Tom Beucler

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Research Interests

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

Education

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, T. Cronin, 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

University of California, Irvine **2019 – Present**
Assistant Project Scientist in Atmospheric Science: Machine Learning for Climate Science *Irvine, CA*
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.

Peer-reviewed Journal Publications and Book Chapters

- (2021) *In prep.*, **Beucler, T.** et al.: Climate-Invariant Machine Learning.
- (2021) *In prep.*, **Beucler, T.** et al.: Reliable Ensemble Streamflow Forecasts Improve Flood Risk Analysis & Water Management.
- (2021) *Under review*, 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.
- (2021) *In press*, **Beucler, T.** et al.: Machine Learning for Clouds and Climate (Invited Chapter for the AGU Geophysical Monograph Series: *Clouds and Climate*).
- (2021) *In press*, Gentine, P., V. Eyring & **T. Beucler**: Deep Learning for the Parametrisation of Subgrid Processes in Climate Models (Invited Chapter for *Deep Learning for the Earth Sciences*, Wiley & Sons. Second).
- (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.*

Formal Mentoring Experience

Direct Research Supervision — **Apr 2019 – Present**
G. Mooers (Ph.D. Student at UCI): Weekly Research Meetings and Thesis Committee Member — *Irvine, USA*

Technical Advising — **Jul 2019 – Present**
A. Jenney (Postdoctoral Fellow at UCI); G. Behrens, A. Grundner (Ph.D. Students at DLR) — *USA & Germany*

Conference Presentations and Invited Seminars

AGCI Workshop on Machine Learning and Climate Science — **Sep 2021**
Invited Workshop Paper in the Category: Cross-cutting Challenges for ML Method Development — *Aspen, USA*

SIAM MPE20, AGU Fall Meeting 2020 & 101st AMS Annual Meeting — **Aug 2020–Jan 2021**
Invited Presentation & Poster: Physical Rescalings Help Neural Networks Generalize Across Climates — *Remote*

IEEE IGARSS 2020, NOAA AI, UMN KGML, USMILE, SIO ML, UCI, UNIL — **Apr 2020–Dec 2020**
Invited Weminar/Paper: Towards Physically-Consistent, Data-Driven Models of Convection — *Remote*

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, UCI, MIT, Yale, ENS Paris, LMU Munich, MPI-M — **Aug 2018–Jul 2019**
Invited Seminar: Interaction between Water Vapor, Radiation and Convection in the Tropics — *USA, France & Germany*

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 — **Aug 2016**
Presentation: A Moist Static Energy Perspective on Atmospheric Rivers — *La Jolla, USA*

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

Fellowships and Awards

- (2021-2022) **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.
- (2019–2021) **Visiting scholar,** Scripps Institution of Oceanography, UCSD
- (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 master's thesis**, École Polytechnique

Service

Reviewer for Journals and Workshops (27 submissions, 39 rounds) — **Nov 2016 – Present**
AGU Books, GRL, JAMES, JAS, JCLI, JGR, JHM, MWR, NeurIPS, PNAS, QJRMS — *USA & Europe*

Reviewer for Proposals — **Sep 2020 – Present**
National Science Foundation — *USA*

CLIVAR Webinar: Emerging Data Science Tools for Climate Variability & Predictability — **May 2020 – July 2021**
Invited Working Group Member: Co-organizer and moderator of the webinar — *USA*

NeurIPS 2020 Workshop: AI for Earth Sciences — **Jun 2020 – Dec 2020**
Co-organizer: Meta-reviewer and organizer of the atmospheric science session — *Vancouver, Canada*

Editor-in-Chief Search Committee for JAMES (AGU) — **Apr 2020 – Sep 2020**
Committee Member — *USA*

MIT Office of Sustainability — **Feb 2018 – Dec 2018**
Graduate research assistant in the Climate Resiliency Committee — *Cambridge, USA*

Student and Post-doc Atmospheric Dynamics Lunch — **Sep 2016 – May 2018**
Head of the organizing committee and founding member — *Cambridge, USA*

EAPS Graduate Student Advisory Council — **Sep 2016 – May 2018**
Secretary — *Cambridge, USA*

Program in Atmospheres, Oceans and Climate Colloquium Series — **Sep 2016 – Dec 2017**
Head of the organizing committee and founding member — *Cambridge, USA*

Program in Atmospheres, Oceans, and Climate 2015 and 2016 Retreats — **Jan 2015 – Oct 2016**
Co-organized 2015/2016 PAOC retreats for the professors, post-docs and students of the program — *Hancock and Brewster, USA*

EAPS Social Hour — **Dec 2015 – Apr 2016**
Organized the daily informal social gathering of the EAPS staff — *Cambridge, USA*

Graduate Climate Conference 2015 — **Jan 2015 – Nov 2015**
Member of the organizational committee of the 2015 Graduate Climate Conference — *Woods Hole, USA*

Teaching Experience

MIT Teaching and Learning Laboratory — **Feb 2017 – May 2017**
Kaufman teaching certificate program — *Cambridge, USA*
Program for MIT graduate students aimed at improving teaching skills.

PAOC, MIT — **Feb 2016 – May 2016**
Teaching Assistant in 12.801, The General Circulation of the Ocean — *Cambridge, USA*
Prof. Raffaele Ferrari.

PAOC, MIT — **Sep 2016 – Dec 2016**
Teaching Assistant in 12.815, Atmospheric Radiation and Convection — *Cambridge, USA*
Prof. Sara Seager and Prof. Kerry Emanuel.

Lycée Sainte-Geneviève — **Sep 2012 – Mar 2014**
Teaching Assistant in physics — *Versailles, France*
Undergraduate level: waves, electromagnetism, optics, newtonian, solid and fluid mechanics.

Professional Experience

Cronite Castings Limited — **Jul 2013 – Aug 2013**
Maintenance engineer — *Crewkerne, UK*
Engineering and operator internship in the Crewkerne foundry.

French Air Force — **Sep 2011 – Apr 2012**
Lieutenant — *Cazaux, France*
Leadership training as part of the engineering school's curriculum.

Computer Skills

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

Language Skills

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

Interests

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