IRG Track 2: Resilient Water Systems: Integrating Environmental Sensor Networks and Real-Time Forecasting to Adaptively Manage Water Quality and Build Social Trust, NSF Award 1737424

- **Cayelan Carey**, François Birgand, Renato Figueiredo, John Little, Madeline Schreiber, Michael Sorice, Quinn Thomas

- Primary partner: Western Virginia Water Authority
- **SmartReservoir.org**

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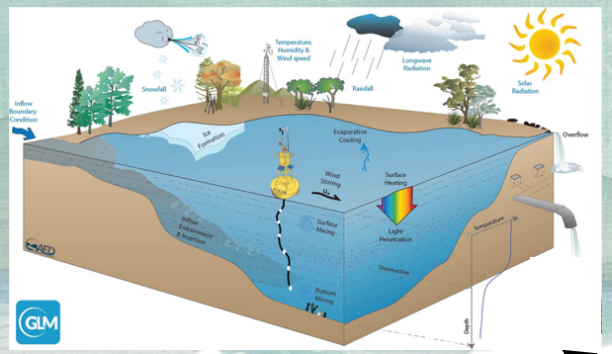
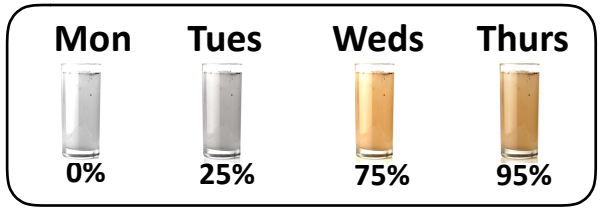
Sensored drinking water reservoir



Novel sensors and secure data transfer and processing in the cloud



Creating real-time water quality forecasts for decision-making

Water quality model and forecasting system

Using forecasts to improve reservoir management

Building resilience in the water supply

Community system of water users

Educating the public on smart technology

Evaluating how technology changes social trust in water utilities

Water utility management system

Smart & Connected Water Systems

ROANOKE

WESTERN VIRGINIA WATER AUTHORITY

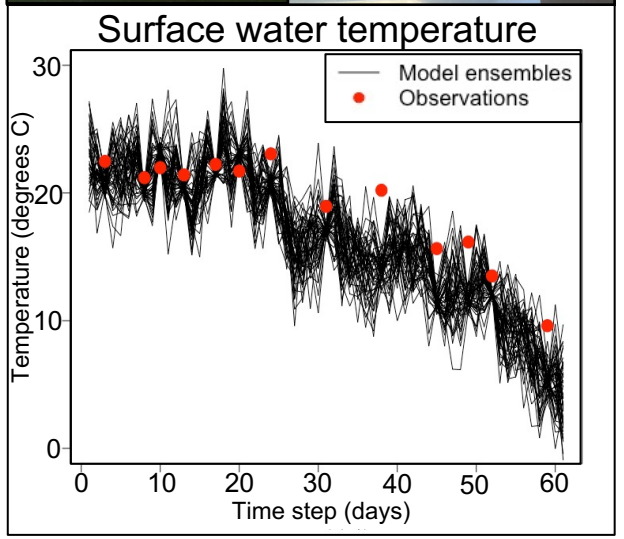
Project Overview

Use-inspired research:

- All steps of our system were co-designed with water utility partners

Fundamental research contributions

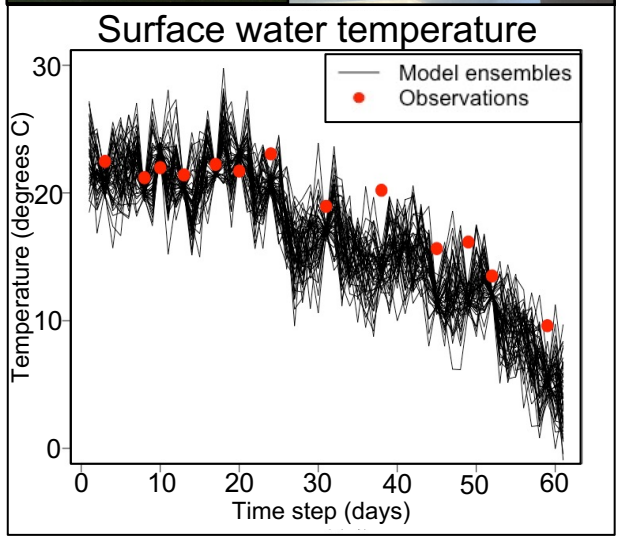
- Scalable, end-to-end forecasting workflow with sensors, cyberinfrastructure, models, and managers serves as a model for other water utilities
- >20 publications and >100 presentations to date, primarily led by early career researchers



Project Updates

Major findings:

- We successfully predicted water quality impairment 4-13 days in advance during 2018-2020
- Generalized our forecasting software, which is now being applied to other lakes and reservoirs
- Provisional patent application submitted
- We have developed and assessed two teaching modules that use sensor data collected in this project to teach undergraduates environmental data science skills



Project evolution

Take-homes:

- As a result of COVID, development and testing of new sensor technology has been postponed
- Consequently, we are using less-complex water quality models for prototype chemistry and algal bloom forecasts in our focal reservoir
- Managers' priorities have shifted over time, necessitating us to add in additional water quality variables into forecasts
- Scaling must be sustainable!

Evaluating project impact on communities

Major survey findings:

- Prior to COVID, we conducted a survey of 350 Roanoke residents to assess how the implementation of forecasting technology into their drinking water supply affected their trust in their drinking water
- We found no relationship between knowledge of forecasting technology and trust
- Information on “smart” technology has minimal effect because the public already believes the utility has their best interests in mind

Anticipated outcomes for next year

Research activities:

- Forecasting system experiments by selectively removing data streams to examine system robustness and security
- Expanding the suite of water quality models that can be integrated into the forecasting system
- Analyzing data in hand: we are working on ~10 manuscripts that span social sciences to computer sciences
- Further disseminating the teaching modules developed in this project, which have been used in many virtual classrooms to teach environmental data science skills during COVID