Dr. Matt Amos

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An experienced data scientist passionate about solving important environmental challenges. Quick learner with a strong background in machine learning, climate science and physics. Motivated by tricky problems and working with others for the good of people.

Employment

2021–Present
Senior Research Associate - Mathematics and Statistics Dept., Lancaster University

Leading independent and collaborative research to build statistical models for climate change and the environment. Producing innovative advances that couple expert knowledge, climate models and multiple streams of data within state-of-the-art machine learning models.

Current projects:

- Probabilistic climate forecasting using Gaussian processes and optimal transport
- Developing sparse methods for hierarchical Gaussian processes
- High resolution air quality predictions using neural processes and Bayesian neural networks
- Graph Gaussian processes for modelling street level air quality

Education

2017-2021
PhD Atmospheric Science - Lancaster University and the British Antarctic Survey

Title: Data science techniques to improve the robustness, accuracy and utility of chemistry-climate model ensembles.

Summary:

- Developed heteroscedastic Bayesian neural networks to assimilate stratospheric ozone data
- Built and tested custom machine learning models using remotely sensed data
- Advanced climate model ensemble assimilation techniques by creating innovative statistical methods
- Produced robust up-to-date estimates of Antarctic ozone hole recovery using a model weighting framework

MPhys Physics Hons with Study Abroad Year - Lancaster University (First)
2013-2017

MPhys dissertation - Nonlinear wave interactions and the physical origin of rogue waves in the ocean.

Experience

Computing & Programming
Skilful and experienced with a typical python and ML development tech stack. Please see links provided for examples.

- **Code**: UNIX systems, conda, git, VSCode, pytest
- **ML**: tensorflow, JAX, GPflow, sklearn
- **Big data**: xarray, dask, pandas/polars, geopandas, SQL
- **Cloud**: GCP, AWS (Cloud Technical Essentials)
- **Distributed computing**: SLURM, LSF on large compute clusters
- **Visualisation**: plotly, matplotlib, dash, seaborn, blender, Adobe Illustrator
- **Publishing**: GitHub, LaTeX, binder

Statistics & Machine learning
Accomplished statistician producing innovative machine learning solutions. Particularly knowledgeable in:

- Bayesian neural networks (deep learning)
- Hierarchical and sparse Gaussian processes
- Model ensembling
- Hybrid modelling
- Bayesian inference
- Geospatial methods
- Time series analysis
- Optimal transport
- Time-frequency analysis
- Generative adversarial networks

Responsibilities & Teaching

- Manage and complete interdisciplinary research, including mentoring postgraduate students
- Co-organiser of a departmental coding support group
- Data manager on a petascale computing platform
- Taught data analysis methods, maths, machine learning and atmospheric science
- Conference organising committee for the 2021 International Global Atmospheric Chemistry conference (IGAC)
- Peer reviewer for Nature, Geoscientific Model Development, Journal of Geophysical Research, Atmospheric Chemistry and Physics
- Designing and risk assessing data collection campaigns
- Member of the statistics working group for the tropospheric ozone assessment report
- Lectured at an environmental science summer school about stratospheric ozone
- Led and instructed hundreds of young adults in high risk outdoors activities

Funding & Awards

- Google cloud credits $5000 (2020) from a successful proposal to use deep generative models to create synthetic climate data
- Google cloud credits $5000 (2019) from a successful proposal to infill historic ozone records with Bayesian neural networks
- Poster prize at the Lancaster Physics Conference (2017)
- Lancaster University Physics Award for 2nd year excellence (2015)

Publications (* denotes equal authorship)

M. Amos* et al. **Identifying latent climate signals using sparse hierarchical Gaussian processes** *Accepted at NeurIPS 2022 Workshop on Gaussian Processes*, (2022). Code

P.J. Young et al. **Update on Global Ozone: Past, present and future, Chapter 3 in Scientific Assessment of Ozone Depletion: 2022**. *World Meteorological Organization* (2022).

M. Amos. **Data science techniques for improving the robustness, accuracy, and utility of chemistry-climate model ensembles**. *Thesis*, (2021). Link

U. Sengupta*, M. Amos*, et al. **Ensembling geophysical models with Bayesian neural networks**. *Advances in Neural Information Processing Systems 33*, (2020). Link. Code

M. Amos et al. **Projecting ozone hole recovery using an ensemble of chemistry-climate models weighted by model performance and independence**. *Atmospheric Chemistry and Physics*, (2020). Link. Code

T. Mondain-Monval, M. Amos et al. **Flyway-scale analysis reveals that the timing of migration in wading birds is becoming later**. *Ecology and Evolution*, (2021). Link

Submitted/in prep work

M. Amos*, T. Pinder*. **Probabilistic climate model projections, using Gaussian Processes and Optimal Transport** *In prep.* Code

R. Duncan, M. Amos, et al. **A skew Kalman filter approach for bias correction and infilling missing data, demonstrated for surface ozone** *In review with Environmetrics*

M. Amos*, et al. **LancasterAQ: A High Resolution Street Level Dataset of Ultrafine Particles** *Submitted.* Link. Code

M. Amos, et al. **A continuous vertically resolved ozone dataset from the fusion of chemistry climate models with observations using a Bayesian neural network**. *Environmental Data Science*, (In review). Link. Code

T. Pinder, D. Booker, M. Amos et al. **Street level air quality modelling using graph Gaussian processes: A demonstration for Lancaster, UK.** *In prep.*