



Developing decision-relevant data and information systems for California water resources through research, collaboration and listening

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California's historic drought of 2011-2015 provided excellent conditions for researchers to listen to water-management challenges from decision makers, particularly with regard to data and information needs for improved decision making. Through the University of California Water Security and Sustainability Research Initiative (<http://ucwater.org/>), in 2015 we began a multi-year dialog with water-resources decision makers and government agencies that provide data and technical support for water management. Near-term products of that collaboration are both a vision for a 21st-century water data and information system, and near-term steps to meet immediate deadlines in a way that is consistent with the longer-term vision. While many university-based water researchers engage with agencies on both science and policy challenges, UC Water's focus was on: i) integrated system management, from headwaters through groundwater and agriculture, and on ii) improved decision making through better water-information systems. This focus aligned with the recognition by water leaders that fundamental changes in the way the California manages water were overdue. UC Water is focused on three "I"s: improved water Information, empowering Institutions to use and to create new information, and enabling decision makers to make smart investments in both natural and built Infrastructure. Effective communication with water decision makers has led to engagement on high-priority programs where large knowledge gaps remain, including more-widespread groundwater recharge of storm flows, restoration of mountain forests in important source-water areas, governance structures for groundwater sustainability, and filling information gaps by bringing new technology to bear on measurement and data programs. UC Water has established a headwater-to-groundwater observatory in the American-Cosumnes River basin, as a proof of concept for whole-watershed (headwaters to groundwater to agriculture) water accounting. Central to the headwaters measurement and restoration is a whole-basin wireless-sensor network capable of accurately reporting the water balance at multiple scales. With over 140 sensor nodes strategically distributed in 14 clusters, the WSN monitors the upper 40 percent of the basin, significantly expanding the total measurement area and providing a more complete picture of the basin's hydrologic profile than is done with operational measurements. Sensors track temperature, humidity, precipitation, snowpack, solar radiation and soil moisture. Using the WSN data, we can estimate the elevation at which precipitation fell as rain versus snow based on dew-point temperatures measured across the basin, and can estimate where and how much precipitation fell as rain versus snow across the basin. Extension of the observatory to valley groundwater is in progress. Continuing engagement of UC Water researchers in public dialog around water resources, through opinion pieces, feature articles, blogs, white papers, social media, video clips and a feature documentary film have also been key to our continuing engagement. These novel partnerships are leading to decision-relevant tools and an improved integrated praxis in on-the-ground water-resources management. Our research is becoming more embedded in policies and our network remains interconnected with decision makers at multiple levels.