Utrecht University

08 Dec 2021

Evaluation of non-pharmaceutical interventions

during the COVID-19 first wave in the Netherlands

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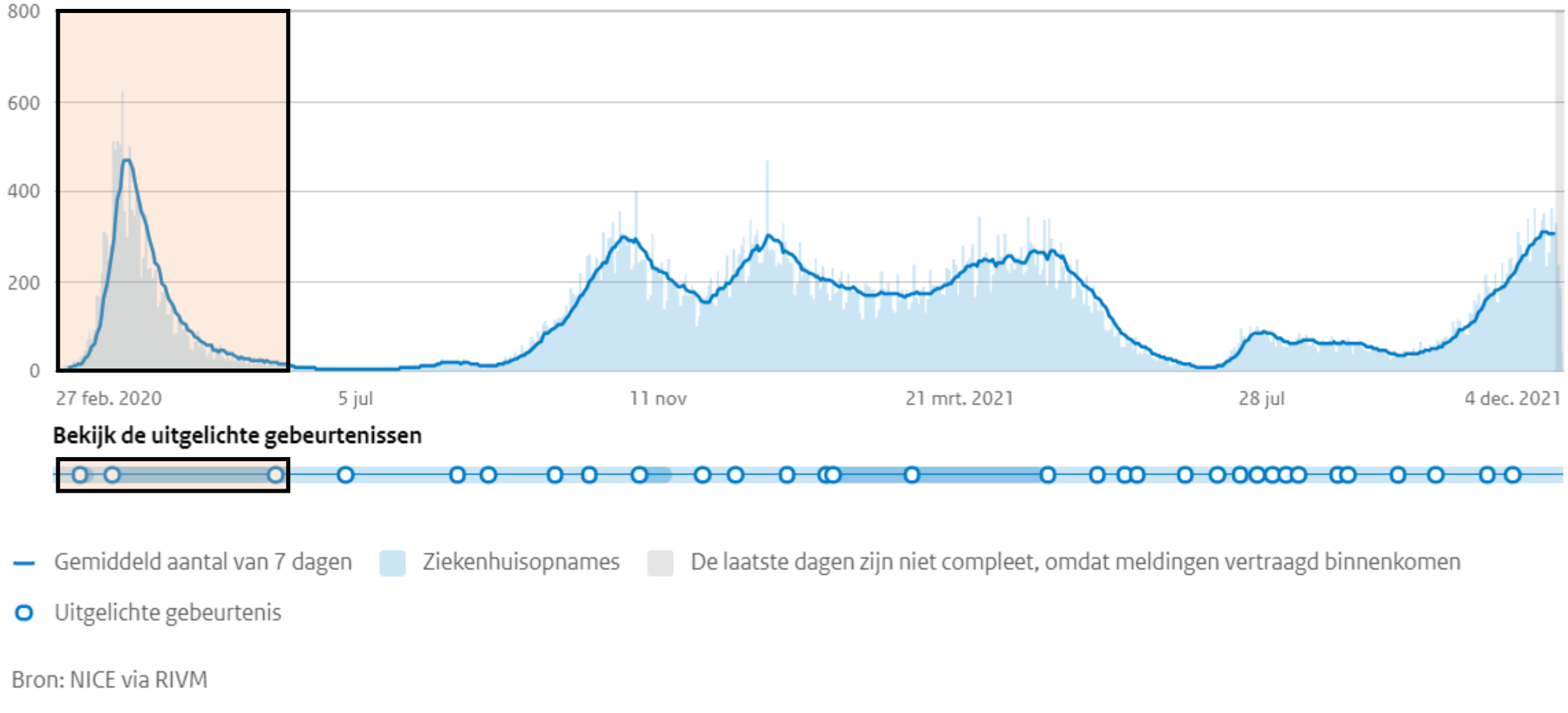


https://coronadashboard.rijksoverheid.nl/landelijk/ziekenhuis-opnames

National or regional?

18 september 2020

Rijksoverheid

Regionale maatregelen tegen het coronavirus

Het gaat niet goed met het coronavirus in ons land. In de regio's waar het aantal besmettingen het snelst toeneemt, worden aanvullende maatregelen genomen.

In welke regio's gelden deze maatregelen?

- Amsterdam-Amstelland
- Haaglanden
- Hollands Midden
- Kennemerland
- Rotterdam-Rijnmond
- Utrecht

Horeca

In deze regio's geldt extra:

Vanaf 0.00 uur 's nachts geen nieuwe bezoekers.

Vanaf 0.00 uur 's nachts gaat de muziek uit.

Sluiting horeca uiterlijk

Samenkomsten

In deze regio's geldt extra:

Geen gezelschappen van meer dan 50 personen, zowel binnen als buiten.

Kijk op rijksoverheid.nl/coronavirus voor een overzicht van uitzonderingen, zoals scholen, erediensten en uitvaarten.

Behaviour or regulated?

NOS Nieuws Sport Uitzendingen

DISCUSSIE OVER 2G

NOS NIEUWS • BINNENLAND • MA 22 NOVEMBER, 22:44 • AANGEPAST DI 23 NOVEMBER, 11:29

OMT: beter naleven basisregels is 'enige wijze' om lockdown te voorkomen

School closure?

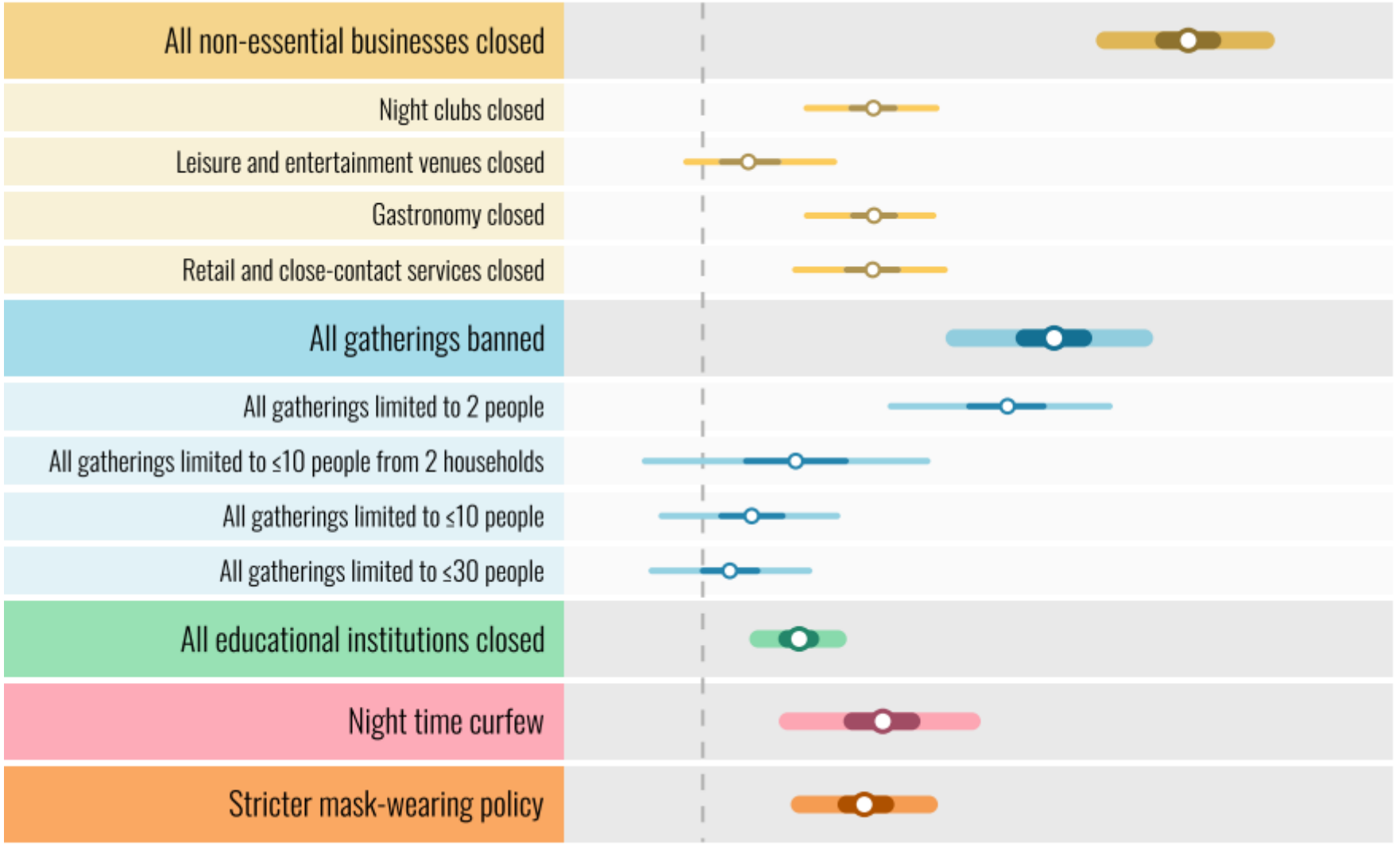
Menu nrc

Luister naar 06:01

Klassen worden naar huis gestuurd, sluiten van scholen is nu niet aan de orde

Basisscholen Ondanks een hoog aantal besmettingen onder scholieren blijft het streven om scholen zoveel mogelijk open te houden.

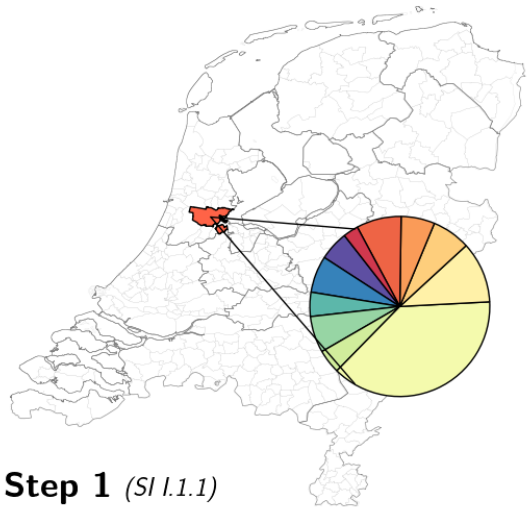
Patricia Veldhuis & Frederiek Weeda 18 november 2021 Leestijd 3 minuten



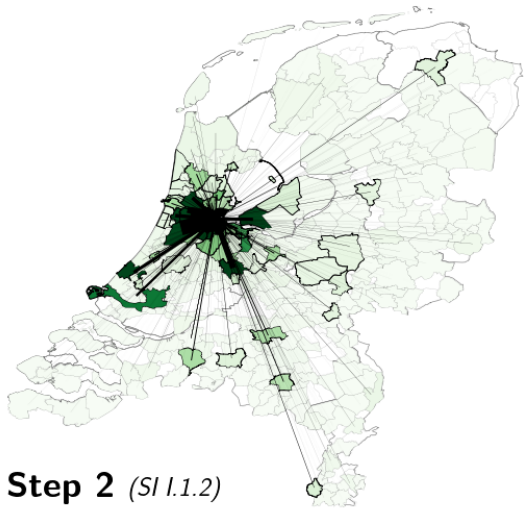
Sharma et al. (2021). Understanding the effectiveness of government interventions against the resurgence of COVID-19 in Europe. Nature Communications.

An individual-based model

Identify agents and mobility

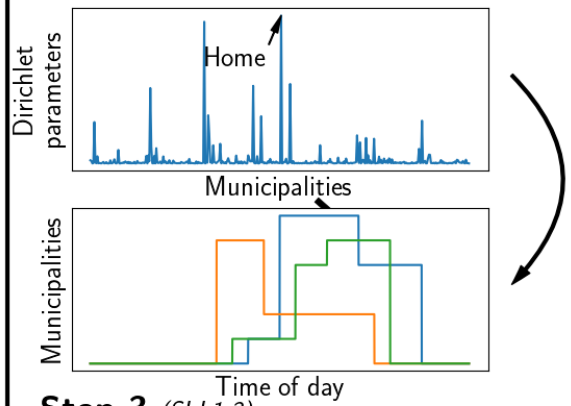


Step 1 *(SI I.1.1)*
Identify 11 demographic groups per municipality using demography data

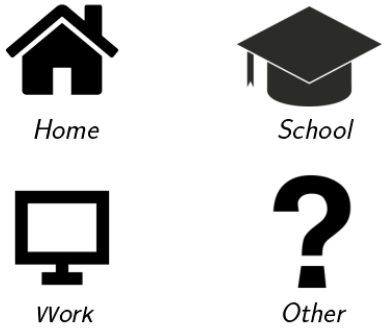


Step 2 *(SI I.1.2)*
Determine inter-municipality travel, using mobile phone signalling data

Use as input for



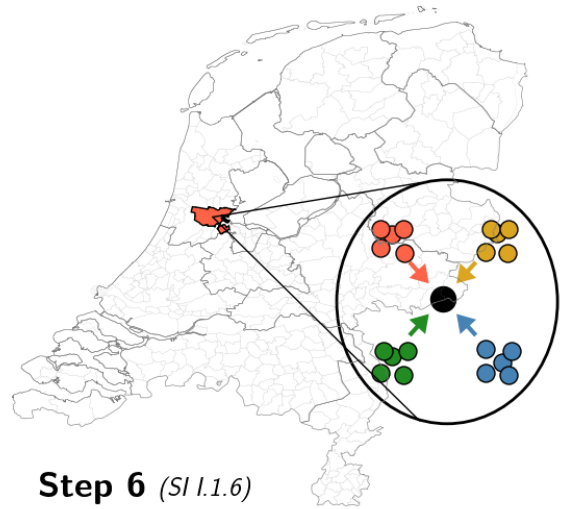
Step 3 *(SI I.1.3)*
Generate agent hourly movements using Dirichlet distributions



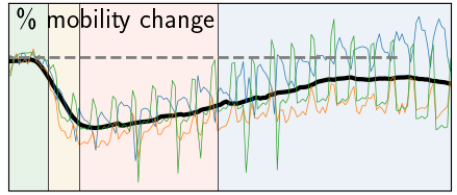
Step 4 *(SI I.1.4)*
Infer mixing situations based on demography, time and location

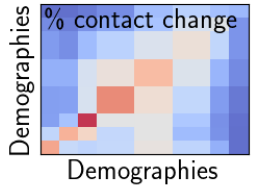
Simulate transmission and interventions

Step 5 *(SI I.1.5)*
Initialise with infection counts estimated from hospital admissions data up to 15/03

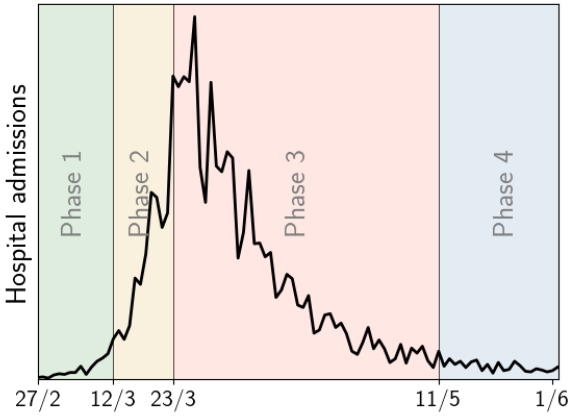


Step 6 *(SI I.1.6)*
Transmission via force of infection determined from infected fractions per group

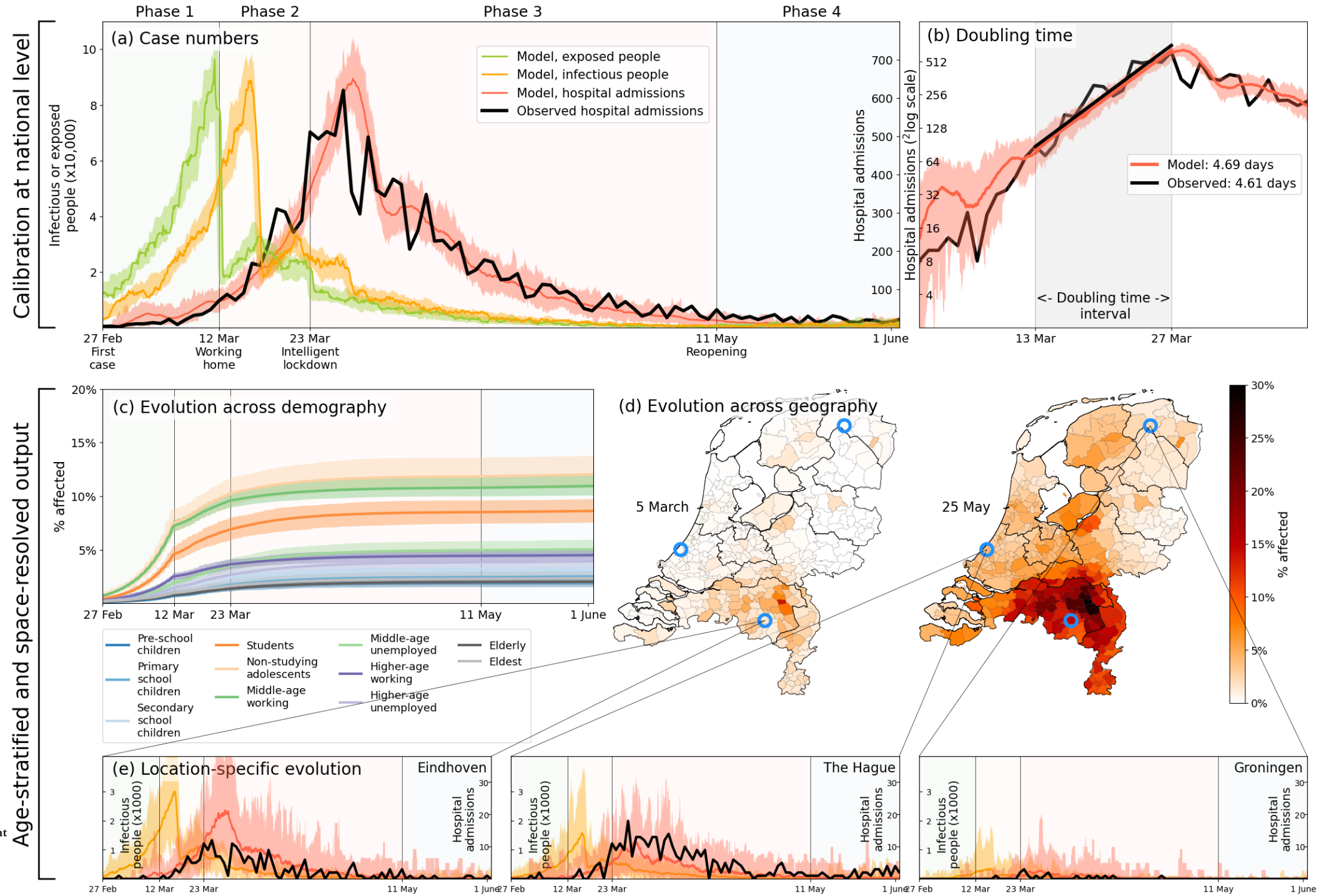




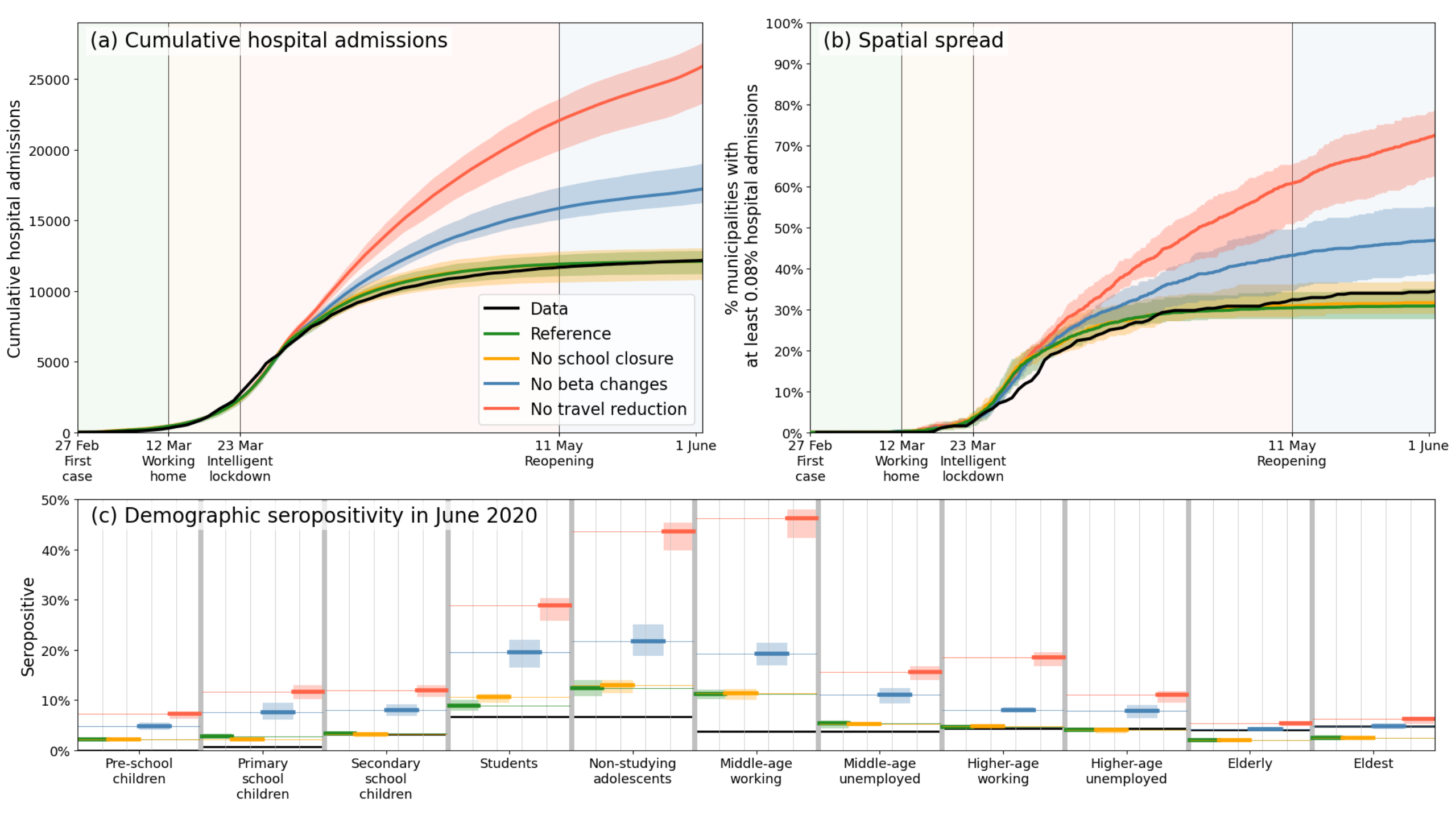
Step 7 *(SI I.1.7)*
Quantify interventions using empirical mobility and contact data throughout the first wave

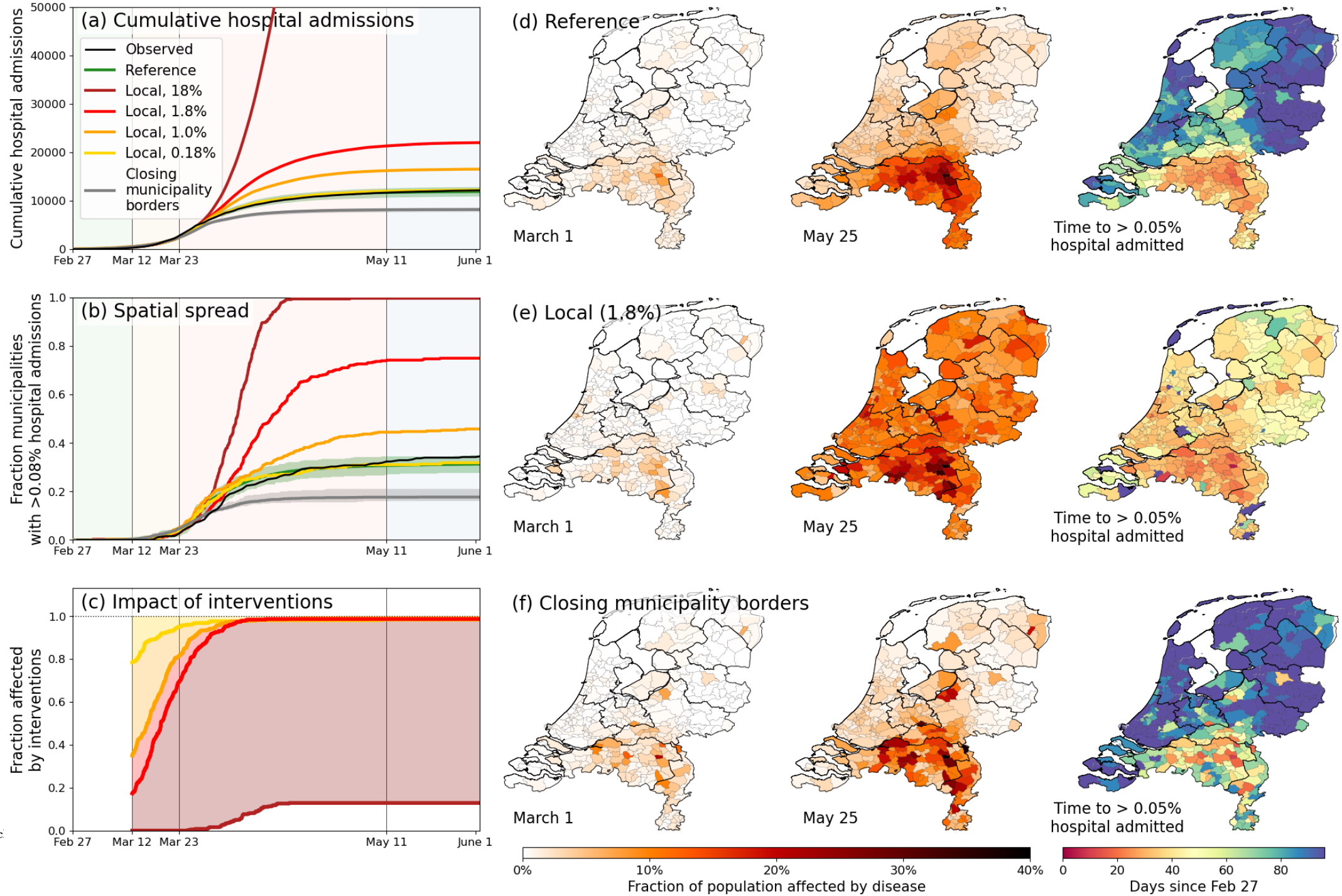


Step 8 *(SI I.1.8, I.2)*
Distinguish 4 phases based on real intervention dates and apply quantified measures


Calibration at national level
Phase 1
Phase 2
Phase 3
Phase 4
(a) Case numbers
Model, exposed people
Model, infectious people
Model, hospital admissions
Observed hospital admissions
Infectious or exposed people (x10,000)
Hospital admissions
27 Feb First case
12 Mar Working home
23 Mar Intelligent lockdown
11 May Reopening
1 June
(b) Doubling time
Hospital admissions (2log scale)
Model: 4.69 days
Observed: 4.61 days
<- Doubling time -> interval
13 Mar
27 Mar
Age-stratified and space-resolved output
(c) Evolution across demography
% affected
Pre-school children
Primary school children
Secondary school children
Students
Non-studying adolescents
Middle-age working
Middle-age unemployed
Higher-age working
Higher-age unemployed
Elderly
Eldest
(d) Evolution across geography
5 March
25 May
% affected
(e) Location-specific evolution
Eindhoven
The Hague
Groningen
Infectious people (x1000)
Hospital admissions

Utrecht


(a) Cumulative hospital admissions
Cumulative hospital admissions
25000
20000
15000
10000
5000
0
Data
Reference
No school closure
No beta changes
No travel reduction
27 Feb
First
case
12 Mar
Working
home
23 Mar
Intelligent
lockdown
11 May
Reopening
1 June
(b) Spatial spread
% municipalities with
at least 0.08% hospital admissions
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
(c) Demographic seropositivity in June 2020
Seropositive
50%
40%
30%
20%
10%
0%
Pre-school
children
Primary
school
children
Secondary
school
children
Students
Non-studying
adolescents
Middle-age
working
Middle-age
unemployed
Higher-age
working
Higher-age
unemployed
Elderly
Eldest


(a) Cumulative hospital admissions
Cumulative hospital admissions
Observed
Reference
Local, 18%
Local, 1.8%
Local, 1.0%
Local, 0.18%
Closing municipality borders
0
10000
20000
30000
40000
50000
Feb 27
Mar 12
Mar 23
May 11
June 1
(b) Spatial spread
Fraction municipalities with >0.08% hospital admissions
0.0
0.2
0.4
0.6
0.8
1.0
(c) Impact of interventions
Fraction affected by interventions
(d) Reference
March 1
May 25
Time to > 0.05% hospital admitted
(e) Local (1.8%)
(f) Closing municipality borders
0%
10%
20%
30%
40%
Fraction of population affected by disease
0
20
40
60
80
Days since Feb 27

Findings

- Reproduction observed evolution fairly accurate
- Interventions to some extent separable
- Mobility reduction crucial in national interventions
- Regional interventions may have been more optimal

Thank you for your attention

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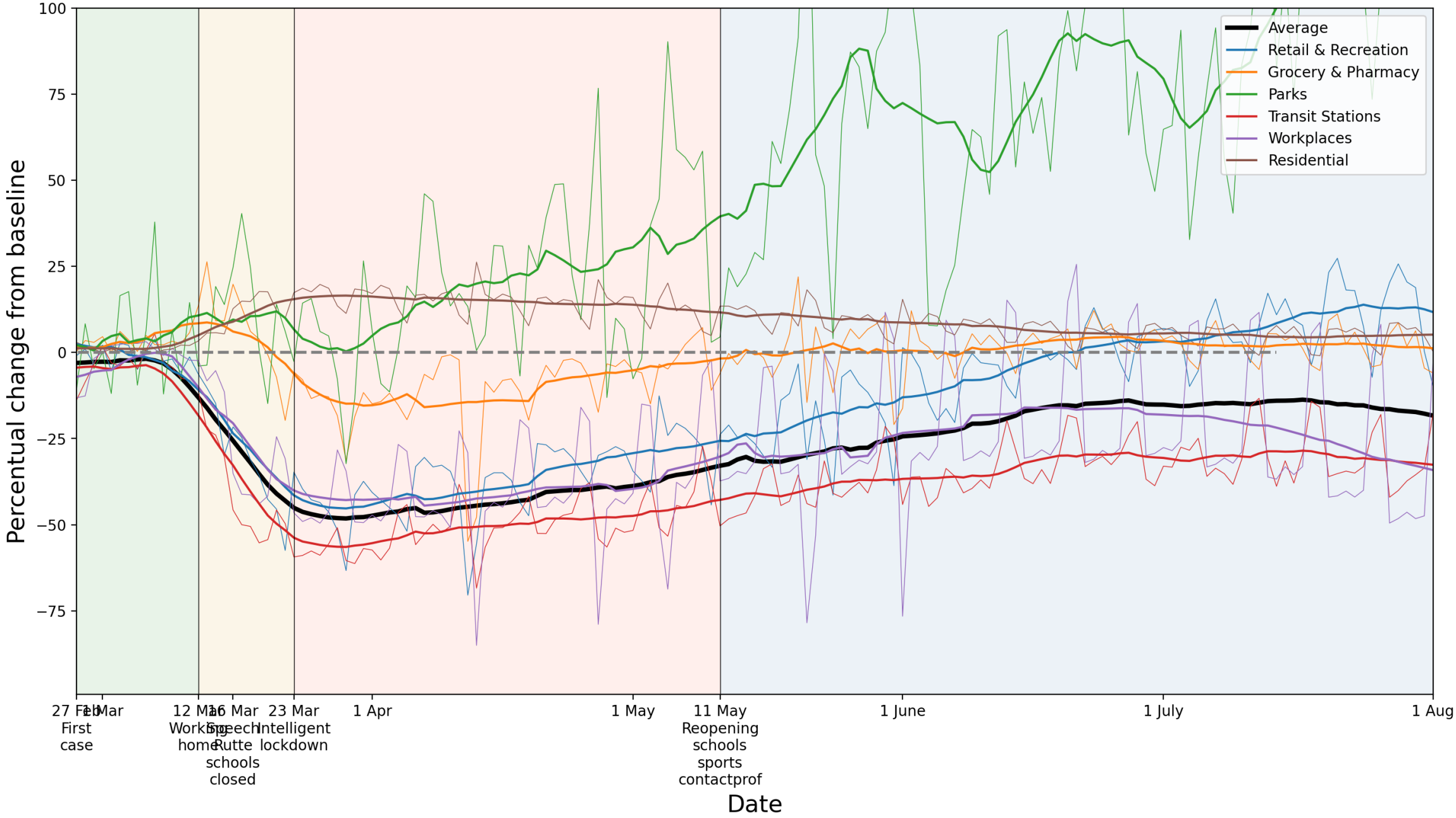
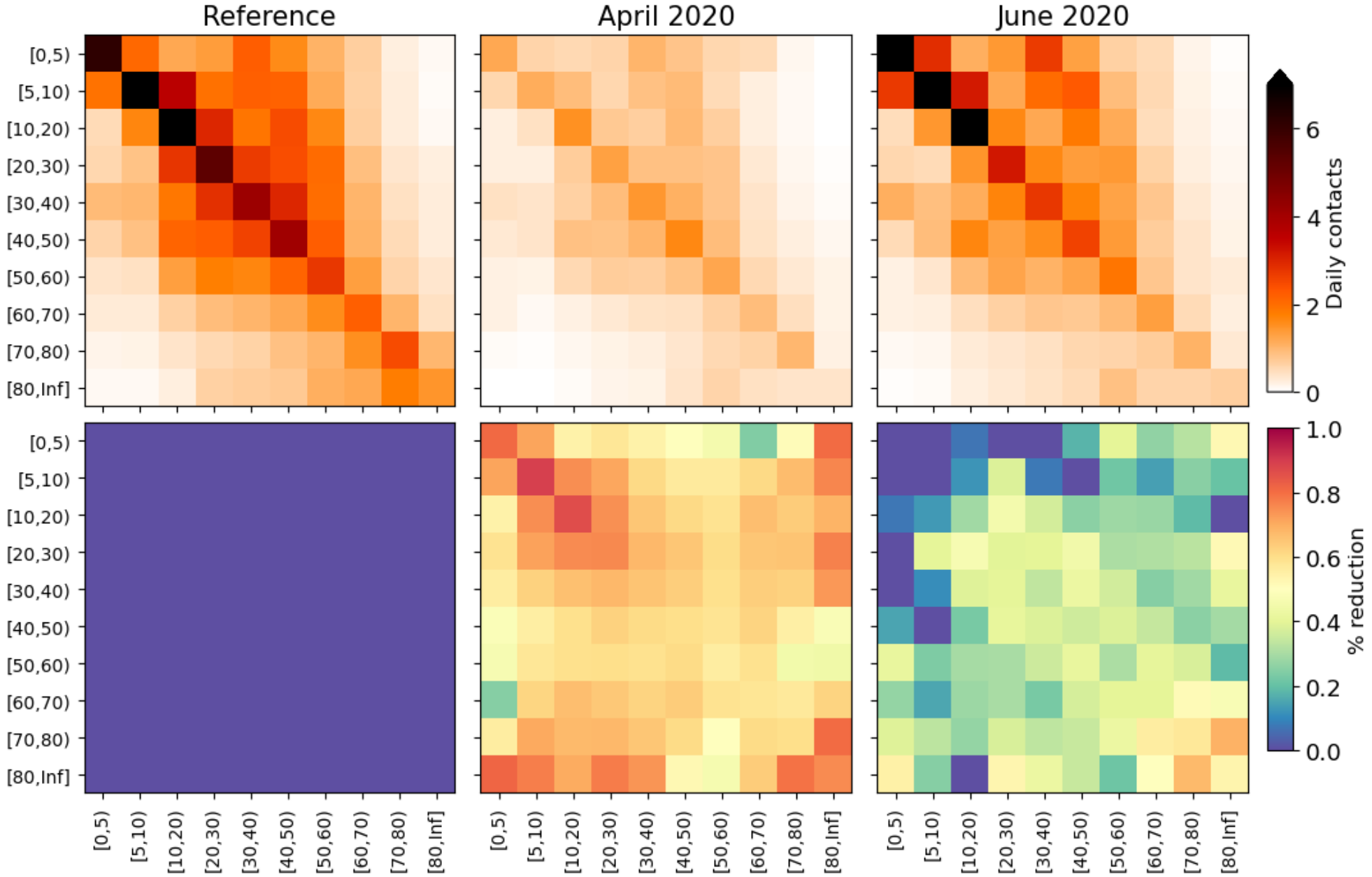
Annex: Google Mobility



Annex: PIENTER mixing matrices



Annex: Model setup

$$S \xrightarrow{\lambda} E \xrightarrow{\rho} I \xrightarrow{\gamma} R$$

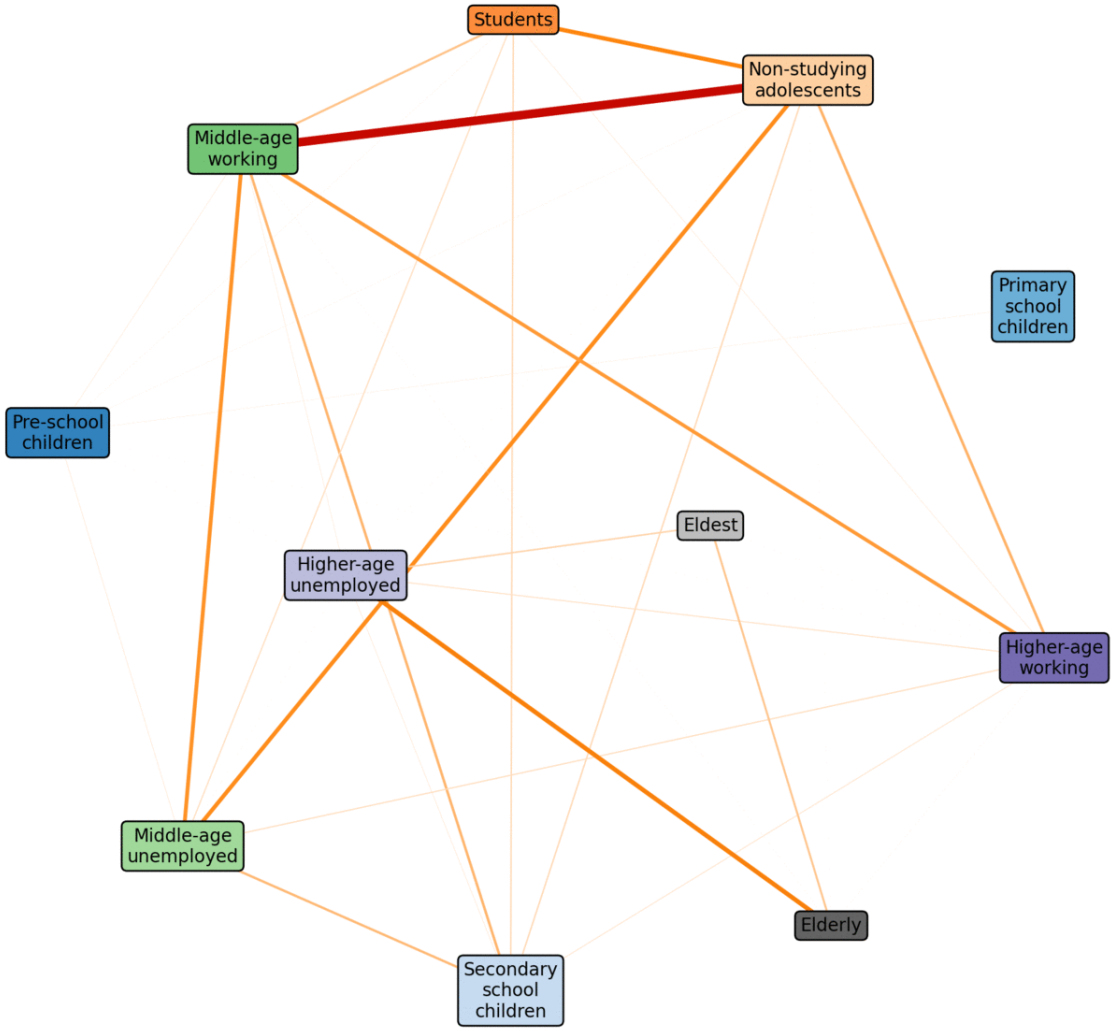
$$\rho = \frac{1}{\text{incubation time}}$$
$$\gamma = \frac{1}{\text{infectious time}}$$

$$\lambda_p(t) = \sum_g \beta'(t, g, p) \frac{I_{gm}(t)}{N_{gm}(t)}$$

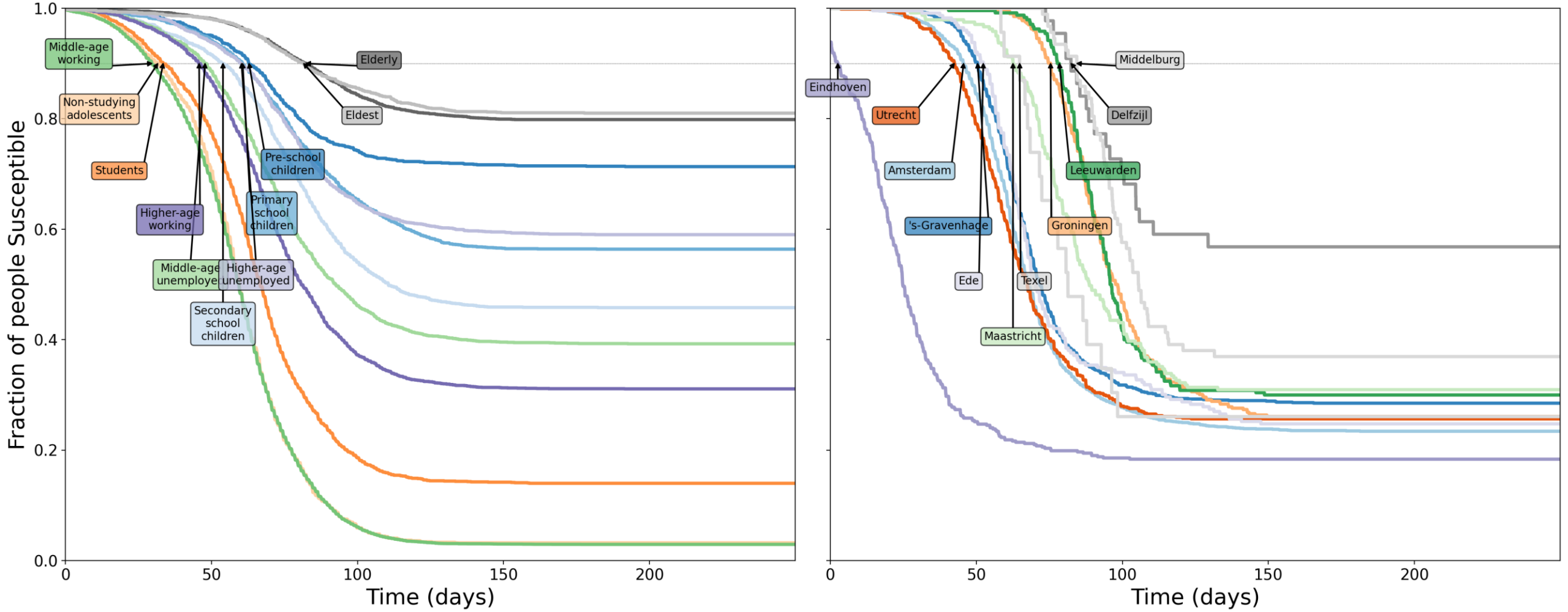
$$\beta'(t, g, p) = d(t) \cdot n_{pg} \cdot \beta_0 \cdot s_p$$

Annex: Force of infection

Eindhoven



Annex: Demographic and geographic evolution (non-intervention run)



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