

# Josh Jacobson

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## Research Interests

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

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## 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

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## Research Experience

- 2020 – present **Bayesian hierarchical modeling for multivariate spatio-temporal processes**  
Ph.D. Candidate, 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].

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## 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 CO<sub>2</sub> 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.

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## 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

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## 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.*)

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## 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 CO<sub>2</sub> 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

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## 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

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## 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

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## Computer Skills

- Advanced CDO, Git, L<sup>A</sup>T<sub>E</sub>X, Linux, Python, R
- Intermediate Julia, Matlab, Shell-scripting