I-WATER: Integrated Water, ATmosphere, Ecosystems Education and Research

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Abstract. Water must be managed responsibly because it is essential to life and because it is limited to meet human and environmental needs. However, water management decisions generate conflicts between humans, ecosystem needs, and political jurisdictions. Therefore, there is a critical need for scientists who can address three important questions: 1) how can limited fresh water be distributed equitably in a socially acceptable and sustainable framework; 2) what are the relative ecological and societal benefits and drawbacks of management actions; and 3) how can science provide answers for wise water management decisions?

I-WATER (Integrated Water, ATmosphere, Ecosytem Education and Research), a new NSF-funded IGERT program at Colorado State University, will address these complex hydrologic, ecologic, and socio-economic challenges facing society by preparing Ph.D. students to work in complex, interdisciplinary research at the interfaces between hydrologic, atmospheric, ecologic, and management disciplines. Issues of variability and uncertainty, vulnerability of human use and ecosystems, and sustainability will be developed in a new interdisciplinary curriculum and probed in the framework of the following research themes defined by research questions at those interfaces: I) Hydrologic, atmospheric, and ecologic systems; II) Hydrologic, ecologic, and socio-economic systems; III) Hydrologic, atmospheric, and socio-economic systems; and IV) I-WATER-Research integration and synthesis. The I-WATER program involves eleven science and engineering departments at Colorado State University, and includes opportunities for trainees to participate in internships at federal and state agencies.

Vulnerability of Future U.S. Water Supply to Shortage

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Abstract. As our climate changes and human populations continue to expand, an understanding of the vulnerability of the systems on which we rely becomes increasingly important. That vulnerability depends both on a system's ability to withstand stresses and on the magnitude of those stresses. Most importantly, it depends on the inherent probabilistic nature of the bio-physical and socio-economic drivers affecting both the system's capacity and stresses. Because the magnitude of the stresses and the capacity to withstand them are uncertain, vulnerability should be quantified probabilistically and depends on the joint probability distribution function of capacity and stresses. We introduce a probabilistic framework for vulnerability analysis and use it to quantify current and future vulnerability of the highly interconnected water supply system of the contiguous United States. We determine the projected changes in vulnerability as well as the relative contributions to those changes from changes in the means and variances of the hydro-climatic and socio-economic drivers. For all scenarios and global climate models examined, the US Southwest including California and the southern Great Plains was consistently found to be the most vulnerable. For most of the US, the largest contributions to changes in vulnerability come from changes in evapotranspiration, followed by those from changes in precipitation. However, for some areas of the larger Southwest changes in vulnerability are caused mainly by changes in demand. Importantly, changes in vulnerability from projected changes in the standard deviations of precipitation, evapotranspiration and demand are of about the same magnitude or larger than those from changes in the corresponding means over most of the US, except in large areas in the Great Plains, in central California and southern and central Texas.