Allison Goodwell

Associate Research Scientist, Illinois State Water Survey goodwel2@illinois.edu
Prairie Research Institute, University of Illinois at Urbana-Champaign

EDUCATION

Ph.D. Civil Engineering, University of Illinois	GPA 4.0/4.0	2017
M.S. Civil Engineering, University of Illinois	GPA 4.0/4.0	2013
B.S. Civil Engineering, Purdue University, IN	GPA 3.9/4.0	2010

HONORS, AWARDS, AND FELLOWSHIPS

NASA New Investigator Program Award (NIP)	2021
Lorenz G. Straub Award for Best Dissertation, St. Anthony Falls Laboratory	2017 (award 2019)
Creative Research Collaborative (CRC) Fellow, CU Denver	2018
University Council on Water Resources (UCOWR) Dissertation Honorable Mention	2018
NASA Earth and Space Science Fellow	2015-2017
Illinois CEE PhD Professional Development Certificate	2016
NSF Graduate Research Fellowship Honorable Mention	2012, 2013
SURGE Fellowship, University of Illinois at Urbana-Champaign	2012-2016
Carver Fellowship, University of Illinois at Urbana-Champaign	2011
Outstanding Civil Engineering Senior Award, Purdue University	2010

EXTERNALLY FUNDED PROJECTS

(PI) NASA New Investigator Program (NIP): Leveraging information theory and flux tower footprints towards improved satellite-based evapotranspiration estimates, 2021-2025
Description: The goal of this project is to improve the way we validate high resolution satellite-based evapotranspiration (ET) data products based on eddy covariance flux tower data.

(Co-PI) Network Cluster CINet: Critical Interface Network in Intensively Managed Landscapes
NSF EAR # 2012850, 2021-2025
Description: The objective of this multi-disciplinary and multi-institutional project is to better understand critical interfaces, such as the floodplain-river, near surface, and root-soil environments that regulate material fluxes, storage, and transformations in an intensively managed critical zone. Within the larger scope, my focus is on near-surface and modeling themes, where we study land-atmosphere fluxes and near-surface processes and evaluate ecohydrological model behaviors. Co-PIs and senior collaborators: Kumar, P., Anders, A., Stumpf, A., Rhoads, B., Druhan, J., Blair, N., Filley, T., Dere, A., Fisher, S., Welp. L, Schaeffer, S.
News release: https://ucdengineeringnews.com/2021/03/10/goodwells-nsf-funded-research-studies-the-critical-interfaces-for-material-transport-in-the-environment/

INTERNALLY FUNDED PROJECTS

National Great Rivers Research Consortium (NGRREC)-funded summer undergraduate internships
This funding supported 2 full-time undergraduate researchers for 10-week internships. Interns work on CINet project topics and travel to sites in the agricultural Midwest for field work.

Creative Research Collaborative (CRC, CU Denver) internal grant: Food-water-energy nexus (2018)

Center for Faculty Development (CFD) Young Upwardly Mobile Professors grant, CU Denver (2020)

CU Denver Teaching Enhancement Grants: Enhancing computing education in undergraduate engineering with Jupyter Notebooks and Arduino class projects (2021, 2022)

CU Denver-seeded Grand Challenge Project: Infrastructure Informatics (2022)

PROFESSIONAL APPOINTMENTS

Associate Research Scientist, Illinois State Water Survey 2026-current
Coordinator for ISWS Innovation Community for Integrated Modeling

Visiting Research Scientist, Prairie Research Institute 2023-2025
Critical Interface Network in Intensively Managed Landscapes (CINet) project

Assistant Tenure-track Professor, University of Colorado, Denver 2018-2023
Duties in teaching, research, and service. Passed P.E. exam in Spring 2022

Postdoctoral Researcher, University of Illinois 2017
Intensively Managed Landscape Critical Zone Observatory (IML-CZO) project

Graduate Research Assistant, University of Illinois 2011-2017
Resilience under Accelerated Change (REACH), Minnesota River Basin project
Intensively Managed Landscape Critical Zone Observatory (IML-CZO) project
PhD Dissertation: Temporal Information Partitioning Networks to infer ecohydrologic behaviors
MS Thesis: Assessment of floodplain vulnerability during extreme Mississippi River Flood 2011

Summer Undergraduate Research Fellowship, Purdue University 2010
Topic: Analysis of coastal upwelling events in southern Lake Michigan

TEACHING

Part-time Lecturer, University of Louisville 2023-2024
ENVS 219: Weather and Climate Lab (online)

Assistant Tenure-Track Professor, CU Denver 2018-2023
CVEN 2200/3200: Computational Methods for Civil Engineers
CVEN 5407: Complex Systems Methods
CVEN 5464: Sustainability and Climate Change

Online Skills Mastery (OSM) Certificate, CU Online 2020
8-week course on online teaching methods

Distinguished Teaching Assistant 2014-2015
CEE 202: Risk and Uncertainty for Civil Engineers
Graduate Teacher Certificate, Center for Innovation in Teaching 2016

Graduate Mentor for Research Experience for Undergraduates (REU) 2013-2014
Purdue Women in Engineering Program (WIEP) tutor 2008-2010

STUDENT ADVISING

<u>*PhD students*</u>
Mozhgan Askarzadeh Farahani (University of Colorado, Denver) 2019-2023
Thesis topic: How ecohydrological models use or misuse available information

<u>*Masters Thesis students (MS degree)*</u>
Jiaze Cao (University of Illinois) 2023-2025
Thesis Title: *Causal discovery methods for functional performance of evapotranspiration models*

Mushfika Zahan (University of Colorado, Denver) 2020-2024
Thesis Title: *Disentangling the effect of landcover heterogeneity on land-atmosphere fluxes in an intensively managed landscape*

Nicholas Campbell (University of Colorado, Denver) 2019-2020
Thesis Title: *Characterizing complex networks of salmon migration through a reservoir network*

Stephanie Vasteno (University of Colorado, Denver) 2019-2020
Thesis Title: *An information-theory approach to comparing evapotranspiration models*

Samuel Franzen (University of Colorado, Denver) 2018-2019
Thesis Title: *Detecting shifts in temporal dependencies between rainfall and streamflow using information theory: a Colorado Headwaters case study*

Masters Report students (MS and MEng degrees at CU Denver)
Amanda Salzman (University of Colorado, Denver)
Report title: *Ozone dynamics and strategies in the Colorado Front Range* 2022-2023 (exp)

Nicole Scardigno (University of Colorado, Denver)
Report title: *An analysis of green roof water requirements in Denver, Colorado* 2022-2023 (exp)

Eric Mathers (University of Colorado, Denver) 2021-2023 (exp)
Report title: *Front Range water resources: a streamflow and water use analysis*

Eric Thomas (University of Colorado, Denver) 2018-2020
Report title: *Changing interactions between streamflow, precipitation, and population within a Denver Watershed*

Nicholas Petersen (University of Colorado, Denver) 2020-2021
Report title: *Sensitivity analysis of a 2D flux footprint model*

Allyssa Brewer (University of Colorado, Denver) 2018-2019
Report title: *Drivers of water quality in the Upper Sangamon River Basin*

Undergraduate Researchers

Mayank Aggarwal	*Remote sensing and IT to examine controls on fluxes*	2024-2025
Rilee Lonberger	*Soil Moisture dynamics in intensively managed landscapes*	2024
Sydney Curts	*Landcover-specific fluxes based on ECOSTRESS*	2021
Ritzwi Chapagain	*Data visualization for precipitation variability across U.S.*	2021
Magdalena Francois	*Inside and Outside the Flux Footprint*	2022

PhD and MS Thesis Committees:

Katie Strauss, PhD candidate, advised by Trent Ford	2027
Harsh Shah, PhD candidate, advised by Praveen Kumar	2026
Tarun Agrawal, PhD, advised by Praveen Kumar	2026
Mahdi Ghafoori, PhD, advised by Moatassem Abdallah	2023
Maya Woods, MS thesis student, advised by David Mays	2021
Fred Sturgell, MS report student, advised by David Mays	2021
Louis Benson, MS thesis student, advised by David Mays	2021
Ed Autterson, MS report student, advised by Jim Guo	2020
Evan Croft, MS report student, advised by Jim Guo	2020

Ryan Tigera, MS thesis student, advised by David Mays 2020
Michelle Swenson, MS thesis student, advised by Arun Karuninithi 2020
James Lindsay, MS thesis student, advised by Jim Guo 2020
Umang Khatiwada, MS report student, advised by Arun Karuninithi 2019

SERVICE

DOE workshop: Lessons Learned from Ecosystem-scale Experimental Field Studies 2025

CU Denver College of Engineering, Computing and Design (CEDC)
Computing Committee 2020-2022

American Geophysical Union (AGU) Hydrology Section
Judge for OSPA (Outstanding Student Presentation Award) 2020
Technical Committee on Hydrologic Uncertainty, member 2017-2019
Hydrology Section Student Subcommittee (H3S), member 2016-2017

CEE Graduate Student Advisory Council (GSAC), University of Illinois 2013-2015
UIUC International Water Resources Association (IWRA)
President of Student Chapter 2012-13
Newsletter and Social Chair 2013-2015

Purdue Society of Women Engineers (SWE)
Executive Board Member 2007-2010

Review and panel participation
NSF panelist, 2 days (Washington, D.C.) 2019
NSF panelist, 3 days (virtual) 2022
NASA panelist, 2 days (virtual) 2021, 2024
Reviewer for following journals 2018-2025
Water Resources Research, HESS, New Phytologist, Entropy, Water, Journal of Hydrometeorology, Agricultural and Forest Meteorology, Earth's Future, Advances in Water Resources, Earth Surface Dynamics, JGR Biogeosciences, Journal of Hydrology, Nature Communications

CONFERENCES AND MEETING ORGANIZATION

PRI Lighting Symposium organizing committee, ISWS representative 2026

PRI AI Frontiers group "PRI AI Training Week" organizing committee 2025

Organizer of CZNet Time-series Data Analysis workshop, UIUC 2024

Organizer for Summer School in Information Theory in Earth Sciences (SITES)
Santander, Spain 2019
Virtual meeting 2020

American Geophysical Union (AGU)
Frontiers in Hydrology Meeting (FIHM) session convener
Hydrocomplexity 2022

AGU Fall Meeting session convener or chair
H51: *Critical Interfaces in the Critical Zone* 2021

H053. *Better Informed than Uncertain: Applications of Information Theory in the Earth Sciences*	2018
Town Hall: *Shaping the Future of Critical Zone Science: Advancing Transdisciplinary and Interagency Collaboration for a Resilient Planet*	2024
H059: *Advancing Prediction, Theory, and Causal Understanding in Geosciences through AI and Big Data.*	2025

PUBLICATIONS (in prep and in review)

Cao, J., **Goodwell, A**., Kumar, P. (2026) *Causal discovery methods for functional performance of evapotranspiration.* In revision for Water Resources Research (January 2026)

Goodwell, A., Saccardi, B., Wang, J., Dere, A., Druhan, J., Welp, L., Stumpf, A., Bauer, E., Sargent, S., Kumar, P. (2025) *Detecting regimes of critical zone processes, drivers and predictability with a data-driven framework.* In revision for AGU Advances (January 2026)

Agrawal, T., **Goodwell, A.,** Kumar, P. (2026) *Integrating flow and solute flux dynamics in an adaptive LSTM model for stream chemistry predictions.* In review for JGR Machine Learning and Computation

Mohlman, J., Doerr, E., Muste, M., Rhoads, B., Bauer, E., Filley, T., **Goodwell, A.,** Dere, A., Stumpf, A., Saccardi, B., Jimenez-Castaneda, M., Kumar, P., Dolant, A. (2026) *From roots to canopy: An integrated framework for critical zone education and outreach.* To be submitted to Environmental Education Research in February 2026

Saccardi, B., DuRussel, K., Rhoads, B., Anders, A., **Goodwell, A.**, Blair, N., Bauer, E., Stumpf, A., Wang, J., Druhan, J., Dere, A., Welp, L., Kumar, P. *The critical role of events in intensively managed agricultural landscapes.* To be submitted to Frontiers in Water in March 2026

Agrawal, T., Shah, H., Wang, J., **Goodwell, A.,** Druhan, J., Kumar, P. *Integrating geospatial attributes into a non-stationary transformer model for improved stream chemistry predictions.* In preparation for JGR Machine Learning and Computation

PUBLICATIONS

*Since 2014, see Google Scholar for complete list of publications and presentations

Wang, J., Bouchez, J., Winnick, M., **Goodwell, A.,** Dere, A., Kumar, P., Druhan, J. (2025) *Drought constrictions on lateral carbon transport.* Nature Geoscience. DOI: 10.1038/s41561-025-01807-z

Saccardi, B., Dere, A., **Goodwell, A.,** Druhan, J., Welp, L., Blair, N., Bauer, E., Haken, J., Jimenez-Castaneda, M., Filley, T. Kumar, P. (2025) *The scale of influence: how different drivers determine CO_2 production at event, daily, and seasonal scales.* Frontiers in Water, Vol. 7, DOI: https://doi.org/10.3389/frwa.2025.1638541

Saccardi, B., Dere, A., **Goodwell, A.,** Druhan, J., Welp, L., Blair, N., Bauer, E., Haken, J., Jimenez-Castaneda, M., Filley, T., Frantal I., Kumar, P. (2025) *A Low Power Low Cost Chamber Based CO2 Sensor.* Frontiers in Water, Vol. 7. DOI: 10.3389/frwa.2025.1638540

Goodwell, A. Zahan, M, Cao, J, URycki, D. (2025) *Spatial heterogeneity of agricultural evapotranspiration as quantified by satellite and flux tower sources,* Agricultural and Forest Meteorology. Vol 372. DOI 10.1016/j.agrformet.2025.110608

Agrawal, T., **Goodwell, A**., Kumar, P. (2025) *Improving stream solute predictions with a modified LSTM model incorporating solute interdependences and hysteresis patterns.* JGR Machine Learning and Computation. Vol. 2, DOI 10.1029/2024JH000383

Farahani, M. and **Goodwell, A.** (2024) Causal drivers of land-atmosphere carbon fluxes from machine learning models and data. JGR Biogeosciences. Vol 129 DOI 10.1029/2023JG007815

Kumar, P, Anders, A., Bauer, E., Cain, M., Dere, A., Druhan, J., Filley, T., Giannopoulos, C., **Goodwell, A.,** Grimley, D., Karwan, D., Keefer, L, Kim, J., Marini, L., Muste, M., Papanicolaou, T., Rhoads, B., Hernandez Rodriguez, L,

Roque-Malo, S., Schaeffer, S., Stumpf, A., Ward, A., Welp, L., Wilson, C., Yan, Q, Zhou, S. (2023) *Emergent Role of Critical Interfaces in the Dynamics of Intensively Managed Landscapes*. Earth-Science Reviews, Vol. 244, DOI 10.1016/j.earscirev.2023.104543

Hernandez Rodriguez, L.C., **Goodwell, A**., and Kumar, P. (2023) *Inside the flux footprint: the role of organized landcover heterogeneity on the dynamics of observed land-atmosphere exchange fluxes.* Frontiers in Water, DOI 10.3389/frwa.2023.1033973

Goodwell, A. and Bassiouni, M (2022) *Source dependency and model structure determine information flow paths in ecohydrologic models*, Water Resources Research, DOI 10.1029/2021WR031164

Farahani, M., Vahid, A., **Goodwell A**. (2022) *Evaluating ecohydrological model sensitivity to input variability with an information theory-based approach*, Entropy, DOI 10.3390/e24070994

Goodwell, A. and Campbell, N. (2022) *Characterizing complex networks of salmon migration through a reservoir network*, PLoS ONE, DOI 10.1371/journal.pone.0269193

Goodwell, A. and Chapagain, R. (2021) *Chains of spatial and temporal precipitation occurrence predictability across the continental U.S.* Frontiers in Climate, Volume 3, DOI 10.3389/fclim.2021.780879

Goodwell, A. (2020) "*It's raining bits": Patterns in directional precipitation persistence across the U.S.* Journal of Hydrometeorology, Volume 21, Issue 12, pp 2907–2921, DOI 10.1175/JHM-D-20-0134.1

Franzen, S., Farahani, M., **Goodwell, A.** (2020) *Information flows: Characterizing precipitation-streamflow dependencies in the Colorado Headwaters with an information theory approach.* WRR, Volume 56, Issue 10, DOI 10.1029/2019WR026133

Goodwell, A., Jiang, P., Ruddell, B., Kumar, P. (2020) *Debates - Does Information Theory provide a new paradigm for Earth science? Identifying causality, interaction, and feedback. WRR, Volume 56, DOI:* 10.1029/2019WR024940

Goodwell, A., Kumar, P. (2019) *A changing climatology of rainfall persistence using information-based measures*. Journal of Hydrometeorology, DOI: 10.1175/JHM-D-19-0013.1

Wilson, C., …, **Goodwell, A.,** et al (2018) *The Intensively Managed Landscape Critical Zone Observatory: A scientific testbed for understanding critical zone processes in agroecosystems.* Vadose Zone Journal, DOI: 10.2136/vzj2018.04.0088

Goodwell, A., Kumar, P., Fellows, A., Flerchinger, G. (2018) *Process connectivity explains ecohydrologic responses to rainfall pulses and drought.* PNAS, 201800236, DOI: 10.1073/pnas.1800236115

Goodwell, A., Kumar, P. (2017) *Temporal Information Partition Networks (TIPNets): A process network approach to infer ecohydrologic shifts*. WRR, Volume 53, pp. 5899-5919, DOI: 10.1002/2016WR020218

Goodwell, A., Kumar, P. (2017) *Temporal Information Partitioning: Characterizing synergy, redundancy, and uniqueness in interacting environmental variables*. WRR, Volume 53, pp. 5920-5942, DOI: 10.1002/2016WR020216

Dutta, D., Wang, K., Lee, E., **Goodwell, A.**, Wagner, D., and Kumar, P. (2016) *Characterizing Vegetation Canopy Structure using Airborne Remote Sensing Data*, IEEE Trans. in Geoscience and Remote Sensing, Issue 99, Nov. 2016, DOI: 10.1109/TGRS.2016.2620478

William, R., **Goodwell, A.**, Richardson, M., Le, P., Stillwell, A., Kumar, P. (2016) *An environmental cost-benefit analysis of alternative green roofing strategies.* Ecological Engineering, Volume 95, pp. 1–9, 2016, DOI: 10.1016/j.ecoleng.2016.06.091

Goodwell, A., Kumar, P. (2015) *Information theoretic measures to infer feedback dynamics in coupled logistic networks.* Entropy, Volume 17, pp. 7468-7492, DOI: 10.3390/e17117468

Plale, B., Kouper, I., Suriarchchi, I., **Goodwell, A.** (2015) *Thread of Trust: Big Data and Science.* Book chapter in Big Data is Not a Monolith, edited by Cassidy R. Sugimoto, Hamid R. Ekbia, and Michael Mattioli. The MIT Press, Cambridge Massachusetts

Dutta, D., **Goodwell, A.**, Greenberg, J., Kumar, P., Garvey, J., Darmody, R., Berretta, D. (2014) *On the feasibility of characterizing soil properties from AVIRIS spectrometer data* (2015) IEEE Transactions on Geoscience and Remote Sensing, Volume 53, Issue 9, 10.1109/TGRS.2015.2417547

CONFERENCE PRESENTATIONS

*selected, since 2021, underlined names are CU Denver or UIUC undergraduate students, postdocs, or graduate students

Goodwell, A., Saccardi, B., Druhan, J., Wang, J., Dere, A., Kumar, P. Intensive management redefines processes and predictability in the critical zone American Geophysical Union (AGU) Fall Meeting, Washington DC, December 2024

Aggarwal, M., **Goodwell, A.** (2024) Remotely Sensed Vegetation Indices Highlight Heterogeneity of Field-scale Critical Zone Processes in Agricultural and Prairie Ecosystems, American Geophysical Union (AGU) Fall Meeting, Washington DC, December 2024

Cao, J., Kumar, P., **Goodwell, A.** Evaluating Functional Performance of Evapotranspiration Models Based on Causal Discovery Methods American Geophysical Union (AGU) Fall Meeting, Washington DC, December 2024

Goodwell, A, Zahan, M., URycki, D. (2023) Information flows from landscape and meteorological drivers to land-atmosphere fluxes in intensively managed landscapes. American Geophysical Union (AGU) Fall Meeting, San Francisco, December 2023

Goodwell, A, Bassiouni, M. (2023) Source dependencies and model structures impact information pathways in ecohydrologic models. Poster presentation, American Meteorological Society (AMS) Annual Meeting, Denver, January 2023

Farahani, M.A., **Goodwell, A.** (2023) Information flow paths determine causal mechanisms of vertical carbon fluxes in models and data. Oral presentation, American Meteorological Society (AMS) Annual Meeting, Denver, January 2023

URycki, D.R., **Goodwell, A.,** Anderson, M.A., Yang, Y., Xue, J. (2022). Information Theory and Flux Footprints to Characterize Drivers of Daily Satellite-Based and Flux Tower Evapotranspiration. Poster presentation, AGU Fall Meeting. Chicago, IL. 12-16 Dec.

Goodwell, A., URycki, D., Farahani, M., Zahan, M. (2022) Causal attribution of landscape versus meteorological drivers of eddy covariance fluxes. Poster presentation, AGU Fall Meeting 2022, online.

Goodwell, A., Bassiouni, M. (2021) Source dependencies and model structures impact information pathways in ecohydrologic models. Oral presentation, AGU Fall Meeting 2021, New Orleans, Session H51C

Zahan, M., **Goodwell, A.** (2021) Evaluating the effect of flux footprint on flux magnitudes in an agricultural landscape. Oral presentation, AGU Fall Meeting 2021, New Orleans

Goodwell, A. (2020) It's raining more bits: Patterns in directional precipitation persistence across the U.S. Oral presentation, AGU Fall Meeting 2020, virtual, Session H132

Cambell, N., **Goodwell, A**. (2020) Drivers of Chinook salmon population dynamics in the Columbia River Basin, Poster presentation, AGU Fall Meeting 2020, virtual, Session H171

SOFTWARE AND DATA

Selected examples, see https://github.com/allisongoodwell for all repositories

CZ Processes, Drivers and Predictability (updated 2025, paper in review)
Description: Python codes to perform time-series data analysis including clustering, PCA, and IT measures
Link: https://github.com/cinet-cluster/CZ_ProcessesDriversPredictability

TIPNet: Temporal Information Partitioning Networks (2017, updated 2020)
Description: Matlab GUI for process network measures based on time-series inputs
Link: https://github.com/allisongoodwell/TIPNet
DOI: 10.5281/zenodo.3722456

Franzen_InfoFlows_2020 (updated 2020)
Description: python codes for Franzen, Farahani, Goodwell, WRR 2020 DOI: 10.1029/2019WR026133
Link: https://github.com/allisongoodwell/Franzen_InfoFlows_2020
DOI: 10.5281/zenodo.3860555

SourceDependency2021 (updated 2022)
Description: repository for codes necessary to reproduce figures and analysis in Goodwell and Bassiouni, 2022, WRR
Link: https://github.com/allisongoodwell/SourceDependency2021

DOI: 10.5281/zenodo.6600721