PROJECTED CHANGES IN CALIFORNIA’S PRECIPITATION INTENSITY-DURATION-FREQUENCY CURVES

CITATION

ABSTRACT
Traditionally, infrastructure design and rainfall-triggered landslide models rely on the notion of stationarity, which assumes that the statistics of hydroclimatic extremes (e.g., rainfall, streamflow, etc.) do not change significantly over time. However, during the last century, we have observed a warming climate with more intense precipitation extremes in some regions, likely due to increases in the water holding capacity of the atmosphere. Consequently, infrastructure and natural slopes will likely face more severe climatic conditions, with potential human and socioeconomic consequences. Here, we outline a framework for quantifying climate change impacts on natural and man-made infrastructure using bias-corrected multi-model simulations of historical and projected precipitation extremes. The approach evaluates changes in rainfall intensity-duration-frequency (IDF) curves and their uncertainty bounds using a non-stationary model based on Bayesian inference. We show that highly populated areas across California may experience extreme precipitation that is more intense and twice as frequent, relative to historical records, despite the expectation of unchanged annual mean precipitation. Since IDF curves are widely used for infrastructure design and risk assessment, the proposed framework offers an avenue for assessing infrastructure resilience and landslide hazard in a warming climate.

HIGHLIGHTS

• The report presents intensity-duration-frequency curves for various locations in California based on multi-model future climate model simulations (2050-2099 relative to 1950-1999). Intensity-Duration-Frequency curves are widely used in infrastructure design and risk assessment, and the curves presented here have potential application in adapting infrastructure design and risk assessment to incorporate projected changes in extreme precipitation.

• Increase in intensity, duration, and frequency of extreme precipitation can adversely impact the integrity of infrastructure, particularly natural and engineered slopes. Indeed, severe rainfall causes flooding, landslides, soil erosion and jeopardizes functionality or integrity of infrastructure systems such as natural gas pipelines.
The report presents a new way of investigating and communicating the risk of hazardous climatic conditions by calculating the expected future return period of historical events, a useful metric for planning and decision making.

Extreme precipitation is expected to increase across most cities in California based on the current multi-model climate simulations presented in this report.

Climate model simulations under the RCP8.5 project that in the future, the frequency of what is currently a 50-year event could double in both Southern California (i.e., San Diego, and Santa Barbara) and Northern California (i.e., San Jose and San Francisco). This means that highly populated areas across California may experience extreme precipitation that is more intense and twice as frequent, relative to historical records, despite the expectation that, on average, annual mean precipitation will not change substantially.

**ACCESS**

For access to the full report, please email Susan.wilhelm@energy.ca.gov

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