Dr Jemima M. Tabeart

Contact Information

School of Mathematics
University of Edinburgh
EH9 3FD

jemima.tabeart@ed.ac.uk
Website: jemimat.github.io/

Brief Narrative Summary

I am a postdoctoral researcher in mathematics with a focus on numerical linear algebra and data assimilation for high dimensional applications. To date my work has considered mathematical and heuristic techniques to improve the solution of large scale iterative solvers, via the development of new preconditioners and reconditioning approaches. The projects I have worked on are wide-ranging, incorporating theoretical linear algebra, the design and coding of numerical testbeds, and complex experiments using 1D-Var, 4D-Var and NEMOVAR schemes at the UK Met Office. I have five published papers and two in review. I have experience working in cross-institution, interdisciplinary programmes both during my PhD and my time as a Postdoctoral Semester Fellow at ICERM. I won a number of awards for research during my studies, and was awarded the Chancellor's Prize for Best Undergraduate Student in 2015. I am also a co-founder of the Communications in Numerical Linear Algebra (CommNLA) online seminar series.

Employment

Postdoctoral Research Associate, School of Mathematics, University of Edinburgh, October 2019 – Present
Project: Modern Linear Algebra for PDE-Constrained Optimisation Models for Huge-Scale Data Analysis, Grant EP/S027785/1, working with Dr John W. Pearson.

Semester Postdoctoral Fellowship, Institute for Computational and Experimental Research in Mathematics (ICERM), Brown University January 2020 – April 2020
Fellowship for the program "Model and dimension reduction in uncertain and dynamic systems"

Education

PhD, EPSRC Centre for Doctoral Training in Mathematics of Planet Earth, **University of Reading**, October 2016 – November 2019
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
- In collaboration with NCEO 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 in practice.

MRes in Mathematics of Planet Earth (Distinction), 2015 – 2016
EPSRC Mathematics of Planet Earth Centre for Doctoral Training
University of Reading & **Imperial College London**,

- Project Title: *On the variational data assimilation problem with non-diagonal observation weighting matrices*
- Supervisors: Dr Amos S. Lawless, Professor Sarah L. Dance, Professor Nancy K. Nichols, and Dr Joanne A. Waller
- Taught Courses: *Partial Differential Equations, Data & Uncertainty, Dynamical Systems, Numerical Analysis, Data Assimilation*

MMath (1st Class Honours), Mathematics with Study Year Abroad, **University of Bath**, 2011 – 2015

- 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.
- MMath Project Title: *Models for Walking Droplets and Their Confined States*
  Supervisor: Dr Paul Milewski
- Awarded Chancellor's Prize for best final year undergraduate student

Research Experience

Visiting Researcher, UK Met Office (July/August 2018)
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, University of Bath (July/August 2014)
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 programs, graphs, and final report produced provided a starting point for my undergraduate research project.

Research Assistant, University of Bath (July/August 2011)
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).

Publications

Published

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

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

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

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

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

Under review

J. M. Tabeart, S. L., Dance, A. S. Lawless, N. K. Nichols, and J. A. Waller. "The conditioning of least squares problems in preconditioned variational data assimilation", *Submitted to Numerical Linear Algebra with Applications*, Preprint arXiv:2010.08416

E. Qian, **J. M. Tabeart**, C. Beattie, S. Gugercin, J. Jiang, P. R. Kramer, A. Narayan "Model Reduction of Linear Dynamical Systems via Balancing for Bayesian Inference", *Submitted to Journal of Scientific Computing*

In Preparation

J. M. Tabeart and J. W. Pearson "Parallelisable saddle point preconditioners for weak constraint 4D-Var", *In preparation*

Funding

Scholarships and fellowships

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

Travel grants

- Research visit to RIKEN, Japan (January 2019): £1500
- Workshop on Sensitivity Analysis and Data Assimilation (August 2018): €820 euros +£200 from DARE training fund.
- International Workshop on Climate Change and Natural Disasters: £4000
- Imperial College SIAM student conference (June 2018): travel funding.

Prizes and awards

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 Speaker

- June 2022 (rescheduled from 14th – 19th June 2020), Householder Symposium XXI
- June 2022 (rescheduled from 24th – 26th June 2020), 7th IMA Conference on Numerical Linear Algebra and Optimization, Birmingham, UK
- 11th – 14th July 2021, 31st European Conference on Operational Research (EURO XXXI), Athens, Greece
  Preconditioners for saddle point weak-constraint 4D-Var with correlated observation errors
- 14th April 2021, Reading Data Assimilation Research Centre seminar, University of Reading, UK
  Parallelisable preconditioners for saddle point weak-constraint 4D-Var
- 30th July 2020, Reading SIAM-IMA student seminar series, University of Reading, UK
  How to use reduced order models in the Ensemble Kalman filter
- 29th May 2020, Scottish Numerical Methods Network, Workshop on Inverse Problems and Optimisation for PDEs, University of Edinburgh, UK
  Why and how should we use correlated observation errors in data assimilation?
- 1st April 2020, NRL seminar, Naval Research Laboratory, Monterey, US
  Including correlated observation error in variational data assimilation problems
- 25th September 2019, Royal Meteorological Society Data Assimilation Special Interest Group Meeting, Reading, UK
  Using reconditioning methods to reduce the cost of using correlated observation error information: theory and practice

- 1st – 2nd July 2019, Advances in Linear Algebra and Huge-Scale Optimization, ICMS, Edinburgh, UK
  Accounting for correlated errors in data assimilation: using linear algebra to improve computational efficiency
- 28th January 2019, Data Assimilation Seminar Series, RIKEN Centre for Computational Science, Kobe, Japan
  Using reconditioning to study the impact of correlated observation errors in the Met Office 1D-Var system
- 2nd November 2018, Environmental Research DTP Student Seminar Series, University of Oxford, UK
  How to use observation error information to improve weather forecasts
- 28th August 2018, Met Office Ocean Group Seminar Series, Exeter, UK
  Estimating correlated observation errors for SST
- 11th June 2018, Imperial College SIAM student conference, Imperial College London UK
  How to use correlated covariance information without breaking the bank
- 7th February 2018, Imperial College Junior Applied Mathematics Seminar, Imperial College London, UK
  How to use correlated covariance information without breaking the bank

Invited Participant

- 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.
- 5th – 6th February 2018, NCEO Researchers' Forum, University of Leicester, UK
  Poster: Accounting for correlated observation errors in variational data assimilation
- 29th August – 2nd September 2017, International Workshop on Climate Change and Natural Disasters, Cemaden/INPE, São Jose dos Campos, Brazil
- 19th – 20th March 2018, MPECDT Industrial Study Group, University of Reading, UK
- 20th – 21st March 2017, MPECDT Industrial Study Group, Imperial College London, UK

Selected contributed presentations
International conferences

Oral presentations

- 17th – 21st May 2021, SIAM Conference on Applied Linear Algebra, New Orleans, USA
  Preconditioners for saddle point weak-constraint 4D-Var with correlated observation errors
- 24th November 2020, Sparse days, Cerfacs, Toulouse, France
  Preconditioners for saddle point weak-constraint 4D-Var with correlated observation errors
- 15th – 19th July 2019, International Congress on Industrial and Applied Mathematics, Valencia, Spain
  How to use observation error information to improve weather forecasts
- 21st – 24th January 2019, 7th International Symposium on Data Assimilation, RIKEN Centre for Computational Science, Kobe, Japan
  Improving the conditioning of estimated observation error covariance matrices
- 1st – 6th July 2018, Workshop on Sensitivity Analysis and Data Assimilation in Meteorology and Oceanography, Meli Ria Hotel, Aveiro, Portugal
  Improving the condition number of estimated covariance matrices

Poster presentations

- 21st – 24th January 2019, 7th International Symposium on Data Assimilation, RIKEN Centre for Computational Science, Kobe, Japan
  The impact of using reconditioned correlated observation error covariance matrices

in the Met Office 1D-Var system

National conferences

Oral presentations

- 19th – 21st September 2018, CliMathNet Conference, University of Reading, UK
  Improving the condition number of estimated covariance matrices
- 27th – 30th June 2017, National Centre for Earth Observation and Centre for Earth Observation Instrumentation annual conference, University of Bath, UK
  Accounting for correlated observation errors in variational data assimilation
- 19th June 2017, Imperial College SIAM student conference, Imperial College London, UK
  Accounting for correlated observation errors in variational data assimilation

Poster presentations

- 4th – 7th September 2018, National Centre for Earth Observation Conference, University of Birmingham, UK
  Improving the condition number of estimated covariance matrices
- 30th April – 1st May 2018, LMS Women in Maths Days, Isaac Newton Institute, Cambridge
  Improving the condition number of estimated covariance matrices
- 21st March 2018, MPECDT Jamboree, University of Reading, UK
  Improving the condition number of estimated covariance matrices
- 22nd March 2017, MPECDT Jamboree, Imperial College, London, UK
  Accounting for correlated observation errors in variational data assimilation

Research Leadership

Communications Officer/Secretary, University of Reading SIAM-IMA Student Chapter October 2016 – September 2018

- Co-organised annual conference for over 50 PhD students from across the South West (June 2017 and May 2018).
  Invited and liaised with keynote speakers, organised travel, booked rooms.
  Awarded £100 additional funding to enable gender diversity of keynote speakers.
- Organising welcome week activities for new PhD students in the department.

Student representative, *Mathematics of Planet Earth Centre for Doctoral Training* October 2015 – June 2019

- Responsible for communicating student concerns and comments to the CDT staff.
- Inviting speakers and organising mini-symposium at annual Jamboree.
- Student representative on committees including the Stakeholder and Steering Committees
- Preparing student reports for EPSRC and internal reviews.

Reviewing

Peer reviewed papers for journals including Tellus A and Computers & Operations Research.

Professional Memberships

Society of 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

Supervision Experience

MSc project supervision: June - August 2020

- Sole supervisor for Computational and Applied Mathematics MSc project (student obtained a Distinction)
- Sole supervisor for Operational Research MSc project (student obtained a Merit)

Teaching Experience

Teaching Assistant

- Numerical Partial Differential Equations (4th/5th year BSc/MSc), *University of Edinburgh*, January – March 2021:

Zoom workshops for 10 students

- Numerical Methods for Financial Engineering (MSc Finance), *University of Reading*, January – March 2017 – 2019:
  Co-leading computer practicals for 16 students assisting with Visual Basic
- Linear Algebra (1st year BSc), *University of Reading* ,September – March 2016 – 2018:
  Co-leading weekly workshops for 30 students
- Data & Uncertainty (MPECDT MRes) *Imperial College/University of Reading* October – December 2016:
  Leading and preparing occasional tutorials for 16 students
- Algebra (1st year BSc), *University of Bath*, October – March 2014 – 2015:
  Leading and preparing weekly tutorials for 16 students

Marking

- Numerical Partial Differential Equations, *University of Edinburgh*, March 2021
  Summative assignments for 50 students
- Linear Algebra/Calculus, *University of Reading*, March 2017 – 2018
  Summative assignments for 210 students.
- Algebra, *University of Bath*, October – March 2014 – 2015
  Weekly formative problem sets for 30 students.

Other professional activities

Communications in Numerical Linear Algebra September 2020 – present

- Co-founder of CommNLA, online seminar series for early career researchers in Numerical Linear Algebra.
- Hosted traditional seminars, panel discussions and industry themed sessions.
- Between 15-40 live viewers on Zoom/Youtube per session. 124 subscribers to the Youtube channel and 2,536 views of recorded videos.
- Managed social media for seminar series.

Outreach activities January 2018 – present

- Taster session at Piscopia Initiative Forum. (September 2020)
- Skype a Scientist Programme (April 2020)
- Outreach sessions for 10 Year 8 classes at Bulmershe School, Woodley using a session I had designed to demonstrate how 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 maths classes. (March – July 2019)
- 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.

Trustee, Reading University Students' Union 2016 – 2018

- 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.

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
Some experience with IDL

Languages	Native English speaker, fluent in French (C1 level)