



USFHealth



CANCER  
INSTITUTE

2026 GVN Annual International Scientific Meeting

Pandemic Preparedness

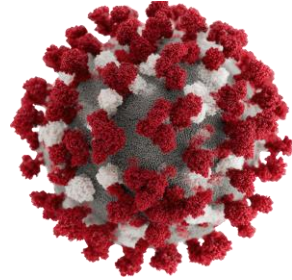
*Spatiotemporal Influenza A/B Wastewater Surveillance  
Provides Early Warning and Reveals an Unequal Severe  
Disease Burden in São Paulo*

Carla Freitas, PhD

Rúbens Alves, PhD







*Influenza infects about **1 billion** people globally each year, causing an economic loss of over **\$11 billion/year***



**Influenza** is the leading candidate for the **next pandemic**

- Proven pandemic track record
- Continuous evolution & reassortment
- Animal reservoirs with spillover risk
- Spreads globally within weeks

## Why Influenza **Surveillance** in **São Paulo** Matters

-  11.5M residents megacity
-  High inequality (Gini 0.62)
-  Major mobility gateway
-  Entry point for emerging diseases

(COVID-19, Zika, Mpox)

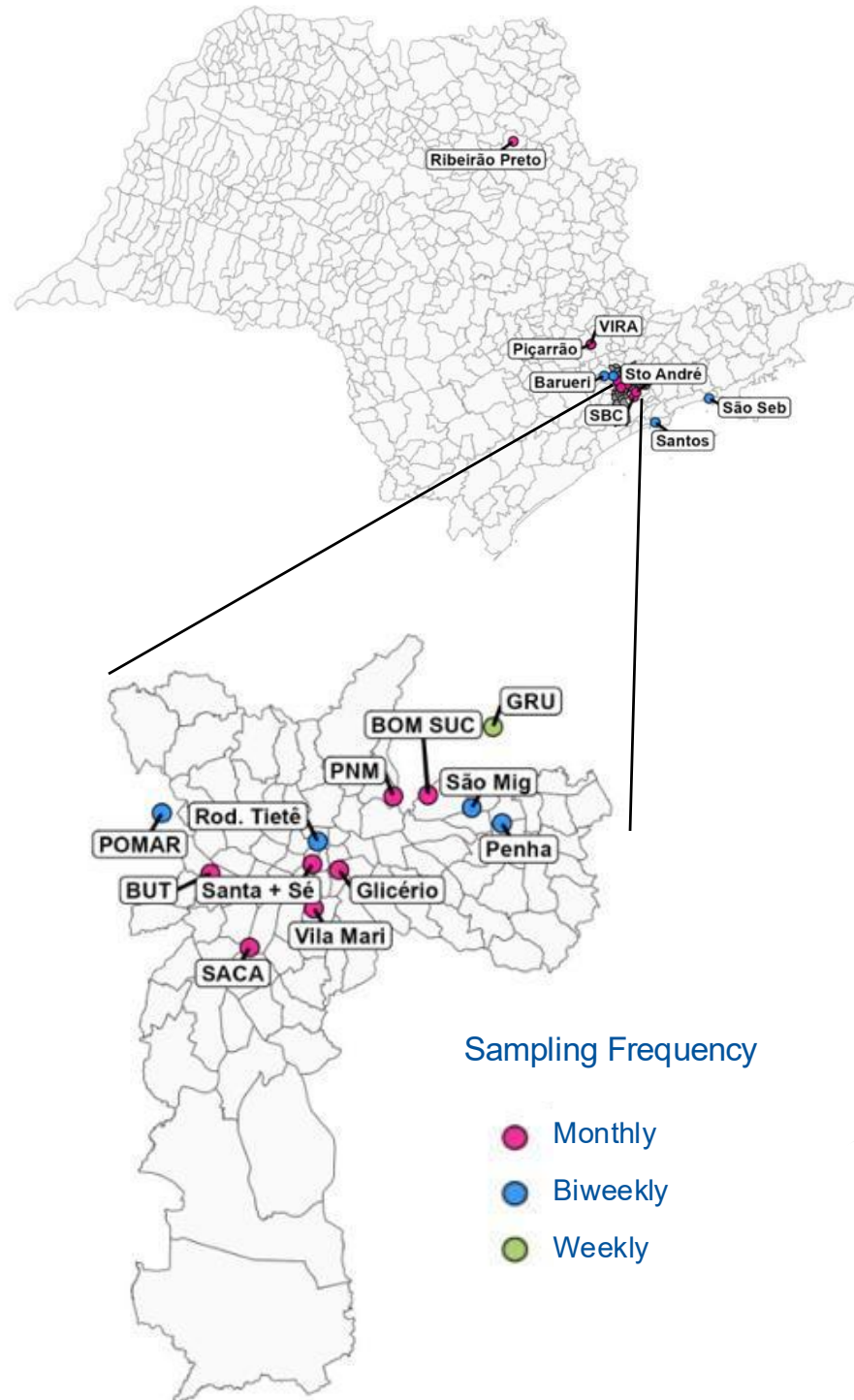
-  Scalable South America model

If we detect **early in São Paulo**, we detect **early in Brazil**

**How can we detect influenza earlier at the population level?**

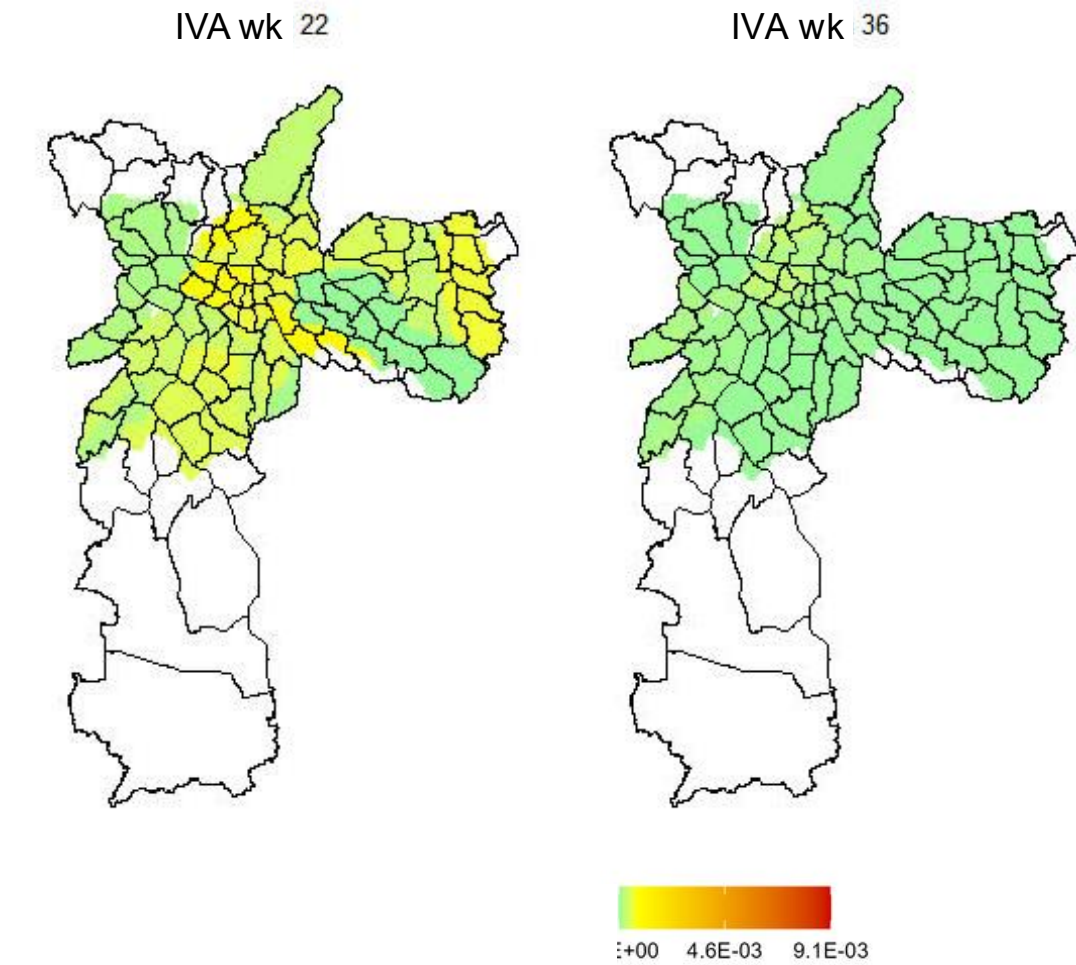
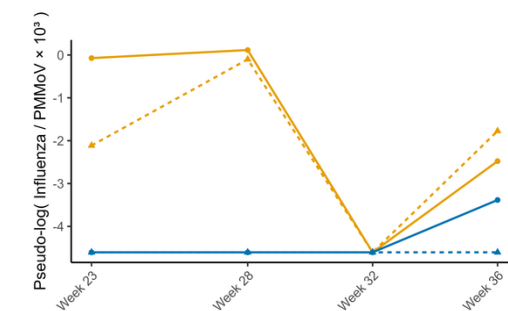
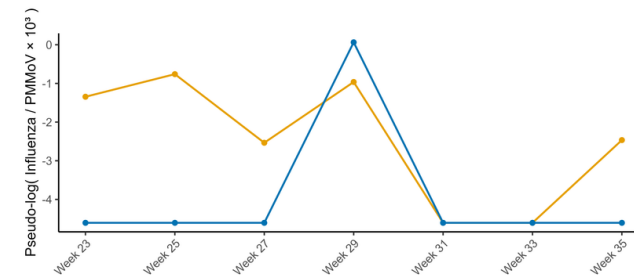
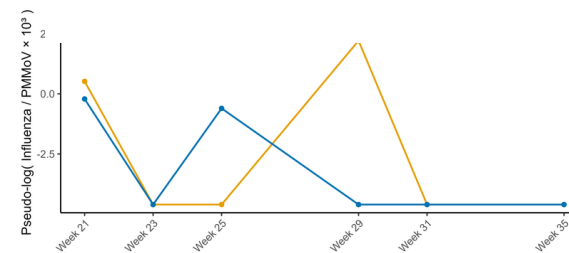
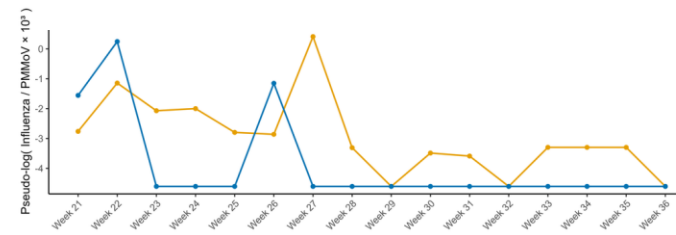
# Wastewater Surveillance Enables Population-Scale Influenza Monitoring in São Paulo

## Influenza A/B Wastewater Surveillance Network in São Paulo



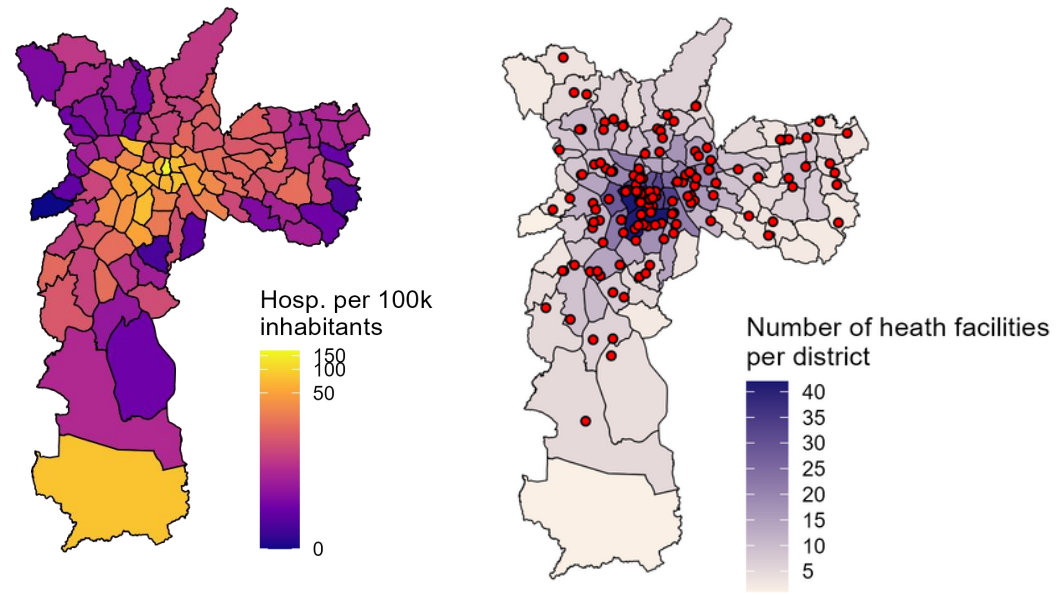
Sampling Frequency

- Monthly
- Biweekly
- Weekly



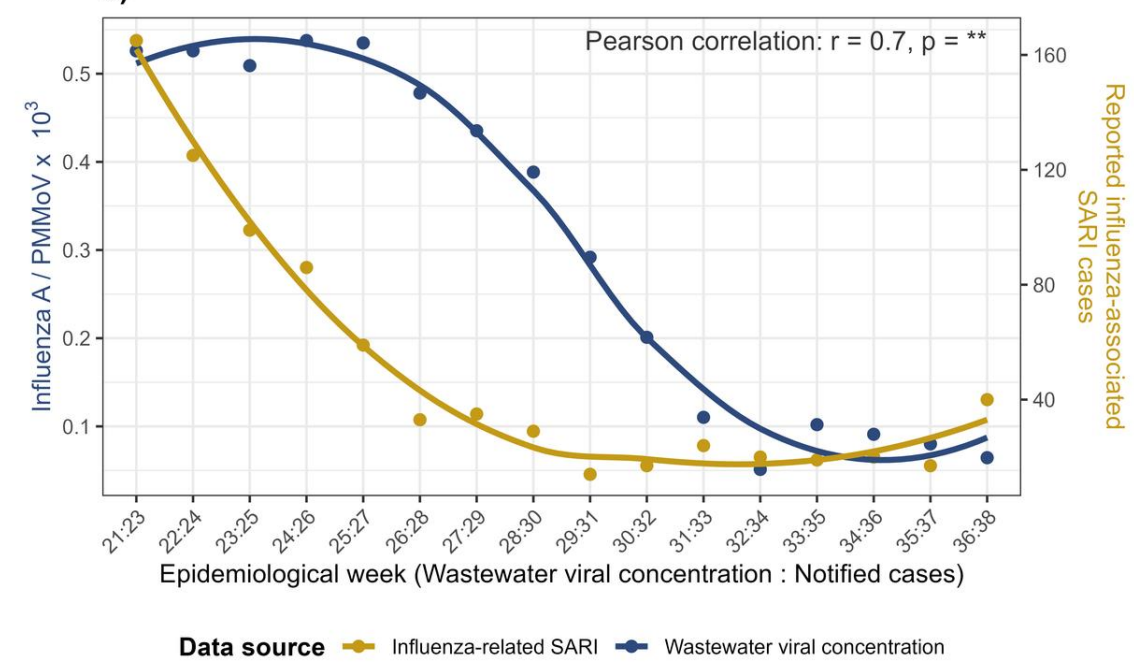
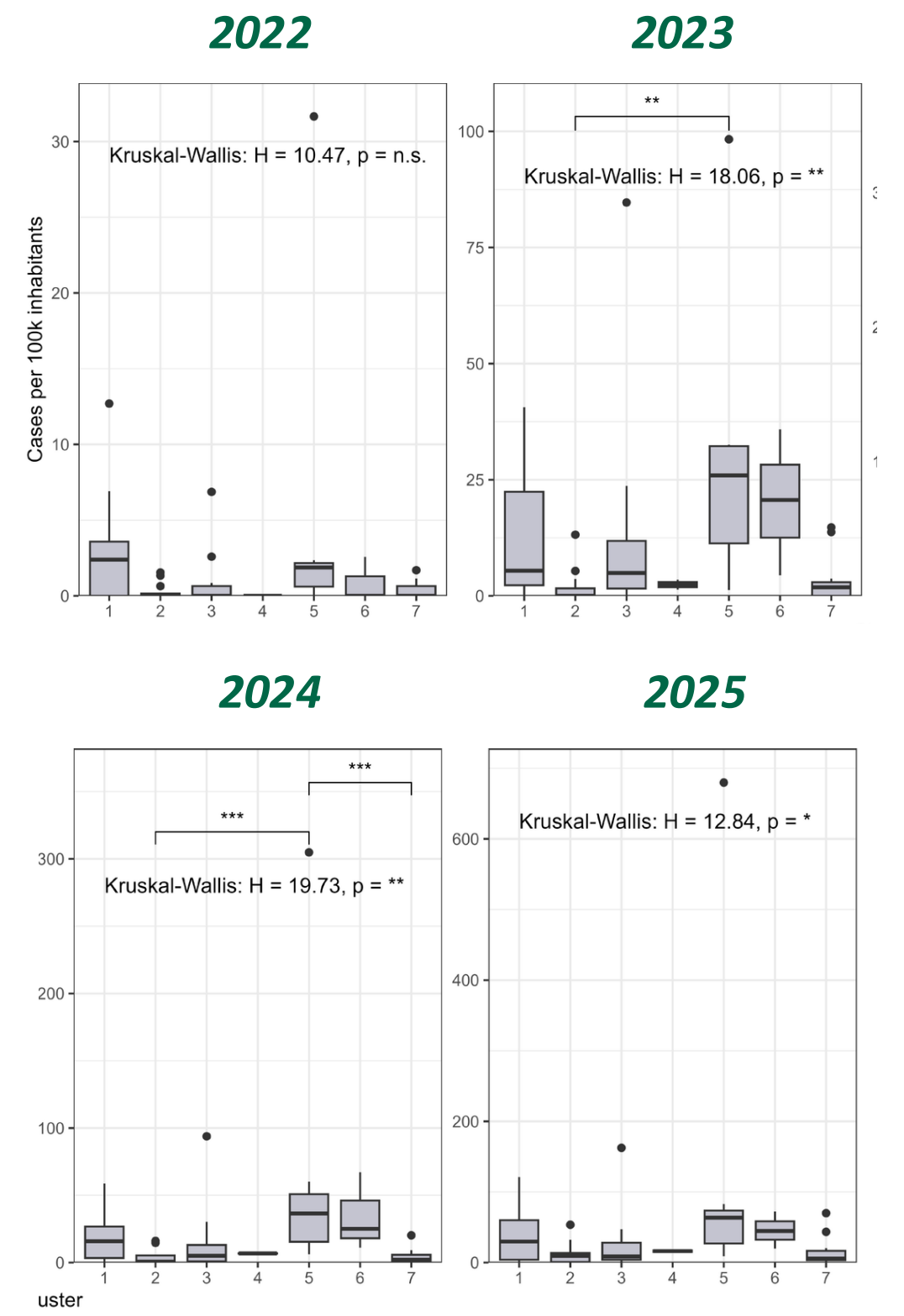
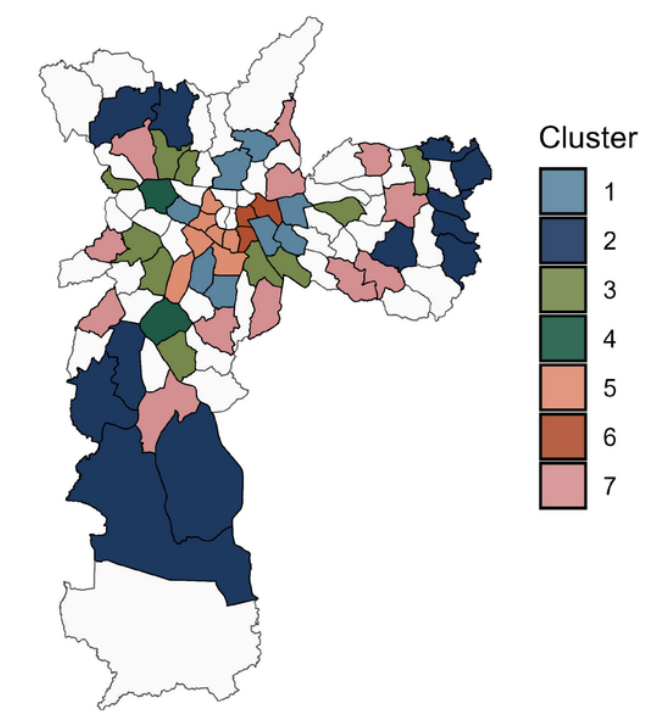
- Wastewater reveals spatial influenza activity
- Captures community transmission patterns
- Clinical relevance?

# Wastewater Influenza A RNA predicts SARI hospitalizations ~2 weeks in advance



2025

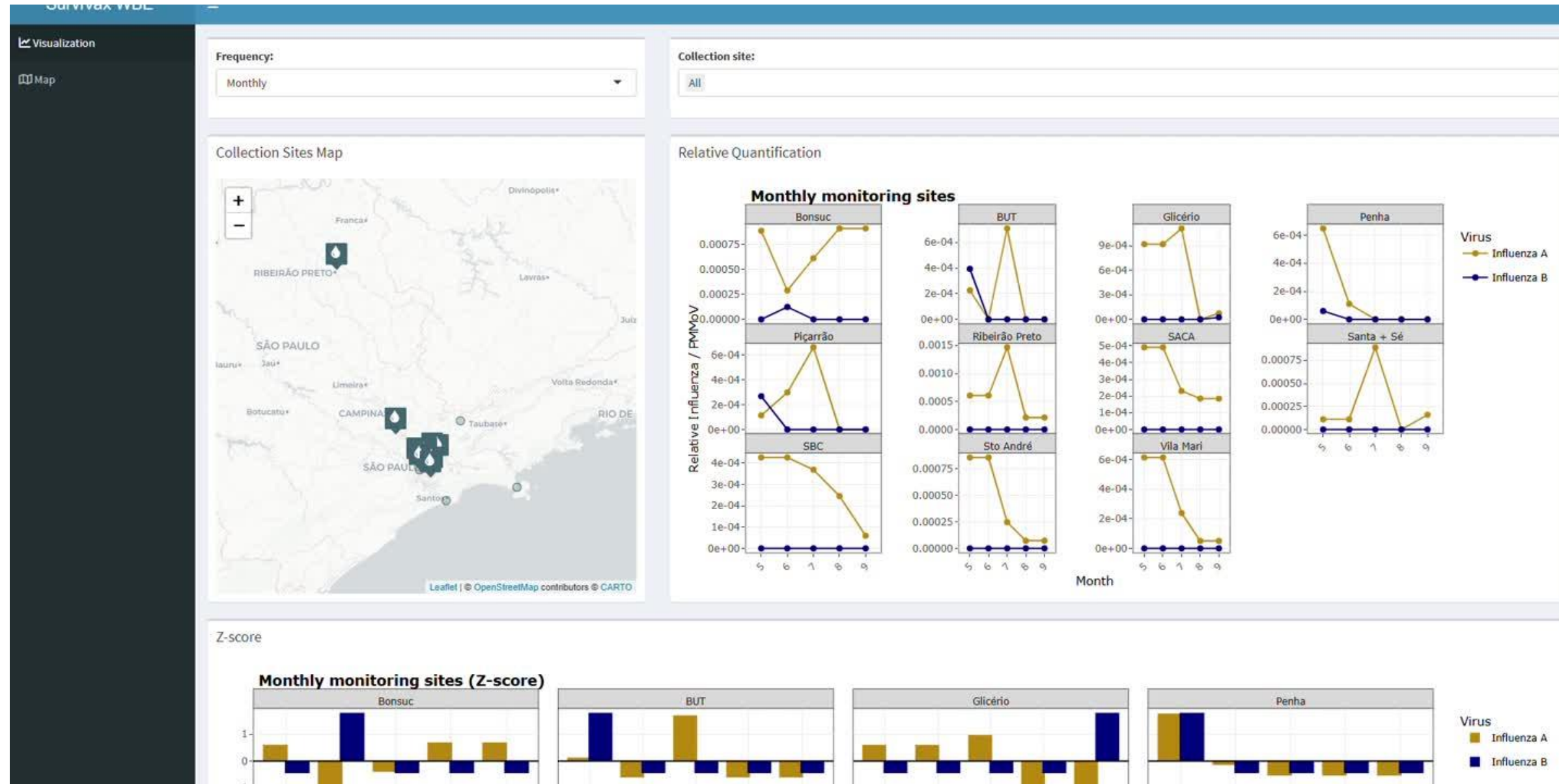
PERMANOVA:  
R<sup>2</sup> = 0.793 | F = 41.76 | p = 0.001



Spatial dynamics consistent with central-to-peripheral spread

# From Wastewater Surveillance to **Real-Time Public Health Intelligence**

Integrates **wastewater viral** signals with **epidemiological data** to support **early outbreak detection** and situational awareness



## Dashboard capabilities

- Real-time influenza monitoring
- Integrated data streams
- Early anomaly detection
- Public health decision support

*Prototype — deployment in progress*

# Acknowledgments



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