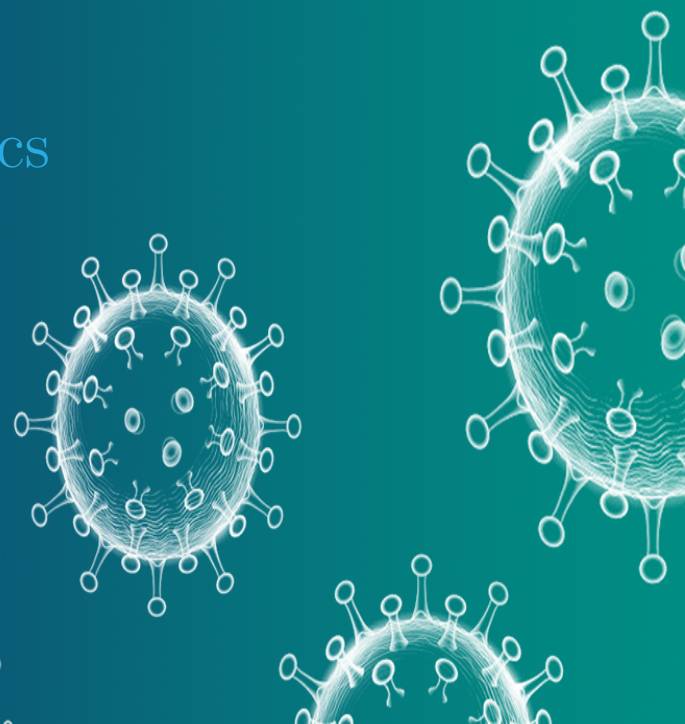
COVID-19
ANALYTICS
PUC-RIO

The Evolution of Covid-19 in Brazil
FGV - November 2020

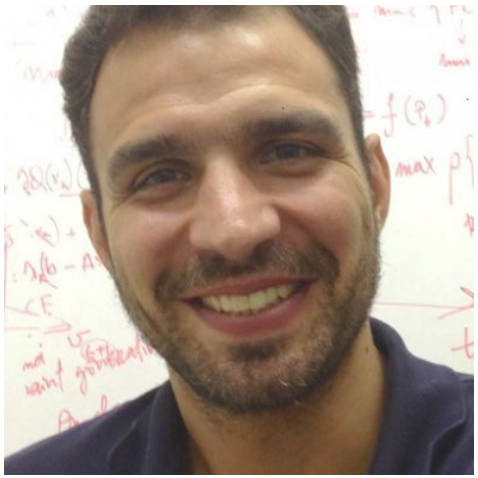
Marcelo C. Medeiros
Department of Economics
PUC-Rio



Who are we?

The Covid19Analytics team: the original group

M.C. Medeiros



A. Street

D. Valladão

G. Vasconcelos

E. Zilberman

Who are we?

The Covid19Analytics team: new associates

M. Fernandes

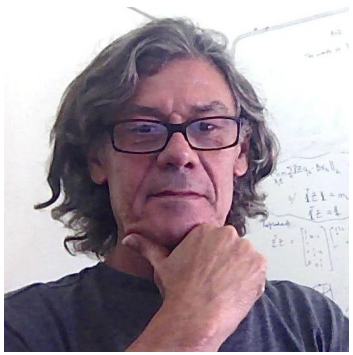
J. Antunes Neto

I. Ferreira

E.F. Mendes

T. Milagres

H. Pires



A. Veiga

Who are we?

The Covid19Analytics team: new associates

C. Belchior

I. Bruxelas

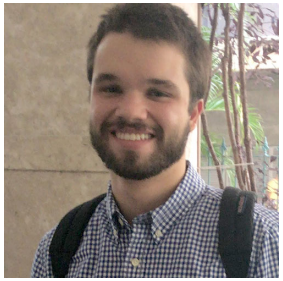
J. Collazos

R. Dias

R. Fonseca

Y. Gomes

J. Gratone



G. Jardim

A. Maranhão

M. Mittelbach

A. Pinheiro

R. Sarlo

D. Safadi

L. Souza

The Covid19Analytics project

Goals

- Develop a tool to aid the Covid-19 crisis management in Brazil and inform the public.
- Forecasts for confirmed cases and deaths.
  - ⋆ Country-level and state-level
  - ⋆ Forecasting for up to 14 days.
  - ⋆ Forecasts for groups of municipalities according to their development level.
- Reproduction number calculation.
  - ⋆ State-level and country-level.
  - ⋆ Groups of municipalities
  - ⋆ Health regions

The Covid19Analytics project

Goals

- Set of descriptive statistics and under-notification analysis .
- Covid-19 and economic indicators.
- Daily updates.
- Forthcoming: Nowcasting new deaths and cases.
  - ⋆ Based on “SRAG” data

Forecasting Model

Motivation

Why Short-Term Forecasts?

Being able to forecast accurately the number of Covid-19 cases and deaths in the very short-run is crucial to manage properly the health system.

- More informed decisions on how to allocate hospital beds and ventilators, on whether to set more field hospitals, on whether to train more health workers, etc.
- Simple statistical model for short-term real-time forecasting of the number of Covid-19 cases and fatalities in countries that are *latecomers*
  - ⋆ i.e., countries where cases of the disease started to appear some time after others

The Model

Pros and Cons

Pros

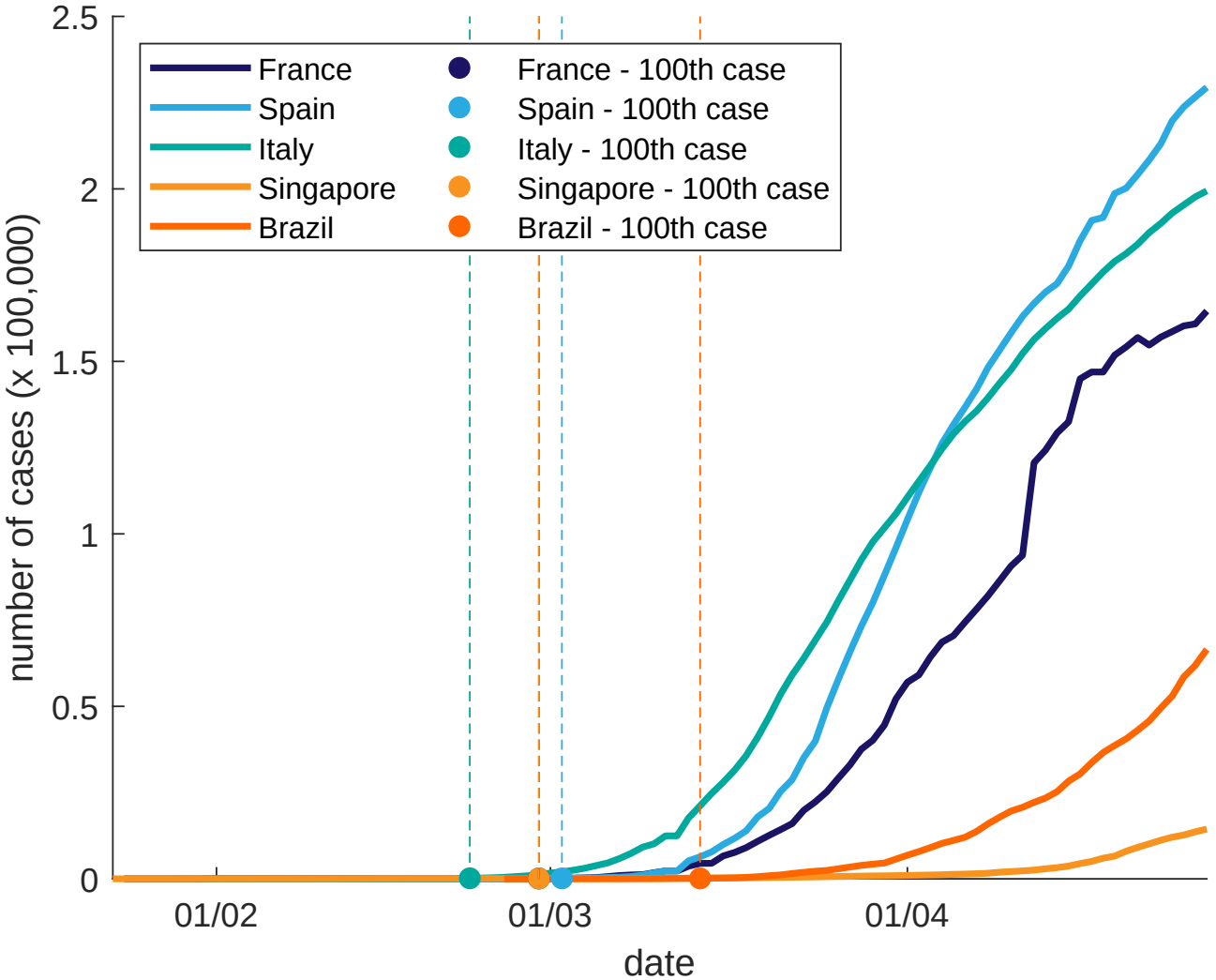
- "Structure-free": avoid tuning of too many parameters
- Data speak for themselves.
- Focus on individuals pressing the health system.
- Simple and cheap to be implemented.

Cons

- Sensitive to structural breaks: the model will take a few days to adapt
- Sensitive to outliers.
- No information about lockdown timing or other policies (although this can be incorporated)

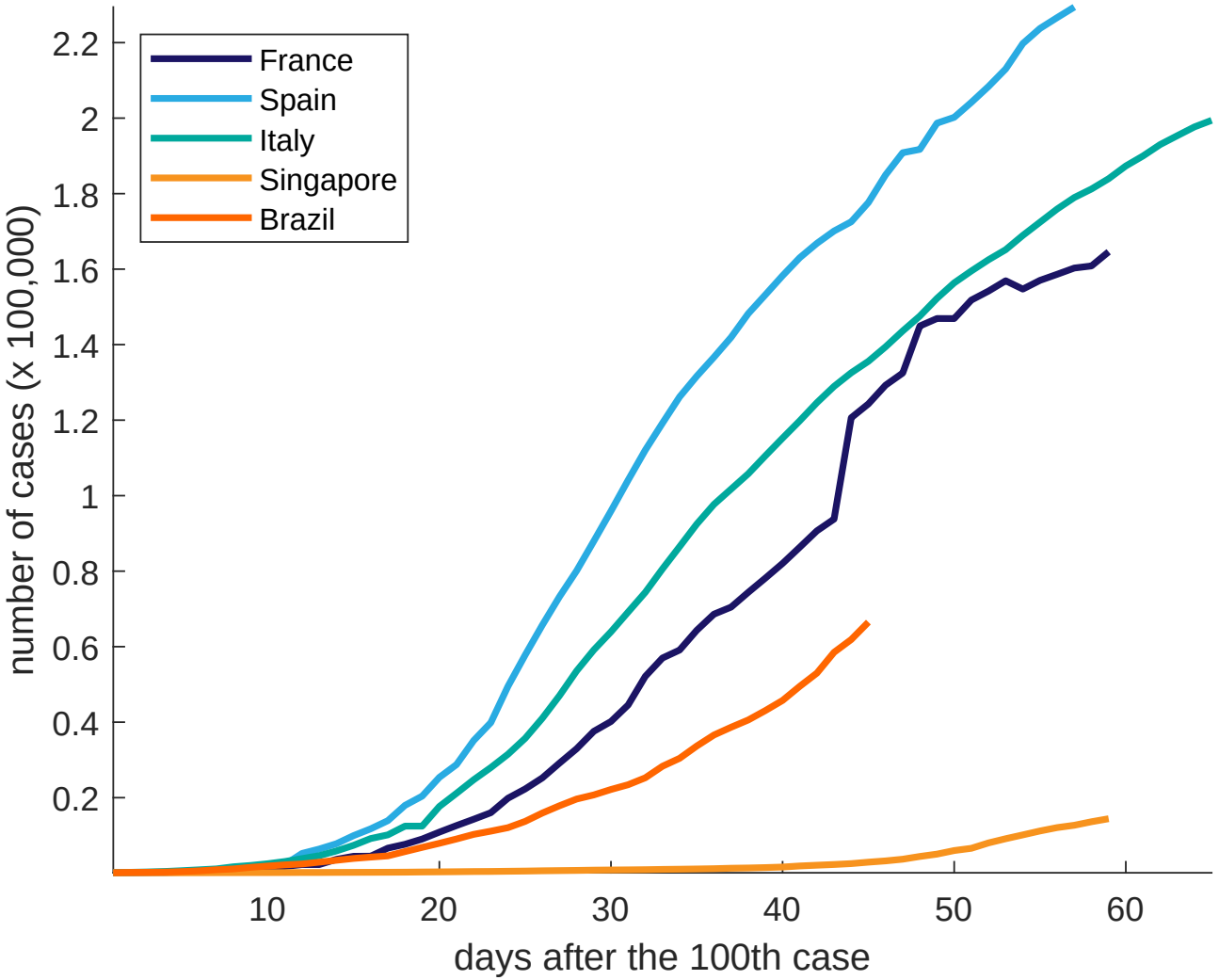
The Model

Data in Calendar Time



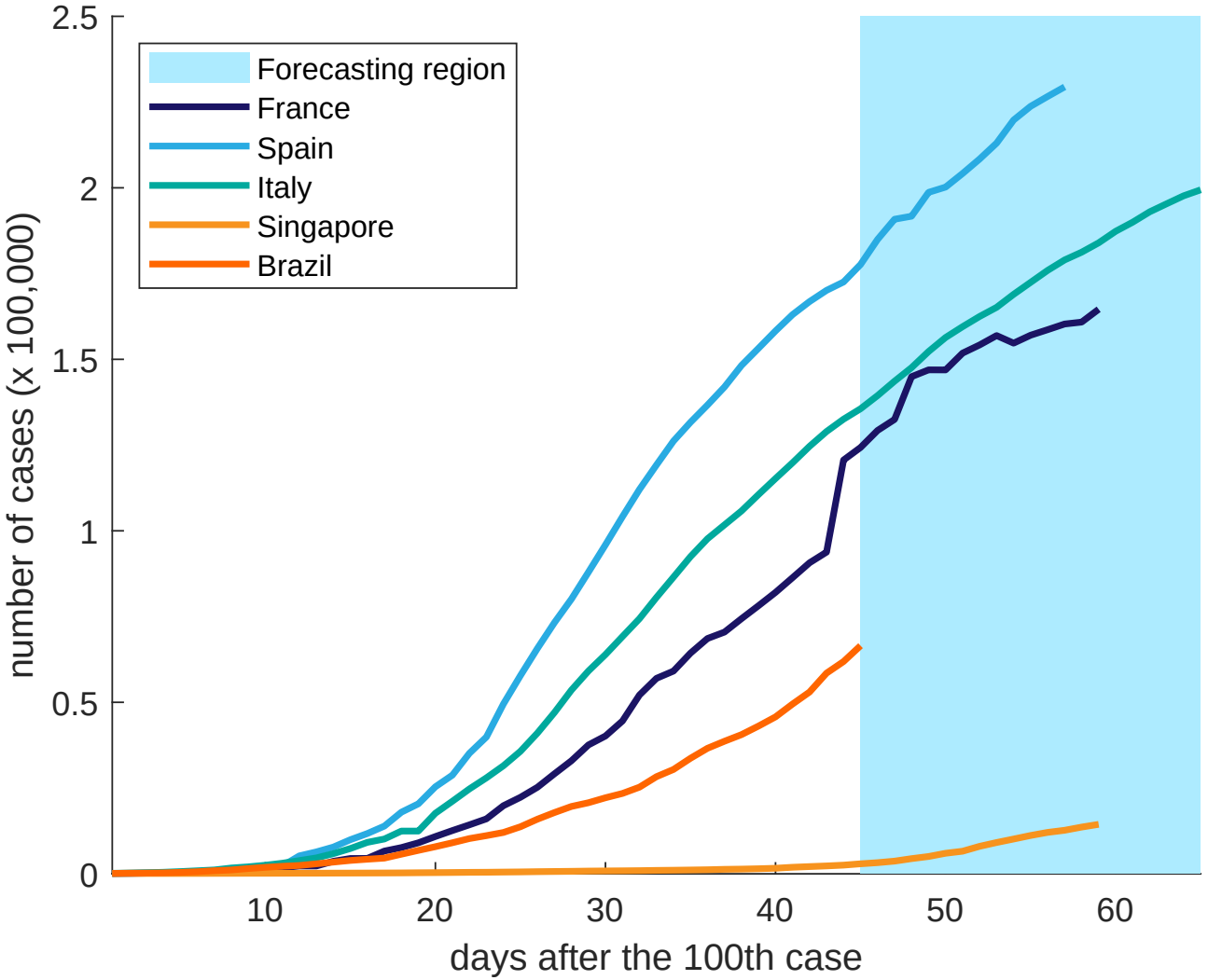
The Model

From Calendar Time to "Case Time" (# of days after the 100th case)



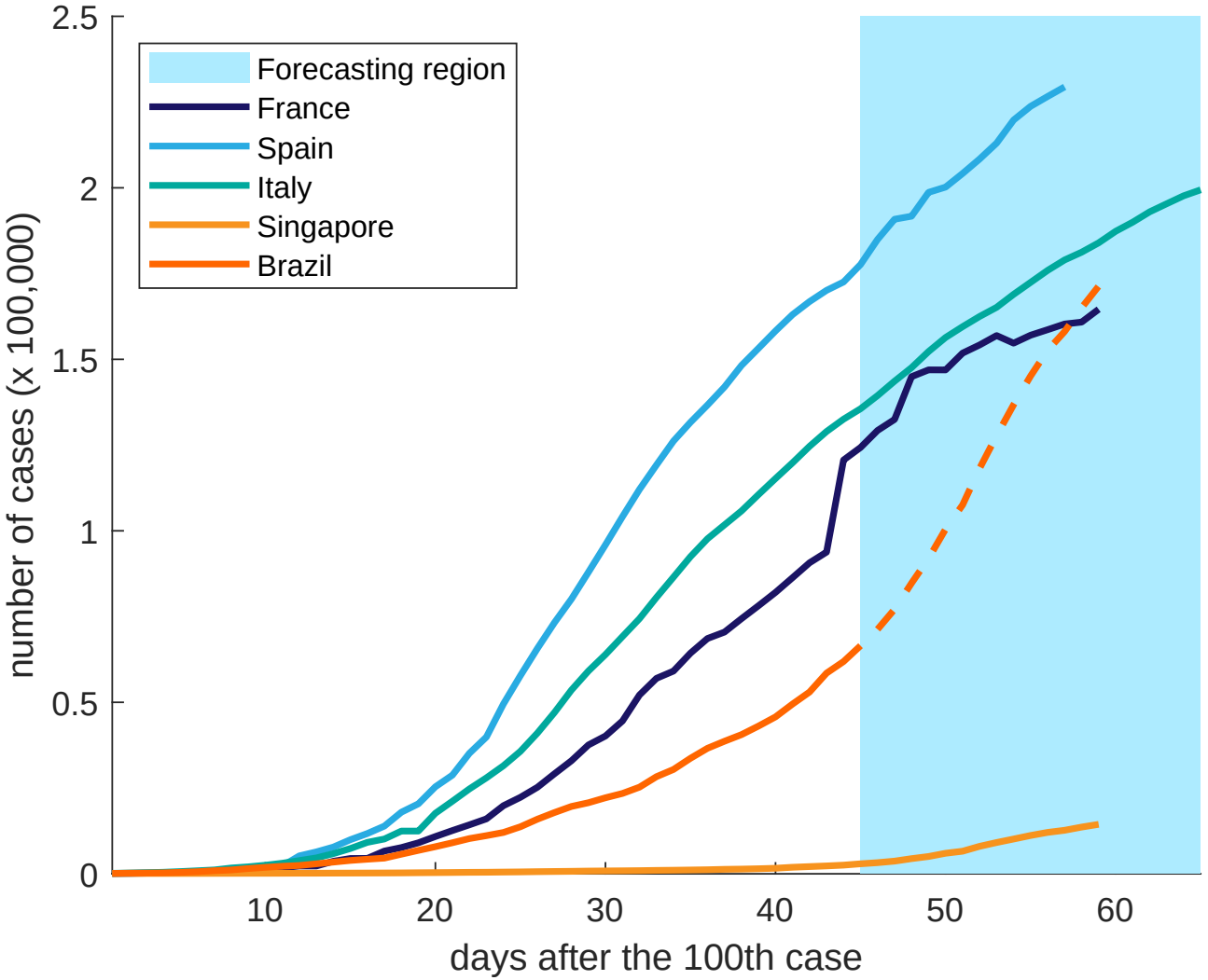
The Model

Other Countries are Ahead of Brazil



The Model

Forecasts (Partly) Based on Future Dynamics



The Model

How Many Countries Are in Fact Ahead?

- 31 countries ahead of Brazil
  - ⋆ 17 countries 7 days ahead of Brazil:

    China, France, Germany, Iran, Italy, Japan, South Korea, Netherlands, Norway, Singapore, Spain, Sweden, Switzerland, USA, United Kingdom
  - ⋆ 7 countries 14 days ahead of Brazil:

    China, France, Iran, Italy, Japan, Singapore, South Korea
- We have discarded China and France
- There are 152 countries behind Brazil. The methodology can be applied to these cases as well.

The Model – First Generation

Log-linear Error-Correction

$$\Delta y_\tau = \Delta \boldsymbol{x}'_\tau \boldsymbol{\pi} + \gamma \left(y_{\tau-1} - \boldsymbol{x}'_{\tau-1} \boldsymbol{\beta} \right) + u_\tau$$

- Daily growth rate (in "case time") in the number of confirmed cases is a function of:
  - ⋆ daily growth rate (in "case time") in the number of confirmed cases from a pool of peers (other countries);
  - ⋆ discrepancy between the target country and the peers in the previous day (**in logs**).
- Remember that the peers are ahead of time from the target in "case time".

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The Model – Second Generation

Log-linear Large Bayesian Vector Autoregression

- Framework: Bańbura et al. (2010).
- Set up a panel with all countries, states and provinces that do not have inconsistent data.
- Place the regions mentioned above in the epidemiological time with cases after 100 days.
- Filter only regions that are at least 14 days ahead of the most "backward" region in Brazil.
- Suppose that T_a is the last data in the epidemiological calendar of the most backward Brazilian state. The first model is estimated with data up to T_a, and forecasts are computed for T_{a+1}. However, in T_{a+1}, only the most delayed state is not observed yet. Therefore, the forecast is used only for this state.
- The next step is to re-estimate the VAR (rolling window) with data up to T_{a+1} and compute the predictions for T_{a+2}.

Where are we and to where are we going?

Forecasts on September 29

Painel Brasil

Dados atualizados em: 30/09/2020 11h31min

Total acumulado e novos casos e mortes nas 24h anteriores à atualização.
Variação percentual relativa ao dia anterior (▲|▼)

4.777.522	32.058
Casos acumulados	**Novos casos**
Confirmados	Confirmados
142.921	863
Mortes acumuladas	**Novas mortes**
Confirmadas	Confirmadas

0,91

–

Nº de Reprodução (R)

Número médio de pessoas contaminadas por cada infectado. (atraso de 1 semana)

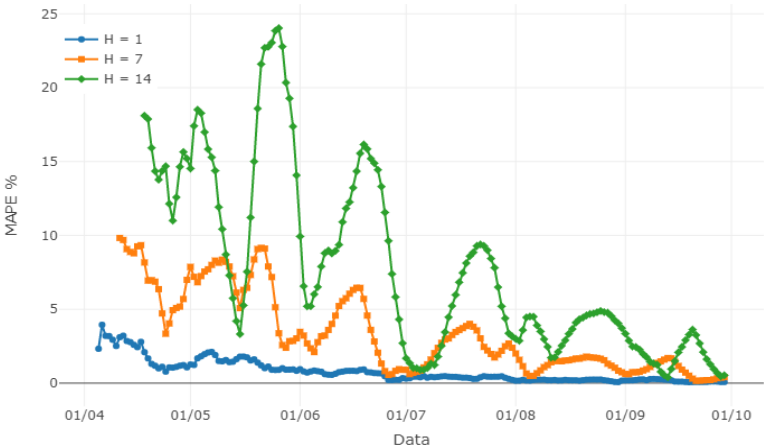
Previsão para os próximos 7 e 14 dias

Total acumulado de casos e mortes previstos, usando modelo estatístico.
(+/-) é o erro padrão preditivo percentual.

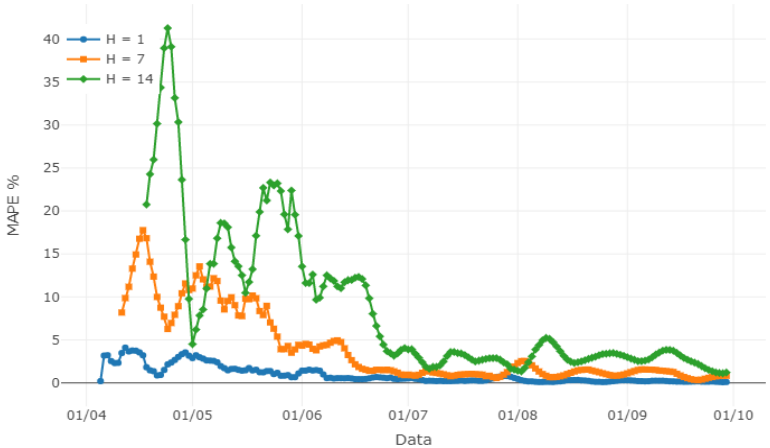
4.983.113	5.185.887
+/- 2,79%	+/- 5,54%
Casos acumulados	**Casos acumulados**
Previstos para 7 dias	Previstos para 14 dias
148.300	153.805
+/- 1,64%	+/- 4,09%
Mortes acumuladas	**Mortes acumuladas**
Previstas para 7 dias	Previstas para 14 dias

Where are we and to where are we going?

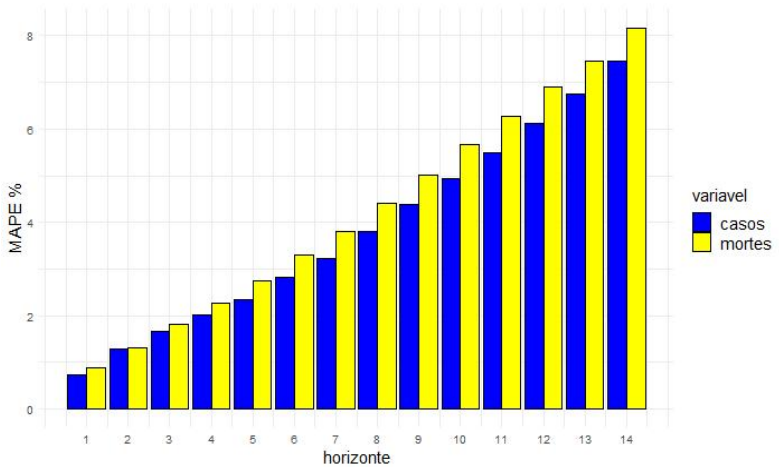
How good are our forecasts for Brazil?



cases 7-day window



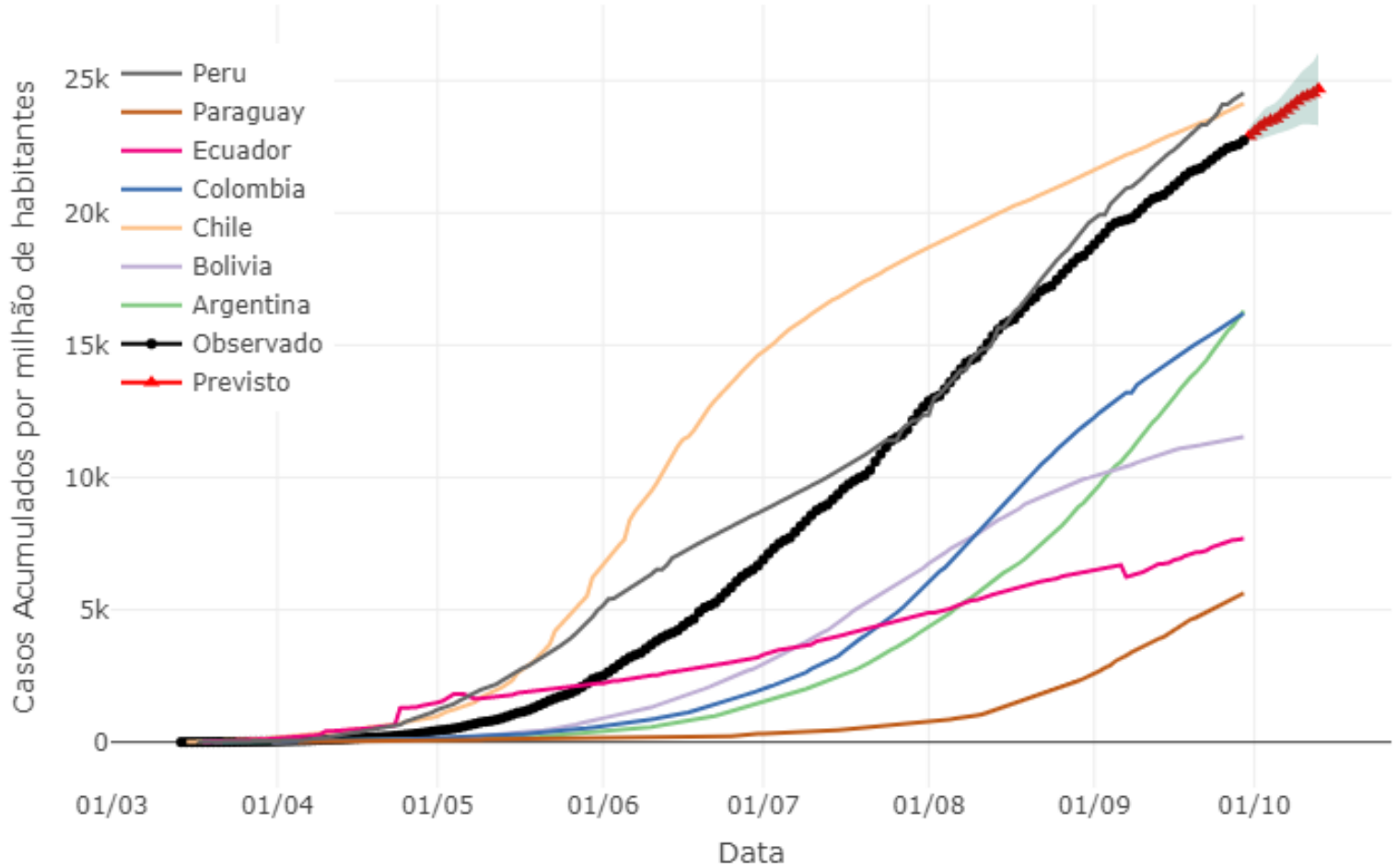
deaths: 7-day window



full-period

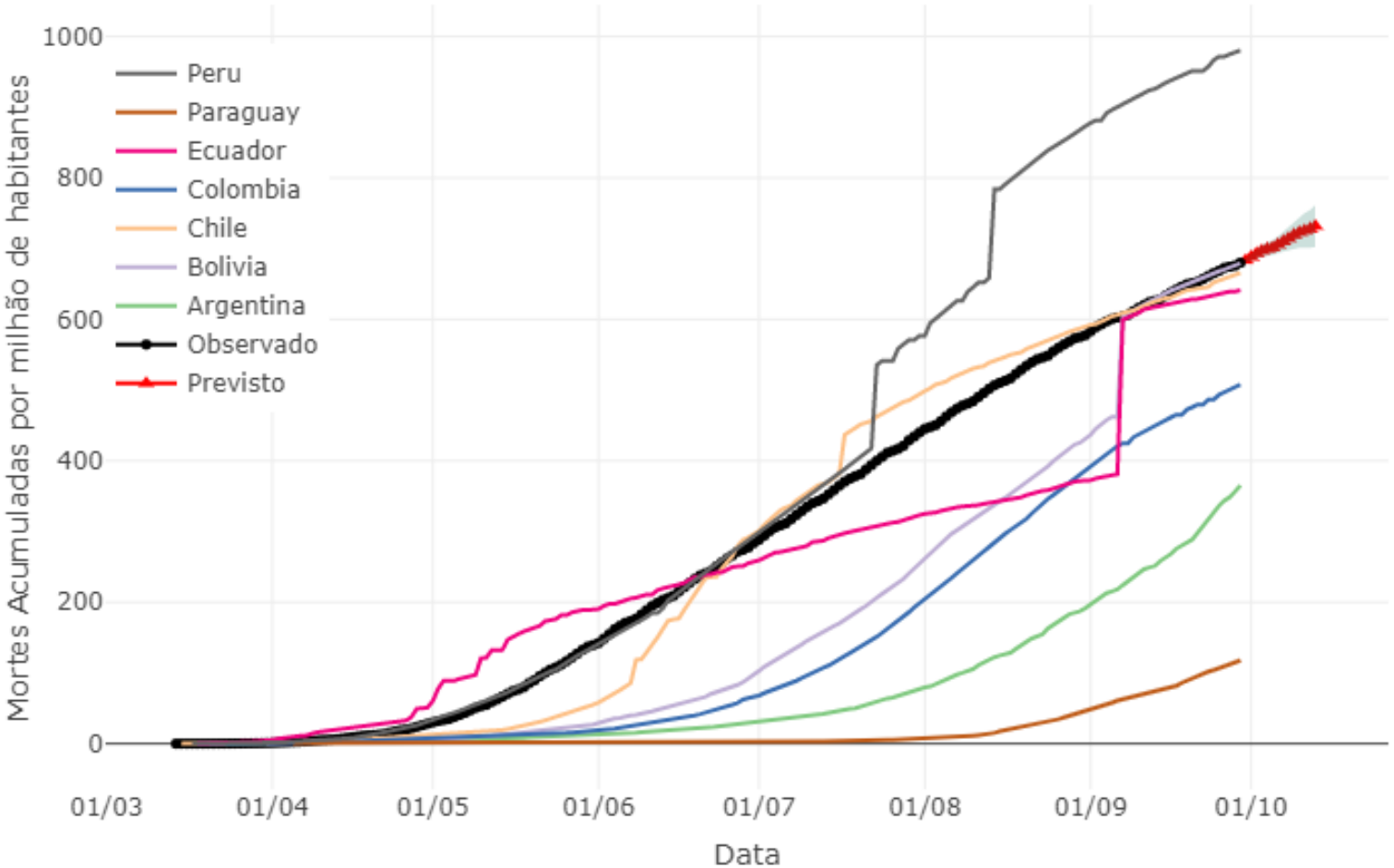
Where are we and to where are we going?

Cases per million of inhabitants



Where are we and to where are we going?

Deaths per million of inhabitants



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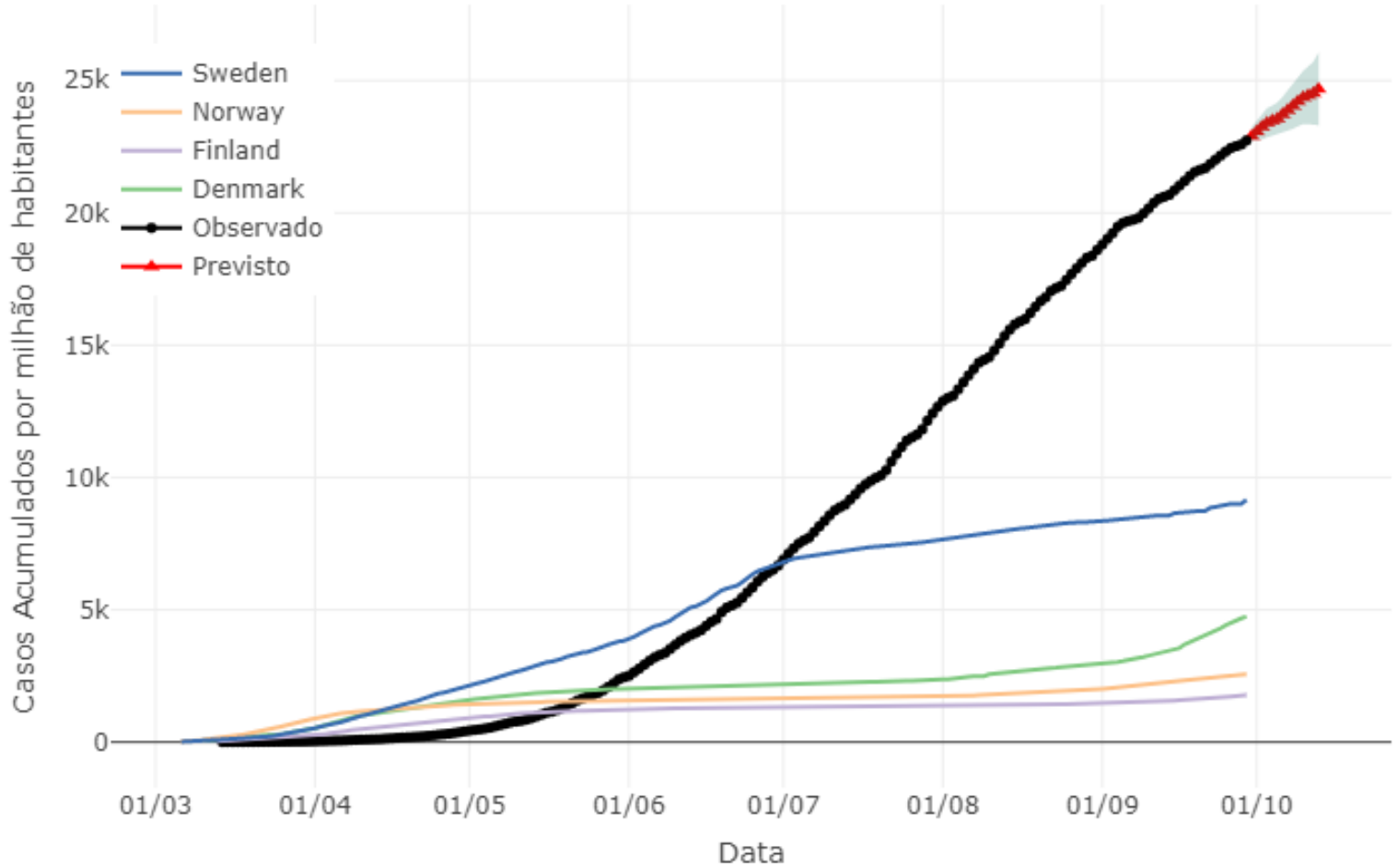

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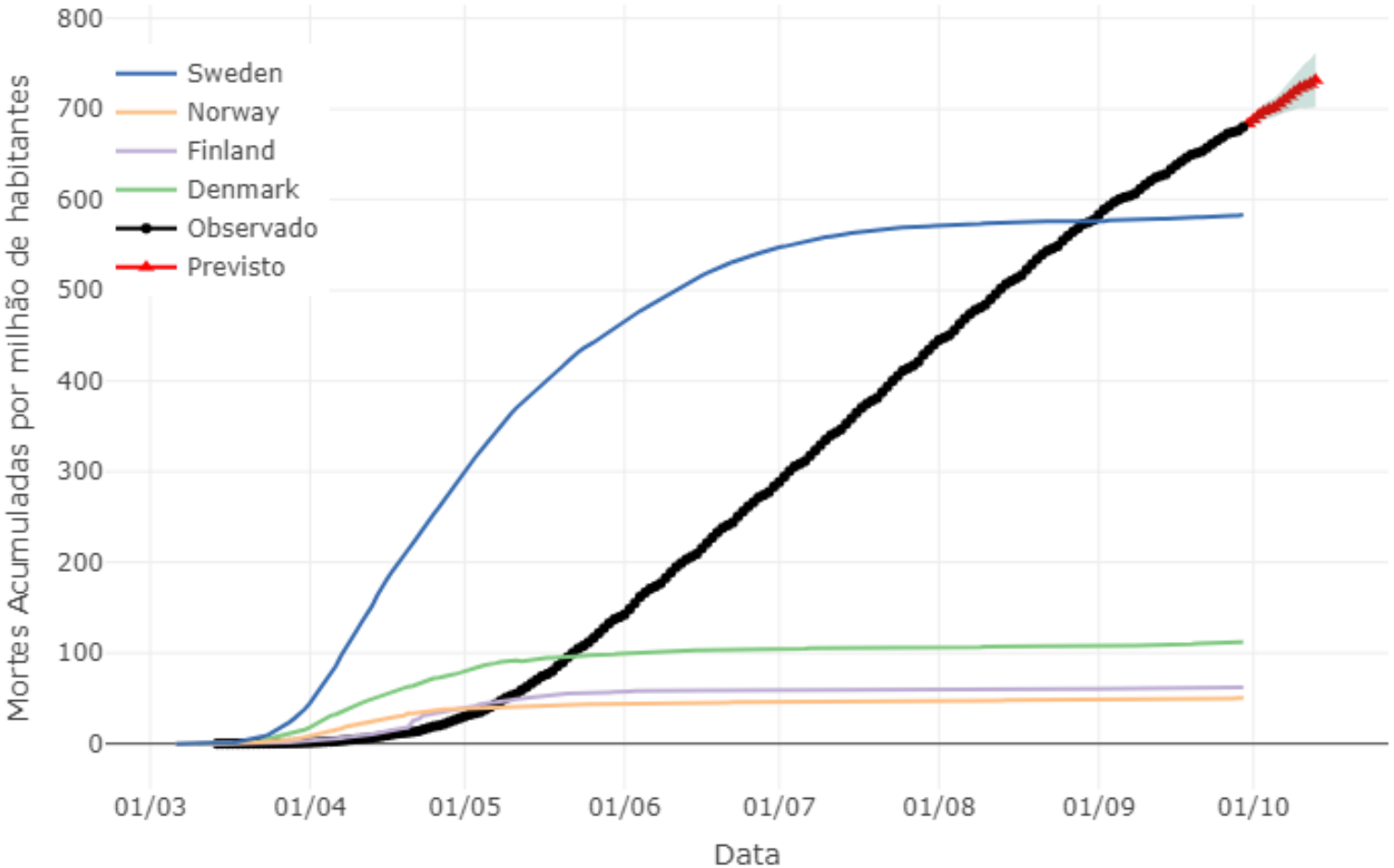

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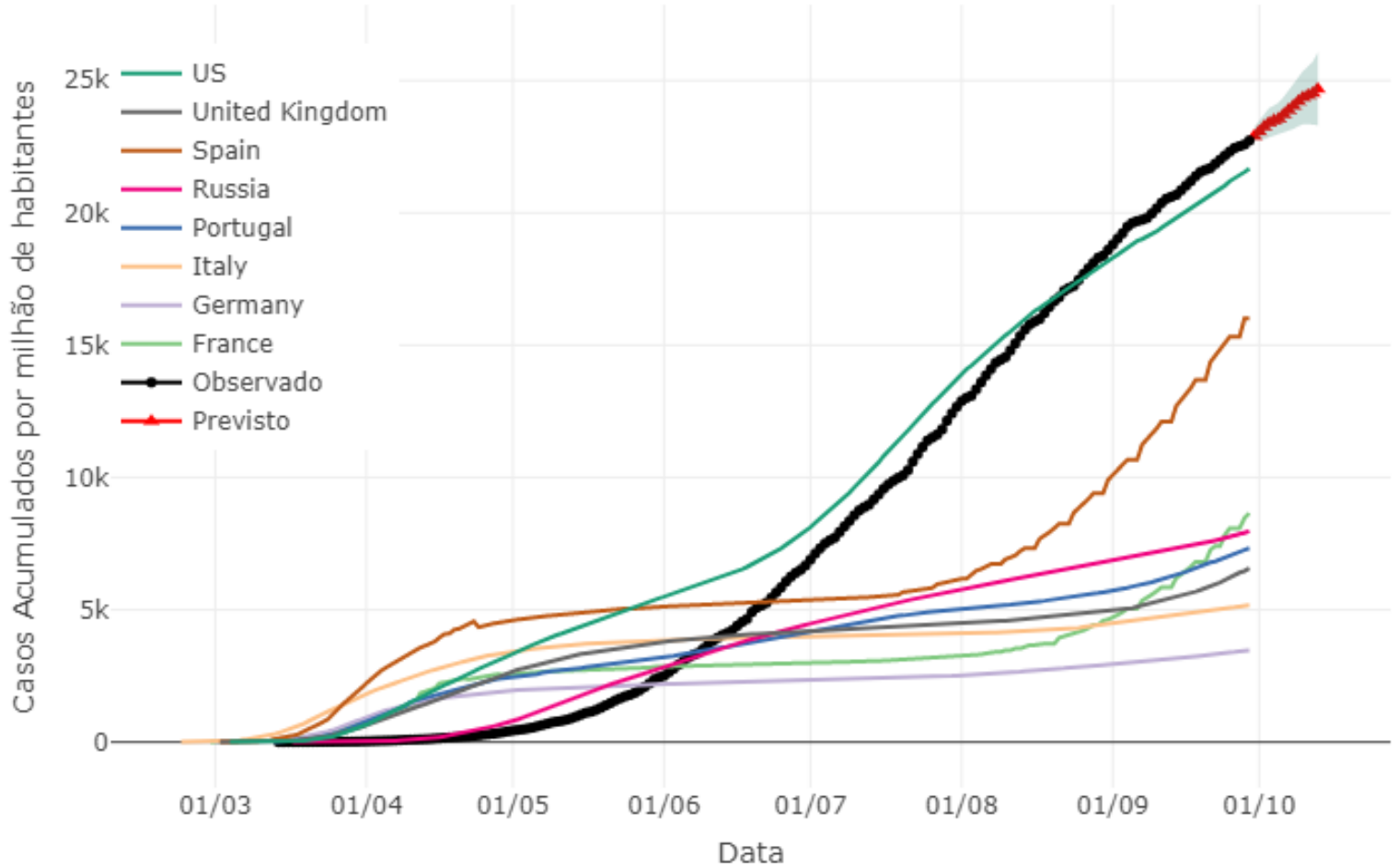
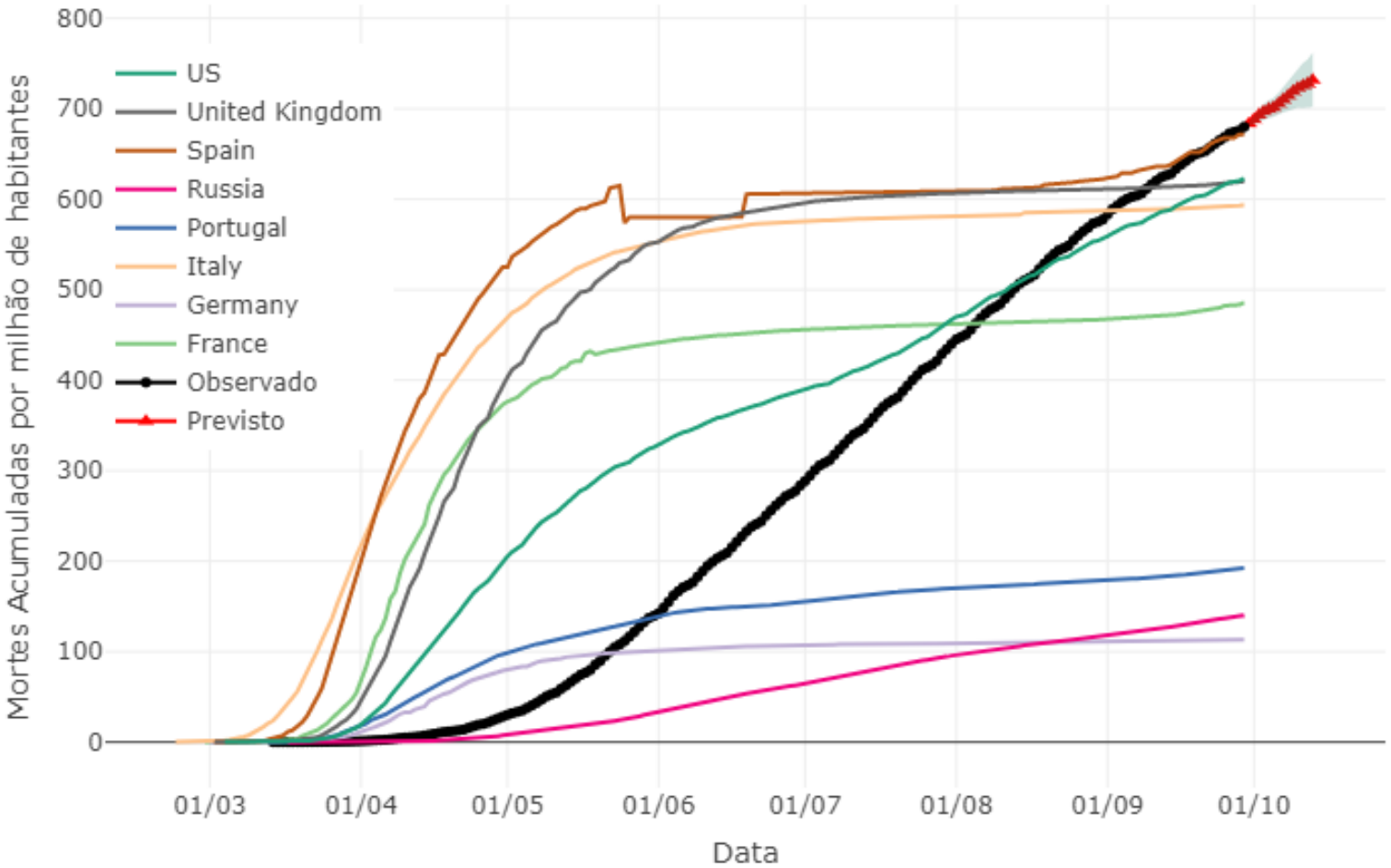


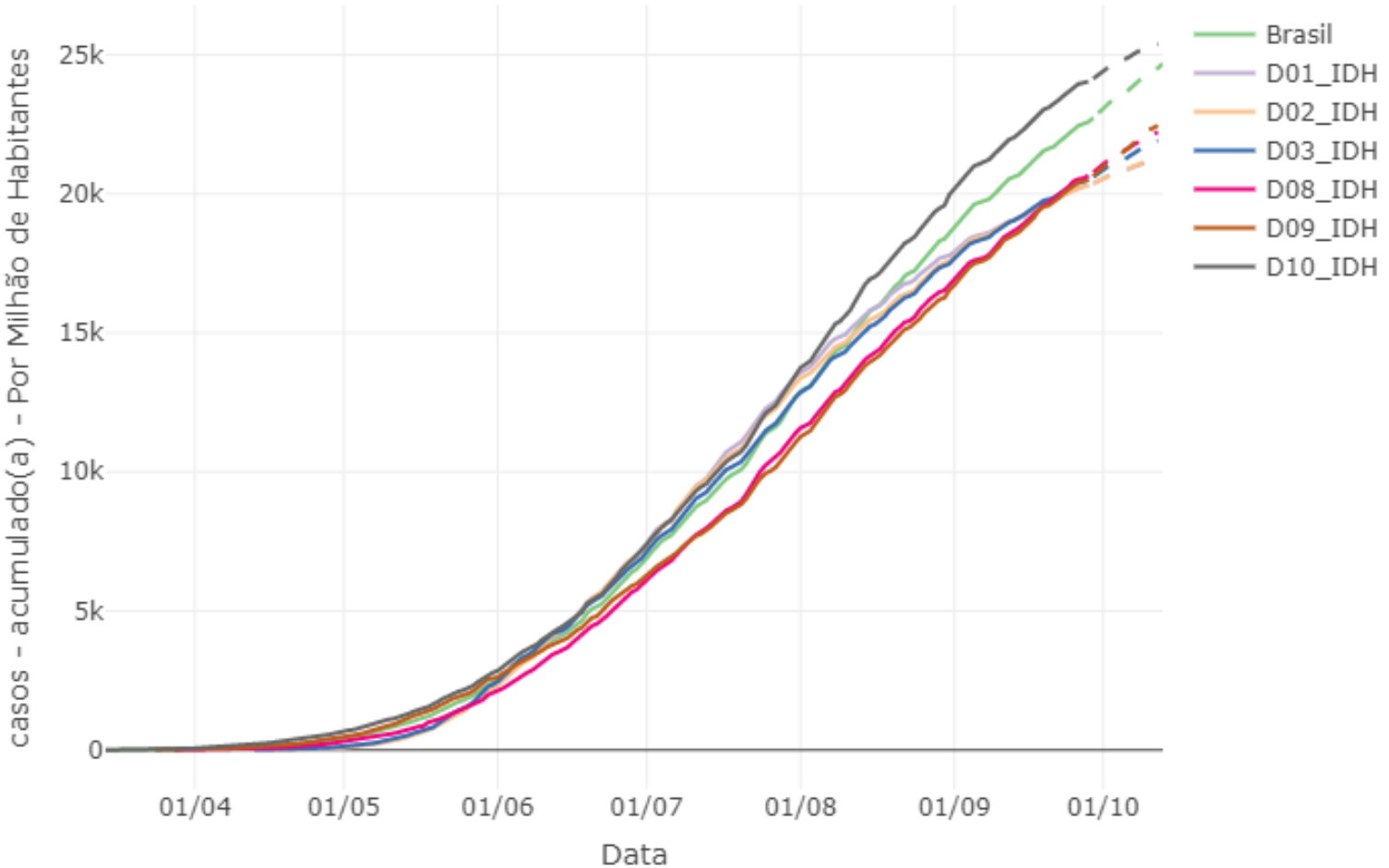
Where are we and to where are we going?

Deaths per million of inhabitants



Where are we and to where are we going?

Cases per million of inhabitants: Heterogeneity among municipalities



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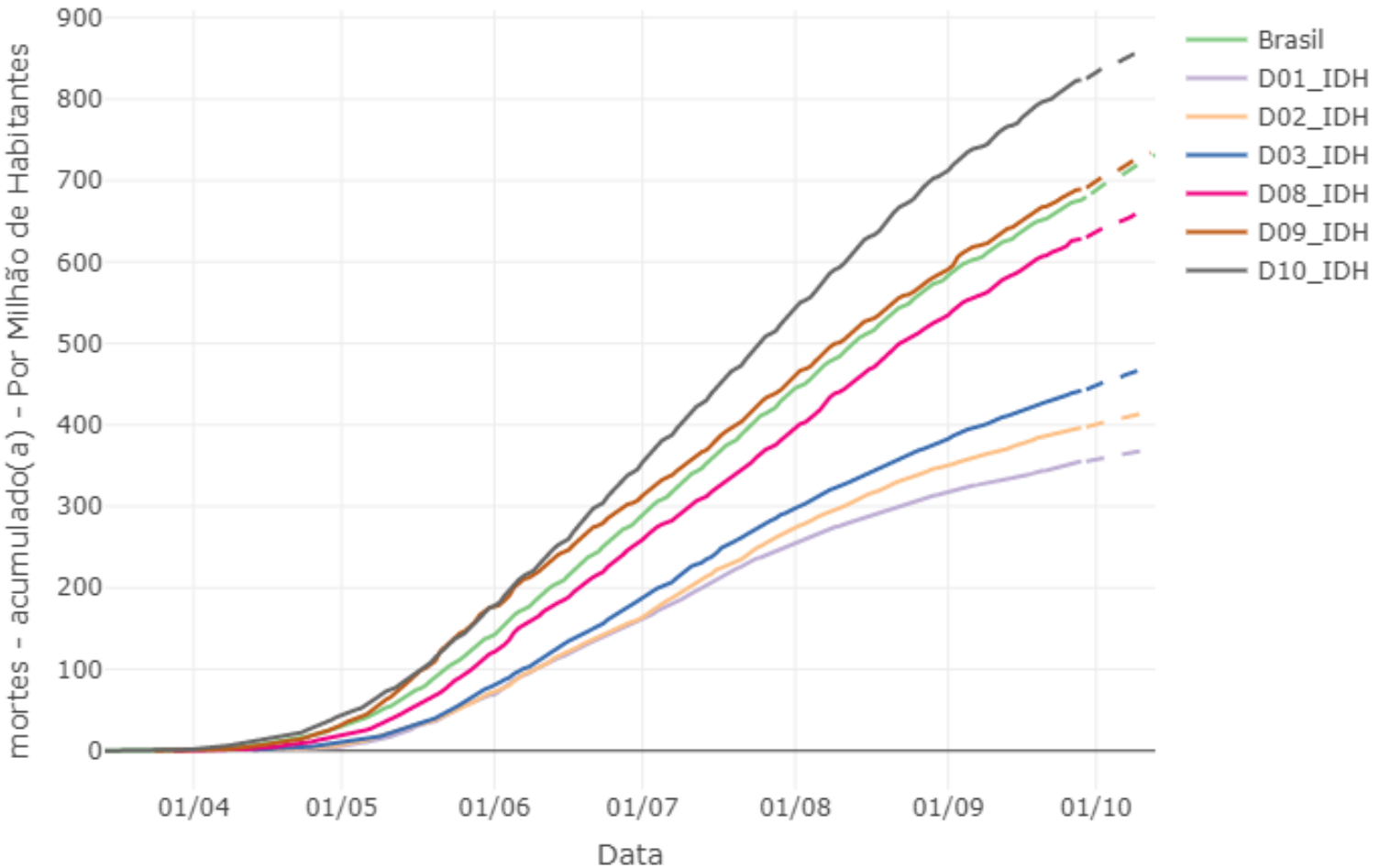
Deaths per million of inhabitants: Heterogeneity among municipalities



Reproduction Number

Where are we and to where are we going?

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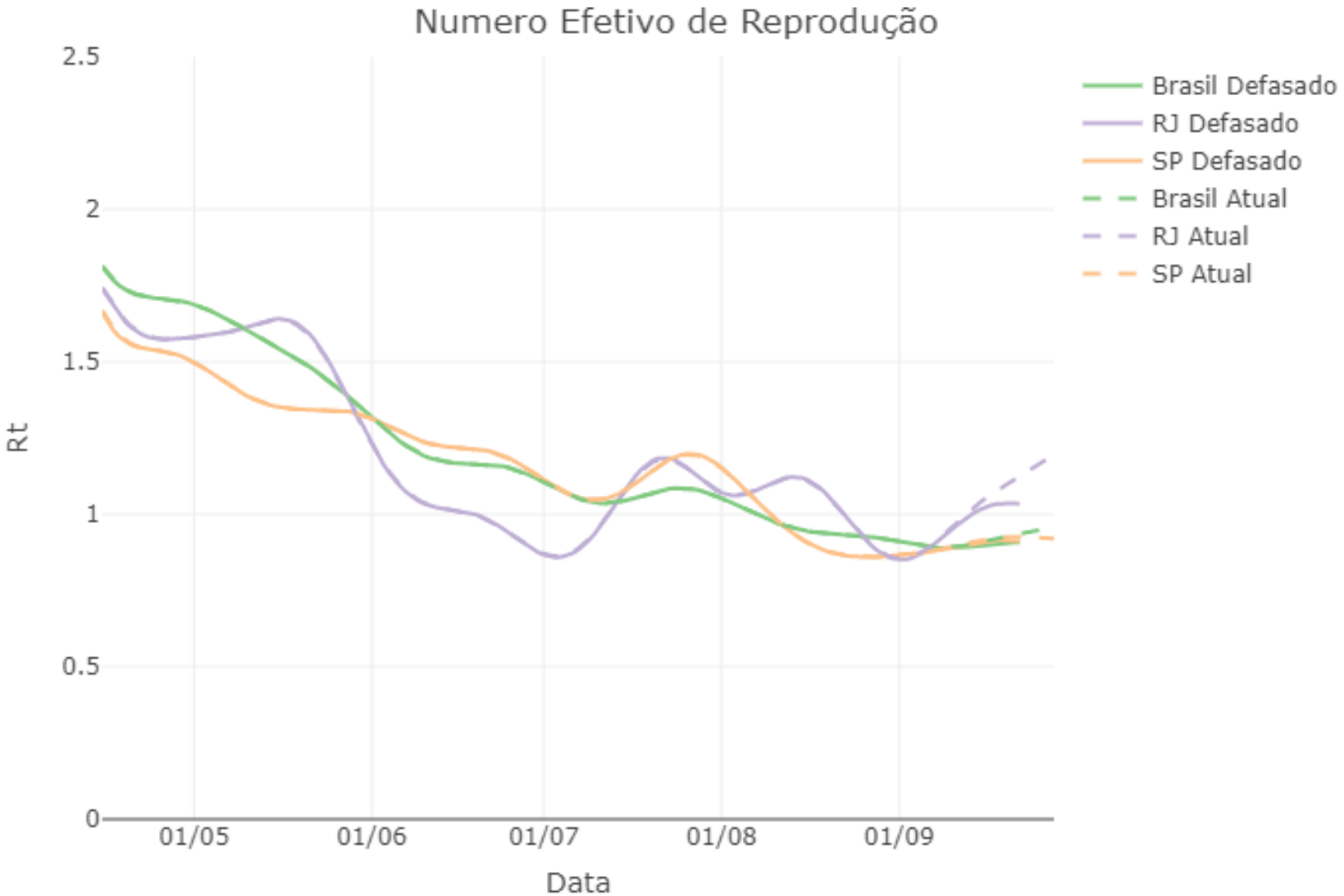

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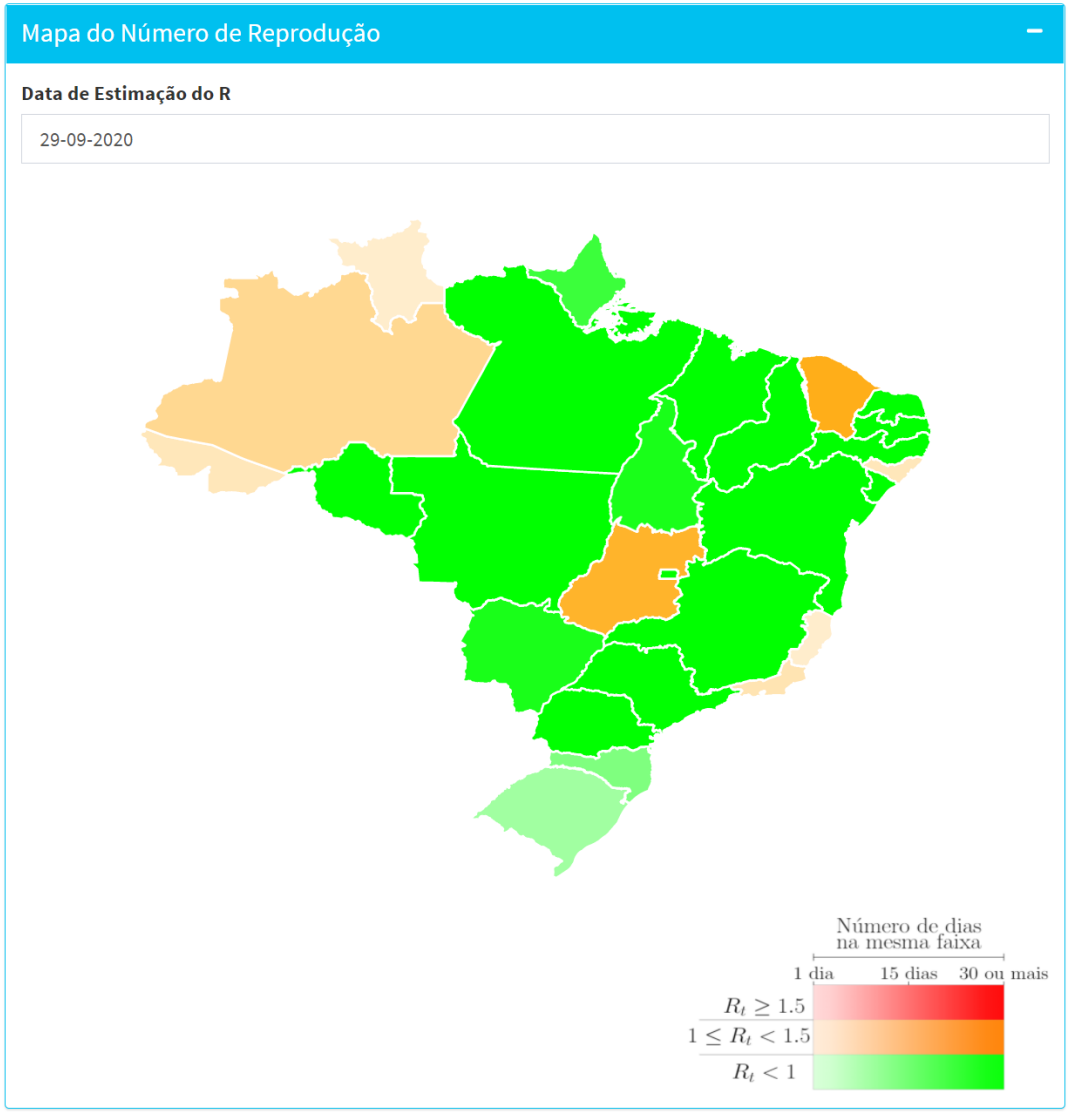
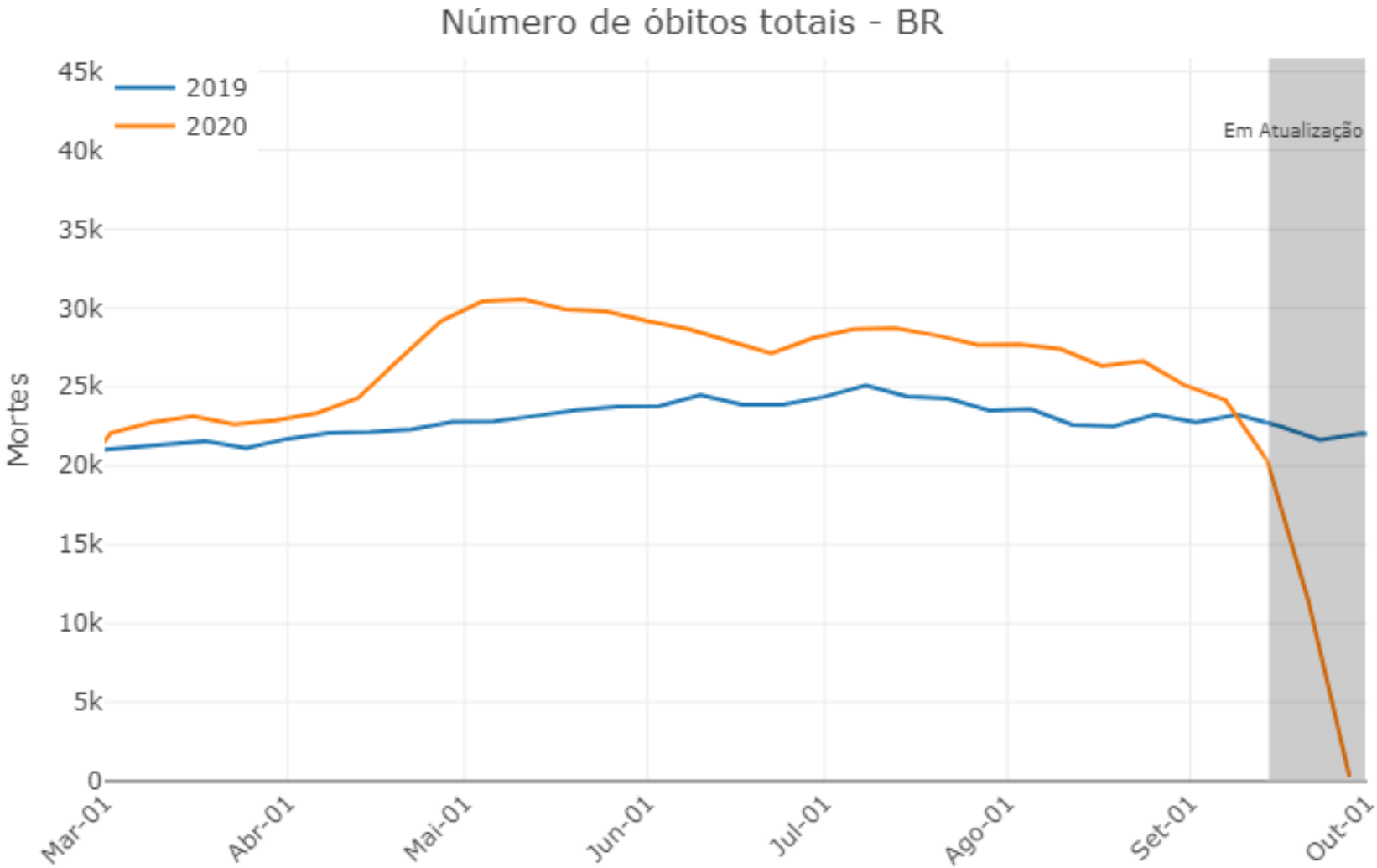


Registry Data

Where are we and to where are we going?

Registry data: numbers organized by death date



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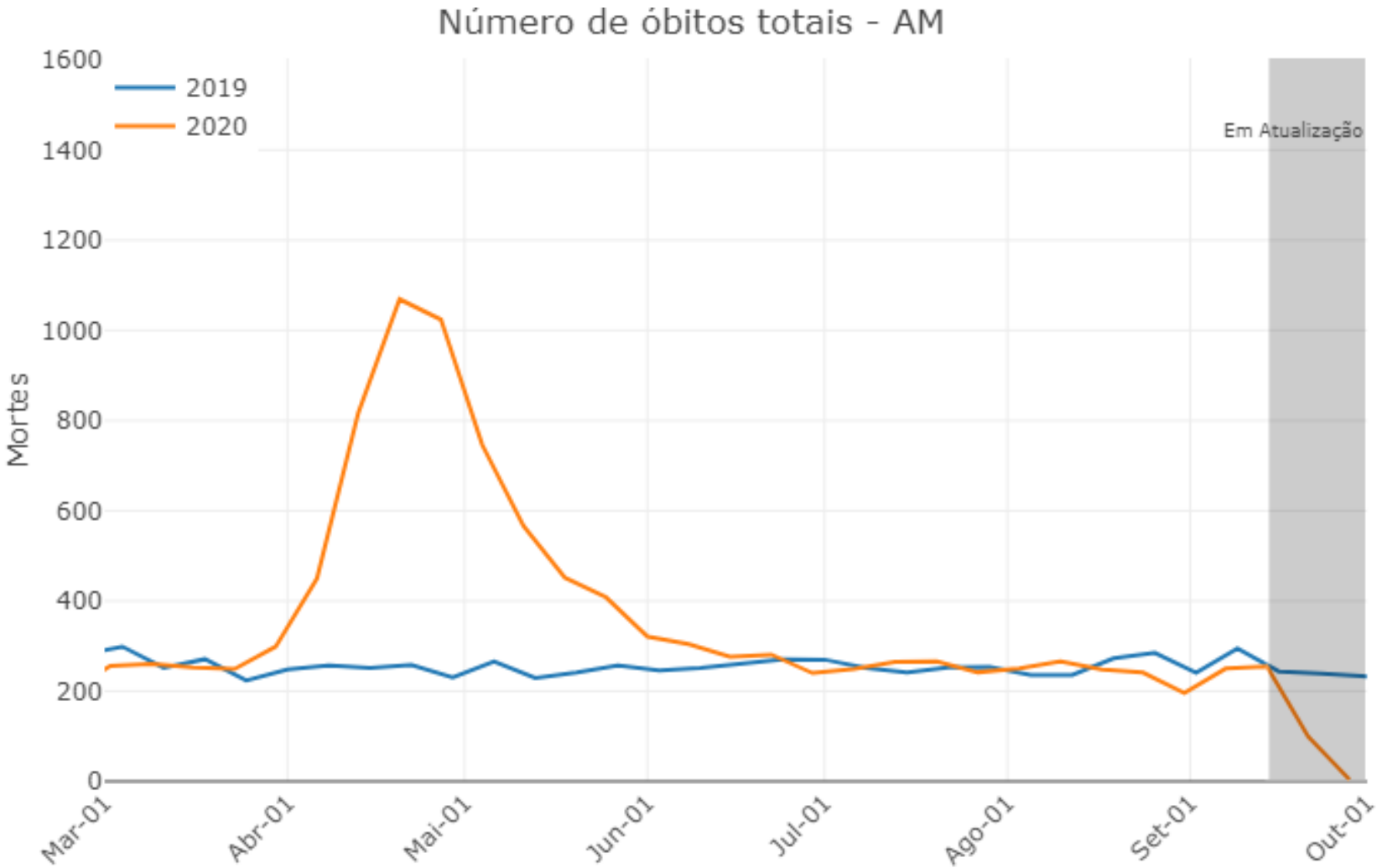

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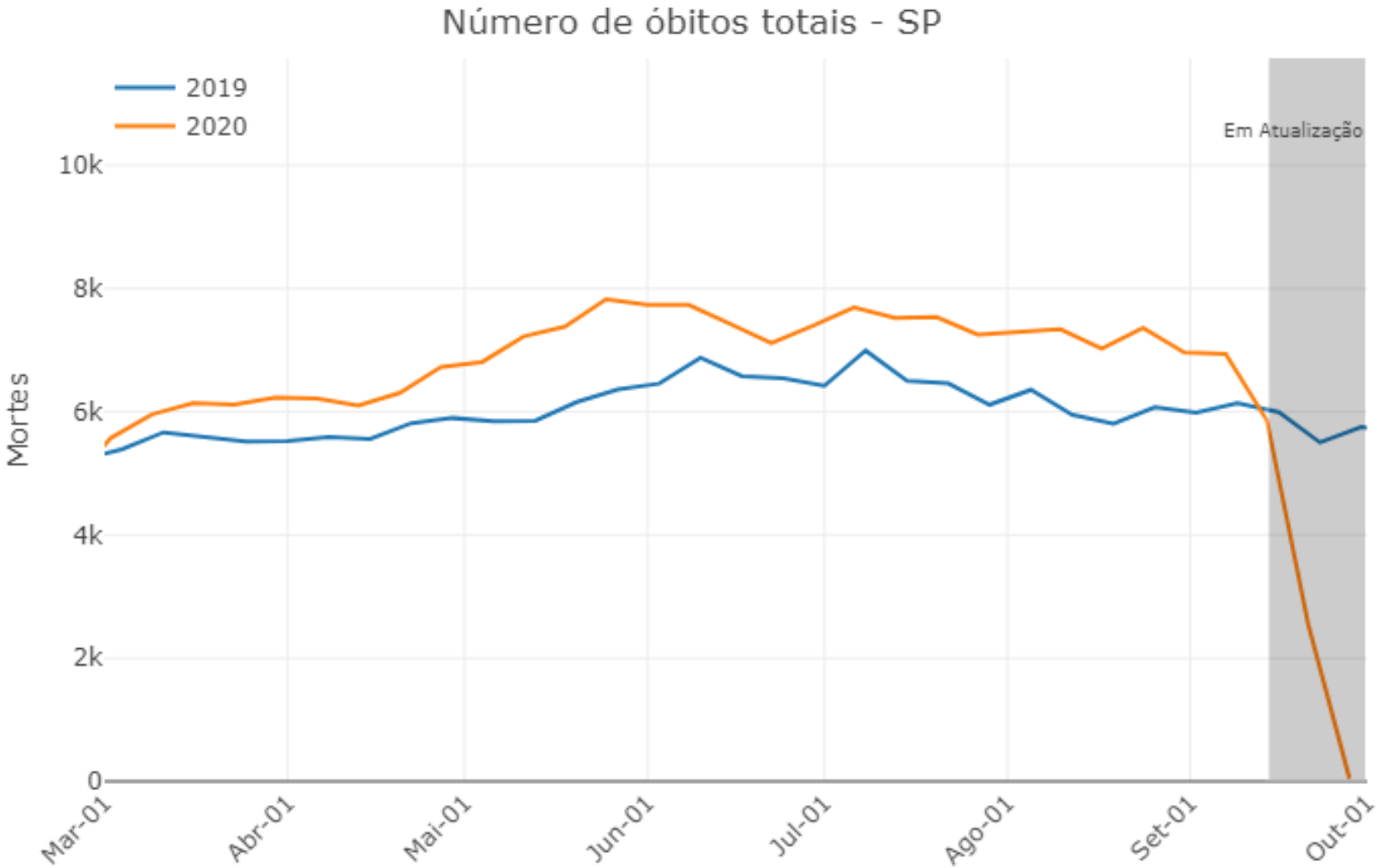

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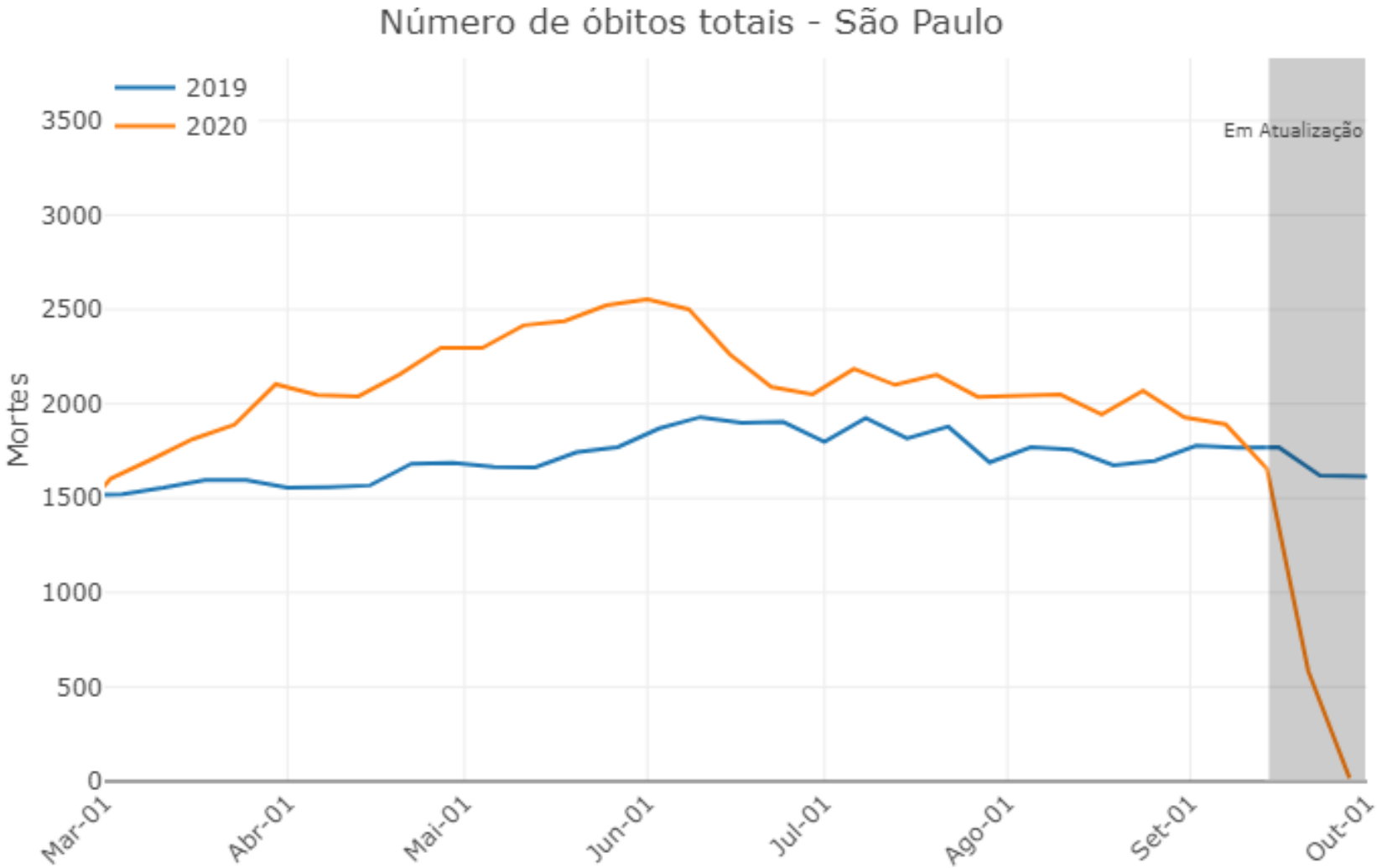

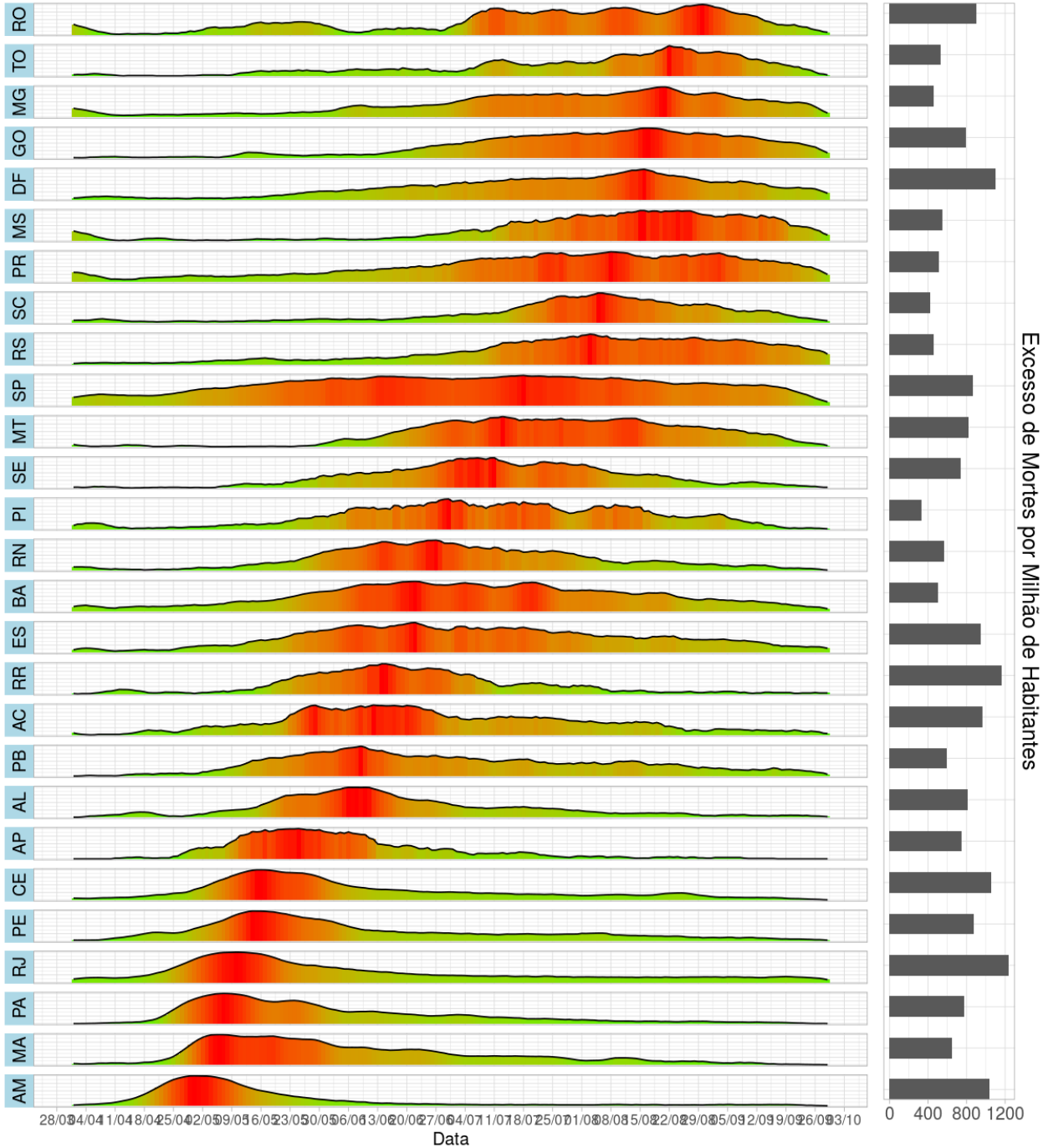
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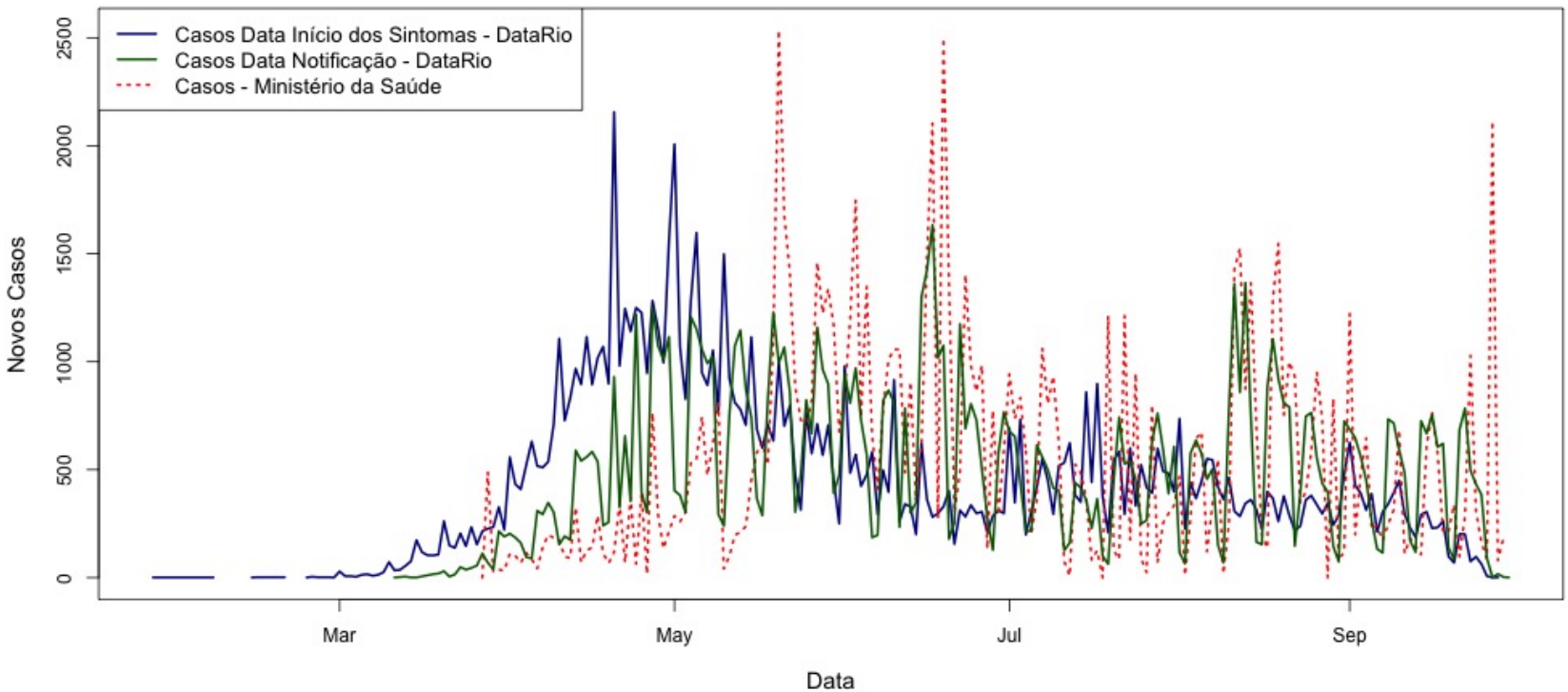
Data
Excesso de Mortes por Milhão de Habitantes
0 400 800 1200

A second wave? The case of Rio de Janeiro

Where are we?

A second wave?



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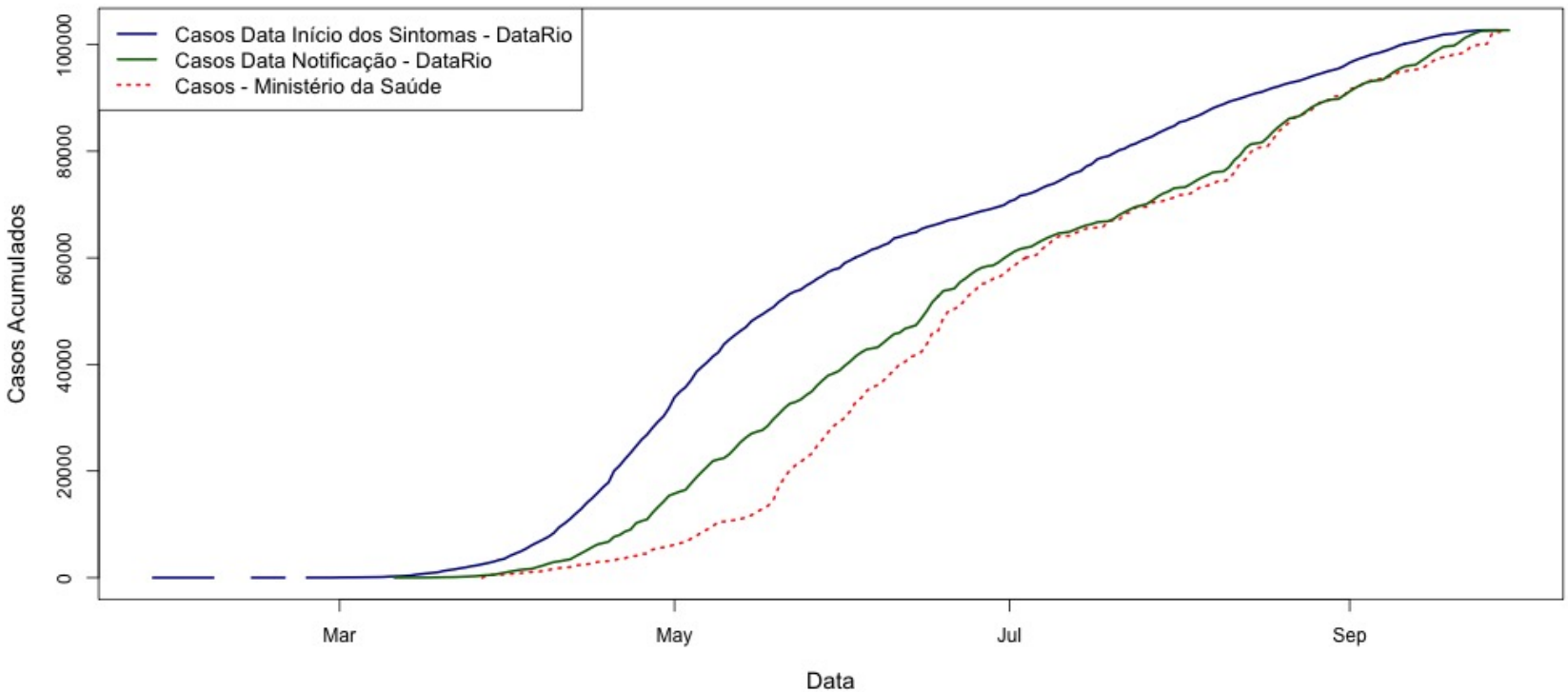
A second wave?



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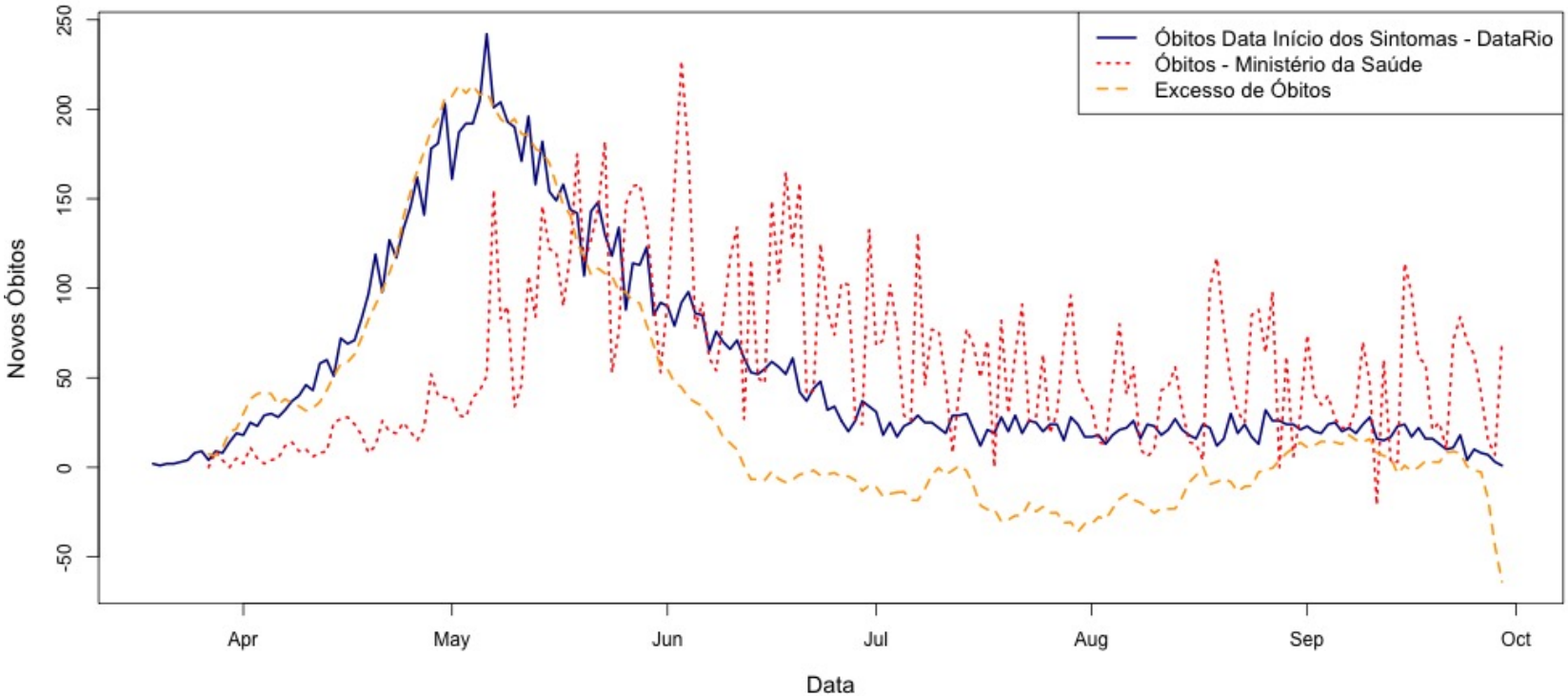

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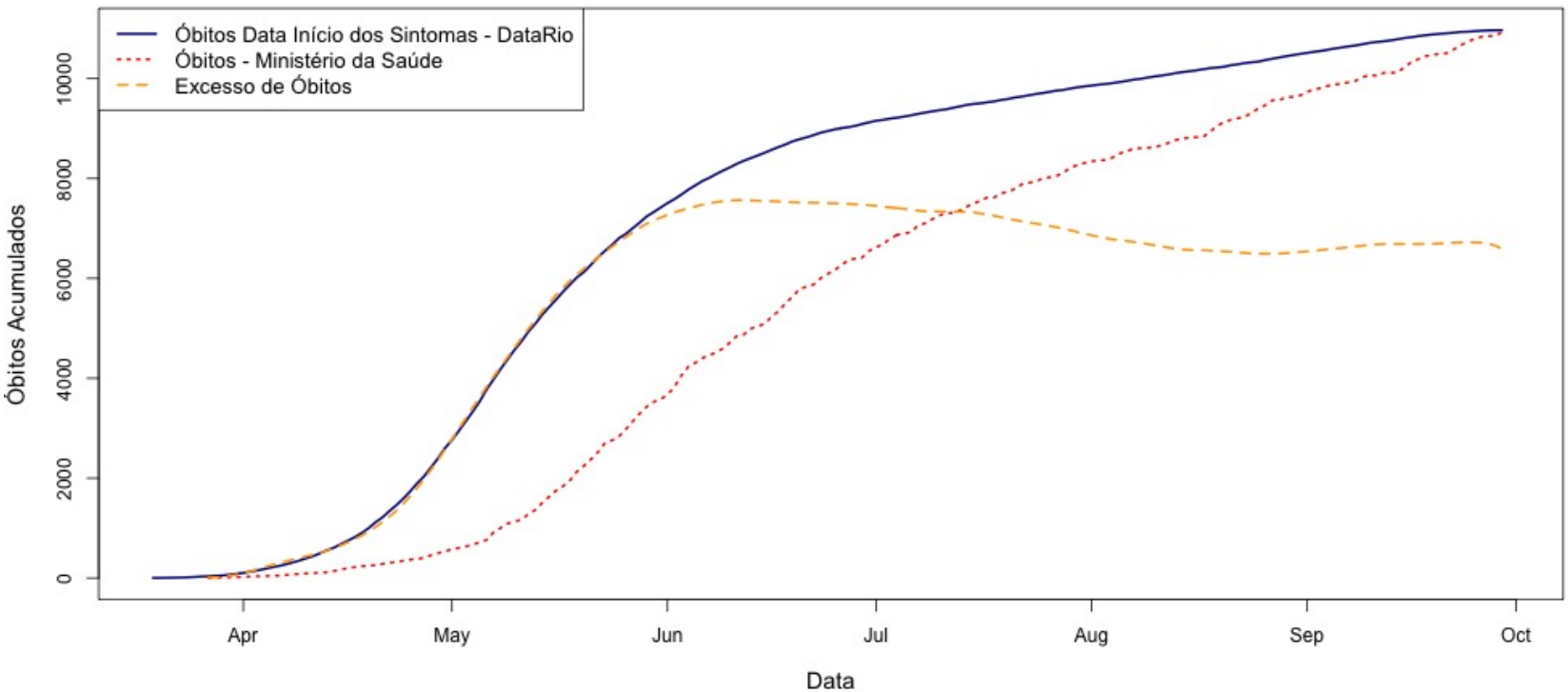
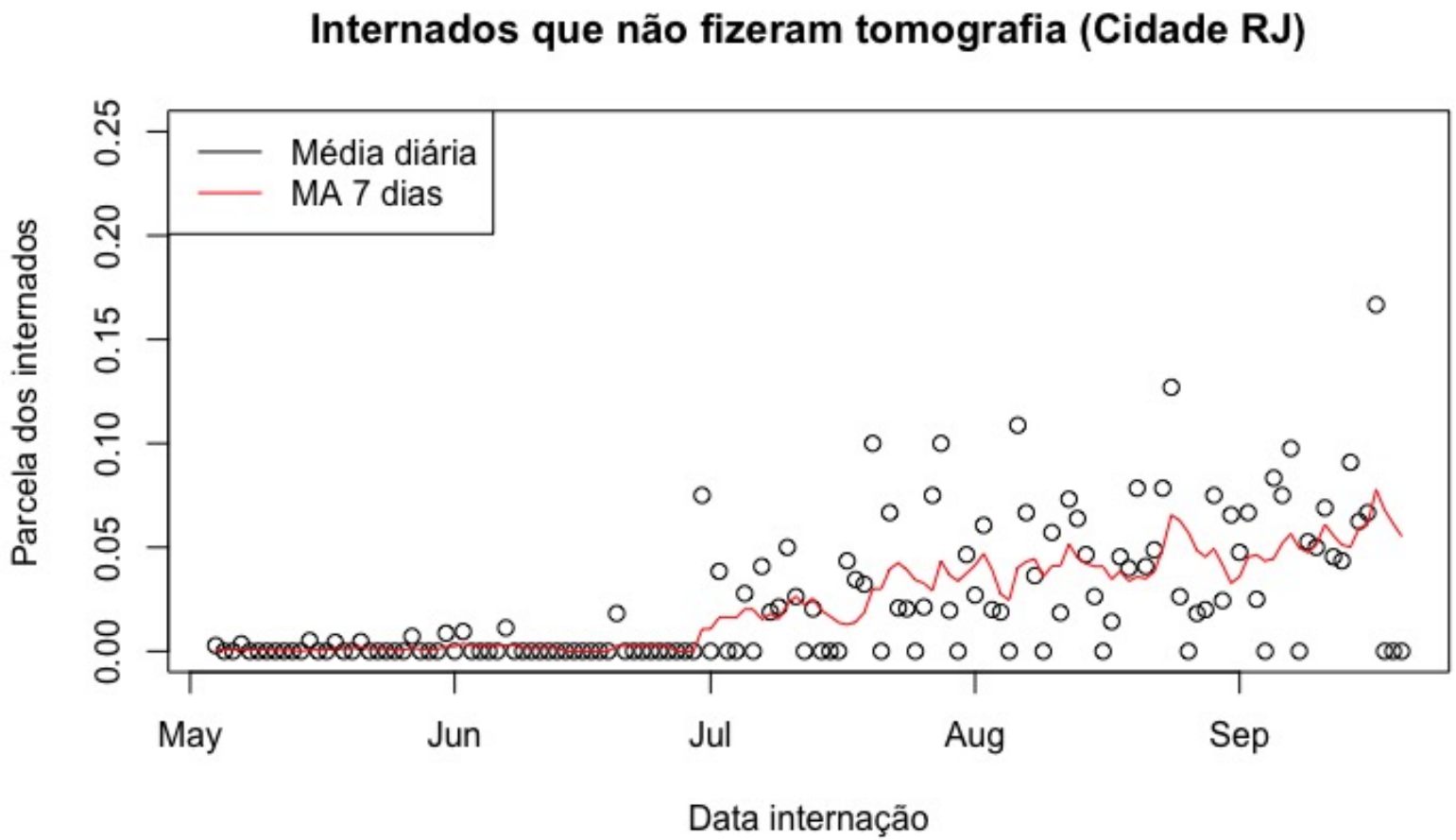


Where are we?

Increasing hospitalization: Criteria for hospitalization



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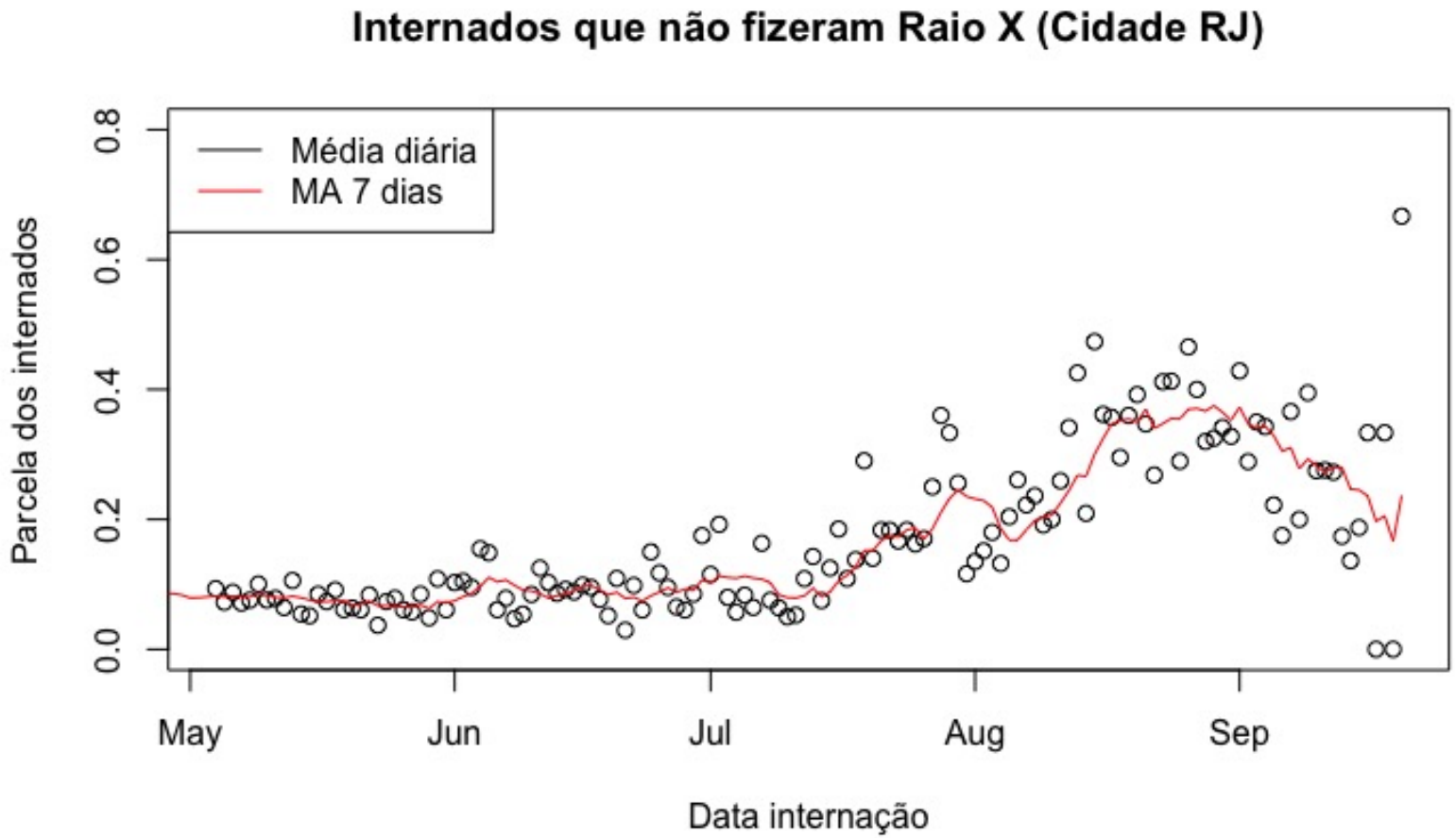

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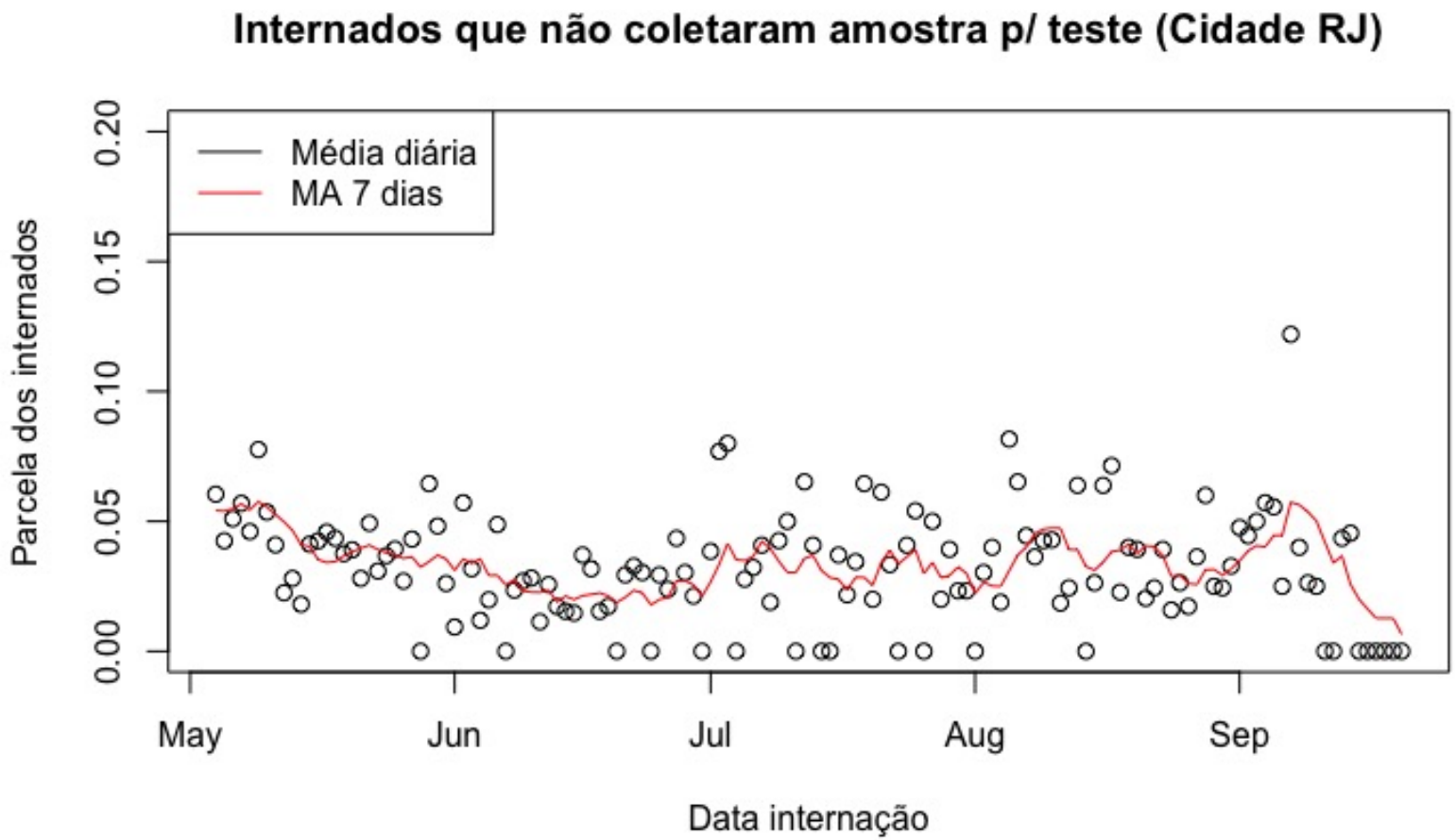
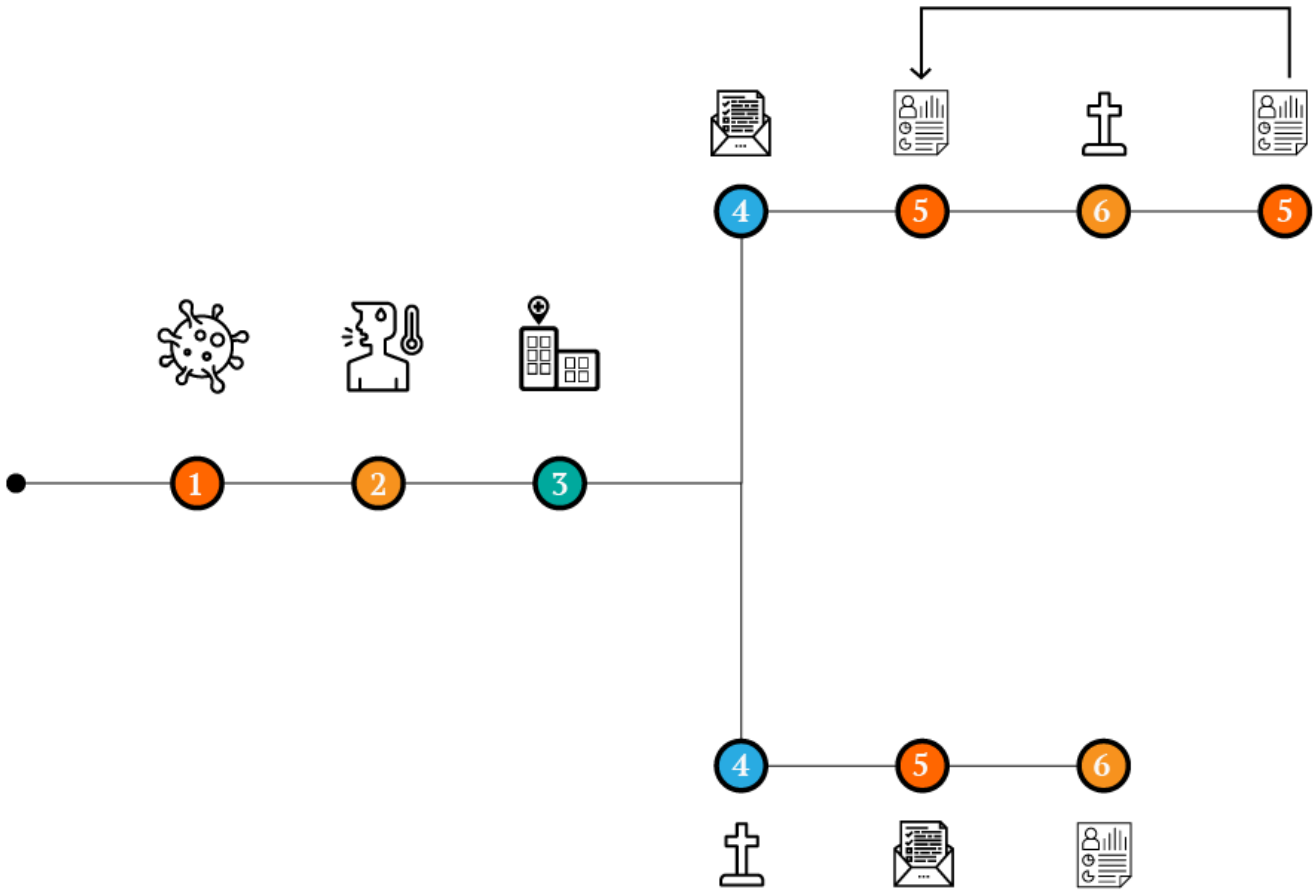


Due to delays is important to NOWCAST!

Nowcast of new cases and deaths

Why should we do it?



Nowcast of new cases and deaths

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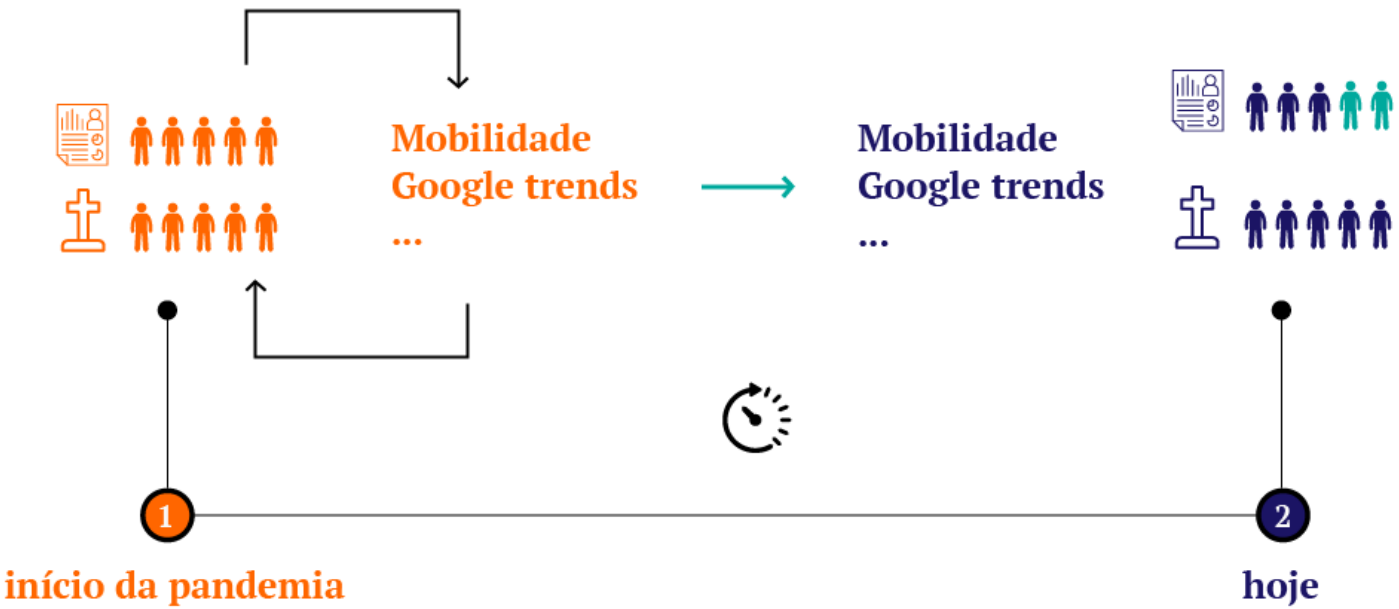
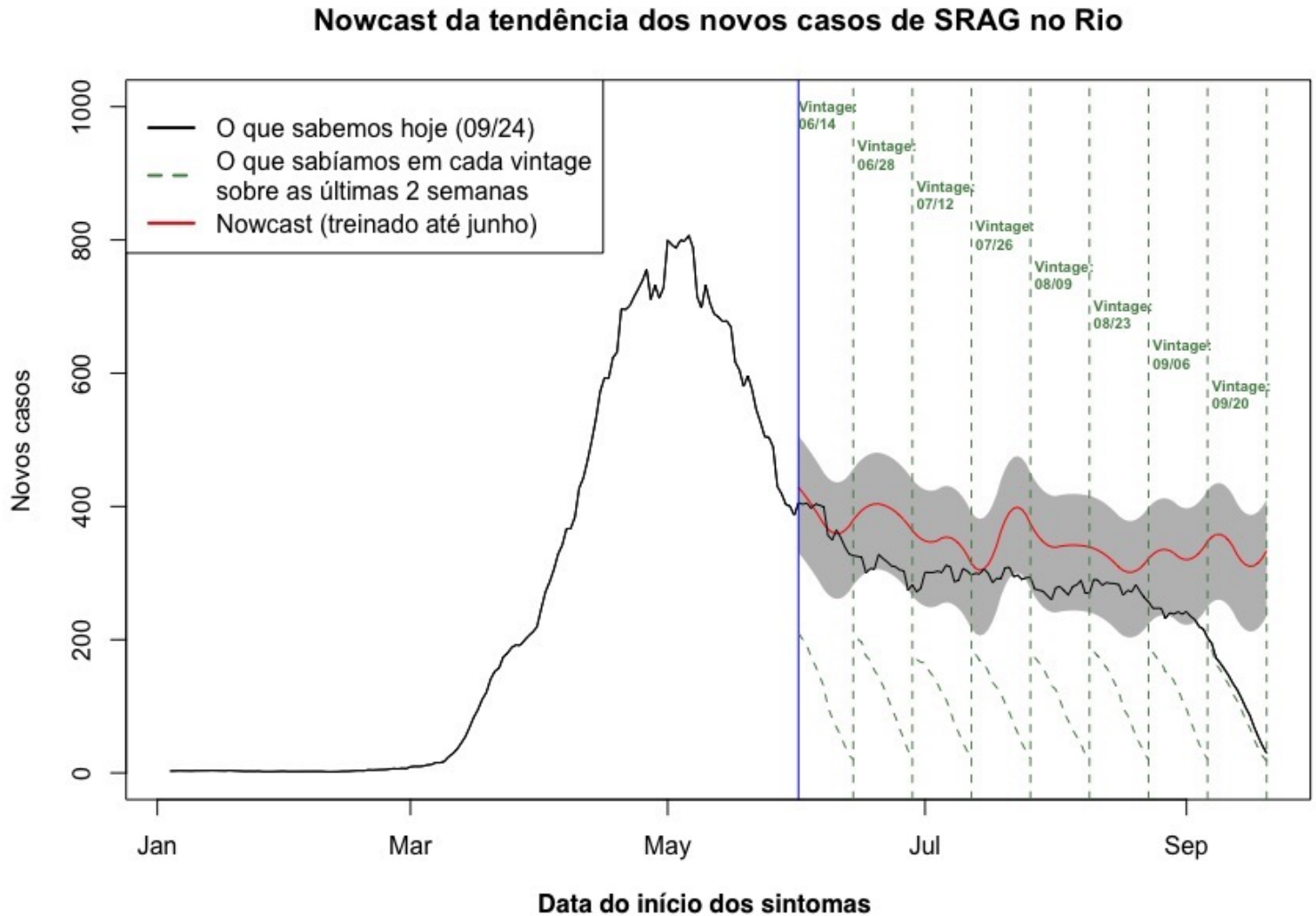


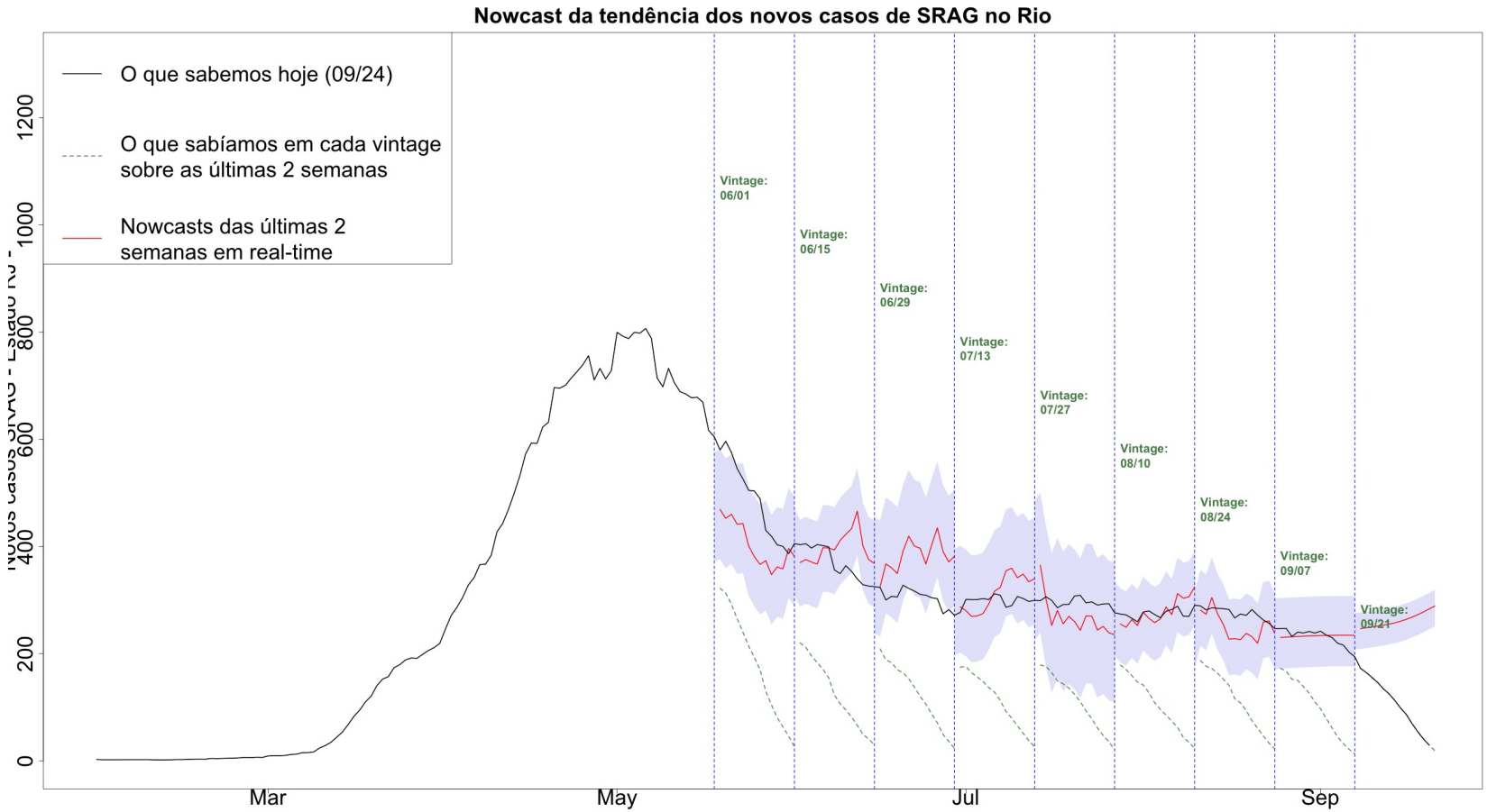
Where are we?

A second wave? Nowcasting the trend of new cases



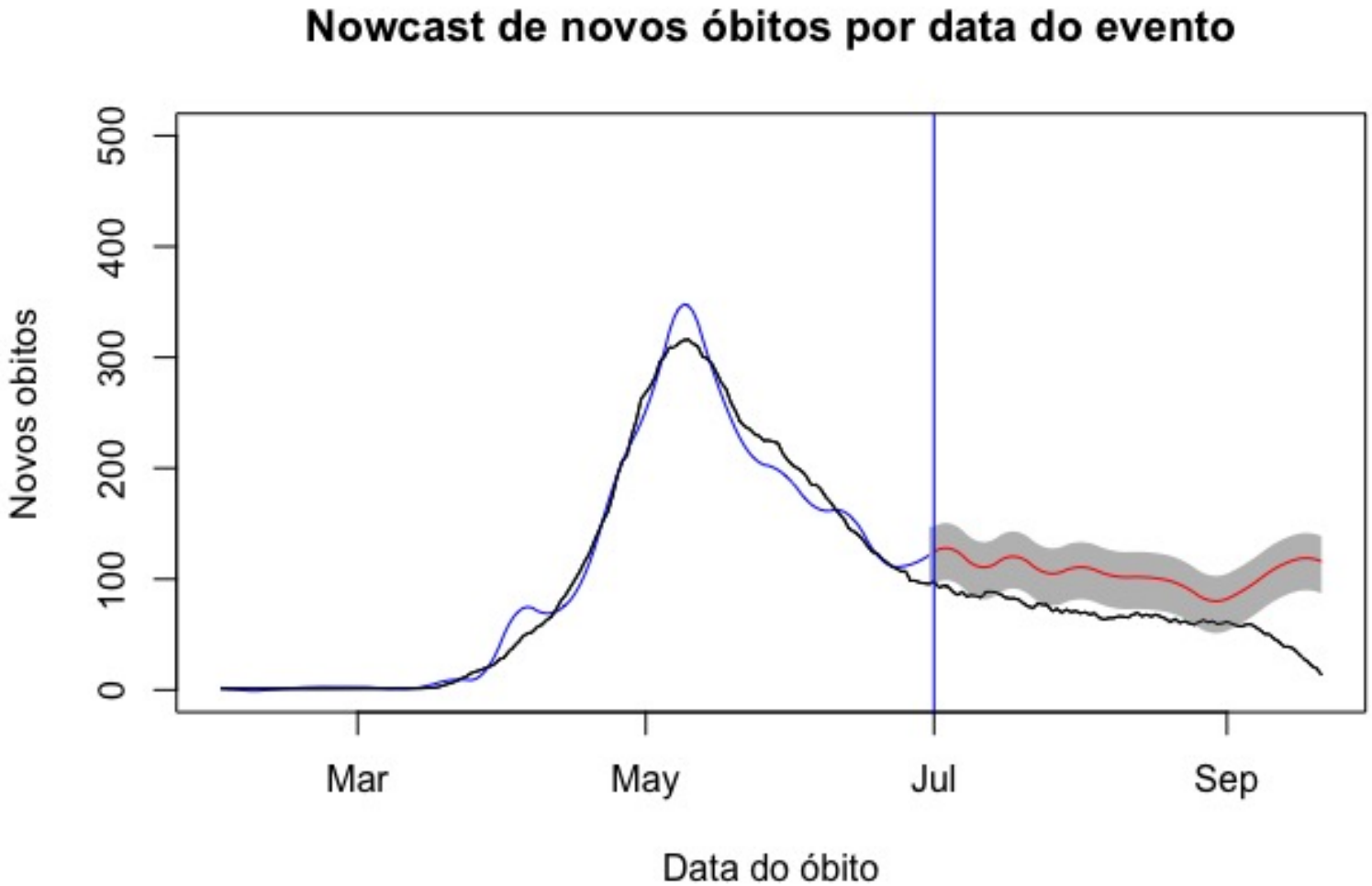
Where are we?

A second wave? Nowcasting the trend of new cases in real-time



Where are we?

A second wave? Nowcasting the trend of new deaths



Where are we?

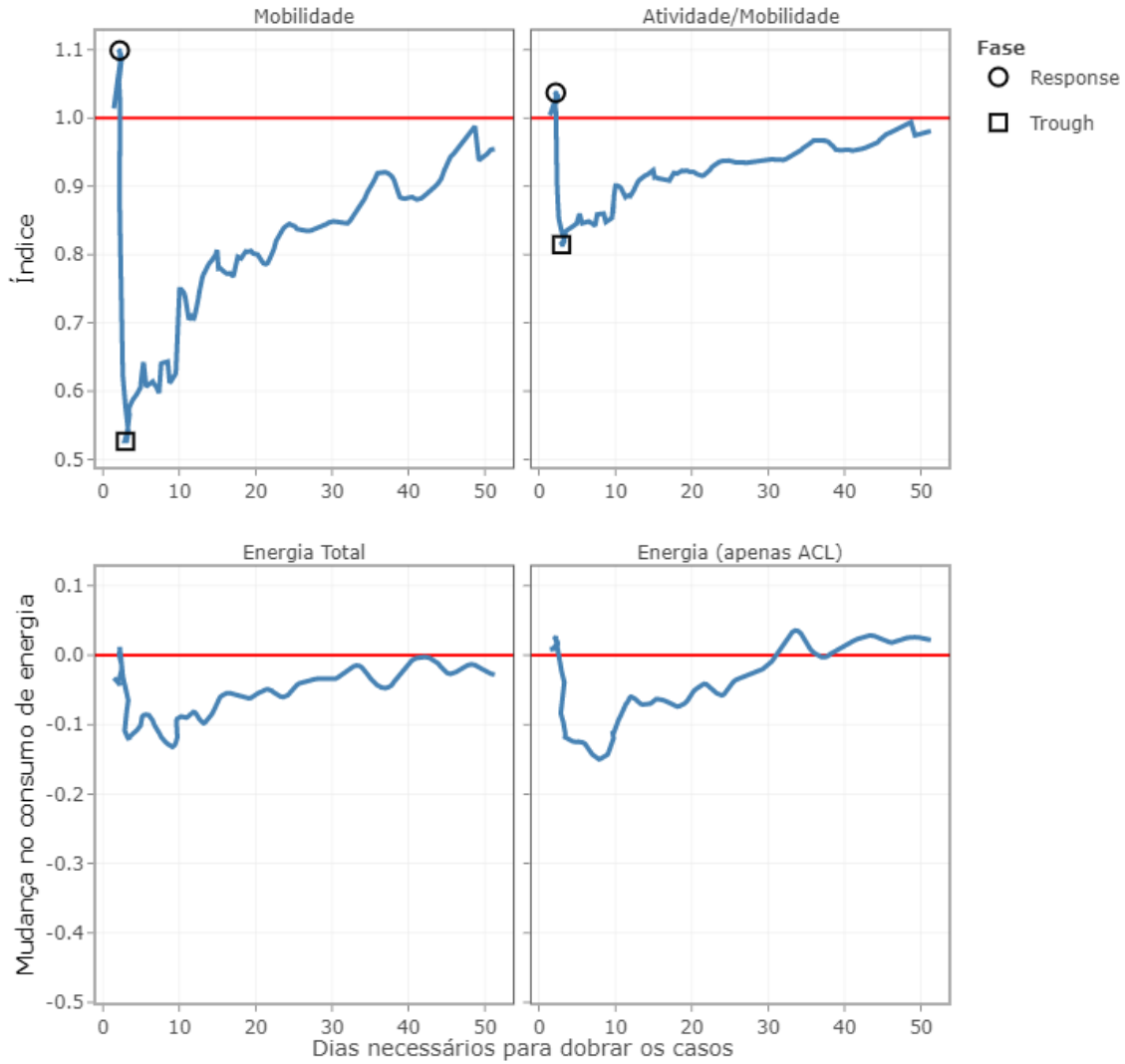
A second wave?

- There is no evidence of a **strong** second wave, but numbers are increasing.
- The increase in the number of cases and deaths seem to be more related to delays in the notifications.
- New hospitalizations were partly due to some changes in the rules, but now we can see a “real” increase in hospitalizations.
- Nowcasts show a small increase in the numbers.

Covid-19 and Economic Activity

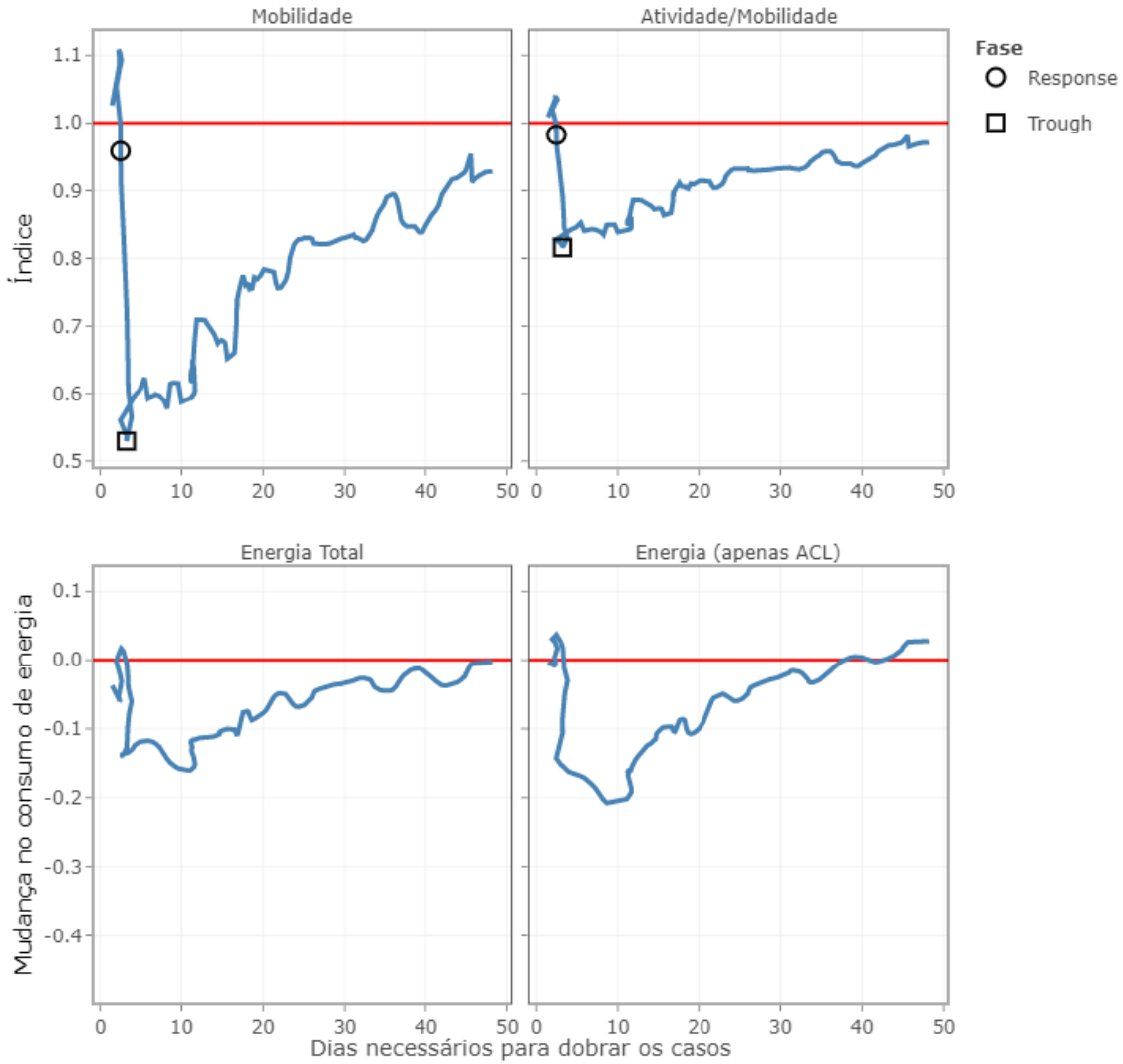
Covid-19 and Economic Activity

Global Pandemic Economy Tracker (PET): Brazil



Covid-19 and Economic Activity

Global Pandemic Economy Tracker (PET): São Paulo



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