

# Trevor Harris, PhD

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Statistics and machine learning researcher developing probabilistic models and uncertainty quantification methods for spatiotemporal data, with applications in climate, weather, and infectious disease.

## Selected Research Projects

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### Conformal prediction and generative calibration

- Showed that differentiable conformal scores define [analytic sampling flows](#). Mixing confidence levels yields calibrated predictive distributions and rare-event samples without training a separate generative model (NeurIPS 2026, accepted).
- Calibrated predictions for precipitation downscaling and climate debiasing with conformal predictive distributions. Reduced error in local spatial variability (MMD) by 75–78% versus the best of six neural baselines.
- Designed locally adaptive conformal inference for neural operators. Obtained 20% narrower bands than the functional conformal baseline with 92% functional coverage (90% target) on global ERA5 temperature forecasting with Fourier Neural Operators.
- Developed minimum distortion calibration via constrained optimal transport. Reduced raw deep ensemble calibration error by 91% and feature space energy score by 27% for shallow water forecasts.

### Climate model integration, evaluation, and calibration

- Developed [neural network Gaussian process regression](#) to assimilate climate model output with observations. Reduced global temperature MSE by 58% versus ensemble averaging on held-out ERA5 data from 2015–2021.
- Co-developed [spherical convolutional Wasserstein distance](#) (SCWD) to detect regional distributional biases in global climate models. Evaluated 79 climate models on 2 TB of raw climate data and released SCWD in PyTorch (NeurIPS 2024 spotlight).
- Introduced [conformal ensembles](#) to calibrate climate projections against observations. Reduced average sliced Wasserstein error by 29–38% versus uncalibrated climate ensembles in tests on withheld models through 2099.

### Graph neural networks for West Nile virus forecasting

- Co-designed [GraphSAGE networks](#) to forecast West Nile virus one week ahead. Achieved ROC AUC 0.844 versus 0.775 for XGBoost, the strongest tested baseline (GeoHealth, 2024).
- Co-developed [GraphMAGE](#) with skip connections from inputs to hidden layers to limit oversmoothing in deep GNNs. Improved mean F1 by 32% over GraphSAGE across eight forecast horizons (arXiv, 2025).
- Integrated 133,867 surveillance records, daily 4km weather, and 30m land cover data. Achieved the highest F1 among tested models on unseen urban and rural trap networks.

## Technical Skills

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**Languages and frameworks.** Python (PyTorch, JAX), R, SQL.

**Methods.** Conformal inference, graph neural networks, neural operators, generative modeling, optimal transport, Gaussian processes, spatiotemporal statistics.

**Scientific data.** ERA5, WeatherBench2, CMIP6, paleoclimate reconstructions, mosquito surveillance.

## Education and Selected Honors

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| <b>PhD, Statistics</b> , University of Illinois Urbana-Champaign (advisor: Bo Li) | 2021 |
| <b>MS, Statistics</b> , University of Illinois Urbana-Champaign                   | 2018 |
| <b>BS, Mathematics</b> , University of Florida, <i>magna cum laude</i>            | 2014 |

**Honors.** JABES Best Paper (2024); Environmetrics top 10 most cited papers, 2022–2023 (2024); Norton Prize for outstanding Statistics thesis, UIUC (2021); UIUC nominee, Schmidt Science Fellows (2020).

## Research and Professional Experience

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### University of Connecticut

2024–Present

Assistant Professor, Statistics (AI/ML Cluster)

- Develop conformal inference, generative neural operators, and distribution control for weather and climate. Train weather models at 1.5° resolution and U-Nets to estimate tail dependence coefficients at high quantiles on NSF ACCESS GH200 GPUs.
- Lead a \$234K Sandia-funded research program on conformal uncertainty quantification (PI, 2024–2027).
- Advise PhD research on manifold-constrained conformal prediction and latent neural ODE climate emulation. Teach Deep Learning and Statistical Programming (Python).

### Texas A&M University

2021–2024

Assistant Professor, Statistics

- Developed climate validation and projection methods, and graph neural networks for disease forecasting.
- Led a \$300K Sandia-funded project assessing climate intervention outcomes and a \$10K project modeling West Nile virus under extreme climate (PI).
- Supervised undergraduate and master's research. Served on PhD dissertation committees. Taught Machine Learning, Bayesian Statistics, and Computational Statistics.

### Sandia National Laboratories

Summers 2018, 2019–2020

Graduate Intern, Mission Algorithms R&S

- Researched functional time series changepoints and trajectory anomalies. Released R packages *fmci* and *elasticdepth* (Environmetrics and Technometrics).

### GEICO

2014–2016

Product Modeling Analyst, Underwriting Research

- Built pricing and risk segmentation models using SQL and R on 100+ GB of policyholder data. Rebuilt a legacy modeling pipeline as an R package, automating a manual reporting workflow across teams.

## Selected Publications and Manuscripts

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1. **Harris, T.** (2026). *Flow-Based Conformal Predictive Distributions*. NeurIPS, accepted.
2. Garrett, R., **Harris, T.**, Wang, Z., & Li, B. (2024). *Validating Climate Models with Spherical Convolutional Wasserstein Distance*. NeurIPS (**spotlight**).
3. Tonks, A., **Harris, T.**, Li, B., Brown, W., & Smith, R. (2024). *Forecasting West Nile Virus with Graph Neural Networks: Harnessing Spatial Dependence in Irregularly Sampled Geospatial Data*. GeoHealth.
4. **Harris, T.**, & Sriver, R. (2024). *Quantifying Uncertainty in Climate Projections with Conformal Ensembles*. Annals of Applied Statistics, accepted.
5. **Harris, T.**, Li, B., & Sriver, R. (2023). *Multimodel Ensemble Analysis with Neural Network Gaussian Processes*. Annals of Applied Statistics.
6. **Harris, T.**, & Liu, Y. (2025). *Locally Adaptive Conformal Inference for Operator Models*. TMLR, under review.
7. Nill, C., **Harris, T.**, & Adams, J. (2026). *Manifold Constrained Conformal Prediction for Spatial Distributions*. ICLR, under review.

Additional publications: Google Scholar and research website.

## Selected Professional Activities

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**Recent invited talks.** CMU (2025, 2026); Penn State, University of Maryland, Verisk Analytics, SIAM UQ, JSM (2026); IMSI (2025); keynote at ICDS (2023).

**Selected service.** Associate Editor, JABES (2026–Present) and the AI+Climate special issue of ASCMO (2024–Present). Reviewer for NeurIPS, ICLR, JMLR, and JASA.