Dr Jemima M. Tabeart

Contact Information

School of Mathematics
University of Edinburgh
EH9 3FD

jemima.tabeart@ed.ac.uk
Website

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 reaching, incorporating theoretical linear algebra, the design and coding of small scale 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 semester fellow at ICERM. 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

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

Ph.D. "On the treatment of correlated observation errors in data assimilation", Awarded: November 2019
EPSRC Mathematics of Planet Earth Centre for Doctoral Training, **University of Reading**,

- 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.

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

- Taught Courses: *Partial Differential Equations, Data & Uncertainty, Dynamical Systems, Numerical Analysis & Data Assimilation*
- 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

MMath (Hons) 1st, 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.
- MMath Project Title: *Models for Walking Droplets and Their Confined States*
  Supervisor: Dr Paul Milewski

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

Jemima 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" *Quarterly Journal of the Royal Meteorological Society* 146 (728), 1372-1390 https://doi.org/10.1002/qj.3741

Jemima M. Tabeart, S. L. Dance, A. S. Lawless, N. K. Nichols and J. A. Waller 'Improving the condition number of estimated covariance matrices' *Tellus A* 72.1 (2020): 1-19. https://doi.org/10.1080/16000870.2019.1696646

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

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

Under review

Jemima 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 Numerical Linear Algebra with Applications* arXiv preprint arXiv:2010.08416

E. Qian, **Jemima 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

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

FUNDING

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): £47.30 travel.

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.

PRIZES AND AWARDS

Best group project: MPE CDT Industrial Study Group, March 2018.

Best group project: presenting NCEO science to an industrial audience, NCEO Researchers' Forum, February 2018.

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.

COMPUTING

Confident 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)

CONFERENCES

Invited Speaker

- Reading SIAM-IMA student seminar series 30th July 2020 *How to use reduced order models in the Ensemble Kalman filter*
- Scottish Numerical Methods Network, Workshop on Inverse problems and optimisation for PDEs 29th May 2020
  Why and how should we use correlated observation errors in data assimilation?
- NRL seminar, Naval Research Laboratory, Monterey, US (remote) 1st April 2020
  Including correlated observation error in variational data assimilation problems
- Royal Meteorological Society Data Assimilation, Reading, UK 25th September, 2019
  Using reconditioning methods to reduce the cost of using correlated observation error information: theory and practice
- Advances in Linear Algebra and Huge-Scale Optimization, ICMS, Edinburgh 1st - 2nd July 2019
  Accounting for correlated errors in data assimilation: using linear algebra to improve computational efficiency
- Environmental Research DTP Student Seminar Series *How to use observation error information to improve weather forecasts*
  University of Oxford 2nd November, 2018
- Ocean Group Seminar Series: *Estimating correlated observation errors for SST*
  UK Met Office, Exeter, UK 28th August, 2018.
- Imperial College SIAM student conference *How to use correlated covariance information without breaking the bank*
  Imperial College London, UK 11th June 2018.
- Imperial College Junior Applied Mathematics Seminar *How to use correlated covariance information without breaking the bank*

Imperial College London, UK 7th February 2018.

Invited Participant

- ECMWF/EUMETSAT NWP SAF Workshop on the treatment of random and systematic errors in satellite data assimilation for NWP 2-5 November 2020.
- NCEO Researchers' Forum, February 2018, *Accounting for correlated observation errors in variational data assimilation*
  University of Leicester, UK (Poster) 5th – 6th February 2018
- International Workshop on Climate Change and Natural Disasters,
  Cemaden/INPE, São Jose dos Campos, Brazil (Oral) 29th August – 2nd September 2017
- MPECDT Industrial Study Group
  Imperial College London, London, UK 20th – 21st March 2017
  University of Reading, UK 19th – 20th March 2018

Cancelled/postponed due to COVID-19

- Householder Symposium XXI, 14-19 June 2020
- 7th IMA Conference on Numerical Linear Algebra and Optimization

Selected contributed presentations

International conferences

Oral presentations

- 31th European Conference on Operational Research (EURO XXXI), *Preconditioners for saddle point weak-constraint 4D-Var with correlated observation errors*
  Athens, Greece, 11th-14th July 2021
- SIAM Conference on Applied linear algebra *Preconditioners for saddle point weak-constraint 4D-Var with correlated observation errors*
  New Orleans, USA (remote) 17th - 21st May 2021
- Sparse days *Preconditioners for saddle point weak-constraint 4D-Var with correlated observation errors*
  Cerfacs, Toulouse, France (remote) 24th November 2020
- International Congress on Industrial and Applied Mathematics *How to use observation error information to improve weather forecasts*
  Valencia, Spain 15th-19th July 2019
- 7th International Symposium on Data Assimilation: *Improving the conditioning of estimated observation error covariance matrices*
  RIKEN Centre for Computational Science, Kobe, Japan 21st-24 January 2019
- Workshop on Sensitivity Analysis and Data Assimilation in Meteorology and Oceanography: *Improving the condition number of estimated covariance matrices*
  Meli Ria Hotel, Aveiro, Portugal 1st-6th July 2018

Poster presentations

- 7th International Symposium on Data Assimilation *The impact of using reconditioned correlated observation error covariance matrices in the Met Office 1D-Var system*
  RIKEN Centre for Computational Science, Kobe, Japan 21st-24 January 2019

National conferences

Oral presentations

- CliMathNet Conference *Improving the condition number of estimated covariance matrices*
  University of Reading, UK 19th-21st September 2018
- NCEO CEOI annual conference *Accounting for correlated observation errors in variational data assimilation*
  University of Bath, UK 27th-30th June 2017.

Poster presentations

- National Earth Observation Conference *Improving the condition number of estimated covariance matrices*
  University of Birmingham, UK 4th-7th September 2018

- LMS Women in Maths Days *Improving the condition number of estimated covariance matrices*
  Isaac Newton Institute, Cambridge 30th April - 1st May 2018

Student and internal conferences

Oral presentations

- Imperial College SIAM student conference *Accounting for correlated observation errors in variational data assimilation*
  Imperial College, London, UK 19th June 2017.

Poster presentations

- MPECDT Jamboree *Improving the condition number of estimated covariance matrices*
  University of Reading UK 21st March 2018
- MPECDT Jamboree *Accounting for correlated observation errors in variational data assimilation*
  Imperial College, London, UK 22nd March 2017

Training courses

- NERC training course Oceans in Weather and Climate 12-16th March 2018
- EUMETSAT/ECMWF NWP-SAF Satellite Data Assimilation 3rd - 7th April 2017
- ECMWF Data Assimilation Course 27th-21st March 2017
- Met Office internal training: Using Rose and Cylc 9th-10th May 2016

Research Leadership

Communications Office/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* October 2015 –

- 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.

Supervision

MSc project supervision: June - August 2020

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

Reviewing

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

Professional memberships

Society of Industrial and Applied Mathematics
Edinburgh Mathematical Society

Teaching Experience

Teaching Assistant

- January - March 2021: Numerical PDEs (3rd year BSc)
  Zoom workshops for 10 students
- January – March 2017-9: Numerical Methods for Financial Engineering (MSc Finance)
  Co-leading computer practicals for 16 students assisting with Visual Basic activities
- September – March 2016-2018: Linear Algebra (1st year BSc)
  Co-leading weekly workshops for 30 students

- October – December 2016: Data & Uncertainty (MPECDT MRes)
  Leading and preparing occasional tutorials for 16 students
- October – March 2014/15: Algebra (1st year BSc)
  Leading and preparing weekly tutorials for 16 students

Marking

- March 2021: Numerical PDEs - *Summative assignements for 50 students*
- March 2017-18: Linear Algebra/Calculus - *summative assignments for 210 students.*
- October - March 2014-15: Algebra - *weekly formative problem sets for 30 students.*

Other professional activities

Communications in Numerical Linear Algebra September 2020 –

- Co-founder of CommNLA, online seminar series for early career researchers in Numerical Linear Algebra.
- Hosted traditional seminars, panel discussions and industry themed sessions.
- Managed social media for seminar series.

Outreach activities January 2018 –

- 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 maths is used in real-world scenarios/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 –)
- Blogs about conference attendance and summarising research including: lay summary of recent paper NCEO website, article in Mathematics Today (August 2017) about student SIAM 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.