Wastewater-based epidemiology of SARS-CoV-2 in Switzerland

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Background

Wastewater surveillance of SARS-CoV-2 in Switzerland:

- data available from 7 February 2022
- 118 ARAs (fluctuating)
- various sampling frequencies (from weekly to daily)
- samples sent to 9 different laboratories
- 20,535 total measurements as of 14 May, 2023

Data

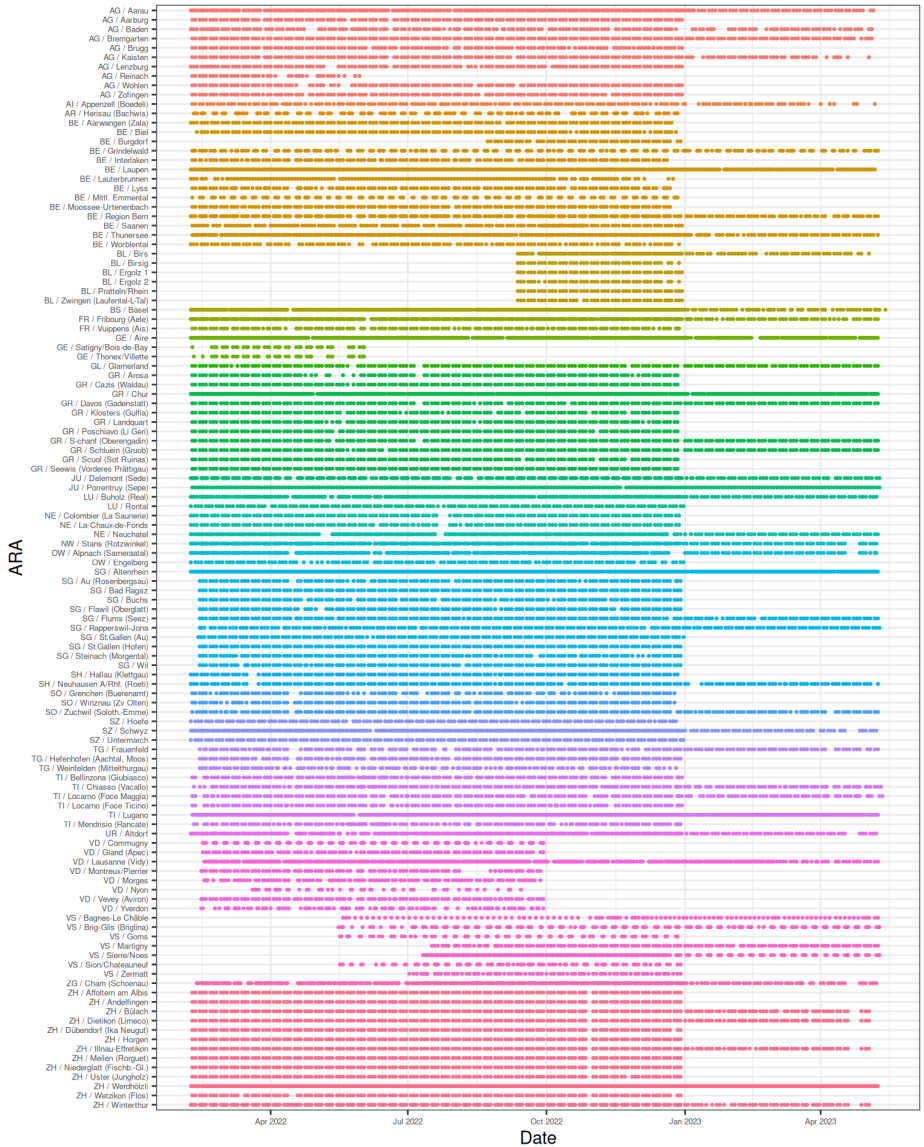

Figure: Available measurements over time by ARA (coloured by canton).

Data

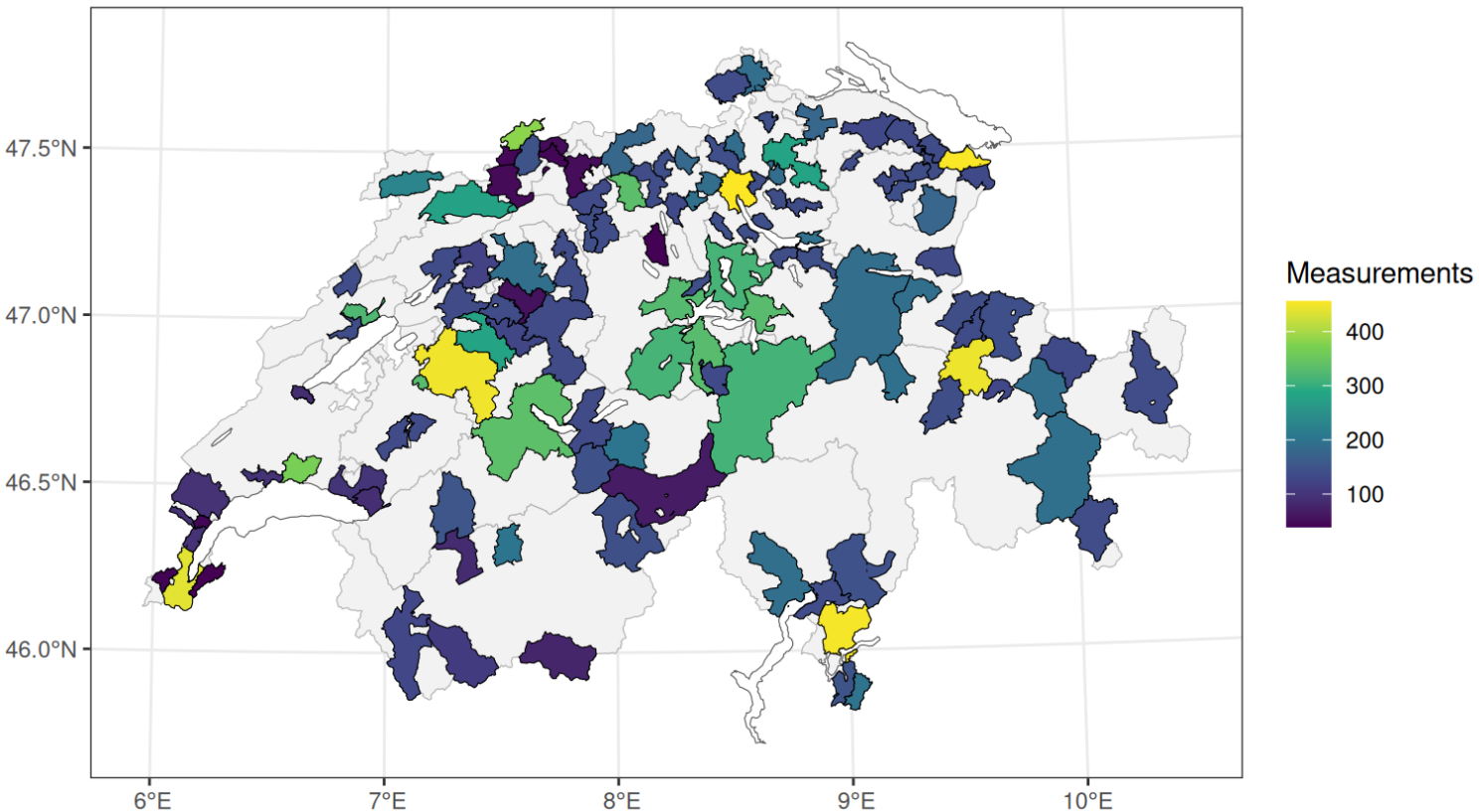

Figure: Number of measurements by ARA.

Data

Large heterogeneity across time and space.

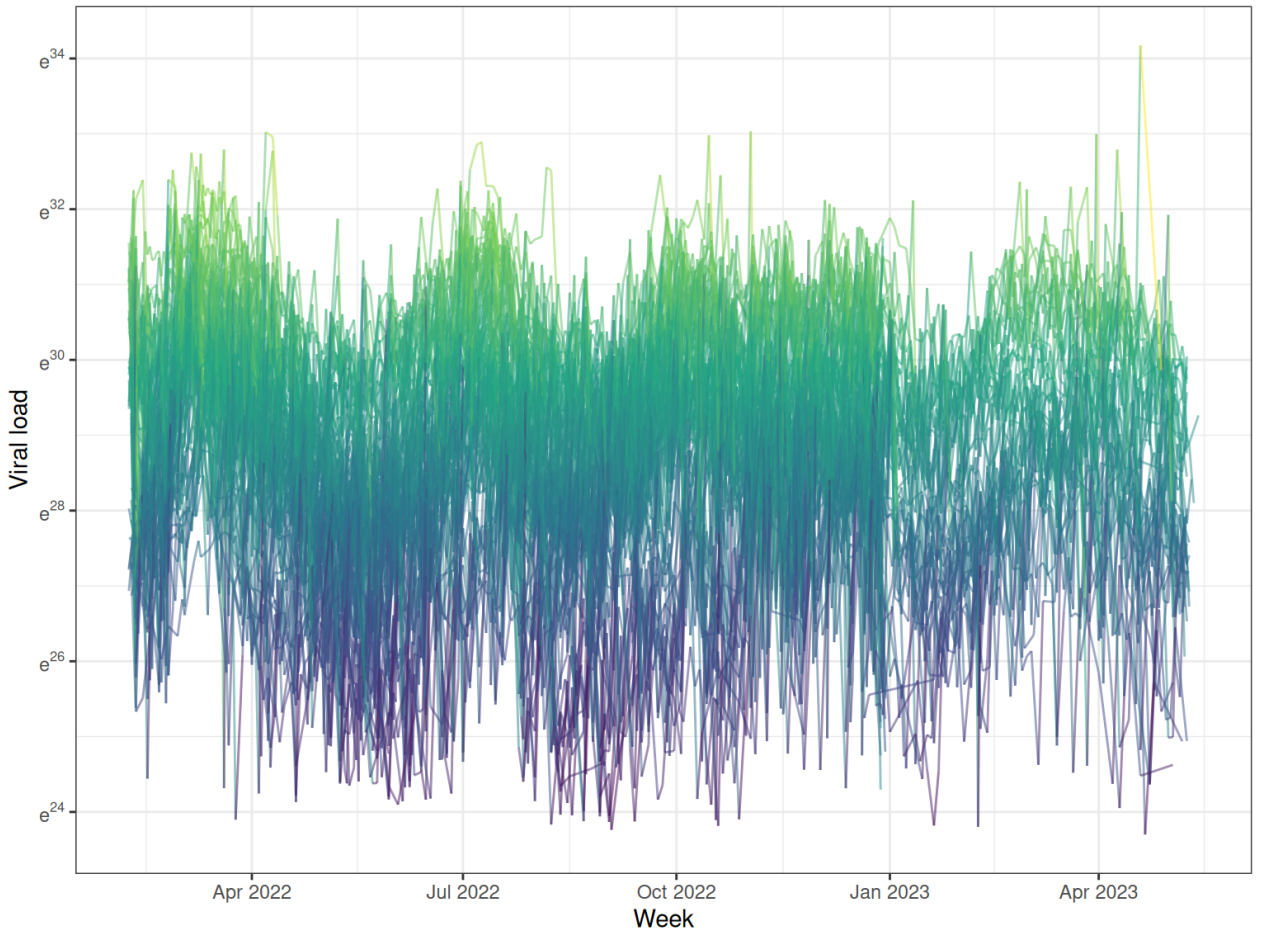

Figure: Daily SARS-CoV-2 viral load in wastewater by ARA (removing values below the LOD or LOQ).

Objectives

1. Disentangle the various sources of heterogeneity
   - laboratory, quantification method, systematic temporal or spatial effects, remaining noise...

2. Extract a clean, "noise-free" temporal signal
   - at the national and/or regional level

3. Assess the agreement with other types of surveillance
   - confirmed cases, hospitalisations...

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Method

Spatial regression model using INLA accounting for:

- population covered
- limits of detection (LOD) and of quantification (LOQ)
- laboratory and quantification method
- systematic temporal effects (holidays, weekends)
- systematic bias by ARA

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Technical aspects:

- gamma likelihood (strictly positive)
- logarithmic link implying multiplicative effects

$$\log(V) = \alpha + X\beta \quad \rightarrow \quad V = \exp(\alpha) \times \exp(X\beta)$$

- iterative model development (model selection tools)
- random walks for temporal trends
- Besag-York-Mollié for spatial correlation (neighbours)

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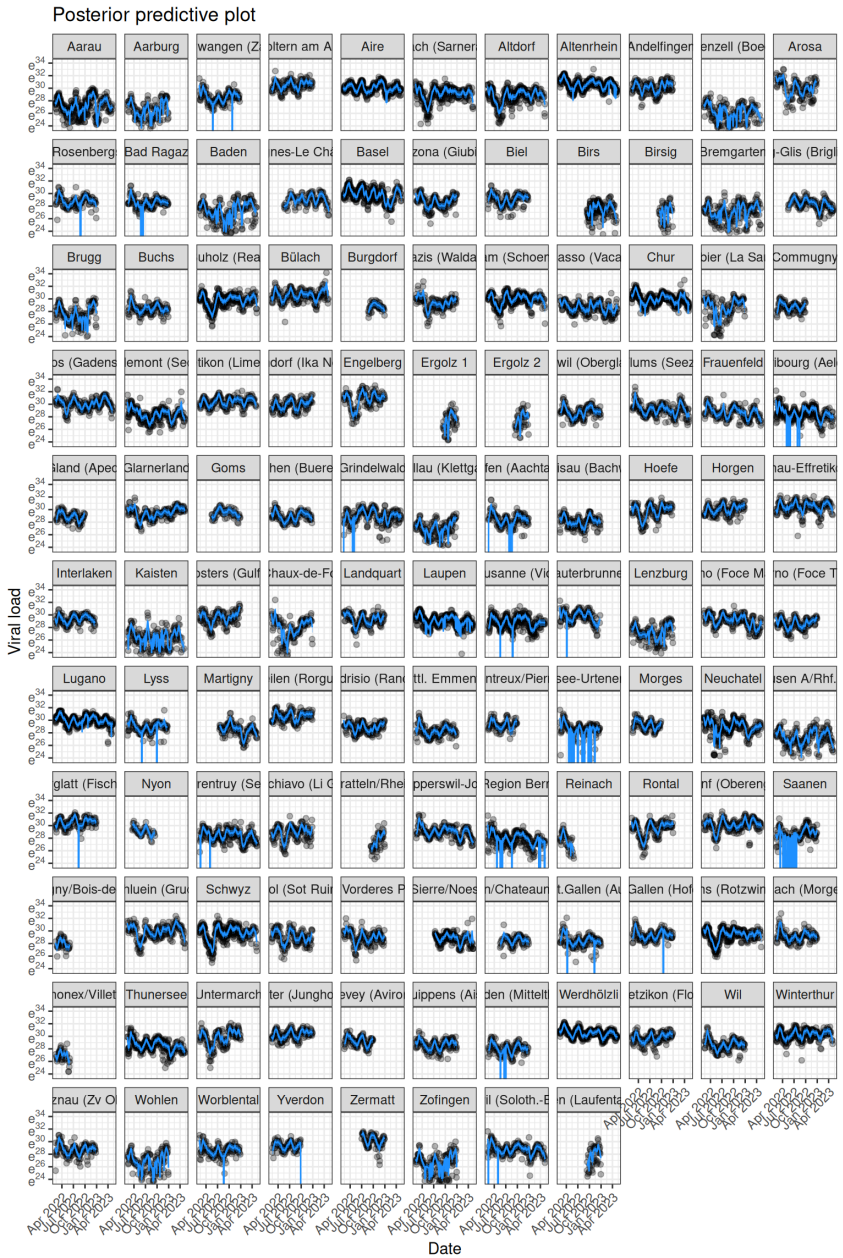
Results


Posterior predictive plot
Viral load
Date
Aarau
Aarburg
Aire
Altdorf
Altenrhein
Arosa
Rosenberg
Bad Ragaz
Baden
Basel
Biel
Birs
Birsig
Brugg
Buchs
Bülach
Burgdorf
Chur
Engelberg
Ergolz 1
Ergolz 2
Frauenfeld
Goms
Grindelwald
Hoefe
Horgen
Interlaken
Kaisten
Landquart
Laupen
Lenzburg
Lugano
Lyss
Martigny
Morges
Neuchatel
Nyon
Reinach
Rontal
Saanen
Schwyz
Thunersee
Werdhölzli
Wil
Winterthur
Wohlen
Worblental
Yverdon
Zermatt
Zofingen
Apr 2022
Jul 2022
Oct 2022
Jan 2023
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