PhD Opportunity: Characteristics, Drivers, and Mechanisms of Recent Marine Heatwaves to Improve Predictability

Step into the growing field of climate extremes and their predictability to increase climate resilience of ecosystems and marine businesses.

The project

Marine heatwaves (MHWs) have intensified and become more frequent worldwide over recent decades, impacting fisheries, aquaculture, biodiversity, and coastal communities. One way to reduce this growing risk is through improved predictability and the establishment of early warning systems (de Boisséson & Balmaseda, 2024; Hartog, Spillman, Smith, & Hobday, 2023; Holbrook et al., 2020; Jacox et al., 2022; Spillman et al., 2025; Sun et al., 2023).

A 3-year project has been initiated to improve the predictability of these extremes over the southwest Pacific using advanced data science techniques. The project brings together researchers from Australia, New Caledonia, USA, and New Zealand.

This PhD will contribute to this international project by:

- Characterising recent MHWs and diagnosing their drivers and mechanisms
- Improving our ability to predict these events on subseasonal to seasonal timescales
- Utilising and evaluating MHW forecasting products

The successful applicant will work at the interface of climate dynamics, oceanography, and data science—linking process understanding with practical prediction tools for stakeholders (fisheries, aquaculture, conservation).

What you will do

- Compile and analyse in-situ observations and high-resolution hindcast simulations.
- Detect and characterise MHWs; attribute events using circulation patterns, heat-budget, and teleconnection diagnostics.
- Improve our understanding of mechanisms, dependencies, and timeframes to advance predictability.
- Evaluate existing and newly developed MHW forecasts.
- Contribute to early-warning products with end-users; publish in leading journals and present at conferences.

About you

Essential

- MSc/First-class Honours (or equivalent) in physical oceanography, climate science, or atmospheric science.
- Strong skills in Python (xarray, numpy, pandas, scipy; netCDF; version control) or Matlab and quantitative analysis.
- Demonstrated interest in climate/ocean dynamics and predictability.

Desirable

- Experience with seasonal prediction datasets, reanalysis, or climate model output.
- Background in time-series verification, extreme-value analysis, or machine learning (PyTorch/TensorFlow, scikit-learn).
- HPC/Linux workflow skills; stakeholder engagement.

Supervision & environment

You will be based at Earth Sciences New Zealand (ESNZ*) in Wellington, New Zealand, and enrolled through the University of Auckland's PhD programme in the Physics Department. Supervisors of your project are Prof. Craig Stevens (Univ. Auckland and ESNZ), Professor Neil Holbrook (University of Tasmania), and Dr. Erik Behrens (ESNZ).

You'll join a collaborative team of ocean and climate scientists working across observation, modelling, and AI over a range of scales. The project offers access to national supercomputing resources, rich forecast archives, and strong links to government, industry, and international partners.

In addition, you will become part of the University of Auckland/ESNZ Joint Graduate School in Coastal and Marine Science.

Funding & start

- Fully funded PhD (tuition + stipend) for 3 years. The project will match University of Auckland Scholarship conditions https://www.auckland.ac.nz/en/study/scholarships-and-awards/scholarship-types/postgraduate-scholarships/doctoral-scholarships.html .
- Start date: early 2026

How to apply

Email one PDF to erik.behrens@niwa.co.nz containing:

1. Cover letter (max 2 pages): motivation, fit, ideas around your experience and interests which could inform the project.
2. CV (incl. publications, talks, software).
3. Academic transcripts.
4. Contact details for two referees.

Subject line: PhD Application – Marine Heatwaves

Application deadline: **12th October (New Zealand)**

Contact: Erik Behrens (erik.behrens@niwa.co.nz) for any questions in relation to this position.

Equity, diversity & inclusion

We welcome applications from all backgrounds and are committed to creating a supportive, inclusive research environment.

*ESNZ Earth Sciences New Zealand was formed in July 2025 through the merger of NIWA and GNS – two leading science agencies.

de Boisséson, E., & Balmaseda, M. A. (2024). Predictability of marine heatwaves: assessment based on the ECMWF seasonal forecast system. *Ocean Science, 20*(1), 265–278.

Hartog, J. R., Spillman, C. M., Smith, G., & Hobday, A. J. (2023). Forecasts of marine heatwaves for marine industries: Reducing risk, building resilience and enhancing management responses. *Deep Sea Research Part II: Topical Studies in Oceanography, 209*, 105276.

Holbrook, N. J., Sen Gupta, A., Oliver, E. C., Hobday, A. J., Benthuysen, J. A., Scannell, H. A., . . . Wernberg, T. (2020). Keeping pace with marine heatwaves. *Nature Reviews Earth & Environment, 1*(9), 482–493.

Jacox, M. G., Alexander, M. A., Amaya, D., Becker, E., Bograd, S. J., Brodie, S., . . . Tommasi, D. (2022). Global seasonal forecasts of marine heatwaves. *Nature, 604*(7906), 486–490. doi:10.1038/s41586-022-04573-9

Spillman, C. M., Hobday, A. J., Behrens, E., Feng, M., Capotondi, A., Cravatte, S., . . . Gupta, A. S. (2025). What makes a marine heatwave forecast useable, useful and used? *Progress In Oceanography, 234*, 103464.

Sun, W., Zhou, S., Yang, J., Gao, X., Ji, J., & Dong, C. (2023). Artificial intelligence forecasting of marine heatwaves in the South China Sea using a combined U-Net and ConvLSTM system. *Remote Sensing, 15*(16), 4068.