Vulnerability of Future U.S. Water Supply to Shortage

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Abstract. Although water use efficiency in the United States has been improving in recent years, expected future population and income growth will place additional demands on water supplies. Climatic change is likely to increase demands as it also decreases supplies in some regions, and to increase hydrologic uncertainty. Taken together, these forces are making careful water management ever more important and call for a realistic broad-scale understanding of the vulnerability of our water supply to shortage. This study aims to provide that understanding for the conterminous US.

Fresh water contribution is estimated as precipitation minus evapotranspiration for each point in a grid covering the study area, and then allocated in major river basins wherein available water supply is compared with a threshold quantity of required water use. Effects of storage and trans-basin diversions are also considered through use of a multi-basin routing model. Precipitation and evapotranspiration being stochastic processes, fresh water contribution is described by a cumulative probability distribution function (CDF), yielding a corresponding CDF of water available to meet demand. Shortage occurs when available supply is insufficient to meet the use threshold. The CDF of available water, when compared with the threshold, yields an estimate of the probability of shortage, and thus a measure of the vulnerability of the water supply system. The comparison of water supply to the water use threshold is performed for both current conditions and for possible future conditions reflecting population and economic growth as well as a changing climate. Examination of future scenarios provides a measure of the extent to which serious future risks of water shortage must be anticipated. Regardless of emissions scenario or GCM employed, this assessment indicates substantial shortages in the American Southwest and Great Plains, with lesser impacts in some other regions.

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