Brandon N. Benton, PhD

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Summary

Senior Software/Data Engineer at the National Renewable Energy Lab with a record of achievement in data science, machine learning, and scientific computing. Multiple publications and presentations relating to generative machine learning, renewable resource modeling, and earth system modeling.

Education

Jan 2016 – Jan 2019 **Cornell University**, PhD in Physics – Ithaca, NY

Jan 2012 – Jan 2016 **Cornell University**, MS in Physics – Ithaca, NY

Jan 2008 – Jan 2012 **Georgia Southern University**, BS in Physics – Statesboro, GA

Experience

Jan 2022 – present **Senior Software/Data Engineer**, National Renewable Energy Lab – Golden, CO

- Lead developer for the National Solar Radiation Database (NSRDB), integrating reanalysis data, satellite observations, and physical modeling to generate high-resolution solar resource data.
- Scaled NSRDB to support 300,000+ annual users across 50+ 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 to improve surface radiation accuracy.
- Developed cloud property estimation and radiative transfer models to enhance data fidelity.
- Lead developer on Super Resolution for Renewable Energy Resource Data project (SUP3R), leveraging machine learning to produce high-resolution wind resource data.
- Publicly released SUP3R framework, consisting of comprehensive suite for feature engineering, data handling, model prototyping, training, and inference.
- SUP3R has users from 20+ countries and 50+ institutions.
- Developed novel GAN-based downscaling methods for SUP3R project, increasing speed of downscaling 300x over dynamical approaches.
- Led applications of this method to generate high-resolution wind resource data over Ukraine, Southeast Asia, and South America.
- Applied SUP3R to produce high-resolution climate projections for the US and assess impact of urban heat islands on energy demand.

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

- Designed and carried out research in areas of computer vision, climatology, weather patterns, 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.
- Developed and planned 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, C++, Fortran, MATLAB, Mathematica

Python Tools: xarray, scikit-learn, keras, cartopy, tensorflow, pytorch, numpy, pandas, dask

Mathematics: Differential equations, statistics, finite difference methods, calculus, linear algebra

Broader Skill Set

Interdisciplinary

Data-driven Science

Machine Learning

Software Design

Team Science

Publications

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

Jan 2025 **Potential effects of climate change and solar radiation modification on renewable energy resources**
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

Nov 2024 **Tackling extreme urban heat: a machine learning approach to assess the impacts of climate change and the efficacy of climate adaptation strategies in urban microclimates**
Grant Buster, Jordan Cox, Brandon N. Benton, Ryan King
arXiv preprint arXiv:2411.05952

Dec 2023 **Integration of a Physics-Based Direct Normal Irradiance (DNI) Model to Enhance the National Solar Radiation Database (NSRDB)**
Yu Xie, Manajit Sengupta, Jaemo Yang, Grant Buster, Brandon Benton, Aron Habte, Yangang Liu
doi.org/10.1016/j.solener.2023.112195 (Solar Energy)

July 2024 **Super-resolution for Renewable Energy Resource Data with Wind from Reanalysis Data (Sup3rWind) and Application to Ukraine**
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)

April 2024 **High-Resolution Meteorology with Climate Change Impacts from Global Climate Model Data Using Generative Machine Learning**
Grant Buster, Brandon N. Benton, Andrew Glaws, Ryan King
doi.org/10.1038/s41560-024-01507-9 (Nature Energy)

Dec 2022 **Intrinsic Century-Scale Variability in Tropical Pacific SSTs and Their Influence on Western US Hydroclimate**
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

Sept 2022 **Minor Impacts of Major Volcanic Eruptions on Hurricanes in Dynamically-Downscaled Last Millennium Simulations**
Brandon N Benton, Marc J Alessi, Dimitris A Herrera, Xiaolu Li, Carlos M Carrillo, Toby R Ault
Climate Dynamics

Nov 2012 **Approximate Mean-Field Equations of Motion for Quasi-2D Bose-Einstein Condensate Systems**
Mark Edwards, Michael Krygier, Hadayat Seddiqi, Brandon Benton, Charles W Clark
Physical Review E

Oct 2011 **Prototyping Method for Bragg-Type Atom Interferometers**
Brandon Benton, Michael Krygier, Jeffrey Heward, Mark Edwards, Charles W Clark
Physical Review A

March 2011 **Momentum-Space Engineering of Gaseous Bose-Einstein Condensates**
Mark Edwards, Brandon Benton, Jeffrey Heward, Charles W Clark
Physical Review A