# Lachlan Astfalck

*Curriculum Vitae*

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## Education

2016–2019 **Doctor of Philosophy**, *Faculty of Engineering, Mathematics and Computing, The University of Western Australia.*
Conferred June 2019

2010–2014 **Bachelor of Mechanical Engineering**, *The University of Western Australia.*
First Class Honours, Valedictorian

## Doctoral Thesis

Title *Quantification and propagation of meteorological and oceanographic uncertainties in offshore engineering*

Supervisors Dr. Edward Cripps, Dr. Ian Milne & Prof. Melinda Hodkiewicz

Description This thesis quantified long-term uncertainties related to wind, surface current, and waves, and propagated the uncertainties through computationally demanding simulators of vessel motions with application to vessels moored off Western Australia. This thesis was graded in the top 5% of PhD theses at UWA.

## Academic Employment

2022–Present **Research Fellow**, *The University of Western Australia*, Perth, Australia.
I am a research statistician within an ARC Research Hub that provides mathematical and data-driven solutions to modern engineering problems. Methodologically, I am focused on developing non-parametric statistical methodology for spectral, temporal and spatio-temporal analysis; some of this work has been recently accepted in *Biometrika*. I work across many applied disciplines, most notably in fine-scale oceanography and the hydrodynamics of moored bodies. Within this capacity I work frequently with multiple and varied shareholders; including, applied scientists, local industry, and international mathematical collaborators.

2020–2022 **Research Fellow**, *The University of Leeds*, Leeds, United Kingdom.
This work, in conjunction with climate scientists, developed rigorous methods of uncertainty quantification for large non-standard spatio-temporal computer models with application to past deglaciation events. A number of novel statistical methods were developed as part of the project, including fast and efficient methodology for reconstructions of spatio-temporal fields, emulation of non-standard computer models, and some extensions to Bayes linear statistics. Some of these results are in published in the *Journal of the American Statistical Association*. As a result of my input to this project, I remain a listed co-investigator and continue to contribute guidance and opinions.

2019 **Research Associate**, *The University of Western Australia*, Perth, Australia.
This work was a consulting position that made much of the research conducted in my PhD thesis operational. This included temporal modelling of directional wave spectra, temporal modelling of wind, and spatio-temporal modelling of surface current. These uncertainty quantifications were used to drive emulators of vessel motion models to provide near-real time probabilistic predictions. The majority of this work was completed with local industry.

2011–2019 **Teaching Responsibilities**, *The University of Western Australia*, Perth, Australia.

I worked in a wide range of teaching roles during my undergraduate and postgraduate degrees. This included teaching and facilitating first, second, and fifth year students through a range of statistics and engineering units in lectures, tutorials, information sessions, practical labs and workshops. I have been responsible for a range of activities including the development and updating of lecture material, creation of quiz and exam material, marking, providing feedback and help to students, and online unit maintenance using the university's LMS.

## Refereed Publications

2024 **LC Astfalck**, EJ Cripps, and AM Sykulski. Debiasing Welch's method for spectral density estimation. ***Biometrika***, asae033.

2024 **LC Astfalck**, DB Williamson, N Gandy, LJ Gregoire, and RF Ivanovic. Coexchangeable process modelling for uncertainty quantification in joint climate reconstruction. ***Journal of the American Statistical Association***, 1–14.

2024 IA Milne, and **LC Astfalck**. Heave response spectra for a semisubmersible in long period swell. *24th Australasian Fluid Mechanics Conference.*

2024 N Gandy, **LC Astfalck**, GL Ives, and GE Rivers. Ice sheet speed-dating: using expert judgement to identify "good" simulations of the LGM North American ice sheets. *Quaternary Science Reviews*, 333:108690.

2024 VL Patterson, LJ Gregoire, RF Ivanovic, N Gandy, J Owen, RS Smith, PJ Valdes, OG Pollard and **LC Astfalck**. Contrasting the Penultimate and Last Glacial Maxima (21 and 140 ka BP) using coupled climate-ice sheet modelling. *Accepted in Climate of the Past.*

2023 **LC Astfalck**, M Bertolacci, and EJ Cripps. Evaluating probabilistic forecasts for maritime engineering operations. *Data-Centric Engineering*, 4:e15.

2023 OG Pollard, NL Barlow, LJ Gregoire, N Gomex, V Cartelle, JC Ely, and **LC Astfalck**. Quantifying the uncertainty in the Eurasian ice-sheet geometry at the Penultimate Glacial Maximum (Marine Isotope Stage 6). *The Cryosphere Discussions*, 17(11):4751–4777.

2023 N Gandy, **LC Astfalck**, LJ Gregoire, RF Ivanovic, and VL Patterson. De-tuning a coupled climate ice sheet model to simulate the North American ice sheet at the Last Glacial Maximum. *Journal of Geophysical Research: Earth Surface*, 128(8):e2023JF007250.

2022 MA Loake, **LC Astfalck**, and EJ Cripps. Modelling sea surface wind measurements on Australia's North-West Shelf. *Ocean Engineering*, 244:110308.

2020 M Masarei, **LC Astfalck**, AL Guzzomi, DJ Merritt, and TE Erickson. Soil rock content influences the maximum seedling emergence depth of a dominant arid zone grass. *Plant and Soil*, 450(1):497–509.

2019 **LC Astfalck**, EJ Cripps, MR Hodkiewicz, and IA Milne. A Bayesian approach to the quantification of extremal responses in simulated dynamic structures. *Ocean Engineering*, 182:594–607.

2019 **LC Astfalck**, EJ Cripps, JP Gosling, and IA Milne. Emulation of vessel motion simulators for computationally efficient uncertainty quantification. *Ocean Engineering*, 172:726–736.

2018 **LC Astfalck**, EJ Cripps, JP Gosling, MR Hodkiewicz, and IA Milne. Expert elicitation of directional metocean parameters. *Ocean Engineering*, 161:268–276.

2017 **LC Astfalck**, GK Kelly, X Li, and TB Sercombe. On the breakdown of SiC during the selective laser melting of aluminum matrix composites. *Advanced Engineering Materials*, 19(8):1600835.

2017 **LC Astfalck**, MR Hodkiewicz. Hamiltonian Monte Carlo sampling for Bayesian hierarchical regression in prognostics. *Asia Pacific Conference of the Prognostics and Health Management Society.*

2016 **LC Astfalck**, MR Hodkiewicz, A Keating, EJ Cripps, and M Pecht. A modelling ecosystem for prognostics. *Annual Conference of the Prognostics and Health Management Society.*

2016 J Sikorska, MR Hodkiewicz, A D'Cruz, **LC Astfalck**, and A Keating. A collaborative data library for testing prognostic models. *Prognostics and Health Management Society European Conference.*

## Publications in Review

2024 **LC Astfalck**, CR Bird, and DB Williamson. Generalised Bayes linear inference. *Submitted to the* ***Journal of the Royal Statistical Society: Series B (discussions)****.*

2024 ALS Ponte, **LC Astfalck**, MD Rayson, AP Zulberti, and NL Jones. Inferring flow energy, space and time scales: freely-drifting vs fixed point observations. *Accepted with revisions in Nonlinear Processes in Geophysics Discussions.*

2024 MD Rayson, **LC Astfalck**, ALS Ponte, AP Zulberti, and NL Jones. Spectral model parameter estimation for non-phase-locked internal tides in a mesoscale eddy field. *Submitted to the Journal of Geophysical Research: Oceans.*

2024 IA Milne, **LC Astfalck**, M Zed, J Lee-Kopi, and EJ Cripps. Hybrid physics-data driven spectral forecasts of semisubmersible response. *Submitted to Ocean Engineering.*

2024 OG Pollard, NL Barlow, LJ Gregoire, N Gomez, **LC Astfalck**, and AM McGuire. Identifying the Antartctic melt contribution to last interglacial sea-level from Eurasian relative sea-level records. *Submitted to Geophysical Research Letters.*

## Grants, Funding, Scholarships and Awards

2024 **ARC Discovery Project**, Developing the next generation of coastal ocean turbulence models, Chief Investigator, $\sim$ \$750 000AUD (EOI accepted, final decision November 2024)

2023 **UWA Shell Chair Funding**, Two years of research funding paid at Level B/C $\sim$ \$250 000AUD

2023 **TIDE Seed Funding** Bayesian time-series analysis of ocean drifter data, Principal Investigator, \$14 700AUD

2023 **TIDE Seed Funding** Remote sensing of surface currents from aircraft, Chief Investigator, \$15 000AUD

2021 **OceanWorks Prototyping Grant** Exploratory analysis of flying-lead failures, Principal Investigator, \$5 000AUD

2017–2019 **ARC OFFshore Hub postgraduate scholarship**, \$10 000AUD per annum top-up

2016–2019 **Research Training Program scholarship** (f.k.a. Australian Postgraduate Award), \$27 000AUD per annum

2014 **Valedictorian**, Mechanical Engineering, UWA

2014 **Chevron Chair Prize in Gas Process Engineering**

2012 **Convocation of UWA Graduate Association Undergraduate Prize**

## Student and Research Associate Supervision

2023–Present William Edge, **Postdoctoral Research Associate**, co-supervisor, UWA, funded for two years

2023–2024 Max Collins, **Graduate Research Associate**, principal supervisor, UWA, funded for 10 weeks full-time equivalent, with option to extend

2022–Present Yutao Zheng, **PhD Candidate**, co-supervisor, UWA, In Progress

2022–2023 Max Collins, **Honours Student**, co-supervisor, UWA, Completed

2022 Anthony D'Angelo, **Honours Student**, co-supervisor, UWA, Completed

2020 Muhammad Qasim, **Masters Student**, co-supervisor, University of Leeds, Completed

2020 Minjie Wu, **Masters Student**, co-supervisor, University of Leeds, Completed

2020 Max Anderson-Loake, **Honours Student**, co-supervisor, UWA, Completed (subsequently awarded a Rhodes Scholarship)

## University Service and Industry Engagement

2024–Present Outreach Chair for the Department of Mathematics and Statistics at UWA

2022–Present Social and Events Chair for the ARC TIDE ITRH

2022–Present Ongoing industry engagement through the ARC TIDE ITRH

2021 Development and presentation of three-part masterclass on Bayesian methods to local offshore industry

2016–2019 UWA UniMentor

## Invited Presentations

2023 *Debiasing Welch's method of spectral density estimation.* Presented at Imperial College London, Lancaster University, and Durham University.

2022 *Probabilistic inference of nonlinear extreme ocean currents for operational forecasting.* UWA Data Science Forum.

2022 *Inferring nonlinear internal wave properties from sparse observations using statistical learning.* The Forum of Operational Oceanography.

2021 *Reconstructing boundary conditions for complex simulations with application to climate models.* Conference of the Royal Statistical Society.

2021 *Uncertainty, probability and decision making.* Bayesian Statistics and Forecasting for the Offshore Industry.

2021 *Hierarchical analysis and statistical analysis of computer codes.* Bayesian Statistics and Forecasting for the Offshore Industry.

2021 *Spatio-temporal modelling.* Bayesian Statistics and Forecasting for the Offshore Industry.