

# Tom Beucler

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CV last updated on September 25, 2022

## Research Interests

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Atmospheric Physics, Climate Informatics, Deep Learning, Environmental Fluid Dynamics, Tropical Meteorology.

## Education

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### MIT Program in Atmospheres, Oceans, and Climate

2014 – 2019

*Ph.D. in Atmospheric Science: Interaction between Water Vapor, Radiation and Convection*

Cambridge, USA

Thesis committee: K. Emanuel (co-advisor), T. Cronin (co-advisor), P. O’Gorman, Z. Kuang, C. Bretherton.

### École Polytechnique

2013 – 2014

*Master of Science in Mechanics*

Palaiseau, France

Major in fluid dynamics and environmental science.

### École Polytechnique & Lycée Sainte-Geneviève

2009 – 2013

*Bachelor of Engineering*

Versailles & Palaiseau, France

Coursework in mechanics, physics, mathematics, chemistry and biology.

## Academic Employment

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### University of Lausanne, Switzerland

2021 – Present

*Assistant Professor of Environmental Data Science*

Lausanne, Switzerland

### University of California, Irvine

2019 – 2021

*Assistant Project Scientist in Atmospheric Science: Machine Learning for Climate Science*

Irvine, USA

Principal investigators: M. Pritchard and P. Gentine.

### University of California, Irvine and Columbia University

2019

*Postdoctoral Scholar in Atmospheric Science: Deep Learning for Convection and Clouds*

Irvine & NYC, USA

Co-advisors: P. Gentine and M. Pritchard.

## Awards

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- (2021-Present) **Principal Investigator, Canton de Vaud funding for IDYST professors:**  $\partial^3$ AWN Lab at IDYST. Estimated value of awarded resources: \$120,000/year (2 PhD students)
- (2021–Present) **Visiting scholar**, Earth System Science Department, UCI
- (2019–Present) **Visiting scholar**, Scripps Institution of Oceanography, UCSD
- (2022) **AGU 2021 Editor’s citation for excellence in refereeing**, Geophysical Research Letters
- (2021) **Invited Participant**, KITP Program on Machine Learning and the Physics of Climate at UCSB
- (2021) **AGU 2020 Editor’s citation for excellence in refereeing**, Journal of Advances in Modeling Earth Systems
- (2020-2021) **Principal Investigator, Columbia University subaward:** *Physics-Guided Deep Learning for Climate Predictions*. Estimated value of awarded resources: \$51,986
- (2020-2021) **Co-Investigator, XSEDE computational resources allocation:** *Simulating global climate with turbulence-permitting cloud superparameterization to train machine learning emulators and advance understanding of aerosol-cloud feedbacks*. Lead PI: Mike Pritchard. Estimated value of awarded resources: \$2,025,427
- (2019) **Rossby award for best doctoral thesis**, Program in Atmospheres, Oceans and Climate, MIT
- (2019) **Invited scholar**, Max Planck Institute for Meteorology
- (2019) **Summer fellow**, 2nd ICTP Summer School on Climate Dynamics and Convective Organization
- (2018) **Finalist of the “Climate Changed” @ MIT competition**, *Higher Grounds* at MIT
- (2018) **AGU 2017 Editor’s citation for excellence in refereeing**, Geophysical Research Letters
- (2018) **Best poster prize (Water & Society)**, *Preparing MIT for 2050 Floodwaters* at the MIT Water Night
- (2018) **Graduate research fellow**, Program on Math. and Stat. Methods for Climate & the Earth System at SIAM Institute
- (2017) **Summer fellow**, Les Houches Summer School on Fundamental Aspects of Turbulent Flows in Climate Dynamics
- (2015) **Geophysical fluid dynamics fellow**, Woods Hole Oceanographic Institution
- (2014-2015) **Rasmussen fellow**, MIT Department of Earth, Atmospheric and Planetary Sciences
- (2014) **Outstanding Masters thesis**, École Polytechnique

## Peer-Reviewed Journal Publications and Book Chapters

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- (2022) *Submitted, Preprint available*, Mooers, G., M. Pritchard, **T. Beucler** et al.: Comparing Storm Resolving Models and Climates via Unsupervised Machine Learning, *arXiv:2208.11843*.
- (2022) *Submitted, Preprint available*, Grundner, A., **T. Beucler** et al.: Deep Learning Based Cloud Cover Parameterization for ICON, *arXiv:2112.11317*.
- (2022) *Submitted, Preprint available*, **Beucler, T.** et al.: Climate-Invariant Machine Learning, *arXiv:2112.08440*.
- (2022) *In press, Preprint available*, **Beucler, T.** et al.: Machine Learning for Clouds and Climate (Invited Chapter for the AGU Geophysical Monograph Series: *Clouds and Climate*).
- (2022) Behrens, G., **T. Beucler** et al.: Non-Linear Dimensionality Reduction with a Variational Encoder Decoder to Understand Convective Processes in Climate Models. *Journal of Advances in Modeling Earth Systems*, e2022MS003130.
- (2021) Gentine, P., V. Eyring & **T. Beucler**: Deep Learning for the Parametrisation of Subgrid Processes in Climate Models, *Deep learning for the Earth Sciences: With Applications and R, Second Edition*, **307-314**.
- (2021) Griffin, M., M. Pritchard, **T. Beucler** et al.: Assessing the Potential of Deep Learning for Emulating Cloud Superparameterization in Climate Models with Real-Geography Boundary Conditions. *Journal of Advances in Modeling Earth Systems*, **13**, e2020MS002385.
- (2021) **Beucler, T.** et al.: Enforcing Analytic Constraints in Neural-Networks Emulating Physical Systems, *Physical Review Letters*, **126.9**: 098302. **Editors' Suggestion**.
- (2020) Brenowitz, N., **T. Beucler**, M. Pritchard & C. Bretherton: Interpreting and Stabilizing Machine-Learning Parametrizations of Convection, *Journal of the Atmospheric Sciences*, **77.12**, 4357-4375.
- (2020) **Beucler, T.**, D. Leutwyler & J. Windmiller: Quantifying Convective Aggregation Using the Tropical Moist Margin's Length, *Journal of Advances in Modeling Earth Systems*, **12.10**, e2020MS002092.
- (2020) Abbott, T., T. Cronin & **T. Beucler**: Convective Dynamics and the Response of Precipitation Extremes to Warming in Radiative–Convective Equilibrium, *Journal of the Atmospheric Sciences*, **77**, 1637-1660.
- (2019) **Beucler, T.**, T. Abbott, T. Cronin & M. Pritchard: Comparing Convective Self-Aggregation in Idealized Models to Observed Moist Static Energy Variability Near the Equator, *Geophysical Research Letters*, **46**, 17-18.
- (2019) **Beucler, T.**: Interaction between Water Vapor, Radiation and Convection in the Tropics, *Ph.D. Thesis in Atmospheric Science*.
- (2018) **Beucler, T.** & T. Cronin: A Budget for the Size of Convective Self-Aggregation, *Quarterly Journal of the Royal Meteorological Society*, **145**, 947–966.
- (2018) **Beucler, T.**, T. Cronin & K. Emanuel: A Linear Response Framework for Radiative–Convective Instability, *Journal of Advances in Modeling Earth Systems*, **10**, 1924-1951.
- (2016) **Beucler, T.** & T. Cronin: Moisture-Radiative Cooling Instability, *Journal of Advances in Modeling Earth Systems*, **8**, 1620–1640.
- (2016) **Beucler, T.**: A Correlated Stochastic Model for the Large-Scale Advection, Condensation and Diffusion of Water Vapour. *Quarterly Journal of the Royal Meteorological Society*, **142**, 1721–1731.
- (2014) **Beucler, T.** & K. Emanuel: Self-Aggregation Phenomenon in Cyclogenesis, *Masters Thesis in Fluid Mechanics*.

## Peer-Reviewed Conference and Workshop Publications

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- (2022) *In press*, Wu, Z., **T. Beucler** et al.: Modeling Stratospheric Polar Vortex Variation and Identifying Vortex Extremes Using Explainable Neural Networks. *Proceedings of the 11th International Conference on Climate Informatics, Environmental Data Science*.
- (2021) Mangipudi, H., G. Mooers, M. Pritchard, **T. Beucler** & S. Mandt: Analyzing High-Resolution Clouds and Convection using Multi-Channel VAEs. *2021 Conference on Neural Information Processing Systems (Workshop)*.
- (2020) **Beucler, T.** et al.: Towards Physically-Consistent, Data-Driven Models of Convection. *IEEE International Geoscience and Remote Sensing Symposium 2020*.
- (2020) Mooers, G., J. Tuyls, S. Mandt, M. Pritchard & **T. Beucler**: Generative Modeling of Atmospheric Convection. *Proceedings of the 10th International Conference on Climate Informatics*, 98-105.
- (2019) **Beucler, T.** et al.: Achieving Conservation of Energy in Neural Network Emulators for Climate Modeling. *2019 International Conference on Machine Learning (Workshop)*.

## Conference Presentations and Invited Seminars

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- AMS 23rd Conference on AOFD, Royal Met. Soc. ML Workshop** Jun 2022–Present  
*Presentation: Systematically Generating Climate Model Hierarchies from Data using ML*  
Upcoming: IMSI, Machine Learning for Climate and Weather Applications  
Breckenridge, USA
- ELLIS & AGCI Workshops on Machine Learning and Climate Science** May 2022–Jun 2022  
*Invited Presentation: Climate-Invariant Machine Learning*  
Valencia, Spain & Aspen, USA
- 102nd AMS Annual Meeting; Postdam Institute for Climate Impact Research** Jan 2022–Present  
*Invited Presentation: Physically and Causally-Informed Neural Networks*  
Remote & Vienna, Austria  
Also given at the:
- 11th Climate Informatics Conference, EGU22, IPSL LSCE, UNIL ML Café
  - ECMWF Machine Learning Workshop 2022
- NCAR Climate & Global Dynamics; ESA-ECMWF Workshop 2021** May 2021–Present  
*Invited Seminar: Atmospheric Physics-Guided Machine Learning*  
Remote, Europe & USA  
Also given at:
- EPFL ENAC; Uni Bern Colloquium in Climatology, Climate Impacts & Remote Sensing
  - CSU/CIRA; ENS Lyon IXI; AI Super-Resolution Simulations Workshop (CMU)
  - LANL Machine Learning in Solid Earth Geoscience Lecture Series
  - MIT Sack Lunch; Princeton PPPL Machine Learning Seminar Series
  - MeteoSwiss; UCLA Atmospheric & Oceanic Sciences Departmental Seminar Series
  - Caltech CliMA; EPFL Applied Machine Learning days 2022
- AI2ES NCAR Summer School on Trustworthy AI** July 2021  
*Invited Tutorial: Integrating Physics into Machine Learning*  
Remote
- SIAM MPE20 & 101st AMS Annual Meeting** Aug 2020–Jan 2021  
*Invited Presentations: Physical Rescalings Help Neural Networks Generalize Across Climates*  
Remote  
Also given as a poster at the AGU Fall Meeting 2020
- IEEE International Geoscience and Remote Sensing Symposium 2020** Apr 2020–Dec 2020  
*Invited Webinar/Paper: Towards Physically-Consistent, Data-Driven Models of Convection*  
Remote  
Also given at:
- NOAA Satellite Applications and Research Seminar Series
  - 1st Annual Workshop on Knowledge-Guided Machine Learning (UMN)
  - UCSD SIO Machine Learners Group Meeting & UCI Earth System Science Departmental Seminar Series
- AGU Fall Meeting 2019 & 100th AMS Annual Meeting** Dec 2019–Jan 2020  
*Invited Presentation: Building a Hierarchy of Hybrid, Neural Network Models of Convection*  
SF & Boston, USA
- AGU Fall Meeting 2019 & 100th AMS Annual Meeting** Dec 2019–Jan 2020  
*Poster & Presentation: Comparing Self-Aggregation in Models to Observed MSE Variability*  
SF & Boston, USA
- UCLA Atmospheric & Oceanic Sciences, UCI Earth System Science Departmental Seminar Series** Aug 2018–Jul 2019  
*Invited Seminars: Interaction between Water Vapor, Radiation and Convection in the Tropics*  
USA, France & Germany  
Also given at:
- MIT Sack Lunch Seminar; Yale Earth & Planetary Science
  - ENS Paris Geosciences; LMU Munich Meteorology; MPI-Meteorology
- International Conference on Machine Learning 2019. Climate Change: How Can AI Help?** Jun 2019  
*Workshop Paper: Achieving Conservation of Energy in Neural Network Emulators for Climate Modeling*  
Long Beach, USA
- 9th Northeast Tropical Workshop** Jun 2019  
*Presentation: Towards Interpretable Neural-Network Parametrizations of Convection*  
Dedham, USA
- 33rd Conference on Hurricanes and Tropical Meteorology** Apr 2018  
*Presentation: A Spectral Budget for the Size of Convective Self-Aggregation*  
Ponte Vedra, USA
- Seminar in Geosciences, Université Pierre et Marie Curie** Dec 2017  
*Invited Seminar: A Spectral Budget for the Size of Convective Self-Aggregation*  
Paris, France
- 17th Conference on Mesoscale Processes** Jul 2017  
*Presentation: A Moist Static Energy Perspective on Atmospheric Rivers*  
San Diego, USA
- 21st Conference on Atmospheric and Oceanic Fluid Dynamics** Jun 2017  
*Presentation: The Vertical Structure of Radiative-Convective Instability*  
Portland, USA
- Seminar in Geosciences, École Normale Supérieure** Jan 2017  
*Invited Seminar: Radiative-Convective Instability*  
Paris, France

**2016 International Atmospheric Rivers Conference - CW3E, Scripps institution of oceanography***Presentation: A Moist Static Energy Perspective on Atmospheric Rivers***Aug 2016**

La Jolla, USA

**32nd Conference on Hurricanes and Tropical Meteorology***Presentation: Instabilities of Radiative Convective Equilibrium with an Interactive Surface***Apr 2016**

San Juan, USA

## Formal Mentoring Experience

**Direct Research Supervision (PhD students & Postdocs)**

- o (Aug 2021 – Present) Milton Gomez (PhD student at UNIL)
- o (Aug 2021 – Present) Saranya Ganesh Sudheesh (Postdoctoral scholar at UNIL)
- o (Sep 2021 – Present) Frederick Iat-Hin Tam (PhD student at UNIL)

**Aug 2021 – Present**  
Lausanne, Switzerland**Technical Advising (Weekly to Biweekly Mentoring of Early-Career Scientists)**

- o (Sep 2022 – Present) Jingyan Yu (Postdoctoral fellow at UNIL)
- o (Feb 2022 – Present) Francesco Zanetta (PhD student at ETH/MeteoSwiss, Visiting student at UNIL)
- o (Sep 2021 – Present) Costa Christopoulos (PhD student at Caltech)
- o (Jan 2020 – Present) Arthur Grundner (PhD student at the German Aerospace Center)
- o (Jul 2019 – Present) Gunnar Behrens (PhD student at the German Aerospace Center)
- o (Apr 2019 – Present) Griffin Mooers (PhD student at UC Irvine)
- o (Dec 2019 – Jul 2021) Andrea Jenney (Postdoctoral fellow at UC Irvine)

**Jul 2019 – Present**  
Europe & USA**PhD Thesis Committee Member**

- o (Jan 2022 – Present) Costa Christopoulos (Caltech)
- o (Sep 2021 – Present) Janbert Aarnink (UNIL)
- o (Jan 2020 – Present) Griffin Mooers (UC Irvine)
- o (Oct 2022) Blanka Balogh (CNRM, Toulouse, only on final evaluation committee)
- o (Sep 2022) Ségolène Crossouard (IPSL, only on final evaluation committee)
- o (May 2022 – Aug 2022) Léo Micollet (Masters intern at UNIL)

**Jan 2020 – Present**  
Europe & USA**Direct Research Supervision (Bachelor & Master students)**

- o (Aug 2022 – Present) Nils Chabloz (Bachelor student at UNIL)
- o (Mar 2022 – Jul 2022) Deborah Bassotto (Post Masters intern at UNIL)
- o (Sep 2021 – Jun 2022) Meryam Cherqaoui (Bachelor student at UNIL)
- o (Jul 2020 – Dec 2020) Ankitesh Gupta (Masters student at UC Irvine)

**Jul 2020 – Present**  
Europe & USA

## Teaching Experience

**FGSE, University of Lausanne***Main Instructor of "Introduction to Scientific Programming with Python" (2 ECTS, ≈50 students)*

Design and delivery of yearly 4-week course open to all Masters and PhD students in Earth/env. sci. &amp; geography.

**Sep 2022 – Present**  
Lausanne, Switzerland**FGSE, University of Lausanne***Main Instructor of "Géomatique et Systèmes d'Information Géographique" (3 ECTS, ≈100 students)*

Design and delivery of yearly 12-week course open to all Bachelor students in Earth/env. sci. &amp; geography.

**Sep 2022 – Present**  
Lausanne, Switzerland**FGSE, University of Lausanne (2 occurrences)***Main Instructor of "Machine Learning for Earth and Environmental Sciences" (5 ECTS, ≈20 students)*

Design and delivery of yearly 8-week course open to all Masters and PhD students in Earth/env. sci. &amp; geography.

**Jan 2022 – Present**  
Lausanne, Switzerland**European Centre for Medium-Range Weather Forecasts***Consultant, Reviewer, and Content Provider of "Machine Learning for Weather and Climate"*

6-Week Massive Open Online Course targeted at anyone interested in both ML and weather/climate.

**Mar 2022 – Present**  
Remote**MIT Teaching and Learning Laboratory***Kaufman teaching certificate program*

Program for MIT graduate students aimed at improving teaching skills.

**Feb 2017 – May 2017**  
Cambridge, USA**PAOC, MIT***Teaching Assistant in 12.801, The General Circulation of the Ocean*

Prof. Raffaele Ferrari.

**Feb 2016 – May 2016**  
Cambridge, USA**PAOC, MIT***Teaching Assistant in 12.815, Atmospheric Radiation and Convection*

Prof. Sara Seager and Prof. Kerry Emanuel.

**Sep 2015 – Dec 2015**  
Cambridge, USA**Lycée Sainte-Geneviève***Teaching Assistant in physics*

Undergraduate level: waves, electromagnetism, optics, newtonian, solid and fluid mechanics.

**Sep 2012 – Mar 2014**  
Versailles, France



## Service

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### Reviewer for Journals and Workshops (32 submissions, 50 rounds)

AGU Books, GMD, GRL, JAMES, JAS, JCLI, JGR, JHM, MWR, NeurIPS, PNAS, QJRM

Nov 2016 – Present  
USA & Europe

### Reviewer for Proposals (6 submissions)

American National Science Foundation, Belgian Science Policy Office, CLIMACT, Climate Change AI

Sep 2020 – Present  
USA & Europe

### Hiring committees at UNIL

Computational Geoscientist (IDYST/ISTE)

Jul 2022 – Present  
Lausanne, Switzerland

### Atmospheric Science Day in Lausanne

Founder and co-organizer of the annual one-day workshop bringing together EPFL & UNIL groups

May 2022 – Present  
Lausanne, Switzerland

### Swiss Geocomputing Centre

Scientific Committee Member

Mar 2022 – Present  
Lausanne, Switzerland

### 20th Edition of the Swiss Geoscience Meeting

Co-chair of the session: Spatial Data Science

Feb 2022 – Present  
Lausanne, Switzerland

### UNIL Climate Physics Journal Club

Co-founder and faculty support for student-driven seminar series

Dec 2021 – Present  
Lausanne, Switzerland

### AMS 21st Conference on AI for Environmental Science

Co-chair of the session: Applications of AI for Improved Estimation and Prediction of Weather and Climate

Apr 2021 – Jan 2022  
Houston, USA

### CLIVAR Webinar: Emerging Data Science Tools for Climate Variability & Predictability

Invited Working Group Member: Co-organizer and moderator of the webinar

May 2020 – July 2021  
USA

### NeurIPS 2020 Workshop: AI for Earth Sciences

Co-organizer: Meta-reviewer and organizer of the atmospheric science session

Jun 2020 – Dec 2020  
Vancouver, Canada

### Editor-in-Chief Search Committee for JAMES (AGU)

Committee Member

Apr 2020 – Sep 2020  
USA

### MIT Office of Sustainability

Graduate research assistant in the Climate Resiliency Committee

Feb 2018 – Dec 2018  
Cambridge, USA

### Student and Post-doc Atmospheric Dynamics Lunch

Head of the organizing committee and founding member

Sep 2016 – May 2018  
Cambridge, USA

### EAPS Graduate Student Advisory Council

Secretary

Sep 2016 – May 2018  
Cambridge, USA

### Program in Atmospheres, Oceans and Climate Colloquium Series

Head of the organizing committee and founding member

Sep 2016 – Dec 2017  
Cambridge, USA

### Program in Atmospheres, Oceans, and Climate 2015 and 2016 Retreats

Co-organized 2015/2016 PAOC retreats for the professors, post-docs and students of the program

Jan 2015 – Oct 2016  
Hancock and Brewster, USA

### EAPS Social Hour

Organized the daily informal social gathering of the EAPS staff

Dec 2015 – Apr 2016  
Cambridge, USA

### Graduate Climate Conference 2015

Member of the organizational committee of the 2015 Graduate Climate Conference

Jan 2015 – Nov 2015  
Woods Hole, USA

## Non-Academic Professional Experience

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### Cronite Castings Limited

Maintenance engineer

Engineering and operator internship in the Crewkerne foundry.

Jul 2013 – Aug 2013  
Crewkerne, UK

### French Air Force

Lieutenant

Leadership training as part of the engineering school's curriculum.

Sep 2011 – Apr 2012  
Cazaux, France

## Computer Skills

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**OS:** Linux, Unix, Windows

**Programming:** Python (incl. TensorFlow, Keras, xarray), Matlab, Fortran 77/90, VBA, Java

## Language Skills

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**Native:** French, **Fluent:** English, **Intermediate:** Spanish, German, **Beginner:** Japanese (N5), Esperanto

## Interests

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Weather Forecasting, Weightlifting, Swimming, Jogging, Trombone, Video Games, Recently rescued two feral kittens (photo).