Pierre-Louis Lemaire

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Education

Polytechnique Montréal September 2023 - September 2025

Research M.Sc. in Applied Mathematics (GPA: 4.00 / 4.00) *Montréal, Canada*

- **Research work:** I implemented probabilistic deep learning models for climate downscaling to improve the prediction of precipitation extremes. I also introduced a novel hybrid approach combining deep learning and Extreme-Value-Theory to integrate the Clausius-Clapeyron relation into AI-based precipitation downscaling models.
- **Relevant coursework:** Machine Learning, Representation Learning, Causal Inference & ML, Climate Science

INSA Toulouse September 2019 - September 2025

Engineering Diploma in Applied Mathematics (BEng + MEng - GPA: 3.85/4.00) *Toulouse, France*

- **Double degree** program in partnership with Polytechnique Montréal.
- **Relevant coursework:** Statistical Modeling, Machine Learning, Data Analysis, Continuous Optimization, Non-Differential Optimization, Signal Processing, Advanced Probability, Markov Chains - Python, R & Git

Industry, Academic & Teaching Experience

Mila September 2025 – ongoing

Collaborating AI Researcher *Montréal, Canada*

- Working on ML-based precipitation downscaling models, with a focus on ensuring geographical transferability to provide accurate high-resolution forecasts in data-sparse regions.

Mila September 2024 – January 2025

Teaching Assistant, IFT6135 Representation Learning (54 students) *Montréal, Canada*

- I created and graded intensive theoretical and practical assignments on deep learning (CNN, UNet, GANs, diffusion models). I contributed to the final exam's questions bank on GANs and graded exams.
- I held 2 office hours per week to help students with assignments.
- I gave an introduction to Pytorch tutorial.

Acsystème June 2023 – August 2023

Optimization Engineer Intern *Rennes, France*

- I conducted a literature review on the 3D Knapsack problem, to design a combinatorial optimization algorithm for truck palletization.
- I designed and implemented a program in MATLAB that increased items by pallet by 40% while being 20x faster to compute.

Coolset June 2022 – August 2022

Data Analyst Intern *Amsterdam, Netherlands*

- I updated the emission factor database and automated data pipelines using web scraping.
- I improved by 45% the accuracy of the ML classifier of carbon emission factors for financial transactions.

Synergiz June 2020 – August 2020

Computer Vision Intern *Saint-Malo, France*

- I developed a C# program aiming to accelerate image labeling to train an Azure AI Custom Vision object detector for an agricultural application.
- I integrated the ML model into a Windows application with .NET.

Publications

1. Alipourhajiagha, M., **Pierre-Louis Lemaire**, Diouane, Y. & Carreau, J. *A Probabilistic U-Net Approach to Downscaling Climate Simulations.* in *AI4Science workshop @ NeurIPS* (Oct. 2025). PDF.
2. **Pierre-Louis Lemaire**. *Deep Learning for Precipitation Downscaling under Climate Change.* MSc thesis (Polytechnique Montréal, 2025). PDF.

Talks & Posters

AI for local-scale precipitation forecasting, [french] *IVADO Futurs Numériques*, October 2025.

🏆 **Special Mention** for Scientific Soundness. 🔗 Video recording.

Precipitation Downscaling under Climate Change using Deep Learning and Extreme Value Theory, *AI + Environment Zürich*, October 2025. 🔗 Virtual poster

Clausius-Clapeyron Informed Deep-Learning for Precipitation Forecasting Super-Resolution, [french] *92ème congrès de l'ACFAS*, May 2025. 🔗 Slides

Multivariate Downscaling over Southern Quebec using a Probabilistic UNet, *10th Ouranos Symposium*, January 2025. 🔗 Poster

Hackathons, Workshops & Summer Schools

NorESM user workshop January 2026
General introduction to the NorESM model system and the climate model data output. *Online*

Mil'Hack Fest - Mila **(Quandela's 1st place)** 2025
Predicting swaptions using Quantum Machine Learning via the Quandela Merlin library. *Montréal, Canada*

CodeML - PolyAI **(WINNER)** 2024
2 days to develop ML models for better flood modeling. *Montréal, Canada*

Climate Science Summer School **(Grade: A+)** May 2024
Summer school for graduate students working on climate science related projects. *Saint-Irénée, Canada*

Community Support

Encode AI Research Fellowship (Mentor) January - April 2026
Technical AI mentor for high-school and college students working on their first AI research project. *Montréal, Canada*

AMS 105th Annual Meeting January - 2025
Selected for the Student Assistant program (Scolarship) *New Orleans, USA*

Montréal AI Symposium SIAM October 2024
Volunteer *Montréal, Canada*

Other Projects

On the necessity of human insight to improve natural adversarial robustness 🔗 | *IFT-6168* grade: 97/100

- We investigated adversarial attacks from a causal perspective and reproduced a causally inspired adversarial training method with PyTorch.
- We proposed and implemented a style-free contrastive regularization method with PyTorch to improve natural adversarial robustness.
- We compared distribution alignment methods and vanilla learning with natural adversarial augmentations on natural adversarial robustness. We found that the proportion of natural adversarial samples per batch plays an important role in the model's robustness.

Data analysis of Paris bike-sharing service | *Python, Scikit-learn, R*

- I implemented (in Python and R) dimensionality reduction algorithms (PCA, LDA), clustering methods (kmeans, HAC, GMM) and advanced factorial methods (CA, MCA, MDS, NMF).
- I provided in-depth interpretation and analysis of the results of all the above methods.

Skills

Programming Languages: Python, R, Matlab, & SQL;

Machine Learning: Pytorch, Lightning, Jax, Scikit-Learn & Wandb;

Climate & Geoscience: Xarray, Dask, & Zarr; **Developer Toolbox:** Git, Poetry, SLURM.