

Marie C. McGraw, Ph.D.

Cooperative Institute for Research in the Atmosphere
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Experience

- 07/2021 - present **Cooperative Institute for Research in the Atmosphere**
Postdoctoral Research Scientist (2021-221) and Research Scientist I (2022-present)
–Analyzed tropical cyclone structure and evolution in AI-generated satellite imagery as part of an AI for science discovery effort (publication forthcoming).
–Developed and improved AI models for tropical cyclone forecasting based on existing products at NOAA and the National Hurricane Center. Projects include using neural networks to reduce forecast errors, extending tropical cyclogenesis forecasts to 5-7 days with gradient boosting, and AI predictions of rapid intensification.
–Worked with colleagues at the NSF AI Institute for Earth Sciences on foundational work for AI in the geosciences, including peer-reviewed publications on uncertainty quantification for neural network models in earth sciences, and identifying and categorizing biases in AI models for Earth sciences.
–Developed educational Jupyter notebooks for AI in the geosciences for the NOAA Center for Artificial Intelligence. I have also acted as an instructor for a trustworthy AI summer school and hackathon, and as a mentor for ClimateChangeAI, where my team was awarded with a spotlight presentation at a 2022 NeurIPS Workshop.
- 01-03/2023 **University of Lausanne, Lausanne, Switzerland**
Visiting Researcher in the Data-Driven Atmospheric and Water Dynamics Group
–Prototyped a climate-invariant machine learning model for tropical cyclone intensity.
–Worked with students and postdocs on projects related to AI and tropical meteorology, including causally-informed feature selection for tropical cyclone forecasting (publication forthcoming) and developing a tropical cyclone benchmarking dataset (to be submitted to NeurIPS 2025).
- 06/2019 - 06/2021 **University of Washington**
Postdoctoral Researcher, Department of Atmospheric Science
–Quantified predictability of extreme sea ice loss events on subseasonal timescales, leading to one publication.
- 06/2013 - 05/2019 **Colorado State University**
Graduate Research Assistant, Department of Atmospheric Science
–Used causal inference and statistical modeling to study extratropical weather and climate dynamics and variability, leading to two publications.
–Used climate model data, including CMIP5, to study a variety of climate variability phenomena such as polar moisture transport, the climate response to volcanic forcing, and seasonality of jet variability, leading to 4 publications in total.

Education

- 10/2015 - 03/2019 **Ph.D., Atmospheric Science**, Colorado State University, Fort Collins, CO, USA.
- 06/2013 - 10/2015 **M.S., Atmospheric Science**, Colorado State University, Fort Collins, CO, USA
- 09/2008 - 06/2012 **B.Sc., Mechanical and Ocean Engineering**, Massachusetts Institute of Technology, Cambridge, MA, USA

Selected Publications (15 total)

6. Fernandez, M., E.A. Barnes, R.J. Barnes, M. DeMaria, **M. McGraw**, G. Chirokova, L. Lu: Predicting tropical cyclone track forecast errors using a probabilistic neural network. Accepted 02/2025 for publication in *Artificial Intelligence in the Earth Systems*.
5. V. Eyring, W.D. Collins, and coauthors (inc. **M. McGraw**) (2024): Pushing the Frontiers in Climate Modeling and Analysis with Machine Learning. *Nature Climate Change*, **14**, 916-928, <https://doi.org/10.1038/s41558-024-02095-y>.
4. McGovern, A., A. Bostrom, **M. McGraw**, R.J. Chase, D.J. Gagne II, I. Ebert-Uphoff, K. Musgrave, and A. Schumacher (2024): Identifying and Categorizing Bias in AI/ML for Earth Sciences, *Bull. Amer. Meteorol. Soc.*, **105**, <https://doi.org/10.1175/BAMS-D-23-0196.1>.
3. Haynes, K., R. Lagerquist, **M. McGraw**, K. Musgrave, and I. Ebert-Uphoff (2023): Creating and evaluating uncertainty estimates with neural networks for environmental-science applications. *Artificial Intelligence for Earth Systems*, **1**, <https://doi.org/10.1175/AIES-D-22-0061.1>.
2. **McGraw, M.C.** and E.A. Barnes (2020): New Insights on Subseasonal Arctic-Midlatitude Causal Connections from a Regularized Regression Model. *Journal of Climate*, doi:10.1175/JCLI-D-19-0142.1.
1. **McGraw, M.C.**, and E.A. Barnes (2018): Memory matters: A case for Granger causality in climate variability studies. *J. Climate*, **31**, doi:10.1175/JCLI-D-17-0334.1.

Skills

Datasets: Highly experienced with complex geospatial datasets, including climate model output such as CMIP5/6, forecasts from numerical and AI weather prediction models, reanalysis, and satellite data

Programming: Python, including data science and machine learning tools (Pandas, xArray, scikit-learn, Tensorflow, Keras, and pyTorch), parallelization tools like Dask and joblib, and visualization libraries like Matplotlib, seaborn, and plotly

Modeling and Data Science: extreme event analysis, probabilistic models, causal inference and Bayesian modeling, and geospatial statistics.

Software: git, Linux, Docker

Awards and Invited Presentations

Invited Seminar, ITU “AI for Good” Seminar Series, 03/2023. *AI for Tropical Meteorology: Challenges and Opportunities*. T. Beucler and **M.C. McGraw**.

Visiting Researcher, Université de Lausanne, 01-03/2023. Received a travel award to visit UNIL as a Visiting Researcher.

Invited Speaker, Aspen Global Change Institute Workshop on Earth System Modeling with Machine Learning and Big Data, 06/2022. *Causality and Interpretability*. **McGraw, M.C.**, and I. Ebert-Uphoff.

Spotlight Presentation, Tackling Climate Change with Machine Learning Workshop, NeurIPS 2022, 12/2022. *Statistical adjustment of decadal climate predictions using deep learning*. Sospreda-Alfonso, R., Exenberger, J., Dang, K., and **M.C. McGraw**.