

# MOCOS data for bulletin - Dec 20, 2021

## 1. Comparison of trajectories without restrictions on Nov 22 with trajectories with restrictions

### Specification of agent based model

We ran an agent based model tailored for Saxony. The configuration and setup includes:

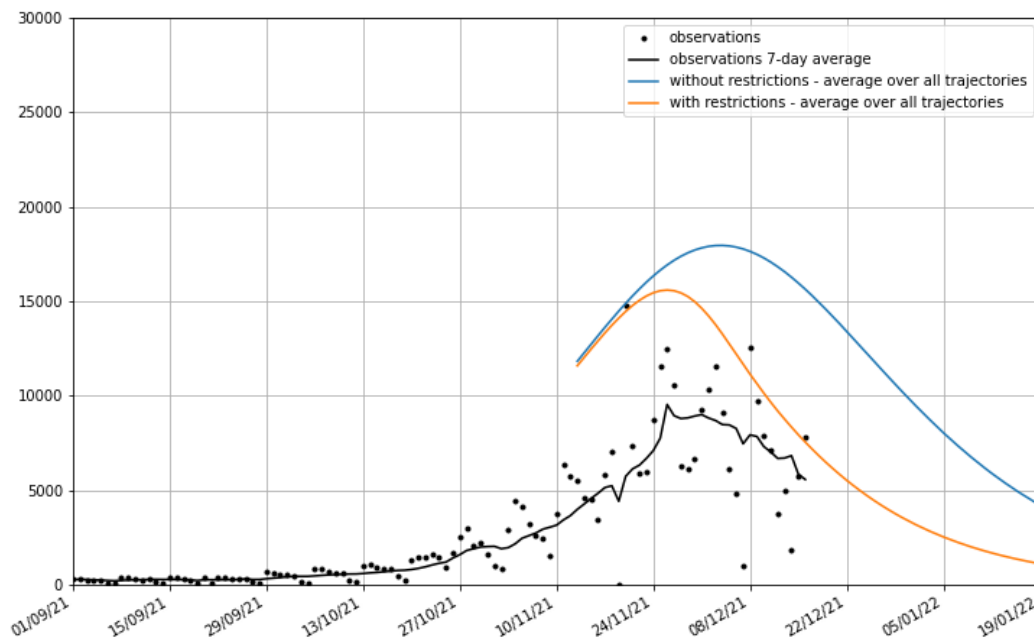
- A. Simulated population
  - a. 4 076 893 individuals sampled based on Saxony population statistics
  - b. Individuals distributed into 2 193 265 households
- B. Parameters set to fixed values based on available data & educated assumptions
  - a. All infections are due to delta variant
  - b. Contact tracing has a delay of around 2 days
  - c. Base level of vaccinations in age groups according to this page as of Nov 13th 2021  
<https://www.coronavirus.sachsen.de/ueberblick-coronaschutzimpfungen-in-sachsen-9874.html#a-11374>
    - i. 0-11: 0%
    - ii. 12-17: 26.7%
    - iii. 18-59: 58%
    - iv. 60+: 78.9%
  - d. Assuming average protection from vaccinations based on the literature:
    - i. Protection against symptomatic infection: 75%
    - ii. Protection against hospitalization: 87.5%
    - iii. Protection against death: 92%
  - e. Assuming 25% of people are naturally immunized due to earlier infections (overall dark figure ~2.8)
  - f. Using social contact freq matrices from COVIMOD
  - g. Screening of kids in schools 2 times per week
    - i. Assuming 80% effectivity of single test
    - ii. Age range of kids screened: 8 - 16
  - h. 37% of people having CoronaWarnApp or similar app that can help in contact tracking
    - i. Assuming 6 hours of delay for testing for CoronaWarnApp users
  - i. Probability of developing symptoms requiring hospitalization based on available dataset of patients. Mean hospital stay assumed to be 10 days
  - j. Distributions used in the disease progression:
    - i. Incubation time: Log-normal distribution with log-mean 1.37 and scale 0.5
    - ii. Symptom onset time: Gamma distribution with shape  $\alpha=0.87$  and scale  $\theta=2.91$
    - iii. Onset - Hospitalization delay: Exponential distribution with mean 3.78 days

- iv. Onset - death delay: Log-normal distribution with log-mean 1.70 and scale 1.21

C. Nov 22th Lockdown has been evaluated to reduce infectivity by 30%

## Pictures and links to csvs

### 1.1. Daily true cases



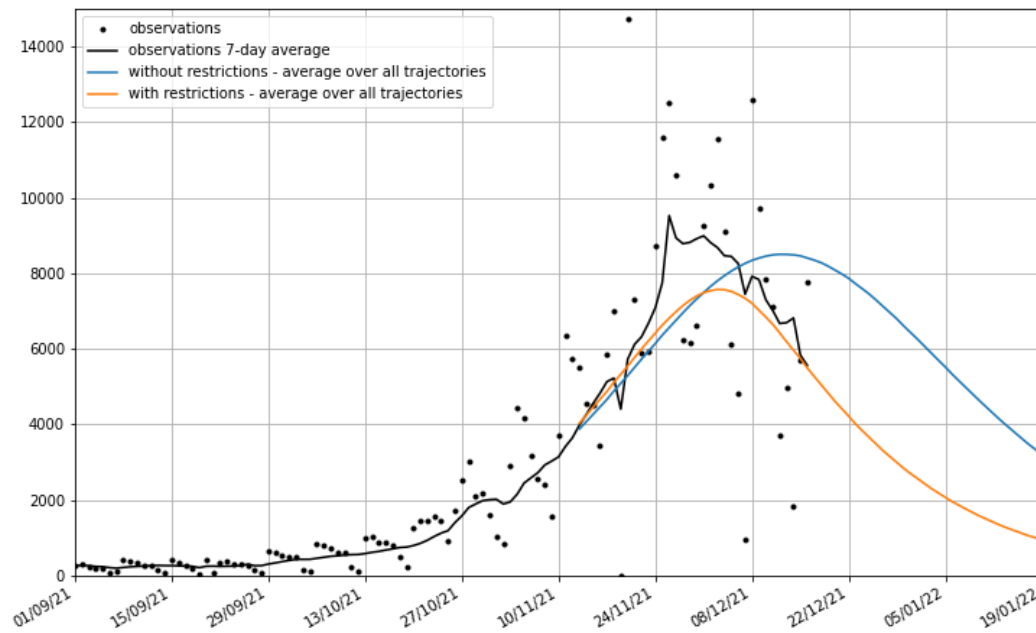
csv:

- a) Without lockdown

<https://drive.google.com/drive/u/0/folders/1YEGliLAQ0NrScf2AKmTartSE7CCfHEBd>

- b) With lockdown <https://drive.google.com/drive/u/0/folders/1HDJSkIQWQ-FweKpHrAN-NAdYsyYLd8tJ>

## 1.2. Daily detections



CSV:

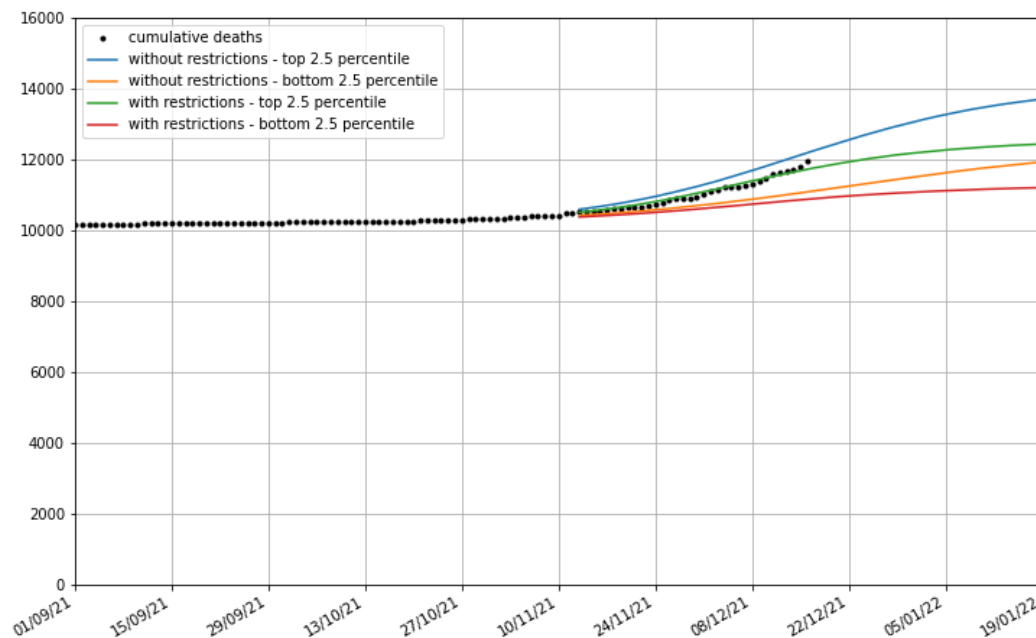
a) Without lockdown

[https://drive.google.com/drive/u/0/folders/1t8RGdRzj\\_zTivBdiTizuHXAMSXNWRw20](https://drive.google.com/drive/u/0/folders/1t8RGdRzj_zTivBdiTizuHXAMSXNWRw20)

b) With lockdown [https://drive.google.com/drive/u/0/folders/1e-](https://drive.google.com/drive/u/0/folders/1e-pjF8hzNXMDxORUYpXhSgh5CXwY8QJf)

[pjF8hzNXMDxORUYpXhSgh5CXwY8QJf](https://drive.google.com/drive/u/0/folders/1e-pjF8hzNXMDxORUYpXhSgh5CXwY8QJf)

### 1.3. Cumulative deaths



CSV:

- c) Without lockdown <https://drive.google.com/drive/u/0/folders/1-ClhPcX3GSdeLqteBqED9OpBmCccu9bT>
- d) With lockdown [https://drive.google.com/drive/u/0/folders/1xkdc4yPtC9mnT4eLCcA8SD\\_bb\\_U8YQsJ](https://drive.google.com/drive/u/0/folders/1xkdc4yPtC9mnT4eLCcA8SD_bb_U8YQsJ)

## 2. Data-driven Omicron scenarios for two assumed values of infectivity of omicron variant, and considering two different IFR levels of the new variant

Main assumptions:

- Booster vaccination gives 75% protection from symptomatic disease
- Natural immunity gives effectively ~40% of protection from symptomatic disease
- Vaccination up to two doses gives 30% protection from symptomatic disease

- Vaccination (either booster or not) gives 87.5% protection against hospitalization and 92% protection against death (like for delta variant)
- Two values of IFR of omicron relative to the delta variant were considered: 10% and 50%.
- Two infectivity levels of omicron relative to the delta variant were considered: 2x and 3x.
- For 2x infectivity we checked three pairs of contact tracing (b) and probability of detecting mild cases (q):  $b=q=0.1$ ,  $b=q=0.2$  and  $b=q=0.3$
- For 3x infectivity we checked only one set of params of contact tracing (b) and probability of detecting mild cases (q):  $b=q=0.1$
- **Level of restricting contacts (f) value has been estimated to be in the range 0.45 - 0.5 (see heatmaps)**
- **Level of effective immunization value has been estimated to be around 40% (against symptomatic progression)**

## Specification of agent based model

We ran an agent based model tailored for Saxony. The configuration and setup includes:

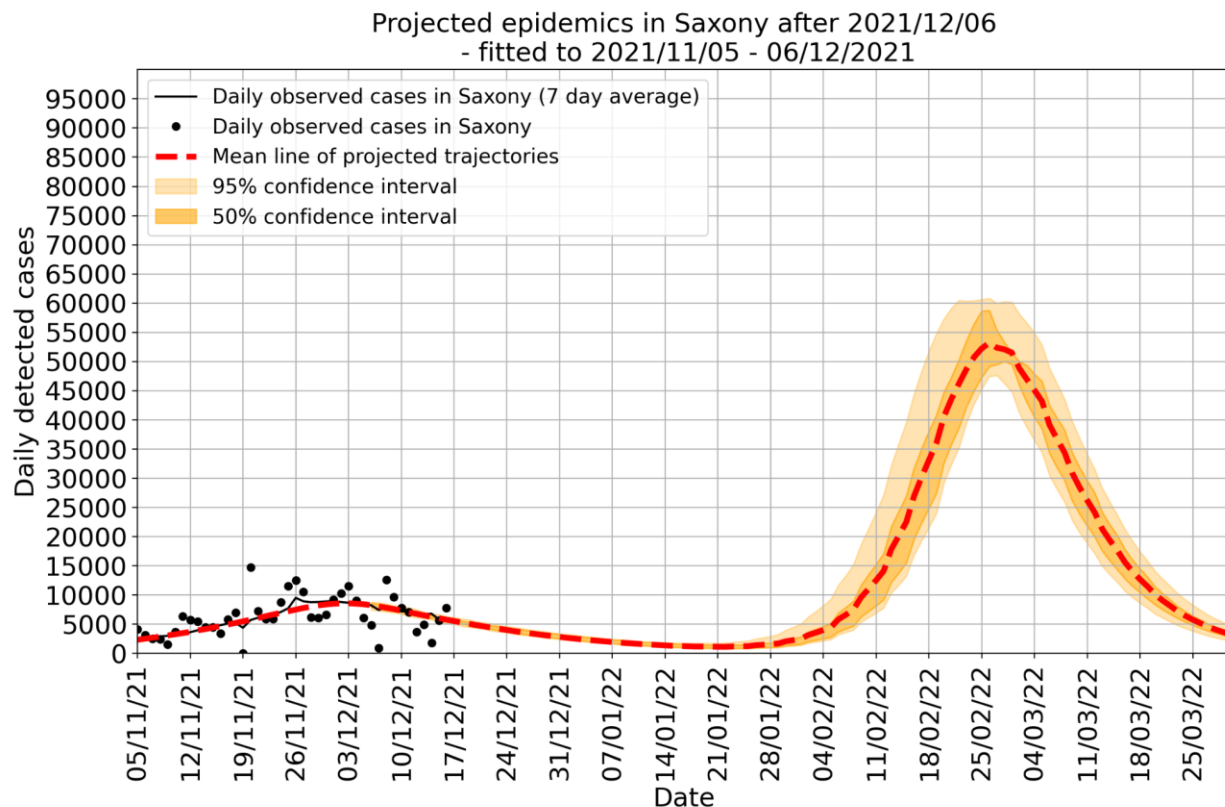
- e) Simulated population
  - i) 4 076 893 individuals sampled based on Saxony population statistics
  - ii) Individuals distributed into 2 193 265 households
- f) Parameters set to fixed values based on available data & educated assumptions
  - i) All infections are due to omicron variant, that are later in a post processing step added on top of current delta-variant forecasts
  - ii) Contact tracing has a delay of around 2 days
  - iii) Base level of vaccinations in age groups according to this page as of Dec 21st 2021  
<https://www.coronavirus.sachsen.de/ueberblick-coronaschutzimpfungen-in-sachsen-9874.html#a-11374>
    - 1) 0-11: at least one dose: 0%, booster: 0%
    - 2) 12-17: at least one dose: 37.5%, booster vaccination: 2.9%
    - 3) 18-59: at least one dose: 63.1%, booster vaccination: 20.5%
    - 4) 60+: at least one dose: 79.9%, booster vaccination: 42.9%
  - iv) Assuming average protection from vaccinations based on the literature:
    - 1) Protection against symptomatic infection: booster: 75%, without booster: 30%
    - 2) Protection against hospitalization: 87.5%
    - 3) Protection against death: 92%
  - v) Assuming 25% of people are naturally immunized due to earlier infections (overall dark figure ~2.8)
    - 1) Assuming natural immunization protects in 40% from symptomatic infection: this gives around 10% of people effectively immune from omicron
  - vi) Using social contact freq matrices from COVIMOD
  - vii) Screening of kids in schools 2 times per week
    - 1) Assuming 80% effectivity of single test
    - 2) Age range of kids screened: 8 - 16
  - viii) 37% of people having CoronaWarnApp or similar app that can help in contact tracking

- 1) Assuming 6 hours of delay for testing for CoronaWarnApp users
- ix) Probability of developing symptoms requiring hospitalization based on available dataset of patients. Mean hospital stay assumed to be 10 days
- x) Distributions used in the disease progression:
  - 1) Incubation time: Log-normal distribution with log-mean 1.37 and scale 0.5
  - 2) Symptom onset time: Gamma distribution with shape  $\alpha=0.87$  and scale  $\theta=2.91$
  - 3) Onset - Hospitalization delay: Exponential distribution with mean 3.78 days
  - 4) Onset - death delay: Log-normal distribution with log-mean 1.70 and scale 1.21

## Pictures and links to csvs

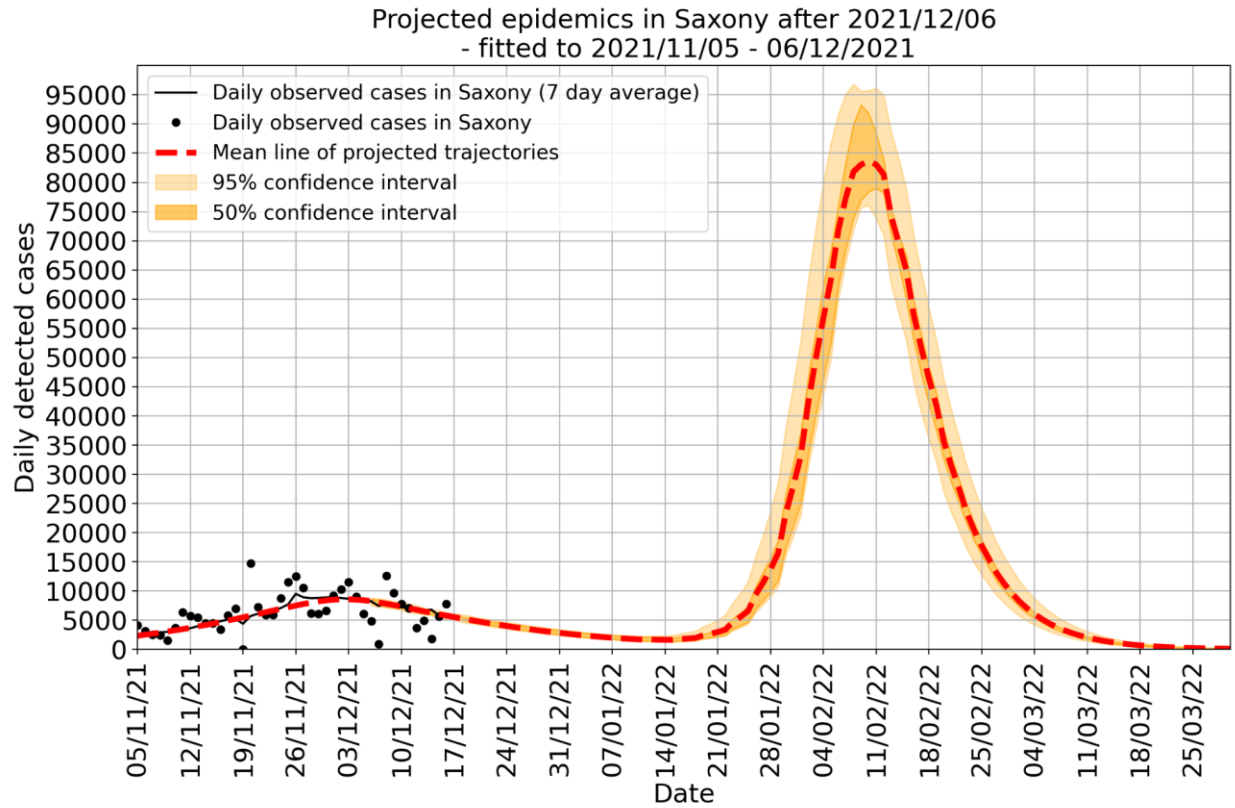
### 2.1. Detections forecast

#### 2.1.1. infectivity 2x Delta



csv: [https://drive.google.com/drive/u/0/folders/1gWppcXPKslp8koIQIsdLI7vtEJU\\_9EAT](https://drive.google.com/drive/u/0/folders/1gWppcXPKslp8koIQIsdLI7vtEJU_9EAT)

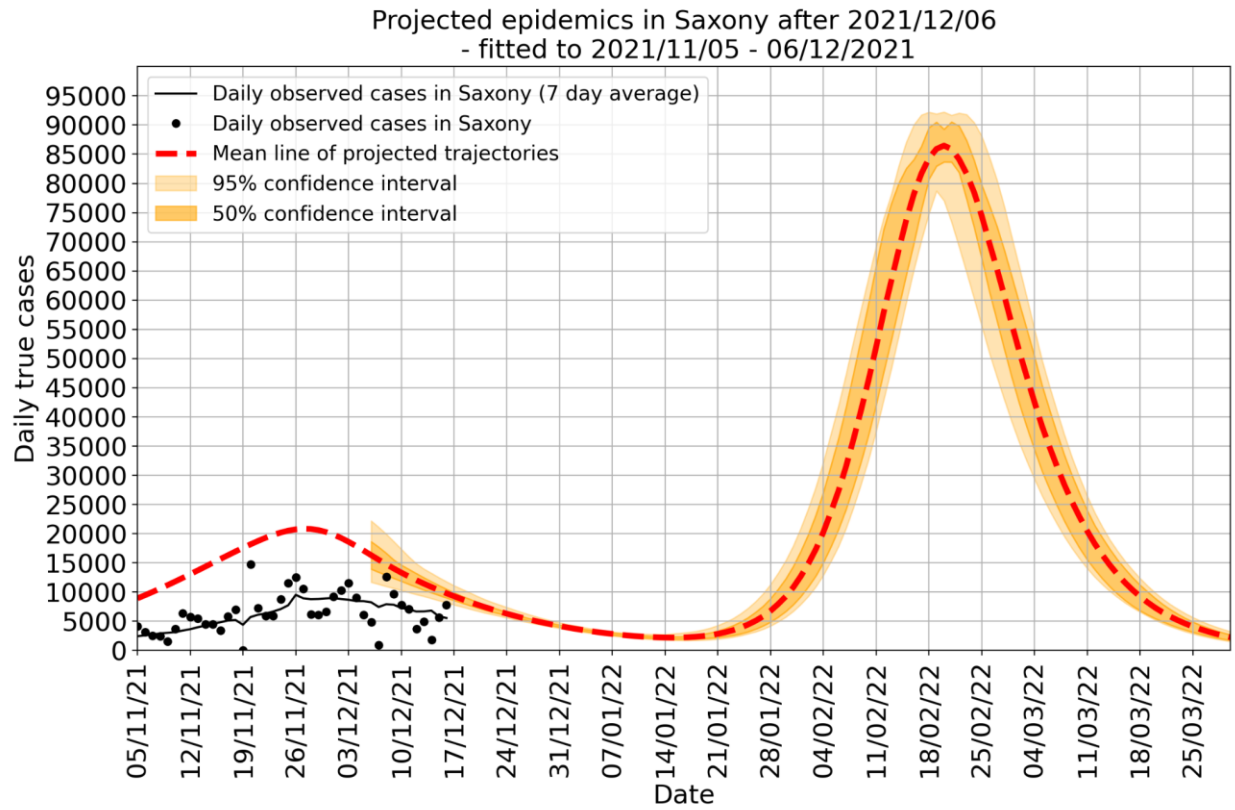
## 2.1.2. Infectivity 3x Delta



csv: [https://drive.google.com/drive/u/0/folders/1\\_So2VpwTTTXHijRzgS2ZUmoqy\\_s4Anvl](https://drive.google.com/drive/u/0/folders/1_So2VpwTTTXHijRzgS2ZUmoqy_s4Anvl)

## 2.2. True cases forecast

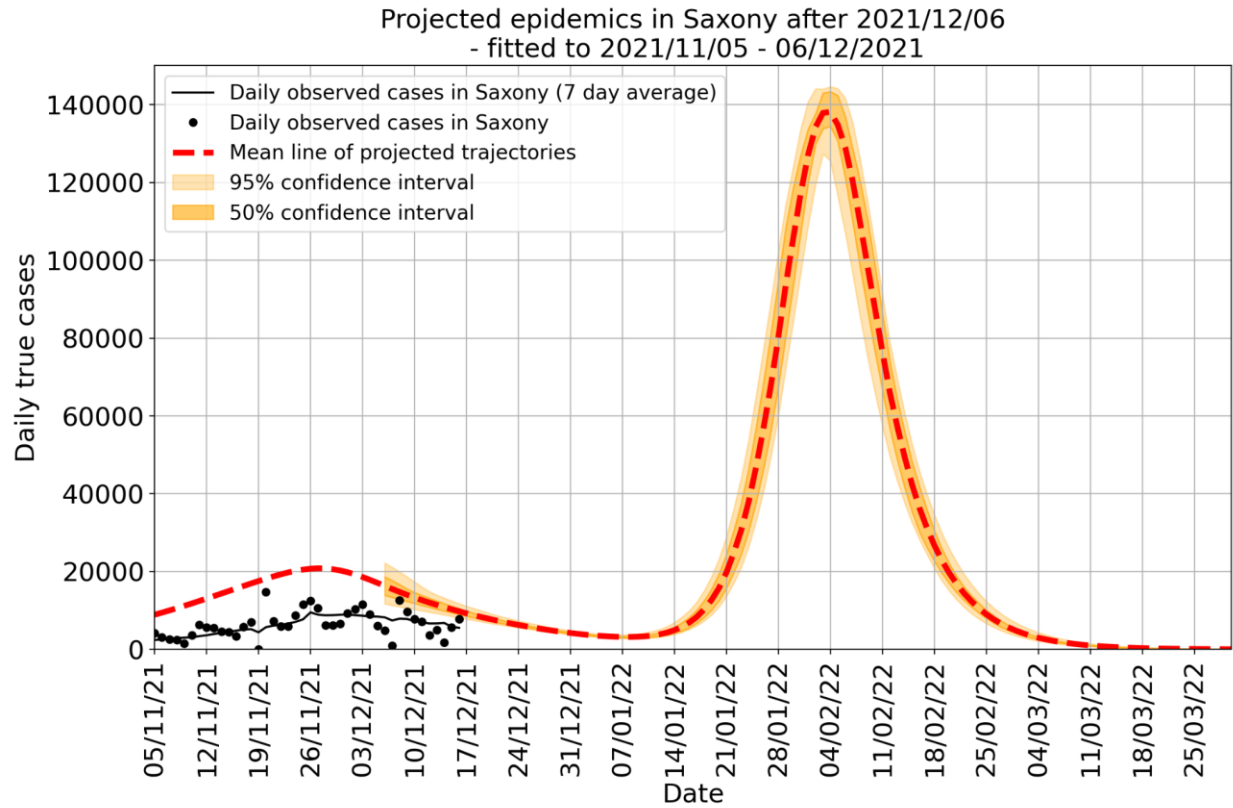
### 2.2.1. Infectivity 2x Delta



csv: [https://drive.google.com/drive/u/0/folders/19LZr0KPgC\\_zKCgA0SaijPnyMXGW6cNFX](https://drive.google.com/drive/u/0/folders/19LZr0KPgC_zKCgA0SaijPnyMXGW6cNFX)



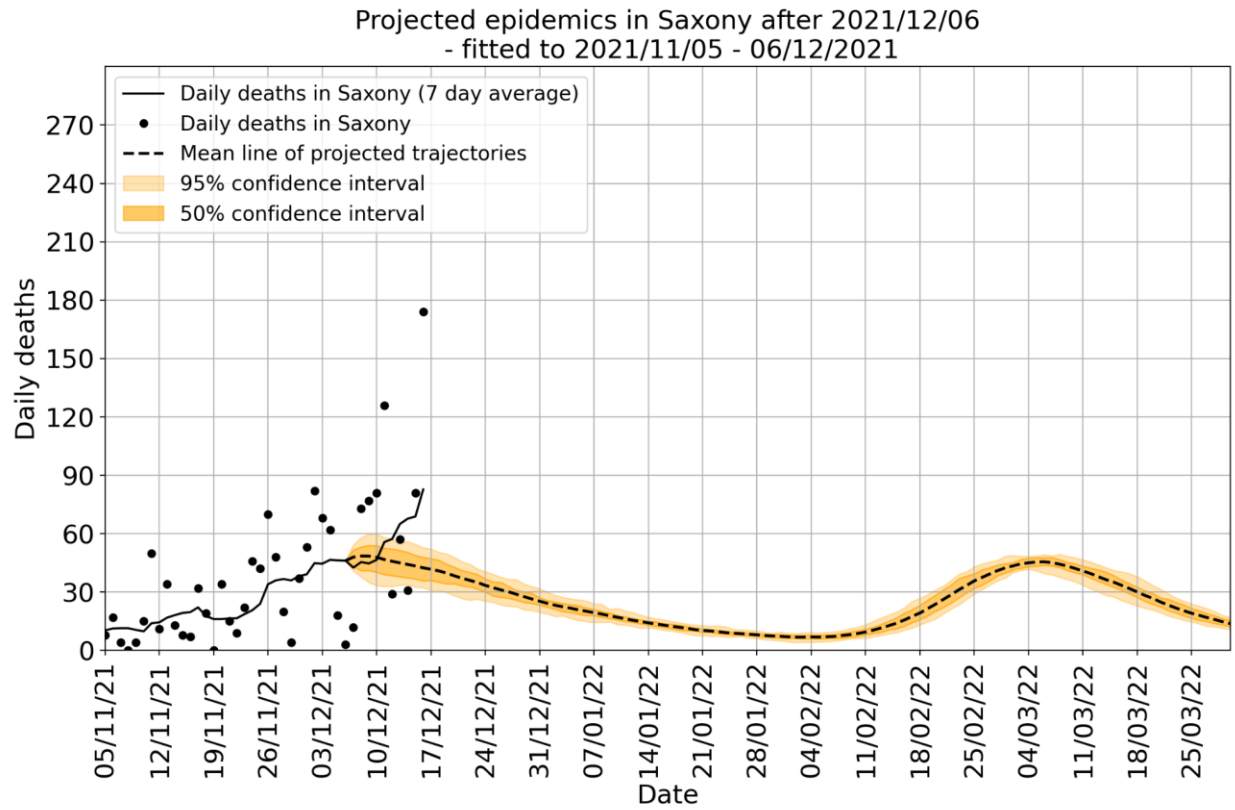
## 2.2.2. Infectivity 3x Delta



csv: [https://drive.google.com/drive/u/0/folders/1T\\_p1A0hUuJxBHQBI0DoTWJsckfhkvvdn](https://drive.google.com/drive/u/0/folders/1T_p1A0hUuJxBHQBI0DoTWJsckfhkvvdn)

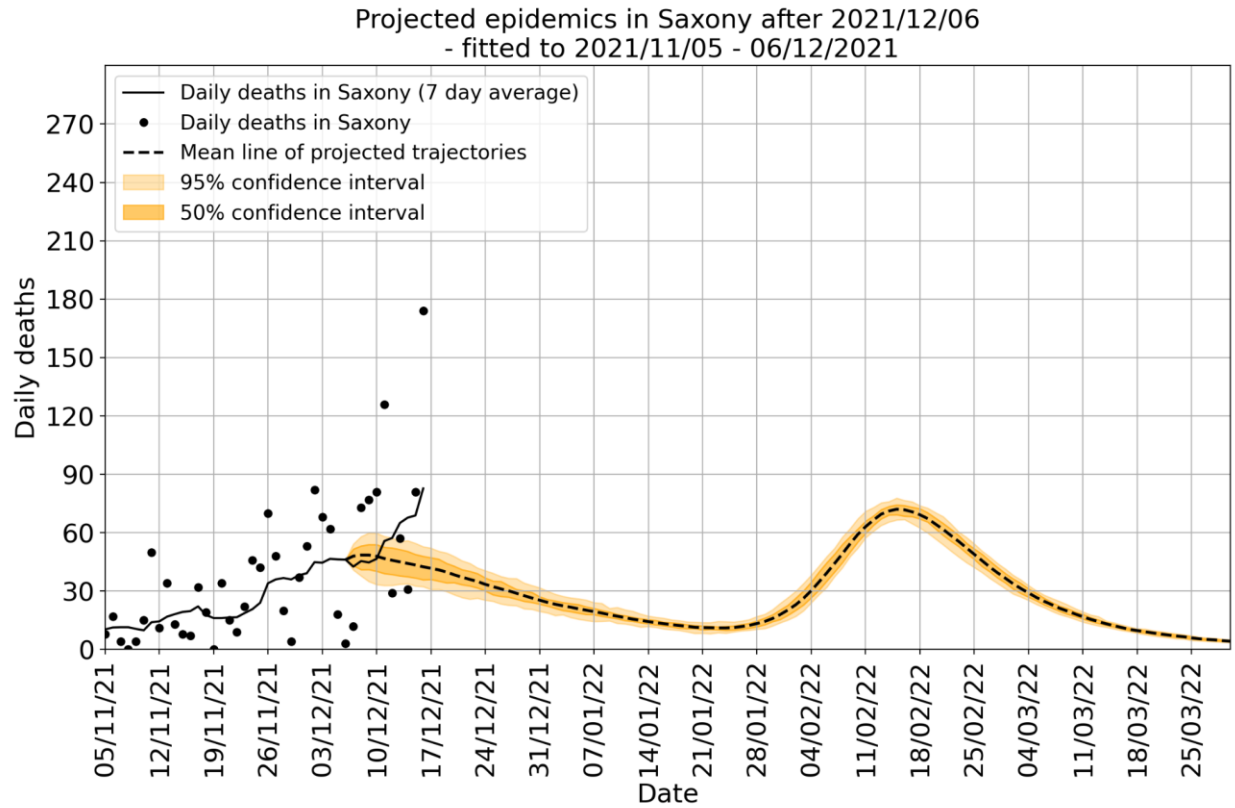
## 2.3. Deaths forecast for 0.1 IFR

### 2.3.1. infectivity 2x Delta



csv: [https://drive.google.com/drive/u/0/folders/1q8WgU2iEN2uygaNolIGcltO5AsZfq\\_Ov](https://drive.google.com/drive/u/0/folders/1q8WgU2iEN2uygaNolIGcltO5AsZfq_Ov)

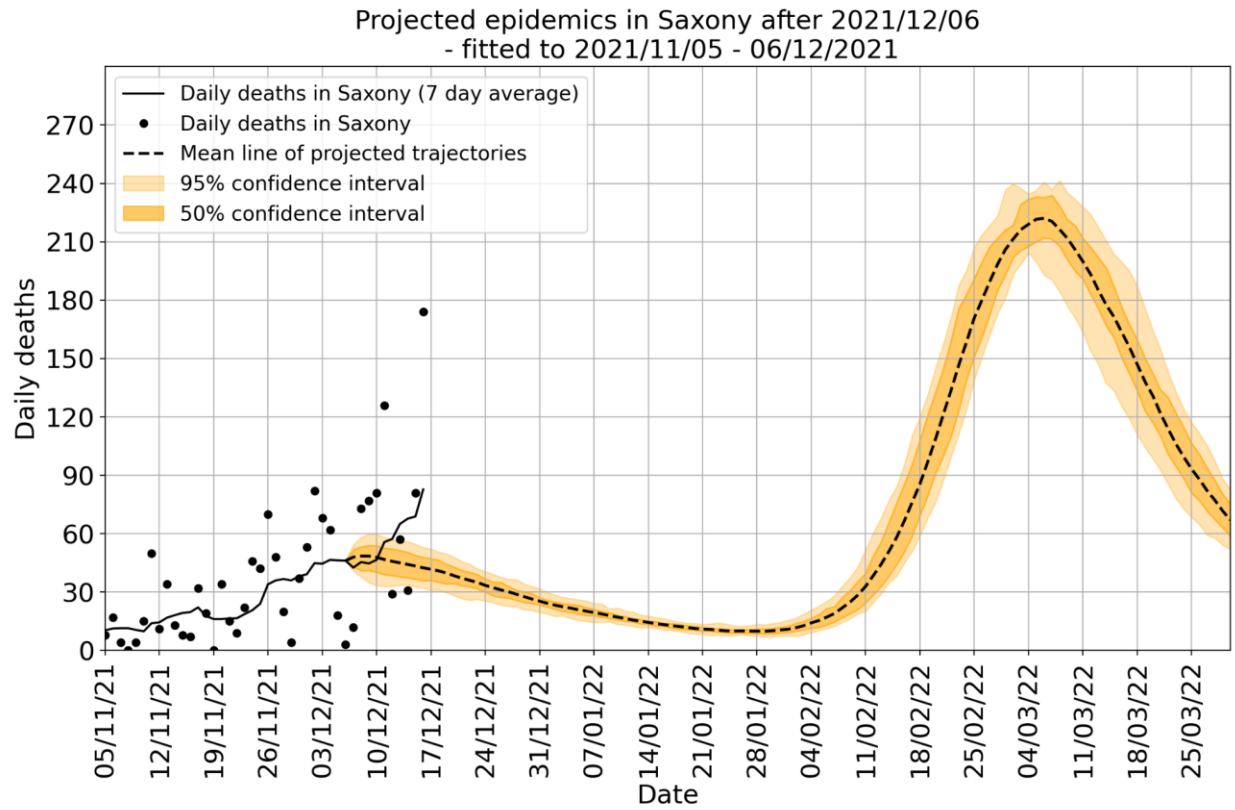
### 2.3.2. Infectivity 3x Delta



csv: <https://drive.google.com/drive/u/0/folders/1CWjfceWyVfdx4WshAT8QPj3cpcfFQBky>

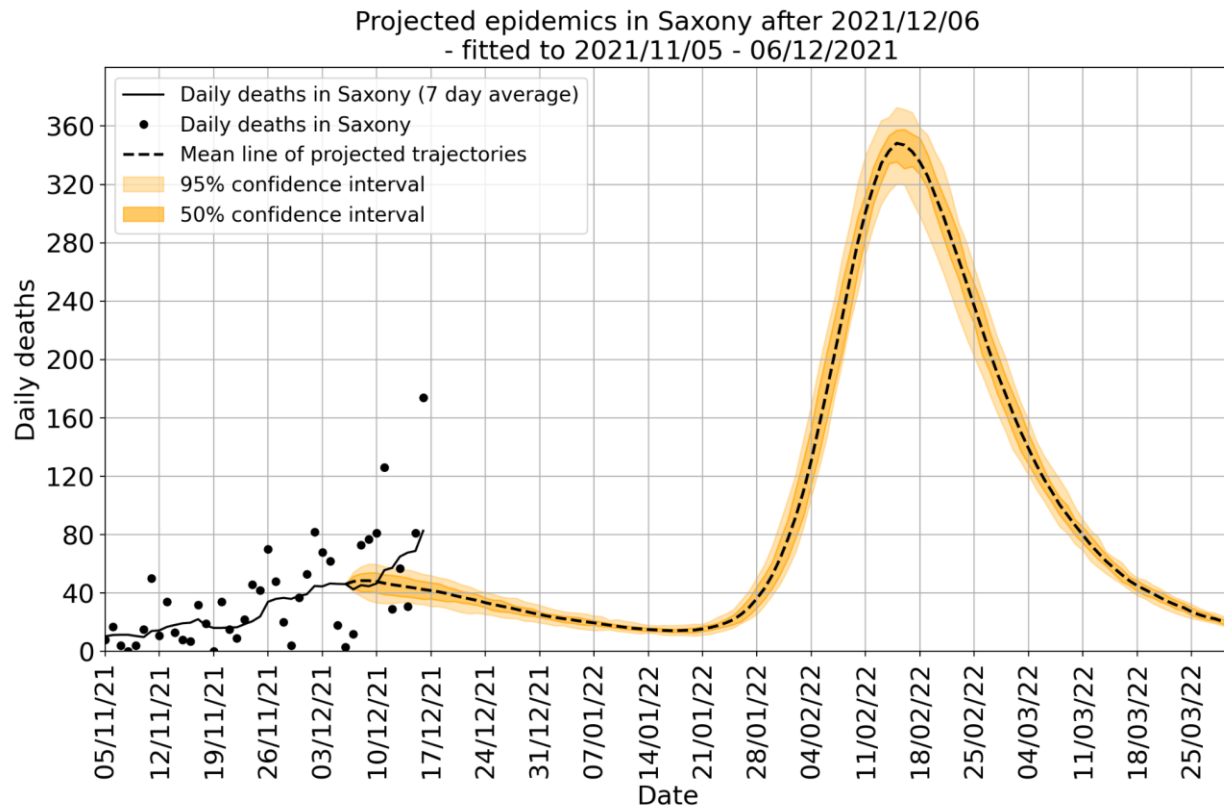
## 2.4. Deaths forecast for 0.5 IFR

### 2.4.1. infectivity 2x Delta



csv: <https://drive.google.com/drive/u/0/folders/1UD8j96jbskC2VI4m17Qo6PO4V2UJtDA9>

## 2.4.2. Infectivity 3x Delta



csv: <https://drive.google.com/drive/u/0/folders/1kdjya8xIVIBYCAyClM-pUXMbmeC9RiqF>

## 3. Simplified booster scenarios for Omicron

### Main assumptions:

- Booster vaccination gives 100% protection from symptomatic disease while the rest (natural immunity or up to two vaccination doses) gives no immunity and no protection against severe symptoms and death  
**Remark: Giving no protection against severe symptoms and deaths is pessimistic assumption resulting in much higher number of deaths compared to more realistic Data-driven Omicron Scenario (See chapter 2)**
- Two values of IFR of omicron relative to the delta variant were considered: 10% and 50%.
- Two infectivity levels of omicron relative to the delta variant were considered: 2x and 3x.
- For 2x infectivity we checked three pairs of contact tracing (b) and probability of detecting mild cases (q):  $b=q=0.1$ ,  $b=q=0.2$  and  $b=q=0.3$

- For 3x infectivity we checked only one set of params of contact tracing (b) and probability of detecting mild cases (q):  $b=q=0.1$
- **Level of restricting contacts (f) value has been estimated to be in the range 0.45 - 0.5 (see heatmaps)**
- **Level of immunization value has been estimated to be in the range 0.25 (see heatmaps)**

## Specification of agent based model

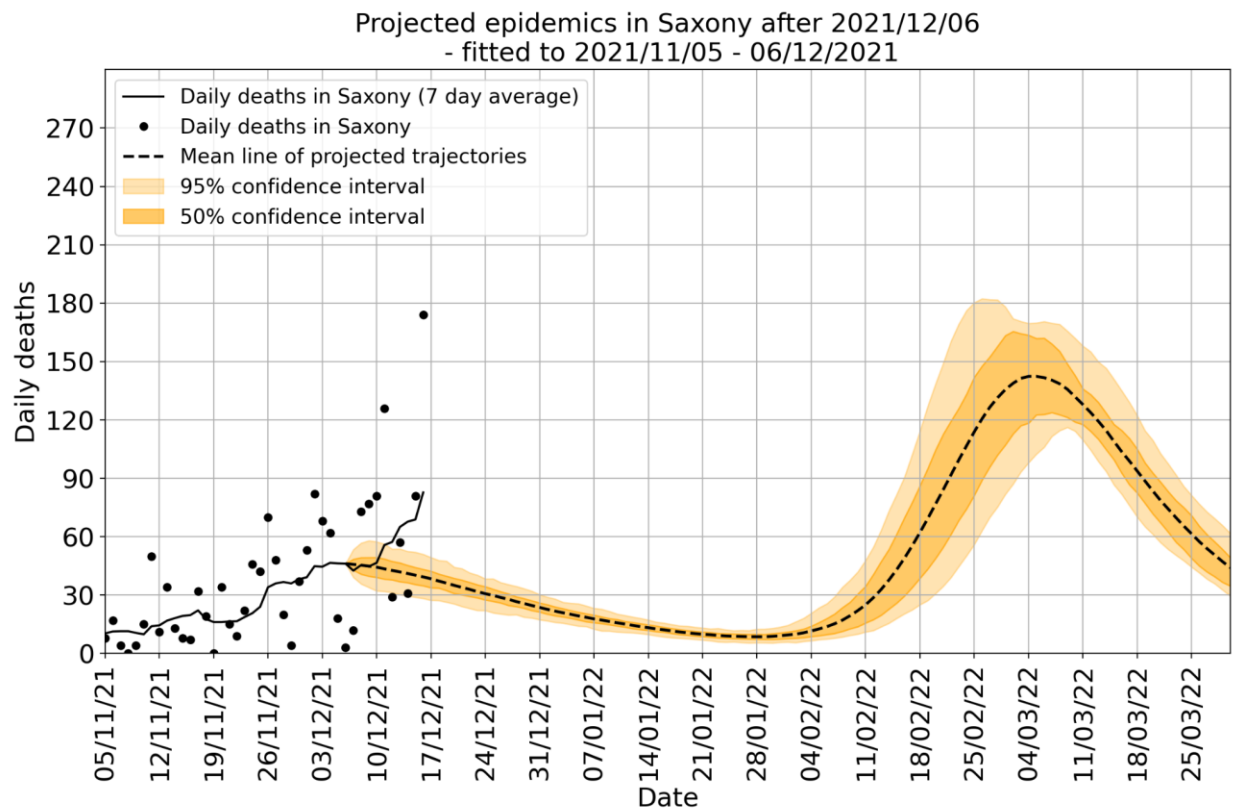
We ran an agent based model tailored for Saxony. The configuration and setup includes:

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  - a. All infections are due to omicron variant, that are later in a post processing step added on top of current delta-variant forecasts
  - b. Contact tracing has a delay of around 2 days
  - c. Base level of vaccinations in age groups according to this page as of Dec 21st 2021 <https://www.coronavirus.sachsen.de/ueberblick-coronaschutzimpfungen-in-sachsen-9874.html#a-11374>
    - i. 0-11: booster: 0%
    - ii. 12-17: booster vaccination: 2.9%
    - iii. 18-59: booster vaccination: 20.5%
    - iv. 60+: booster vaccination: 42.9%
    - v. Total population: booster vaccination: 25%
  - d. Assuming simplified protection from vaccinations:
    - i. Protection against symptomatic infection: booster: 100%, without booster: 0%
    - ii. Protection against hospitalization: booster: 100%, without booster: 0%
    - iii. Protection against death: booster: 100%, without booster: 0%
  - e. Assuming natural immunization protects in 0% from symptomatic infection
  - f. Using social contact freq matrices from COVIMOD
  - g. Screening of kids in schools 2 times per week
    - i. Assuming 80% effectivity of single test
    - ii. Age range of kids screened: 8 - 16
  - h. 37% of people having CoronaWarnApp or similar app that can help in contact tracking
    - i. Assuming 6 hours of delay for testing for CoronaWarnApp users
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    - iii. Onset - Hospitalization delay: Exponential distribution with mean 3.78 days

- iv. Onset - death delay: Log-normal distribution with log-mean 1.70 and scale 1.21

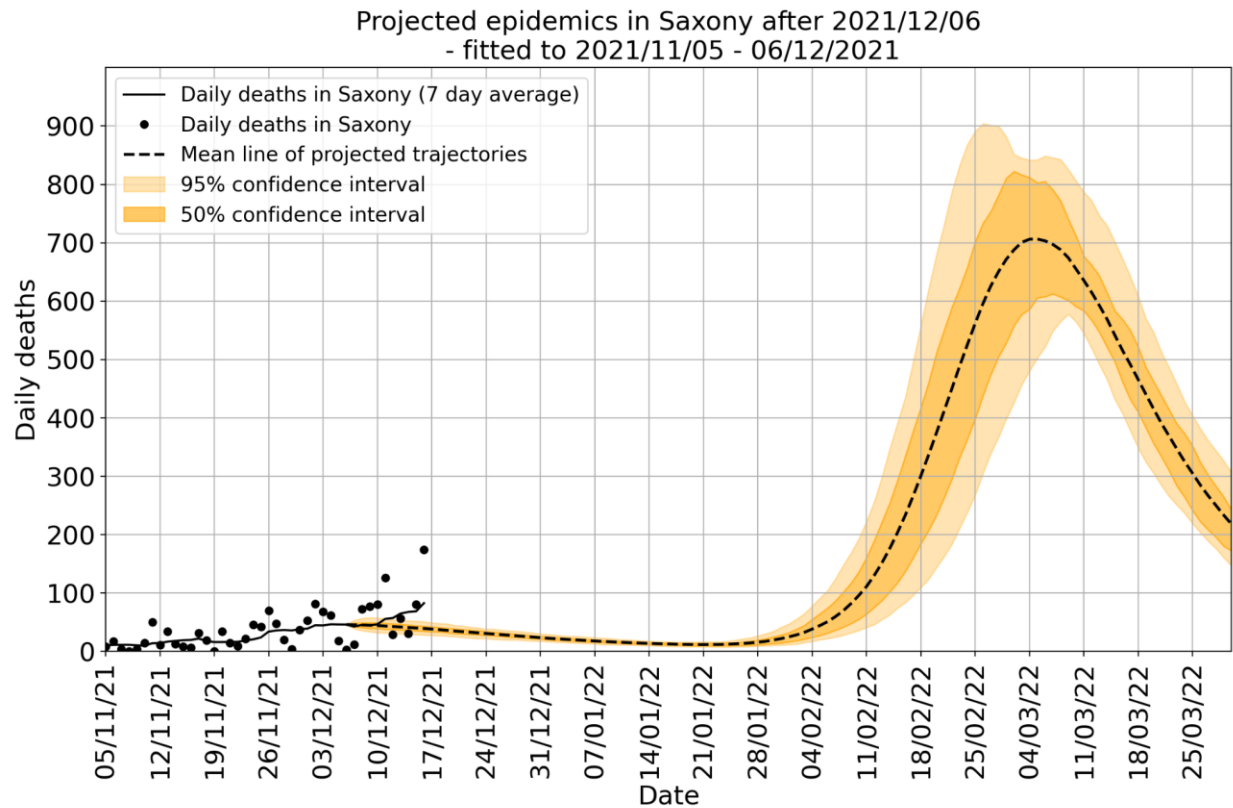
## Pictures and links to csvs

### 3.1. Deaths forecasts for 0.1 IFR and 2x infectivity



csv: <https://drive.google.com/drive/u/0/folders/1GGdFdGYQsed6iVnCtx706fD4TrcM9zzS>

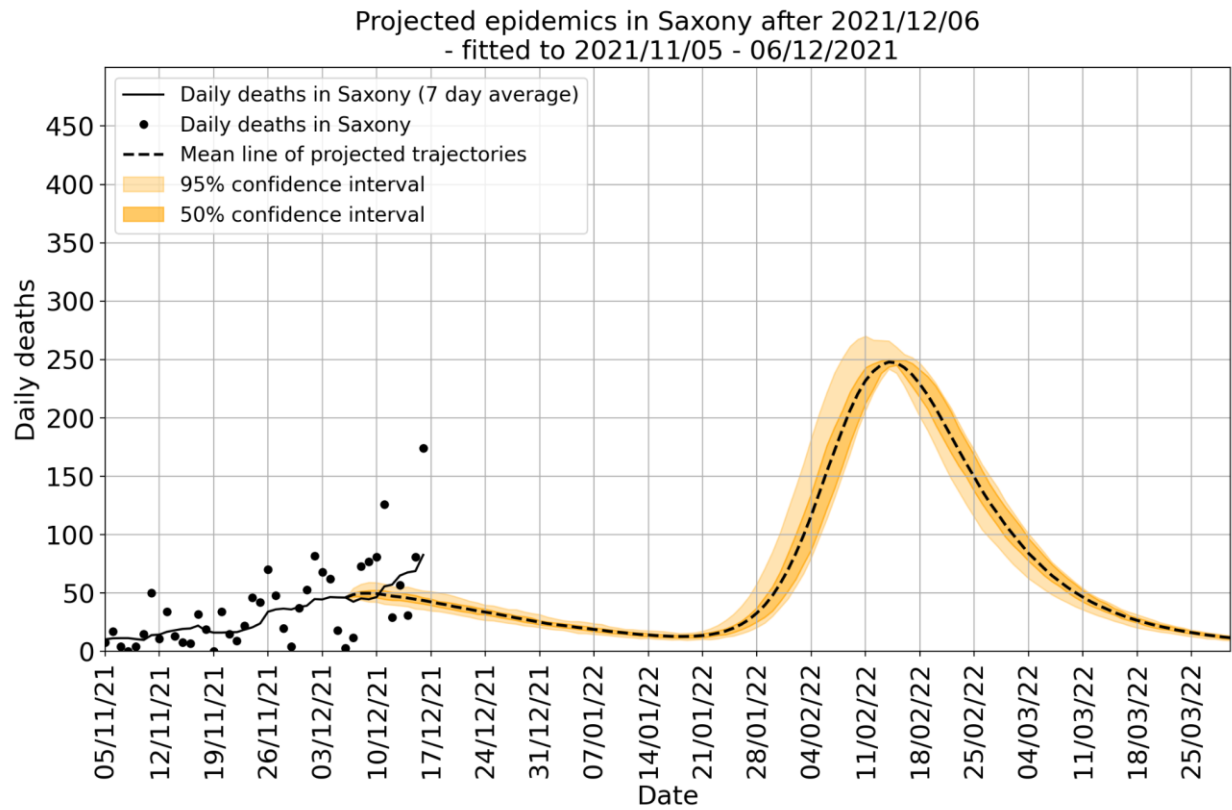
### 3.2. Deaths forecasts for 0.5 IFR and 2x infectivity



csv: <https://drive.google.com/drive/u/0/folders/1q5QzsscHqQ9tnu0WZ6GNWmrSW5ZCDeSR>

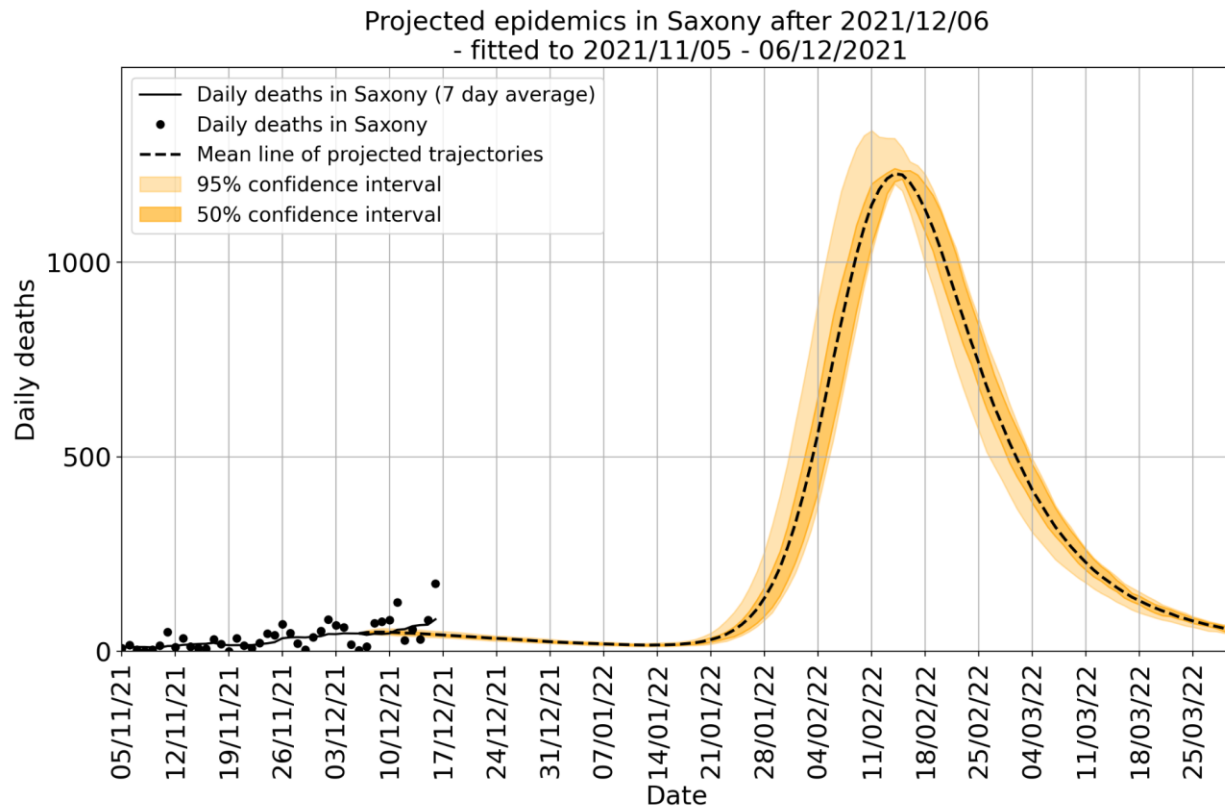


### 3.3. Deaths forecasts for 0.1 IFR and 3x infectivity



csv: <https://drive.google.com/drive/u/0/folders/1efJBegCMBpoX67c-KtM2VWVaxvX9wVYJ>

### 3.4. Deaths forecasts for 0.5 IFR and 3x infectivity



csv: <https://drive.google.com/drive/u/0/folders/1IZq-cy-gvgpFmfktbeuKogNIVAXmKoXk>

## 4. Heatmaps - simplified booster scenario

### Main assumptions:

- Booster vaccination gives 100% protection from symptomatic disease while the rest (natural immunity or up to two vaccination doses) gives no immunity and no protection against severe symptoms and death  
**Remark: Giving no protection against severe symptoms and deaths is pessimistic assumption resulting in much higher number of deaths compared to more realistic Data-driven Omicron Scenario (See chapter 2)**
- Two infectivity levels of omicron relative to the delta variant were considered: 2x and 3x.
- For 2x infectivity we checked three pairs of contact tracing (b) and probability of detecting mild cases (q):  $b=q=0.1$ ,  $b=q=0.2$  and  $b=q=0.3$
- For 3x infectivity we checked only one set of params of contact tracing (b) and probability of detecting mild cases (q):  $b=q=0.1$

- **Level of restricting contacts (f) value has been estimated to be in the range 0.7 - 0.75 (see heatmaps)**

## Specification of agent based model

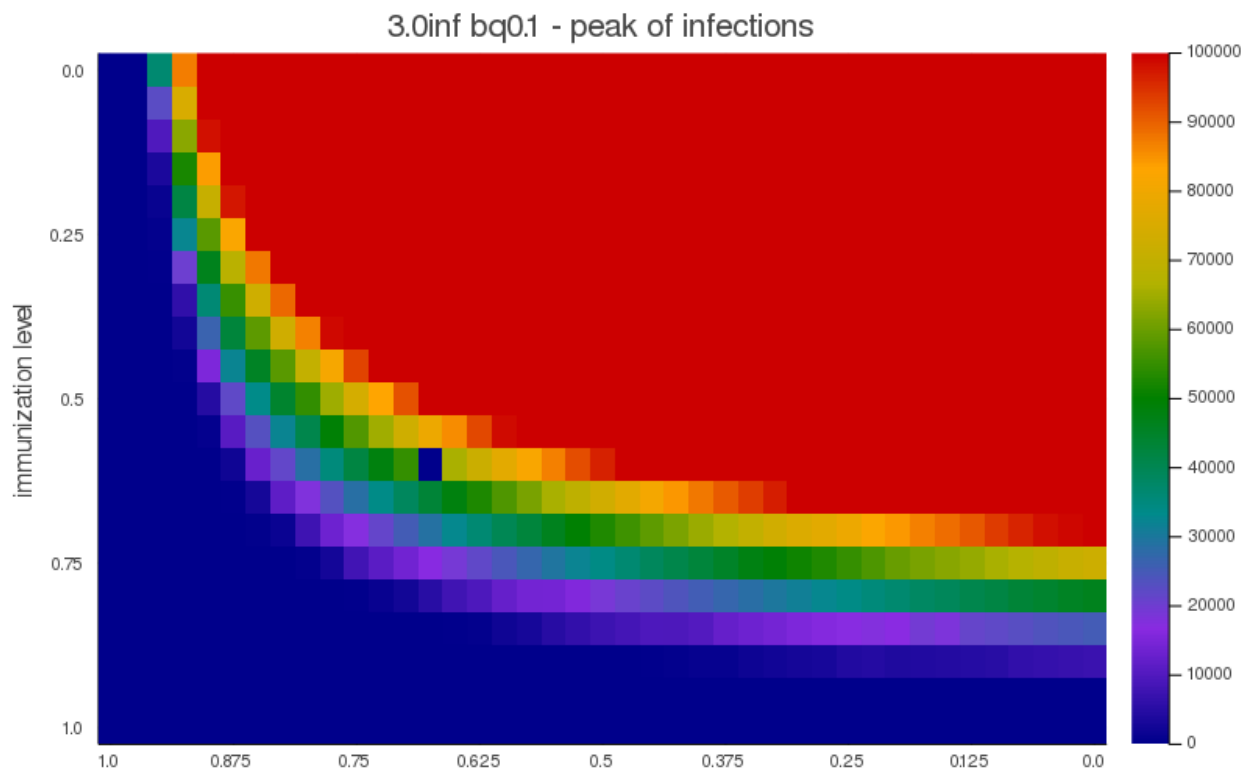
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  - b. Contact tracing has a delay of around 2 days
  - c. Assuming simplified protection from vaccinations:
    - i. Protection against symptomatic infection: booster: 100%, without booster: 0%
    - ii. Protection against hospitalization: booster: 100%, without booster: 0%
    - iii. Protection against death: booster: 100%, without booster: 0%
  - d. Assuming natural immunization protects in 0% from symptomatic infection
  - e. Using social contact freq matrices from COVIMOD
  - f. Screening of kids in schools 2 times per week
    - i. Assuming 80% effectivity of single test
    - ii. Age range of kids screened: 8 - 16
  - g. 37% of people having CoronaWarnApp or similar app that can help in contact tracking
    - i. Assuming 6 hours of delay for testing for CoronaWarnApp users
  - h. Probability of developing symptoms requiring hospitalization based on available dataset of patients. Mean hospital stay assumed to be 10 days
  - i. Distributions used in the disease progression:
    - i. Incubation time: Log-normal distribution with log-mean 1.37 and scale 0.5
    - ii. Symptom onset time: Gamma distribution with shape  $\alpha=0.87$  and scale  $\theta=2.91$
    - iii. Onset - Hospitalization delay: Exponential distribution with mean 3.78 days
    - iv. Onset - death delay: Log-normal distribution with log-mean 1.70 and scale 1.21

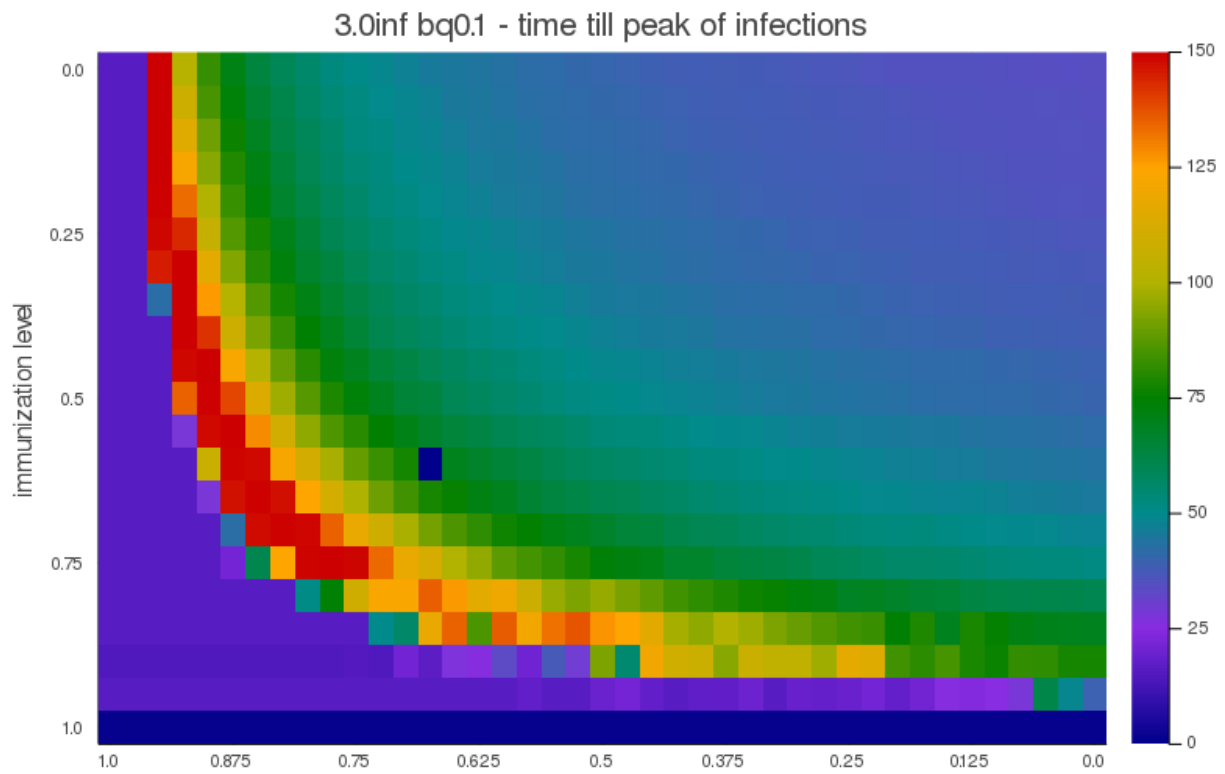
## Heatmaps

4.1 for 3x infectivity and  $b=q=0.1$

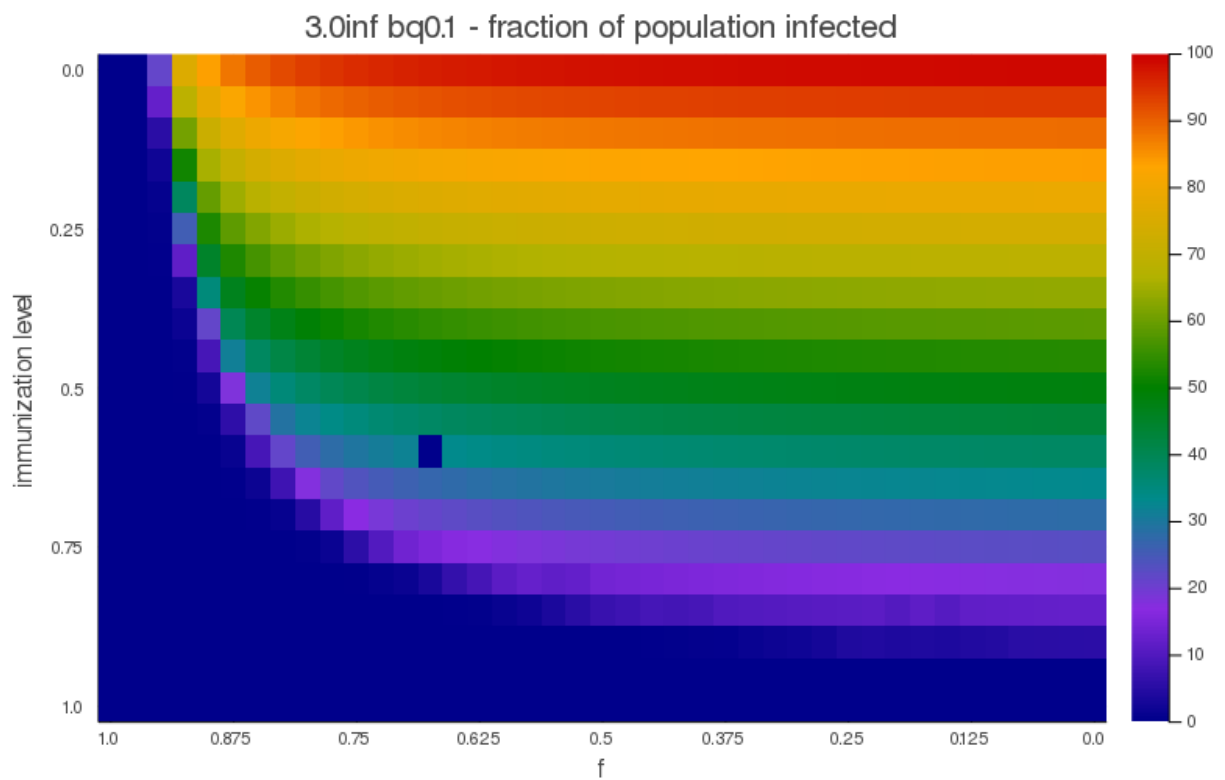
4.1.1 peak of infections



4.1.2 Time till peak of infections

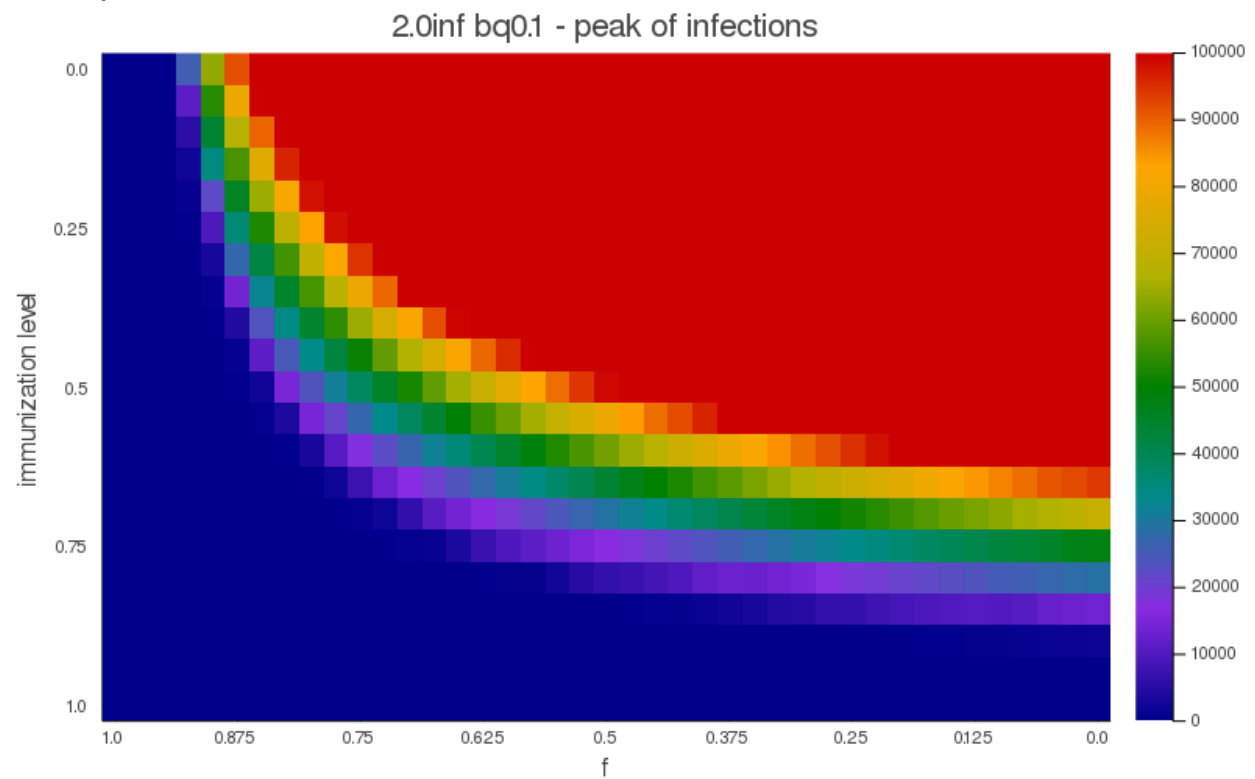


#### 4.1.3 Fraction of population infected

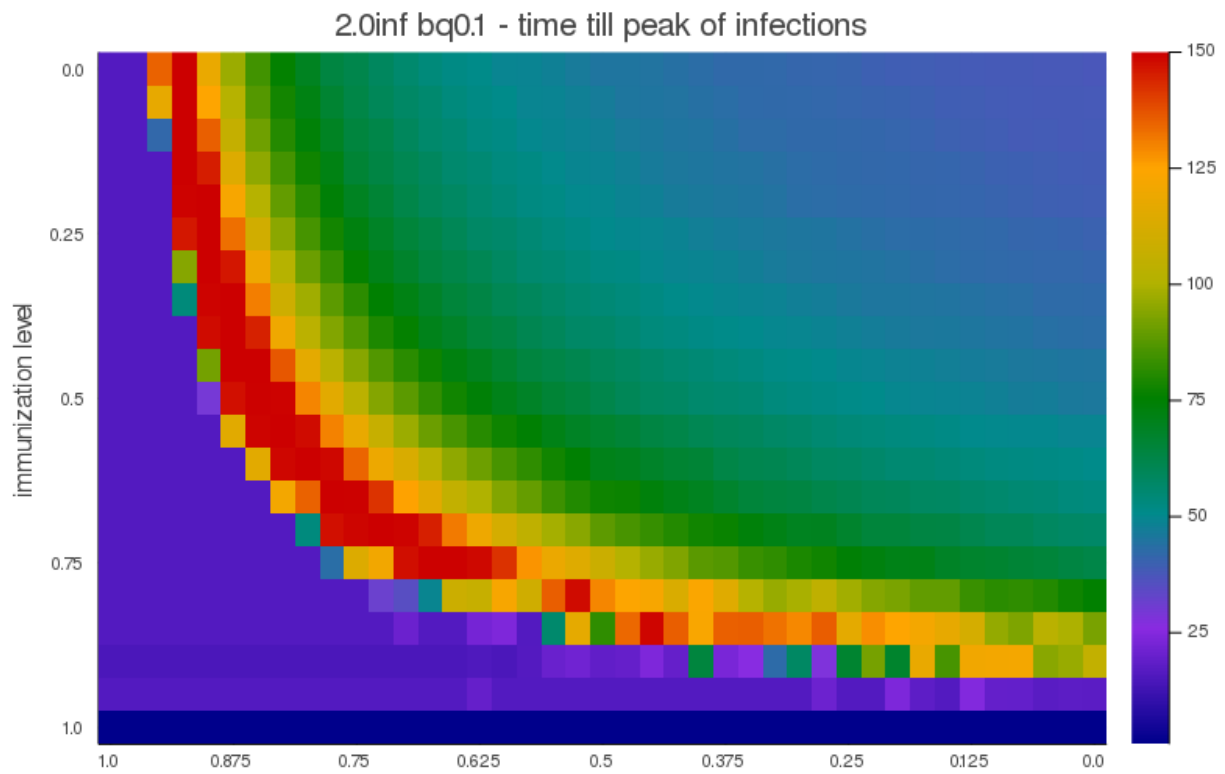


4.2 for 2x infectivity and  $b=q=0.1$

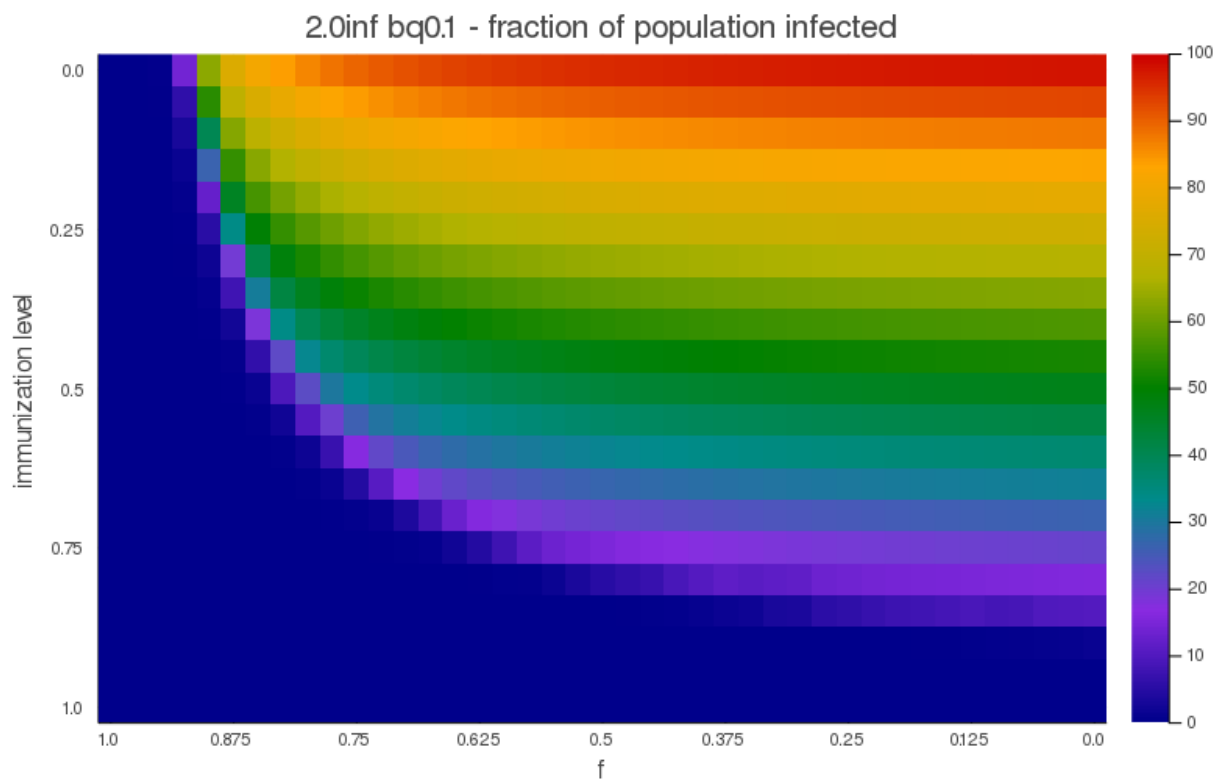
#### 4.2.1 peak of infections



#### 4.2.2 Time till peak of infections



#### 4.2.3 Fraction of population infected



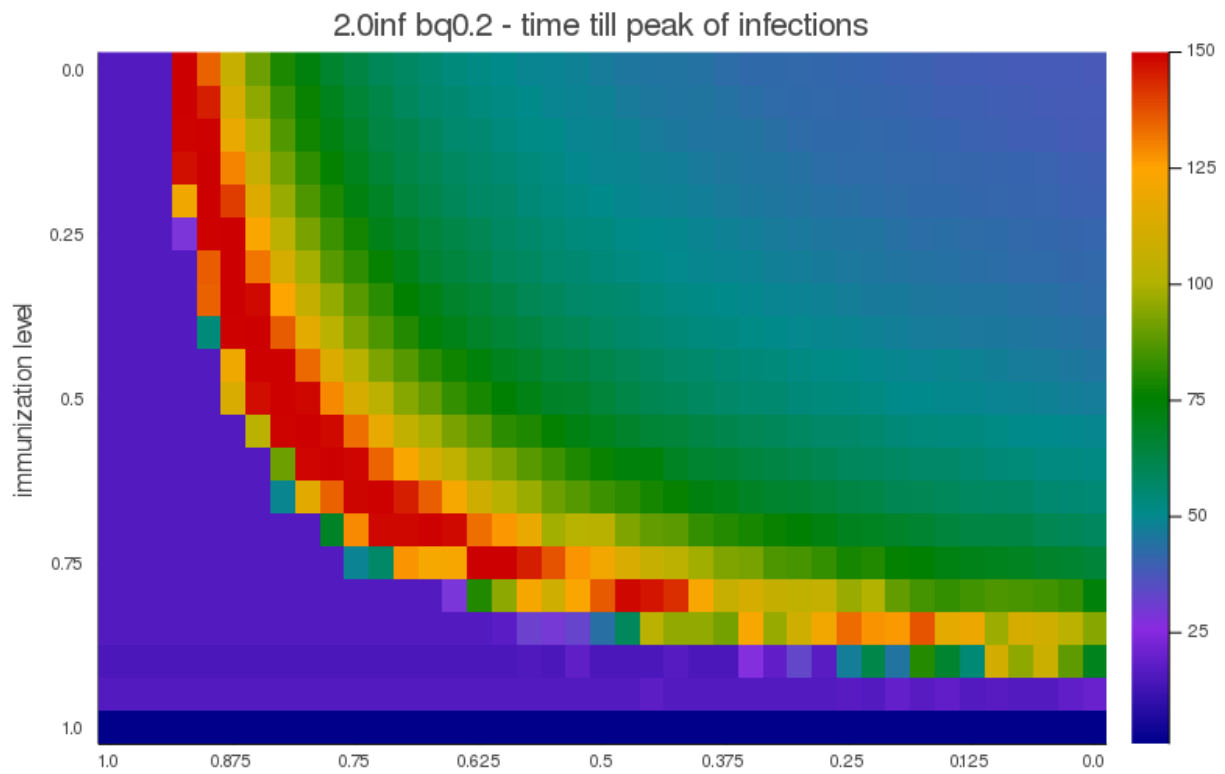
4.2 for 2x infectivity and  $b=q=0.2$

#### 4.2.1 peak of infections

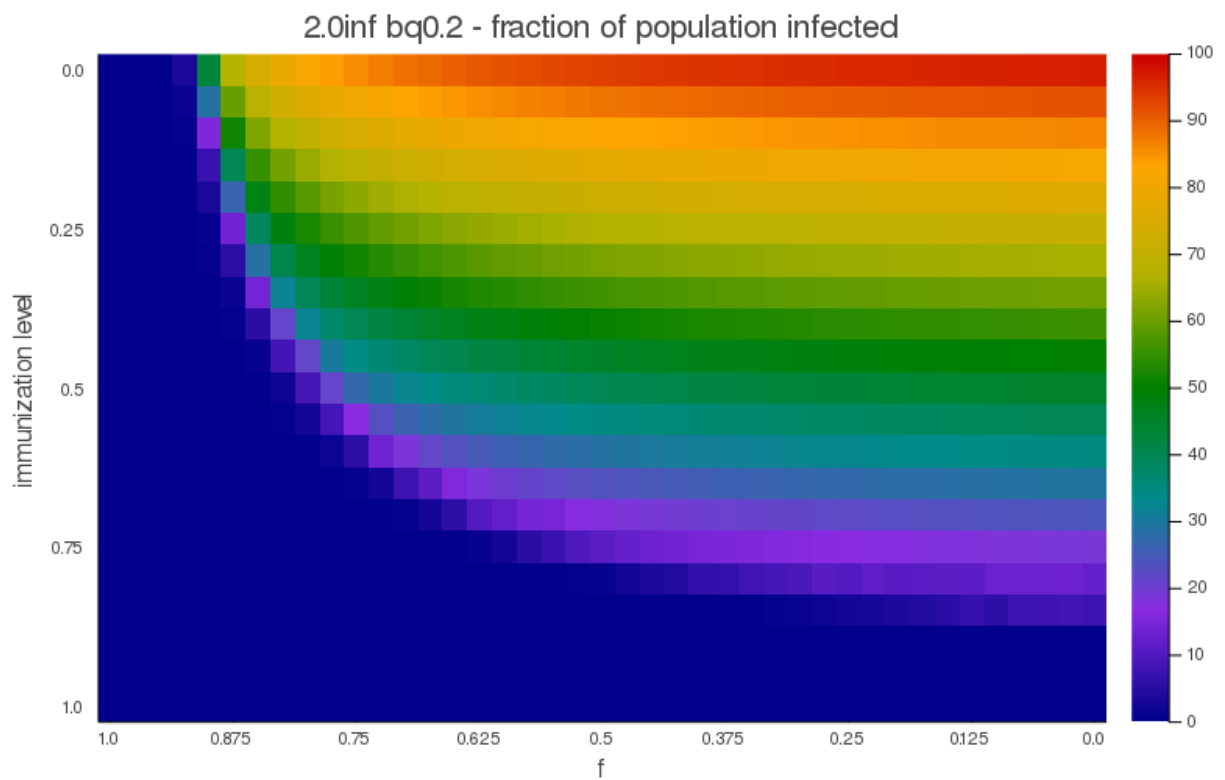


#### 4.2.2 Time till peak of infections



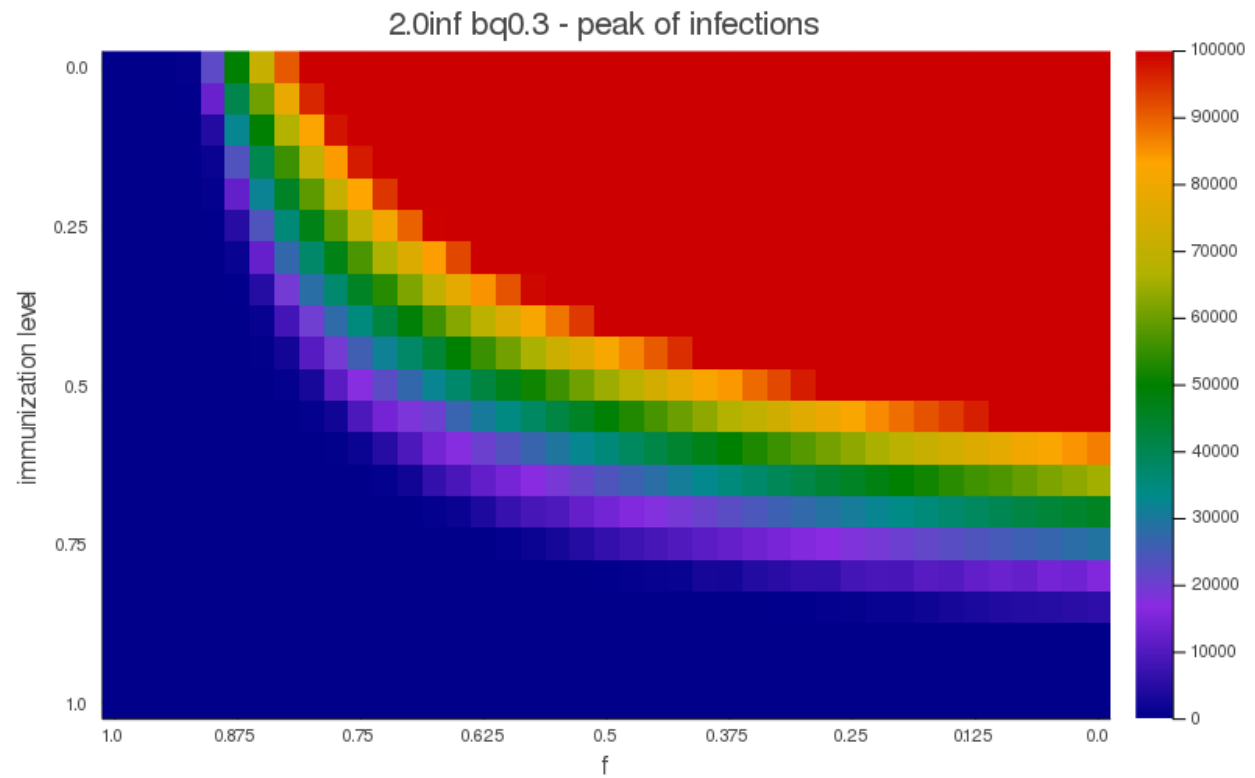


#### 4.2.3 Fraction of population infected

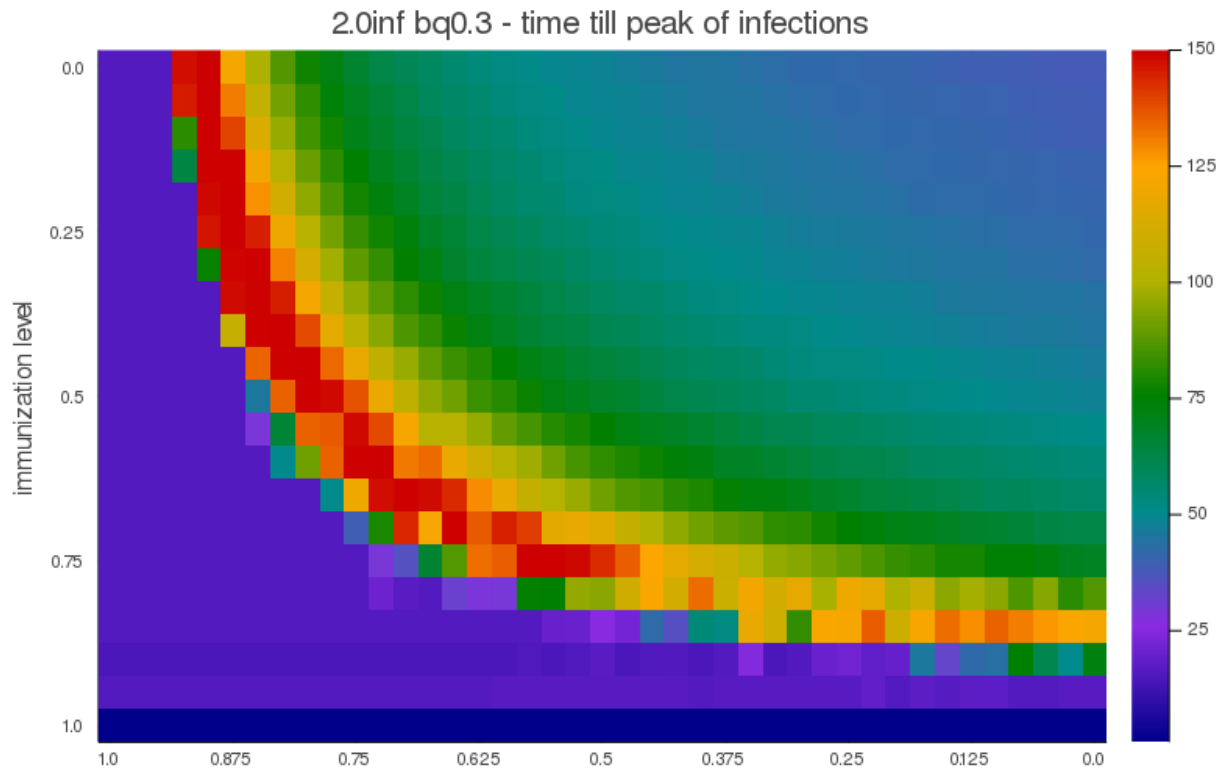


4.2 for 2x infectivity and  $b=q=0.3$

#### 4.2.1 peak of infections



#### 4.2.2 Time till peak of infections



#### 4.2.3 Fraction of population infected

