EWRS CONCENTRATION

Research and courses within the Environmental and Water Resources Systems Engineering group are concerned with the development and application of quantitative methods for the **evaluation, planning, and operation of water resource and environmental systems.** Efforts address the integration and analysis of engineering and economic-policy issues posed by the need to manage water, land, air and human resources, as well as environmental remediation efforts. The fundamental sciences upon which such analyses are based include hydrology, hydraulics, environmental sciences, biology, and environmental engineering.

Student projects in the EWRS area have addressed regional water resources management issues in California, New York, New Jersey, Mexico, North Africa, Europe and parts of Asia. In a time of quantum leaps in computing technology, when local and national governments face tight budgets, and when society as a whole has a desire for economic efficiency and sustainability, an interest in the intelligent use of environmental resources, and a concern for risks to human health, we believe environmental systems engineering is an important and promising area for research and study.

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Grad Student Organizations

Civil and Environmental Engineering graduate students have the opportunity to participate in several national or local organizations. The most popular are:

- CEE GSA - CEE Graduate Student Organization
- EGSA - Engineering Graduate Student Organization
- GPSA - Graduate and Professional Student Assembly
- MEngSA - Master of Engineering Student Association

www.cee.cornell.edu/news/student_spotlights.cfm

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CornellEngineering
Civil and Environmental Engineering

ENVIRONMENTAL & WATER RESOURCE SYSTEMS

Master of Science/
Doctor of Philosophy

FACULTY RESEARCH

Graduate students collaborate with EWRS faculty on research that pushes the boundaries of our knowledge. Our faculty has always represented the best the field has to offer-engineers and scholars of the highest caliber.

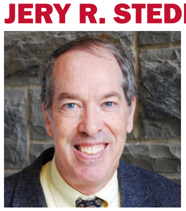
C. LINDSAY ANDERSON

Research Interests: The Anderson Lab investigates operational methods for more effective integration and use of renewable energy technologies. This is an interdisciplinary research area with aspects of operations, optimization, as well as environmental and systems engineering. The Anderson Lab investigates operational methods for more effective integration and use of renewable energy technologies. Although prior global technological revolutions in agricultural, industry, and the internet occurred over decades, the current shift in energy is happening far more rapidly. The shift in energy sources is further complicated by a growing awareness of the need to understand and manage interactions among energy, food and water systems, leveraging modern communications and computational resources. The complexity and evolution of these systems and the earth's climate lead to challenging technical, operational and economic problems. The Anderson Lab's approach is interdisciplinary, combining engineering, economics and mathematics to better understand the interactive forces of systems and markets.

PATRICK M. REED

Research Interests: Dr. Reed's primary research interests relate to sustainable water management given conflicting demands from renewable energy systems, ecosystem services, expanding populations, and climate change. The tools developed in Dr. Reed's group bridge sustainability science, risk management, economics, multiobjective decision making, operations research, computer science, and high performance computing. Engineering design and decision support software developed by Dr. Reed has been used broadly in governmental and industrial application areas (e.g., civil infrastructure planning and management as well as US satellite constellation design and management). The Reed Research Group is exploring new frameworks for effectively combining a wide range of knowledge sources with simulation, optimization, and information technologies to capture impacted systems' governing processes, elucidate human and ecologic risks, limit management costs, and satisfy stakeholders' conflicting objectives. The management modeling tools developed by the Reed Research Group combine multiobjective optimization, high performance computing, and advanced spatiotemporal visualization and uncertainty modeling techniques to facilitate improved stakeholder decisions.

JERY R. STEDINGER



Research Interests: Stedinger's research focuses on statistical issues in hydrology and optimal operation of water resource systems. Research projects have addressed the value of historical and paleoflood data in flood frequency analysis, regional hydrologic regression and network analyses, risk and uncertainty analysis of flood-risk reduction projects, calibration and uncertainty analysis for rainfall-runoff models, stochastic simulation of water resource systems, and efficient multiple-reservoir and hydropower system operation and system design. Current projects also consider earth energy systems and geothermal resource mapping.

SCOTT STEINSCHNEIDER

Research Interests: The Steinschneider Research Group explores the intersection between anthropogenic, hydrologic, and climatic systems with an emphasis on water resources planning and management. The broad goal of our research is to provide decision-centric information for the sustainable design and management of integrated water resource systems. Often this must be accomplished under an array of deeply uncertain future conditions, such as climate variability and change, alterations to the hydrologic landscape, shifts in agricultural production and energy usage, population growth, and evolving requirements to support aquatic ecosystems – all can influence (and be influenced by) our water systems. We aim to better understand these interconnections so that we can develop knowledge that promotes sustainability across the myriad of sectors linked to water resources management. This research demands an interdisciplinary approach that combines aspects of hydroclimatology, systems analysis, economics, ecology, and risk management. Our work draws upon a wide range of techniques and methods including systems simulation and optimization, hierarchical Bayesian modeling, and the study of spatiotemporal hydroclimate variability. The tools and knowledge developed through our research are applied to complex water systems to inform and improve the choices made by a diverse set of decision-makers.

M.S./Ph.D.

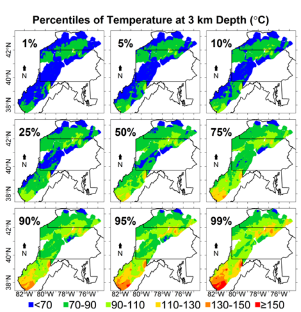
In the Master of Science program, each student plans an individualized course of study with the assistance of a special committee made up of faculty members who represent major and minor concentrations of study. The degree requires a thesis and a final oral examination. In the Ph.D. program, each student plans an individualized course of study with the assistance of a special committee made up of faculty members representing major and minor concentrations of study. The degree requires qualifying and comprehensive examinations, as well as a thesis and final oral examination.

Graduate students in the M.S. and Ph.D. programs are expected to demonstrate mastery of knowledge in a specific subject area in Civil and Environmental Engineering and to synthesize and create new knowledge, making original and substantial contributions to their discipline.

STUDENT RESEARCH

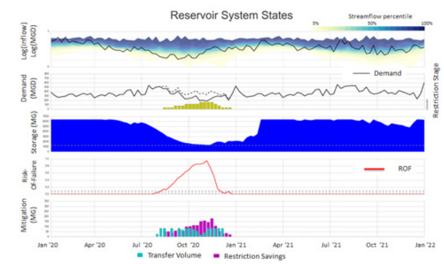
JARED SMITH

Geothermal resource assessments for sedimentary basins often rely on abundant low quality thermal and geological information to estimate temperatures at depths of several kilometers. With many uncertain and spatially correlated variables, it is not clear a priori which variables contribute most to temperature uncertainty. Identifying important variables spatially provides guidance for how to allocate time and financial resources for geothermal energy projects. I use geostatistical simulations, like the figure below, and sensitivity analyses to estimate where temperatures are the most uncertain, and which variables contribute most to the uncertainty.



At left: The temperature at 3 km depth in the Appalachian Basin, shown as percentiles from a Monte Carlo analysis of about 60 geologic and thermal variables. A temperature of 70 °C is considered a minimum for direct-use heating, and temperatures in excess of 150 °C may be used for electricity generation. Locations with the greatest uncertainty in the temperature at 3 km are those where the temperature increases markedly as the percentile increases, like southern West Virginia.

DAVID GOLD



Our research group focuses on decision support for complex environmental and water resources systems. My work explores the creation and implementation of sustainable water management policies for multi-actor systems, focusing on a test case in the Research Triangle region of North Carolina. Successful management policies must be robust to uncertain future conditions (e.g. climate change, socio-economic conditions) while balancing conflicting objectives and stakeholder priorities. Policies are crafted using a water resources model coupled with a multi-objective evolutionary algorithm to search the feasible decision space for policies that optimize stakeholder objectives. Diagnostic tests are then performed on preferable policies to understand how the actions of each utility impact the regional system.

Above figure: Diagnostic output from a reservoir simulation for the city of Durham, NC in the years 2020-2021. The top panel represents the simulated streamflow of the system superimposed over the historical streamflow quantiles. The second panel shows the simulated system demands as well as the level of restrictions implemented by the utility (as a response to drought conditions). The third panel shows the Risk-Of-Failure (the risk that the reservoir storage will drop below 20% based off historical inflow data) for the utility over the simulation, this risk metric is used to trigger short-term mitigation actions including inter-utility transfers and water use restrictions, shown in the bottom panel.