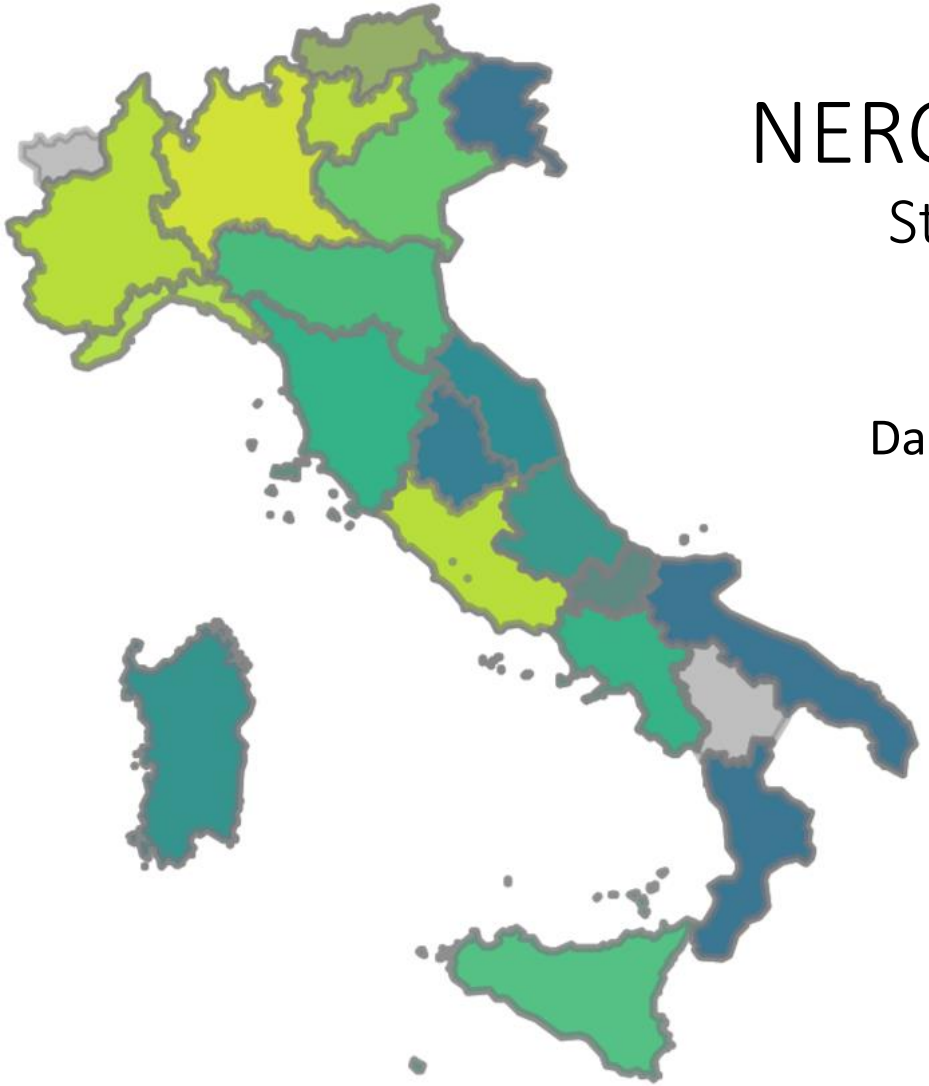


Bath Air Squad

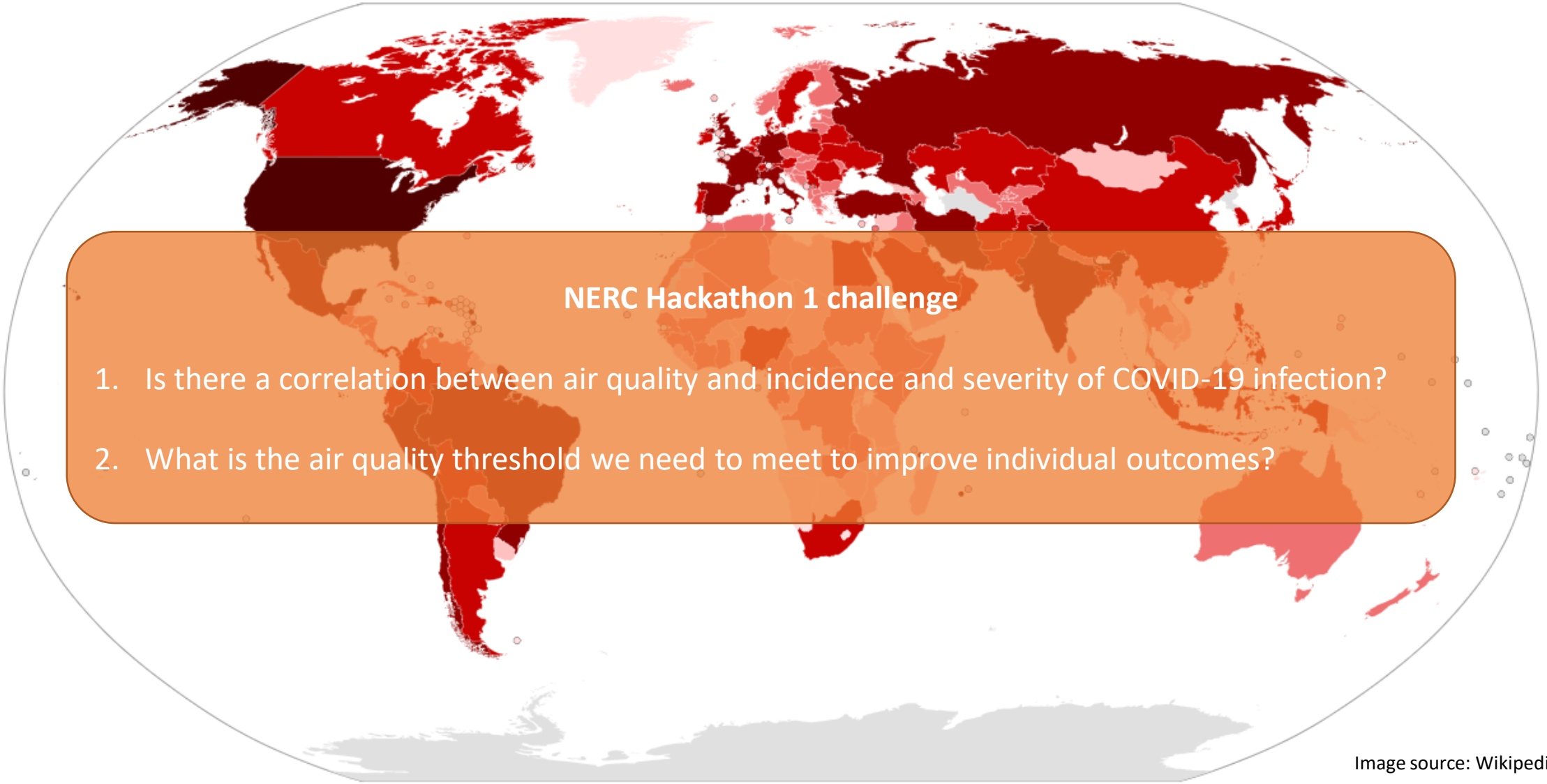
NERC Hackathon 1 summary presentation

State-of-the-art Bayesian framework for analysing air pollution effect on COVID-19 infection rate

Daniel Burrows, Piotr Morawiecki, Laura Oporto and Yang Zhou

UNIVERSITY OF BATH

Introduction



NERC Hackathon 1 challenge

1. Is there a correlation between air quality and incidence and severity of COVID-19 infection?
2. What is the air quality threshold we need to meet to improve individual outcomes?

Image source: Wikipedia

Infection model

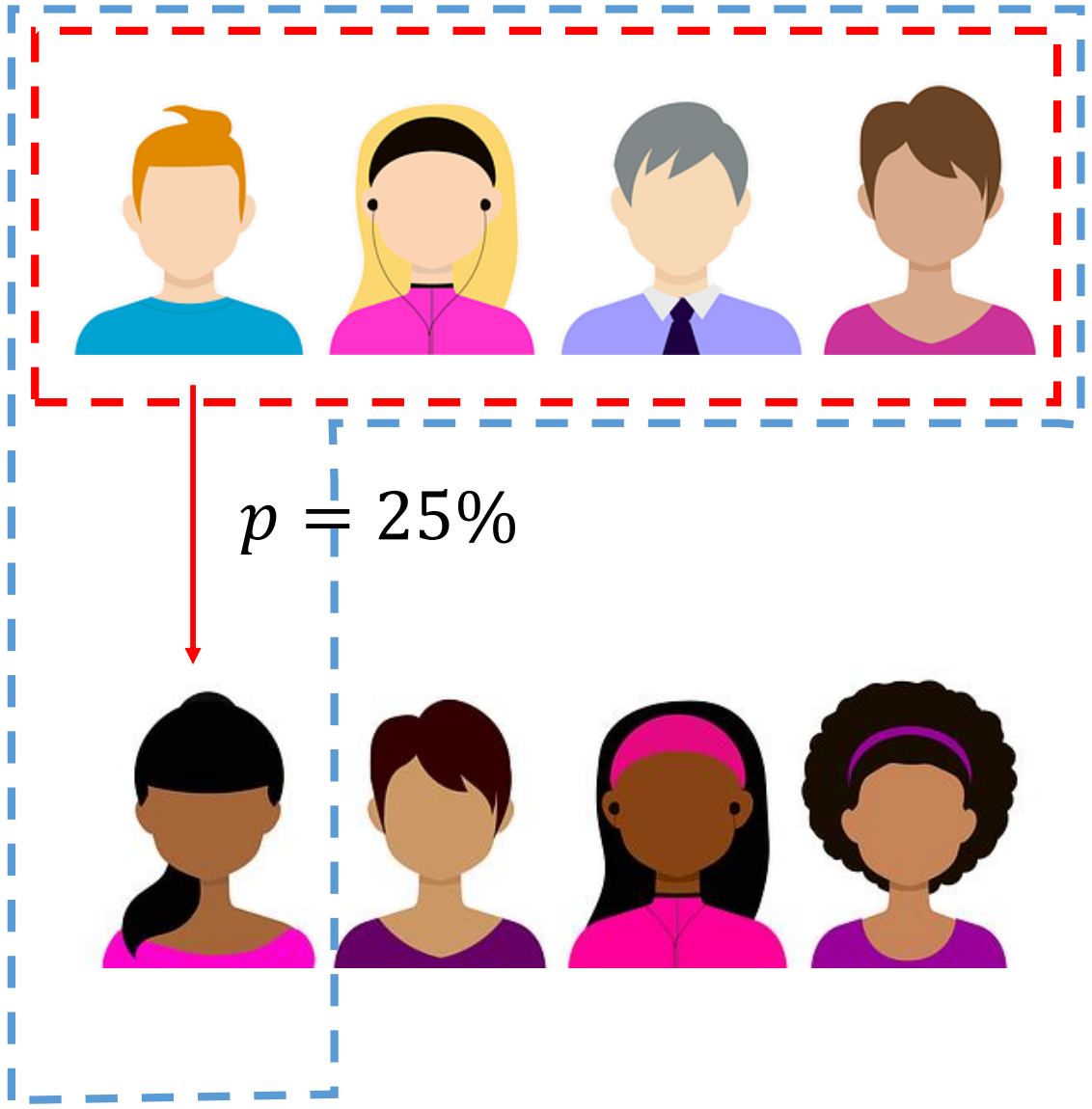
$$a_{t+1}^i - a_t^i = \text{Poisson}(a_t^i p_t^i)$$

$$\ln(p_t^i) = \theta_0 + \theta X_t^i + u^i + v_t + w_t^i$$

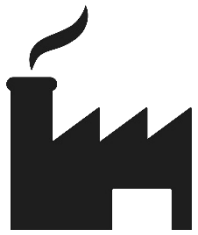
Linear coefficients

Parameters

Random effects



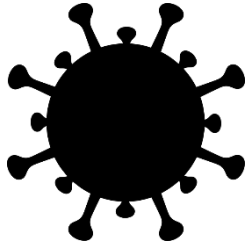
Bayesian framework in R



Air pollution data

Pollutant _data_preprocessing

pollution_data.csv



COVID data, county data

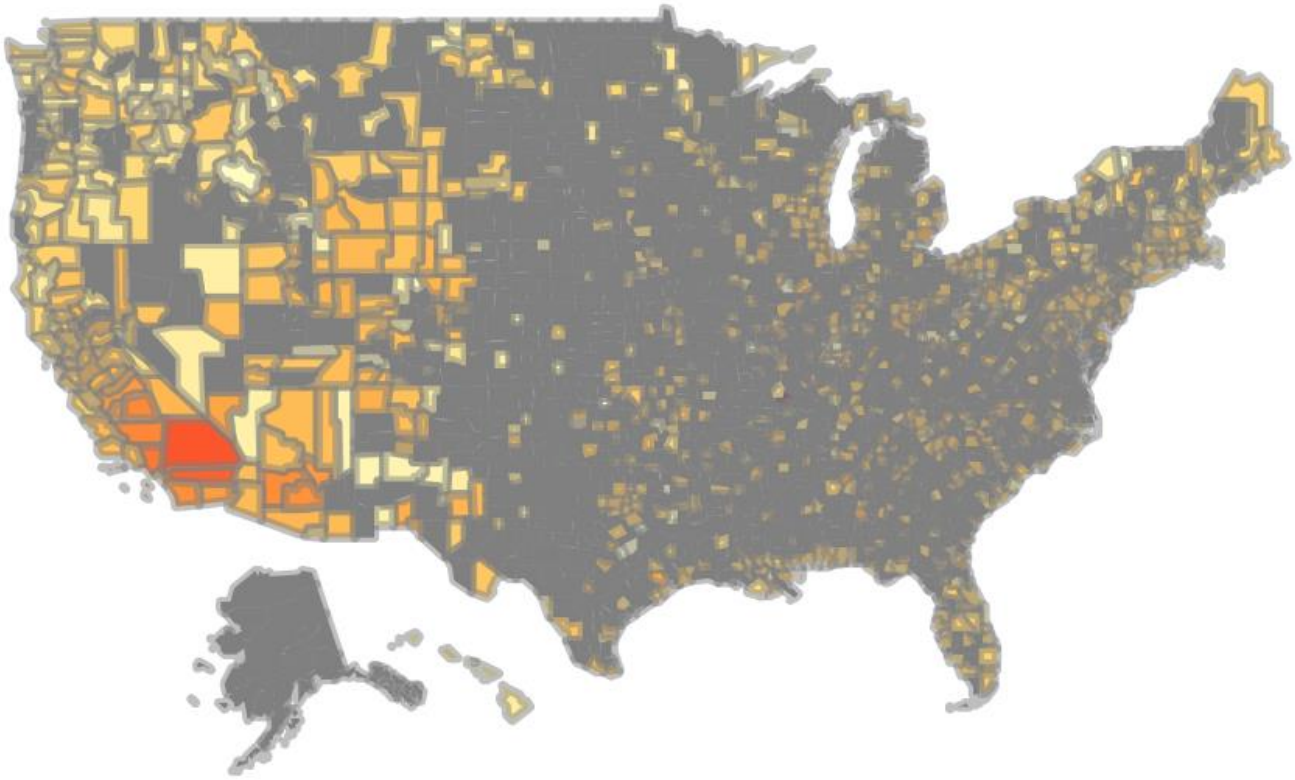
INLA_data_preprocessing

county_data.csv
weekly_data.csv
daily_data.csv

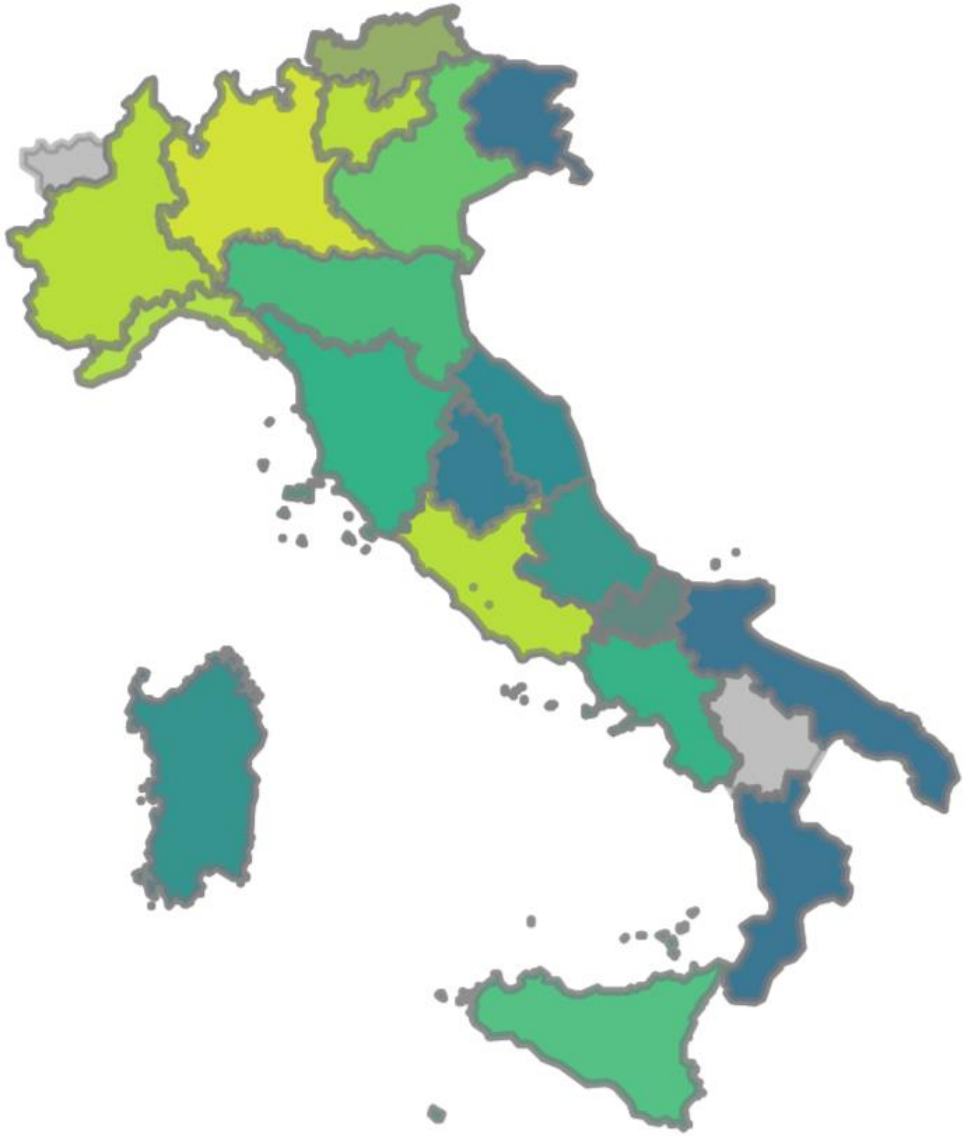
INLA_Bayesian_framework

Estimates of effect of each factor on infection rate

Images source: Pixabay



>50 parameters for USA



6 parameters for Italy

Italy Air Pollution data BathAirSquad/Hackathon 1 NO2 PM2.5 PM10 INLA results

Italy NO2 map

https://people.bath.ac.uk/lcol20/hackathon1/Italy_AirPollutionMap.html

Mean NO2 (2016-2019). Source: EPA,2020

Show 10 entries Search:

id	region	NO2
02	Valle d'Aosta	
21	P.A. Bolzano	33.9061111111111
21	P.A. Bolzano	35.8013966480447
21	P.A. Bolzano	35.3568452380952
21	P.A. Bolzano	
22	P.A. Trento	39.096694214876
22	P.A. Trento	41.3852320675106
22	P.A. Trento	39.4991666666667
22	P.A. Trento	36.5867403314917
11	Marche	19.9479069767442

Showing 1 to 10 of 77 entries

Previous 1 2 3 4 5 ... 8 Next

How to create model?

use_deaths <- TRUE

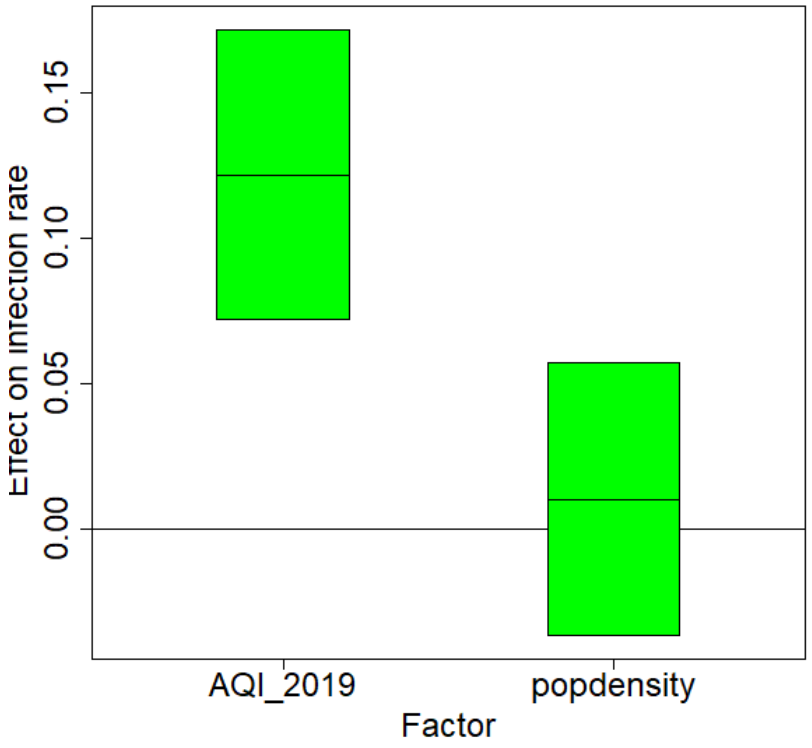
use_Poisson <- TRUE

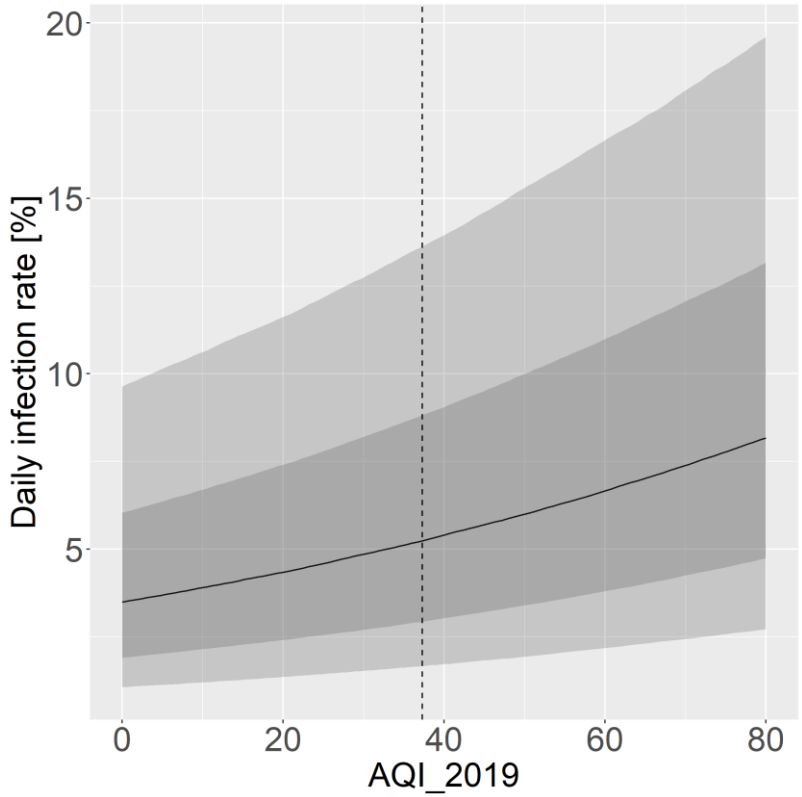
use_weekly <- TRUE

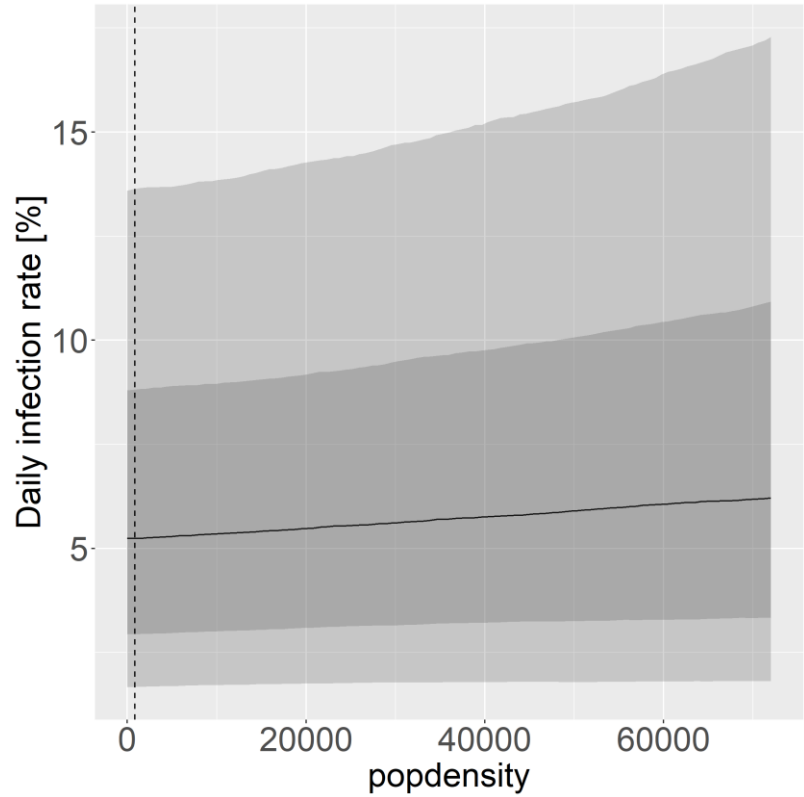
$$\ln\left(p_t^i\right) = \theta_0 + \theta_1 AQI_{2019} + \theta_2 D + u^i + v_t + w_t^i$$

```
covariates <- c("AQI_2weeks", "popdensity")
formula <- new_cases ~ AQI_2019 + popdensity +
    f(id, model = "iid") +  f(day, model = "ar1") + f(rowId, model = "iid")
```

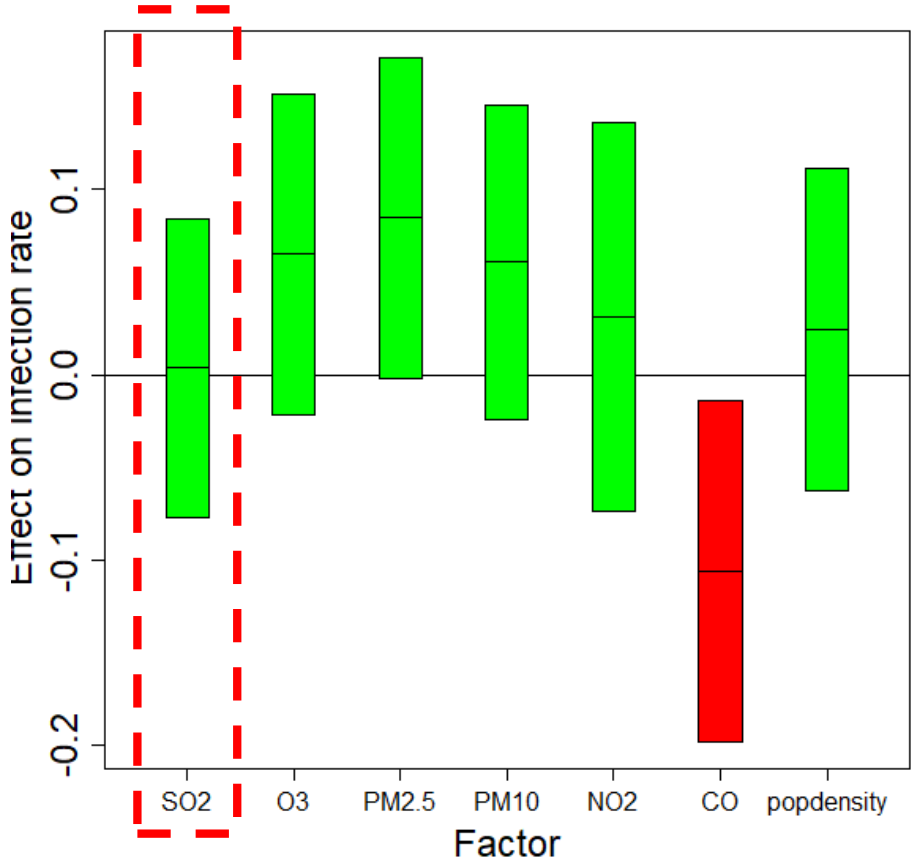
Model output

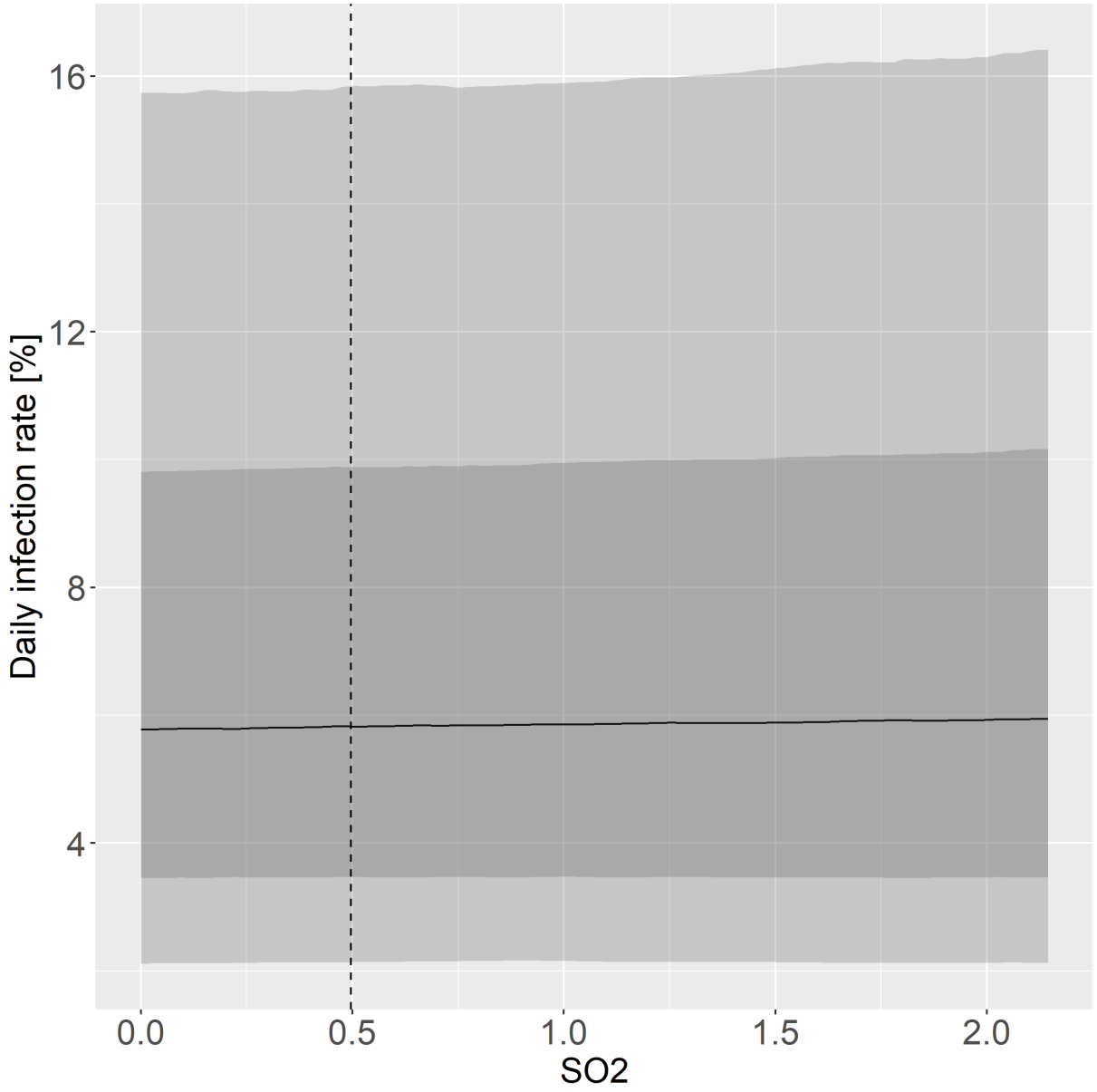




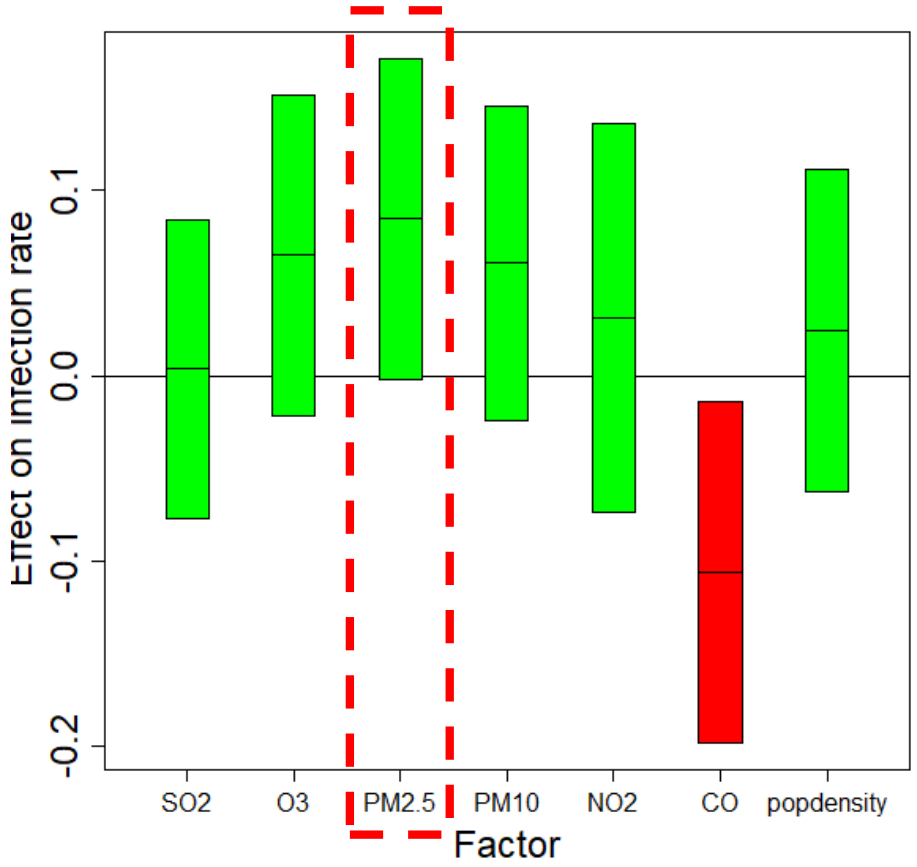


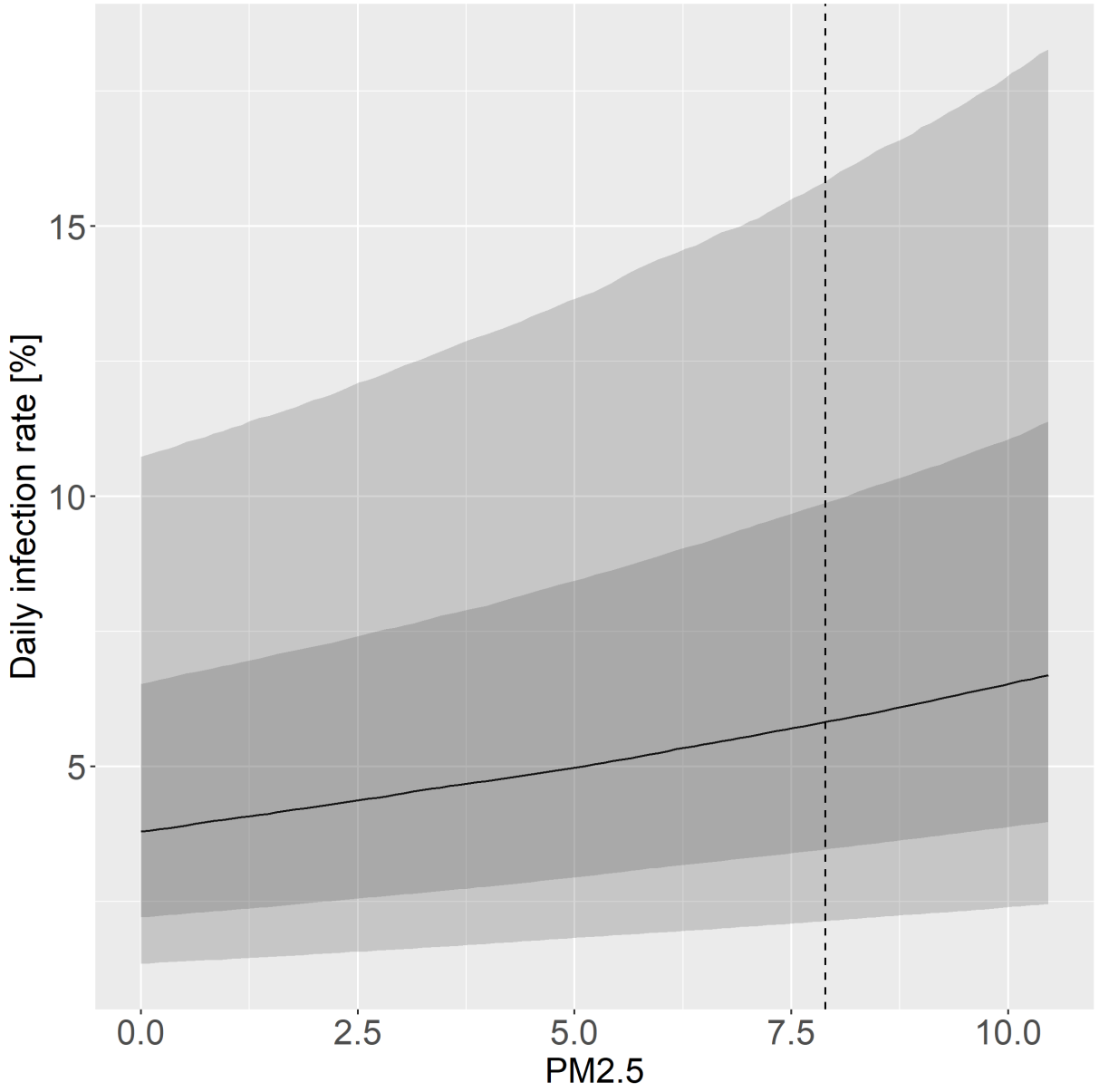
Another result



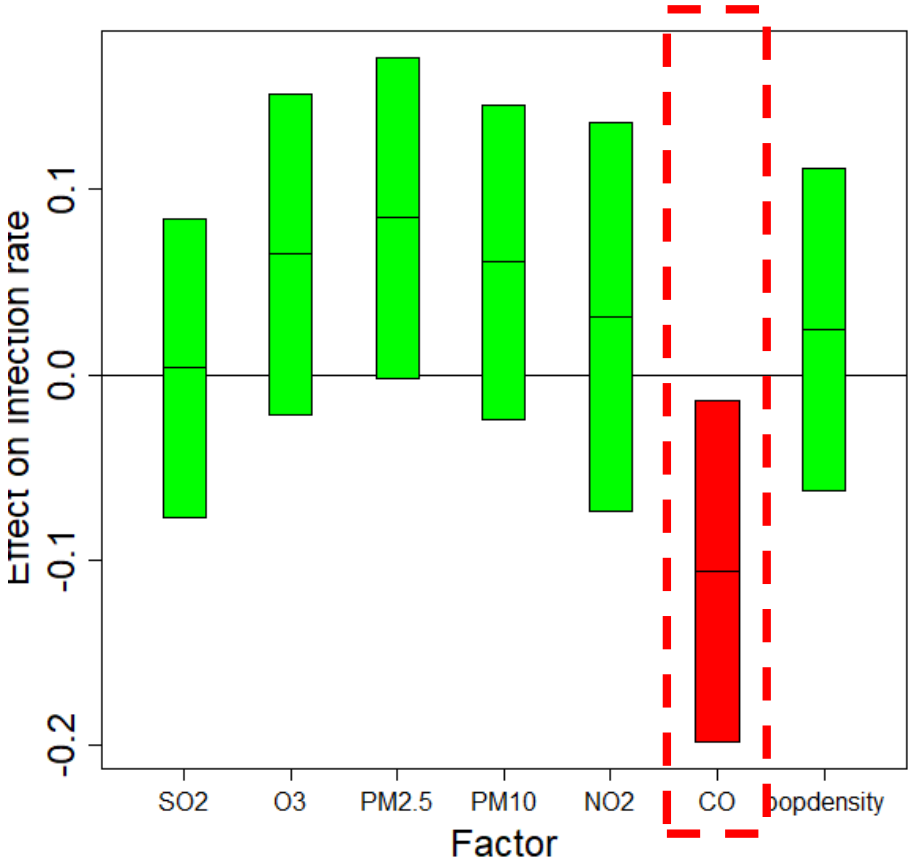


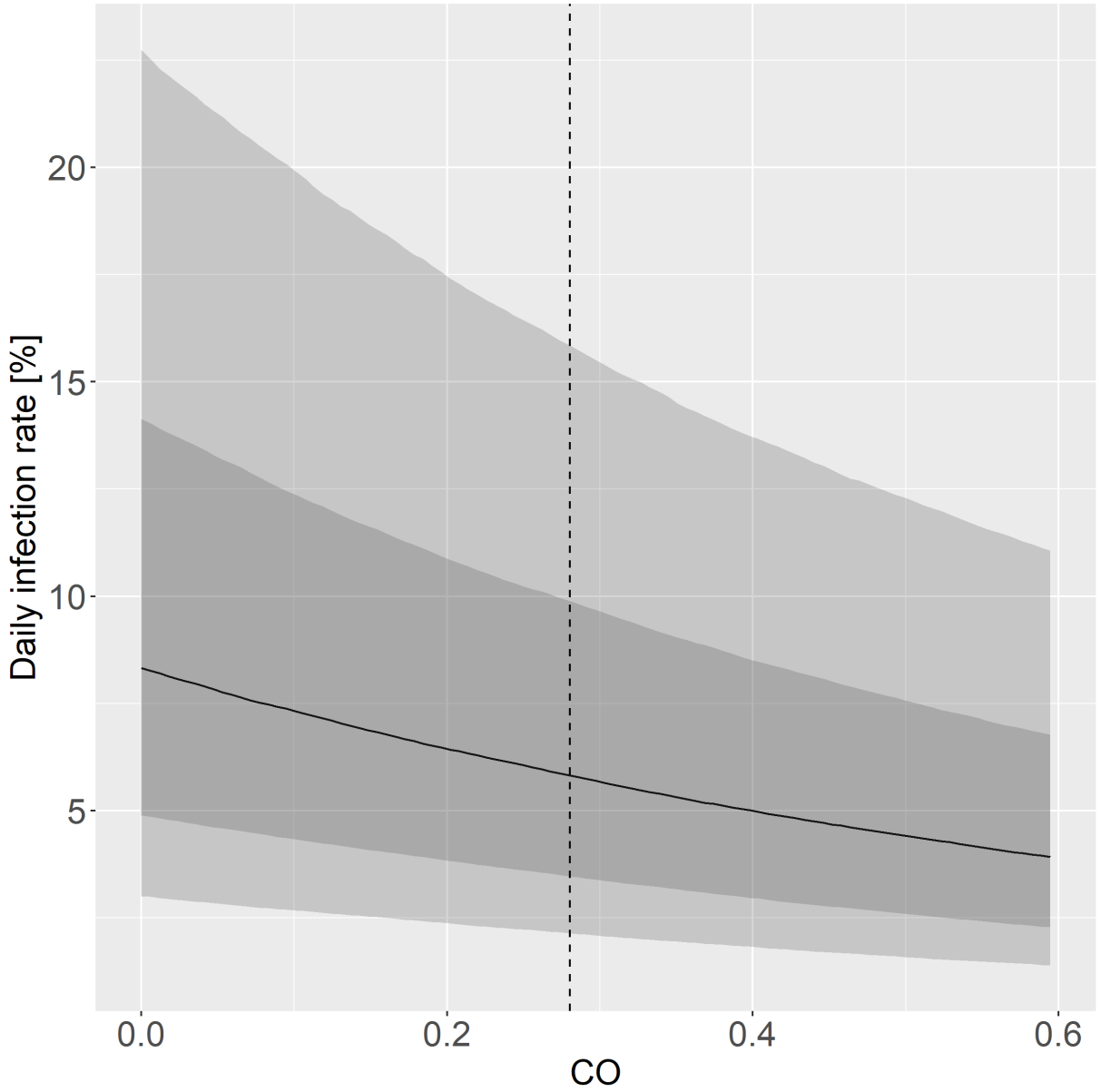
Another result





Another result





Summary

- Flexible, easy to use Bayesian framework for COVID-19 research
- Preliminary results allowed to investigate effect of air pollution in different time scales and effect of different pollutants.

Summary

- Flexible, easy to use Bayesian framework for COVID-19 research
- Preliminary results allowed to investigate effect of air pollution in different time scales and effect of different pollutants.

What's next?

- Extending air pollution data set with a transportation model assimilated with both satellites and monitoring stations data.
- Studying the standard epidemic models (e.g. SIR) with infection rate dependent on pollutant concentration.