

Thomas M. Bury

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EDUCATION

- 2015 – 2019 **PhD, Applied Mathematics**, University of Waterloo, Canada
Thesis: Detecting and distinguishing transitions in ecological systems: model and data-driven approaches.
GPA: 96.4%
Advisors: Dr. Chris Bauch, Dr. Madhur Anand
- 2014 – 2015 **MMATH, Mathematics**, University of Cambridge, UK
Merit.
Director of studies: Dr. Julia Gog, OBE
- 2011 – 2014 **BA, Mathematics**, University of Cambridge, UK

PROFESSIONAL APPOINTMENTS

- 2020 – present **Postdoctoral Researcher**
Department of Physiology
Faculty of Medicine
McGill University, Canada

AWARDS & HONORS

- 2022 – 2024 FRQNT postdoctoral research scholarship (\$45,000 *per annum*)
- 2021 CAMBAM postdoctoral fellowship, Centre for Applied Mathematics in Bioscience and Medicine, McGill University (\$10,000)
- 2021 PNAS [Cozzarelli Prize](#) for scientific excellence and originality—finalist
- 2020 CAMBAM postdoctoral fellowship, Centre for Applied Mathematics in Bioscience and Medicine, McGill University (\$7,000)
- 2019 Doctoral thesis award, University of Waterloo (\$5000)
- 2019 Combined travel grants, Waterloo Institute for Complexity and Innovation (\$2500)
- 2017 Research dissemination award, GRADTalks, University of Waterloo (\$500)
- 2017 Second place at Fields Thesis Competition, Fields Institute, Toronto (\$300)
- 2017 Finalist at 3-Minute Thesis competition, University of Waterloo (\$100)
- Recording:  youtube.com/watch?v=UQ1nW9PNil8

PUBLICATIONS


PAPERS

- 2023 **T. M. Bury**, K. Diagne, D. Olshan, L. Glass, A. Shrier, B. Lerman and G. Bub. The Inverse Problem for Cardiac Arrhythmias *Chaos: An Interdisciplinary Journal of Nonlinear Science (in review)*.
- ‡ **T. M. Bury**, D. Dylewsky, C. Bauch, M. Anand, L. Glass, A. Shrier and G. Bub. Predicting discrete-time bifurcations with deep learning. *Nature Communications*. doi:10.1038/s41467-023-42020-z. **Editors' highlight**.
- Code:  [ThomasMBury/dl_discrete_bifurcation](https://github.com/ThomasMBury/dl_discrete_bifurcation)
- ‡ **T. M. Bury**. ewstools: A Python package for early warning signals of bifurcations in time series data *Journal of Open Source Software*. doi:10.21105/joss.05038.
- Code:  [ThomasMBury/ewstools](https://github.com/ThomasMBury/ewstools)
- ‡ K. Diagne, **T. M. Bury**, M. Deyell, Z. Laksman, A. Shrier, G. Bub and L. Glass. Rhythms from two competing periodic sources embedded in an excitable medium *Physical Review Letters*. doi:10.1103/PhysRevLett.130.028401. **Editors' suggestion**.
- 2022 ‡ F. Dablander and **T. M. Bury**. Deep learning for tipping points: Preprocessing matters. *Proceedings of the National Academy of Sciences*. doi:10.1073/pnas.2207720119.
- ‡ D. Dylewsky, T. Lenton, M. Scheffer, **T. M. Bury**, C. Fletcher, M. Anand, and C. Bauch. Universal early warning signals of phase transitions in climate systems. *Journal of the Royal Society Interface*. doi:10.1098/rsif.2022.0562.
- 2021 ‡ **T. M. Bury**, R. Sujith, I. Pavithran, M. Scheffer, T. Lenton, M. Anand, and C. Bauch. Deep learning for early warning signals of tipping points. *Proceedings of the National Academy of Sciences*. doi:10.1073/pnas.2106140118. **Cozzarelli finalist**.
- Code:  [ThomasMBury/deep-early-warnings-pnas](https://github.com/ThomasMBury/deep-early-warnings-pnas)
- ‡ J. Menard, **T. M. Bury**, C. T. Bauch, and M. Anand. When conflicts get heated, so does the planet: coupled social-climate dynamics under inequality *Proceedings of the Royal Society B*. doi:10.1098/rspb.2021.1357.
- 2020 **T. M. Bury**, C. Lerma, G. Bub, Z. Laksman, M. W. Deyell, L. Glass. Long ECGs reveal rich and robust dynamical regimes in patients with frequent ectopy. *Chaos: An Interdisciplinary Journal of Nonlinear Science*. doi:10.1063/5.0023987.
- ‡ **T. M. Bury**, C. T. Bauch, M. Anand. Detecting and distinguishing tipping points using spectral early warning signals. *Journal of the Royal Society Interface*. doi:10.1098/rsif.2020.0482.
- Code:  [ThomasMBury/ewstools](https://github.com/ThomasMBury/ewstools)
- 2019 ‡ **T. M. Bury**, C. T. Bauch, M. Anand. Charting pathways to climate change mitigation in a coupled socio-climate model. *PLoS computational biology*. doi:10.1371/journal.pcbi.1007000.
- Code:  [ThomasMBury/socio_climate_model](https://github.com/ThomasMBury/socio_climate_model)
- ‡ D. A. Pananos, **T. M. Bury**, C. Wang, J. Schonfeld, S. P. Mohanty, B. Nyhan, M. Salathé, C. T. Bauch. Critical dynamics in population vaccinating behavior. *Proceedings of the National Academy of Sciences* doi:10.1073/pnas.1704093114.








OPEN-SOURCE SOFTWARE

2019 – present **ewstools**

A Python package for computing early warning signals for bifurcations in time series data.
doi:[10.5281/zenodo.3497512](https://doi.org/10.5281/zenodo.3497512)

- Role: Creator, core developer
- Code:  [ThomasMBury/ewstools](https://github.com/ThomasMBury/ewstools)

CONFERENCE PRESENTATIONS

- 2023 **T. M. Bury**, R. Sujith, I. Pavithran, M. Scheffer, T. Lenton, M. Anand, and C. Bauch. Deep learning discrete-time bifurcations: an application to noisy cardiac systems. *SIAM Conference on Applications of Dynamical Systems*, Portland OR.
- Slides:  doi.org/10.6084/m9.figshare.24183513.v1
- T. M. Bury**. Tipping points in the era of big data. *Youreka Symposium*, McGill University, Montréal, QC.
- **Invited talk**
 - Slides:  doi.org/10.6084/m9.figshare.24183543.v1
- 2021 **T. M. Bury**, R. Sujith, I. Pavithran, M. Scheffer, T. Lenton, M. Anand, and C. Bauch. Deep learning for early warning signals of bifurcations. *Dynamics Days Europe*, Virtual.
- Slides:  doi.org/10.6084/m9.figshare.16892431.v1
- T. M. Bury**, C. Lerma, G. Bub, Z. Laksman, M. W. Deyell, L. Glass. Long ECGs reveal rich and robust dynamical regimes in patients with frequent PVCs. *Society for Mathematical Biology Annual Meeting*, Virtual.
- Slides:  doi.org/10.6084/m9.figshare.16892593.v1
- T. M. Bury**, C. Lerma, G. Bub, Z. Laksman, M. W. Deyell, L. Glass. Patterns of premature ventricular complexes in the human heart. *Department of Physiology Seminar Series, McGill University*, Virtual.
- **Invited talk**
 - Slides:  doi.org/10.6084/m9.figshare.24415936.v1
- 2020 **T. M. Bury**, C. T. Bauch, M. Anand. Detecting and distinguishing bifurcations from noisy time series data. *Applied Mathematics Seminar, Centre de Recherches Mathématiques*, Virtual.
- **Invited talk**
 - Recording:  [youtube.com/watch?v=QGs2knhnXDM](https://www.youtube.com/watch?v=QGs2knhnXDM)
 - Slides:  doi.org/10.6084/m9.figshare.16892632.v1
- T. M. Bury**. Bifurcations in the era of big data: Applications to cardiology and ecology. *Applied Mathematics Seminar Series, University of Ottawa*, Virtual.
- **Invited talk**
- T. M. Bury**. Bifurcations in the era of big data: Applications to cardiology and ecology. *Seminar Series in Quantitative Life Sciences and Medicine, University of McGill*, Virtual.
- **Invited talk**

- T. M. Bury**, M. Anand, C. T. Bauch. Fold or Flip? Distinguishing bifurcations in advance with spectral early warning signals. *Workshop on Critical Transitions in Complex Systems, Shanghai Institutes for Biological Sciences*, Virtual.
- **Invited talk**
 - Recording:  drive.google.com/file/d/1kp2G6q-Eu-H13JpVgUCcbezF_rZzKjJ3
 - Slides:  doi.org/10.6084/m9.figshare.16892644.v1
- 2019 **T. M. Bury**, C. T. Bauch, M. Anand. Spectral early warning signals improve tipping point detection and description. *Society for Mathematical Biology Annual Meeting*, Montréal, Canada.
- Poster:  doi.org/10.6084/m9.figshare.16892395.v2
- T. M. Bury**, C. T. Bauch, M. Anand. Spectral early warning signals improve tipping point detection and description. *Canadian Society of Applied and Industrial Mathematics, Annual Meeting 2019*, Whistler, Canada.
- Slides:  doi.org/10.6084/m9.figshare.16892662.v1
- 2018 **T. M. Bury**, M. Anand, C. T. Bauch. Early warning indicators of ecological tipping points. Do they predict critical transitions, or something else? *Ecological Society of America, Annual Meeting*, New Orleans, U.S.
- **Invited talk**
- T. M. Bury**, M. Anand, C. T. Bauch. Characterizing impending transitions in complex systems. *Dynamics Days US 2018*, Denver, U.S.
- 2017 **T. M. Bury**. The mathematics of tipping points. *TEDx, University of Toronto*, Toronto, Canada.
- **Invited talk**
 - Recording:  youtube.com/watch?v=pfm7OqBVA6I
- T. M. Bury**, M. Anand, C. T. Bauch. Anticipating Critical Transitions in Socio-Ecological Systems *Applied Mathematics, Modeling and Computational Science, International Conference*, Waterloo, Canada.
- T. M. Bury**, M. Anand, C. T. Bauch. Regime Shifts in Socio-Ecological Systems *Mathematical Models in Ecology and Evolution, Conference*, London, UK.
- T. M. Bury**, M. Anand, C. T. Bauch. Regime Shifts in Socio-Ecological Systems *Waterloo Institute for Complexity and Innovation, Interdisciplinary Conference on Resilience in Complex Natural and Human Systems*, Waterloo, Canada.

MEDIA COVERAGE (SELECTED)

- 2023 Physics Today
-  pubs.aip.org/physicstoday/article/
- 2021 The Independent
-  independent.co.uk/climate-change/news/
- 2021 The Daily Mail
-  dailymail.co.uk/sciencetech/

- 2019 Canadian Broadcasting Corporation
 •  [cbc.ca/news/canada/](https://www.cbc.ca/news/canada/)

TEACHING

GRADUATE

- 2021 – 2022 **Instructor**, *McGill University*
 Foundations of Quantitative Life Sciences, (Fall 2021, Fall 2022)
- 2017 – 2018 **Teaching Assistant and Guest Lecturer**, *University of Waterloo*
 Stochastic Processes in the Physical Sciences, (Winter 2017, Winter 2018)
- 2017 **Teaching Assistant**, *University of Waterloo*
 Mathematical Modeling with Differential Equations, (Fall 2017)

UNDERGRADUATE

- 2018 **Instructor**, *University of Waterloo*
 Calculus I for the Sciences, (Fall 2018)
- 2018 **Teaching Assistant**, *University of Waterloo*
 Partial Differential Equations I (Winter 2018)
- 2016 **Teaching Assistant**, *University of Waterloo*
 Introduction to Differential Equations, (Winter 2016)
- 2015 – 2016 **Teaching Assistant**, *University of Waterloo*
 Various calculus courses for math and engineering students
 (Fall 2015, Summer 2016, Fall 2016)

CREDENTIALS

- 2017 – 2019 Certificate of University Teaching, *University of Waterloo*
 An in-depth, selective, 2-year teaching course for PhD students. Includes multiple teaching observations, guided self-reflection and improvement, workshops and a pedagogical research project.
- 2015 – 2016 Fundamentals of University Teaching, *University of Waterloo*
 Includes weekly workshops on teaching fundamentals including active learning, equitable teaching, and effective delivery.

STUDENT SUPERVISION

PhD

- 2019 – present Khady Diagne (co-advisor)
 McGill University
 Project: Spatio-temporal dynamics of pure parasystole in cardiac tissue

UNDERGRADUATE


- 2020 – 2021 Alix Vanpoperinghe (advisor)
 McGill University
 Project: Simulation of cardiac monolayers under optogenetic control
- 2020 – 2021 Glisant Plasa (co-advisor)
 McGill University
 Project: Reinforcement learning for discovery of reentry mechanisms in cardiac tissue

ACADEMIC SERVICE

COMMITTEES

- 2021 – 2022 CGSM evaluation committee member, *McGill University*
 Served as an evaluator for the 2021 and 2022 Canada Graduate Scholarship-Master's competition.
- 2017 – 2018 Senate Graduate and Research Council, *University of Waterloo*
 Served as the math grad student representative for matters of academic quality and research activity within the university.

SUMMER SCHOOLS AND WORKSHOPS

- 2021 Summer School in Nonlinear Dynamics for the Life Sciences (online)
CAMBAM and NSERC-CREATE, McGill University
 Technical lead for 2-week, international summer school with 50 participants and 24 instructors.
- 2020 Interactive Data Visualisation in Python (online)
CAMBAM-CRM, McGill University
 Designed and implemented 5-hour workshop with 60 participants including students and faculty.
 - Code:  [ThomasMBury/workshop_datavis_python](https://github.com/ThomasMBury/workshop_datavis_python)
- 2018 A Hands-on Introduction to Mathematical Modelling
Waterloo Institute for Complexity and Innovation: Leveraging systems approaches to improve human and planetary health
 Co-designed and implemented 4-hour workshop.

OUTREACH

- 2020 – present Interviews with newspapers and magazines including *The Scientific American*, *The Waterloo Region Record*, *The McGill Tribune* and *The Charlatan*.
- 2022 – present Technical author for [Towards Data Science](#), Medium publication.
- 2023 Lecture to CEGEP students at Youreka Canada. “Data science: practice and principles”.
 Montreal, Canada.
- 2022 – 2023 Poster judge for the Quantitative Life Sciences Research Day in 2022 and 2023. *McGill University*, Montreal, Canada.

- 2022 Lecture to high school students at Kelly College. “Mathematics beyond school: university, careers and life”. Devon, UK.
- 2016 – 2018 Workshop facilitator at primary school visits. *Let’s Talk Science*, Waterloo, Canada.
- 2017 [TEDx speaker](#). *University of Toronto*, Toronto, Canada.
- GRADTalks speaker and panelist *University of Waterloo*, Waterloo, Canada.
- Volunteer at Physics Lab Day for Grade 11-12. *University of Waterloo*, Waterloo, Canada.
- Science fair judge for Grade 8 projects. *Centennial Public School*, Waterloo, Canada.

REVIEWER

- Nature
- Nature Communications
- Physical Review X
- Ecology Letters
- Proceedings of the Royal Society A
- Proceedings of the Royal Society B
- Journal of the Royal Society Interface
- Methods in Ecology and Evolution
- Chaos: An Interdisciplinary Journal of Nonlinear Science
- Ecological Economics
- Climatic Change
- PLOS One

LANGUAGES

- English Native
- French TEFaQ Level C1 (proficiency) obtained in 2020.