Supplementary Files

Integrating Wastewater-Based Epidemiology and Mobility Data to predict SARS-CoV-2 Cases in Lichtenstein and Austria

Hannes Schenk[1], Rezgar Arabzadeh[2], Soroush Dabiri[1], Heribert Insam[3], Norbert Kreuzinger[4], Monika Büchel-Marxer[5], Rudolf Markt[3], Fabiana Nägele[3] and Wolfgang Rauch[1]*

[1]Unit of Environmental Engineering, University of Innsbruck, Innsbruck, Austria

[2]Department of Civil and Environmental Engineering, University of Waterloo, Waterloo, ON, Canada

* Correspondence: wolfgang.rauch@uibk.ac.at

Restriction policies in Liechtenstein

Our data resources, also, includes the policy and restriction factors set in Liechtenstein for controlling the pandemic. Figure S1 depicts different policies and restriction levels deployed in Liechtenstein. Obviously, the higher the values, the stricter the policy.

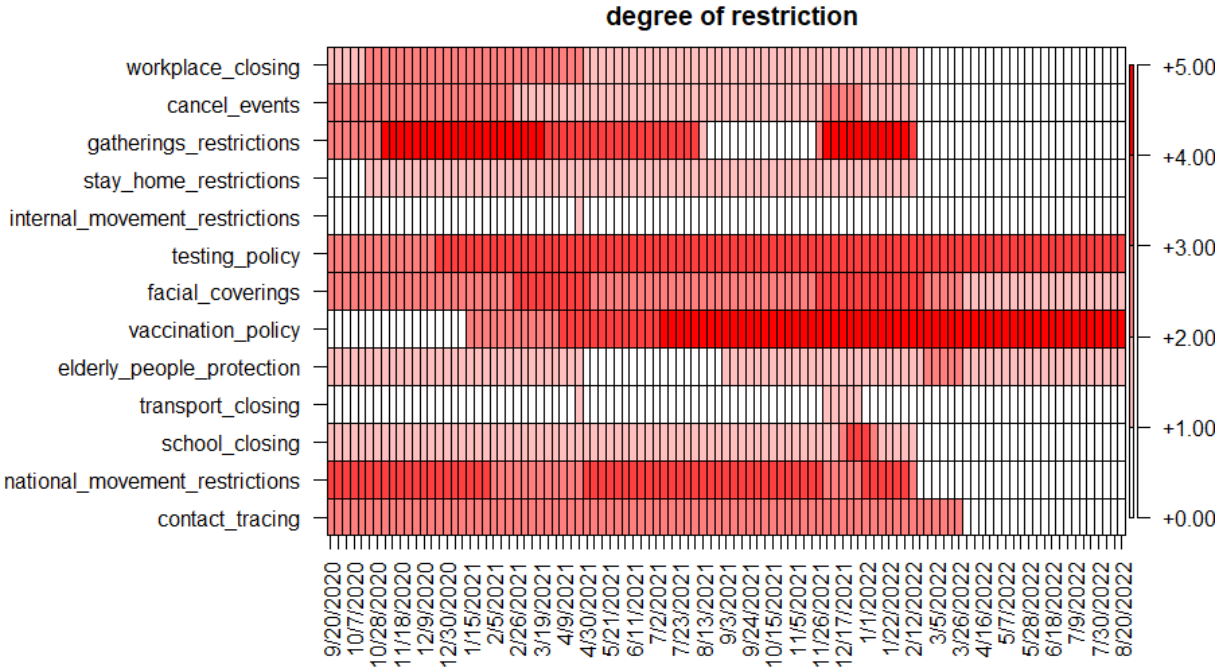


Figure S1. different policies and restriction levels deployed in Liechtenstein

In addition to forecasting with wastewater and mobility data, it might be worth to look in a simple Spearman correlation plot. The correlogram, shown in Figure S2, depicts the correlation value and magnitude for all pairs of the Liechtenstein time series used in this study. To simplify the labeling, alphabetic labels are used for the time series in the study. For **instance**, zt denotes for the COVID -19 active cases and g represents cancelling events within the studied region. The table next to the correlogram, elaborates the labels and their original equivalent time series.

According to the correlogram, the variables with a significant correlation with zt (active cases) are: a (Wastewater virus load), i (stay-home restrictions), f (workplace closing), n (elderly people protection), q (international movement restrictions), g (cancelling events), k (testing policy) and b (mobility in transit).

label	Original variable
q	International movement restrictions
j	Internal movement restrictions
n	Elderly people protection
e	People fully vaccinated
h	Gathering restrictions
i	Stay-home restrictions
m	Vaccination policy
d	People vaccinated
f	Workplace closing
o	Transport closing
l	Facial coverings
r	Contact tracing
k	Testing policy
p	School closing
c	Mobility in workplace
g	Cancelling events
a	Wastewater virus load
b	Mobility in transit
zt	Active cases

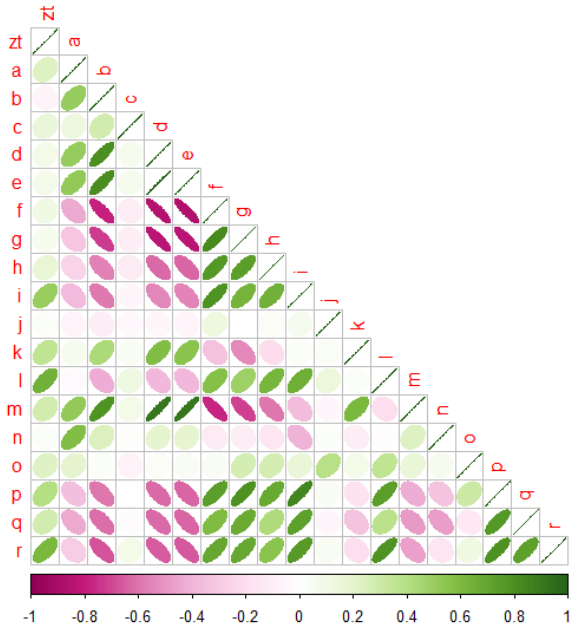
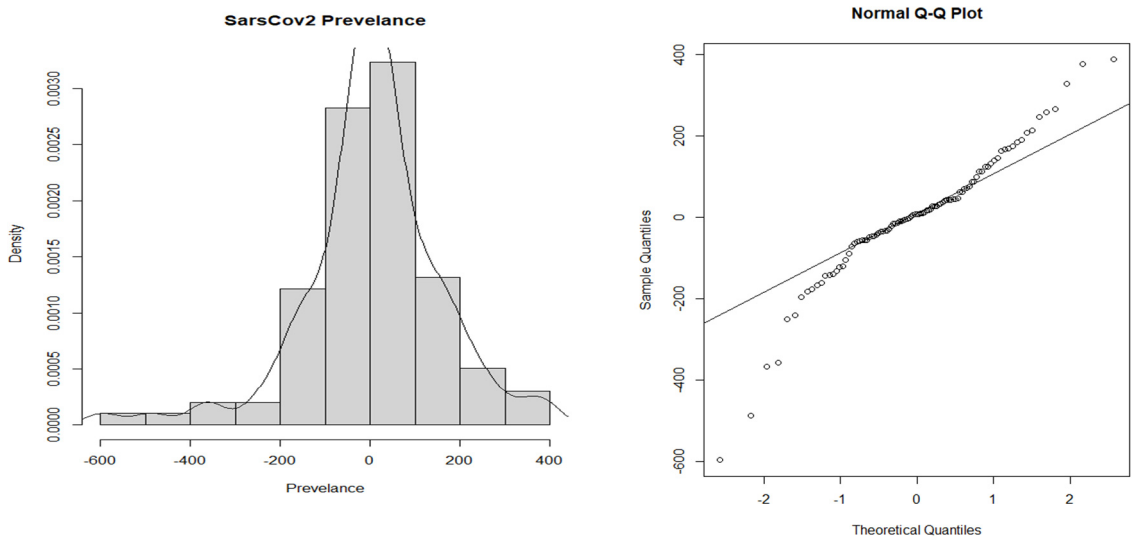


Figure S2. the correlation diagram between the restriction policies and COVID active cases. Shape and colour of the circles outline the sign and strength of the correlation.

Time series preprocessing for Liechtenstein

After Mann-Kendall (MK) test, the differentiation function is employed to stabilize the trend of time series. Afterwards, the normality of the data is checked via histogram and QQ-plot, as well as Shapiro-Wilk test. Figure S3 depicts the both diagrams.



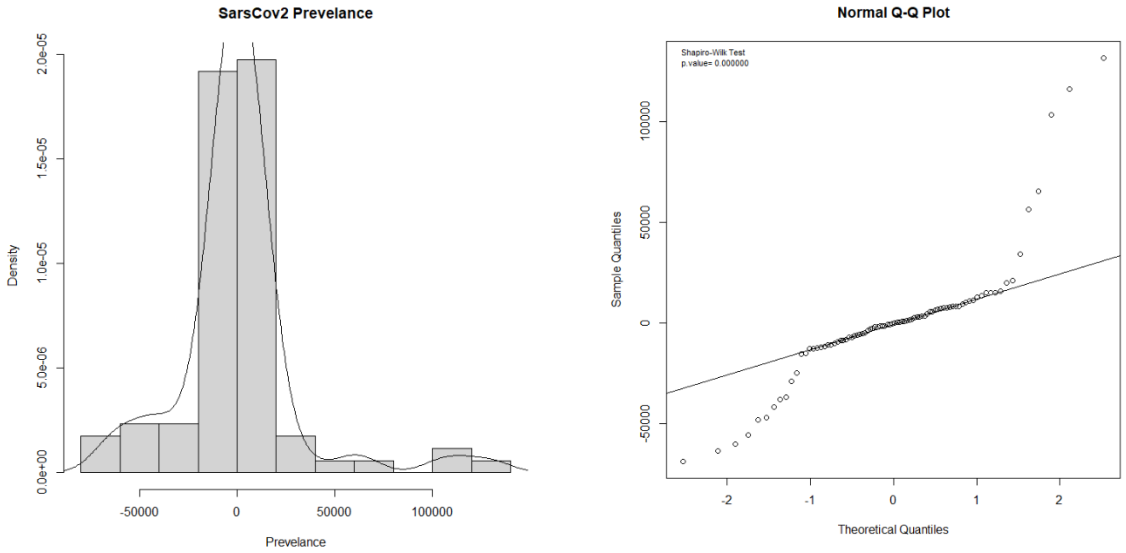
(a) (b)

Figure S3. the histogram (a) and QQ-plot (b) of Liechtenstein active cases time series, before BoxCox transformation

As it is clear from the diagrams that the time series is not normally distributed. In addition, the Shapiro-Wilk test shows the p-Value is below 0.0001, which proves again that the data is not normally distributed. Hence, it requires further manipulation.

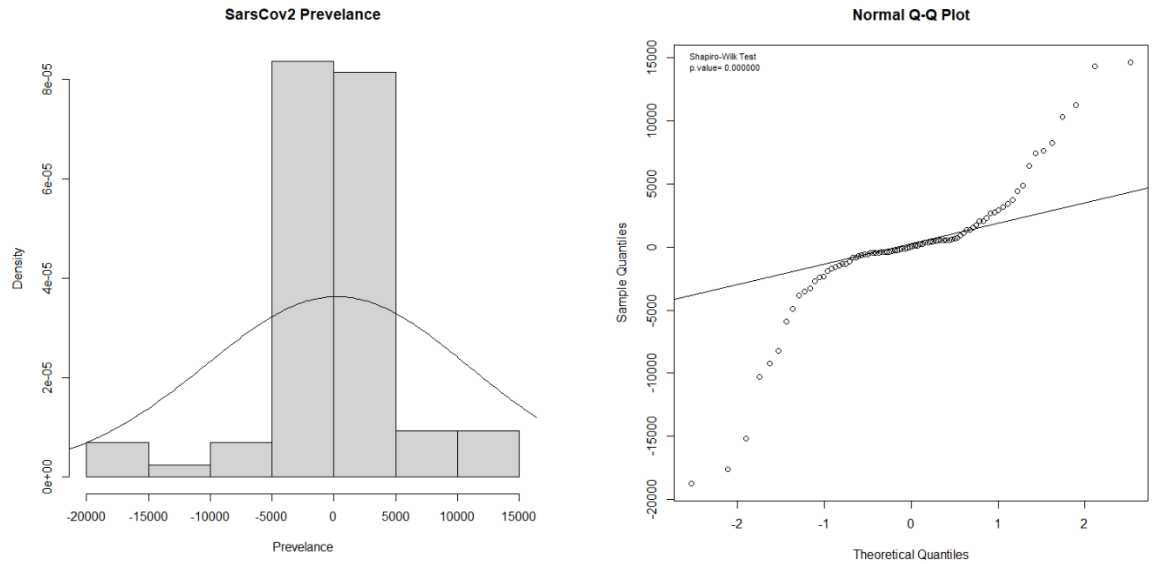
Time series preprocessing for Austria

Following a Mann-Kendall (MK) test and applying a differentiation function to the time series, the normality of the data is checked via histogram and QQ-plot. Figure S4 and Figure S5 show both diagrams and the p-value derived from Shapiro-Wilk test (which is close to zero), for Vienna and Vorarlberg, respectively.



(a) (b)

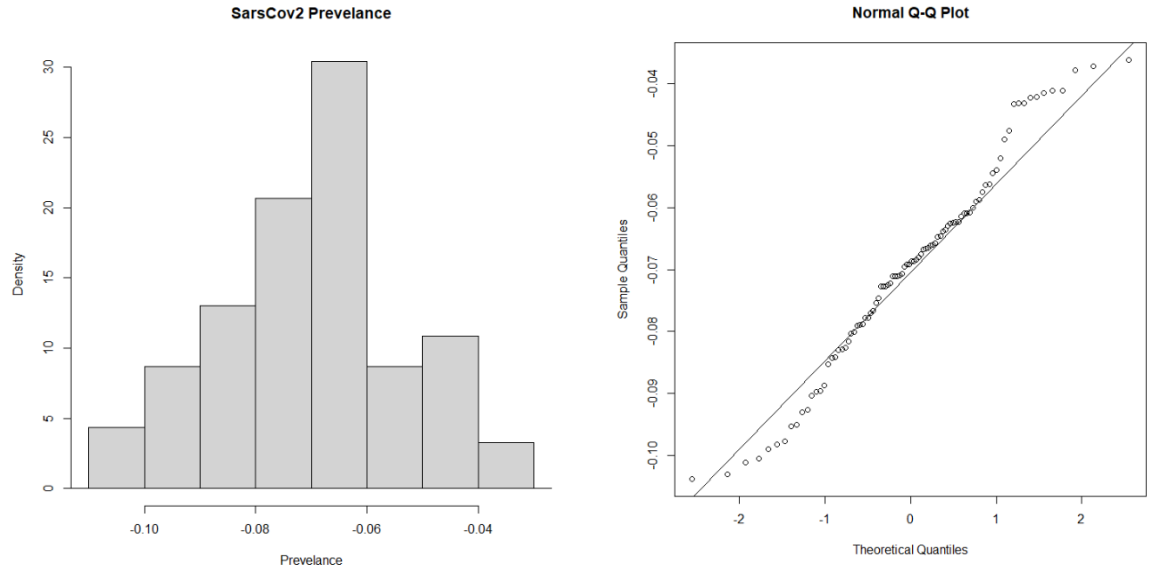
Figure S4. the histogram (a) and QQ-plot (b) of Vienna active cases time series, before BoxCox transformation



(a) (b)

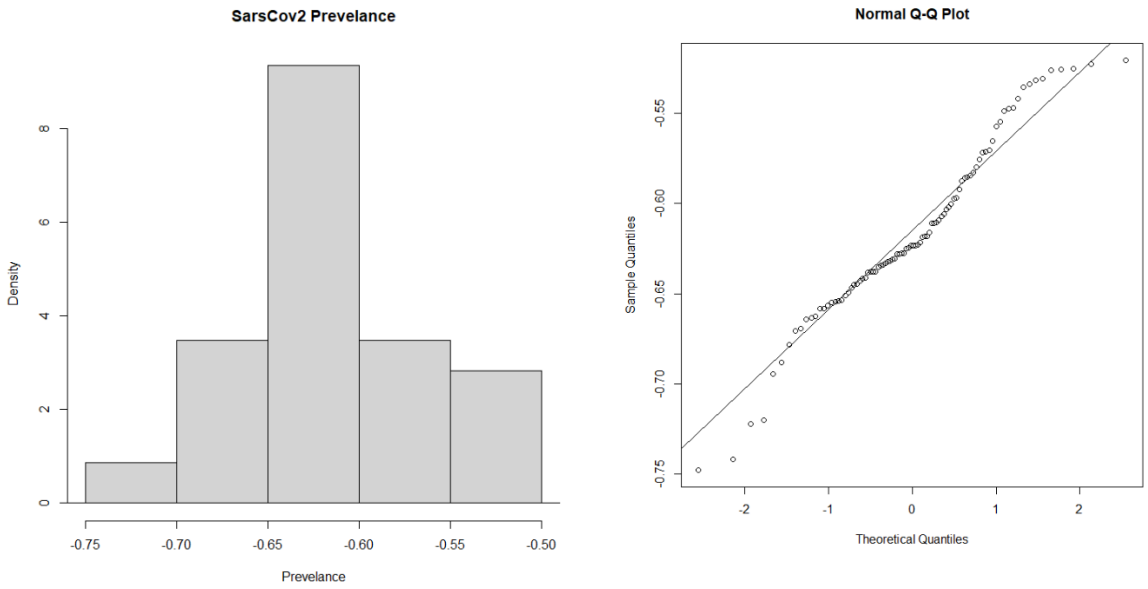
Figure S5. the histogram (a) and QQ-plot (b) of Vorarlberg active cases time series, before BoxCox transformation

Similar to Liechtenstein data, these diagrams depict that the time series are not normally distributed. Hence, the data requires further manipulation. We apply BoxCox transformation. In the following the normality of the transformed data is shown in Figure S7.



(a) (b)

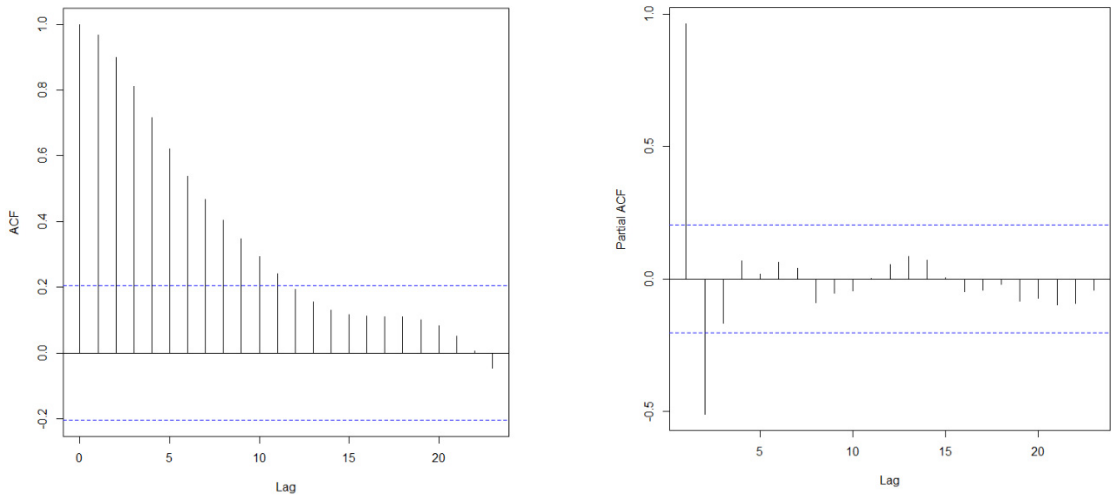
Figure S6. the histogram (a) and QQ-plot (b) of Vienna active cases time series, after BoxCox transformation



(a) (b)

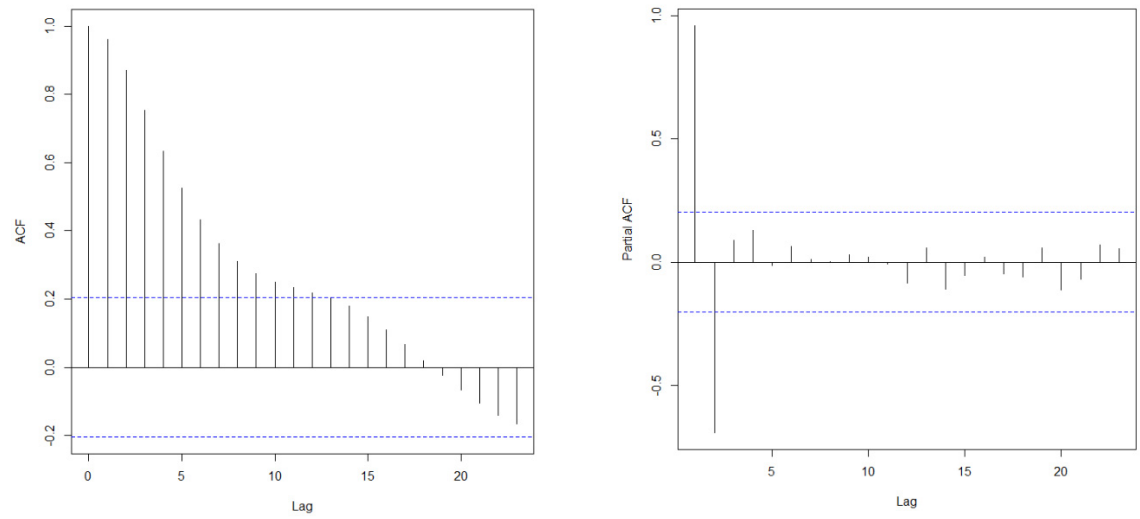
Figure S7. the histogram (a) and QQ-plot (b) of Vorarlberg active cases time series, after BoxCox transformation

After normalizing the data, the ACF and PACF plots are depicted for Vienna and Vorarlberg in Figure S8 and Figure S9, respectively.



(a) (b)

Figure S8. the ACF (a) and PACF (b) plots for the time series of Vienna active cases



(a) (b)

Figure S9. the ACF (a) and PACF (b) plots for the time series of Vorarlberg active cases

Table S1. List of model structures

Structure no.	p	q	r	P	Q	R
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