

Elizabeth K. McGeorge

Curriculum Vitae

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Education

- 2019 – **Ph.D. Candidate in Mathematics**, *University of Canterbury*.
Topic: Inverse Problems in Ice Flow Modelling.
Expected completion: 2022.
- 2015–2018 **Bachelor of Science (Honours, 1st Class)**, *University of Canterbury*.
Major: Mathematics, GPA: 8.75/9.00.
See below “Mathematics courses taken” for more detail.
- 2012–2014 **NCEA Levels 1,2,3**, *Villa Maria College*, Christchurch.
NCEA Levels 1, 2 & 3 with excellence endorsement. NZQA Scholarship in Physics, Calculus & Statistics. Level 3 subjects: Biology, Calculus, Chemistry, Classics, English, Physics, Religious Studies, Statistics.

Publications

Publications marked with a “*” are under review.

- *2021 **McGeorge, E. K., Moyers-Gonzalez, M., Sellier, M., et al. An augmented Lagrangian algorithm for recovery of ice thickness in unidirectional flow using the Shallow Ice Approximation**, submitted 28 July 2021.
- Abstract: A key parameter in ice flow modelling is basal slipping at the ice-bed interface as it can have a large effect on the resultant ice thickness. Unfortunately, its contribution to surface observations can be hard to distinguish from that of bed undulations. Therefore, inferring the ice thickness from surface measurements is an interesting and non-trivial inverse problem. This paper presents a method for recovering dually the ice thickness and the basal slip using only surface elevation and speed measurements. The unidirectional shallow ice approximation is first implemented to model steady state ice flow for given bedrock and basal slip profiles. This surface is then taken as synthetic observed data. An augmented Lagrangian algorithm is then used to find the diffusion coefficient which gives the best fit to observations. Combining this recovered diffusion with observed surface velocity, a simple Newton's method is used to recover both the ice thickness and basal slip. The method was successful in each test case and this implies that it should be possible to recover both of these parameters in two-dimensional cases also.

- 2021 **McGeorge, E.K., Sellier, M., Moyers-Gonzalez, M. et al. Bedrock reconstruction from free surface data for unidirectional glacier flow with basal slip. Acta Mech 232, 305–322 (2021)**, Accepted 23 September 2020.

Abstract: Glacier ice flow is shaped and defined by several properties, including the bedrock elevation profile and the basal slip distribution. The effect of these two basal properties can be present in similar ways in the surface. For bedrock recovery, this makes distinguishing between them an interesting and complex problem. The results of this paper show that in some synthetic test cases it is indeed possible to distinguish and recover both bedrock elevation and basal slip given free surface elevation and free surface velocity. The unidirectional shallow ice approximation is used to compute steady-state surface data for a number of synthetic cases with different bedrock profiles and basal slip distributions. A simple inversion method based on Newton's method is applied to the known surface data to return the bedrock profile and basal slip distribution. In each synthetic test case, the inversion was successful in recovering both the bedrock elevation profile and the basal slip distribution variables. These results imply that there are a unique bedrock profile and basal slip which give rise to a unique combination of free surface velocity and free surface elevation.

Conference Presentations

Conferences marked with a "*" are upcoming.

- Nov 14–16, **Inverse Problems and Uncertainty Workshop, Auckland, New Zealand (online)**
2021 This workshop brings together experts from the fields of uncertainty quantification, inverse problems, and model calibration to network and exchange ideas. I gave a 30 minute presentation on optimisation methods I have employed in my PhD candidature and their outputs.
- Aug 22–27, **ICTAM 2020+1, Milan, Italy (online)**
2021 The ICTAM congresses was a unique occasion to gain a direct experience of the new progresses in mechanics and of the continuously growing field of applications of this ever-green discipline. I presented a poster on my paper "Bedrock reconstruction from free surface data for unidirectional glacier flow with basal slip."
- Jan 27–29, **Fluids in New Zealand, Christchurch, New Zealand**
2021 FiNZ provides a forum to facilitate the dissemination of ideas across the different branches of fluid mechanics, and to promote interdisciplinary collaborations between New Zealand scientists. I gave a 15 minute presentation on the two open-source Python libraries I am using; FEniCS and dolfin-adjoint
- Jan 30–31, **Southern Exposure: Antarctic Research at the University of Canterbury, Christchurch, New Zealand**
2020 This conference aimed to enhance and promote Antarctic research within the University of Canterbury, to create greater transparency around ongoing Antarctic research projects and encourage inter-departmental and intercollegiate coordination and collaboration on Antarctic research and inspire researchers interested in working on Antarctic issues. I gave a 15 minute presentation covering the governing models for ice sheet flow as well as some key results from my research. This talk was targeted to an audience with little mathematical background.
- Jan 30–31, **Fluids in New Zealand, Auckland, New Zealand**
2020 See above.
- Nov 25–26, **Materials @ UC: The Story Behind the Research, Christchurch, New Zealand**
2019 The story behind the research theme explores and shares the human element behind research. The conference placed emphasis on participants research stories, professional, and personal development as the hidden engine driving scientific and technical innovations. I gave a poster presentation on my paper "Bedrock reconstruction from free surface data for unidirectional glacier flow with basal slip."

Nov 22–25, 2019 **New Zealand Mathematics and Statistics Postgraduate Conference**, Wainui, New Zealand

The New Zealand Mathematics and Statistics Postgraduate conference is an annual event for postgraduates in New Zealand. It provides a platform for students to gain experience in presenting our work to an audience. I gave a 15 minute presentation covering the basic mathematics of the inverse problem in ice flows, targeted towards an audience of mainly statisticians, as well as some key results.

Teaching Experience

2022 **Teaching Lecturer**, *University of Canterbury*

I will be lecturing for 6 weeks, commencing April, for a second year course, ENCH298, a course in applied mathematics for chemical engineers. Topics lectured include Laplace and Fourier transforms as well as some simple multivariate calculus. Other duties in addition to teaching consisted of writing and marking assignments and examination questions and providing office hours for one-on-one student help.

2020 **Guest speaker for EMTH171**, *University of Canterbury*

EMTH171 is a course for first year engineers which covers the mathematics and implementation of some basic numerical methods. I gave a talk to the students outlining the background of my research and how I used some of the methods they learned in different stages.

2020–2021 **Mathematics 200 Level Tutor**, *University of Canterbury*

Tutoring in linear algebra and differential equations. Topics covered in linear algebra include vector spaces, linear transformations, eigenvalues, and orthogonality with applications to Markov chains, population and economic models, least squares approximation, cryptography, coding theory, data compression. Topics in differential systems include systems of linear and non-linear first order differential equations, phase plane techniques, numerical methods, stiff systems, Laplace transforms (including initial value problems, shift theorems, step functions and impulses, convolution, resonance), Fourier series and elementary Fourier transforms.

2018–2021 **Mathematics 100 Level Tutor**, *University of Canterbury*

Tutoring in a variety of first year mathematics papers. This involves both explanations to small groups as well as one-on-one work with the students. One of the courses tutored on has a large distance cohort of high-school students which often required a more hands-on approach with regards to content explanation.

2018–2021 **Examination Marker/Supervisor**, *University of Canterbury*

Assisting in marking of test and exam papers for a number of both first and second year courses. This task requires consistency across up to 800 exam scripts while working to a tight deadline.

2016 **CHCH 101 Teaching Assistant**, *University of Canterbury*

CHCH 101 is a course designed around the community response to the Christchurch earthquakes in 2010 and 2011. The course covered a variety of topics including hazard mitigation and post disaster response with a focus on volunteerism. As a teaching assistant, I was in charge of students health and safety on off-campus trips. Additionally, I lead group discussions regarding learning objectives, assessment requirements and projects. Administrative duties included marking written essays fairly and efficiently to the set guidelines.

Other employment history

2016–2017 **Store Supervisor**, *Vail Resorts Retail*, Keystone, CO

General management duties including shipping/receiving, mentoring, timetabling, inventory monitoring, ensuring company policy compliance, day-to-day floor management as well as store cash handling.

2015–2016 **UC Host**, *University of Canterbury*, Christchurch, New Zealand

Provided support for a number of different events throughout the year which specialised in community and corporate engagement as well as recruitment. At each event, duties involved setting up venues, greeting and assisting guests, giving tours and food services.

- 2014 **Casual Labourer**, *Canterbury PVC Windows*, Christchurch, New Zealand
Assisted in the design and construction of a retaining wall and deck. This required attention to detail, precision and extensive planning.
- 2012–2014 **Takeaway Assistant**, *Burger Wisconsin*, Christchurch, New Zealand
Worked in a variety of roles; on the till, answering the phone, food preparation, fryer, grill and dishes. Often had to deal with customer enquiries and complaints while working under high stress. Food preparation required strict adherence to set procedures.

Volunteer work

- 2021 **NZMS Colloquium Organising Committee**, *New Zealand Mathematical Society*
In charge of updating the website with new information in a timely manner.
- 2021 **FiNZ Organising Committee**, *Fluids in New Zealand*
Organised accommodation and catering as well as being in charge of daily space set-up/pack-down during the conference.
- 2021, 2018 **Maths Craft Day Volunteer**, *Maths Craft New Zealand*.
Maths Craft uses the medium of craft to introduce adults and children alike to a new and exciting way of engaging with mathematics. As a volunteer, I guided attendees through the activities. When there was interest, further insight into the mathematical nature of the craft was provided.
- 2018–2019 **Secretary**, *Canterbury University Snow Sports Club*
Organised and attended weekly meetings and provided detailed minutes within two days. Provided administration support for events throughout the year and kept track of club communications and finances.
- 2016 **Student Mentor**, *Emerging Leaders Development Programme, University of Canterbury*
Helped to organise retreats, leadership forums and social events, and create service projects as part of the Emerging Leaders Development Programme. Attended formal leadership training sessions and acted as a mentor to scholarship students.
- 2013–2014 **Band Manager**, *Villa Maria College Jazz Band*
Completed general administration for the band including organising rehearsals, selecting and providing music scores.
- 2010–2014 **Cantamath tutoring**, *Villa Maria College*
Cantamath, short for Canterbury Mathematics, is a yearly competition run in my region for ages 9 to 14. The competition has many aspects, with one of the most exciting being the team competition where teams of up to 4 students race in a relay type format to answer interesting mathematical questions and earn points. In the month leading up to this competition, I spent 5 hours a week tutoring the intermediate students at my school in preparation for the competition.

Languages

- English First language.
- French Intermediate level from three years of study at high school.

Scholarships & prizes

- 2021 Highly commended at the departmental “Thesis in Three” competition heats.
- 2020 Best poster with a geological/natural material theme at the Materials @ UC Conference
- 2019 Edward and Isabel Kidson Memorial Scholarship
- 2019 University of Canterbury (UC) Doctoral Scholarship
- 2018 Graduate Women Canterbury Inc. Trust Board Scholarship
- 2018 Golden Key International Honours Society Invitation
- 2017 UC Senior Scholarship
- 2017 UC Outbound Exchange Scholarship
- 2017 William Brent Wilson Memorial Prize

- 2016, 2018 UC Mathematics and Statistics Scholarship
- 2015 UC Mathematics and Statistics STAR Scholarship
- 2015 UC Undergraduate Entrance Scholarship

Interests

- Trail Running A hobby that takes me to places less travelled and challenges me both mentally and physically.
- Cycling Keen commuter cyclist and have recently taken up mountain biking.
- Sailing Raced in a number of dinghy sailing classes throughout high school and attended national regattas regularly. Currently crew on a cruising keel yacht. Aspiring to complete an open ocean voyage by 2023.
- Skiing After learning to ski in 2016, I now enjoy back-country skiing for its diversity in skills. Particularly enjoy the route planning and risk assessment nature of the sport.
- Rogaining This is orienteering-type sport which involves long distance cross-country navigation, including route planning and navigation between checkpoints using a variety of map types. Competing requires teamwork and endurance. This year I would like to compete in my first 24 hour rogaine.

References

Academic

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Character

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