

DHRUV BHAGTANI

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PROFESSIONAL SUMMARY

Multi-scale modeling and machine-learning scientist with a PhD in Earth Sciences and 7+ years of experience applying scientific programming and statistical modeling to weather, climate, ocean, and geospatial data. Skilled in developing reproducible workflows for multi-terabyte NetCDF/Zarr datasets using Xarray and Dask across cloud-native and Linux-based HPC environments to answer scientific questions central to climate change. Experience owning projects on (but not limited to) CMIP6 climate projections, observational-data reconstruction, drivers of ocean circulation, and cyclone-induced coastal inundation. Strong domain knowledge of atmosphere-ocean dynamics, extreme weather events, numerical modeling, and model-observation comparison.

TECHNICAL SKILLS

- **Programming & ML:** Python, PyTorch, scikit-learn, Julia, Fortran, C++, SQL, Bash; regression, classification, neural networks, random forests, Kalman filtering, clustering, dimensionality reduction
- **Research Engineering:** Git/GitHub, Linux/Unix, HPC/SLURM, CUDA, Jupyter, collaborative scientific software
- **Geospatial Data:** xarray, Dask, NumPy, pandas, SciPy, Matplotlib, Cartopy, GeoPandas; NetCDF, Zarr, HDF5, eofs, CMIP6, reanalysis and observational datasets
- **Machine Learning & Statistics:** PyTorch, scikit-learn, regression, classification, Kalman filtering, dimensionality reduction, clustering, signal detection, uncertainty quantification, model validation, time-series analysis
- **Experimentation:** model sensitivity tests and evaluation, spectral and time-series analysis, ensemble analysis, uncertainty quantification, observational-reconstruction
- **Weather and climate:** atmosphere-ocean dynamics, ocean circulation, surface forcing, climate variability, Earth system models, cyclone inundation, mapping raw observations to gridded datasets

WORK EXPERIENCE

- **Postdoctoral Research Associate, Princeton University**

Department of Geosciences and the HMEI | [Integration of Models and Observations Across Scales](#) | Princeton, NJ | Feb 2025-Present

- Leading research on quantifying climate-driven changes in global ocean oxygen and their links to anthropogenic heat and carbon uptake, from scientific scoping through analysis, uncertainty assessment, and manuscript preparation.
- Improving statistical and machine-learning reconstructions of observed ocean fields from sparse measurements using temperature, salinity, location, depth, and seasonality as predictors.
- Designing realistic sampling, gap-filling, and sensitivity experiments to distinguish genuine climate signals from artifacts introduced by incomplete observations and reconstruction methods.
- Evaluating 14 CMIP6 Earth-system models and multiple observational products across timescales and reconstruction methods.
- Processing & analyzing multi-terabyte geospatial datasets using Python, xarray, Dask, NetCDF/Zarr, and Linux-based HPC systems.
- Coordinating cross-continental collaborators and communicating results through presentations and peer-reviewed manuscripts.

SELECT WEATHER AND CLIMATE PROJECTS

- **Climate Drivers of North Atlantic Ocean Circulation**

Department of Earth Sciences, Australian National University | Doctoral Research | Feb 2024-Dec 2024

- Designed and analyzed a suite of century-scale global ocean and sea-ice simulations to quantify how changes in the North Atlantic Oscillation alter subtropical and subpolar gyre circulation.
- Developed vorticity budgets to separate wind-driven, topographic, frictional, and nonlinear controls on circulation changes.

- **Wind and Buoyancy Controls on Ocean Circulation and Heat Transport**

Department of Earth Sciences, Australian National University | Doctoral Research | Oct 2020-Jan 2024

- Designed controlled numerical experiments to isolate how surface wind stress, buoyancy forcing, and ocean stratification influence large-scale circulation and meridional heat transport.
- Used [momentum](#) and [heat transport](#) diagnostics to determine physical mechanisms behind changes in large-scale circulation.
- Developed reproducible workflows on Australia's supercomputer (Gadi) for model configuration, experiment management, data reduction, visualization, and quantitative comparison across forcing scenarios.

- **Cloud-Native CMIP6 Analysis-Ready Data Workflow: OceanHackWeek 2021**

Online | August 2021

- Co-developed a [Pangeo workflow](#) using Python, intake-esm, Xarray, regionmask, and cmip6_preprocessing to access cloud-hosted CMIP6 datasets and transform them into analysis-ready regional products.
- Analyzed multi-model climate projections, applied regional masks and spatial weighting, and generated Arabian Sea climate time series for downstream ecological modeling and scenario analysis.

- **Cyclone Inundation and Coastal Physical-Risk Modeling**

Department of Ocean Engineering and Naval Architecture, IIT Madras | Undergraduate Thesis | July 2019-May 2020

- Developed a [finite-element solver](#) for cyclone-driven storm surge and coastal inundation along the east coast of India, including idealized cyclone experiments and an application to Cyclone Gaja.
- Parallelized the model using OpenMP and CUDA to improve computational performance for high-resolution hazard simulations.

- **Open-Source Ocean and Climate Modeling Tools**

Department of Earth Sciences, Australian National University | Doctoral Research | Oct 2020-Dec 2024

- Contributed to collaborative scientific-software and documentation projects, including the [regional-mom6 Python package](#) and the [COSIMA Recipes](#) for reproducible analysis of large ocean and sea-ice model datasets.
- Contributed to [Oceananigans](#), a Julia-and GPU-based ocean model solver that reduces computational cost and simulation time by 2 orders of magnitude compared to traditional ocean models.

- **Hydrodynamic coefficient estimation using Kalman Filtering**

Department of Ocean Engineering and Naval Architecture, IIT Madras | Undergraduate Research | July 2018-May 2019

- Developed an [Extended Kalman Filter](#) to estimate drag and inertia coefficients for slender offshore structures from measured wave-induced forces, combining the Morison's equation with sequential parameter estimation.
- Recovered time-varying hydrodynamic coefficients from noisy data and evaluated its accuracy across different wave conditions.

EDUCATION

- **PhD in Earth Sciences, Australian National University, Canberra, Australia**

Department of Earth Sciences | Canberra, ACT | Oct 2020-Jun 2025

Thesis: "Ocean Gyres Driven by Wind Stress and Surface Buoyancy Forcing."

- **BTech (Honors), Ocean Engineering and Naval Architecture, Indian Institute of Technology Madras, Chennai, India**

Department Rank 1 (CGPA: 9.19/10); Department of Ocean Engineering | Chennai, Tamil Nadu | Jul 2016-May 2020

Thesis: "Parallelized Finite Element-Based Solver for Cyclone Inundation on the East Coast of Tamil Nadu."

SELECT PUBLICATIONS AND COMMUNICATION

- Several first-author peer-reviewed studies on ocean circulation, climate variability, and physically informed model diagnostics.
- Co-author of [regional-mom6](#), a Python package for generating regional ocean-model configurations.
- Contributing author to [Australia's State of Weather and Climate Extremes Report 2023](#).
- Presented climate-modeling research at 20+ international conferences and 5+ invited university seminars.
- Student Ambassador, ANU Future Research Talent Program: advised 150+ prospective researchers and coordinated international panels and outreach events.