Climate and Flood Frequency in the Santa Ana River Watershed

SAWPA

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

Key Findings

- Simulations indicate a significant increase in flow for 200-year storm events in the future.
- Similarly the likelihood of experiencing what was historically a 200-year event will nearly double (i.e. the 200-year historical event is likely to be closer to a 100-year event in the future).
- Findings indicate an increased risk of severe floods in the future.
- There is large variability between climate simulations.
- Although there are clear trends in the median values, the range of flows is also large.

Additional Considerations

- Results are demonstrated for the Prado Dam gage but they can be easily replicated for other locations.
- Future work should expand this analysis to consider floods of different return periods as well as longer flood durations.
- Pearson Log III distributions were fit for this analysis. However, other extreme value functions may also be relevant (e.g. distributions with time varying parameters) .

Results

Will floods become more severe and threaten flood infrastructure?

It is projected that floods will be more severe in the future. Figure 1 shows the distribution of 200-year flood estimates for the Prado Dam gage based on results from 112 CMIP-3 climate change projections. As shown here, the median 200-year flood value is projected to increase significantly in all future periods (from ~134,000 cfs in the historical period to ~239,000 cfs in the last future period (2055-2084)). However, there is significant variability between projections so there are cases where the 200-year flood intensity is projected to decrease.

Are dams sufficiently sized for the 200-year storm, or does the risk level increase?

The risk level is expected in increase significantly. Figure 2 shows the distribution of return periods for the median 200-year historical flood estimate (~134,000 cfs). In all future periods the median return period for the historical 200-year flood is decreased significantly (~80 years by 2020 and 2050, and ~70 years by 2070). This indicates an increase in the risk of a 200-year and larger storm events and potential for negative impacts to infrastructure. This same point can also be seen in Figure 1 with the increased flow values for a 200-year event. However, once again it should be noted that there is significant variability in results. While the median indicates a decrease return period for the historical 200-year flow value, there are outlying simulations where the return period increases.

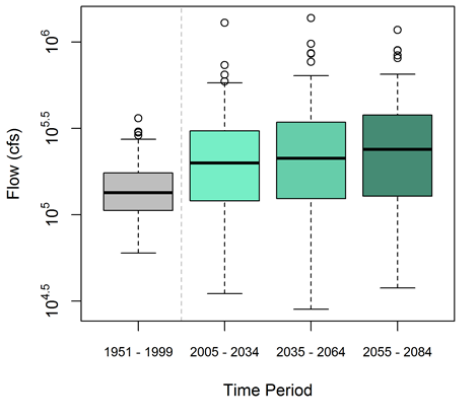

Figure 1 - Boxplot of 200-year flood estimates from 112 climate projections at the Prado Dam Gage

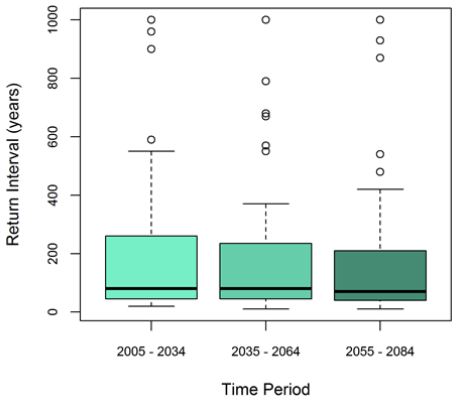

Figure 2 - Boxplot of return intervals for the median 200-year historical flood (134,000cfs) at the Prado Dam Gage

Methods

Daily stream flow values from 1950 to 2099 are generated for 112 CMIP-3 climate projections using the VIC model forced with downscaled climate variables. Flood frequencies are estimated following the method outlined in Bulletin 17-B published by the Interagency Advisory Committee on Water Data (1982). For this methodology, annual one-day flow maximums are generated and fit to a log-Pearson III distribution for each time period and climate scenario using the L-moments approach. Using the parameters for the log-Pearson III distributions, the 200-year return period flow values are estimated for every climate simulation and analysis period. The distribution is also used to calculate the return period for the median historical 200-year flood for each climate simulation and future time period.

Link to full technical report: www.usbr.gov/lc/socal/basinstudies/OWOW.html