Hydrologic observatory design in the Western United States: Scaling measurements and modeling in the Sierra Nevada of California

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A team of scientists in hydrology and related disciplines are working to develop an environmental observatory in the semiarid mountain-valley landscape of the far western United States, specifically to address priority research needs in mountain hydrology. Our immediate aims are to: i) formulating basin-scale measurement and modeling strategies to meet priority research issues, and ii) assessing different instrument cluster designs to provide the ground-based measurements needed for hydrologic process research. Achieving these aims will both help to establish a "virtual" observatory, and provide direction for building new infrastructure in an actual observatory. The critical first step in any observatory design is to have a robust, usable infrastructure for managing data and information. Our observatory design concept involves establishing intensive measurements at ground-based instrument clusters, integrated with broad coverage offered by satellite remote sensing, plus operational networks. Results from three prototype instrument clusters provide guidance for more widespread deployment of instruments across the mountain landscape. For example, elevation and aspect are the primary controlling variables for snowcover and soil moisture at the catchment scale, with vegetation structure being equally important at the plot scale. The main science challenge is that of scaling between the instrument clusters. Basing an observatory design on instrument clusters at representative points across the landscape recognizes that it is logistically infeasible to measure everything, everywhere, all the time. Instrument clusters co-locate key measurements, in order to illuminate linkages among processes within each cluster's relatively small footprint. Design challenges include configuring instrument clusters to maximize the scientific payoff for a given investment of resources; and determining how well the data from these clusters represent the landscape that surrounds them.