

# Pierre-Louis Lemaire

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## EDUCATION

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### 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.
- **Course work:**
  - \* MTH-1115D - Differential Equations (grade: A)
  - \* MTH-6420 - Continuous Optimization (grade: A\*)
  - \* MTH-8107 - Mathematics of Deep Learning (grade: A\*)
  - \* MTH-8245E - Machine Learning (grade: A)
  - \* (MILA) IFT-6135 - Representation Learning (grade: A+)
  - \* (MILA) IFT-6168 - Causal Inference & ML (grade: A+)
  - \* (ETS) TSMGC921 - Climate Science Summer School (grade: A+)

### INSA Toulouse

September 2019 - September 2025

*Engineering Diploma in Applied Mathematics (BEng + MEng)*

*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

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### Mila

September 2025 – March 2025

*Research Intern*

*Montréal, Canada*

- I am now working on using deep-learning models for precipitation downscaling to km-scale, 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

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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**. *Apprentissage Profond pour la Réduction d'Échelle des Précipitations en Changements Climatiques*. MSc thesis (Polytechnique Montréal, 2025). PDF.

## TALKS & POSTERS

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**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

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### Mil'Hack Fest - Mila

*Predicting swaptions using Quantum Machine Learning via the Quandela Merlin library.*

**Quandela's 1st place 2025**

*Montréal, Canada*

### CodeML - PolyAI

*2 days to develop ML models for better flood modeling.*

**WINNER 2024**

*Montréal, Canada*

## COMMUNITY SUPPORT

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### AMS 105th Annual Meeting

*Selected for the Student Assistant program (Scholarship)*

January - 2025

*New Orleans, USA*

### Montréal AI Symposium SIAM

*Volunteer*

October 2024

*Montréal, Canada*

## OTHER PROJECTS

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**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

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

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

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

## REFERENCES

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**David Rolnick**

*Research internship co-supervisor — drolnick@mila.quebec*

Assistant Professor & CIFAR AI Chair

*McGill University, Mila*

**Alex Hernandez-Garcia**

*Research internship co-supervisor — alex.hernandez-garcia@mila.quebec*

Assistant Professor

*Université de Montréal, Mila*

**Julie Carreau**

*MSc main supervisor — julie.carreau@polymtl.ca*

Assistant Professor

*Polytechnique Montréal, Mila*