Jun 26th, 2:00 PM - 3:20 PM

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iEMSs International Congress on Environmental Modelling and Software

9th International Congress on Environmental Modelling and Software
Fort Collins, Colorado, USA, Mazdak Arabi, Olaf David, Jack Carlson, Daniel P. Ames (Eds.)
https://scholarsarchive.byu.edu/iemssconference/2018/

DiscoverWater: An Interactive Visualization Web App for Multiple Spatio-temporal Datasets with Application to Water Resources

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Abstract: Environmental commodities have been exploited extensively in Kansas, with consequences such as large-scale groundwater depletion from irrigation in western Kansas, streambank destabilization, and harmful algal blooms. For all of these issues, spatial and temporal aspects are important, and long timeframes and spatially distributed process drivers and consequences make it difficult to understand cause and effect relations. Methods of analysing and presenting the relevant multivariate, temporal data to scientists, resource managers, and stakeholders are needed to address scientific questions and provide decision-support. Previous work resulted in a visualization platform capable of clearly depicting correlations and suggesting interdependencies between time-varying, spatially-distributed quantities; it is called DiscoverWater. DiscoverWater is a time-evolving map and graphs based on time-series data. It is designed and built to display how water resources change on the landscape and in the subsurface. While hard-wired in the prototype, programming using open source data visualization and web-mapping JavaScript APIs allows points on the map to be selected and activates the synchronized graphs. The prototype is demonstrated considering the consequences of past irrigation pumping of the using hydrologic data in southwest Kansas, where the High Plains aquifer has been severely depleted, by examining the interactions between these major components—water-use, groundwater level, streamflow, and climate. Through data-driven visualization methods, this dynamic map allows for analyses to be made on various temporal scales, from across historical record to a select season, and spatial scales, from individual gage stations to the entire Arkansas River. DiscoverWater is a powerful tool that can be applied to various water resource scenarios but has not yet been used widely. Therefore, it is necessary to strengthen the correlative measures among datasets and test the efficacy in a range of important hydrologic systems.

Keywords*: Data-driven visualization; water resources; multivariate spatio-temporal data; web app; qualitative trend analysis.*