Geophysical Research Abstracts
Vol. 18, EGU2016-12245, 2016
EGU General Assembly 2016

Extreme Hydrological Changes in the Western United States Drive Reductions in Water Supply by Mid Century

Brianna Pagan (1,2), Moetasim Ashfaq (3), Deeksha Rastogi (3), Shih-Chieh Kao (3), Bibi Naz (3), Rui Mei (3), Donald Kendall (1,2), and Jeremy Pal (1)

(1) Department of Civil Engineering and Environmental Science, Loyola Marymount University, Los Angeles, CA, USA, (2) Department of Civil and Environmental Engineering, University of California Los Angeles, Los Angeles, CA, USA, (3) Climate Change Science Institute, Oak Ridge National Laboratory, Oak Ridge, TN, USA

The Western United States has a greater vulnerability to climate change impacts on water security due to a reliance on snowmelt driven imported water. The State of California, which is the most populous and agriculturally productive in the United States, depends on an extensive artificial water storage and conveyance system primarily for irrigated agriculture, municipal and industrial supply and hydropower generation. This study provides an integrated approach to assessing climate change impacts on the hydrologic cycle and hydrologic extremes for all water supplies to Southern California including the San-Joaquin River, Tulare Lake, Sacramento River, Owens Valley, Mono Lake, and Colorado River basins. A 10-member ensemble of coupled global climate models is dynamically downscaled forcing a regional and hydrological model resulting in a high-resolution 4-km output for the region. Greenhouse gas concentrations are prescribed according to historical values for the present-day (1965-2005) and the IPCC Representative Concentration Pathway 8.5 for the near to mid term future (2010-2050). While precipitation is projected to remain the same or slightly increase, rising temperatures result in a shift in precipitation type towards more rainfall, reducing cold season snowpack and earlier snowmelt. Associated with these hydrological changes are substantial increases in both dry and flood event frequency and intensity, which are evaluated by using the Generalized Extreme Value distribution, Standardized Precipitation Index and ratio of daily precipitation to annual precipitation. Daily annual maximum runoff and precipitation event events significantly increase in intensity and frequency. Return periods change such that extreme events in the future become much more common by mid-century. The largest changes occur in the Colorado River where the daily annual maximum runoff 100-year event, for example, becomes approximately ten times more likely and twice as likely in the other basins. Volumes for annual cumulative maximum runoff increase and in contrast decrease for annual cumulative minimum runoff. Intuitively, increased frequency of years with below historical average runoff put further strain on water supply. However, the escalating likelihood of runoff occurring earlier in the year and in significantly higher amounts poses a substantial flood control risk requiring the release of water from reservoirs, also potentially decreasing water availability. Significant reductions in snowpack and increases in extreme runoff necessitate additional multiyear storage solutions for urban and agricultural regions in the Western United States.