

## Emily C. Hector

North Carolina State University

Email: [ehector@ncsu.edu](mailto:ehector@ncsu.edu)

Website: [emilyhector.com](http://emilyhector.com)

Department of Statistics

2311 Stinson Drive

5140 SAS Hall

Raleigh, NC

## RESEARCH INTERESTS

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### *Theory/Methods*

Composite likelihood, Correlated data, Divide-and-conquer, Distributed estimation and inference, Estimating equations, Generalized method of moments, Heterogeneous data integration, High-dimensional data, Parallel computing.

### *Applications*

Brain imaging analysis, Metabolomics, Spatial data, Wearable devices.

## PROFESSIONAL POSITIONS

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Assistant Professor, Department of Statistics 2020-present  
North Carolina State University

Graduate Student Research Assistant, Department of Biostatistics 2015-2020  
University of Michigan

## EDUCATION

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PhD Biostatistics 2020  
University of Michigan  
Thesis: “Distributed estimation and inference for the analysis of big biomedical data”  
Advisor: Peter X.-K. Song, PhD

MSc Biostatistics 2016  
University of Michigan

BSc Honors Probability and Statistics 2014  
McGill University

## AWARDS & HONORS

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1. *Thank-An-Advisor note*, submitted by a student to the Academic Advising Programs and Services, North Carolina State University ('23)
2. *Internationalization Seed Grant award*, Office of Global Engagement, North Carolina State University ('23).
3. *Thank-A-Teacher note*, submitted by a student to the Office for Faculty Excellence, North Carolina State University ('22)
4. *Faculty Research and Professional Development award*, North Carolina State University ('21).
5. *Finalist*, grant proposal submitted to the *Second Joint Biostatistics-Statistics Research Retreat, Shark Tank for Research Ideas in Data Science and Statistics (STRIDES)*. Departments of Biostatistics and Statistics, University of Michigan ('20)
6. *Excellence in Research Award*, awarded annually to one student in recognition of research excellence. Department of Biostatistics, University of Michigan ('19)
7. *Gertrude M. Cox Scholarship, Honorable Mention*, sponsored by the American Statistical Association (ASA) Committee on Women in Statistics and the Caucus for Women in Statistics (CWS) ('19)
8. *John Van Ryzin Award* for most outstanding paper submitted to the International Biometric Society (IBS) Eastern North American Region's (ENAR) Distinguished Student Paper Award Competition ('18)
9. *Rackham Conference Travel Grant*, University of Michigan ('16, '17, '18, '19)
10. *Outstanding First-Year Masters Student*, Department of Biostatistics, University of Michigan ('15)
11. *First Class Honors*, McGill University ('14)
12. *Natural Sciences and Engineering Research Council of Canada (NSERC) Undergraduate Student Research Award (USRA)*, McGill University ('13)
13. *J W McConnell Scholarship* (major award), McGill University ('11-'13)

## FUNDING

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### *Current*

Projecting flood frequency curves under a changing climate using spatial extreme value analysis (Reich)

NSF, Role: co-PI (2022-2025)

Development and Application of New Ionization Methods for Biological Mass Spectrometry (Muddiman)

NIH, Role: co-I (2022-2026)

Scalable statistical approaches for robust and resilient extreme weather adaptation: a new approach to climate science (Hector)

Office of Global Engagement, North Carolina State University, Role: PI (2023-2024)

Molecular Transducers of Physical Activity Consortium Coordinating Center (Miller, Rejeski, Tracy, Esser)

NIH, Role: Subcontract PI (2023)

*Past*

Functional regression for intensive longitudinal data: a new lens through data partitioning (Hector)

NCSU Faculty Research and Professional Development award, Role: PI (2021 - 2022)

## **PUBLICATIONS**

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\* co-first author; † corresponding author; + student author

*Peer-reviewed journal articles – Statistical Methodology*

1. **Hector EC**<sup>†</sup>. Fused mean structure learning in data integration with dependence. To appear in *The Canadian Journal of Statistics* (2023+).
2. **Hector EC**<sup>†</sup>, Reich BJ. Distributed inference for spatial extremes modeling in high dimensions. *Journal of the American Statistical Association* (2023). doi: 10.1080/01621459.2023.2186886.
3. Luo L, Wang J, **Hector EC**<sup>†</sup>. Statistical inference for streamed longitudinal data. *Biometrika* (2023). doi: 10.1093/biomet/asad010. With discussion.
4. Shi L<sup>+</sup>, Wank M<sup>+</sup>, Chen Y<sup>+</sup>, Wang Y<sup>+</sup>, Liu Y, **Hector EC**, Song P XK<sup>†</sup>. Sleep Classification with Artificial Synthetic Imaging Data from Empatica E4 Wristband by Convolutional Neural Networks. *IEEE Journal of Biomedical and Health Informatics* (2023). 27(1):421-432.
5. **Hector EC**<sup>†\*</sup>, Luo L<sup>\*</sup>, Song P XK. Parallel-and-stream accelerator for computationally fast supervised learning. *Computational Statistics and Data Analysis* (2022). 177:107587.
6. **Hector EC**<sup>†</sup>, Song P XK. Joint integrative analysis of multiple data sources with correlated vector outcomes. *The Annals of Applied Statistics* (2022). 16(3):1700-1717.
7. **Hector EC**<sup>†</sup>, Song P XK. Doubly distributed supervised learning and inference with high-dimensional correlated outcomes. *Journal of Machine Learning Research* (2020). 21(173):1–35.
8. **Hector EC**<sup>†</sup>, Song P XK<sup>†</sup>. A distributed and integrated method of moments for high-dimensional correlated data analysis. *Journal of the American Statistical Association* (2021). 116(534):805-818.

*Peer-reviewed journal articles – Statistical Applications*

1. Tagelsir AA<sup>†</sup>, **Hector EC**, Urena-Cirett JL, Mercado-Garcia A, Cantoral A, Hu H, Peterson KE, Téllez-Rojo MM, Martinez-Mier EA (2023). Early lead exposure is associated with molar incisor hypomineralization. *Pediatric Dentistry*, accepted.
2. Twiddy J, **Hector EC**, Dubljević V<sup>†</sup>. Perceived invasiveness and therapeutic acceptability of transcranial magnetic stimulation. *American Journal of Bioethics –Neuroscience* (2022). 14:1, 17-20, doi: 10.1080/21507740.2022.2150710.
3. Sohn AL<sup>†</sup>, Ping L, Glass JD, Seyfried NT, **Hector EC**, Muddiman DC. Interrogating the metabolomic profile of amyotrophic lateral sclerosis in the post-mortem human brain by Infrared Matrix-Assisted Laser Desorption Electrospray Ionization (IR-MALDESI) mass spectrometry imaging (MSI). *Metabolites* (2022). 12(11), 1096, doi: 10.3390/metabo12111096.
4. Yin X<sup>†</sup>, Chan LS, Bose D, Jackson AU, VandeHaar P, Locke AE, Fuchsberger C, Stringham HM, Yu K, Fernandes Silva L, Zhang D, **Hector EC**, Young E, Ganel L, Das I, Abel HJ, Erdos MR, Bonnycastle LL, Kuusisto J, Stitzel NO, Hall I, Wagner GR, Kang J, Morrison J, Burant CF, Collins FS, Ripatti S, Palotie A, Freimer NB, Mohlke KL, Scott L, Wen X, Fauman E, Laakso M, Boehnke M. Genome-wide association studies of metabolites in Finnish men identify disease-relevant loci. *Nature Communications* (2022), doi: 10.1038/s41467-022-29143-5.
5. Goodrich JM<sup>\*†</sup>, **Hector EC\***, Tang L, Labarre JL, Dolinoy DC, Mercado-Garcia A, Cantoral A, Song P XK, Téllez Rojo MM, Peterson KE. Integrative analysis of gene-specific DNA methylation and untargeted metabolomics data from the ELEMENT cohort. *Epigenetic Insights* (2020). 13:1-10. doi: 10.1177/2516865720977888.
6. Jansen EC<sup>†</sup>, **Hector EC**, Goodrich JM, Cantoral A, Téllez Rojo MM, Basu N, Song P XK, Torres Olascoaga L, Peterson KE. Mercury exposure in relation to sleep duration, timing, and fragmentation among adolescents in Mexico City. *Environmental Research* (2020). 191: 110216. doi: j.envres.2020.110216.
7. Perng W<sup>†</sup>, **Hector EC**, Song P XK, Tellez Rojo MM, Raskind S, Kachman M, Cantoral A, Burant BF, Peterson KE. Metabolomic determinants of metabolic risk in Mexican adolescents. *Obesity (Silver Spring)* (2017). doi:10.1002/oby.21926.

*Book chapters with peer-review*

1. **Hector EC**<sup>†</sup>, Tang L, Zhou L, Song P XK (2022+). Data integration and fusion in the Bayesian and Frequentist frameworks. Chapter in “Handbook on Bayesian, Fiducial and Frequentist Inference”, tentatively accepted. In press.

*Preprints*

1. **Hector EC**<sup>†</sup>, Eloyan A (2023+). Distributed model building and recursive integration for big spatial data modeling.
2. **Hector EC**<sup>†</sup>, Martin R (2022+). Turning the information-sharing dial: efficient inference from different data sources.

3. Hickey J<sup>+</sup>, Williams JP and **Hector EC** (2022+). Transfer learning with uncertainty quantification: Random Effect Calibration of Source to Target (RECaST).
4. Huang W<sup>+</sup>, **Hector EC**, Cape J, McKennan C<sup>+</sup> (2023+). A statistical framework for GWAS of high dimensional phenotypes using summary statistics, with application to metabolite GWAS.
5. Kim H<sup>+</sup>, Ghosh S and **Hector EC**<sup>+</sup> (2023+). Bayesian estimation of clustered dependence structures in functional neuroconnectivity.
6. Manschot C<sup>+</sup>, **Hector EC** (2022+). Functional regression with intensively measured longitudinal outcomes: a new lens through data partitioning.

## **SOFTWARE**

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### *R packages*

1. ISEDI: Estimates mean regression parameters by borrowing information from a prior analysis on another dataset.
2. SLA: Performs streaming inference of intensively measured longitudinal data.
3. BRdac: Divide-and-conquer estimation and inference for max-stable spatial process modeling.
4. DIQIF: Performs joint integrative regression analysis of multiple data sources with correlated vector outcomes using quadratic inference functions.
5. DDIMM: Performs doubly distributed and integrated method of moments regression for high-dimensional correlated responses.
6. DIMM: Performs singly distributed and integrated method of moments regression for high-dimensional correlated responses.

## **TEACHING**

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### **North Carolina State University, Department of Statistics**

ST422: Introduction to Mathematical Statistics II (Fall '21, '22, '23)

ST502: Fundamentals of Statistical Inference II (Spring '21, '22, '23, Fall '23)

Guest lecture for NCSU Libraries Statistics Power Half Hour (Spring '22)

Guest lecture for Summer Institute in Biostatistics (Summer '22, Summer '23)

### **Duke University, Department of Statistics**

Guest lecture for STA561: Probability for Machine Learning (Spring '22)

### **University of Michigan, School of Public Health**

Taught two lectures for the 2019 Big Data Summer Institute (BDSI); recordings available online at the U-M BDSI 2019 Wiki (<https://sph.umich.edu/bdsi/>). ('19)

## **ADVISING & MENTORING**

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### **PhD students (co-)advised**

- Jimmy Hickey (PhD co-advisor with Jonathan Williams) (NCSU, Statistics, expected graduation Spring '24)
- Hyoshin Kim (PhD co-advisor with Sujit Ghosh) (NCSU, Statistics, expected graduation Spring '24)
- Ryan Li (PhD co-advisor with Brian Reich) (NCSU, Statistics, expected graduation Spring '26)
- Cole Manschot (PhD co-advisor with Eric Laber) (NCSU, Statistics, graduated Spring '23)
- Joe Zhao (PhD co-advisor with Shu Yang) (NCSU, Statistics, graduated Summer '23)
- Wei Zhao (PhD co-advisor with Brian Reich) (NCSU, Statistics, expected graduation Spring '26)

### **PhD Student committees**

- Mohamed Abdelkader Abba (NCSU, Statistics, expected graduation Summer '23)
- Akshay Bharadwaj (NCSU, Industrial and Systems Engineering, graduated Spring '23)
- Sanghyun Choo (NCSU, Industrial and Systems Engineering, graduated Spring '22)

### **Masters students advised**

- Annabel Settle (NCSU, Statistics, graduated Spring '23)

### **Undergraduate students mentored**

- Livia Poppa (NCSU, Statistics, graduated Spring '22)
- Vrishank Ghosh (NCSU, Statistics, graduated Spring '23)

## **PRESENTATIONS**

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### *Oral* (\*upcoming)

1. \*Title TBD (invited). Statistical Sciences Applied Research and Education Seminar (Mar '24). Toronto, Canada.
2. \*Distributed model building and recursive integration for functional connectivity modeling (invited). CMStatistics (Dec '23). Berlin, Germany.
3. \*There and back again: a (bio)statistician's unexpected journey (invited). University of Michigan Biostatistics Alumni Spotlight (Sep '23). Virtual.

4. New methods for analyzing wearable device data (invited). NYU DPH Biostatistics Seminar Series (Sep '23). Virtual.
5. Distributed model building and recursive integration for spatial data modeling (invited). Joint Statistical Meetings (JSM) (Aug '23). Toronto, Canada.
6. Partition learning for functional neuroconnectivity (invited). EcoSta (Aug '23). Virtual.
7. Information sharing for efficient inference from different data sources. International Statistical Institute World Statistics Congress (July '23). Ottawa, Canada.
8. Parallel-and-stream accelerator for computationally fast supervised learning (invited). New England Statistics Symposium (Jun '23). Virtual.
9. Distributed inference for spatial extremes modeling in high dimensions (invited). 2023 Clemson Climate Extremes Workshop (May '23). Clemson, SC.
10. Functional regression with wearable device data: a new lens through data partitioning (invited). Colloquium of the Department of Statistics and Actuarial Science of the University of Iowa (Apr '23). Virtual.
11. Information sharing for efficient inference from different data sources (invited). ENAR Spring Meeting (Mar '23). Nashville, TN.
12. A statistical exploration of the many complexities and promises of wearable device data (invited). Seminar of the Wake Forest Biostatistics and Data Science Department (Feb '23). Wake Forest, NC.
13. Distributed inference for spatial extremes modeling in high dimensions (invited). '22 IMS International Conference on Statistics and Data Science (Dec '22). Florence, Italy.
14. Functional regression with wearable device data: a new lens through data partitioning (invited). Seminar of Columbia University's Department of Biostatistics (Dec '22). New York, NY.
15. Turning the data-integration dial: efficient inference from different data sources (invited). University of North Carolina at Chapel Hill Colloquium of the Department of Statistics and Operations Research (Nov '22). Chapel Hill, NC.
16. Distributed inference for spatial extremes modeling in high dimensions (invited). KAUST Statistics Workshop (Nov '22). King Abdullah University of Science and Technology, Saudi Arabia.
17. Mean structure learning with high-dimensional correlated data (invited). AISC (Oct '22). Greensboro, NC.
18. Distributed inference for extreme value analysis of large spatial datasets (invited). COMPSTAT '22 (Aug '22). Bologna, Italy. Participating virtually.
19. Streaming inference with intensively measured longitudinal outcomes from wearable devices (invited). Joint Statistical Meetings (JSM) (Aug '22). Washington, DC.
20. Functional regression with wearable device data (invited). ICSA Canada Chapter Symposium (Jul '22). Banff, Canada.
21. Joint integrative analysis of dependent data sources (invited). ICSA Applied Statistics Symposium (June '22). Gainesville, FL.
22. Statistical inference for streamed longitudinal data (invited). EcoSta (June '22). Virtual.

23. Functional regression with wearable device data: a new lens through data partitioning (invited). Seminar of the University of California – Berkeley Division of Biostatistics (Apr ‘22). Berkeley, CA.
24. Learning mean homogeneity structure in image-on-scalar regression. ENAR Spring Meeting (Mar ‘22). Houston, TX.
25. Sleep classification with artificial synthetic imaging using deep learning CNN (invited). AAAS Annual Meeting Symposium (Feb ‘22). Held virtually.
26. A framework for data integration with dependence and heterogeneity (invited). CMStatistics (Dec ‘21). Held virtually.
27. Data integration meets divide-and-conquer: dealing with heterogeneity and dependence in big data (invited). Seminar of the University of Pittsburgh Department of Statistics (Oct ‘21). Held virtually.
28. Fused mean structure learning in data integration with dependence. Joint Statistical Meetings (JSM) (Aug ‘21). Held virtually.
29. Integrated fused mean structure learning with application to image-on-scalar regression (invited). Statistical Methods in Imaging Conference (May ‘21). Held virtually.
30. Joint integrative analysis of multiple data sources with correlated vector outcomes (invited). ENAR Spring Meeting (Mar ‘21). Held virtually.
31. Parallel-and-Stream accelerator for regression analysis with big data (invited). Seminar of the North Carolina State University Department of Statistics (Feb ‘21). Held virtually.
32. Joint integrative analysis of multiple data sources with correlated vector outcomes (invited). Joint seminar of the HEC Département de sciences de la décision and the McGill University Department of Statistics (Feb ‘21). Held virtually.
33. Accelerated distributed inference through a unified Fiducial and Frequentist paradigm (invited). BFF6.5 Virtual Workshop on Bayesian, Fiducial and Frequentist Statistical Inference (Feb ‘21). Held virtually.
34. Distributed inference with correlated outcomes (invited). Seminar of the North Carolina State University Department of Statistics (Nov ‘19). Raleigh, NC.
35. A unifying framework for distributed and integrated inference with high-dimensional correlated outcomes. Workshop on BFF (Bayes, Fiducial and Frequentist) paradigm in data integration, machine learning and applications (Nov ‘19). Ann Arbor, MI.
36. Doubly distributed and integrated inference for correlated data with heterogeneous parameters. Joint Statistical Meetings (JSM) (Jul ‘19). Denver, CO.
37. A distributed and integrated method of moments for high-dimensional correlated data analysis (invited). Workshop on Recent Developments in Statistical Theory and Methods Based on Distributed Computing (May ‘18). Casa Matemática Oaxaca (CMO), Banff International Research Station for Mathematical Innovation and Discovery. Oaxaca, Mexico. Recording available at <http://www.birs.ca/events/2018/5-day-workshops/18w5089/videos>.
38. A distributed and integrated method of moments for high-dimensional correlated data analysis. ENAR Spring Meeting (Mar ‘18). John Van Ryzin Award winner. Atlanta, GA.



39. A distributed and integrated method of moments for high-dimensional correlated data analysis. University of Michigan Data Science Research Forum ('17). Michigan Institute for Data Science (MIDAS). Ann Arbor, MI. Recording available at <https://www.youtube.com/watch?v=SGPPfX2T4dI>.

#### *Poster*

1. Distributed quadratic inference functions. Joint Statistical Meetings (JSM) ('20). Held virtually.
2. A doubly distributed and integrated method of moments for high-dimensional correlated data analysis. Joint Statistical Meetings (JSM) ('18). Vancouver, Canada.
3. Regression analysis for high-dimensional correlated outcomes. Spatial Statistics Conference ('17). University of Lancaster. Lancaster, England.
4. Change in variance of IGF2 gene methylation associated with three metabolites. ENAR Spring Meeting ('16). Austin, TX.

#### *Other*

Panel Discussant. Fifth Bayesian, Fiducial and Frequentist (BFF5) Conference: Foundations of Data Science ('18). Ann Arbor, MI.

## **PROFESSIONAL SERVICE**

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### **American Statistical Association**

- Associate Editor for Reproducibility ('22-present), Journal of the American Statistical Association
- IMS contributed session chair, Joint Statistical Meetings ('24).
- Co-organizer and chair of Topic-Contributed Session at the Joint Statistical Meetings: "*Recent Advances in High-Dimensional Estimation and Inference Methods*" ('22)
- Organizer and Chair of Topic-Contributed Session at the Joint Statistical Meetings: "*Integrative inference with data from multiple sources: challenges and new developments*" ('21)
- ASA Section on Statistical Learning and Data Science 2021 Student Paper Award judge ('21)

### **International Biometric Society**

- Chair of Contributed Papers Session at ENAR: "*Clustered Data Methods*" ('22)

### **International Chinese Statistical Association**

- Organizer and chair of Invited Sessions at the 2023 ICSA Applied Statistics Symposium:
  - "*Statistical methods for wearable devices*"
  - "*New developments in spatial extremes modelling*"

## **International Statistical Institute**

- Organizer and Chair of Invited Session at the 64th World Statistics Congress: “*Integrative inference with data from multiple sources: challenges and new developments*” (‘23)

## **Referee**

Annals of Applied Statistics, Biometrics, Biostatistics, Computational Statistics and Data Analysis, Journal of the American Statistical Association, Journal of Applied Statistics, Journal of Computational and Graphical Statistics, Journal of Data Science, Journal of Mathematical Imaging and Vision, Journal of Statistical Computation and Simulation, Proceedings of the National Academy of Sciences of the United States of America, Scandinavian Journal of Statistics, Science Advances, Statistics in Biosciences, Statistics in Medicine, Statistical Methods in Medical Research

## **DEPARTMENTAL SERVICE**

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### **North Carolina State University**

1. Seminar Committee, Member (‘21-‘22, ‘23-‘24), Chair (‘22-‘23).
2. Departmental Climate Committee, Member (‘21-present).
3. Departmental Qualifying Exam Committee, Member (‘22).
4. Beach Trip Committee, Member (‘22).
5. Professional Strategies Working Group, Member (‘20-present).

### **University of Michigan, School of Public Health**

1. Faculty Search Committee, Student representative (‘19-‘20)
2. Biostatistics Computing, Social Media and Website Reform Committee, Student representative (‘18-‘19)
3. Michigan Student Symposium for Interdisciplinary Statistical Sciences (MSSISS), Lead member, Planning Committee (‘17-‘18)
4. Fifth Bayesian, Fiducial, and Frequentist (BFF5) Conference, Member, Planning Committee (‘17-‘18)
5. Biostatistics Brown Bag Seminar, Member (‘14-‘18), President (‘16-‘18)
6. STATCOM (Statistics in the Community at Michigan) (‘15-‘17)