Data Owners and Methodologists: Towards Fruitful Collaborations

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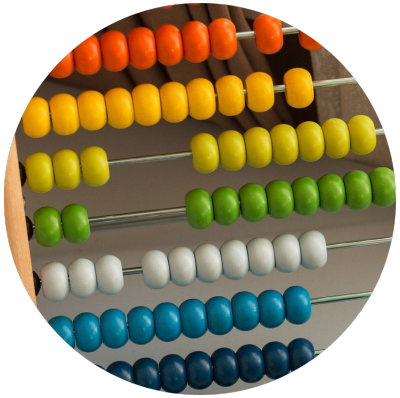
Introduction

Overview

The fast growing production and gathering of data generates problems whose complexity grows at an exponential rate. New efficient statistical methods become unavoidably necessary. Our main objective is to contribute to the development of new computationally efficient statistical methods for the analysis of large scale models.

Research Areas

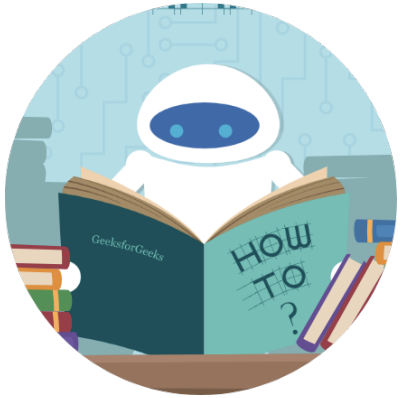


Computational Statistics

Monte Carlo methods
Simulation-based inference

High Dimensional Data

Simulation-based bias correction
Model selection



Machine Learning

Wrapper methods
Applications in Genomics

Signal Processing

Time series analysis
Applications in Robotics

Biostatistics

Bioequivalence
Prevalence estimation

Applied Statistics

Applications in Biology,
Education and Civil Engineering

Role of Statisticians in Interdisciplinary Research

Methodological statistics 

- Inferential methods
- Predictive methods
- Algorithms
- etc.

Modelling 

- Probability structures
- Prediction models
- Network structures
- etc.

Applied statistics and validation 

- Data visualisation/exploration
- Model selection/validation
- etc.

Examples of collaborative projects

 Bioequivalence (pharmaceutical sciences)

 Integrated navigation (aerospace engineering)

 Prevalence estimation (public health)

 Analytics for omics data (medicine)

 Causal inference (biology)

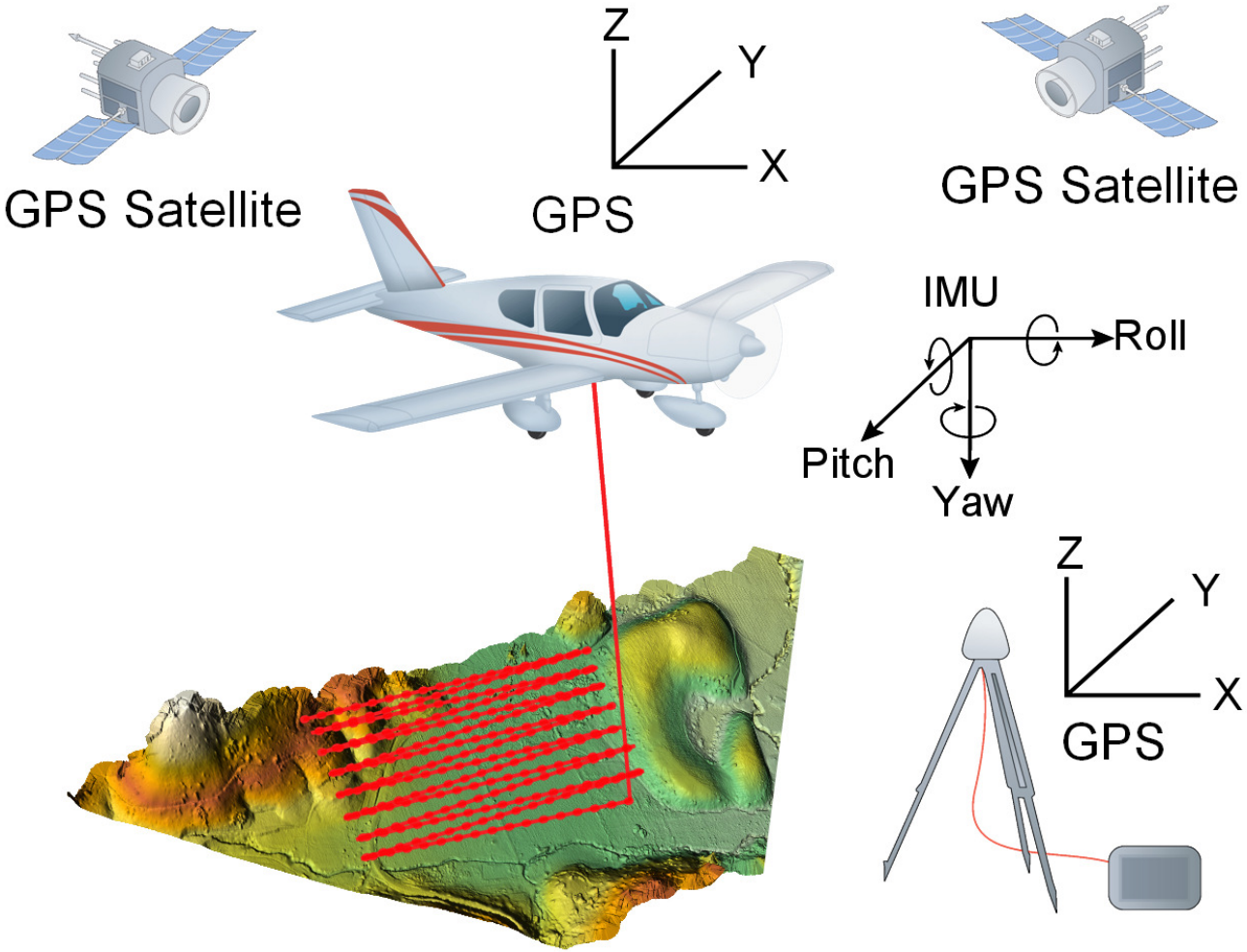
 Energy consumption modelling (architecture/civil engineering)

 Natural disaster modelling (environmental sciences)

 Risk management (actuarial sciences)

 Analysis of career choice of medical students (education sciences)

Integrated navigation (ex: LIDAR/UAV)

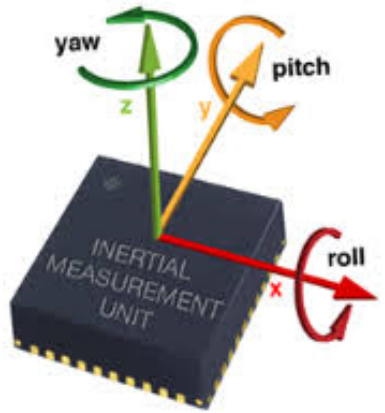


From Nagarajan et al., 2008

Integrated navigation

Research outcome

In collaboration with several engineering research teams in Universities (e.g. EPFL, Illinois, Calgary) and private companies (e.g Hexagon), we developed **new statistical methods to improve (integrated) navigation**.



Impact and implementation

- Scientific publications in statistics and different engineering disciplines
- Several research grants (innosuisse, SNFS)
- Open-source software
- PhD course on these developments at EPFL

Introduction to the GMWM
with R

Inference for large-scale time series with application to sensor fusion

1 - Introduction to Modelling and Estimation in Linear Dynamic Systems

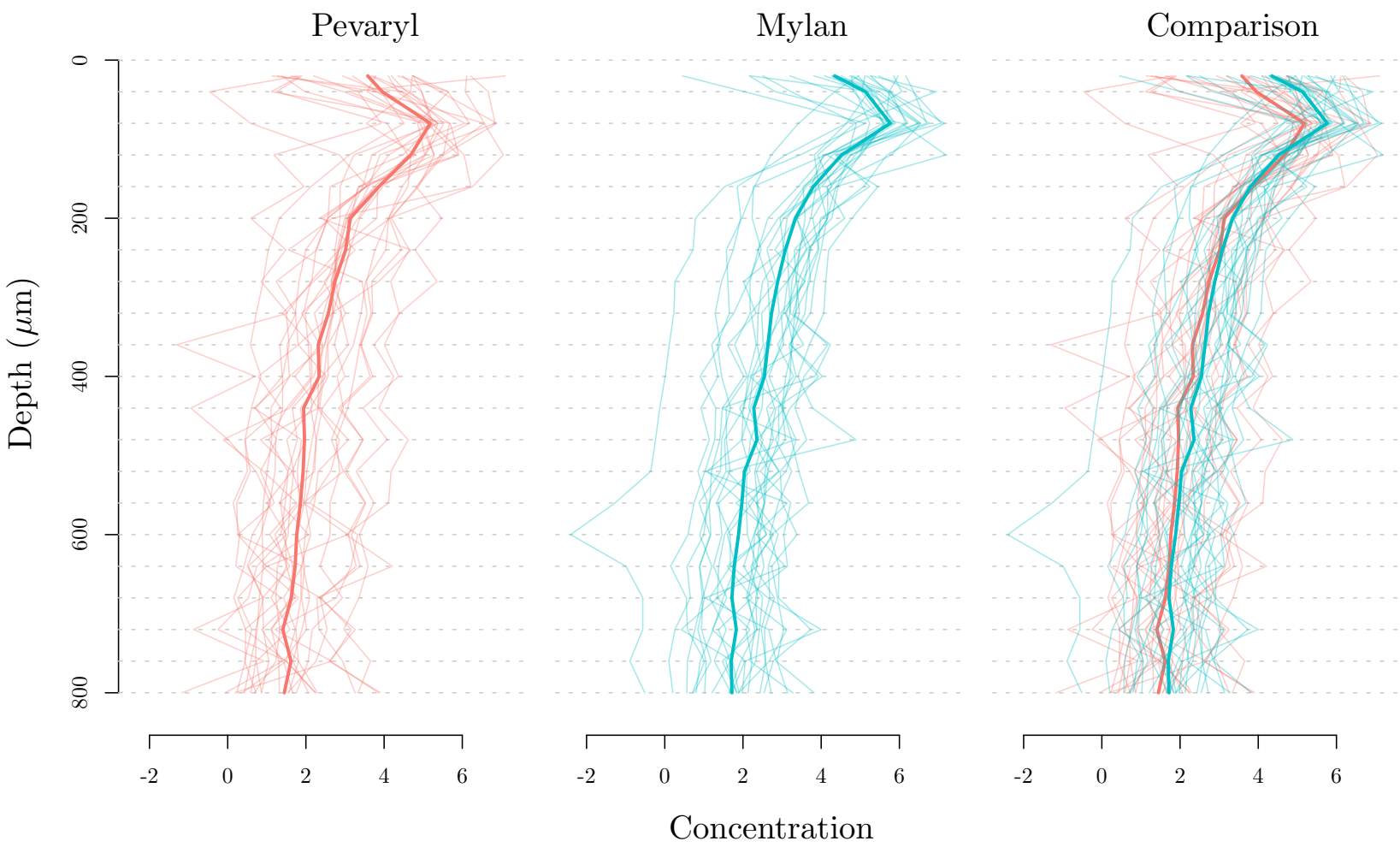
This chapter reviews the fundamentals of modelling and estimation techniques used in linear dynamic systems with several examples that highlight the importance of correct stochastic models (structure and value of parameters) in sensor fusion.

2 - Introduction to Times Series

This chapter provides a brief introduction to (time domain) time series analysis as well as on statistical estimators.

https://gmwm.netlify.app/

Bioequivalence (ex: cutaneous biodistribution)



Bioequivalence

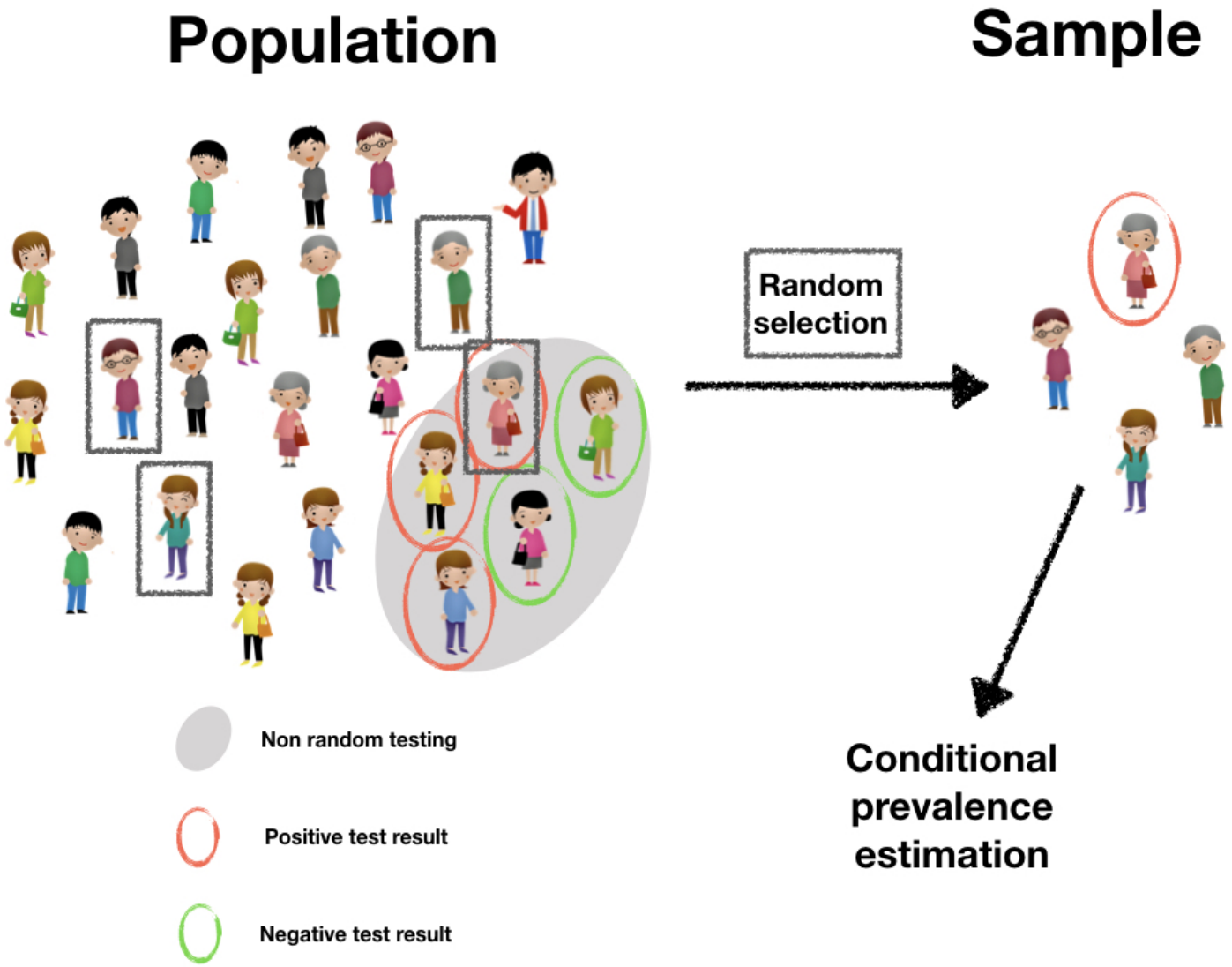
Research outcome

In collaboration with researchers in Pharmaceutical Sciences (University of Geneva) and biostatistics (Cambridge University), we are developing **new (multivariate) methods to assess bioequivalence** in challenging settings (e.g. cutaneous biodistribution).

Impact and implementation

- Several scientific publications (in statistics and in pharmaceutical sciences) submitted.
- Open-source software being finalized.

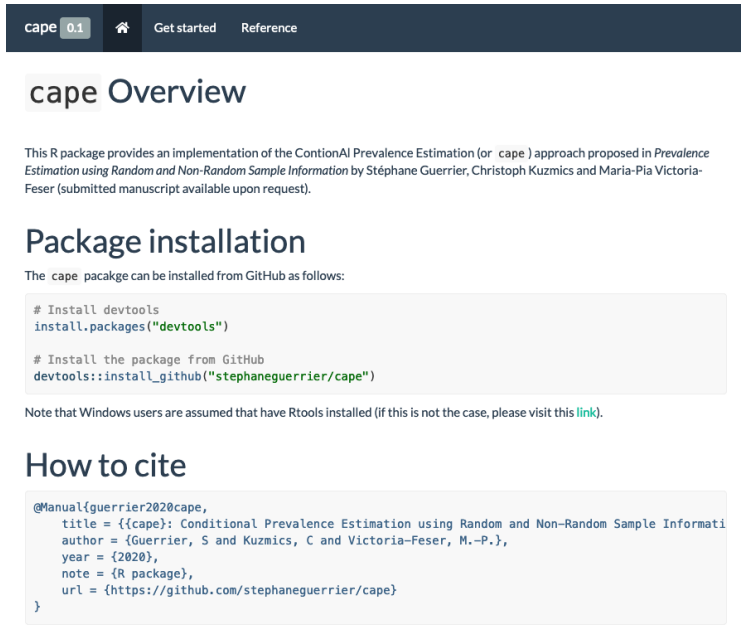
COVID-19 Prevalence estimation



COVID-19 Prevalence estimation

Research outcome

In collaboration with researchers in public health (University of Geneva) and in game theory (University of Graz), we propose an **estimator of the prevalence of any infectious disease, by using monitoring data, as is the case for the COVID-19**. The results imply that one gains accuracy in estimation (shorter confidence intervals) by recycling monitoring data, for cost/time effective surveying.

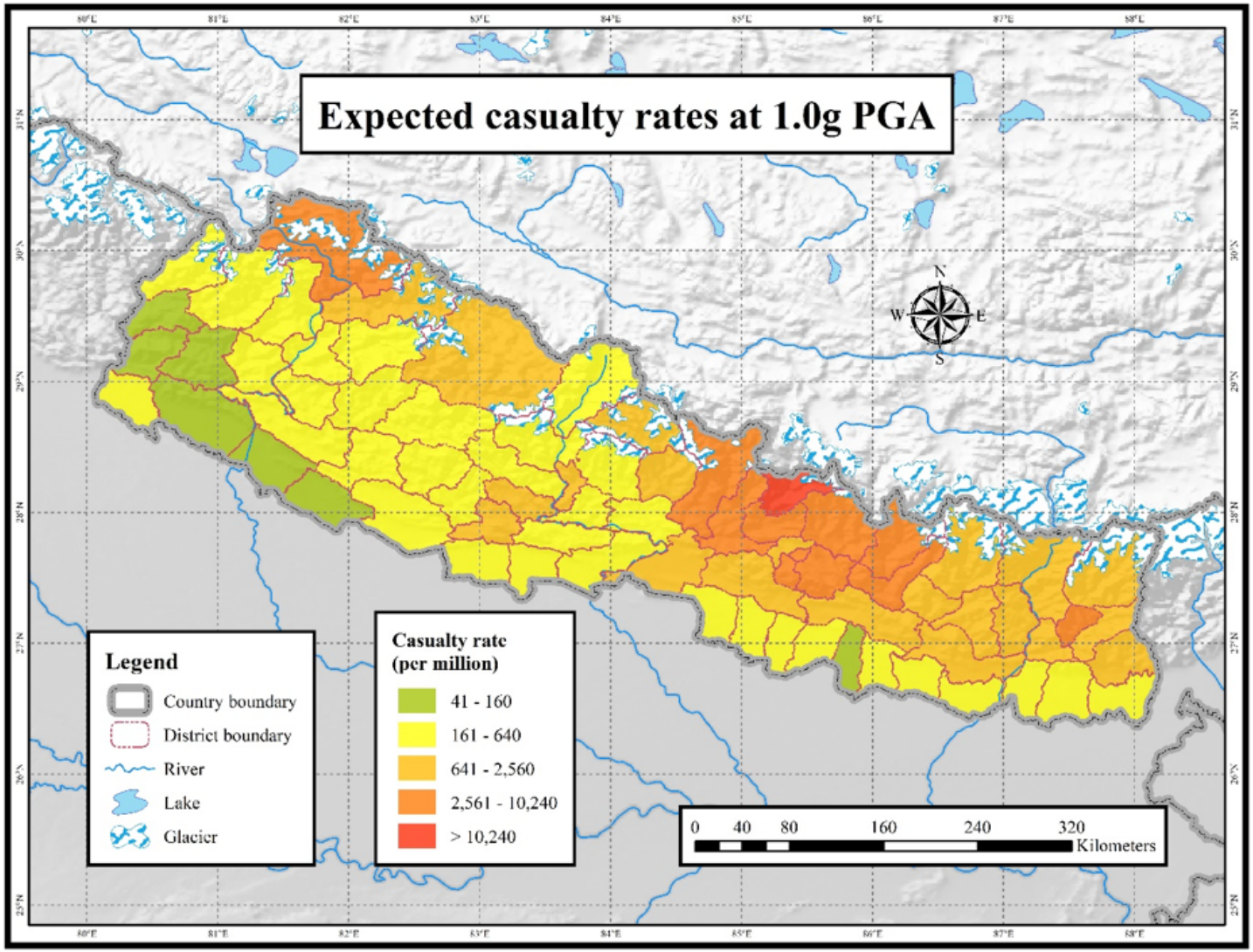


https://stephaneguerrier.github.io/cape/

Impact and implementation

- Scientific publications in biostatistics journals submitted.
- Open-source software available on GitHub.

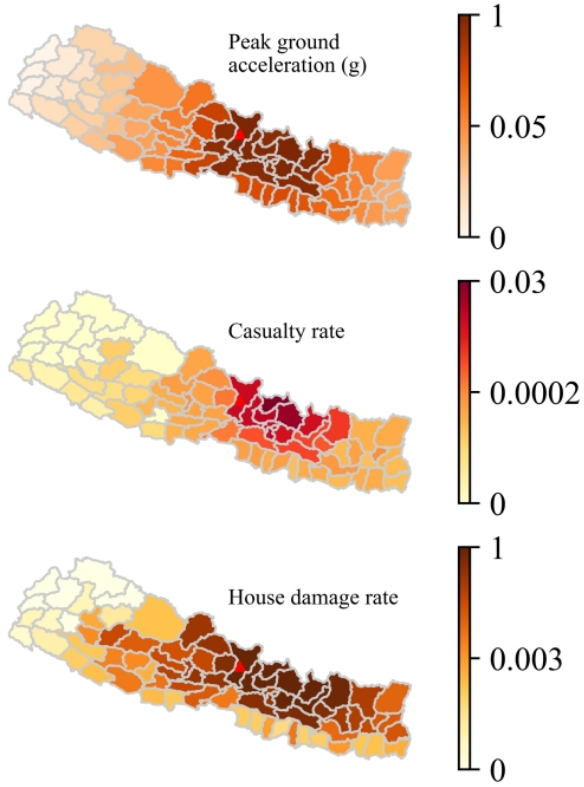
Natural Disaster Modelling (ex: Earthquakes in Nepal)



Natural Disaster Modelling

Research outcome

In collaboration with researchers in civil engineering, ethics and law (University of Illinois), we studied the relationship between natural disaster (e.g. earthquakes, storm surges) damages and social inequalities. Our studies allow to construct new metric of social vulnerability that can be coupled with hazard maps for risk analysis to predict adverse impacts or poor recoveries associated with future natural hazard events.



Impact and implementation

- Scientific publications in Geography and Earth Sciences.

Thank you very much for your attention!

Any questions?