

Josh Jacobson

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Research Interests

Spatio-temporal statistics • Bayesian hierarchical modeling • Extreme-value theory
Computational statistics • Climate & environmental applications

Education

- 2020 – present **Ph.D., Applied Statistics**
University of Wollongong Wollongong, NSW
Advisors: Noel Cressie & Andrew Zammit Mangion
- 2018 – 2020 **M.S., Applied Mathematics**
University of Colorado Boulder, CO
Advisors: Will Kleiber & Michael Scheuerer
- 2015 – 2019 **B.S., Applied Mathematics**
University of Colorado, Graduation with Honors Boulder, CO
Minors: Computer Science, Atmospheric & Oceanic Sciences

Research Experience

- 2020 – present **Bayesian hierarchical modeling for multivariate spatio-temporal processes**
Ph.D. Student, University of Wollongong Wollongong, NSW
Improved inference on the spatio-temporal distribution of natural carbon fluxes across Earth's surface by extending a Bayesian hierarchical assimilation framework through conditioning on an additional environmental process [5, 6]. Assimilated large remote-sensing datasets (~2M observations) using high-performance computing to implement efficient MCMC algorithms, including slice sampling and exact Hamiltonian Monte Carlo for constrained Gaussian distributions. Separately, developed a method for multivariate spatial prediction (cokriging) over North America using the full bivariate Matérn covariance model with parameters estimated from empirical (cross-) semivariograms by composite weighted least squares [4].
- 2020 – 2022 **Bayesian spatial copula modeling for multivariate extreme events**
Data Science Consultant, Jupiter Intelligence Boulder, CO
Analyzed spatial patterns in joint return periods for regional-scale wind speed and precipitation simulations by linking Gumbel and gamma marginal distributions through a Gumbel copula model for joint dependence. Accommodated nonstationarity in the marginal distributions through spatially-varying parameters. Conducted parameter inference via the No-U-Turn Sampler (NUTS) with chains run in parallel on GPU cloud instances. Presented results at the 2023 Annual Meeting of the American Meteorological Society.
- 2019 – 2020 **Spatial forecast verification**
Master's Student, University of Colorado Boulder, CO
Investigated the utility of threshold exceedance histograms for assessing calibration of spatial structure within ensemble forecast fields, focusing on downscaled precipitation forecasts. Tested sensitivity to different correlation structures and exceedance thresholds in an extensive simulation study using multivariate Gaussian processes to generate correlated ensembles. This work was published in *Nonlinear Processes in Geophysics* [2] and was selected for Paper of the Month by the editors.
- 2017 – 2018 **High-dimensional visualization**
Undergraduate Apprentice, University of Colorado Boulder, CO
Authored an interactive parallel coordinates visualization library for tradeoff analysis in multi-objective optimization problems, with application to water resources management. This work was published in *Environmental Modelling & Software* [1].

Publications

In Preparation

- **Jacobson, J.**, M. Bertolacci, A. Zammit-Mangion, and N. Cressie (2024+). Separating natural carbon fluxes using solar-induced fluorescence (SIF) observations in a global Bayesian inversion.

Published

5. Cressie, N., A. Zammit-Mangion, **J. Jacobson**, and M. Bertolacci (2023). Earth's CO₂ battle: a view from space. *Significance*, 20(1), pp. 14–19.
4. **Jacobson, J.**, N. Cressie, and A. Zammit-Mangion (2023). Spatial statistical prediction of solar-induced chlorophyll fluorescence (SIF) from multivariate OCO-2 data. *Remote Sensing*, 15(16), p. 4038.
3. Vu, Q., Y. Cao, **J. Jacobson**, A. R. Pearse, and A. Zammit-Mangion (2021). Discussion on “Competition on Spatial Statistics for Large Datasets”. *Journal of Agricultural, Biological and Environmental Statistics*, 26, pp. 614–618.
2. **Jacobson, J.**, W. Kleiber, M. Scheuerer, and J. Bellier (2020). Beyond univariate calibration: verifying spatial structure in ensembles of forecast fields. *Nonlinear Processes in Geophysics*, 27(3), pp. 411–427.
1. Raseman, W. J., **J. Jacobson**, and J. R. Kasprzyk (2019). Parasol: an open source, interactive parallel coordinates library for multi-objective decision making. *Environmental Modelling & Software*, 116, pp. 153–163.

Honors, Awards, & Fellowships

- 2021 Allison Harcourt Poster Award: 1st, Early Career & Student Statisticians Conference
- 2021 ECSSC 2021 Scholarship, Early Career & Student Statisticians Conference
- 2021 Statistical Data Science Scholarship, Australian Mathematical Sciences Institute (AMSI)
- 2020 – 2024 University Postgraduate Award, University of Wollongong
- 2020 NPG Paper of the Month Award [2] chosen by editors of *Nonlinear Processes in Geophysics* for paper of the month, October 2020
- 2015 – 2019 Dean's List, University of Colorado
- 2015 – 2019 Engineering Merit Scholarship, University of Colorado
- 2015 – 2019 Hale Esteemed Scholar Award, University of Colorado

Grants

- 2023 – 2025 NASA Research Opportunities in Space and Earth Science (ROSES): “Hierarchical Spatio-Temporal Statistical Methods for Analyzing OCO-2/3 Data”
PI: Michael Bertolacci; Co-PIs: Noel Cressie, Andrew Zammit Mangion, Beata Bukosa; Students: Josh Jacobson, Daemon Kennett, Alan Pearse
Award: \$0 (*International organizations are not eligible for cash funding, but the award grants membership of the OCO Science Team.*)

Presentations

Conferences & Workshops

- 2023-12 Spatial prediction of solar-induced fluorescence (SIF) from multivariate satellite data
Australian Statistics Conference, Wollongong, NSW, Australia
- 2023-10 coSIF: Spatial statistical prediction of SIF from multivariate OCO-2 data
NASA OCO Science Team Meeting, Virtual
- 2023-01 A fully-Bayesian spatial copula model for joint-frequency analysis of extreme events
American Meteorological Society (AMS) 103rd Annual Meeting, Denver, CO, USA

- 2021-07 Multivariate spatial prediction of column-averaged carbon dioxide over North America
Australian Mathematical Sciences Institute (AMSI) Winter School, Virtual
- 2021-07 Spatial prediction of column-averaged carbon dioxide over the globe
Australian and New Zealand Statistical Conference (ANZSC), Virtual
- 2019-12 Improving interpretability of multi-objective tradeoff sets for environmental systems
American Geophysical Union (AGU) Fall Meeting, San Francisco, CA, USA
- 2018-09 Interactive visualizations for multi-objective optimization problems
RMACC HPC Symposium, Boulder, CO, USA
- Seminars & Colloquia
- 2023-04 A fully-Bayesian spatial copula model for joint-frequency analysis of extreme events
National Institute for Applied Statistics Research Australia (NIASRA), University of Wollongong, Wollongong, Australia
- 2022-04 Approximate Bayesian computation for non-stationary processes
Jupiter Intelligence, Boulder, CO, USA
- 2019-11 Verification of spatial structure in ensembles of forecast fields
Department of Mathematics, University of Zurich, Zurich, Switzerland
- 2019-08 Uncertainty quantification for sea level rise
Jupiter Intelligence, Boulder, CO, USA
- Posters
- 2024-10 A multivariate Bayesian hierarchical model for global CO₂ surface flux
American Statistical Association ENVR Workshop, Boulder, CO, USA
- 2021-07 Multivariate spatial-dependence modelling with satellite data
Early Career & Student Statisticians Conference, Virtual
- 2020-12 Flexible methodology for hyperlocal flooding risk due to sea level rise
American Geophysical Union (AGU) Fall Meeting, Virtual

Teaching

- Fall 2024 Teaching Assistant, STAT 3/804: Stochastic Processes and Time Series Analysis, University of Wollongong
- Spring 2024 Teaching Assistant, STAT 3/832: Generalised Linear Models, University of Wollongong
- Fall 2023 Teaching Assistant, STAT 3/801: Statistical Methods for Data Science, University of Wollongong
- Spring 2023 Teaching Assistant, STAT 3/832: Generalised Linear Models, University of Wollongong
- Fall 2018 Teaching Assistant, APPM 4/5350: Fourier Series and Boundary Value Problems, University of Colorado
- Fall 2016 Teaching Assistant, CSCI 1320: Introduction to Programming for Engineers, University of Colorado

Service & Leadership

- 2024 Postgraduate Seminar Series Head, School of Mathematics and Applied Statistics, University of Wollongong
- 2019 Radio Show Host, “Probably Novel Podcast,” Department of Applied Mathematics, University of Colorado
- 2016 – 2018 Academic Mentor, Engineering Honors Program, University of Colorado

Computer Skills

- Advanced CDO, Git, L^AT_EX, Linux, Python, R
- Intermediate Julia, Matlab, Shell-scripting