Past, present and future of drought in southwestern North America

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The IPCC AR4/CMIP3 global climate models robustly projected a drying of southwest North America (SWNA) in the current century as a consequence of rising greenhouse gases and subtropical drying and expansion. The IPCC AR5/CMIP5 models in general agree with the add-on of a projection of a weakening of the North American monsoon precipitation. However it is far from easy to identify these trends in the century or so of observational data. This is quite likely due to the impressive natural variability - ocean-forced, generated by internal atmospheric variability and, potentially, forced by changes in solar irradiance and volcanism - that impacts the region and is of sufficient amplitude to obscure, for now, the anthropogenic-forced signal. Here we will consider the last millennium of drought history across the region and, in more detail, the history of the last century. The mechanisms for GHG-forced hydroclimate change will be explained relating them to changes in moisture, mean circulation and storm tracks and these mechanism will be compared and contrasted with the mechanisms of natural hydroclimate variability. Methods will then be used to remove from observations the dominant patterns of natural hydroclimate variability and examine the residual for evidence of anthropogenic change. It will be concluded that there is strong evidence that global hydroclimate is evolving in response to rising GHGs as models predict it should. However this is still a small signal amidst tremendous natural variability. The near-term future hydroclimate of SWNA on the decadal timescale will therefore depend on a mix of radiatively-forced change and evolving natural variability which could amplify or oppose the forced change at varying times and create bumps on the road to a drier climate.