

ONKAR JADHAV, PhD

Research Fellow | Climate & Ocean AI | Climate Downscaling | Generative Modelling

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SUMMARY

Research Fellow with a PhD in Mathematics and 7+ years of experience in scientific machine learning, reduced-order modelling and uncertainty-aware generative methods. At the University of Western Australia, I develop PODiff and PatchPODiff for sea surface temperature downscaling, marine heatwave analysis and coastal decision support using regional ocean-model, satellite, seasonal-forecast and CMIP6 data. Experienced in Python, PyTorch, xarray and large-scale HPC workflows, with a strong record of interdisciplinary research, publication and student mentoring.

RESEARCH INTERESTS

Climate and ocean artificial intelligence; sea surface temperature downscaling; marine heatwaves; generative and diffusion models; uncertainty quantification; probabilistic forecasting; scientific machine learning; reduced-order modelling; POD/SVD.

EXPERIENCE

Research Fellow (Machine Learning & AI) – University of Western Australia, Perth, Australia

November 2023 - Present

- Developed PODiff, a reduced-order generative framework performing diffusion in a structured POD coefficient space, enabling efficient ensemble generation, interpretable latent representations, and uncertainty-aware reconstruction of high-dimensional scientific fields
- Designed conditional generative models, including Residual CNNs, Residual U-Nets, FiLM-conditioned networks and diffusion models, for super-resolution, probabilistic downscaling and stochastic generation of spatial fields
- Built reproducible pipelines for CMIP6 historical and scenario simulations, ROMS, ECMWF seasonal ensembles and IMOS/GHRSSST satellite SST, including regional subsetting, regridding, climatology/anomaly construction and location-specific time-series extraction
- Built large-scale AI/ML pipelines for sea surface temperature downscaling, ensemble uncertainty estimation, marine heatwave likelihood mapping, and location-specific probabilistic analysis for coastal decision support
- Built multimodal ML pipelines combining spatial data, temporal features, and large language models (GPT, Claude) to interpret maps and animations and automatically generate scientific analyses
- Led training and evaluation on large-scale HPC infrastructure (Setonix, NCI) using reproducible workflows across CPU and GPU environments
- Collaborated with climate and ocean scientists to translate probabilistic ML outputs into interpretable scientific products, publications, demos and stakeholder-facing analyses

Postdoctoral Researcher – University of Luxembourg, Luxembourg

January 2022 - September 2023

- Developed machine learning models and a multi-fidelity computational framework to predict wind pressure distributions on high-rise buildings from computational fluid dynamics data
- Integrated low-fidelity Reynolds-averaged Navier–Stokes simulations with a small number of high-fidelity Large Eddy Simulation results, substantially reducing the need for expensive high-fidelity simulations
- Built an AI-driven digital twin integrating simulation outputs and learned representations for real-time inference, analysis and scenario exploration

PhD Researcher (Mathematics & ML) – Technical University of Berlin, Germany

(with applied research collaboration at MathConsult GmbH, Austria)

November 2018 - December 2021

- Developed an adaptive, ML-driven greedy sampling framework for latent-space reduced-order models, enabling efficient and accuracy-controlled learning of high-dimensional parametric PDE systems
- Designed projection-based latent representations (POD/SVD), reduced bases and neural reduced-order models to replace expensive numerical solvers while preserving accuracy
- Built ML-accelerated surrogate and PINN-based pipelines for large-scale scenario generation and uncertainty-aware inference in financial risk modelling

SELECTED RECOGNITION

Marie Skłodowska-Curie Fellow (ROMSOC) • ICML 2026 paper accepted • ICML 2026 Gold Reviewer • Invited climate-AI talk at the Bureau of Meteorology

EDUCATION

- **PhD, Mathematics**, *Technical University of Berlin, Germany*
September 2018 - February 2022
Marie Skłodowska-Curie Fellow (MSCA), ROMSOC 765374.
Thesis: Model order reduction for parametric high-dimensional models in financial risk analysis.
Research: Model Order Reduction, Optimisation, PDEs, ML-accelerated solvers for financial risk analysis
- **MSc, Computational Science & Engineering**, *University of Rostock, Germany*
- **B. E. Mechanical Engineering**, *University of Pune, India*

SELECTED PUBLICATIONS

- PODiff: POD-Conditioned Diffusion Models for Efficient Probabilistic Generation, ICML 2026 (Accepted). arXiv: 2605.03399
- Patch-PODiff-ViT: Structured Latent Diffusion with Patchwise POD for Super-Resolution and Uncertainty Quantification, NeurIPS 2026 (submitted). arXiv:2606.31290
- Deep learning-based statistical downscaling of sea surface temperature using a Residual Corrective Neural Network, Journal of Geophysical Research: Machine Learning and Computation, under review, 2026. 10.22541/essoar.175510661.11731470/v1
- A multi-fidelity wind surface pressure assessment via ML, Building and Environment, 2023.
<https://doi.org/10.1016/j.buildenv.2023.110135>
- Error analysis of a model order reduction framework for financial risk analysis, ETNA, 2022. 10.1553/etna_vol55s469
- Model order reduction for simulation of parametric interest rate models, Journal of Mathematics in Industry, 2021. 10.1186/s13362-021-00105-8

ONGOING RESEARCH PROJECTS

PODiff for Marine Heatwave Forecasting and Coastal Risk Mapping - *Manuscript in preparation*

- Developing high-resolution probabilistic maps of marine heatwave likelihood from coarse seasonal forecast ensembles
- Translating downscaled ensemble outputs into daily and persistent exceedance probabilities for location-specific coastal decision support

Med-PODiff: Uncertainty-Aware Diffusion for Biomedical Image Reconstruction - *Manuscript in preparation*

- Developing POD-space diffusion methods for calibrated reconstruction, uncertainty decomposition and hallucination-risk detection in medical imaging

INVITED TALKS (SELECTED)

- Ocean Temperature Forecasts for Coastal Decision Making – Invited Talk, Oceans of Data, July 2026, Perth, Australia
- Super-Resolution and Uncertainty-Aware Climate Downscaling - Invited Research Talk, September 2025, Bureau of Meteorology (BoM), Melbourne
- Generative Modeling of Marine Heatwaves and Extreme Climate Events - Invited Talk, Australian Marine Heatwave Symposium 2024/25

TEACHING, MENTORING & ACADEMIC SERVICE

- Casual Academic / Teaching Team Member, University of Western Australia, Semester 2, 2026: STAT3064/5061 Statistical Learning and CITS4403 Computational Modelling
- Teaching Assistant, University of Rostock 2018: master's courses in dynamical systems, model reduction, simulation and machine learning; designed tutorials, assignments and assessment materials
- Mentored master's students and delivered graduate research seminars at TU Berlin on neural surrogates, reduced-order modelling and financial risk analysis
- Reviewer: ICML 2026 (Gold Reviewer), NeurIPS, Building and Environment, and EGU sphere

TECHNICAL AND TEACHING SKILLS

Machine Learning & AI: Generative models, diffusion models, deep learning, ResNets, U-Nets, uncertainty quantification, calibration, ensemble methods, model interpretability.

Climate & ocean data: CMIP6, ROMS, ECMWF, IMOS/GHRSSST, NetCDF, xarray, regridding, anomalies and marine heatwave diagnostics

Data Science & Scientific Computing: Python, PyTorch, TensorFlow, NumPy, SciPy, pandas, xarray, Linux, HPC (Setonix and Gadi/NCI), reproducible ML workflows, Docker, Singularity

Mathematical Modelling: Model order reduction, POD/SVD, reduced bases, dynamical systems, PDEs, optimisation, surrogate modelling