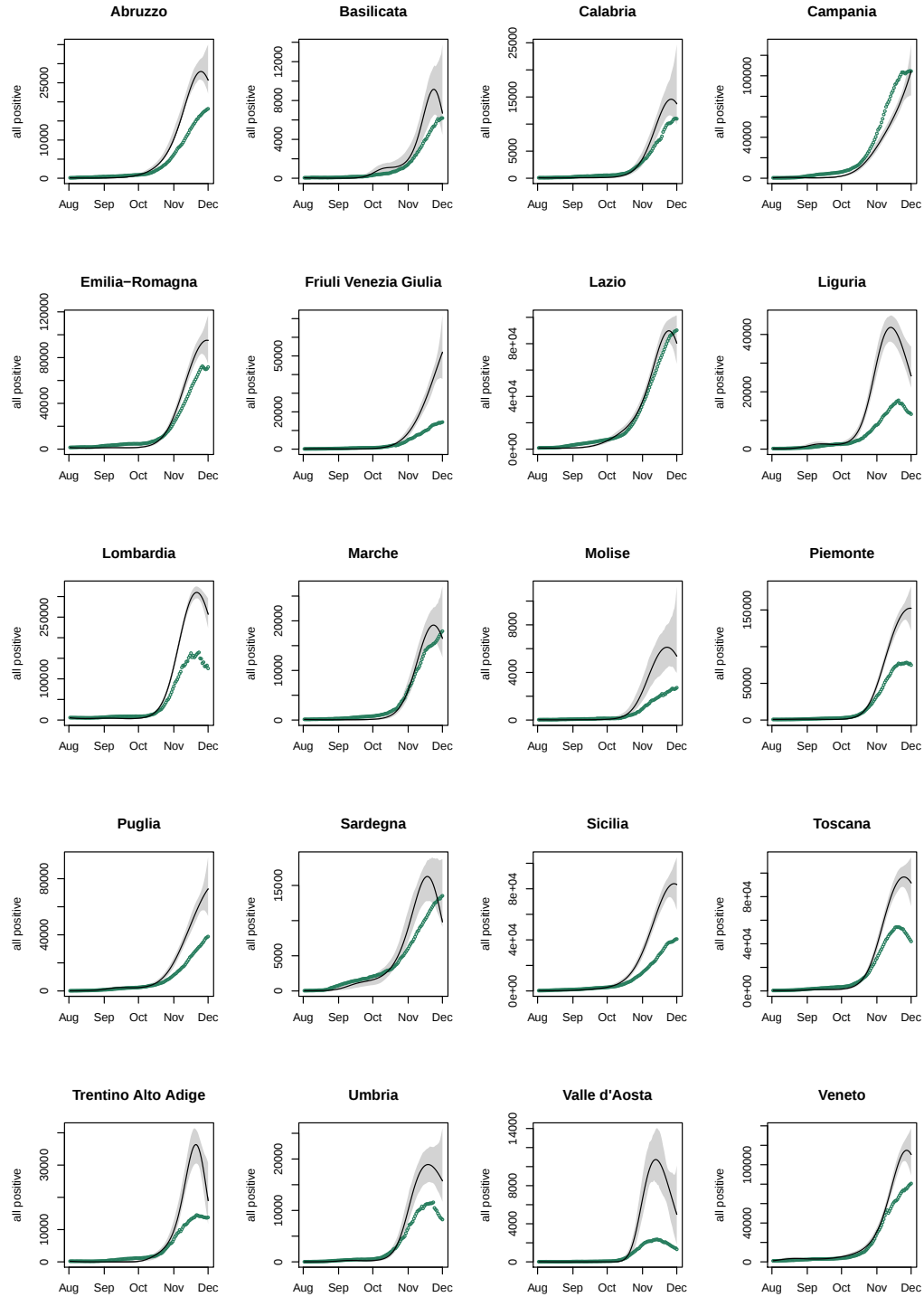


Fig. S11. Estimated number of circulating infections with pointwise 90% confidence bands assuming an infection fatality rate equal to 0.78% (black line) and observed number of circulating infections (green points), by region.

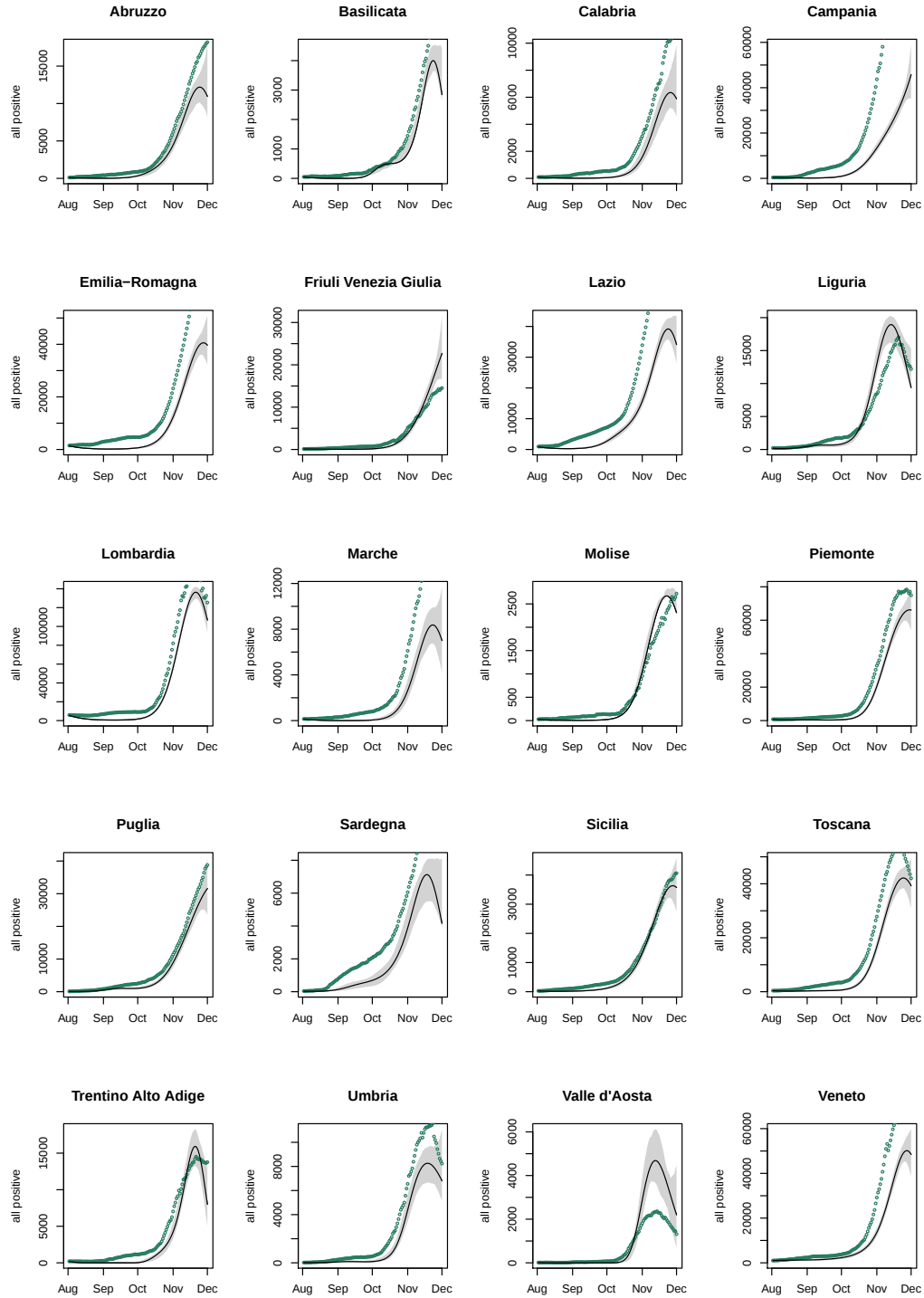


Fig. S12. Estimated number of circulating infections with pointwise 90% confidence bands assuming an infection fatality rate equal to 1.79% (black line) and observed number of circulating infections (green points), by region.

TABLES

Region	Pop. size	Deaths	$I(0)$
Abruzzo	1305770	421	111
Basilicata	556934	125	50
Calabria	1924701	198	97
Campania	5785861	1238	395
Emilia-Romagna	4467118	1310	1496
Friuli Venezia Giulia	1211357	493	122
Lazio	5865544	1504	945
Liguria	1543127	820	200
Lombardia	10103969	5049	6011
Marche	1528400	277	147
Molise	302265	95	27
Trentino Alto Adige	1074819	488	202
Piemonte	4356406	2110	799
Puglia	4008296	931	95
Sardegna	1630474	310	33
Sicilia	4968410	1272	275
Toscana	3737000	1507	387
Umbria	880285	327	18
Valle d'Aosta	125501	169	12
Veneto	4907704	1637	1000

Table S1. Population size (at December 31st 2020), observed number of deaths from August 1st to November 30th and observed number of circulating infections on July 31st ($I(0)$), by region.

Region	September 1st			October 1st			November 1st			November 23rd		
	prev.	90% CI		prev.	90% CI		prev.	90% CI		prev.	90% CI	
Abruzzo	0.10	0.03	0.33	1.14	0.48	1.82	13.25	10.58	16.67	33.35	28.04	38.84
Basilicata				1.69	0.51	2.89	5.97	3.80	9.32	25.58	18.33	31.61
Calabria	0.08	0.02	0.18	0.13	0.04	0.33	3.26	2.23	4.44	11.69	9.43	14.35
Campania	0.12	0.08	0.25	0.63	0.41	0.86	8.75	7.75	10.11	21.85	19.79	23.79
Emilia-Romagna	0.44	0.20	0.68	0.57	0.33	0.84	10.92	9.55	12.54	31.66	28.77	34.69
Friuli Venezia Giulia	0.18	0.08	0.53	0.49	0.20	0.90	12.34	9.91	15.89	51.07	43.99	57.81
Lazio	0.26	0.14	0.41	1.81	1.36	2.28	10.25	9.11	11.60	23.89	21.68	26.15
Liguria	1.23	0.65	2.04	1.87	1.11	2.76	32.55	28.34	37.07	35.80	31.35	41.08
Lombardia	0.88	0.64	1.16	0.72	0.54	0.92	22.15	20.76	23.60	47.03	44.82	49.42
Marche	0.09	0.02	0.24	0.18	0.05	0.39	6.87	5.12	9.04	19.62	15.74	23.83
Molise				0.36	0.08	1.20	13.70	8.92	19.86	31.43	21.82	43.42
Trentino Alto Adige				0.37	0.02	0.78	15.50	11.85	19.94	49.01	41.71	57.06
Piemonte	0.45	0.22	0.71	0.45	0.27	0.67	18.51	16.49	20.80	52.33	48.63	56.19
Puglia	0.52	0.29	0.77	0.96	0.62	1.37	8.54	7.23	9.91	24.39	21.73	26.95
Sardegna	0.29	0.11	0.59	1.57	0.78	2.23	9.14	7.31	11.66	14.00	11.52	17.75
Sicilia	0.18	0.07	0.31	0.97	0.66	1.34	10.27	8.91	11.70	25.59	23.03	28.16
Toscana	0.40	0.18	0.65	0.68	0.41	1.01	17.47	15.36	19.57	40.33	36.94	44.17
Umbria	0.31	0.05	0.56	0.48	0.24	1.06	19.41	14.96	24.34	32.22	26.46	38.24
Valle d'Aosta							89.79	66.70	119.28	97.08	65.01	123.30
Veneto	1.01	0.68	1.36	1.74	1.26	2.22	10.66	9.33	12.02	35.67	32.76	38.68

Table S2. Prevalence of infections (number of infections over 1,000 inhabitants) with 90% confidence intervals on September 1st, October 1st, November 1st and November 23rd assuming an infection fatality rate equal to 0.5%, by region. Missing estimates are due to the extremely poor information in the absence of observed deaths.

Region	September 1st			October 1st			November 1st			November 23rd		
	prev.	90% CI		prev.	90% CI		prev.	90% CI		prev.	90% CI	
Abruzzo	0.06	0.03	0.17	0.72	0.45	1.00	8.47	8.43	10.46	21.39	19.78	23.86
Basilicata				1.06	0.32	1.81	3.82	2.58	5.92	16.42	11.77	20.85
Calabria	0.04	0.01	0.13	0.08	0.02	0.20	2.09	1.43	2.83	7.50	6.02	9.27
Campania	0.07	0.04	0.15	0.41	0.26	0.56	5.62	4.92	6.48	14.00	12.75	15.17
Emilia-Romagna	0.27	0.12	0.45	0.37	0.21	0.54	7.01	6.10	8.02	20.29	18.48	22.10
Friuli Venezia Giulia	0.11	0.04	0.32	0.32	0.13	0.58	7.91	6.14	10.13	32.73	28.29	37.15
Lazio	0.16	0.08	0.25	1.16	0.88	1.47	6.58	5.83	7.41	15.31	13.89	16.74
Liguria	0.77	0.48	1.27	1.23	0.73	1.75	20.77	18.01	23.93	22.52	19.56	25.97
Lombardia	0.45	0.31	0.61	0.46	0.33	0.59	14.12	13.16	15.14	30.18	28.65	31.67
Marche	0.05	0.02	0.15	0.11	0.03	0.24	4.40	3.39	5.82	12.59	10.30	14.98
Molise				0.22	0.06	0.68	8.78	5.79	12.63	20.16	14.95	26.94
Trentino Alto Adige	0.00	0.00	0.05	0.20	0.08	0.51	9.96	7.91	13.18	31.47	26.50	35.16
Piemonte	0.28	0.13	0.44	0.29	0.18	0.44	11.88	10.51	13.35	33.55	31.02	36.02
Puglia	0.33	0.18	0.49	0.61	0.41	0.88	5.48	4.62	6.38	15.64	14.04	17.29
Sardegna	0.20	0.07	0.40	1.00	0.53	1.41	5.84	4.57	7.37	8.97	7.43	11.57
Sicilia	0.11	0.05	0.20	0.62	0.40	0.84	6.57	5.72	7.45	16.41	14.79	18.07
Toscana	0.25	0.12	0.41	0.44	0.26	0.65	11.20	9.84	12.63	25.86	23.62	28.29
Umbria	0.21	0.04	0.39	0.30	0.13	0.68	12.43	9.47	15.92	20.66	17.09	25.46
Valle d'Aosta							57.52	42.43	78.14	62.19	41.87	76.36
Veneto	0.63	0.43	0.87	1.11	0.82	1.43	6.85	6.01	7.78	22.87	21.07	24.88

Table S3. Prevalence of infections (number of infections over 1,000 inhabitants) with 90% confidence intervals on September 1st, October 1st, November 1st and November 23rd assuming an infection fatality rate equal to 0.78%, by region. Missing estimates are due to the extremely poor information in the absence of observed deaths.

Region	September 1st			October 1st			November 1st			November 23rd		
	prev.	90% CI		prev.	90% CI		prev.	90% CI		prev.	90% CI	
Abruzzo	0.04	0.02	0.14	0.48	0.20	0.74	5.78	4.73	7.32	14.65	12.35	16.81
Basilicata				0.70	0.20	1.24	2.60	1.76	4.11	11.24	8.13	14.33
Calabria	0.02	0.01	0.09	0.05	0.01	0.15	1.42	0.94	2.02	5.14	4.10	6.23
Campania	0.05	0.03	0.10	0.28	0.18	0.39	3.84	3.38	4.44	9.58	8.61	10.38
Emilia-Romagna	0.14	0.07	0.28	0.25	0.14	0.38	4.76	4.10	5.51	13.91	12.71	15.13
Friuli Venezia Giulia	0.07	0.03	0.22	0.22	0.08	0.40	5.41	4.20	6.96	22.39	19.20	25.42
Lazio	0.10	0.05	0.17	0.80	0.62	1.01	4.50	3.98	5.07	10.48	9.55	11.46
Liguria	0.52	0.33	0.86	0.87	0.52	1.14	14.07	12.56	16.12	15.02	13.22	17.37
Lombardia	0.22	0.14	0.34	0.31	0.23	0.39	9.61	8.97	10.30	20.67	19.61	21.68
Marche	0.02	0.01	0.09	0.07	0.02	0.15	3.00	2.26	3.94	8.62	6.97	10.24
Molise				0.15	0.09	0.21	6.00	6.00	7.82	13.80	13.36	15.65
Trentino Alto Adige				0.11	0.06	0.35	6.82	5.39	8.96	21.56	17.93	24.12
Piemonte	0.18	0.08	0.29	0.20	0.12	0.30	8.13	7.21	9.15	22.95	21.24	24.70
Puglia	0.22	0.12	0.33	0.42	0.28	0.59	3.75	3.15	4.36	10.70	9.56	11.90
Sardegna	0.14	0.06	0.29	0.69	0.34	0.96	3.98	3.12	5.12	6.14	5.05	7.73
Sicilia	0.07	0.03	0.14	0.42	0.28	0.57	4.48	3.88	5.11	11.23	10.18	12.28
Toscana	0.16	0.07	0.27	0.30	0.17	0.43	7.65	6.69	8.62	17.70	16.13	19.39
Umbria	0.14	0.02	0.27	0.21	0.09	0.43	8.49	6.64	10.84	14.13	11.69	17.26
Valle d'Aosta							39.31	28.45	55.60	42.54	28.17	51.90
Veneto	0.42	0.28	0.58	0.76	0.56	0.98	4.70	4.11	5.26	15.65	14.36	16.92

Table S4. Prevalence of infections (number of infections over 1,000 inhabitants) with 90% confidence intervals on September 1st, October 1st, November 1st and November 23rd assuming an infection fatality rate equal to 1.14%, by region. Missing estimates are due to the extremely poor information in the absence of observed deaths.

Region	September 1st			October 1st			November 1st			November 23rd		
	prev.	90% CI		prev.	90% CI		prev.	90% CI		prev.	90% CI	
Abruzzo	0.02	0.02	0.09	0.29	0.13	0.46	3.66	3.09	4.72	9.34	7.79	10.67
Basilicata				0.43	0.25	0.57	1.65	1.65	2.46	7.17	6.53	8.11
Calabria	0.01	0.01	0.06	0.03	0.01	0.07	0.91	0.65	1.34	3.27	2.64	3.93
Campania	0.03	0.02	0.06	0.18	0.12	0.25	2.45	2.17	2.82	6.10	5.52	6.64
Emilia-Romagna	0.05	0.05	0.12	0.15	0.08	0.21	3.00	2.61	3.47	8.88	8.01	9.69
Friuli Venezia Giulia	0.04	0.02	0.13	0.14	0.05	0.25	3.45	2.74	4.44	14.25	12.23	16.04
Lazio	0.05	0.04	0.09	0.50	0.37	0.62	2.84	2.55	3.24	6.68	6.09	7.27
Liguria	0.31	0.16	0.56	0.56	0.32	0.75	8.91	7.98	10.32	9.50	8.45	11.20
Lombardia	0.07	0.08	0.15	0.18	0.13	0.24	6.07	5.70	6.58	13.18	12.47	13.84
Marche	0.00	0.00	0.05	0.04	0.01	0.11	1.91	1.40	2.59	5.50	4.40	6.54
Molise				0.08	0.06	0.08	3.82	3.82	4.81	8.79	8.79	9.35
Trentino Alto Adige				0.04	0.02	0.21	4.35	3.49	5.63	13.75	11.37	15.54
Piemonte	0.10	0.04	0.17	0.12	0.07	0.20	5.17	4.59	5.80	14.63	13.58	15.73
Puglia	0.14	0.08	0.20	0.27	0.18	0.38	2.38	2.01	2.77	6.82	6.08	7.58
Sardegna	0.09	0.04	0.18	0.44	0.22	0.63	2.53	1.98	3.25	3.91	3.24	4.96
Sicilia	0.04	0.02	0.08	0.26	0.17	0.36	2.84	2.50	3.24	7.16	6.48	7.86
Toscana	0.09	0.04	0.15	0.18	0.10	0.28	4.86	4.27	5.46	11.28	10.28	12.28
Umbria	0.09	0.01	0.18	0.13	0.05	0.28	5.40	4.23	6.87	9.00	7.43	10.97
Valle d'Aosta							25.03	18.36	34.29	27.08	18.09	32.90
Veneto	0.26	0.17	0.36	0.48	0.36	0.63	3.00	2.61	3.39	9.96	9.14	10.78

Table S5. Prevalence of infections (number of infections over 1,000 inhabitants) with 90% confidence intervals on September 1st, October 1st, November 1st and November 23rd assuming an infection fatality rate equal to 1.79%, by region. Missing estimates are due to the extremely poor information in the absence of observed deaths.