Christian Selinger

Disease Modeler

"Don't forget that the bacteria watch us from the other end of the microscope." - Stanisław Jerzy Lec

Research statement

Question *How can we meaningfully quantify the impact of health interventions while accounting for biological and real-world uncertainties and heterogeneities?*

Methods agent-based models, computational topology, differential equations, stochastic simulation algorithms, statistical inference

Publications epidemiological modeling (19), computational biology (11), pure mathematics (2)

Education

2006–2010 **PhD in Mathematics**, *University of Luxembourg*, Luxembourg, *Geometry and Stochastic Calculus on Wasserstein spaces*.
Supervision: Prof. Anton Thalmaier & Prof. Josef Teichmann

2001–2006 **Master's degree in Mathematics**, *University of Vienna*, Austria, *Gradient Flows on Spaces of Probability Measures*.
Supervision: Prof. Walter Schachermayer & Prof. Josef Teichmann

Research experience and achievements

2021–Present **Senior Research Scientist**, Swiss TPH, Basel.
- Causal impact analysis of vector control on malaria incidence using routine data
- Uncertainty quantification for agent-based models of malaria transmission

2017–2021 **Research Scientist**, CNRS & IRD, Montpellier.
- Improving predictive accuracy of SARS-CoV2 hospitalization using human mobility data
- Immuno-modulatory impact of early HPV infections

2014–2017 **Research Scientist**, Institute for Disease Modeling, Seattle.
- Prospective impact and cost-effectiveness of HIV vaccines in South Africa
- Stability of poliovirus vaccine cessation across sanitation and immunization settings

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2012–2014 **Postdoc**, University of Washington, Seattle.
- Host response to vaccination as correlates of protection in simian HIV vaccines
- Computational topology of host transcriptomics in MERS-CoV pathogenesis

Teaching experience

Modeling, simulation & inference

- Advanced infectious disease models (30h), 2025 at AIMS-Rwanda
- OpenMalaria - an agent-based model for malaria intervention impact modeling (40h), 2024 at Swiss TPH
- Simulation algorithms and numerics for infectious disease models, (12h+8h), 2024 at AIMS-Senegal & AIMS-Rwanda
- Inférence de paramètres et algorithmes de simulation pour les modèles de maladies infectieuses, (8h+12h), 2022 & 2021 at Ecole Polytechnique de Thiès & Université Nazi Boni, Bobo-Dioulasso
- Introduction à la modélisation mathématique des maladies infectieuses, (12h), 2020 at Université Nazi Boni, Bobo-Dioulasso
- Introduction to EMOD, an agent-based network model for HIV (6h), 2017 at University of Washington

Mathematics

- Branching processes (3h), 2019 & Evolutionary Epidemiology (3h), 2018, Master 2 quantitative epidemiology at Université de Montpellier
- Introduction to mathematical finance in discrete time (30h), 2009, Master 2 applied mathematics, Université de Metz
- Hyperbolic geometry (28h), 2008, mathematics undergraduate, Université du Luxembourg
- Introduction to Probability and Statistics (28h), 2007, mathematics undergraduate, Université du Luxembourg

Mentoring experience

PhD co-supervision

- Thomas Beneteau: *Modélisation mathématique des infections HPV : quel rôle du hasard dans la persistance et l'oncogénèse* at Université de Montpellier, 2019-2023
- Bastien Reyné: *Modélisation mathématique de vaccination: approches EDP* at Université de Montpellier, 2020-2023
- Zenabu Suboi: *Uncertainty quantification for agent-based models with application to malaria intervention modeling*, at Universität Basel, 2023-ongoing

MSc co-supervision

- Amelia Bertozzi-Villa: *Disentangling the impact of seroconversion age and set-point viral load on ART-free HIV survival* at the University of Washington, 2016
- Thomas Beneteau: *Modélisation de la dynamique intra- et inter-cellulaire des papillomavirus humains* at AgroParisTech, 2019
- Dorian Vlaeminck: *Epidemics on networks* at Université de Montpellier 2019
- Baptiste Elie: *Individual heterogeneity in outbreak modeling* at ENS Paris Saclay, 2020
- Smaila Amoanu: *Retrospective Impact Quantification of Malaria Interventions in Ghana*, at AIMS-Rwanda and University of Cape Coast, Ghana, 2024

Internship co-supervision

- Jean Pachebat: *Analysing COVID-19 time series*, at Télécom Paris 2020
- Juliette Lepère: *Retrospective analysis of IRS impact on malaria incidence*, at ENSAE, 2023

Fellowships

- Erasmus fellowship (EU), 2004-2005, mathematics at the University of Paris 6
- research semester fall 2007 at Felix Hausdorff Institute in Bonn
- research stay September 2009 at ETH Zürich with J Teichmann
- research stay April, May 2010 at TU Berlin with M von Renesse

Publications

Epidemiological modeling and population health

- Selinger C et al.: **Retrospective impact evaluation of indoor residual spraying in Côte d'Ivoire using routine malaria surveillance data: the role of contemporaneous covariates and data quality** manuscript in preparation
- Beneteau T, Groc S, Murall, CL, Boue V, Elie B, Tessandier N, Bernat C, Bonneau M, Foulongne V, Graf C, Grasset S, Rahmoun M, Segondy M, Tribout V, Reynes J, Selinger C, Boulle N, Bravo IG, Sofonea MT, Alizon S: **Incidence and duration of human papillomavirus infections in young women: insights from a bimonthly follow-up cohort** Infectious Diseases 2024.
- Uysal IB et al.: **Concomitant and productive genital infections by HSV-2 and HPV in two young women: A case report** IDCases 2022.
- Tessandier N, Uysal IB, Elie B, Selinger C, et al.: **Does exposure to different menstrual products affect the vaginal environment?** Molecular Ecology Oct 2022.
- Elie B, Selinger C, Alizon S: **The source of individual heterogeneity shapes infectious disease outbreaks.** Proc. R. Soc. B. 289: 2022023.
- Reyné B, Richard Q, Selinger C, Sofonea MT, Djidjou-Demasse R, Alizon S: **Non-Markovian modelling highlights the importance of age structure on Covid-19 epidemiological dynamics.** Math. Model. Nat. Phenom. 17 (2022) 7
- Alizon S, Selinger C et al.: **Epidemiological and clinical insights from SARS-CoV-2 RT-PCR cycle amplification values.** Euro Surveill. 2022;27(6)
- Selinger C, Choisy M, Alizon S: **Predicting COVID-19 incidence in French hospitals using human contact network analytics.** International Journal of Infectious Diseases Volume 111, October 2021, Pages 100-107
- Reyné B, Selinger C, Sofonea MT, Miot S, Pisoni A, Tuaillon E, Bousquet JJ, Blain H, Alizon S: **Analysing different exposures identifies that wearing masks and establishing COVID-19 areas reduce secondary-attack risk in aged-care facilities** International Journal of Epidemiology 2021
- Sofonea MT, Reyné B, Elie B, Djidjou-Demasse R, Selinger C, Michalakis Y, Alizon S: **Memory is key in capturing COVID-19 epidemiological dynamics.** Epidemics Volume 35, June 2021, 100459
- Haim-Boukobza S, Roquebert B, Trombert-Paolantoni S, Lecorche E, Verdurme L, Foulongne V, Selinger C, Michalakis Y, Sofonea MT, Alizon S: **Rapid SARS-CoV-2 variants spread detected in France using specific RT-PCR testing** Emerging Infectious Diseases Volume 27, Number 5, May 2021
- Djidjou-Demasse R, Selinger C, Sofonea MT: **Épidémiologie mathématique et modélisation**

de la pandémie de Covid-19 : enjeux et diversité Revue Francophone des Laboratoires 2020 (526) 63–69

- Guinat C, Tago D, Corre T, Selinger C, Djidjou-Demasse R, Paul M, Raboisson D, Thi Thanh TN , Inui K, Thanh Long P, Padungtod P, Vergne T: **Optimizing the early detection of low pathogenic avian influenza H7N9 virus in live bird markets** Journal of the Royal Society Interface 2021
- Murall CL, Reyné B, Selinger C et al.: **HPV cervical infections and serological status in vaccinated and unvaccinated women** *Vaccine 2020*
- Murall CL, Rahmoun M, Selinger C, et al.: **Natural history, dynamics, and ecology of human papillomaviruses in genital infections of young women: protocol of the PAPCLEAR cohort study** *BMJ Open, 2019;9:e025129.*
- Selinger C, Bershteyn A, Dimitrov D, Adamson BJ, Revill P, Hallett T, Phillips A, Bekker L, Rees H, Gray G: **Targeting and Vaccine Durability are Key for Population-level Impact and Economic Evaluation of the P5 HIV Vaccine in South Africa** *Vaccine 37 (16) 2258-2267, 2019*
- Selinger C, Dimitrov D, Eckhoff Ph, Bershteyn A: **The future of a partially effective HIV vaccine: assessing limitations at the population level** *International Journal of Public Health 64(6) 957–964*
- Famulare M, Selinger C, Chabot-Couture G, Eckhoff Ph, McCarthy KA, : **Assessing the stability of polio eradication after the withdrawal of oral polio vaccine.** *PLoS Biology 16(4): e2002468*
- Kirtane AR, Abouzid O, Minahan D, Bensel T, Hill AL, Selinger C, Bershteyn A, Mo SS, Craig M, Mazdiyasni H, Cleveland C, Rogner J, Lee YAL, Booth L, Javid F, Wu SJ, Grant T, Bellinger AM, Nikolic B, Hayward A, Wood L, Eckhoff PA, Nowak MA, Langer R, Traverso G: **Development of an oral once-weekly drug delivery system for HIV antiretroviral therapy.** *Nature Communications 9(1), 2018*
- Selinger C and Katze MG: **Mathematical Models of Viral Latency.** *Current Opinion in Virology 3 (2013), pp. 402–407.*

Computational biology

- Kamiya Ts, Tessandier N, Elie B, Bernat C, Boué V, Grasset S, Groc S, Rahmoun M, Selinger C, CHumphrys MS, Bonneau M, Graf C, Foulongne V, Reynes J, Tribout V, Segondy M, Boulle N, Ravel J, Murall CL, Alizon S: **Factors shaping vaginal microbiota long-term community dynamics in young adult women** Peer Community in Microbiology 2024.
- Tessandier N et al.: **Viral and immune dynamics of genital human papillomavirus infections in young women with high temporal resolution** PLoS Biology 2025
- Beneteau Th, Selinger C, Sofonea, MT, Alizon S: **Episome partitioning and symmetric cell divisions: quantifying the role of random events in the persistence of HPV infections.** PLoS Comput Biol 17(9): e1009352.
- Selinger C, Alizon S: **Reconstructing contact network structure and cross-immunity patterns from multiple infection histories.** PLoS Comput Biol 17(9): e1009375.
- Selinger C, Rahmoun M, Murall CL, Bernat C, Boué V, Bonneau M, Graf C, Grasset S, Groc S, Reynes J, Hirtz C, Jacobs N, Alizon S: **Cytokine response following perturbation of the cervicovaginal milieu during HPV genital infection.** Immunologic Research volume 69, pages 255–263 (2021)
- Tisoncik-Go J, Gasper DJ, Kyle JE, Eisfeld AJ, Selinger C, Hatta M, Morrison J, Korth MJ, Zink EM, Kim YM, Schepmoes A, Nicora CD, Purvine SO, Weitz KK, Peng X, Green RR, Tilton SC,

Webb-Robertson BJ, Waters KM, Metz TO, Smith RD, Kawaoka Y, Suresh M, Josset L, Katze MG: **Integrated omics analysis of pathogenic host responses during pandemic H1N1 influenza virus infection: the crucial role of lipid metabolism.** Cell Host & Microbe 19(2) 2016, 254–266

- Forero A, Tisoncik-Go J, Watanabe T, Zhong G, Hatta M, Tchitchek N, Selinger C, Chang J, Barker K, Morrison J, Berndt JD, Moon RT, Josset L, Kawaoka Y, Katze MG: **The 1918 PB2 protein enhances virulence through the disruption of inflammatory and Wnt-mediated signaling in mice.** Journal of Virology 90(5) 2015, 2240–2253
- Selinger C, Tisoncik-Go J, Menachery VD, Agnihothram S, Law GL, Chang J, Kelly SM, Sova P, Baric RS and Katze MG: **Cytokine systems approach demonstrates differences in innate and pro-inflammatory host responses between genetically distinct MERS-CoV isolates.** BMC Genomics 15 2014, 1161.
- Selinger C, Strbo N, Gonzalez L, Aicher L, Weiss JM, Law GL, Palermo RE, Vaccari M, Franchini G, Podack ER, Katze MG: **Multiple Low-dose Challenges in a Rhesus Macaque AIDS Vaccine Trial Result in an Evolving Host Response that affects Protective Outcome.** Clinical and Vaccine Immunology 21(12) 2014, 1650–1660.
- Ghosh T, Aprea J, Nardelli J, Engel H, Selinger C, Mombereau C, Lemonnier T, Moutkine I, Schwendimann L, Dori M, Irinopoulou T, Henrion-Caude A, Benecke AG, Arnold SJ, Gressens P, Calegari F, Groszer M: **MicroRNAs establish robustness and adaptability of a critical gene network to regulate progenitor fate decisions during cortical neurogenesis.** Cell Reports 7(6) 2014, 1779–88.

Mathematics

- Selinger C: **Brenier's solution to the optimal transport problem in the Euclidean case, Polar factorization of vector-valued maps.** Oberwolfach Report No. 18/2009, 991–992.
- Selinger C: **Zeta Function regularized Laplacian on the smooth Wasserstein space above the unit circle.** Theory of Stochastic Processes 17 (2011), 109–118.

Technical Reports

- Analyse rétrospective 2012-2022 des activités de lutte contre le paludisme en Côte d'Ivoire, 2023 (Global Fund & Ministry of Health in Côte d'Ivoire, 93p)

Communications

Seminar and conference talks

- 2024: Network modeling of infectious disease: some problems of inference and control (AIMS Ghana, Accra)
- 2024: Network modeling of infectious disease: some problems of inference and control (University of Cape Coast, Ghana)
- 2023: Modeling the prospective impact of SMC in Northern Côte d'Ivoire (Ecole Polytechnique de Thiès, Senegal)
- 2022: Reconstructing contact network structure and cross-immunity patterns from multiple infection histories (Ecole Polytechnique de Thiès, Senegal)
- 2022: Model-based evaluation of the potential epidemiological impact of introducing Seasonal Malaria Chemoprevention in Northern Côte d'Ivoire (ASTMH2022, Seattle, USA)
- 2021: Using Facebook colocation data for COVID-19: Time series forecasting for hospital incidence and optimal spatial control (Pasteur Institute, Paris)
- 2020: Activités de modélisation Covid19 et données de mobilité humaine dans le contexte de

modèles épidémiologiques spatiaux (Labex Numev, Montpellier)
- 2019: Multiple infection patterns as indicators of contact network properties and cross-immunity (MMEE2019, Lyon)
- 2019: Modeling Multiple Infection on Networks (Séminaire Mivegec, Montpellier)
- 2018: Mathematical modeling of episomal replication (AFIPP2018, Obernai)
- 2018: Multiple Infections on Networks (ECMTB Lisbon 2018)
- 2017: Modeling Population-level Impact and Cost-effectiveness of a Pox-Protein vaccine in South Africa (CAVD meeting Gates Foundation, Seattle)
- 2017: Modeling Population-level Impact and Cost-effectiveness of the HVTN702 vaccine in South Africa: Targeting and Vaccine Durability (Fred Hutch VTN, Seattle)
- 2017: Targeting and Vaccine Durability are Key for Population-level Impact of the HVTN702 HIV Vaccine in South Africa (ICRC/UW seminar)
- 2016: Modeling population-level impact and cost-effectiveness of an ALVAC P5 HIV vaccine in South Africa (P5 HIV vaccine modeling stakeholder meeting 2016, Cape Town, South Africa)
- 2016: Projected effectiveness of mass HIV vaccination with multi-dose regimens to be tested in South Africa (Institute for Disease Modeling Symposium 2016, Bellevue, WA)
- 2016: Branching processes on graphs with application to disease eradication (2016, Worcester Polytechnic Institute, MA)
- 2012: Du transport optimal à la dynamique des populations (Université de Toulouse Paul Sabatier)
- 2010: Regularized Wasserstein Laplacian (IRMA Strasbourg)
- 2010: Diffusion processes on histograms via optimal transport (Regen Winter school)
- 2009: Renormalized Laplacians on smooth Wasserstein spaces above tori ('Stochastic Analysis and Random Dynamical Systems 2009' University of L'viv)
- 2009: Brenier's solution to the optimal transport problem in the Euclidean case, Polar factorization of vector-valued maps (Oberwolfach)
- 2006: Lie bracket on smooth Wasserstein space (University of Bonn)

Poster presentations

- Goers R, Selinger C, Winkel M, Tittmann L, Champagne C, Pothin E: Country-specific individual-based malaria modeling, a standardized workflow in R. ASTMH 2022
- Selinger C, Alizon S: Multiple infection patterns as indicators of contact network properties and cross-immunity. Roscoff Ecology and Evolution 2019
- Nikolov M, Selvaraj P, Selinger C, Wenger E, Eckhoff P: Optimal release algorithms and propagation bounds for population replacement gene drives over spatial vector meta-population networks. EPIDEMICS 2017
- Selinger C, Famulare M, McCarthy K: Spatial patterns of vaccine reversion under declining immunity. Roscoff Ecology and Evolution 2017
- Selinger C, Kirtane A, Abouzid O, Langer R, Traverso C, Bershteyn A: Anticipated Adherence, Efficacy, and Impact of weekly oral Pre-Exposure Prophylaxis. CROI2017
- Selinger C, Bershteyn A, Dimitrov D, Hallett T, Bekker L-G, Rees H, Gray G: Population-level Impact and Cost-Effectiveness of an HIV Vaccine in South Africa. CROI2017
- Selinger C, Bershteyn A, Daniel Wood, Gilbert P, Dimitrov D: Population-level Impact of an ALVAC/AIDSVAX Vaccine Augmented with Additional Booster Through Targeted Campaigns in South Africa. R4P 2016 Chicago
- Selinger C, Bershteyn A, Oishi K, Eckhoff Ph: Intra-host Model of Transmitted Tenofovir Resistance after Breakthrough Infection with Topical HIV PrEP. R4P 2015 Cape Town
- Selinger C, Strbo N, Gonzalez L, Aicher L, Weiss JM, Law GL, Palermo RE, Vaccari M, Franchini

G, Podack ER, Katze MG: Genomics analysis of a non-human primate model of a gp96-Ig AIDS vaccine. 31st Annual Symposium on Non-Human Primate Models for AIDS 2013 Atlanta

Service to the scientific community

Press	HIV vaccine modeling (Die Zeit), Covid-19 modeling (Le Figaro, Libération, Sciences et Avenir)
Coordinating	*MaModAfrica* **PhD program** in malaria modeling at AIMS-Rwanda 2022-2026 *Methods in Malaria modeling* **training school** at AIMS-Senegal, Nov 13 - Dec 8, 2023 Paris School of Neuroscience **PhD program** at Inserm-Paris 2011-2012
Reviewing	**manuscripts** for *Ann. Probab.*, *J. Appl. Probab.*, *PLoS Biol.*, *PLoS Comput. Biol.*, *PLoS Biology*, *PLoS Medicine*, *Nat. Commun.*, *Vaccine*, *J. R. Soc. Interface*, *Bull. Math. Biol.*, *Pathogens and Disease*, *Epidemics*, *Bioinformatics*
Evaluating	grant **proposals** in *Computational Life Sciences* and *Expansion and networking of modelling expertise for severe infectious diseases* program of the German Federal Ministry of Education and Research (BMBF) Abou Bakari Diabaté's PhD thesis *Contribution à la modélisation mathématique et au contrôle optimal des maladies infectieuses*, Université Nazi Boni, 2024 as **rapporteur**
Outreach	Infectious disease modeling, Gymnasium Kirschgarten Basel

Computer skills

Basic	C++
Intermediate	PYTHON, MATLAB, Linux, High-performance computing
Advanced	R, LaTeX

Languages

- German, first language
- English, business fluent
- French, business fluent
- Polish, conversationally fluent

Interests

- Mountaineering
- Trumpet in brass & symphony

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