A Novel Regional Approach for Estimating Ecological Streamflow Regimes in Ungaged Basins Combining Hydrological and Statistical Modeling

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Abstract. Natural streamflow variability is crucial for maintaining the ecological integrity of streams; however, population growth across the globe has prompted land use change, dam construction, flow extraction, and urbanization, which have altered natural streamflow regimes. Few regions of the United States have experienced as extensive urbanization over the past few decades as the coastal region of Southern California, including the San Diego and Los Angeles areas. Environmental streamflow management using the ELOHA framework has been proposed as a holistic method for managing water resources in Southern California to reduce the negative effects of urban growth on local hydrology, biology, and overall stream health. This approach benefits from the extensive bioassessment sampling network established throughout the region. Unfortunately, streamflow data are far sparser than bioassessment data in Southern California, prompting a need to accurately estimate ecological streamflow regimes in ungaged basins across the region. This study describes a novel approach for assessing ecological flow regimes at a regional scale. Thirty-one continuous hourly HEC-HMS rainfall-runoff models were calibrated to optimize two elements of the flow regime found to critically shape local benthic macroinvertebrate communities: streamflow flashiness and drying. Robust statistical methods including jackknifing, cluster analyses, Random Forest, and an optimized weighting scheme were used to determine which of the thirty-one hydrological models best extrapolates to a new, ungaged site. This novel approach is being compared to other common hydrological and statistical modeling techniques in its ability to predict ecological flow components and overall streamflow regime accuracy in ungaged basins.