First workshop of the Glasgow-Edinburgh Extremes Network (GLE^{2}N)

Advances in EVT theory, methodology, and real-world impact

11 December 2025 University of Glasgow, UK

School of Mathematics & Statistics

Mathematics & Statistics Building, 32 University Place, Glasgow, G12 8QQ

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1 About the workshop

This one-day workshop marks the first in-person meeting of the Glasgow–Edinburgh Extremes Network (GLE²N), taking place in December 2025 at the University of Glasgow. Since its launch in 2024, GLE²N has established a regular programme of online seminars, creating a vibrant community around extreme value theory and statistical risk analysis. The December event celebrates the network's one-year anniversary and provides an opportunity to strengthen connections across Scotland and beyond.

The workshop will bring together a small group of around 25–30 participants, including students, early-career researchers, established academics, and colleagues from industry. It will focus on advances in extreme value theory and its applications to real-world problems, fostering collaborative discussions across disciplines and career stages.

Goals

- Facilitate dialogue on challenges and opportunities in modelling extremes.
- Encourage collaboration by bringing together researchers from academia and applied fields.
- Identify future directions for methodological and applied development and foster knowledge exchange.

We hope that this collective effort will pave the way for stronger interdisciplinary connections and more impactful applications of statistics of extremes.

2 Location

We will meet in Room 237C, located on the ground floor of the ARC Building (Google map). The building is just a 6-minute walk from Hillhead subway station.

3 Programme overview

09:00 - 09:15 — GLEN and workshop introduction

09:15 - 09:45 — Invited talk by Kirstin Strokorb

09:45 - 10:15 — Invited talk by Paul Northrop

10:15 - 10:40 — Coffee break

10:40 - 11:00 — Contributed talk by Johnny Lee

11:00 - 11:20 — Contributed talk by Mengran Li

11:20 - 11:40 — Contributed talk by Simon Brown

11:40 - 12:00 — Contributed talk 4

12:00-13:30 — Lunch (not included)

13:30 - 14:00 - Invited talk by Alison Poulston

14:00 - 14:30 - Invited talk by Jon Tawn

14:30-15:00 — Coffee break

15:00-17:00 — Discussion (with a 10min break in between)

17:00-onwards — Drinks & dinner (not included)

4 Abstracts

The talks progress from theoretical advances in modelling extremes, through modern Bayesian and causal methods, to applied frameworks for AI-driven environmental risk. This sequence highlights the continuum from statistical foundations to practical applications in understanding and managing extreme events.

4.1 Kirstin Strokorb (University of Bath)

Thematic focus: *Foundations and processes*

Title: Modelling of extreme excursions of stochastic processes in space and time: Foundations for a new tail process

Summary. Extreme excursions of stochastic processes in space and time often appear to be more localized the more extreme they are. While classical stochastic processes in extreme value theory cannot model this effect, we introduce an adapted version, where a suitable domain-scaling can be incorporated to accommodate this behaviour. Our theory is inspired by the triangular array convergence of maxima of Gaussian processes to a Brown–Resnick process and turns out to be natural in this context. We study key properties of the resulting tail process and demonstrate its ability to approximate conditional exceedance probabilities of a range of stochastic processes. Joint work with Marco Oesting and Raphael de Fondeville (based on the preprint https://publications.mfo.de/handle/mfo/4206).

4.2 Paul Northrop (UCL)

Thematic focus: *Model refinements and robustness*

Title: Accounting for missing data when modelling block maxima

Summary. Modelling block maxima using the generalised extreme value (GEV) distribution is a classical and widely used method for studying univariate extremes. It allows for theoretically motivated estimation of return levels, including extrapolation beyond the range of observed data. A frequently overlooked challenge in applying this methodology comes from handling datasets containing missing values. In this case, one cannot be sure whether the true maximum has been recorded in each block, and simply ignoring the issue can lead to biased parameter estimators and, crucially, underestimated return levels. We propose an extension of the standard block maxima approach to overcome such missing data issues. This is achieved by explicitly accounting for the proportion of missing values in each block within the GEV model. Inference is carried out using likelihood-based techniques, and we propose an update to commonly used diagnostic plots to assess model fit. We assess the performance of our method via a simulation study, with results that are competitive with the "ideal" case of having no

missing values. The practical use of our methodology is demonstrated on sea surge data from Brest, France, and air pollution data from Plymouth, U.K.

4.3 Johnny Myung Won Lee (University of Edinburgh)

Thematic focus: *Modern Bayesian/regularisation methods*

Title: BLAST: A Bayesian Lasso Tail Index Regression Model With an Application to Extreme Wildfires

Summary. The emergence of unprecedented extreme events highlights the critical need to quantitatively investigate these phenomena as well as their drivers. Motivated by this, in this paper we propose a novel regression-based approach to model extreme events and their underlying risk factors. Our methodological contribution leverages Bayesian regularization within a generalized additive framework for tail index regression, enabling a more flexible approach to analyzing extreme values. Our framework revolves around a conditional Pareto-type specification, enriched by the inclusion of Bayesian Lasso-type shrinkage priors and further refined through low-rank thin plate splines basis expansion. The proposed approach admits a neural model representation and it balances parsimony and flexibility through a prior that favors linear effects by penalizing complexity, while allowing nonlinear effects when justified by the data. The performance of the proposed method is validated through a simulation study that recovers the true covariate-adjusted tail index over a variety of scenarios along while regularizing the covariates. Our model is applied to investigate extreme wildfire events in Portugal—such as the devastating wave of wildfires of October 2017—analyzing how the magnitude of such occurrences relates with other risk factors.

Joint work with. M. de Carvalho, D. Paulin, S. Pereira, R. Trigo and C. da Camara

4.4 Mengran Li (University of Glasgow)

Thematic focus: *Tail-focused causal inference for attribution*

Title: Tail-calibrated quantile treatment effects for extreme event attribution

Summary. Extreme event attribution (EEA) usually relies on climate model ensembles or reanalysis-based gridded products, but both sources tend to underestimate extremes due to model biases and spatial smoothing. Observational data provides a more direct perspective, but pose major statistical challenges, including the need to control for confounding factors and the lack of tools specifically designed for inference in the tails of the distribution. We propose a Tail-calibrated Inverse Estimating Equation (TIEE) framework that integrates extreme value theory with causal inference to quantify how anthropogenic forcing has shifted the magnitude of extreme precipitation, beyond the range where standard quantile treatment effect estimators remain valid. Our method is compatible with inverse probability weighting and doubly robust signal functions and yields consistent inference under mild conditions. We benchmark

performance under light- and heavy-tailed simulated scenarios and apply our framework to daily precipitation data from EEAR-Clim, comparing pre-industrial and modern periods to assess differences in tail behaviour across Austrian Alps. To account for large-scale circulation and thermodynamic influences, we include covariates derived from the ERA5 reanalysis as confounders in the analysis. The findings reveal shifts in high quantiles and demonstrate that tail-aware causal methods can provide new insights into the changing nature of climate extremes.

4.5 Simon Brown (Met Office)

Thematic focus: *Tail-focused causal inference for attribution*

Title: Recent advances in non-stationary univariate and conditional EVT applied to present and future meteorological hazards

Summary. Changing extreme weather could be the sharp end of climate change for society. However, good adaptation decisions will require good estimates of future hazards, particularly due to the potentially high cost of adapting. Furthermore, meteorological hazards have both spatial and temporal characteristics that are relevant to impacts. Quantifying these features and their future changes is very challenging. Here we present work aimed at addressing this need.

4.6 Alison Poulsto (JBA Risk Managment)

Thematic focus: *Applications with AI and environmental integration*

Title: Evaluating extremes in AI-generated weather for flood risk assessment

Summary. Accurate estimation of flood risk requires large ensembles of plausible meteorological scenarios that extend beyond the observational record, particularly to capture low-probability, high-impact events. We introduce PrecipHENS, a machine learning–based weather generator built on the Spherical Fourier Neural Operator (SFNO) framework and coupled with a diagnostic precipitation model, designed to generate thousands of synthetic European winter seasons of temperature and precipitation at 0.25° resolution. We benchmark PrecipHENS against a conditional multivariate extreme value model commonly used in industry, with a focus on evaluating extremes within the generated ensembles. Evaluation metrics include preservation of observed climatology, spatial and temporal dependence structures, and the statistical and physical realism of extreme precipitation behaviour. Using the Elbe basin as a case study, we show that PrecipHENS reproduces key climatological features while producing a greater diversity of spatially coherent extremes than the benchmark. Our results highlight both the potential and the challenges of AI-based weather generation for hydrological risk

applications. We invite discussion on diagnostic frameworks for evaluating extremes in high-dimensional generative models and on approaches to ensure physically consistent extrapolation beyond the training climatology.

5 Invited speakers

Paul Northrop is a Professor of Statistical Science at University College London. His research interests lie mainly in developing and applying statistical methods for the environmental sciences, with application areas including off-shore engineering, climate science and hydrology. A particular focus is in developing user-friendly methods and software for the modelling of extreme values.

Alison Poulston is technical lead for statistics at JBA Risk Management, interested in the representation of extremes in weather modelling and how their uncertainty propagates through to our understanding of risk from flooding, under present and future conditions. She has a PhD in environmental Bayesian statistics from the University of Sheffield. JBA Risk Management is the global leader in flood risk science. Affectionately known as The Flood People®, our flood maps, catastrophe models, and data are used by some of the world's largest insurers, financial institutions, property companies and governments.

Kirstin Strokorb is a Senior Lecturer in Statistics at the University of Bath, where she joined the Statistics research group of the Department of Mathematical Sciences in 2025. Previously, she was Senior Lecturer in the School of Mathematics of Cardiff University. Her research focus lies on multivariate, spatial and temporal dependence phenomena in extreme value theory.

Professor Jonathan Tawn is a Distinguished Professor of Statistics at Lancaster University, internationally recognised for his contributions to extreme value theory and its applications across science, engineering, and finance. He served as Head of Department (2000–2007) and has directed the STOR-i Doctoral Training Centre since 2010. His awards include the RSS Guy Medals in Bronze (1993) and Silver (2024) and the Barnett Award (2015).

6 Discussion session description and proposed topics for discussion

6.1 Interactive Discussion: Connecting Theory, Methods, and Impact

The afternoon session is designed to foster open discussion and collective reflection on key themes in extreme value research. Throughout the day, participants are invited to contribute their thoughts on six themed posters placed around the room, each focusing on a different link across the research pipeline, from theory to policy. Post-it notes will be available to capture ideas, questions, and challenges as they arise during the talks and breaks.

In the discussion session, participants will be divided into six groups, each taking responsibility for one theme. Groups will review the collected notes, identify emerging insights and gaps, and prepare a short summary to share with everyone. These conversations aim to highlight shared priorities, spark collaboration, and help define directions for future research.

6.2 Themes

6.2.1 Theme 1: Linking theory and methods (Foundations)

Brief description: From principles to practice: how can theory shape methodological innovation?

Prompt questions:

- Which theoretical developments are most needed to advance applied extreme value modelling?
- Where do current theoretical results fail to meet practical needs (e.g. high-dimensional or non-stationary settings)?
- How can we better translate advances in asymptotic theory into implementable methods?

6.2.2 Theme 2: Linking theory and methods (Computation and inference)

Brief description: Bridging rigour and reality: computation-aware theory

Prompt questions:

- How can theory evolve to accommodate computationally intensive inference (e.g. INLA, variational Bayes, deep learning)?
- What role can theory play in developing scalable uncertainty quantification tools?

- Are there theoretical gaps that limit our ability to use modern data sources (e.g. satellite, reanalysis)?

6.2.3 Theme 3: Connecting methods and applications (Environmental data)

Brief description: Turning data into understanding: methodological challenges in environmental extremes

Prompt questions:

- What are the biggest methodological bottlenecks in analysing real-world environmental datasets?
- How do we balance flexibility, interpretability, and computational efficiency?
- Which datasets could serve as benchmarks to promote methodological comparison and reproducibility?

6.2.4 Theme 4: Connecting methods and applications (Beyond environment)

Brief description: Extremes everywhere: cross-domain transfer of methods

Prompt questions:

- How can techniques developed for environmental extremes be adapted for other domains (finance, health, networks)?
- What are the main barriers to such transfer: data, scale, or conceptual differences?
- Are there methodological frameworks that could unify different domains?

6.2.5 Theme 5: Linking applications and impact (Communication and policy)

Brief description: From modelling to meaning: making extremes actionable

Prompt questions:

- How can we communicate complex extreme value results to stakeholders and policymakers?
- What types of visualisation or uncertainty summaries are most effective?
- How can we ensure our research informs risk management, adaptation, and resilience planning?

6.2.6 Theme 6: Linking applications and impact (Collaboration and future directions)

Brief description: Building the future of extremes research

Prompt questions:

- What collaborations or data infrastructures would best support progress in the next 5 years?
- How can GLEN facilitate connections between theory, methods, and real-world impact?
- What training or community resources are missing (e.g. reproducibility, software, communication skills)?