# Sara C. Troutman

Ph.D. Candidate
Department of Civil and Environmental Engineering
University of Michigan

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## EDUCATION

**University of Michigan**, Ann Arbor, MI
Ph.D. Environmental Engineering — Anticipated April 2020
M.S.E. Electrical and Computer Engineering — December 2019
Signal & Image Processing and Machine Learning
M.S.E. Civil Engineering — April 2017
Intelligent Systems

**North Carolina State University**, Raleigh, NC
B.S. Environmental Engineering — May 2015
B.S. Mathematics — May 2015
Minor: Spanish
Valedictorian, *summa cum laude*

## SELECTED ACTIVITIES IN PROGRAMMING

- Proficient programmer in Python, MATLAB, Julia, LaTeX.
- Contributor to `pystorms`, a Python package and stormwater control simulation sandbox that builds on the widely used U.S. EPA Storm Water Management Model (SWMM) simulation engine and PySWMM, a Python wrapper of SWMM. github.com/kLabUM/pystorms
- Contributor to `rrcf`, a Python-based open-source implementation of the robust random cut forest algorithm for anomaly detection on streaming data. github.com/kLabUM/rrcf

## RESEARCH AND PROFESSIONAL EXPERIENCE

**University of Michigan**, Ann Arbor, MI
**Graduate Research Assistant**

**Data-driven, real-time modeling and control of urban water systems** — August 2015–Present
- Developing an automated modeling toolchain to predict wet-weather impacts on combined sewer systems and wastewater treatment plant operations and performance
- Establishing coordinated control methodologies to operate distributed sewer assets for system-wide objectives
- Elucidating how dynamic and coupled control sewer and wastewater treatment systems impact operational decisions and regional water quality outcomes

**Simulation sandbox and Python package (`pystorms`) for smart stormwater** — March 2019–Present
- Creating a library of anonymized stormwater networks and corresponding delineated assessment scenarios
- Constructing a streamlined programming interface for users of the package
- Hosting a web portal with forum and tutorials for broad adoption in stormwater and control communities

**Energy-food-water systems** — August 2015–April 2017
- Worked within REFRESCH, a University-wide interdisciplinary team, to design an off-grid recirculating aquaculture system, focusing on water, energy, and food budgets

**North Carolina State University**, Raleigh, NC
**Undergraduate Researcher**

**Experimental granular activated carbon studies** May 2014–May 2015

- Designed isotherm experiments for carcinogenic volatile organic compound (cVOC) removal using granular activated carbon (GAC)
- Analyzed relationships between cVOC concentrations, GAC adsorption capacity, temperature, and GAC type

**Distributed water treatment train modeling and optimization** January 2013–May 2015

- Examined influence of design parameters on effectiveness and costs of water treatment methods, including granular activated carbon, packed tower aeration, and advanced oxidation processes
- Constructed mathematical functions for modeling water conveyance and treatment sequences
- Analyzed monthly pumping data from groundwater wells to determine seasonal demand patterns

**Eaton Corporation**, Middlesex, NC January 2012–August 2013*
**Environmental, Health, and Safety Co-op** *Three semesters

- Collaborated with engineers and operators for the installation and troubleshooting of water recirculation systems
- Led Green Team monthly meetings to discuss and further environmental projects in industrial plant
- Calculated water and electricity usage and waste generation in industrial plant

## PEER-REVIEWED JOURNAL PUBLICATIONS

[4] Rimer, S. P., A. Mullapudi, **S. C. Troutman**, B. Kerkez *et al*. 2020. pystorms: A simulation sandbox for the development and evaluation of stormwater control algorithms. In preparation. open-storm.org/pystorms; github.com/kLabUM/pystorms.

[3] **Troutman, S. C.**, N. G. Love, B. Kerkez. 2020. Balancing water quality and flows in combined sewer systems using real-time control. In review. github.com/stroutm/LBCsewer.

[2] Bartos, M. D., A. Mullapudi, **S. C. Troutman**. 2019. rrcf: Implementation of the Robust Random Cut Forest algorithm for anomaly detection on streams. *Journal of Open Source Software*, **4**(35): 1336. DOI: 10.21105/joss.01336. github.com/kLabUM/rrcf.

[1] **Troutman, S. C.**, N. Schambach, N. G. Love, B. Kerkez. 2017. An automated toolchain for the data-driven and dynamical modeling of combined sewer systems. *Water Research*, **126**: 88–100. DOI: 10.1016/j.watres.2017.08.065. github.com/kLabUM/DRIPS.

## MAGAZINE PUBLICATIONS

[1] Ewing, G., A. Mullapudi, **S. C. Troutman**, B. Kerkez, W. Barrott. 2019. Open-Storm Detroit Dynamics: Real-time stormwater controls reduce combined sewer overflows and defer millions in capital investments. *Water Environment & Technology*, **31**(7): 28–35.

## ORAL PRESENTATIONS **presenter*

[12] **Troutman, S. C.***, N. G. Love, B. Kerkez. Real-Time Control of Sewer Systems to Balance Flow and Water Quantity Objectives. Borchardt Conference: 25th Triennial Symposium on Advancements in Water & Wastewater. Ann Arbor, MI, USA. Feb 25–26 2020.

[11] **Troutman, S. C.**, S. P. Rimer*, A. Mullapudi, B. Kerkez. A Benchmarking Library for Making Smart Stormwater Research Accessible. American Geophysical Union Fall Meeting, AGU. San Francisco, CA, USA. Dec 9–13 2019.

[10] **Troutman, S. C.***, A. Mullapudi, S. P. Rimer, B. Kerkez. A Benchmarking Framework for Evaluating the Performance of Control Algorithms in Smart Stormwater Networks. 17th International Computing & Control for the Water Industry Conference, CCWI. University of Exeter, Exeter, United Kingdom. Sep 1–4 2019.

[9] Mullapudi, A.*, S. P. Rimer, **S. C. Troutman**, B. Kerkez. A Benchmarking Framework for Control of Smart Stormwater Networks. 10th IWA Symposium on Modelling and Integrated Assessment, Watermatex. Copenhagen, Denmark. Sep 1–4 2019.

[8] Rimer, S. P.*, A. Mullapudi, **S. C. Troutman**, B. Kerkez. A Benchmarking Framework for Smart Stormwater Systems. World Environmental & Water Resources Congress, EWRI. Pittsburgh, PA, USA. May 19–23 2019.

[7] **Troutman, S. C.***, A. Mullapudi, B. Kerkez. Open-Storm Detroit Dynamics. Water@Michigan: Urban Water. University of Michigan, Ann Arbor, MI, USA. May 6 2019.

[6] Ewing, G.*, A. Mullapudi, **S. C. Troutman**, B. Kerkez, W. Barrott, C. Nastally. Open-Storm Detroit Dynamics. LIFT Intelligent Water Systems Challenge, WEFTEC. New Orleans, LA, USA. Oct 1–3 2018. **Award: 1st Place.**

[5] **Troutman, S. C.***, N. G. Love, B. Kerkez. Evaluating Market-Based Algorithms for System-Level TSS Control. 13th International Conference on Hydroinformatics, HIC. Palermo, Italy. Jul 1–6 2018.

[4] **Troutman, S. C.***, N. G. Love, B. Kerkez. Market-Based Real-Time Control of TSS across Large Sewer Systems. World Environmental & Water Resources Congress, EWRI. Minneapolis, MN, USA. Jun 4–7 2018.

[3] **Troutman, S. C.***, N. G. Love, B. Kerkez. Controlling a Sewer Network as an Extension of the Wastewater Treatment Plant. AEESP Research and Education Conference: Advancing Healthy Communities through Environmental Engineering and Science. Ann Arbor, MI, USA. Jun 20–22 2017.

[2] **Troutman, S. C.***, N. G. Love, B. Kerkez. Understanding Combined Sewer Flow Dynamics through Data-Driven Modeling. World Environmental & Water Resources Congress, EWRI. Sacramento, CA, USA. May 21–25 2017.

[1] **Troutman, S. C.***, N. Schambach, B. Kerkez, N. G. Love. Predicting Combined Sewer Flow through the Use of Real-Time, City-Scale Sensor Data. World Environmental & Water Resources Congress, EWRI. West Palm Beach, FL, USA. May 22–26 2016.

## POSTER PRESENTATIONS **presenter*

[3] Rimer, S. P.*, A. Mullapudi, **S. C. Troutman**, B. Kerkez. A Benchmarking Framework for Control and Optimization of Smart Stormwater Networks. ACM/IEEE International Conference on Cyber-Physical Systems. Montreal, Canada. Apr 16–18 2019.

[2] **Troutman, S. C.***, N. Schambach, B. Kerkez, N. G. Love. Use of Real-Time Sensor Data in City-Scale Water Modeling. Poster presented at three different conferences:

- Borchardt Conference: 24th Triennial Symposium on Advancements in Water & Wastewater, Ann Arbor, MI, USA, Feb 21–22 2017;
- Michigan Institute for Data Science Annual Symposium, University of Michigan, Ann Arbor, MI, USA, Nov 15–16 2016 (Award: Most Likely Health Impact);
- CUAHSI Biennial Symposium, Shepherdstown, WV, USA, Jul 24–27 2016.

[1] **Troutman, S. C.***, D. Knappe, H. Chmielewski, R. Ranjithan. Informing Water Treatment Designs through Mathematical Modeling. Water Resources & Environmental Engineering Graduate Research Symposium, North Carolina State University. Raleigh, NC, USA. Mar 7 2014.

## AWARDS AND HONORS

WRF & WEF LIFT Intelligent Water Systems Challenge — 2018
- Open-Storm Detroit Dynamics Team
- Placed 1st out of 19 teams, $25,000 prize

National Science Foundation Graduate Research Fellowship — 2016

Scholarly Achievement Senior Award — 2015
- Department of Civil, Construction, and Environmental Engineering, NCSU
- Awarded to one graduating undergraduate student in department each year

Phi Beta Kappa, Honor Society — 2014

Tau Beta Pi, Engineering Honor Society — 2012

## LEADERSHIP AND SERVICE

**Member**, Graduate Student Advisory Council (CEE, UM) — 2017–2019

**Secretary**, GrEENPEAS (CEE, UM) — 2016–2017

(Graduate Environmental Engineering Network of Professionals, Educators, and Students)

**Corresponding Secretary**, Tau Beta Pi (NCSU) — 2013–2014

**Cataloger**, Tau Beta Pi (NCSU) — 2012–2013

## PROFESSIONAL ORGANIZATIONS

**Society for Industrial and Applied Mathematics**, Member — 2017–Present

**American Society for Civil Engineers**, Member — 2016–Present

**Water Environment Federation**, Member — 2015–Present

## CERTIFICATIONS

**Engineer in Training**, North Carolina — 2015