Joseph Lemaitre | PhD Student

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My thesis involves infectious disease modeling towards the design of effective control policies, with practical applications on COVID-19 and Cholera. We use models to answer questions related to diseases dynamics, and communicate results to decision makers. These models combine novel data sources, scientific knowledge and state-of-the-art statistical methods to guide effective policies from noisy, incomplete and often misleading data.

Education

2017 – 2021 **PhD**, *Laboratory of Ecohydrology (ECHO)*, Swiss Federal Institute of Technology (EPFL), Switzerland.
Advisor: Prof. Andrea Rinaldo; Co-advisor: Prof. Damiano Pasetto.

2020 **PhD Mobility**, *Infectious Disease Dynamics Group*, Johns Hopkins Bloomberg School of Public Health, MD, USA.
with Prof. Justin Lessler.

2013 – 2017 **Master of Science in Computational Science and Engineering**, EPFL.

2010 – 2013 **Bachelor in Microengineering**, EPFL.

Research Projects

2017 – Now **PhD on infectious diseases modeling towards the design of effective control policies**.
My objective was to guide public-health decision makers towards the design of informed policies, using state-of-the-art statistical models to forecast epidemics. During these 4.5 years my main projects were:

- **COVID-19**:
  - contributing the JHU COVID Scenario Pipeline, a flexible modeling framework that projects epidemic trajectories and healthcare impacts under different suites of interventions in order to aid in scenario planning. It produces reports aimed at various governmental entities, and the pipeline is actively developed to meet the ever-changing decision maker needs.
  - assessing the effectiveness of non-pharmaceutical interventions in Switzerland for the first COVID-19 wave. In collaboration with local hospitals, we benefitted from detailled healthcare data which allowed us to mitigate the underreporting due to the low test capacity.
- **Cholera**:
  - providing a model-based evaluation of the potential of a mass vaccination campaign against cholera in Haiti, as one of four groups of a multi-model comparison study.
  - formal model comparison study to gauge the effect of intra-seasonal rainfall events on cholera transmission in Juba, South Sudan.
- **Optimal control of infectious diseases**: using automatic differentiation and non-linear programming, we explored methods to construct optimal vaccination strategies in space and time around any spatial epidemiological model, such that the impact of each dose is maximal.

2017 **Master Thesis: Agent-based Modelling of Schistosomiasis Transmission Dynamics**. ECHO.

2014–2015 **Semester Projects**.

- **Left-Atrium Segmentation**, *LHTC*, CHUV, Switzerland. Development of a 4D segmentation framework to reconstruct the left-atrium from MRI scans, with GUI for practicians.
- **Autonomous Vehicle Formations**, *DISAL*, EPFL.

Professional Expertise

Soft skills

Soft	I enjoy working in multi-cultural environments, and collaborating across disciplinary boundaries. Creative, self-motivated, I strive to tackle complex, fast-moving, and ambiguous problems.
Comm.	Public-speaking and presenting results to audiences with diverse, non-quantitative backgrounds.

Quantitative methods

Data	Exploratory Data Analysis (EDA), data visualization, predictive modeling, mechanistic or statistical modeling. Statistical inference using MCMC, particle filtering, frequentist or bayesian methods...
Optimization	Optimal Control, Automatic Differentiation (AD), Non-Linear Programming (NLP).
Epi. modeling	Compartmental (SIR), agent-based (ABM), spatial, stochastic or ODE-based models.

Computer skills

Python	Numpy, Pandas, Numba, Dask, Matplotlib/Seaborn, CasADi...
Programming	R (incl. tidyverse), C, C++ (incl. Pybind11), Matlab, a bit of Stan.
Development	Git, Mercurial, CI and TDD, Docker, Slurm, High-Performance Computing.
Other	Latex, Markdown, GNU/Linux, Wordpress, Microsoft Office Suite, Adobe Creative Suite.

Publications (& Preprints)

2021 **Optimizing the spatio-temporal allocation of COVID-19 vaccines: Italy as a case study**, ***J. Lemaitre***, *D. Pasetto, M. Zanon, E. Bertuzzo, L. Mari, S. Miccoli, R. Casagrandi, M. Gatto, A. Rinaldo.*
medRxiv.

2021 **Modeling of future COVID-19 cases, hospitalizations, and deaths by vaccination and nonpharmaceutical interventions scenarios — United States, April–September 2021**, *R. Borchering, C. Viboud, E. Howerton, C. Smith, S. Truelove, M. Runge, N. Reich, L. Contamin, J. Levander, J. Salerno, W. van Panhuis, M. Kinsey, K. Tallaksen, R. F. Obrecht, L. Asher, C. Costello, M. Kelbaugh, S. Wilson, L. Shin, M. Gallagher, L. Mullany, K. Rainwater-Lovett,* ***J. Lemaitre****, J. Dent, K. Grantz, J. Kaminsky, S. Lauer, E. Lee, H. Meredith et al.*
MMWR. Morbidity and mortality weekly report 70.19, 719-724.

2021 **Wastewater monitoring outperforms case numbers as a tool to track COVID-19 incidence dynamics when test positivity rates are high**, *X. Fernandez-Cassi, A. Scheidegger, C. Bänziger, F. Cariti, A. Tuñas Corzon, P. Ganesanandamoorthy,* ***J. Lemaitre****, C. Ort, T. Julian, T. Kohn.*
Water Research, 117252.

2021 **Evaluation of individual and ensemble probabilistic forecasts of COVID-19 mortality in the US**, *E. Cramer, V. Lopez, J. Niemi, G. George, J. Cegan, I. Dettwiller, W. England, M. Farthing, R. Hunter, B. Lafferty, I. Linkov, M. Mayo, M. Parno, M. Rowland, B. Trump, L. Wang, L. Gao, Z. Gu, M. Kim, Y. Wang, J. Walker, R. Slayton, M., Matthew B. et al.*
medRxiv.

2021 **A scenario modeling pipeline for COVID-19 emergency planning**, ***J. Lemaitre****, K. Grantz*, J. Kaminsky*, H. Meredith*, S. Truelove*, S. Lauer, L. Keegan, S. Shah, J. Wills, K. Kaminsky, J. Perez-Saez, J. Lessler, E. Lee.*
Nature Scientific Reports 11 (1), 1-13.

2021 **Effect of specific non-pharmaceutical intervention policies on SARS-CoV-2 transmission in the counties of the United States**, *B. Yang, A. Huang, B. Garcia-Carreras, W. Hart, A. Staid, M. Hitchings, E. Lee, C. Howe, K. Grantz, A. Wesolowski,* ***J. Lemaitre****, S. Rattigan, C. Moreno, B. Borgert, C. Dale, N. Quigley, A. Cummings, A. McLorg, K. LoMonaco, S. Schlossberg, D. Barron-Kraus, H. Shrock, UFCOVID Interventions Team, J. Lessler, C. Laird, D. Cummings*.
Nature Communications 12 (1), 1-10.

2020 **Assessing the impact of non-pharmaceutical interventions on SARS-CoV-2 transmission in Switzerland**, ***J. Lemaitre****, J. Perez-Saez*, A. Azman, A. Rinaldo, J. Fellay*.
Swiss Medical Weekly 150, w20295.

2021 **Range of reproduction number estimates for COVID-19 spread**, *D. Pasetto,* ***J. Lemaitre****, E. Bertuzzo, M. Gatto, A. Rinaldo*.
Biochemical and Biophysical Research Communications 538, 253-258.

2019 **Achieving coordinated national immunity and cholera elimination in Haiti through vaccination: a modelling study**, *E. Lee*, D. Chao*,* ***J. Lemaitre****, L. Matrajt*, D. Pasetto, J. Perez-Saez, F. Finger, A. Rinaldo, J. Sugimoto, M. E. Halloran, I. Longini, R. Ternier, K. Vissieres, A. Azman, J. Lessler, L. Ivers*.
The Lancet Global Health 8 (8), e1081-e1089.

2019 **Rainfall as a driver of epidemic cholera: comparative model assessments of the effect of intra-seasonal precipitation events**, ***J. Lemaitre****, D. Pasetto, J. Perez-Saez, C. Sciarra, JF. Wamala, A. Rinaldo*.
Acta tropica 190, 235-243.

2018 **Near real-time forecasting for cholera decision making in Haiti after Hurricane Matthew**, *D. Pasetto, F. Finger, A. Camacho, F. Grandesso, S. Cohuet,* ***J. Lemaitre****, A. Azman, F. Luquero, E. Bertuzzo, A. Rinaldo*.
PLoS Computational Biology 14 (5), e1006127.

2015 **Distributed graph-based convoy control for networked intelligent vehicles**, *A. Marjovi, M. Vasic,* ***J. Lemaitre****, A. Martinoli*.
2015 IEEE International Geoscience and Remote Sensing Symposium (IGARSS).

2015 **Cloud Base Height Estimation Using High-Resolution Whole Sky Imagers**, *F. Savoy,* ***J. Lemaitre****, S. Dev, Y. Lee, S. Winkler*.
2015 IEEE Intelligent Vehicles Symposium (IV).

Other academic contributions

Community work

2020–2021 **Peer-reviews**.
for PNAS$^{(\times 2)}$, Swiss Medical Weekly$^{(\times 1)}$, Royal Society Open Science$^{(\times 4)}$, Nature Scientific Reports$^{(\times 1)}$, PLoS One$^{(\times 2)}$, Lancet Regional Health – Europe$^{(\times 1)}$.

2017–2021 **Mentoring of Master students**, EPFL.
On various infectious disease dynamics topics. Students: Thomas Fry, Cristiano Trevisin (now PhD student), Eloi Benvenuti, Maëlle Romero Grass, Briac Virey, Cloé Keller.

2012–2020 **Teaching Assistant**, EPFL.
for bachelor and master level courses: Analysis (2012, 2016), Programming (2012 – 2014), Logical Systems (2012 – 2014), Mechanical Design (2013), Physics (2016), Hydrology (2017 – 2019), Water Ressources Engineering (2019).

Outreach

Links Interviewed or quoted in RTS, Der Bund, Berner Zeitung, Tages-Anzeiger, 24 Heures, Tribune de Genève, Le Temps, Le Temps (2), Le Figaro, Radio Canada, Heise, EPFL news.

Awards

2021 **Swiss National Fund**, *PhD mobility grant*.
15'000.- CHF for a mobility at Johns Hopkins University, Baltimore, USA.

Invited Talks

Dec. 2021 **Environmental Engineering Seminar Series**, *EPFL*.
Epidemiological modelling during the COVID-19 pandemic: between Science and Public Health.

Secondary Experience

2015 **Junior Scientist**, *Illinois at Singapore Pte Ltd*, Singapore.
6 month internship on cloud segmentation using MODIS Satellites and Whole-Sky Imagers.

2009 – 2013 **Embedded Developer for Mobile Robots**, *Club Vaudois de Robotique Autonome, Switzerland*.
Participation to the European robotic contest *Eurobot*. Worked on computer vision, embedded programming, control systems and electrical design.

Sum. 2012 **Machining Traineeship**, *École des métiers de Lausanne*.
Physical and precision work in loud environments.

Languages

French Mother tongue.

English Advanced, professional working proficiency.

Personal Informations

Nationalities French, Swiss.

Civil status Married.

Age 28 year old.

Misc. B driving license, no military obligations.