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Abstract: Federated data services and interactive workspaces for integrated modeling and advanced decision support will transform the practice of transdisciplinary research and improve science-based communication with decision makers and stakeholders. Integrated models are needed and they must be developed in a way that streamlines comparative analyses and makes them accessible to users. This research advances a framework of accessible computational tools for connecting data and models through reusable workflows and interactive decision support dashboards.

The prototype application, called Watermark, is used to analyze and apply integrated methods to an urban groundwater management problem. Watermark's interactive mapping tools and touch-enabled interfaces for interacting with datasets provide a strong suite of utilities to serve individual and group use cases, such as multi-stakeholder meetings. The Watermark infrastructure utilizes a client/server system that provides users with access to spatial and tabular data with low bandwidth requirements.

Case study results replicate advanced decision support functionality and enable comparative analysis across scientific interpretations of input parameters, like recharge, to evaluate the robustness of candidate solutions. A workflow was implemented to generate combinatorial outputs across 11 decision variable settings for pumping and optimized for key performance measures, including spring flow, total storage, and available aquifer yield. Simulated results for a set of ~80,000 runs were compared and presented in an interactive dashboard. The Watermark approach to federated decision support reflects next generation development for DSS that will streamline accessibility, data fusion, and reusability across case study types and enable application of Environmental DSS to integrated system problems.

Keywords*:* Decision support system; open-source framework; reproducible workflows; automated reasoning; groundwater