Victor **Boussange**

Engineer in Energy & Environmental Systems
Ph.D candidate in Environmental Sciences

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Zürich, Switzerland Born 1995 (age 26) | France Citizen

I am a researcher with interest in complex systems, mathematical modeling and scientific machine learning. My Ph.D aims at better understanding the drivers behind diversification processes in biological and economic systems. I conduct my investigations with mathematical models capturing eco-evolutionary dynamics. In parallel, I develop machine learning methods to empower these models and obtain an agreement with empirical data. I believe that the combination of mechanistic models and machine learning provides a powerful approach to better understand and forecast the dynamics of real ecosystems and economies. This is crucial for policy-makers to take the right decisions, in the face of potentially important ecosystem changes and accelerating threats.

Education

September 2022 (expected) – September 2018

Ph.D in Environmental Sciences, Swiss Federal Institute for Forest, Snow and Landscape (WSL), Switzerland

Title : "*Diversification in Complex Adaptive Systems : from biological populations to economic sectors*"

- Part I : "*Neutral and adaptive diversification in spatial graphs*"
- Part II : "*Scientific Machine Learning with applications to eco-evolutionary modeling*"
- Part III : "*Econobiology : understanding economic dynamics with biological models*"

eco-evolutionary modeling | graphs | partial differential equations | Scientific Machine Learning | GPU computing

June 2017 – September 2016

Full year academic exchange, University of New South Wales (UNSW Sydney), Australia

computational methods for finance | electrical energy | chemical reaction engineering

June 2017 – February 2017

Master thesis in theoretical geomechanics, UNSW Sydney | CSIRO, Australia

- Title : "*Numerical continuation and bifurcation analysis for unconventional geomechanics*"
- Supervisor : Thomas Poulet (CSIRO Australia)

numerical continuation | bifurcation analysis

August 2018 – September 2013

B.S./ M.S. in Energy and Environmental Engineering, Institut National Des Sciences Appliquées de Lyon (INSA Lyon), France

- Two-year undergraduate intensive course in mathematics and physics Ranking : 21/650 students
- Three-year undergraduate engineering course in Energy and Environmental Systems, focused on Advanced Energy Systems and Efficiency.

fluid mechanics | thermodynamics | networks and optimisation | energy markets

Professional appointments

August 2018 – March 2018

R&D intern, Compagnie National du Rhône (CNR), France

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)

software development | mathematical optimisation | energy trading

Publications

Preprints

- Boussange, V. & Pellissier, L.,*Topology and habitat assortativity drive neutral and adaptive diversification in spatial graphs*, [bioRxiv] (2021), 25 pages. Revision requested from Communications Biology.

Proceedings

- 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.

Works in progress

- Boussange, V., Becker, S., Jentzen, A., Pellissier, L., *Deep learning approximations for non-local nonlinear PDEs with Neumann boundary conditions*.
- Boussange, V., Sornette, D., Pellissier, L., *Eco-evolutionary dynamics in economic systems*.
- Boussange, V., Vilimelis-Aceituno, P., Pellissier, L., *Interpretable Machine Learning for forecasting dynamical processes in ecosystems*.
- Boussange, V., Becker, S., Rackauckas, C., Pellissier, L., `HighDimPDE.jl` : *A Julia package for solving high dimensional, non-local, nonlinear PDEs*.

Talks

November 2021	StAMBio seminar, St Andrews, UK.*Numerical approximations of solutions of highly dimensional, non-local nonlinear PDEs*.
October 2021	Conference on Complex Systems, Lyon, France. *Graph topology and habitat assortativity drive phenotypic differentiation in an eco-evolutionary model*.
October 2021	ECBC, Amsterdam, Netherlands. *Using graph-based metrics to assess the effect of landscape topography on diversification*.
September 2021	International Conference on Computational Methods in Systems Biology, Bordeaux, France. *Solving non-local nonlinear Partial Differential Equations in high dimensions with HighDimPDE.jl*.
April 2021	Mathematical Population Dynamics, Ecology and Evolution, CIRM Marseille, France. *Responses of neutral and adaptive diversity to complex geographic population structure*.

Softwares

HighDimPDE.jl 2021

github.com/vboussange/HighDimPDE.jl documentation

A Julia package that breaks down the curse of dimensionality in solving non local, non linear PDEs.

Julia

EvoId.jl 2019 - 2021

github.com/vboussange/EvoId.jl documentation

Evolutionary individual based modelling, mathematically grounded.

Julia

OptiVPP 2018

confidential

Energy Management System for Virtual Power Plants.

Python GAMS

Open Source contributions

DiffEqFlux.jl, CUDA.jl, Flux.jl, LightGraphs.jl.

Programming

Programming languages	**Julia**, **Python**, **C++**, Java, Matlab, R, Bash, VBA
Libraries	Flux.jl, DifferentialEquations.jl, DiffEqFlux.jl, CUDA.jl, LightGraphs.jl, TensorFlow, ArchGDAL, matplotlib

Teaching and Mentoring

December 2020 September 2020	**701-3001-00L Environmental Systems Data Science, ETH Zürich, D-USYS, Switzerland** Undergraduate course. In charge of the unit *Supervised Deep Learning - Application*.
June 2020 April 2020	**262-0100-00L Lab rotation, ETH Zürich, D-BSSE, Switzerland** Supervision of Cecilia Valenzuela Agui in the frame of her MS in *Computational Biology and Bioinformatics*.
December 2020 September 2020	**Taste of research internship, Polytech Nice-Sophia, France** Supervision of Nicolas Demolin for his research internship in the frame of his MS in *Applied Mathematics and Modeling*.

Languages

French ●●●●●
English ●●●●●

Spanish ●●●○○
German ●●○○○

Hobbies

- Ski touring, ski mountaineering. **Major achievements** : Graubünden Haute Route, 6 days, group leader, 2021 | Hausstock 3158m, S ridge, 38° / D, 2021 | Stucklistock 3313m, S ridge, 40° / D, 2021.
- Alpinism. **Major achievements** : Spaghetti tour, 6 days, group leader, AD, 2021 | Mönch 4017m, Normal route, AD, 2020 | Piz Palü 3882m, traverse W-E from Rifugi dals Chamuotschs-Fortezza, PD 2c, 2020.
- Rock climbing, alpine climbing. **Major achievements** : Sewenstock 2820m, “Amarone”, 10 pitches, 7 pitches in 6a+, 2021 | Hannibalturm 2920m, “Conquest of Paradise”, 6 pitches, 6b, 2020 | Brüggler, “Sonntagweg”, 7 pitches, 6a+, 2020.
- Enduro mountainbiking, bikepacking. **Major achievements** : ”From the first to the last droplet of the Rhone river”, Furkapass to Marseille, 11 days, group leader, 2018-2020 | Tour du Mont Blanc, 5 days, group leader, 2019.
- Surfing.

References

Prof. Dr. Loïc Pellissier
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Dr. Thomas Poulet
Deep Earth Imaging, CSIRO
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