



Climate and Flood Frequency in the Santa Ana River Watershed



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 to 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.

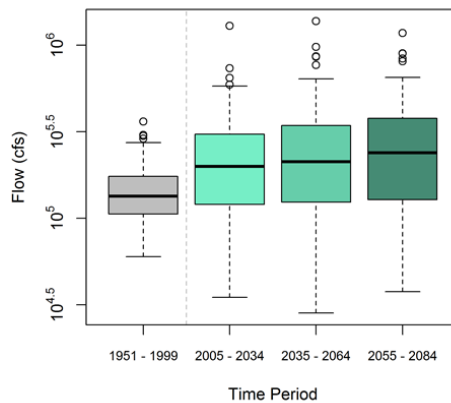


Figure 1 - Boxplot of 200 year flood estimates from 112 climate projections at the Prado Dam Gage

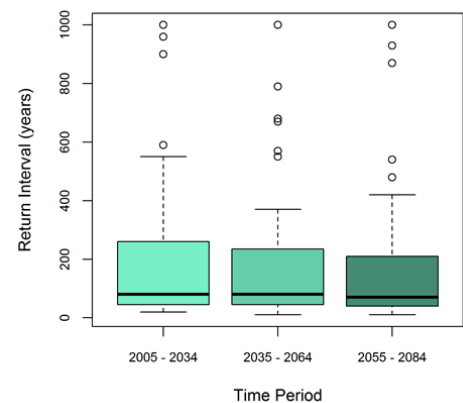


Figure 2 - Boxplot of return intervals for the median 200 year historical flood (134,000cfs) at the Prado Dam Gage

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 value 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.