

Some macroscopic observations about COVID- 19 mortality in Israel

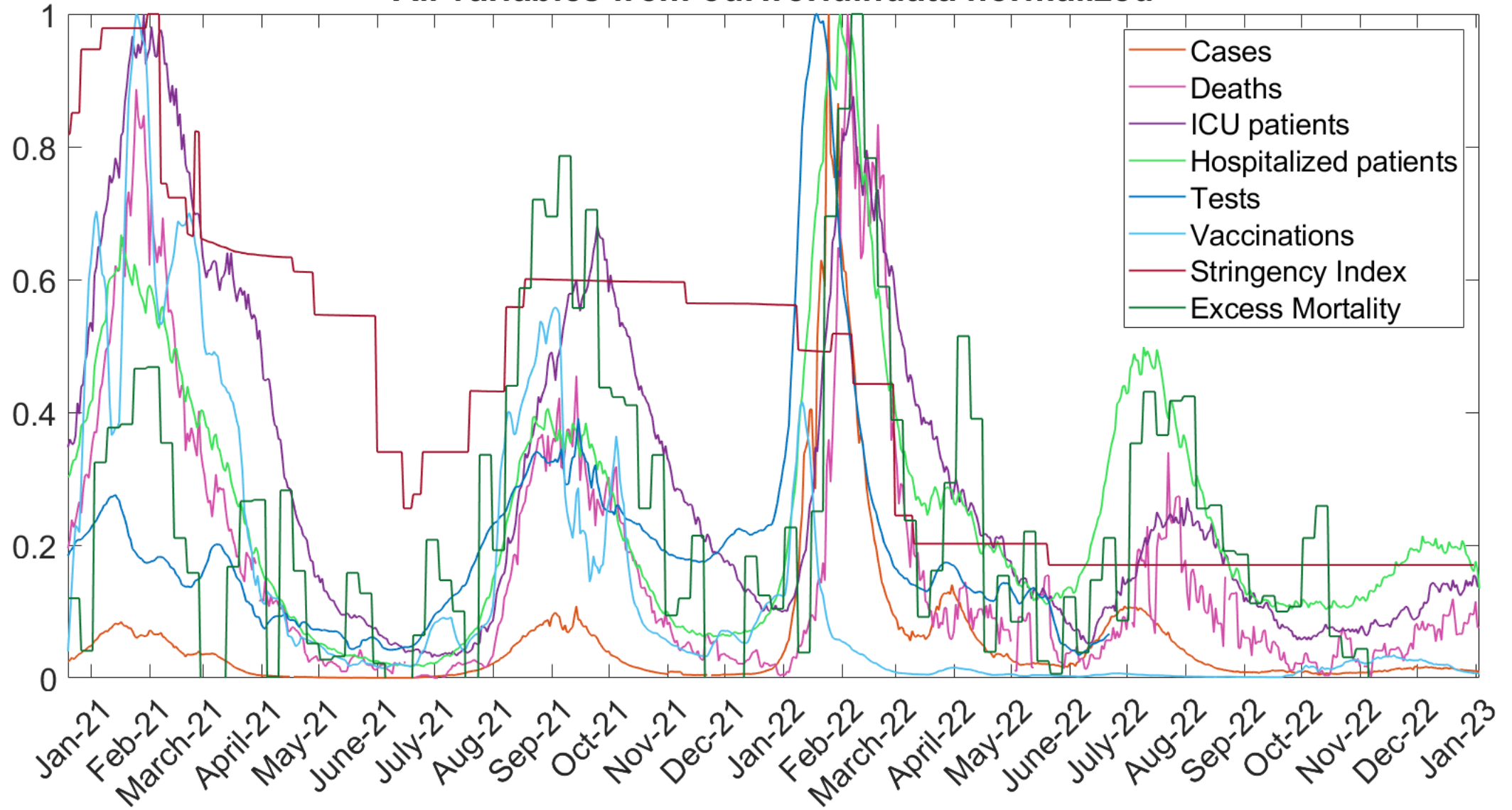
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University of the Basque Country

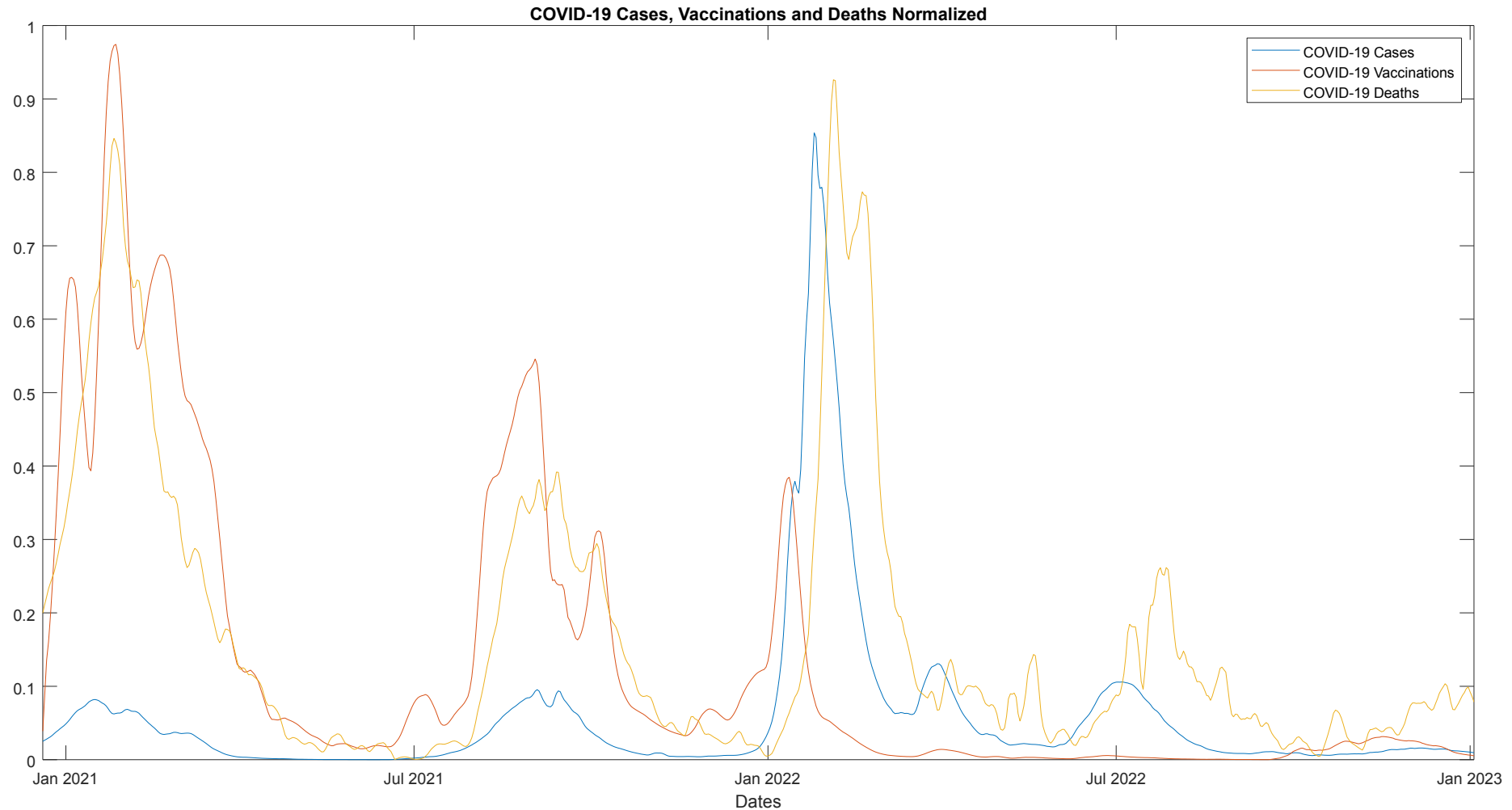
Why Israel?

- Israel has been like a testbed during the pandemic for several extreme measures
 - Strong lockdowns and social measures
 - Pioneering implementation of sanitary/vaccination pass
 - Monoculture of Pfizer Biontech vaccines until very late in the pandemic

All variables from ourworldindata normalized

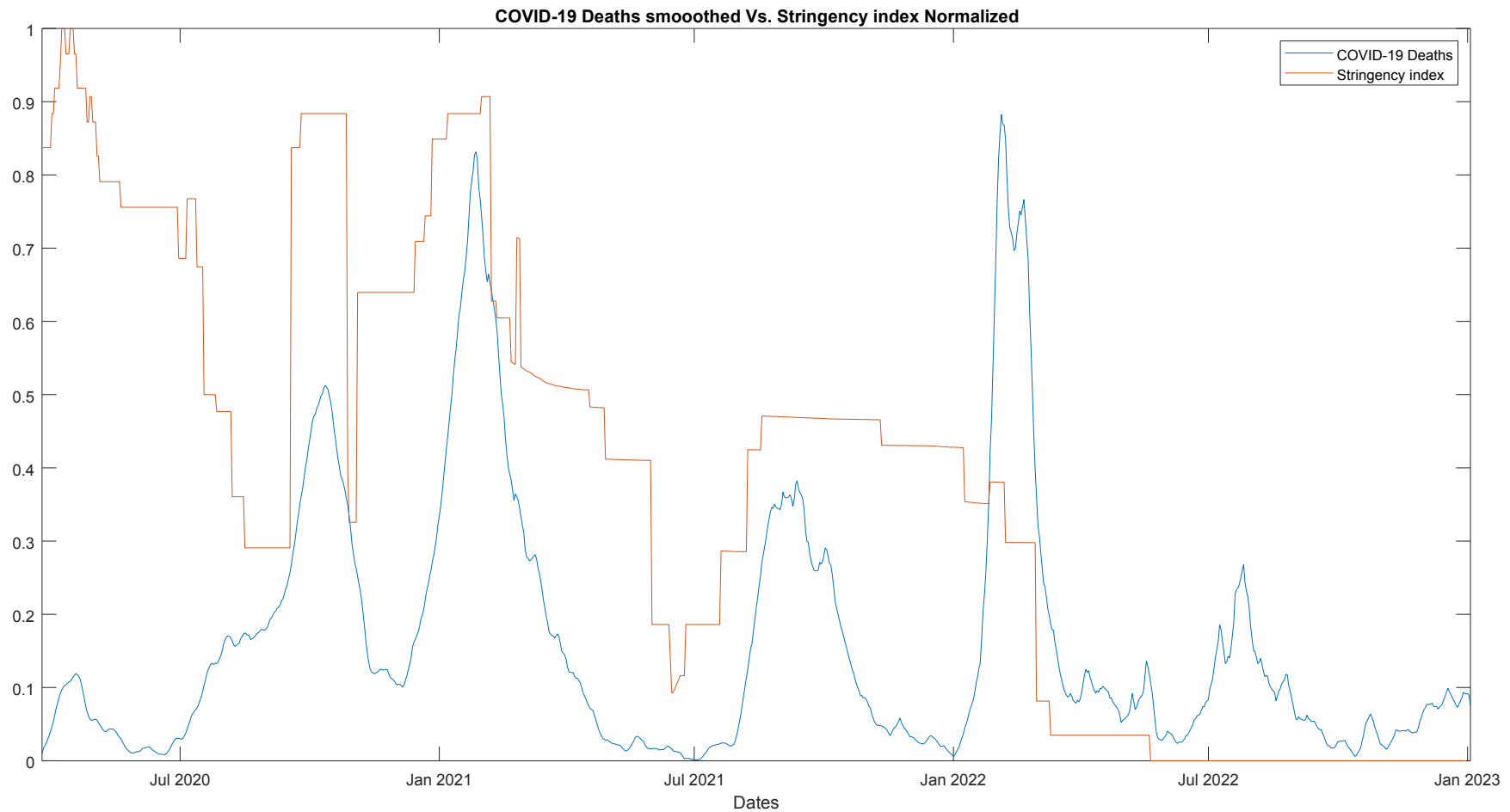


Cases, vaccine doses, deaths • Normalized to [0,1]



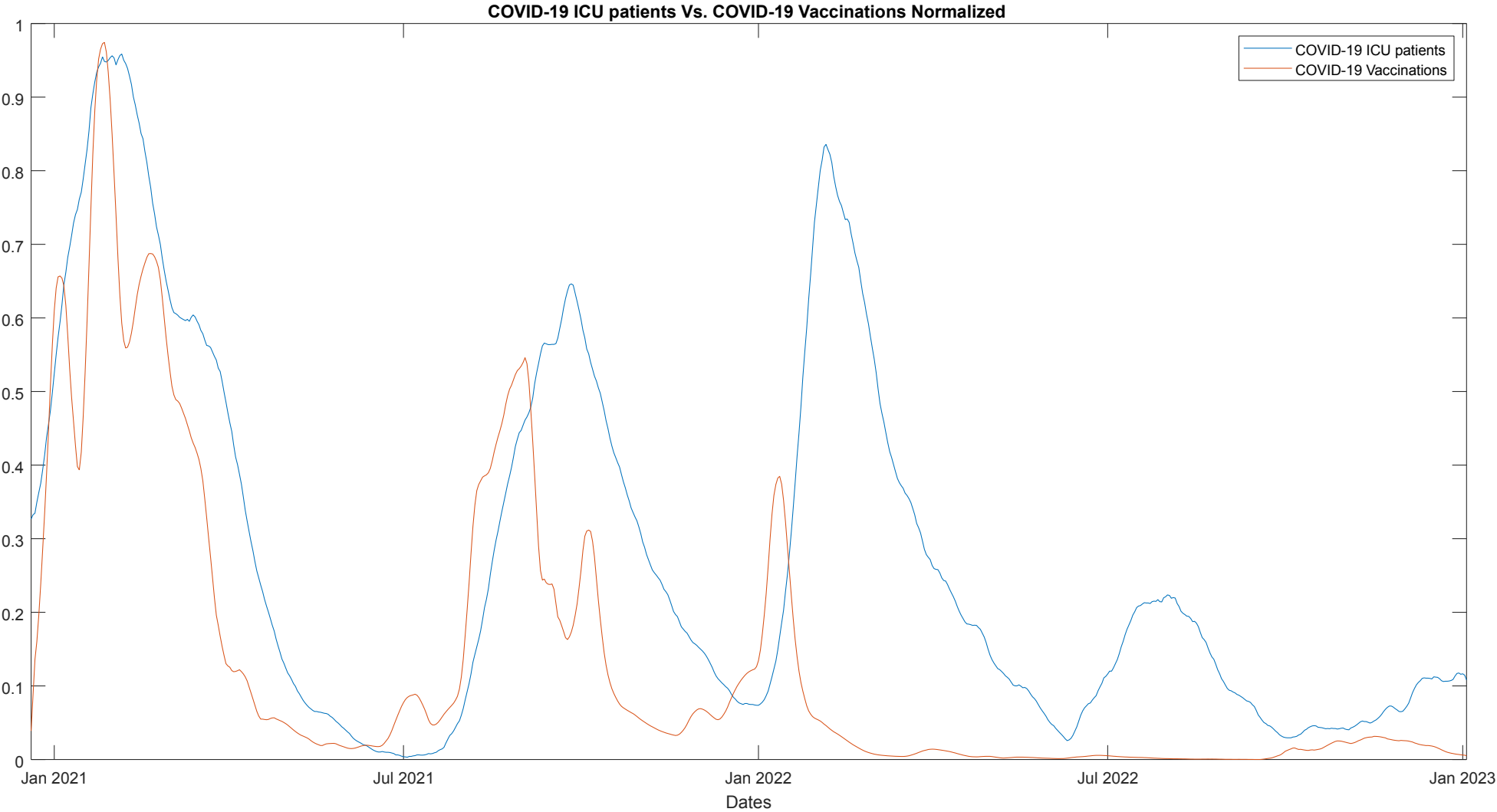
Stringency index, deaths

- Normalized to [0,1]

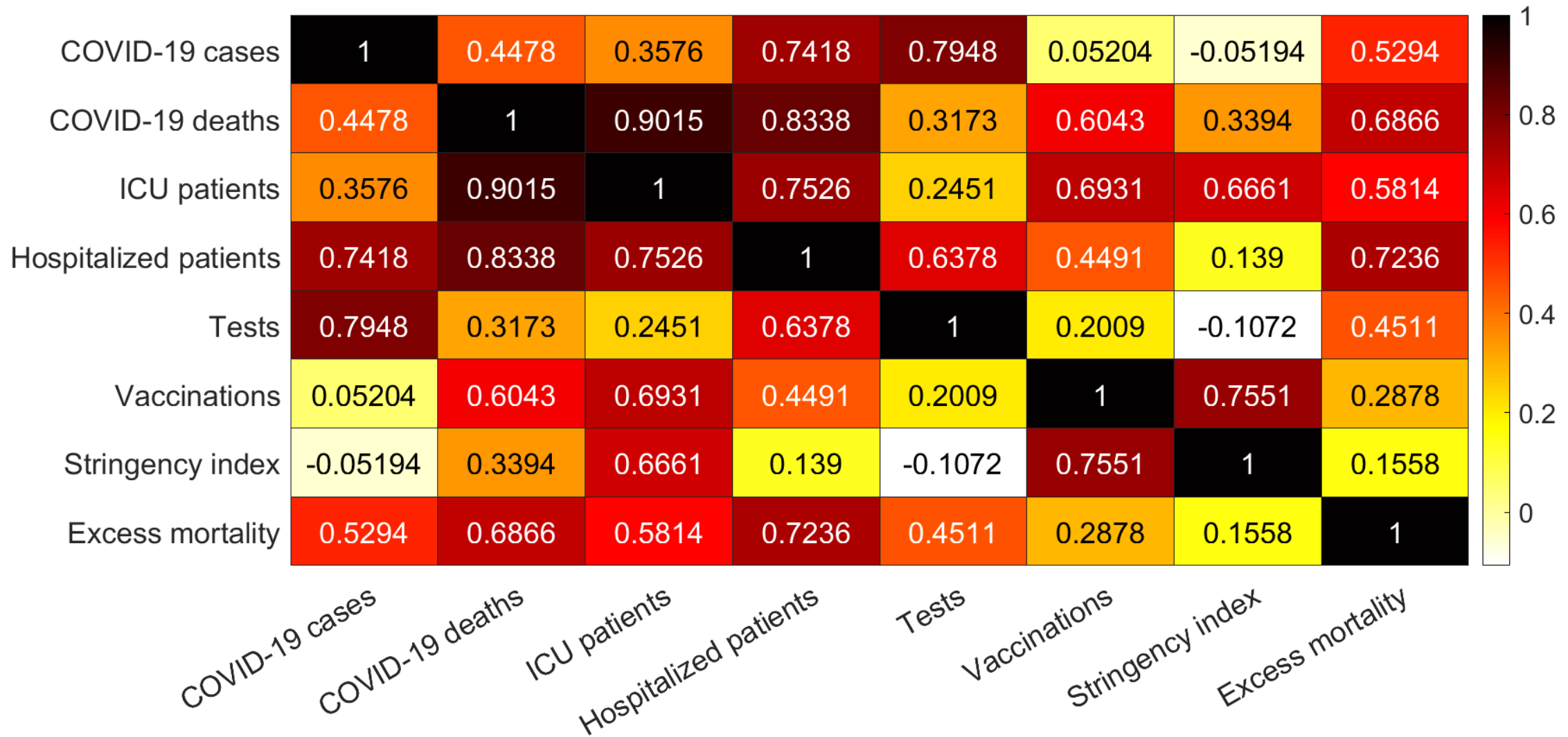


Vaccination doses, ICU patients

Normalized to [0,1]



I.I. Overall Signal Correlation



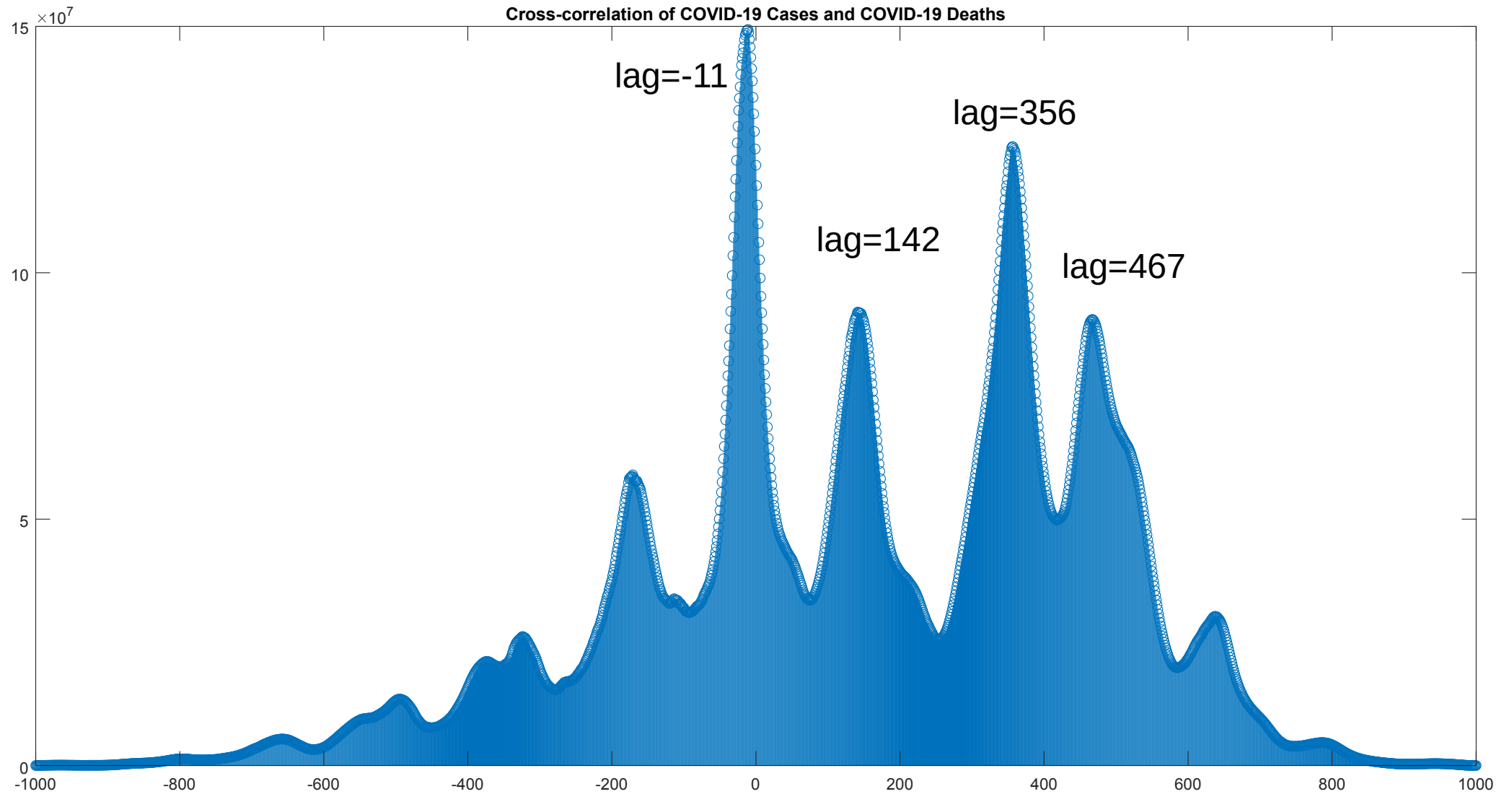
Overall signal correlations 2021-2022

- Non-surprising positive correlations:
 - Deaths – cases, Deaths – ICU patients
- Surprising positive correlation
 - Deaths – Vaccination
- Surprising null correlation
 - Stringency index – deaths and cases

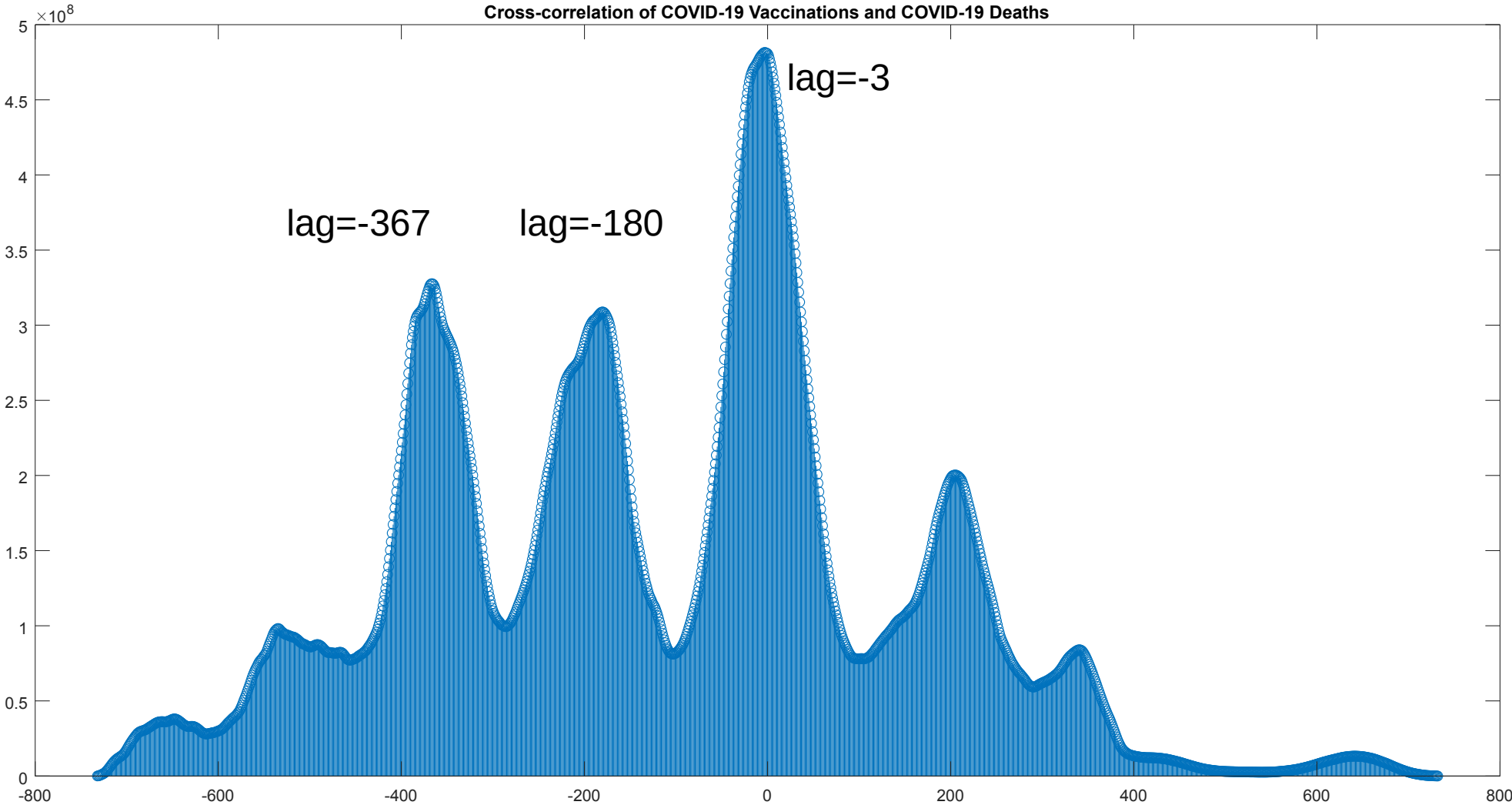
Some cross correlation analysis

```
xcorr(new_cases_smoothed, new_deaths_smoothed)
```

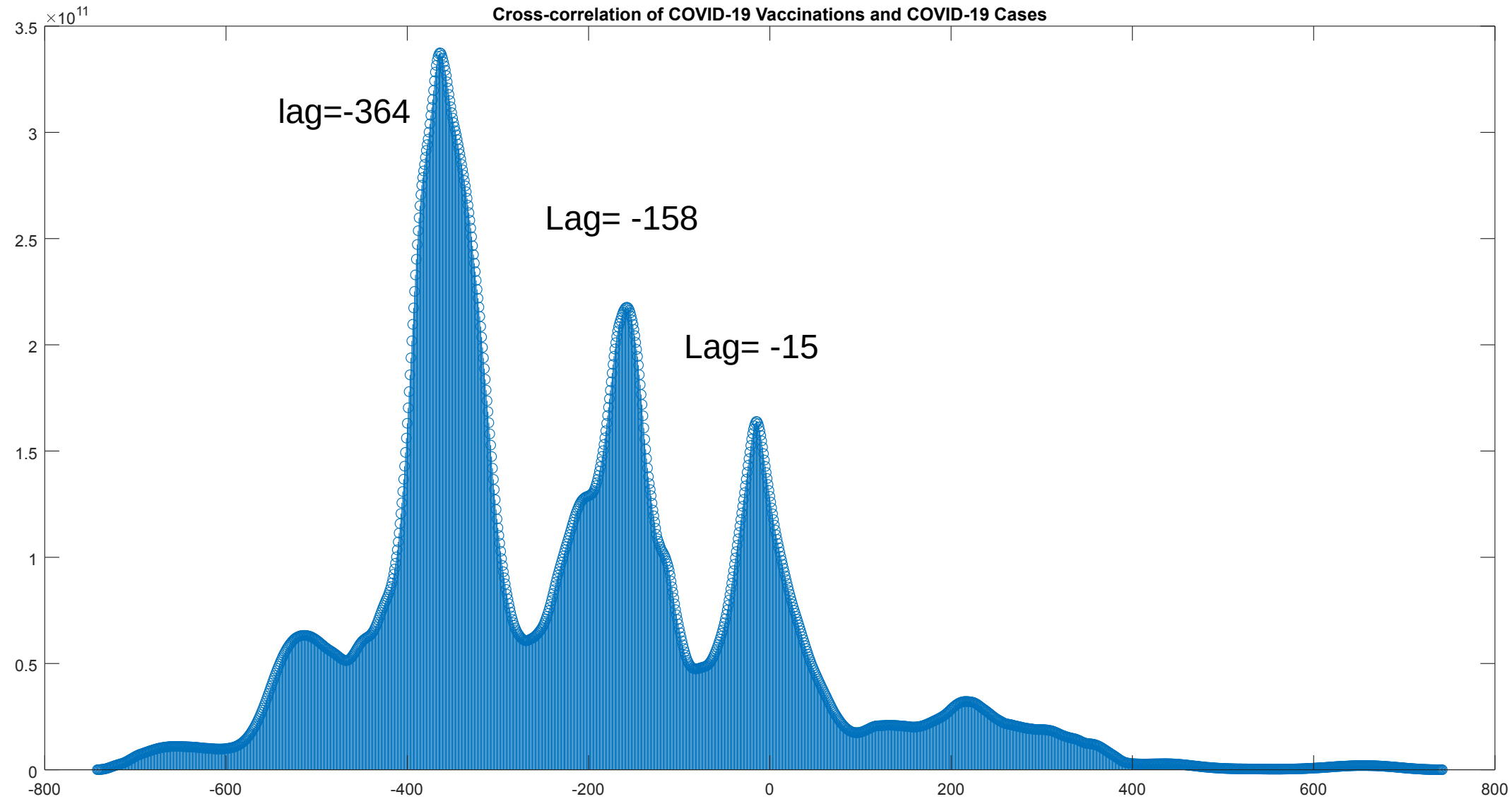
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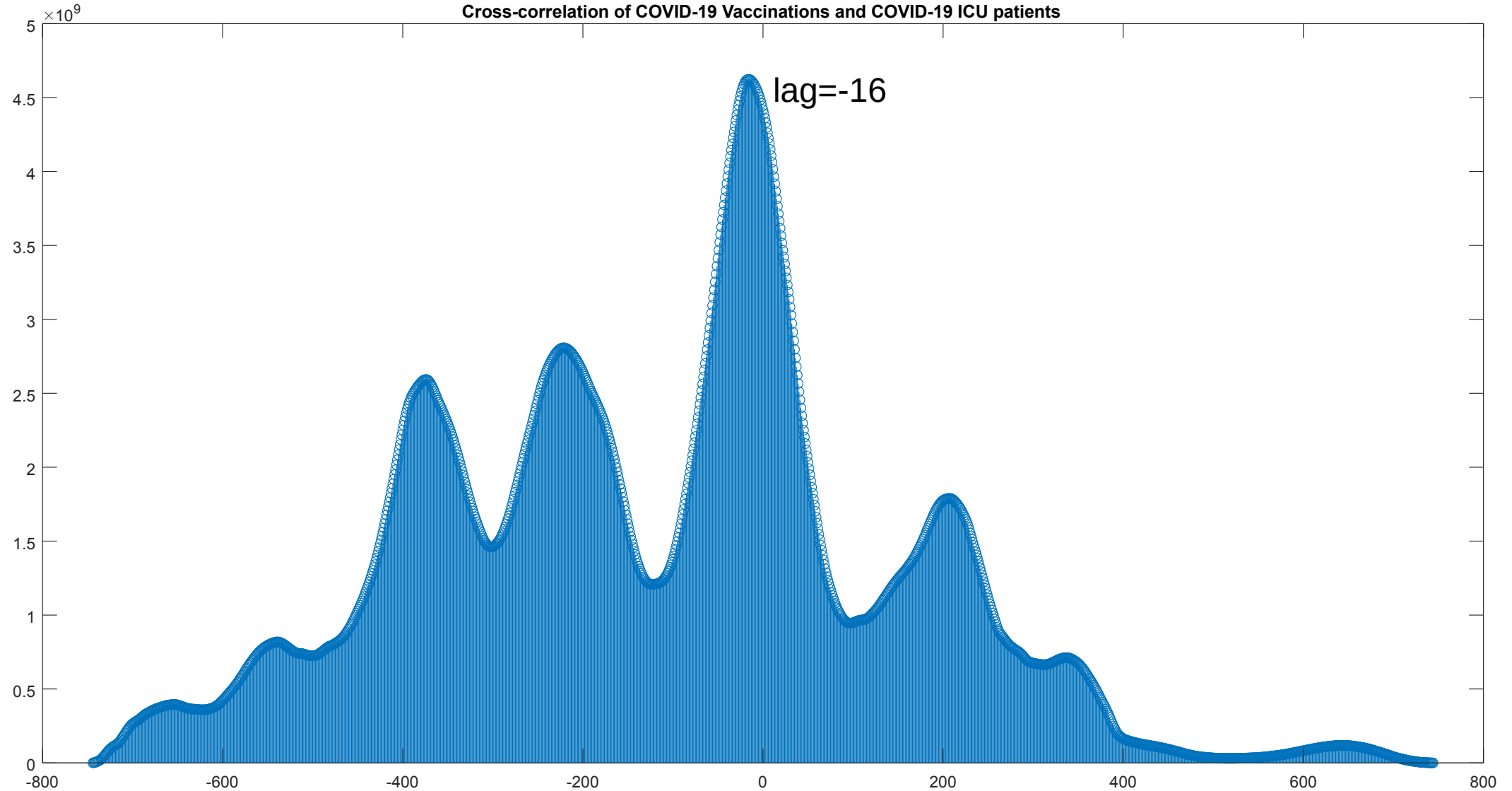
`xcorr(new_vaccinations_smoothed, new_deaths_smoothed)`



`xcorr(new_vaccinations_smoothed , new_cases_smoothed)`



`xcorr(new_vaccinations_smoothed , icu_patients)`

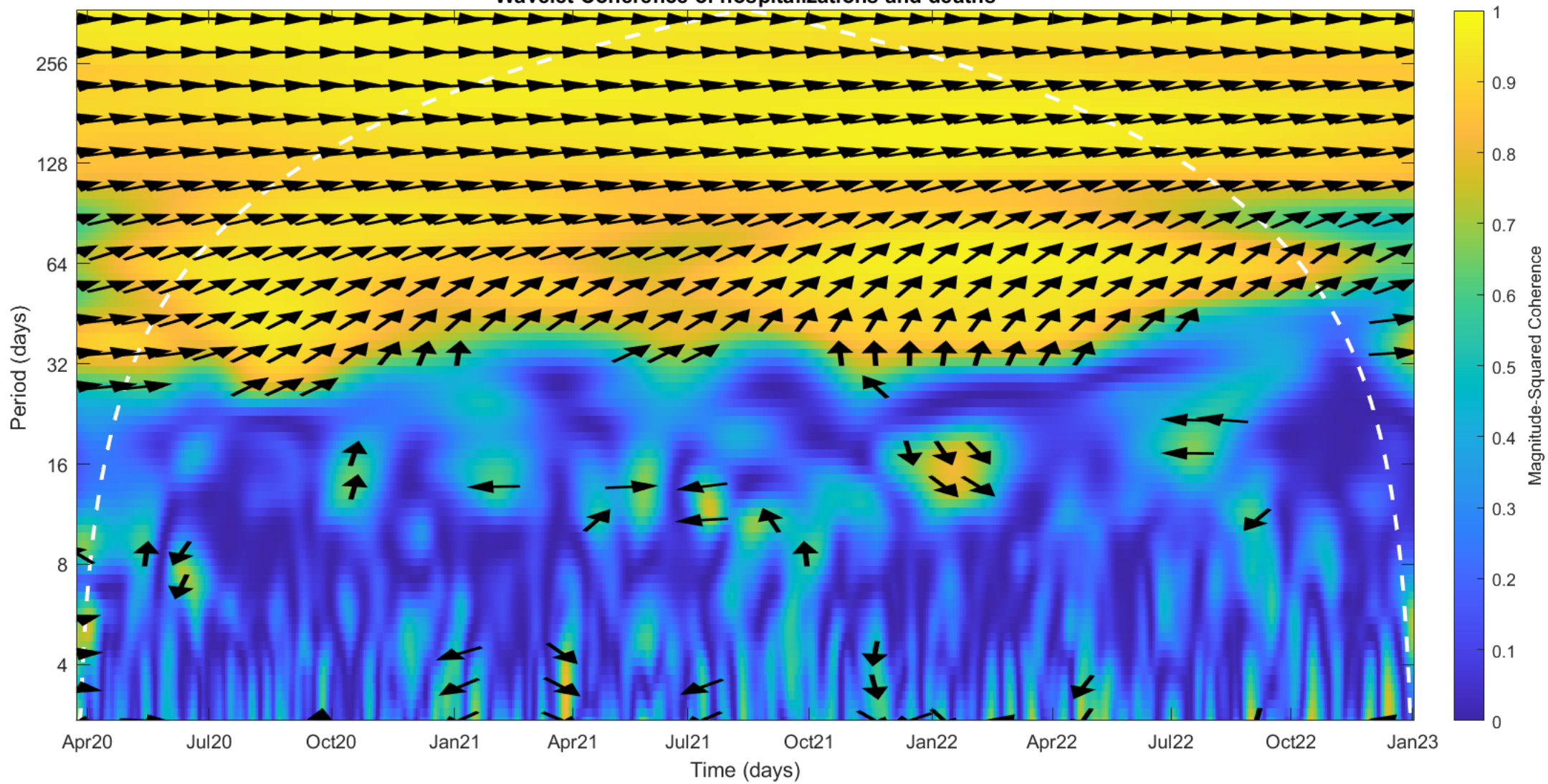


Results from cross-correlation

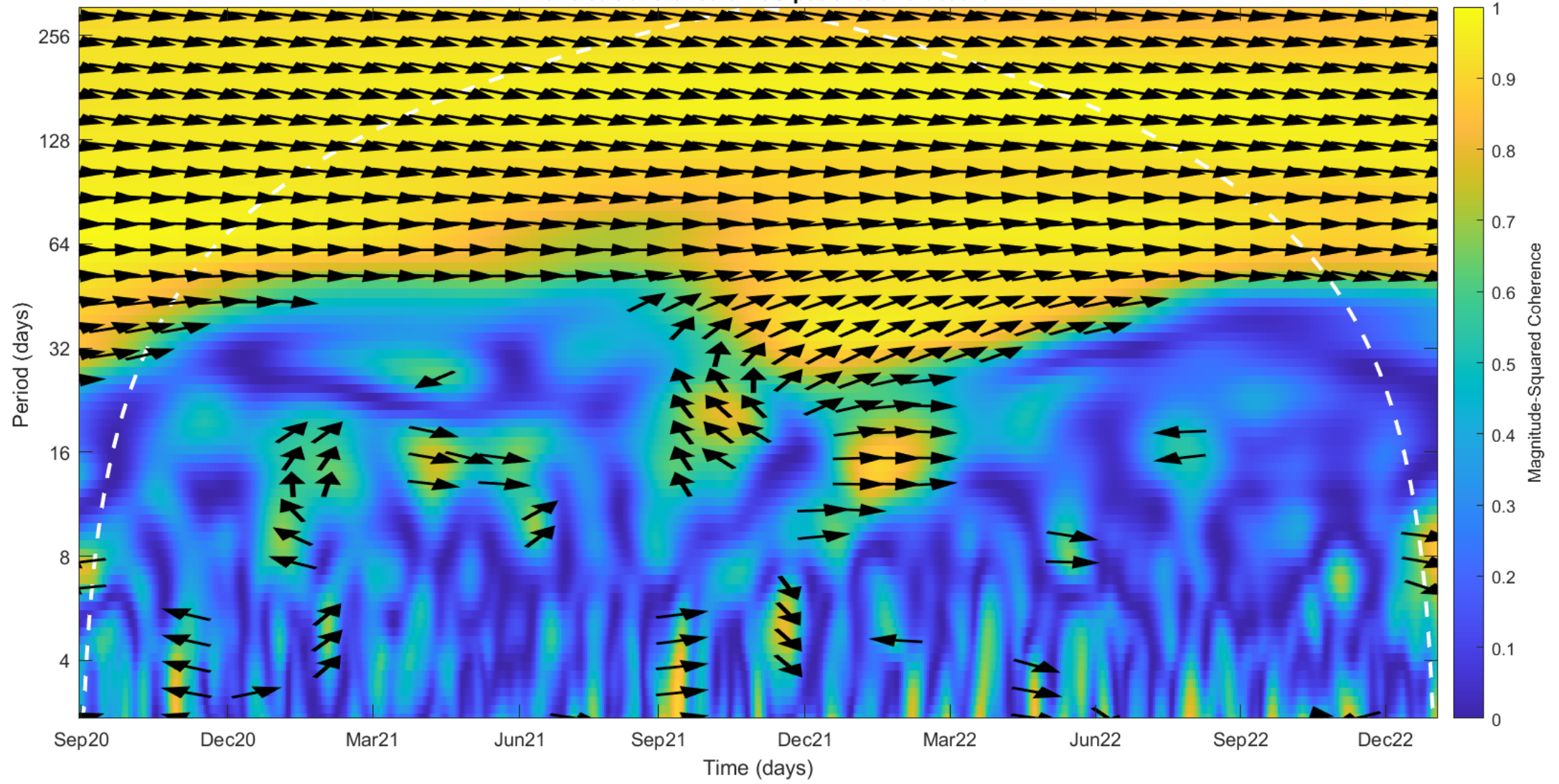
- Non surprising
 - Cases match/predict deaths after 11 days
- Surprising
 - Vaccination doses match/predict ICU after 16 days
 - Vaccination doses match/predict deaths after 3 days
 - Vaccination doses match/predict cases after 15, 158 days
 - Maximal at 365 days??

Wavelet coherence analysis

Wavelet Coherence of hospitalizations and deaths



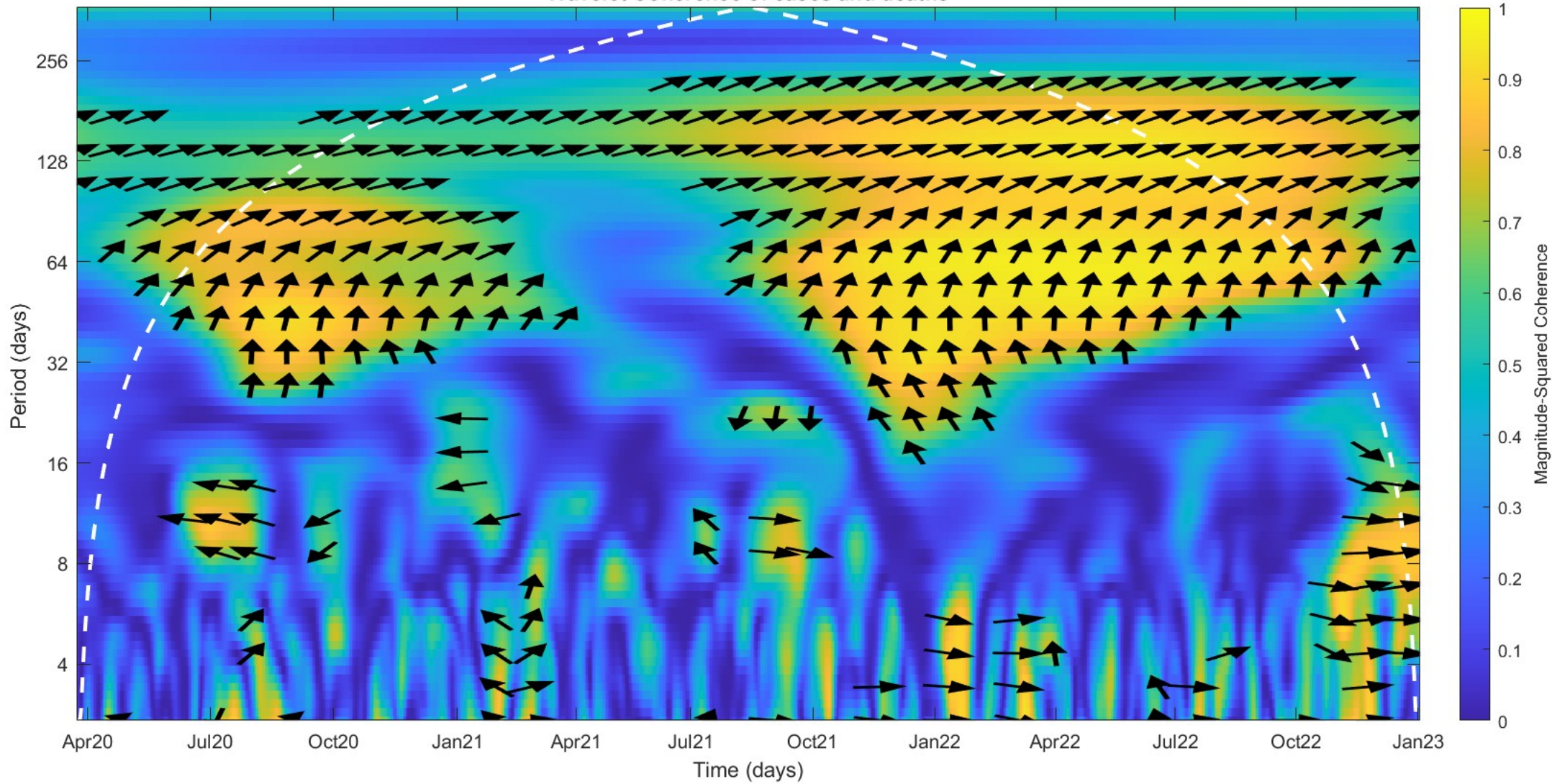
Wavelet Coherence of ICU patients and deaths



observations

- Non surprising long term in phase coherence of hospitalizations and ICU patients with deaths
- For periods below 32 days there is surprisingly little coherence

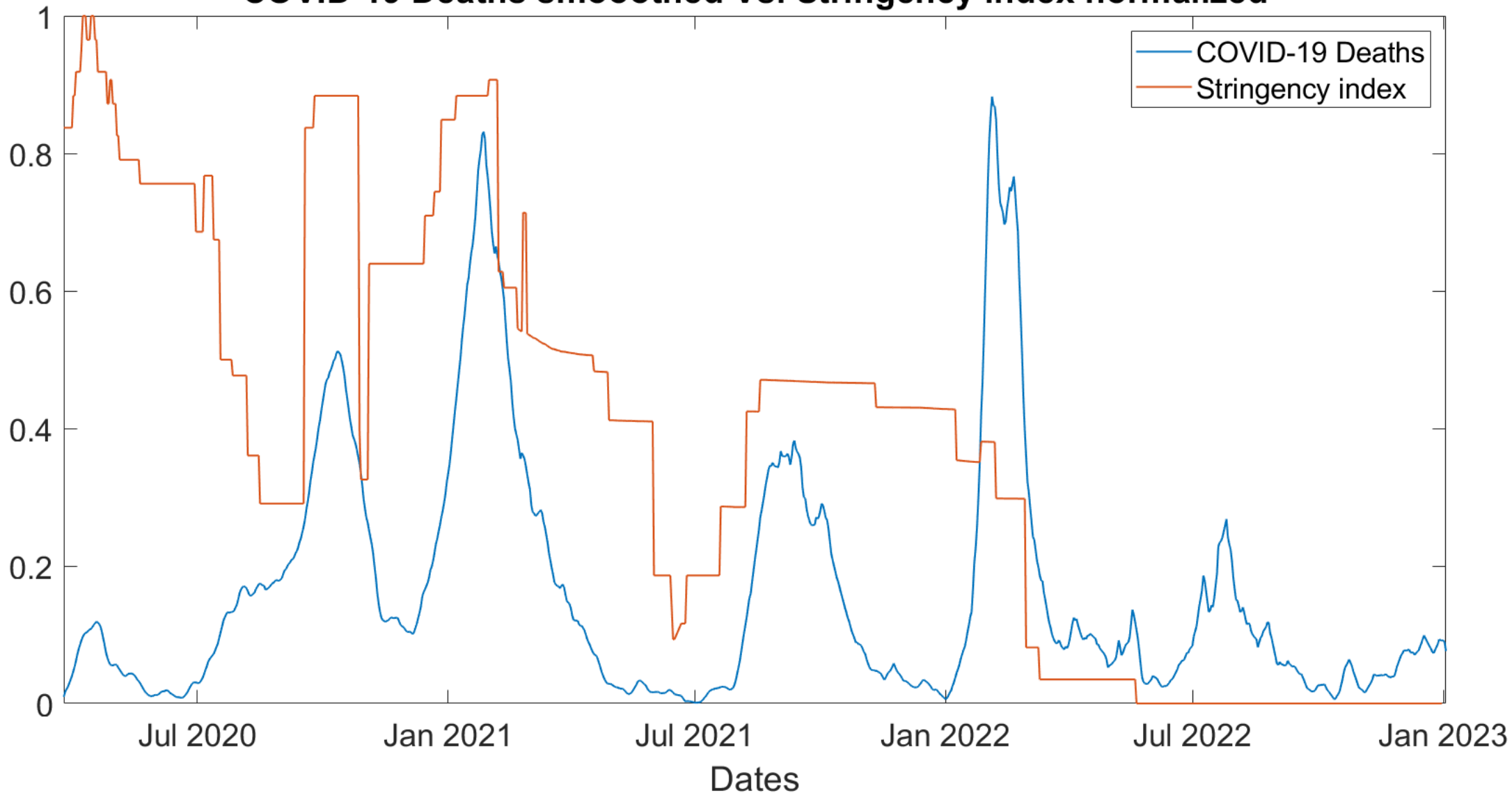
Wavelet Coherence of cases and deaths



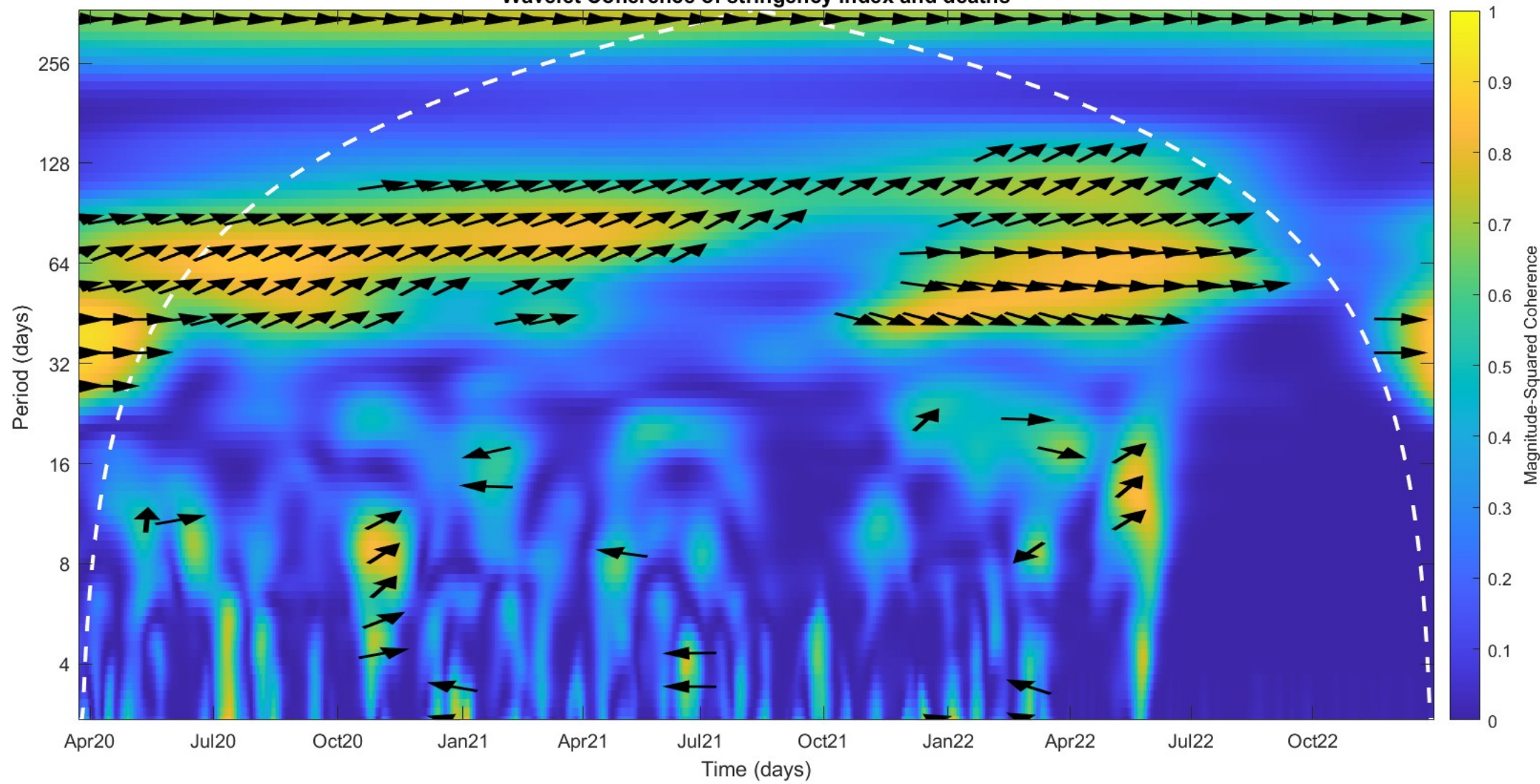
observations

- Surprisingly, the long term coherence between cases and deaths is absent
- In some localized periods of time there is medium term (32 to 64 days) coherence where cases are predicting deaths (up arrow)
- Surprisingly there is little coherence at short term
-

COVID-19 Deaths smoothed Vs. Stringency index normalized



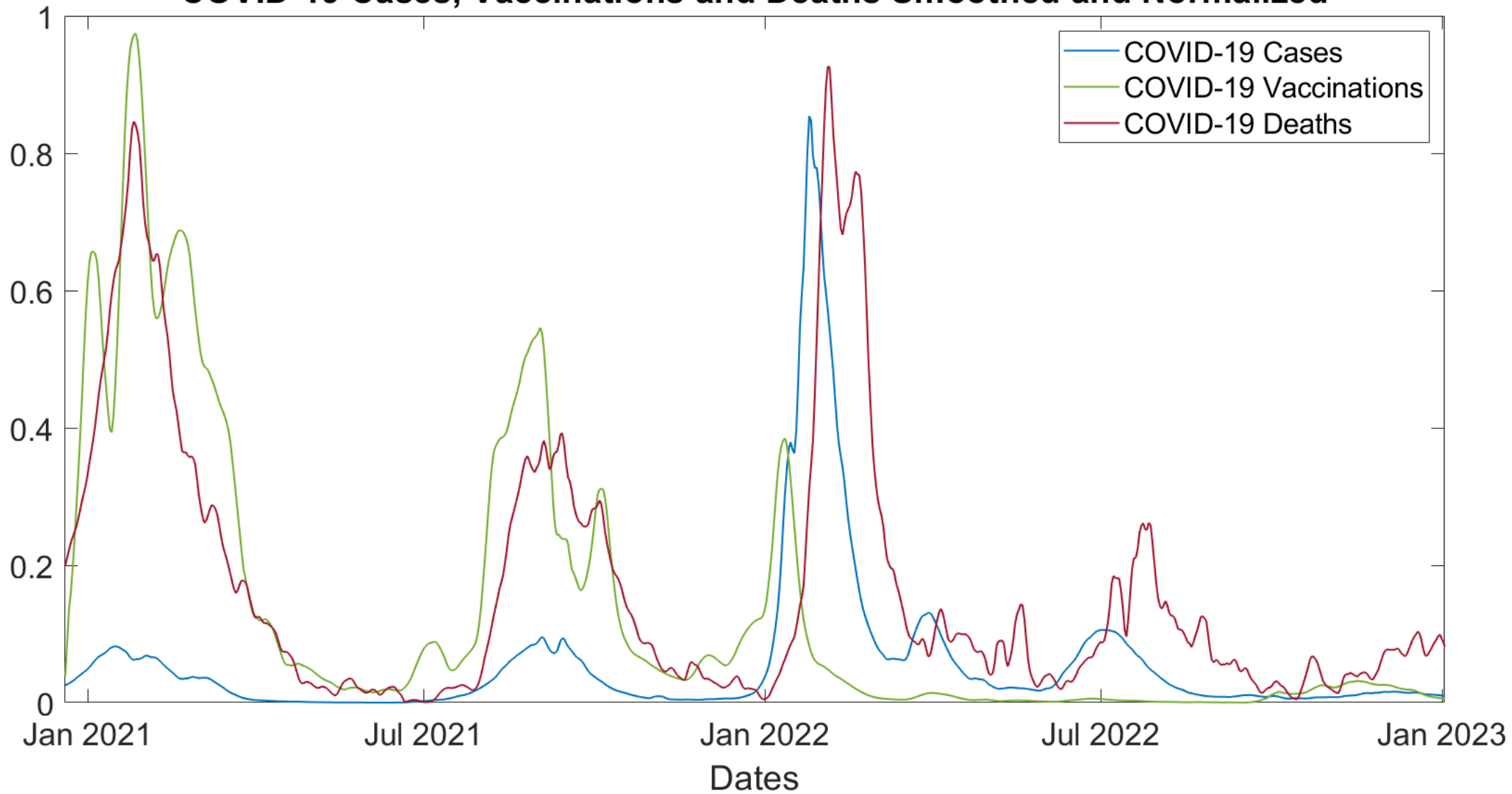
Wavelet Coherence of stringency index and deaths



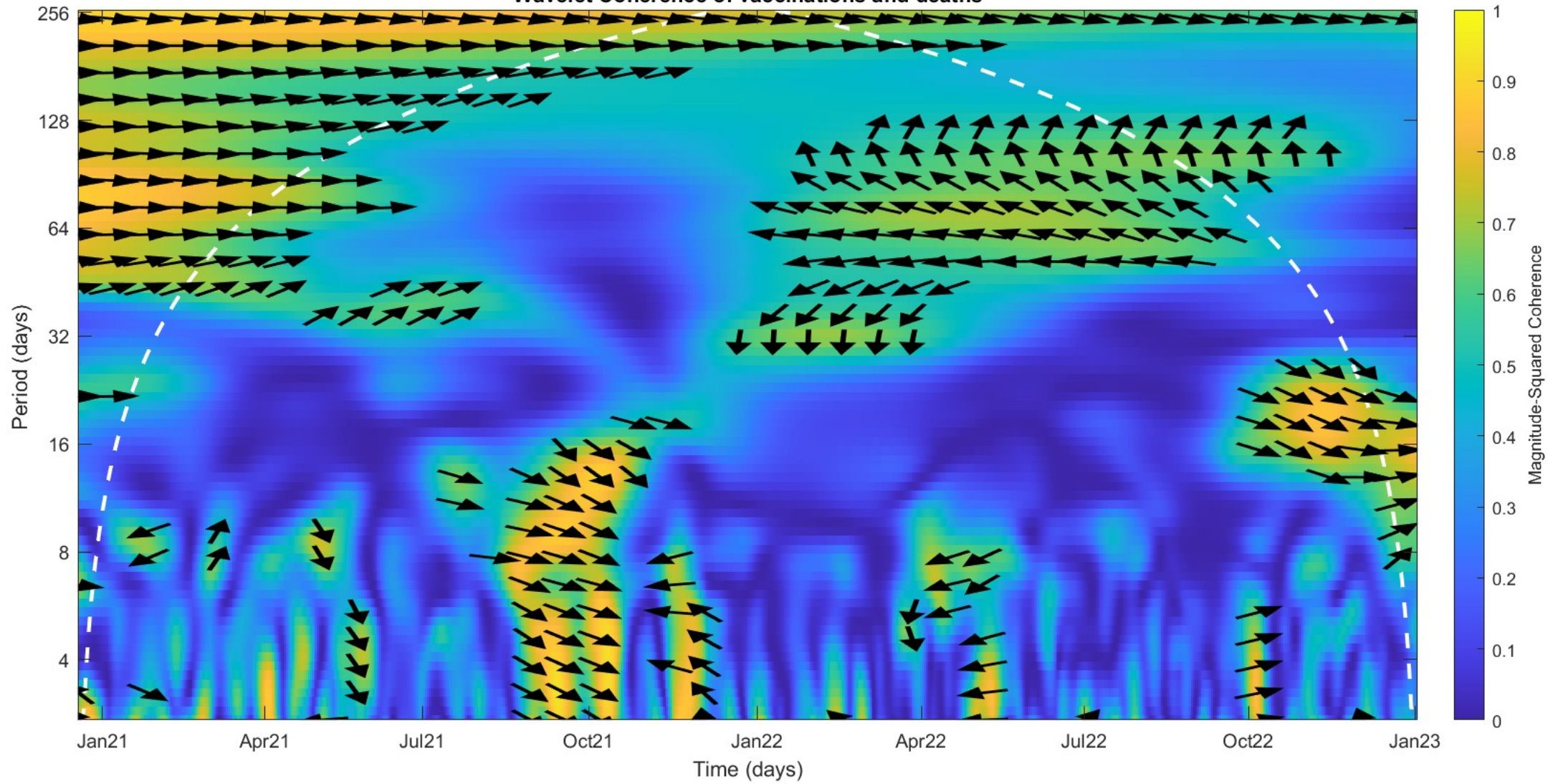
observations

- Long term coherence in phase is detected with low significance
 - In phase: more stringency more deaths
- During most of 2020 and until mid 2021, there is medium term (64 days) coherence where stringency predicts deaths
- In 2022 there is in phase medium term coherence between stringency and deaths

COVID-19 Cases, Vaccinations and Deaths Smoothed and Normalized



Wavelet Coherence of vaccinations and deaths



observations

- During 2021 there is long term in phase coherence between vaccine doses and deaths
- In the first quarter of 2021 there is a strong in phase medium term coherence of vaccine doses and deaths
- Around october 2021 there is strong almost in phase short term coherence of vaccine doses and deaths
- At the end of 2022 there is strong almost in phase short term coherence of vaccine doses and deaths

Regressing COVID-19 deaths from the other variables

Variable importances

Input variables	Estimate	SE	tStat	P-Value
hospitalized patients	0,0185	0,0011	16,6508	3.2960e-50
tests	-7,4430e-05	6,5829e-06	-11,3065	1.1820e-26
stringency index	0,1391	0,0224	6,2203	1.0211e-09
ICU patients	0,0343	0,0057	6,0615	2.5932e-09
cases	-1,2579e-04	4,9114e-05	-2,5611	0.0107
vaccinations	-2,3440e-05	1,0562e-05	-2,2193	0.0269

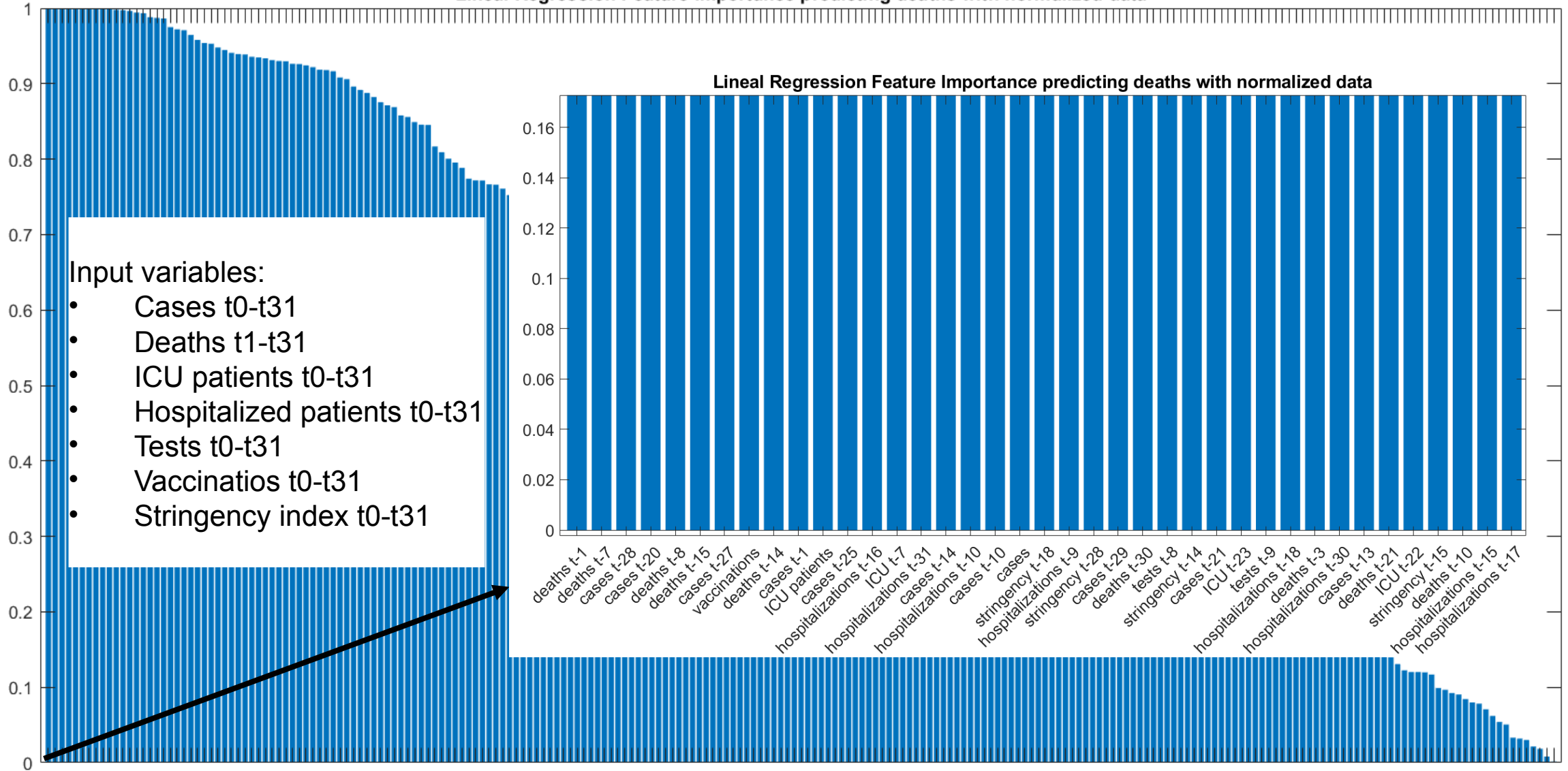
Normalized to $[0,1]$

Variables	Estimate	SE	tStat	P-Value
hospitalized patients	0,9232	0,0554	16,6508	3,2960e-50
tests	-0,3890	0,0344	-11,3065	1,1820e-26
stringency index	0,1373	0,0221	6,2203	1,0211e-09
ICU patients	0,1908	0,0315	6,0615	2,5932e-09
cases	-0,1752	0,0684	-2,5611	0,0107
vaccinations	-0,0594	0,0268	-2,2193	0,0269

observations

- Main effect comes from the hospitalized patients
- Stringency index has a positive coefficient highly significant ($p \ll 0.005$)
- Vaccination doses has a minor negative effect with low significance ($p = 0.02$)

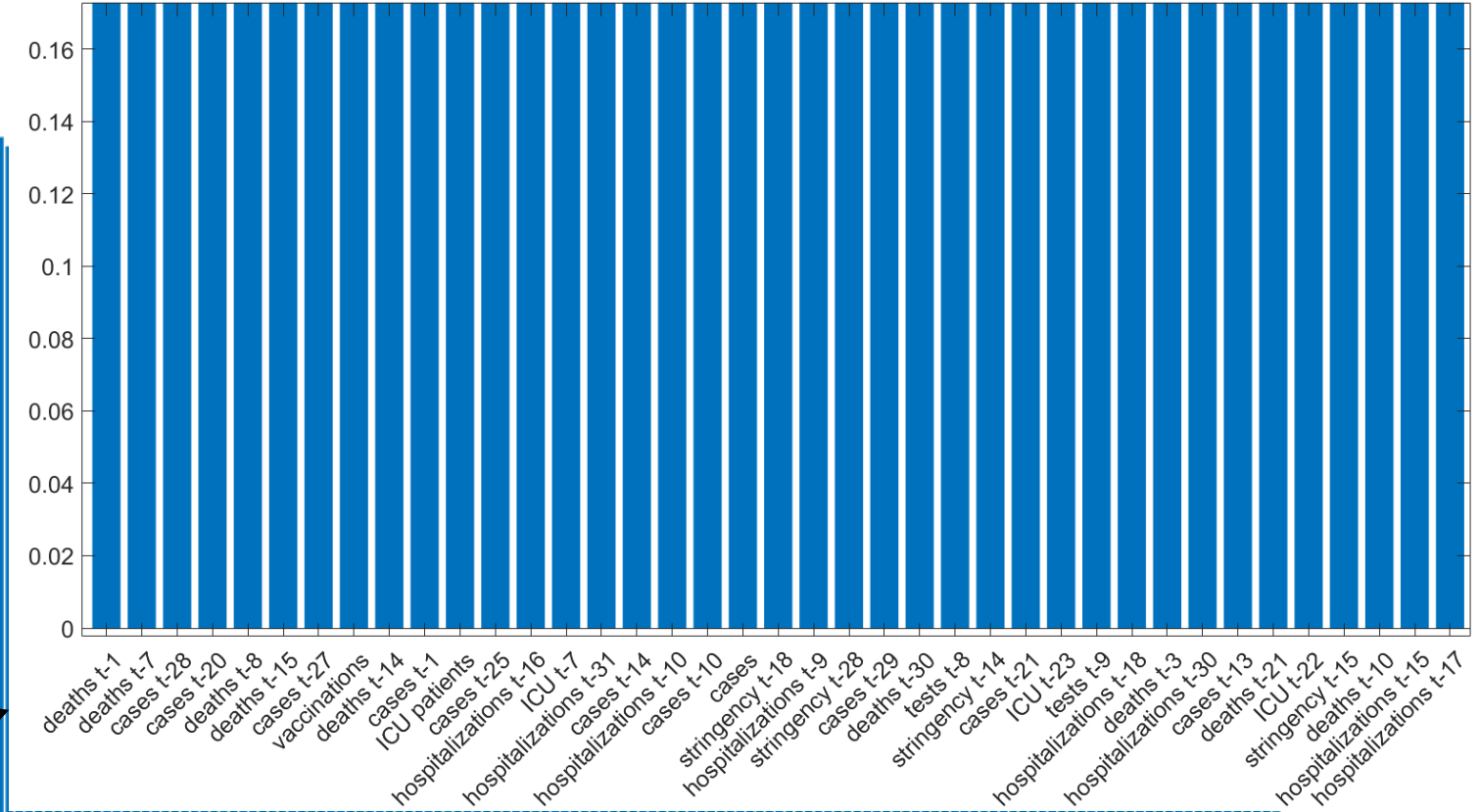
Lineal Regression Feature Importance predicting deaths with normalized data



Input variables:

- Cases t0-t31
- Deaths t1-t31
- ICU patients t0-t31
- Hospitalized patients t0-t31
- Tests t0-t31
- Vaccinatiois t0-t31
- Stringency index t0-t31

Lineal Regression Feature Importance predicting deaths with normalized data



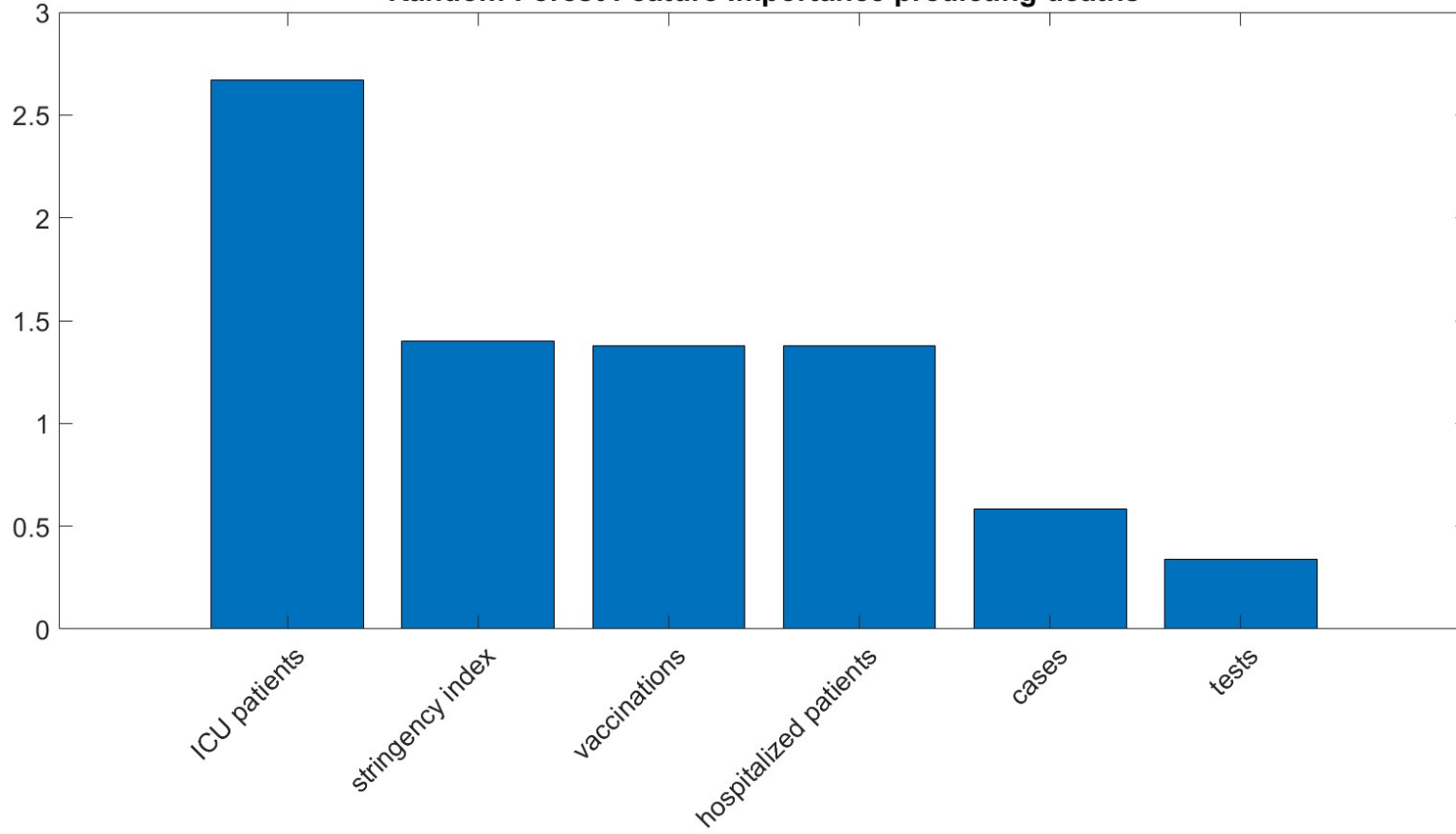
deaths t-1, deaths t-7, cases t-28, cases t-20, deaths t-8, deaths t-15, vaccinations, deaths t-14, cases t-1, ICU patients, cases t-25, hospitalizations t-16, hospitalizations t-7, hospitalizations t-31, hospitalizations t-14, cases t-10, cases t-10, stringency t-18, hospitalizations t-9, stringency t-9, cases t-28, deaths t-29, deaths t-30, tests t-8, stringency t-14, cases t-21, ICU t-23, tests t-9, hospitalizations t-18, deaths t-3, hospitalizations t-30, cases t-13, deaths t-21, ICU t-22, stringency t-15, deaths t-10, hospitalizations t-15, hospitalizations t-17

observations

- Importance == $1 - \text{p-value}$
- Past values of death and cases series have a large effect,
- Vaccination doses appear among the most salient variables

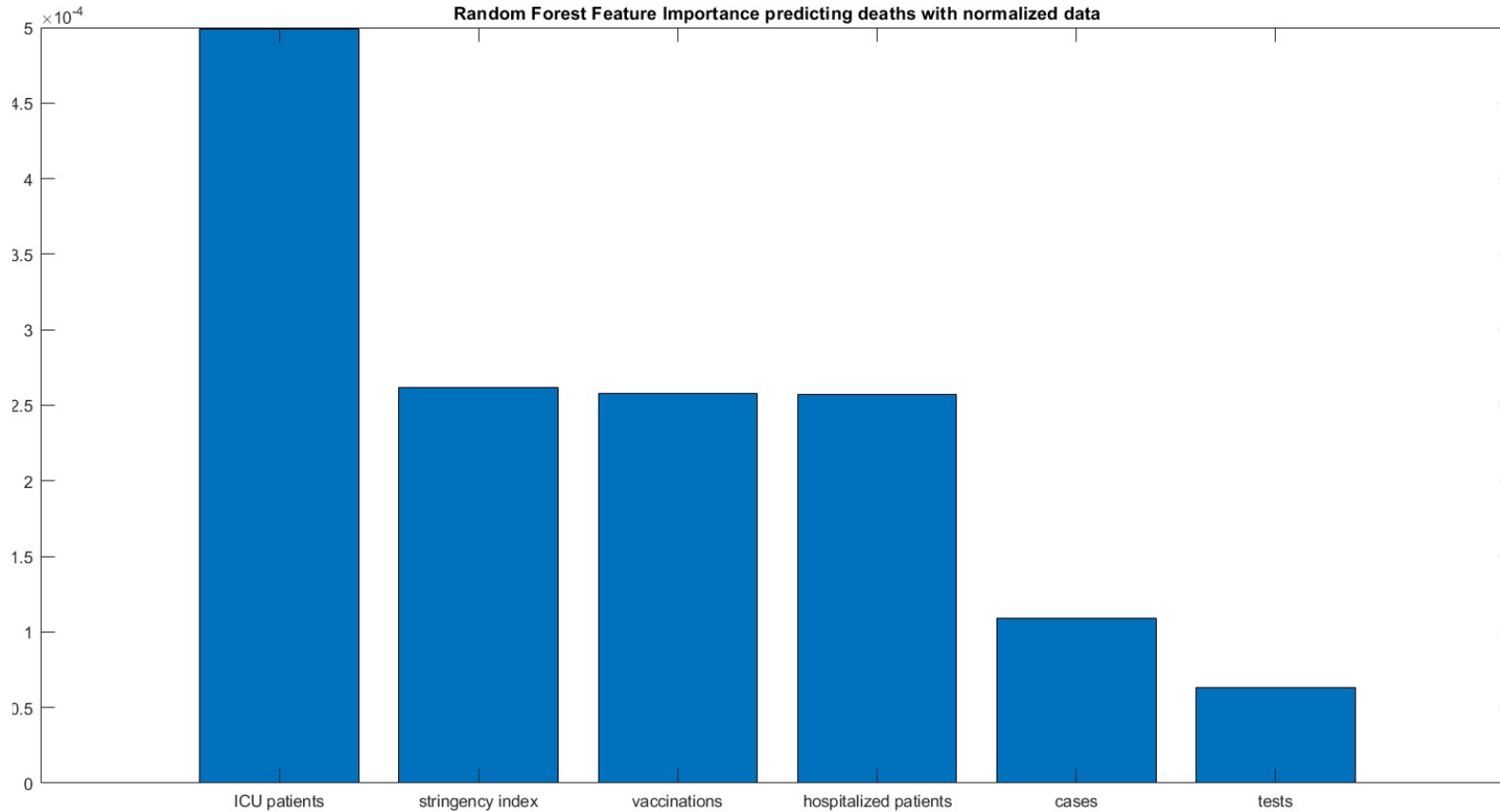
Prediction of covid-19 deaths by random forest regression

Random Forest Feature Importance predicting deaths



Variables	Importance
ICU patients	2,6699
stringency index	1,3994
vaccinations	1,3791
hospitalized patients	1,3769
cases	0,5851
tests	0,3396

Normalizing data

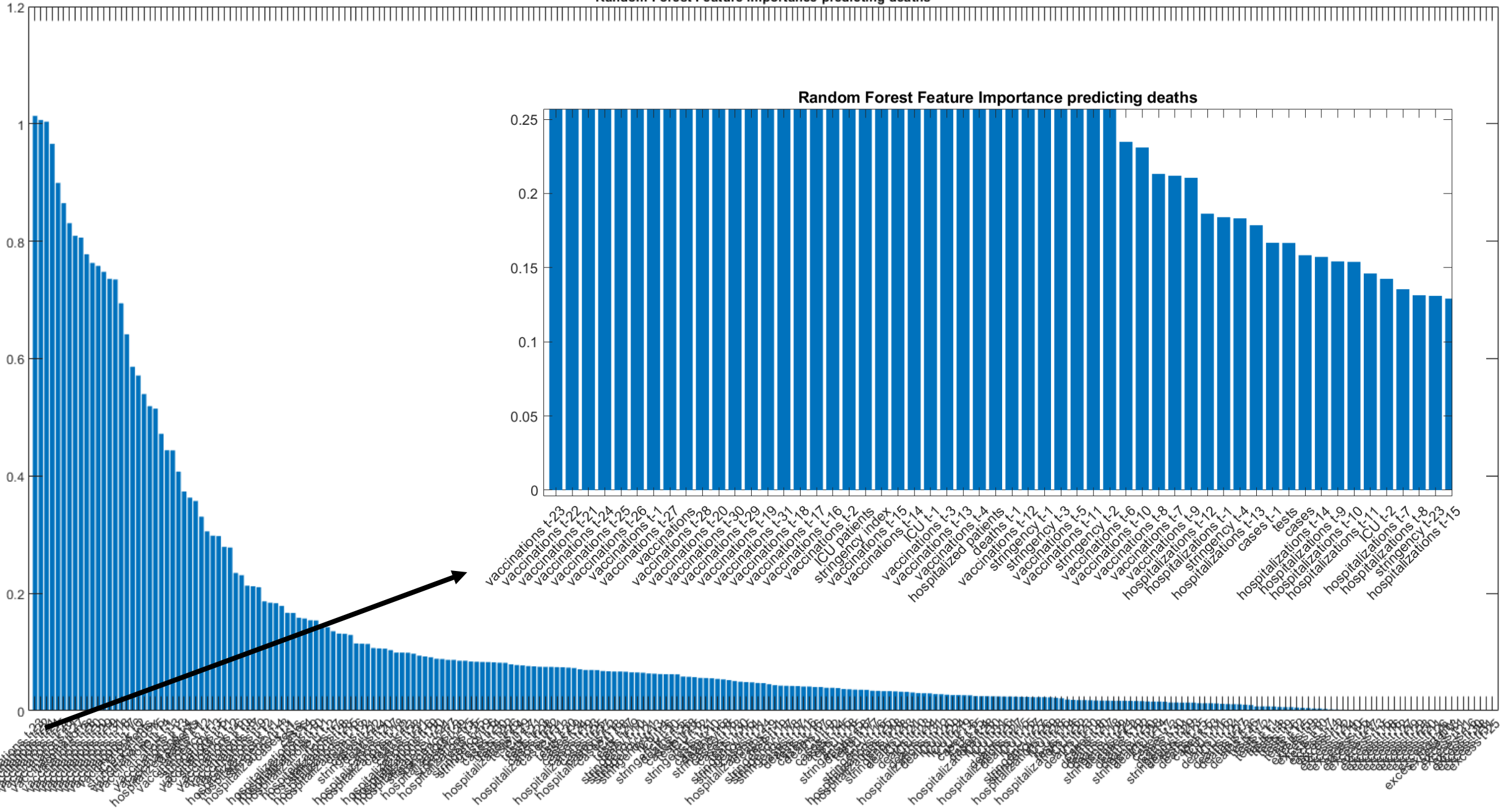


Variables	Importance
ICU patients	4,9902e-04
stringency index	2,6155e-04
vaccinations	2,5776e-04
hospitalized patients	2,5735e-04
cases	1,0935e-04
tests	6,3481e-05

observations

- Stringency index and vaccine doses appear as more important variables than hospitalizations, cases and tests
- Do not provide the direction of causality

Random Forest Feature Importance predicting deaths



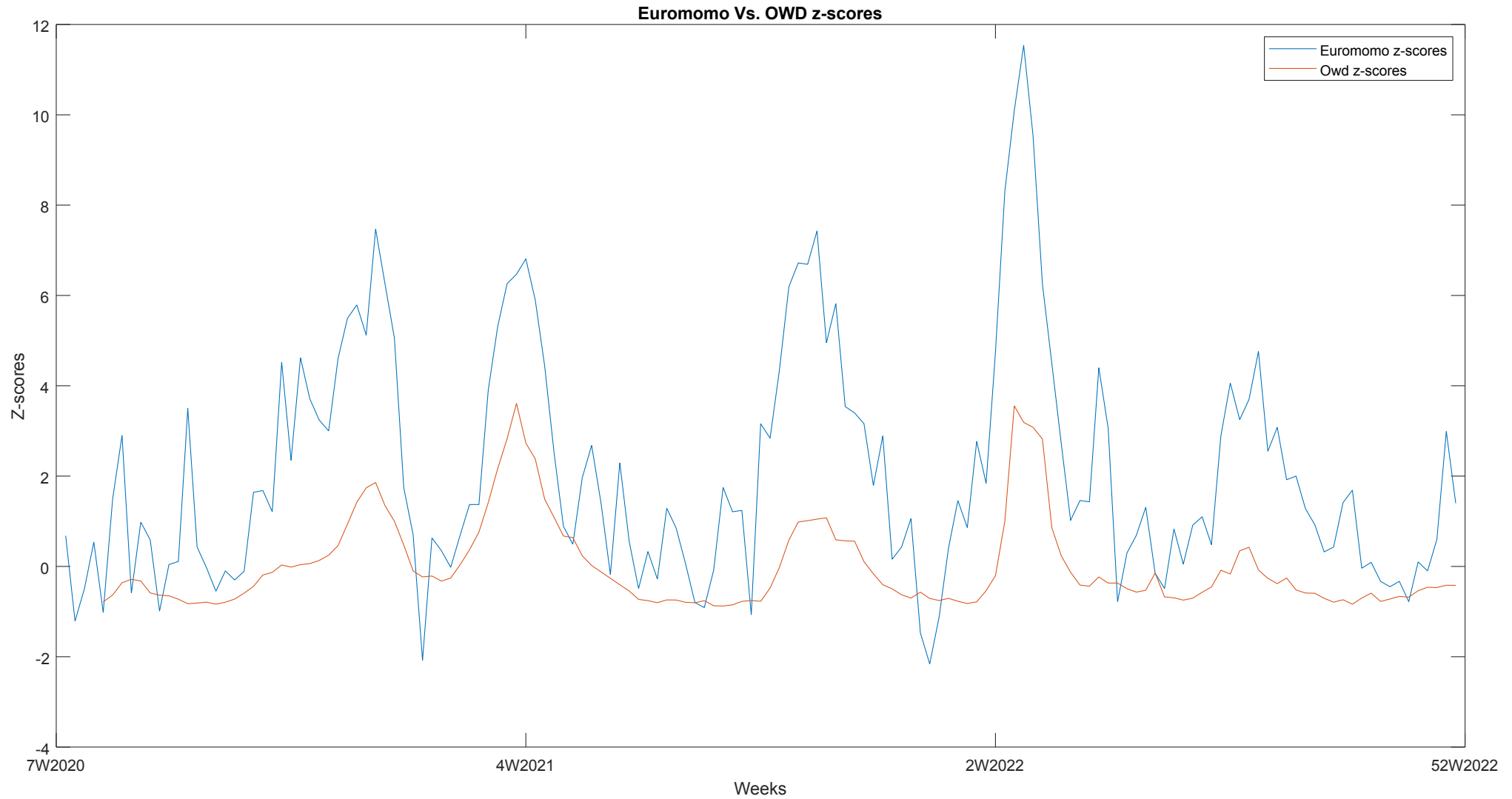
observations

- Past values of stringency index and vaccine doses appear as more important variables than hospitalizations, cases and tests
- Do not provide the direction of causality

COVID mortality versus all cause mortality

- All cause mortality from euromomo.org
- OWD data converted to z-score for joint plotting:
 - comparison is qualitative
- Observations:
 - there is some synchronization of peaks
- BUT
 - There are excess mortality periods unrelated to COVID

II. Euromomo vs OWD zscores



Variability of data reported in euromomo accross the
pandemic

Data downloaded on 1-March-2022 peak 2022-05 = 9,24

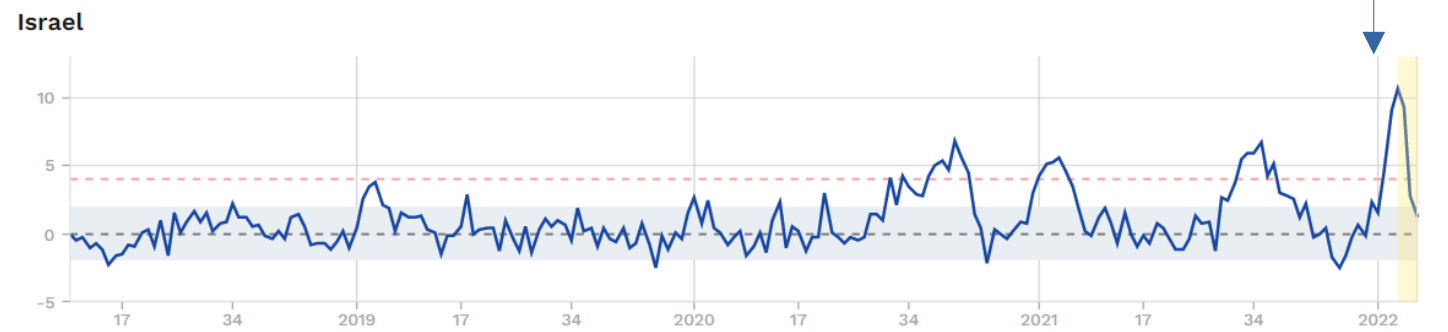
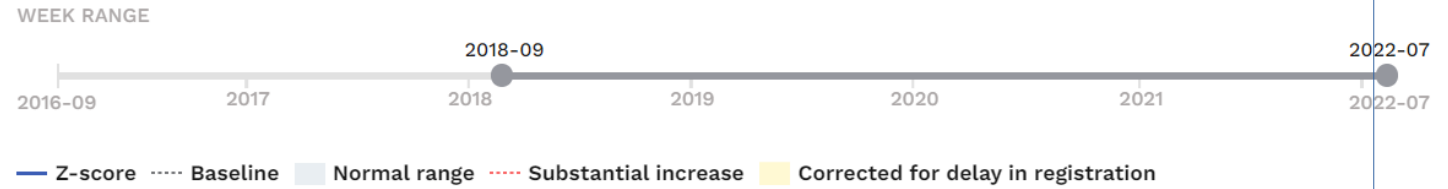
INTERNET ARCHIVE WayBackMachine <https://www.euromomo.eu/graphs-and-maps/> 2,419 captures 23 Apr 2020 - 7 Jan 2023

Go JAN MAR APR 01 2021 2022 2023 About this capture

AGE GROUP
All ages

COUNTRIES
Israel x +

- Austria
- Belgium
- Cyprus
- Denmark
- Estonia
- Finland
- France



Data downloaded on 1-Apr-2022 peak 2022-05 = 12,04

INTERNET ARCHIVE <https://www.euromomo.eu/graphs-and-maps/> | Go | 01 | 2021 | 2022 | 2023 | About this capture

WayBackMachine 2,419 captures 23 Apr 2020 - 7 Jan 2023

AGE GROUP

All ages

COUNTRIES

Israel x +

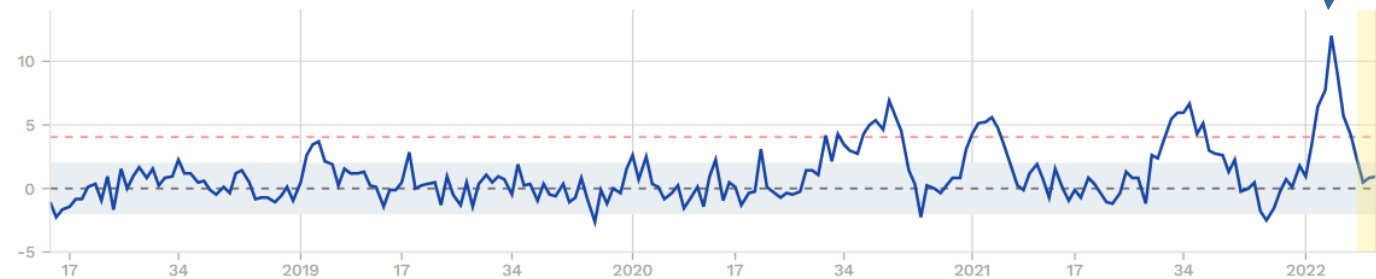
- Austria
- Belgium
- Cyprus
- Denmark
- Estonia
- Finland
- France

WEEK RANGE



— Z-score - - - - Baseline ■ Normal range - - - - Substantial increase ■ Corrected for delay in registration

Israel



Data downloaded on 2-Oct-2022 peak 2022-05 = 11,52

INTERNET ARCHIVE Wayback Machine <https://www.euromomo.eu/graphs-and-maps/> 2,419 captures 23 Apr 2020 - 7 Jan 2023

Go SEP OCT NOV 02 2021 2022 2023 About this capture

AGE GROUP

All ages

COUNTRIES

Israel x +

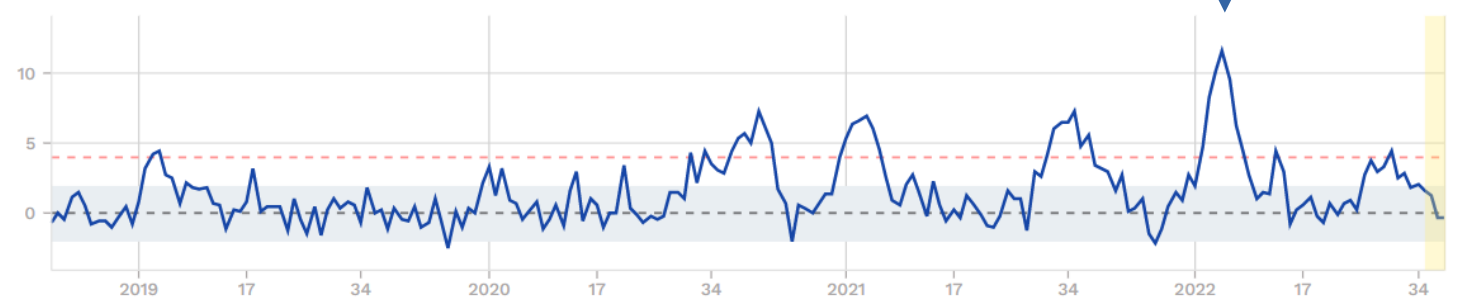
- Austria
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- France

WEEK RANGE

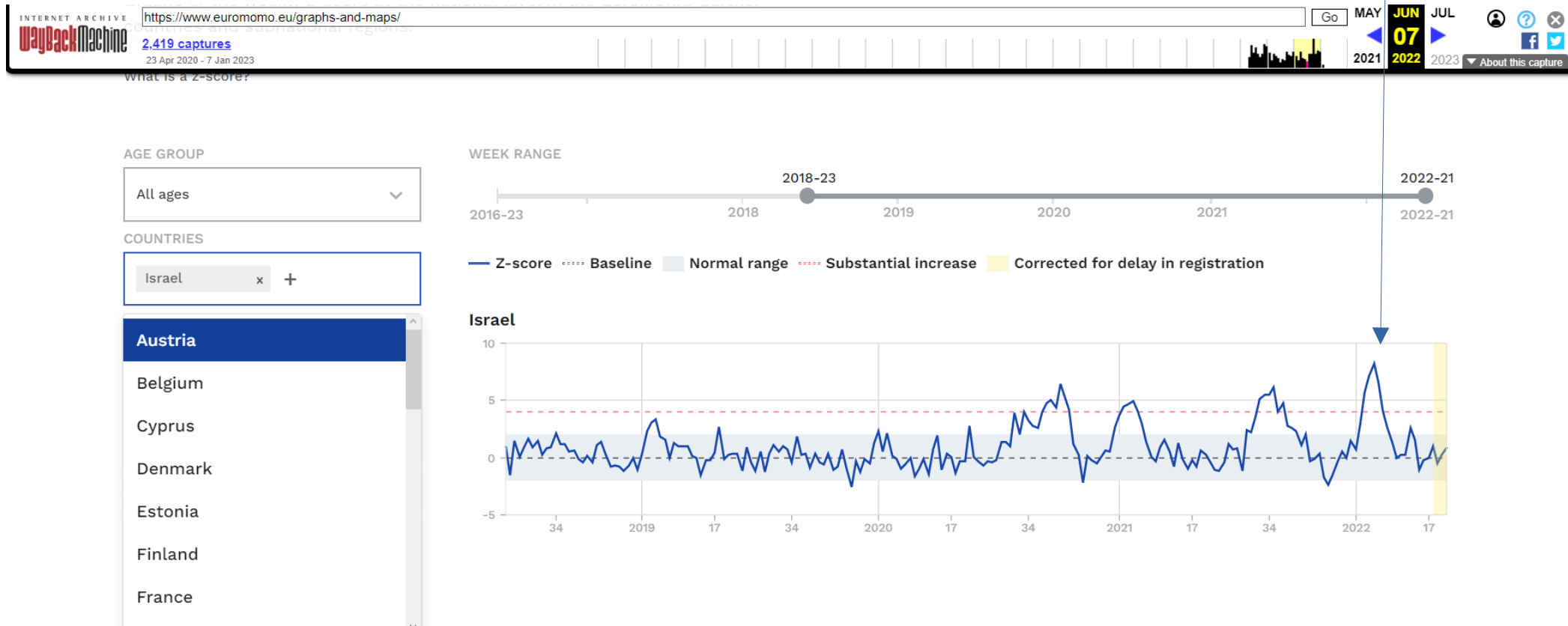


— Z-score - - - - Baseline ■ Normal range - - - - Substantial increase ■ Corrected for delay in registration

Israel

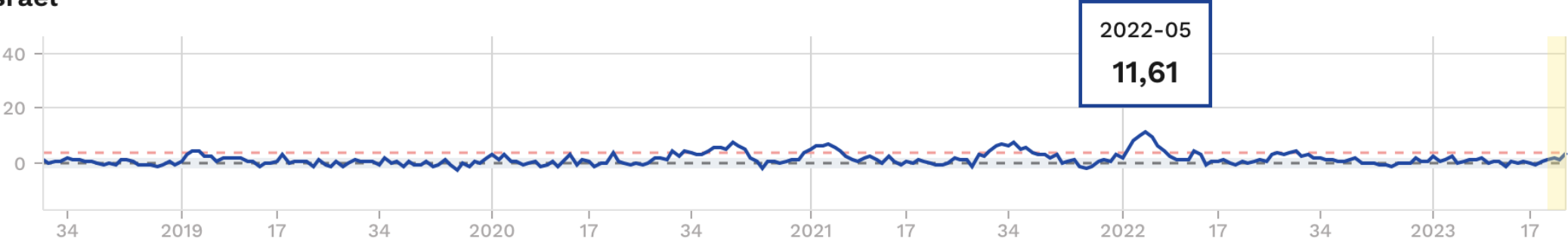


Data downloaded on 7-Jun-2023 peak 2022-05 = 8,22



Current plot at 2023-06-16

Israel

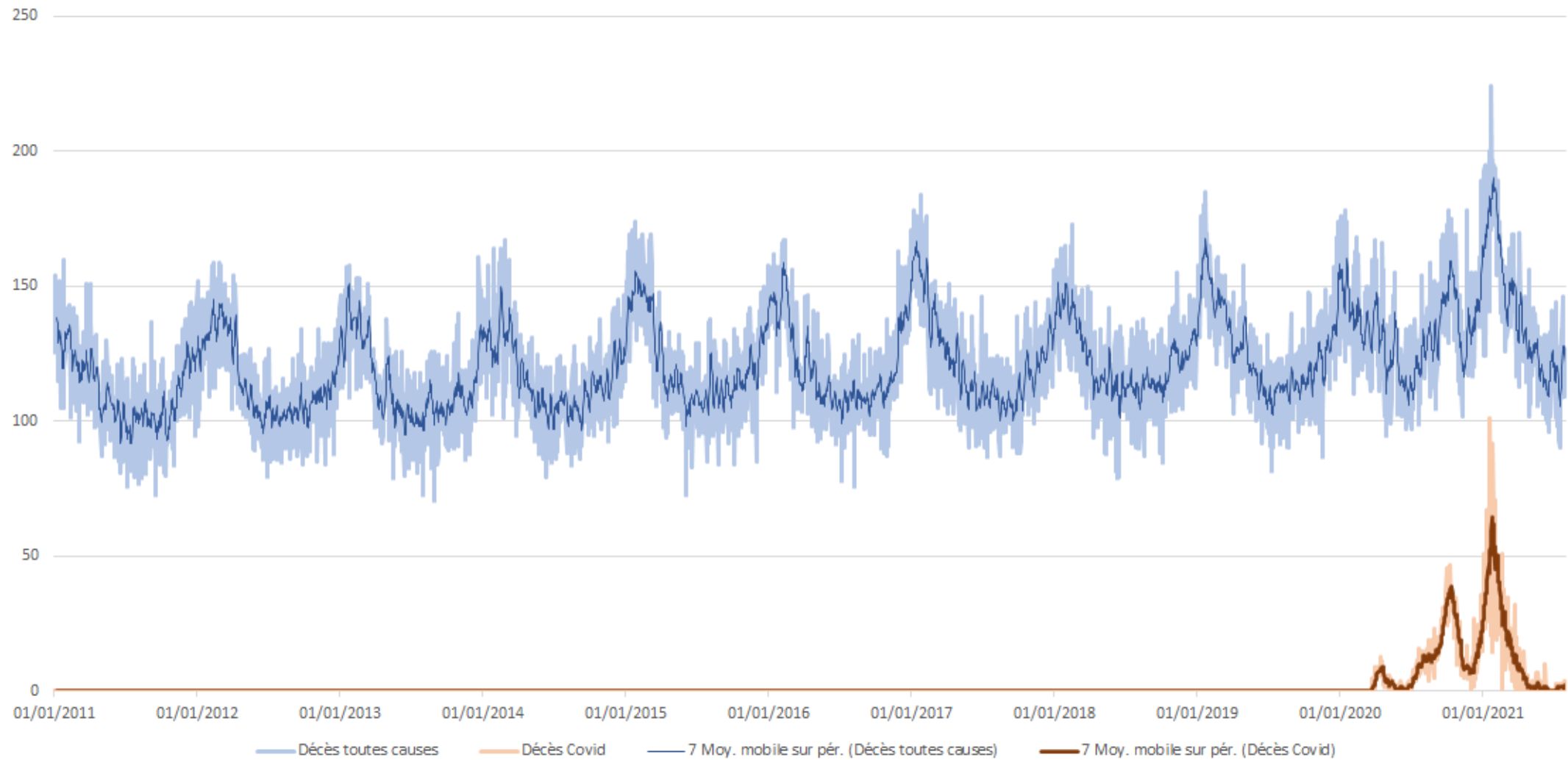


observations

- Published data can be subjected to unexplained variations
- Trust in official data should be backed with some kind of certification (?)
- Who defines truth?

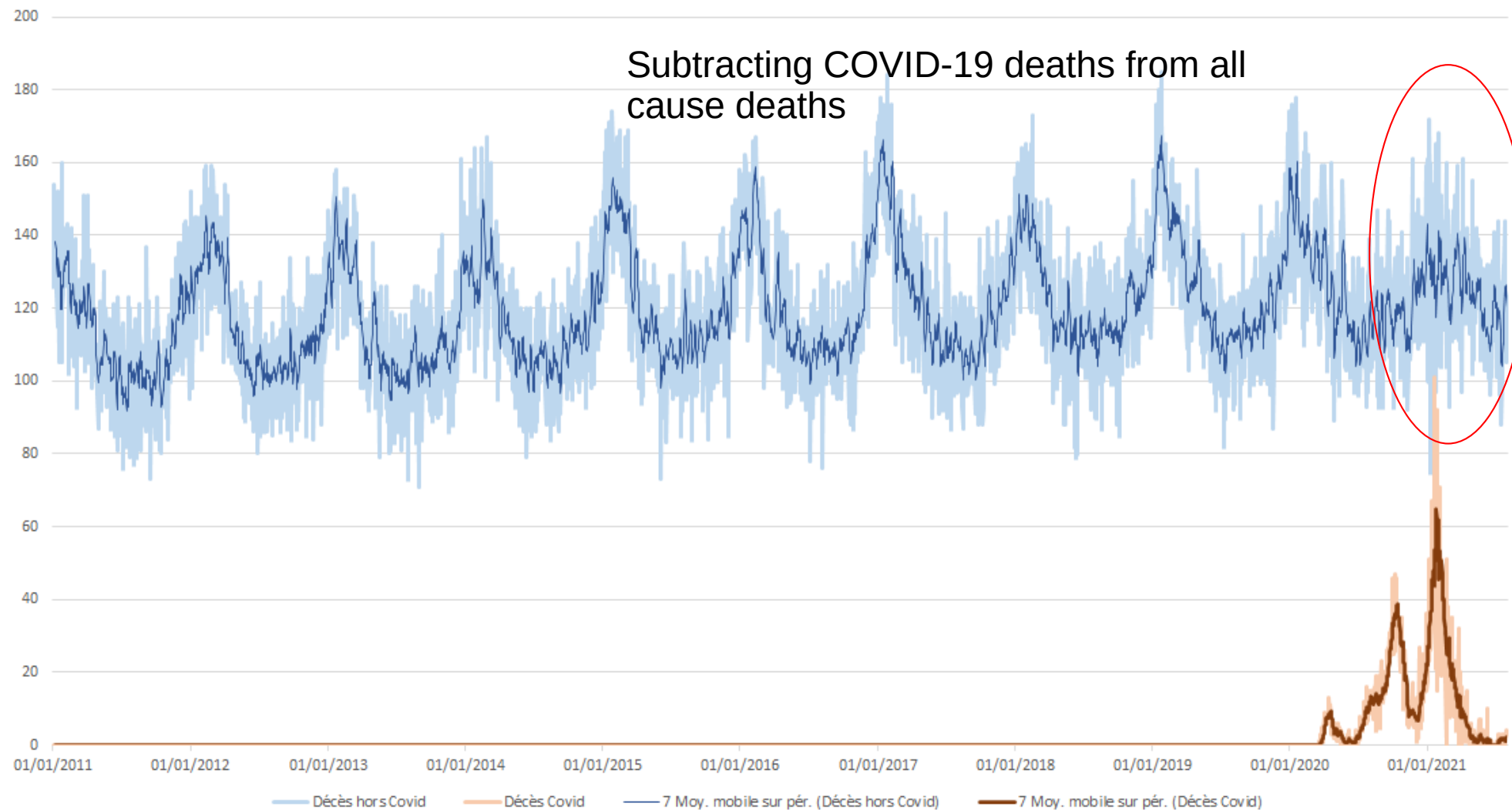
A perspective over a longer span of time

Figure 5 : Nombre de décès quotidiens en Israël
toutes causes et considérés Covid-19



https://covid.irsan.eu/fr/script/index/figure_Livre_Pierre_Chailot

Figure 5b : Nombre de décès quotidiens en Israël
toutes causes hors Covid-19 et considérés Covid-19



observations

- COVID-19 deaths account for a minimal fraction of all cause deaths
- Removing COVID-19 deaths from all cause deaths
 - Produces an artificial reduction of all cause death profile that reproduced yearly

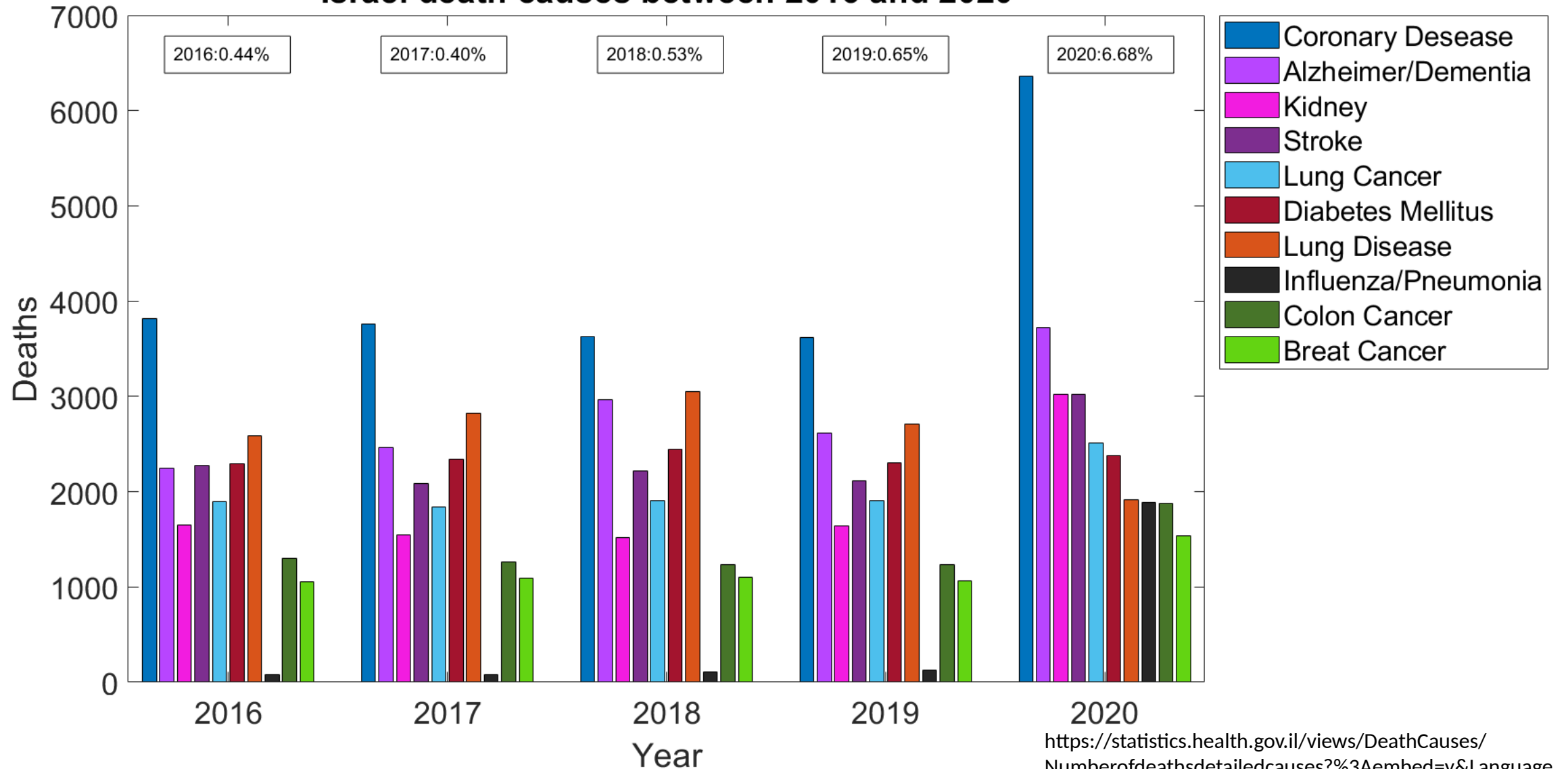
Causes of death

COVID included in influenza + pneumomy????

<https://statistics.health.gov.il/views/DeathCauses/Numberofdeathsdetailedcauses?%3Aembed=y&Language%20Desc=English>

Death Causes

Israel death causes between 2016 and 2020



<https://statistics.health.gov.il/views/DeathCauses/Numberofdeathsdetailedcauses?%3Aembed=y&Language%20Desc=English>

Concluding remarks

Concluding remarks

- Israel has been portrayed as the show case of Biontech vaccination solution
- The relation of virus control measures (stringency + vaccination) shows some surprises that are not easy to characterize numerically
- There is no reference model of the expected response to control measures
 - I.e. in automobiles we expect the car to stop when we pull the brake
 - However, in COVID-19 after mass vaccination the peaking of omicron cases was strongly correlated stopped with the end of massive testing

A final question

- Imagine that the virus control solution was applied to HIV instead of a coronavirus
- Imagine that the COVID-19 time series of cases is a time series of HIV cases
- Would you repeat all the steps taken to control SARS-COV-2?

A final question

- In fact, the Bill & Melinda Gates foundation published funding to both Moderna and Biontech prior to 2020 for research on HIV vaccines.