Jemima M. Tabeart

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Research Interests and Contributions

Numerical linear algebra, data assimilation, numerical partial differential equations, optimization, model order reduction, high-dimensional industrial problems (partners include the Met Office and Cerfacs).

Employment

- **Hooke Research Fellow** — September 2022 –
  Mathematical Institute, University of Oxford
  Independent research fellowship in the Numerical Analysis Group
- **Fulford Junior Research Fellow** — October 2022 –
  Somerville College, University of Oxford
- **Postdoctoral Research Associate** — October 2019 – August 2022
  School of Mathematics, University of Edinburgh
  Project: Modern linear algebra for PDE-constrained optimisation models for huge-scale data analysis, EPSRC Grant EP/S027785/1, working with Dr John W. Pearson.
- **Semester Postdoctoral Fellowship** — January 2020 – April 2020
  Institute for Computational and Experimental Research in Mathematics (ICERM) — *Brown University*
  Fellowship for the program "Model and dimension reduction in uncertain and dynamic systems".

Education

- **PhD** — October 2016 – November 2019
  EPSRC Centre for Doctoral Training in Mathematics of Planet Earth — *University of Reading*
  Thesis title: On the treatment of correlated observation errors in data assimilation
  Supervised by: Professor Sarah L. Dance, Dr Amos S. Lawless, Professor Nancy K. Nichols, Dr Joanne A. Waller, and Dr David Simonin (MetOffice@Reading)
  In collaboration with the National Centre for Earth Observation and the Met Office, my research investigated how correlated observation error can be incorporated into a data assimilation framework whilst reducing the negative impact on convergence that has been observed theoretically and operationally.
- **MRes in Mathematics of Planet Earth (Distinction)** — 2015 – 2016
  Imperial College London and University of Reading
  Project title: On the variational data assimilation problem with non-diagonal observation weighting matrices
  Awarded Best MRes Project.
- **MMath (1st Class Honours), Mathematics with Study Year Abroad** — 2011 – 2015
  University of Bath
  Undertook assessed third year at Université Joseph Fourier (now part of Université Grenoble Alpes) where I completed the Parcours A stream for students preparing to study graduate mathematics.
  Awarded Chancellor's Prize for best final year undergraduate student.

Research Employment

- **Visiting Researcher** — July – August 2018
  Met Office, Exeter, UK
  8 week research project based in Ocean Forecasting and Research Development group to investigate importance of error covariances for sea surface temperature observations. Compared diagnosed errors obtained using method of Desroziers et al. (2005) with estimates produced by ESA CCI SST project, finding significant differences between the two estimate types.
- **Researcher** — July – August 2014
  University of Bath
  8 week research placement based at the Universities of Bath and Cambridge. The bouncing droplet phenomenon, a fluid dynamics problem with parallels in quantum physics, was modelled in 1D using MATLAB. *The resulting programs, graphs, and final report provided a starting point for my undergraduate research project.*
- **Research Assistant** — July – August 2011
  University of Bath
  Awarded a 5 week Bursary placement in June 2010 – subsequently returned to work on a European-wide project studying Gallium Nitride (GaN). Created a new tool to aid the 3D visualisation of GaN's physical properties, which involved learning to program in Visual Basic, communicating with other scientists on the same project and presenting my work to non-experts. The placement culminated in the publication of a joint paper in Integrated Ferroelectrics (Vol 133 Issue I).

Research Visits

- University of Edinburgh (18th – 22nd September 2023)
  Funded by London Mathematical Society Research in Pairs Scheme
- Cerfacs, Toulouse (30th May – 2nd June 2023)
- Charles University, Prague (15th – 17th March 2023)
- KU Leuven (5th – 9th September 2023)
  Funded by Una Europa grant
- University of Bologna (4th – 8th July 2023)
  Funded by Una Europa grant
- Cerfacs, Toulouse (22nd – 26th November 2021)

Journal Publications

JP1, D. Palitta and **J. M. Tabeart** (2023) "Stein-based preconditioners for weak-constraint 4D-Var", *submitted to Journal of Computational Physics*, 112068.

JP2, E. Qian, **J. M. Tabeart**, C. Beattie, S. Gugercin, J. Jiang, P. R. Kramer, and A. Narayan. (2022) "Model reduction of linear dynamical systems via balancing for Bayesian inference", *Journal of Scientific Computing*, 91, (29) https://doi.org/10.1007/s10915-022-01798-8

JP3, **J. M. Tabeart**, S. L. Dance, A. S. Lawless, N. K. Nichols, and J. A. Waller. (2021) "New bounds on the condition number of the Hessian of the preconditioned variational data assimilation problem", *Numerical Linear Algebra with Applications*, e2405. https://doi.org/10.1002/nla.2405

JP4, S. Vetra-Carvalho, S. L. Dance, D. C. Mason, J. A. Waller, E. S. Cooper, P. J. Smith, and **J. M. Tabeart**. (2020). "Collection and extraction of water level information from a digital river camera image dataset", *Data in Brief*, 33, 106338. https://doi.org/10.1016/j.dib.2020.106338

JP5, **J. M. Tabeart**, S. L. Dance, F. Hilton, A. S. Lawless, S. Migliorini, N. K. Nichols, and J. A. Waller (2020) "The impact of reconditioning of the correlated observation error covariance matrix on the Met Office system", *Quarterly Journal of the Royal Meteorological Society*, 146(728), 1372-1390. https://doi.org/10.1002/qj.3741

JP6, **J. M. Tabeart**, S. L. Dance, A. S. Lawless, N. K. Nichols, and J. A. Waller (2020). "Improving the condition number of estimated covariance matrices", *Tellus A: Dynamic Meteorology and Oceanography*, 72(1), 1–19. https://doi.org/10.1080/16000870.2019.1696646

JP7, **J. M. Tabeart**, S. L. Dance, S. A. Haben, A. S. Lawless, N. K. Nichols, and J. A. Waller. (2018) "The conditioning of least squares problems in variational data assimilation", *Numerical Linear Algebra with Applications*, 25(5), e2165. https://doi.org/10.1002/nla.2165

JP8, M.-L. Hicks, **J. Tabeart**, M. J. Edwards, E. D. Le Boulbar, D. W. E. Allsopp, C. R. Bowen, and A. C. E. Dent. (2012) "High temperature measurement of elastic moduli of (0001) Gallium Nitride", *Integrated Ferroelectrics*, 133(1) 17–24. https://doi.org/10.1080/10584587.2012.663309

Submitted

PP1, **J. M. Tabeart** and J. W. Pearson. "Parallelisable saddle point preconditioners for weak constraint 4D-Var", *Electronic Transactions on Numerial Analysis*, Preprint arXiv:2105.06975.

In Preparation

IP1, **J. M. Tabeart** and J. W. Pearson. "Using low-rank observation information to precondition weak-constraint 4D-Var", *In preparation.*

IP2, **J. M. Tabeart**, S. Gürol, J. W. Pearson, and A. Weaver, "Block circulant preconditioners for parallel-in-time diffusion-based correlation operators", *In preparation.*

Funding

Research funding

- Grant author and awardee for **funded** grant: London Mathematical Society Research in Pairs Scheme (June – September 2023) for research exchange with Dr John W. Pearson (University of Edinburgh).
- Co-investigator and co-author for **funded** grant: Una Europa Seed Funding DIGITALIZED! call (November 2021) for the project 'Tensor-based Optimal Control approaches for Deep Learning' with Dr Davide Palitta (University of Bologna) and Dr Nick Vannieuwenhoven (KU Leuven), https://site.unibo.it/toc4deep/en. Wrote proposal with Co-Is. Value of award: €11,000
- Named member and contributing grant author for: Isaac Newton Institute Network Support for the Mathematical Sciences for 24,100 (submitted February 2023)

Scholarships and fellowships

- Postdoctoral semester fellowship, ICERM, Brown University (Spring 2020): $\$26,500$ stipend, \$800 travel funding
- MRes/PhD studentship at Mathematics of Planet Earth Centre for Doctoral Training. £100,000 over 4 years.

Travel grants

- Research visit to RIKEN, Japan (January 2019): £1500
- Workshop on Sensitivity Analysis and Data Assimilation (August 2018): DARE training fund €820 euros +£200
- International Workshop on Climate Change and Natural Disasters (August 2017): £4000

Prizes and Awards

- Best invited talk: It's Her! Women in STEMM Summit 2023.
- Nominated: Edinburgh University Students' Association (EUSA) Teaching Award, "Outstanding Course" category for tutoring/co-lecturing on Numerical Partial Differential Equations BSc/MSc course, April 2022
- Associate Fellow of the Higher Education Academy, September 2021
- Poster Prize: LMS Women in Mathematics Day, University of Strathclyde, June 2021.
- Best group project: MPE CDT Industrial Study Group, March 2018. 2 day study group on industrial problem from AIR worldwide. Team of PhD students developed a research idea using industrial data and presented to a panel of academics and industry representatives.
- Best group project: presenting National Centre for Earth Observation science to an industrial audience, NCEO Researchers' Forum, February 2018. Team of researchers from across NCEO developed a presentation on a specified topic to promote novel NCEO research and its societal impacts. Judged by panel of academics and science communication experts.
- Best poster presentation: NCEO Researchers' Forum, February 2018.
- Best MRes project: MPE CDT, March 2017.
- Chancellor's Prize for best final year undergraduate student: University of Bath, June 2015.

Conferences

Invited conference and workshop talks

1. 27th – 30th June 2023 29th Biennial Numerical Analysis Conference, University of Strathclyde, UK
2. 3rd – 5th April 2023, British Applied Mathematics Colloquium, University of the West of England, UK
3. 27th February – 3rd March 2023, SIAM Computational Science and Engineering, Amsterdam, The Netherlands
4. 20th – 22nd June 2022, Sparse Days, Saint-Girons, France
5. 13th – 17th June 2022 (rescheduled from 14th – 19th June 2020), Householder Symposium XXI
6. 6th – 10th June 2022, Numerical Methods for Large Scale Problems, Belgrade, Serbia
7. 11th – 14th July 2021, 31st European Conference on Operational Research (EURO XXXI), Athens, Greece
8. 10th May 2021, Communications in Numerical Linear Algebra seminar series, Online, https://bit.ly/3q4sR9T
9. 30th July 2020, Reading student seminar series, University of Reading, UK
10. 29th May 2020, Scottish Numerical Methods Network, Workshop on Inverse Problems and Optimisation for PDEs, University of Edinburgh, UK
11. 25th September 2019, Royal Meteorological Society Data Assimilation Special Interest Group, Reading, UK
12. 1st – 2nd July 2019, Advances in Linear Algebra and Huge-Scale Optimization, ICMS, Edinburgh, UK
13. 11th June 2018, Imperial College SIAM student conference, UK

Invited seminars

1. 2nd June 2023 Algo-Coop seminar, Cerfacs, Toulouse
2. 28th April 2023 Numerical Analysis seminar, University of Bath, UK
3. 27th April 2023 Computational Mathematics and Applications Seminar, Rutherford Appleton Laboratory, UK
4. 26th April 2023 Imperial/UCL Numerics seminar, Imperial College, UK
5. 16th March 2023 Departmental seminar, Charles University, Prague, Czechia
6. 2nd June 2022 Institute for Computational and Experimental Research in Mathematics, Providence, USA
7. 18th March 2022, Numerical Analysis and Scientific Computing Seminar, University of Manchester, UK
8. 22nd October 2021, Applied Mathematics Seminar, University of Warwick, UK
9. 19th July 2021, Oberseminar Dynamics, Technical University of Munich, Germany
10. 6th July 2021 Algo-Coop seminar, Cerfacs, Toulouse
11. 14th April 2021, Reading Data Assimilation Research Centre seminar, University of Reading, UK
12. 1st April 2020, NRL seminar, Naval Research Laboratory, Monterey, US
13. 28th January 2019, Data Assimilation Seminar Series, RIKEN Centre for Computational Science, Kobe, Japan
14. 2nd November 2018, Environmental Research DTP Student Seminar Series, University of Oxford, UK
15. 28th August 2018, Met Office Ocean Group Seminar Series, Exeter, UK
16. 7th February 2018, Imperial College Junior Applied Mathematics Seminar, UK

Invited workshop participant

1. 27th August – 1st September 2023, New Directions in Applied Linear Algebra, Banff International Research Station for Mathematical Innovation and Discovery, Canada
2. 2nd – 5th November 2020, ECMWF/EUMETSAT NWP SAF Workshop on the treatment of random and systematic errors in satellite data assimilation for NWP, European Centre for Medium-Range Weather Forecasts, Reading, UK
3. 5th – 6th February 2018, NCEO Researchers' Forum, University of Leicester, UK
   Poster: Accounting for correlated observation errors in variational data assimilation
4. 29th August – 2nd September 2017, International Workshop on Climate Change and Natural Disasters, Cemaden/INPE, São Jose dos Campos, Brazil
5. 19th – 20th March 2018, MPE CDT Industrial Study Group, University of Reading, UK
6. 20th – 21st March 2017, MPE CDT Industrial Study Group, Imperial College London, UK

Selected contributed presentations

International oral presentations

1. 6th – 10th June 2022, International Symposium on Data Assimilation, Fort Collins, USA
2. 17th – 21st May 2021, SIAM Conference on Applied Linear Algebra, New Orleans, USA
3. 24th November 2020, Sparse Days, Cerfacs, Toulouse, France
4. 15th – 19th July 2019, International Congress on Industrial and Applied Mathematics, Valencia, Spain
5. 21st – 24th January 2019, 7th International Symposium on Data Assimilation, RIKEN Centre for Computational Science, Kobe, Japan
6. 1st – 6th July 2018, Workshop on Sensitivity Analysis and Data Assimilation in Meteorology and Oceanography, Meli Ria Hotel, Aveiro, Portugal

International poster presentations

1. 21st – 24th January 2019, 7th International Symposium on Data Assimilation, RIKEN Centre for Computational Science, Kobe, Japan

National oral presentations

1. 19th – 21st September 2018, CliMathNet Conference, University of Reading, UK
2. 27th – 30th June 2017, National Centre for Earth Observation and Centre for Earth Observation Instrumentation annual conference, University of Bath, UK
3. 19th June 2017, Imperial College SIAM Student Conference, Imperial College London, UK

National poster presentations

1. 16th June 2021, LMS Women in Mathematics Day, University of Strathclyde, UK
2. 4th – 7th September 2018, National Centre for Earth Observation Conference, University of Birmingham, UK
3. 30th April – 1st May 2018, LMS Women in Maths Days, Isaac Newton Institute, Cambridge, UK
4. 21st March 2018, MPE CDT Jamboree, University of Reading, UK
5. 22nd March 2017, MPE CDT Jamboree, Imperial College, London, UK

Teaching Experience

- **Guest Lecturer** — January – March 2022
  Numerical Partial Differential Equations (4th/5th year BSc/MSc) — *University of Edinburgh*
  Lectured on spectral methods
  Managed and marked computational assessment for 65 students
  Nominated for Outstanding Course (Edinburgh University Students' Association Teaching Awards)

- **Lecturer** — October – November 2021
  Computational Methods for Data Driven Modelling (PhD level) — *University of Edinburgh*
  Lectured on: optimization, gradient descent, convex optimization, mirror descent
  Managed and marked assessment for 18 students.

- **Tutor** — January - April 2023
  Continuous Optimisation (MSc) — *University of Oxford*
  Leading in-person tutorials and mentoring a teaching assistant. Leading revision classes

- **Tutor** — October - December 2022
  Networks (4th year BSc/MSc) — *University of Oxford*
  Leading in-person tutorials and mentoring a teaching assistant

- **Teaching assistant** — 2021 – 2022
  Numerical Partial Differential Equations (4th/5th year BSc/MSc) — *University of Edinburgh*
  Leading Zoom and in-person workshops and Python computer labs

- **Teaching assistant** 2017 – 2019
  Numerical Methods for Financial Engineering (MSc Finance) *University of Reading*
  Co-leading computer practicals for 16 students assisting with Visual Basic

- **Teaching assistant** 2016 – 2019
  Linear Algebra (1st year BSc) *University of Reading*
  Co-leading weekly workshops for 30 students, and marking termly summative assignments for 210 students

- **Teaching assistant** 2015 – 2016
  Linear Algebra (1st year BSc) *University of Bath*
  Leading and preparing weekly tutorials for 16 students. Marking weekly formative problem sets for 30 students

Supervision

- **Group MSc project** January – March 2023
  University of Oxford
  Designing, supervising and mentoring 5 MSc students through an 8 week project. Marking oral and written presentations.

- **MSc project supervision** Summer 2020 and 2021
  University of Edinburgh
  Sole supervisor for 3× students on Computational and Applied Mathematics MSc and 2×Operational Research MSc projects. Students obtained Distinction (×2), Merit (×2), and Pass.

Leadership

- **Workshop co-organiser** April/July/September 2022
  Universities of Edinburgh, Bologna and KU Leuven
  Co-organiser of 3 hybrid workshops as part of the TOC4Deep Una Europa grant, hosted at the University of Edinburgh (April), University of Bologna (July) and KU Leuven (September), https://site.unibo.it/toc4deep/en/agenda

- **Workshop co-organiser** April 2022
  International Centre for Mathematical Sciences, Edinburgh
  Recent Advances in Numerical Linear Algebra for PDEs, Optimization, and Data Assimilation Conference website

- **Communications in Numerical Linear Algebra** September 2020 – June 2021
  Online seminar series
  Co-founder and co-organiser of CommNLA, online seminar series for early career researchers in Numerical Linear Algebra
  Hosted traditional seminars, panel discussions, and industry themed sessions. 41 seminars talks to date.
  Between 15-40 live viewers on Zoom/YouTube per session. 140 subscribers to the YouTube channel and 3,454 views of recorded videos.

- **Communications Officer/Secretary** October 2016 – September 2018
  University of Reading SIAM–IMA Student Chapter
  Co-organised annual conference for over 50 *PhD students from across the South West (June 2017 and May 2018).*
  Awarded £100 *additional funding to enable gender diversity of keynote speakers.*

- **Trustee** 2016 – 2018
  Reading University Students' Union
  Served as Deputy Chair, 2017 – 2018.
  Represented the views of post-graduate students.
  Ensured the organisation continued to act in the best interest of its members.

Reviewing

Peer reviewed papers for journals including BIT Numerical Mathematics, Tellus A: Dynamic Meteorology and Oceanography, Geoscientific Model Development, Computers & Operations Research, Electronic Transactions in Numerical Analysis.

Professional Memberships

- Society for Industrial and Applied Mathematics
- Edinburgh Mathematical Society
- GAMM Activity Group on Optimization with Partial Differential Equations
- GAMM Activity Group on Applied and Numerical Linear Algebra
- UK Higher Education Academy

Outreach activities

- Delivered a taster lecture at Piscopia Initiative Forum. (September 2020)
- Ran online presentation and discussion sessions to families as part of the Skype a Scientist Programme. (April 2020)
- Designed and led outreach sessions for 10 Year 8 classes at Bulmershe School, Woodley. Demonstration of how curriculum mathematics is used in real-world scenarios and research. (May and June 2019)
- Completed University of Reading Students in Schools programme, weekly volunteering in GCSE mathematics classes. (March – July 2019)
- Undertook school visits to promote STEM careers with 14–18 year old students. (January 2018 – June 2019)
- Blogs about conference attendance and summarising research including: lay summary of recent paper NCEO website, article in Mathematics Today (August 2017) about SIAM Student Conference.

Training courses

- NERC training course Oceans in Weather and Climate — 12th – 16th March 2018
- EUMETSAT/ECMWF NWP-SAF Satellite Data Assimilation — 3rd – 7th April 2017
- ECMWF Data Assimilation Course — 27th – 31st March 2017
- Met Office internal training: Using Rose and Cylc — 9th – 10th May 2016

Computing

Highly proficient with Unix, Matlab, Python, LaTeX
Significant experience with high performance computing, using the Met Office Rose/Cylc system, netCDF

Languages

Native English speaker, fluent in French (C1 level)