Brandon N. Benton, PhD

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 bnb32

Summary

Senior Researcher at the National Renewable Energy Lab with a focus on enhancing physical modeling through integration of physics-based and machine learning methods. Lead developer on multiple large codebases with users from 50+ institutions and 50+ countries. Record of achievement in data science, machine learning, and scientific computing with publications and presentations relating to generative machine learning, renewable resource modeling, and earth system modeling. Proven ability to lead interdisciplinary teams, develop innovative solutions, and communicate complex scientific concepts effectively.

Education

PhD	**Cornell University**, Physics	Ithaca, NY Jan 2016 – Jan 2019
	• Thesis: Analysis of Low-Frequency Climate Variability Through Computational Modeling and Tree-Ring Data Synthesis	
MS	**Cornell University**, Physics	Ithaca, NY Jan 2012 – Jan 2016
	• Thesis: VR Quadcopter Telepresence Proposal	
BS	**Georgia Southern University**, Physics	Statesboro, GA Jan 2008 – Jan 2012
	• Thesis: Prototyping Method for Bragg-type Atom Interferometers	
	• Honors: Magna cum laude, University Honors Program	

Experience

National Renewable Energy Lab, Senior Researcher / Software Engineer — Golden, CO — Jan 2022 – present

Lead developer for the National Solar Radiation Database (NSRDB) and Super Resolution for Renewable Energy Resource Data (SUP3R). NSRDB integrates MERRA-2 reanalysis data, GOES satellite observations, and physical modeling to generate high-resolution solar resource data, and has 300,000+ annual users from 50+ countries. SUP3R leverages machine learning to produce high-resolution meteorological data, with applications in wind and solar resource data generation and climate projections, and has users from 50+ institutions and 20+ countries.

- Optimized NSRDB pipeline, reducing reprocessing time by 80%
- Extended NSRDB coverage from 60°N to full polar region, broadening its applicability.
- Incorporated temperature-sensitive snowy albedo model into NSRDB to improve surface radiation accuracy.
- Developed cloud property estimation and radiative transfer models to enhance NSRDB data fidelity.
- Publicly released SUP3R framework, consisting of comprehensive suite for feature engineering, data handling, model prototyping, training, and inference.
- Developed novel GAN-based downscaling methods for SUP3R project, increasing speed of downscaling 300x over dynamical approaches.
- Led applications of SUP3R to generate high-resolution wind resource data over Ukraine, Southeast Asia, and South America from coarse ERA5 inputs.
- Applied SUP3R to produce high-resolution climate projections for the US and assess impact of urban heat islands on energy demand.

Cornell University, Post-Doctoral Fellow — Ithaca, NY — Jan 2020 – Jan 2022

Designed and carried out research in areas of global and regional climate modeling, computer vision, weather forecasting, and COVID modelling.

- Developed tools for detecting hurricane conditions in satellite images using computer vision techniques.
- Developed AWS interface to allow general public to perform climate simulations.
- Planned and developed hyperlocal weather forecasting system designed to improve winter-storm emergency response and enhance natural disaster coordination for New York state's rural communities.
- Led team of four undergraduate students using this code to perform on-demand weather forecasting for Tompkins County.
- Led research on effect of heat anomalies injected into aquaplanet SSTs and surface fields on polar vortex.
- Built custom compartmental infectious disease model including asymptomatic, symptomatic, hospitalization, and death projections for entire United States.
- Updated and improved complex database of tree ring information from variety of disparate, obscure, and hard-to-access data sources.

Strengths

High Performance Computing: NCAR's Yellowstone/Cheyenne, NREL's Eagle/Kestrel, PBS, SLURM, Linux

Physics: Meteorology, Earth Systems, Condensed Matter, Fluid Dynamics

Programming: Python, Bash, Mathematica, MATLAB, C++, Fortran

Python Tools: Xarray, Scikit-learn, Keras, Cartopy, Tensorflow, Pytorch, Numpy, Pandas, Dask

Earth Systems Data / Modeling: CMIP6, ERA5, HRRR, WRF, CESM

Mathematics: Differential Equations, Statistics, Finite Difference Methods, Calculus, Linear Algebra

Broader Skill Set

Interdisciplinary

Computational Physics

Data-driven Science

Machine Learning

Software Design

Team Science

Publications

On the effectiveness of neural operators at zero-shot weather downscaling.　April 2025
Saumya Sinha, Brandon Benton, Patrick Emami
Environmental Data Science

The influence of cloud cover on the reliability of satellite-based solar resource data　Feb 2025
Yu Xie, Manajit Sengupta, Jaemo Yang, Aron Habte, Grant Buster, Brandon Benton, Michael Foster, Andrew Heidinger, Yangang Liu
Renewable and Sustainable Energy Reviews

Potential effects of climate change and solar radiation modification on renewable energy resources　Jan 2025
Andrew Kumler, Ben Kravitz, Caroline Draxl, Laura Vimmerstedt, Brandon Benton, Julie K Lundquist, Michael Martin, Holly Jean Buck, Hailong Wang, Christopher Lennard, Ling Tao
Renewable and Sustainable Energy Reviews

Tackling extreme urban heat: a machine learning approach to assess the impacts of climate change and the efficacy of climate adaptation strategies in urban micro-climates

Nov 2024

Grant Buster, Jordan Cox, Brandon N. Benton, Ryan King

arXiv preprint arXiv:2411.05952

Integration of a Physics-Based Direct Normal Irradiance (DNI) Model to Enhance the National Solar Radiation Database (NSRDB)

Dec 2023

Yu Xie, Manajit Sengupta, Jaemo Yang, Grant Buster, Brandon Benton, Aron Habte, Yangang Liu

doi.org/10.1016/j.solener.2023.112195 ↗ (Solar Energy)

Super-resolution for Renewable Energy Resource Data with Wind from Reanalysis Data (Sup3rWind) and Application to Ukraine

July 2024

Brandon N. Benton, Grant Buster, Pavlo Pinchuk, Andrew Glaws, Ryan N. King, Galen Maclaurin, Ilya Chernyakhovskiy

arXiv preprint arXiv:2407.19086. Wind Energy (Under Review)

High-Resolution Meteorology with Climate Change Impacts from Global Climate Model Data Using Generative Machine Learning

April 2024

Grant Buster, Brandon N. Benton, Andrew Glaws, Ryan King

doi.org/10.1038/s41560-024-01507-9 ↗ (Nature Energy)

Intrinsic Century-Scale Variability in Tropical Pacific SSTs and Their Influence on Western US Hydroclimate

Dec 2022

Colin P Evans, Sloan Coats, Carlos M Carrillo, Xiaolu Li, Marc J Alessi, Dimitris A Herrera, Brandon N Benton, Toby R Ault

Geophysical Research Letters

Minor Impacts of Major Volcanic Eruptions on Hurricanes in Dynamically-Downscaled Last Millennium Simulations

Sept 2022

Brandon N Benton, Marc J Alessi, Dimitris A Herrera, Xiaolu Li, Carlos M Carrillo, Toby R Ault

Climate Dynamics

Approximate Mean-Field Equations of Motion for Quasi-2D Bose-Einstein Condensate Systems

Nov 2012

Mark Edwards, Michael Krygier, Hadayat Seddiqi, Brandon Benton, Charles W Clark

Physical Review E

Prototyping Method for Bragg-Type Atom Interferometers

Oct 2011

Brandon Benton, Michael Krygier, Jeffrey Heward, Mark Edwards, Charles W Clark

Physical Review A

Momentum-Space Engineering of Gaseous Bose-Einstein Condensates

March 2011

Mark Edwards, Brandon Benton, Jeffrey Heward, Charles W Clark

Physical Review A