Predicted Impacts of Climate Change on Snowpack and Streamflow in the West

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From the scale of the entire globe down to a watershed, ranch or town in the West, there are many growing challenges posed by climate change, water shortage, human demographics and other environmental issues. The interconnected issues of climate change, snowpack and streamflow provide a disturbing example: over the same 30-year period the population in Arizona is expected to double, the climate of the region will likely – assuming little or no reductions in greenhouse-gas emissions – become more arid and drought-prone. Surface air temperatures are already rising faster than elsewhere in the coterminous United States, and will continue to rise steadily. These temperature increases are already causing snow to fall increasingly as rain, and also to melt earlier in the year. Thus, even in the absence of a precipitation decrease, there will be less snow-related run-off and streamflow. This trend is also being exacerbated in some parts of the West by human-caused increases in atmospheric dust loading. Unfortunately, nearly all state-of-the-art climate models being forced with increasing greenhouse gases (and other human-caused pollution) are also simulating a steady decline in average winter-time precipitation in the Southwest. More troubling is the fact that these simulated changes are also in accord with what has been happening in the real world – there is a growing scientific consensus that winters will become much hotter, and also significantly drier, due to the greenhouse-gas climate forcing. In contrast, there is little agreement as to what the summer North American monsoon will do, even though there is a growing consensus that warming in summer will be more extreme than in winter. On top of these trends in average conditions is the likelihood that multi-year, even multi-decade, drought will also become more common. Thus, all the signs indicate that Colorado River streamflow, and other surface flow as well, will likely decline by significant amounts into the future. Although climate change mitigation strategies (e.g., dramatic reductions in carbon emissions to the atmosphere) are the key to avoiding these dramatic climate, snowpack and streamflow changes, it is also clear that climate change adaptation will be needed to reduce vulnerability in the face the climate and streamflow change that is inevitable.