

# Brandon N. Benton, PhD

Data Scientist, Climate Scientist

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Senior Software/Data Engineer at the National Renewable Energy Lab. Record of achievement in the areas of data science, machine learning, and scientific computing. Multiple publications and presentations relating to climate modeling, condensed matter, and fluid dynamics. Additional experience instructing physics and mathematics classes for undergraduates and overseeing graduate student research programs.

## Work History

**2022-01 – Senior Software/Data Engineer - NATIONAL RENEWABLE ENERGY LAB,**

**Present** Golden, CO

### Solar:

- Streamlined NSRDB pipeline and led reprocessing for 2022 data update.
- Added temperature dependent snowy albedo model to improve accuracy of surface radiation predictions.
- Developing cloud property prediction and radiative transport models.

### Wind:

- Developed novel deep learning based downscaling method using GANs.
- Increased speed of downscaling by two orders of magnitude over dynamical approaches
- Led applications of this method to generate high-resolution wind resource data over South-East Asia, North-America, Ukraine, and South-America.
- Publicly released robust GAN framework for feature engineering, data handling, model prototyping, training, and inference (Super Resolving Renewable Resource Data - sup3r).

**2020-01 - Post-Doctoral Fellow**

**2022-01** CORNELL UNIVERSITY, Ithaca, NY

- Designed and carried out research in areas of computer vision, climatology, weather patterns, and COVID modelling.
- Relied on extensive experience with big data, machine learning, software development, statistical analysis, and modelling.

**Climate AI: Image classification – Computer vision – python – TensorFlow – Keras.**

- Developing tools for detecting hurricane conditions in satellite images.

**Climate Modelling: Cloud-based development – python – modelling.**

- Developing AWS interface to allow general public to perform climate simulations.
- Grant provided by Carl Sagan Institute.


**Weather Forecasting: Big Data – python – modelling – cloud-based development – applied math – education.**


- Developing and planning hyperlocal weather forecasting system designed to improve winter-storm emergency response and enhance natural disaster coordination for New York state's rural communities.
- Developed python code to setup WRF on AWS and post-processing environment on Amazon Workspace.
- Led team of four undergraduate students using this code to perform on-demand weather forecasting for Tompkins County.


**Idealized Planet Simulations: Cloud-based development – cluster deployment – python – fortran – modelling.**


- Led research on effect of heat anomalies injected into aquaplanet SSTs and


## Skills


High Performance Computing  Excellent

Machine Learning  Excellent


Data Visualization  Excellent


Numerical Modeling  Excellent


Statistical Analysis  Excellent


Scientific Computing  Excellent


## Development


Python  Excellent


Bash  Excellent


TensorFlow  Excellent

Keras  Excellent

MATLAB  Excellent

Mathematica  Excellent

C++  Excellent

Fortran  Excellent

drycore surface fields on polar vortex.

- Ran aquaplanet and drycore simulations on Cheyenne Supercomputer using CESM.

**COVID Modeling: Big Data – cloud-based development – python – modeling – applied math.**

- Built custom compartmental infectious disease model including asymptomatic, symptomatic, hospitalization, and death projections for entire United States.
- Social distancing included along with gradient descent-based parameter estimation.
- Correctly predicted deaths and hospitalizations one month ahead.
- Model hosted on AWS and constantly updated using CovidTracking API.

**Low Frequency Climate Variability in Tree Rings: Big data – python – MATLAB – modelling – statistical analysis.**

- Updated and improved complex database of tree ring information from variety of disparate, obscure, and hard-to-access data sources.

## 2012-01 - Independent Researcher

2021-01 BRANDON BENTON, Ithaca, NY

- Developed and carried out data science, aerodynamics, engineering, and physics research.

**Quadcopter Build:**

- Designed and built working quadcopter with GPS-enabled navigation, remote control capability, and computer control interfaces.

**Twitch Bot: NLP – python – NLTK – scikit-learn.**

- Developed Twitch bot to filter offensive content in channels.
- Bot trained on chat data classified based on messages being timed out or not.
- Bot achieved 98% success rate and is currently in use on Twitch channel.

## 2012-01 - Graduate Teaching Assistant

2019-01 CORNELL UNIVERSITY, Ithaca, NY

- Instructed classes in Climate & Energy, Computer Graphics, Numerical Analysis, and Fundamentals of Physics.
- Prepared examinations and classroom materials.
- Led class projects and lab sessions.

## 2013-01 - PhD Researcher

2019-01 CORNELL UNIVERSITY, Ithaca, NY

- Designed and carried out research in areas of climatology, weather patterns, virtual reality interface design, and aerodynamic sound modeling.
- Relied on extensive experience with Big Data, software development, statistical analysis, and modelling.

**Low Frequency Climate Variability in Tree Rings: Big data – python – MATLAB – modelling – statistical analysis**

- Performed multi-taper Fourier and singular value decomposition analysis on chronologies to detect and reconstruct climate signals.
- Developed successful code to construct and de-trend tree ring chronologies from various data sources.
- Built first comprehensive tree ring chronology database, to facilitate detection and reconstruction of climate response signals.

**Effect of Volcanic Eruptions on Hurricanes: Big data – python – CESM – WRF – modelling – statistical analysis.**

- Analyzed effect of volcanic eruptions on hurricane intensity, life span, and frequency.
- Led largest (temporally and spatially) downscaling of global circulation model data, spanning 1,000 years of climate data and encompassing Atlantic Ocean and continental US.
- Produced and analyzed 20TB of raw data from high-resolution coupled atmosphere-ocean regional climate simulations with focus on hurricane statistics.
- Created code to parallelize annual downscaling of global circulation model data.
- Improved efficiency by automating storage, cleaning, and compression of dataset.

Pandas



Excellent

Scikit-Learn



Excellent

Git



Excellent

NumPy



Excellent

SciPy



Excellent

- Submitted results for publication, demonstrating minor effects of volcanic eruptions and hurricane statistics.

**Virtual Reality Quadcopter Interface:** *Python – C++.*

- Designed comprehensive plan for constructing virtual reality interface for unmanned aerial vehicles.
- Utilized 3D spatial reconstruction from sparse sensor data to resolve bandwidth and latency issues.

**First-Person Aerodynamic Sound:** *Python – C++ – OpenFOAM.*

- Developed algorithmic approach for producing first-person aerodynamic sound in real time, with goal of utilizing algorithm for virtual reality applications.
- Modeled air flow around human head using computational fluid dynamics software.
- Investigated feasibility of particle-based fluid modeling operating on GPUs coded in CUDA to generate aerodynamic sound.
- Used MATLAB to generate sound using autoregressive stochastic models.

**Aerodynamics of Maple Seeds:** *Python – C++ – MATLAB.*

- Analyzed the aerodynamics of falling maple seeds, using analytical and experimental procedures to create a physical model, with the goal of applying insights to miniature drone flight performance.
- Developed empirical models using computer vision techniques in laboratory.

**2009-01 - Undergraduate Researcher**

**2013-01** *GEORGIA SOUTHERN UNIVERSITY, Statesboro, GA*

- Conducted research and experimentation in physics.
- Performed numerical modeling.
- Studied Bose-Einstein condensate systems undergoing various dynamics.
- Modeled expansion, pulsed laser response, and confinement behavior of condensate systems.
- Published 3 papers in professional journals and presented on results at NIST and DAMOP conferences.

**Education**

**2016-01 - PhD: Physics**

**2019-01** *Cornell University - Ithaca, NY*

**2013-01 - MS: Physics**

**2016-01** *Cornell University - Ithaca, NY*

**2008-01 - BS: Physics**

**2012-01** *Georgia Southern University - Statesboro, GA*  
 Graduated magna cum laude, University Honors Program

**Publications**

- Xie, Y., Sengupta, M., Yang, J., Buster, G., **Benton, B.**, Habte, A. and Liu, Y., 2023. Integration of a physics-based direct normal irradiance (DNI) model to enhance the National Solar Radiation Database (NSRDB). *Solar Energy*, 266, p.112195.
- Evans, C.P., Coats, S., Carrillo, C.M., Li, X., Alessi, M.J., Herrera, D.A., **Benton, B.N.** and Ault, T.R., 2022. Intrinsic Century-Scale Variability in Tropical Pacific Sea Surface Temperatures and Their Influence on Western US Hydroclimate. *Geophysical Research Letters*, 49(23), p.e2022GL099770.
- **Benton, B.N.**, Alessi, M.J., Herrera, D.A. et al. Minor impacts of major volcanic eruptions on hurricanes in dynamically-downscaled last millennium simulations. *Clim Dyn* (2022).
- Edwards, M, Krygier, M, Seddiqi, H, **Benton, B.** and Clark, C; "Approximate mean-field equations of motion for quasi-2D Bose-Einstein condensate systems," *Physical Review E*, 86(5), November 2012.
- **Benton, B.**, Krygier, M, Heward, J, Edwards, M, and Clark, C; "Prototyping method for Bragg-type atom interferometers," *Physical Review A*, 84(4), October 2011.
- Edwards, M, **Benton, B.**, Heward, J, and Clark, C; "Momentum-space engineering of gaseous Bose-Einstein condensates," *Physical Review A*, 84(4), December 2010.

## Presentations

- "Spatiotemporal Downscaling Global and Regional Climate Model Data with Generative Adversarial Networks," AMS 103<sup>rd</sup> Annual Meeting, January 2023.
- "Prototyping method for Bragg-type atom interferometers," NIST Quantum Information and Bose-Einstein Condensate Meeting, July 2011.
- "Momentum-space engineering of gaseous Bose-Einstein condensates," APS DAMOP Conference, June 2011.
- "Enhanced Interferometry through Quantum Information Science," APS DAMOP Conference, June 2011.
- "Quantum Computing with Bose-Einstein Condensate Interferometry," APS DAMOP Conference, May 2010.