Assessing Water Stress Risk in a Variable Climate in the American Southwest

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Abstract. The fresh water supply available for both human and environmental requirements in arid and semi-arid watersheds around the globe is coming under increasingly unsustainable, and often disproportionate pressure from both growing anthropogenic demands and increasing climate pattern uncertainties. The southwest region of the United States is no exception, with fresh water withdrawals of both ground and surface water resources in the Colorado River Basin continuing a several decade long trend of growth in order to meet the demands of rising population, urbanization, and irrigation intensive agriculture. The strain on the region's water supply can be quantified by using existing and diversified water stress indicators, applied at fine temporal and spatial scales, to summarize the water scarcity risk throughout the region, and study their spatio-temporal variability and changes. Water scarcity linkage with large-scale climate variability will help us understanding climate associations with water stress risk, which can inform us about predictability and uncertainty quantification of water stress risk on the system that is explained by climate. Many water stress indicators and indexes have been created to characterize stresses of different natures due to a broad range of natural and anthropogenic factors. Computing several appropriate existing indicators, through collections of necessary available data, gives the deepest and most informed picture of the situation, encompassing both the temporal and spatial variability of water supply and demand. Water availability per person, and the ratio of water use and renewable and non-renewable supply will be calculated by sub-basin and county across the study area so that spatial dependencies and spatio-temporal variability will be accounted for. Potential jurisdictional conflicts may be highlighted as basin and county boundaries overlap. Drought indicators may be especially relevant to the region and will be applied as well. A measure of maximum cumulative water deficit within a year, and deficits that carry over multiple years will be performed. An analysis of annual and seasonal minimum river flow amount and durations is also an important drought/water scarcity indicator for ecosystem services, which are also considered in this study. All these analyses cumulatively will help us to characterize water scarcity issues for the study region from different perspectives (natural and anthropogenic and their combinations), develop vulnerability maps as well as present their connections with large-scale climate with the future goal of predictability study.