



# Forward and inverse modelling of eco-evolutionary dynamics



in biological and economic systems

**Victor Boussange**

*Forward and inverse modelling of eco-evolutionary dynamics in biological and economic systems*

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Cover picture: Top: forest in Sorapiss, Dolomites, Italy. Bottom: New York City, USA. @ Luca  
Bravo / PhotoSpirit

The document format is based on the *Clean Thesis* style developed by Ricardo Langner.

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# CV

## Personal Information

Residence	Zürich, Switzerland
E-mail	bvictor@ethz.ch
Website	vbuossange.github.io
Github	github.com/vbuossange
Age	Born 1995 (age 27)
Citizenship	France citizen

## Personal skills

Languages	English (fluent)
	French (native)
	Spanish (B2)
	German (B1)

Programming languages	Julia
	Python
	C++
	Java
	Matlab
	R
	Bash
	VBA
Sports	Ski mountaineering
	Alpinism
	Rock climbing
	Enduro mountainbiking
	Surfing

Alpine CV [vbuossange.github.io/pages/alpine\_cv/]

## Education

- 10.2022 **Ph.D in Environmental Sciences**, Swiss Federal Institute for Forest, Snow and Landscape (WSL | Swiss Federal Institute of Technology Zurich, ETH), Switzerland  
*Forward and inverse modelling of eco-evolutionary processes.* Under the guidance of Prof. Dr. Loïc Pellissier.
- 06.2017 **Full year academic exchange**, University of New South Wales (UNSW Sydney), Australia
- 06.2017 **Master thesis in theoretical geomechanics**, UNSW Sydney | CSIRO, Australia  
*Numerical continuation and bifurcation analysis for unconventional geomechanics.* Under the guidance of Dr. Thomas Poulet.
- 08.2018 **M.S. in Energy and Environmental Engineering**, Institut National Des Sciences Appliquées de Lyon (INSA Lyon), France  
Three-year undergraduate engineering course in Energy and Environmental Systems, focused on Advanced Energy Systems and Efficiency.
- 08.2018 **B.S. in Mathematics and Physics**, Institut National Des Sciences Appliquées de Lyon (INSA Lyon), France  
Ranking : 21/650 students.

## Professional appointments

- 08.2018 **R&D intern**, Compagnie National du Rhône (CNR), France  
03.2018 Development of an Energy Management System based on various optimisation techniques for optimal production of renewable resources. Applications to EU sponsored projects: **Jupiter1000** (power-to-gas), **Move in pure** (vehicle-to-grid), **Marie-Galante island** (micro-grid)

## Publications

### Peer-reviewed

1. **Boussange, V.** & Pellissier, L., *Eco-evolutionary model on spatial graphs reveals how habitat structure affects phenotypic differentiation*. *Commun Biol* 5, 668 (2022). [[bioRxiv](#)]

### Preprints

1. **Boussange, V.**, Vilimelis-Aceituno, P., Pellissier, L., *Mini-batching ecological data to improve ecosystem models with machine learning* [[bioRxiv](#)] (2022), 46 pages. In review.
2. **Boussange, V.**, Becker, S., Jentzen, A., Kuckuck, B., Pellissier, L., *Deep learning approximations for non-local nonlinear PDEs with Neumann boundary conditions*. [[arXiv](#)] (2022), 59 pages. Revision requested from Partial Differential Equations and Applications.

### Proceedings

1. Poulet, T., Alevizos, S., Veveakis, M., **Boussange, V.**, Regenauer-Lieb, K., *Episodic mineralising fluid injection through chemical shear zones*, ASEG Extended Abstracts (2018), 5 pages.

### In preparation

1. **Boussange, V.**, Sornette, D., Lischke, H., Pellissier, L., *Analogous forces to ecological interactions, dispersal and mutations shape the dynamics of economic activities*.

## Talks

- 07.2022 **Speaker**, HIGHDIMPDE.JL: A Julia package for solving high-dimensional PDEs, JuliaCon2022, online. [youtube.com/watch?v=4sXqGhhknT4](https://www.youtube.com/watch?v=4sXqGhhknT4)
- 06.2022 **Speaker**, Interpretable machine learning for forecasting dynamical processes in ecosystems, World Biodiversity Forum, Davos, Switzerland.
- 06.2022 **Invited speaker**, Investigating empirical patterns of biodiversity with mechanistic eco-evolutionary models, Seminar at the Theoretical Ecology and Evolution group, Universität Bern.
- 11.2021 **Invited speaker**, Numerical approximations of solutions of highly dimensional, non-local nonlinear PDEs, StAMBio seminar, St Andrews, UK.
- 10.2021 **Speaker**, Graph topology and habitat assortativity drive phenotypic differentiation in an eco-evolutionary model, Conference on Complex Systems, Lyon, France.
- 10.2021 **Speaker**, Using graph-based metrics to assess the effect of landscape topography on diversification, ECBC, Amsterdam, Netherlands.
- 09.2021 **Speaker**, Solving non-local nonlinear Partial Differential Equations in high dimensions with HighDimPDE.jl, International Conference on Computational Methods in Systems Biology, Bordeaux, France.
- 04.2021 **Speaker**, Responses of neutral and adaptive diversity to complex geographic population structure, Mathematical Population Dynamics, Ecology and Evolution, CIRM Marseille, France.

## Softwares

- 2022 **MiniBatchInference.jl** Julia  
[github.com/vboussange/MiniBatchInference.jl](https://github.com/vboussange/MiniBatchInference.jl)  
A Julia package for maximum likelihood estimation and model selection of strongly nonlinear dynamical models.
- 2021 **HighDimPDE.jl** Julia  
[github.com/vboussange/HighDimPDE.jl](https://github.com/vboussange/HighDimPDE.jl)  
A Julia package that breaks down the curse of dimensionality in solving non local, non linear PDEs.
- 2021 **EvoId.jl** Julia  
2019 [github.com/vboussange/EvoId.jl](https://github.com/vboussange/EvoId.jl)

Evolutionary individual based modelling, mathematically grounded.

2018 **OptiVPP** Python, GAMS  
**confidential**

Energy Management System for Virtual Power Plants.

## Open source software contributions

SciML  
DiffEqFlux.jl  
CUDA.jl  
Flux.jl  
LightGraphs.jl

## Teaching and supervision

12.2020 **701-3001-00L Environmental Systems Data Science**, ETH Zürich, D-USYS,  
09.2020 Switzerland

06.2020 **262-0100-00L Lab rotation**, ETH Zürich, D-BSSE, Switzerland  
04.2020

12.2020 **Taste of research internship**, Polytech Nice-Sophia, France  
09.2020

## Reviews

2022 **Journal of Open Source Software**  
2019 **Journal of Theoretical Biology**



