**ABSTRACT**

**Modeling the Effects of Fire on Streamflow in a Chaparral Watershed**

**by**

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A comprehensive understanding of the effects of fire and post-fire succession on streamflow dynamics in California chaparral watersheds is needed to facilitate effective planning and management in these semi-arid shrublands. Watershed experiments have provided insights into the hydrologic effects of fire and post fire succession in chaparral watersheds, however extrapolation of these results is constrained by the small number of studies and the limited space and/or time scales examined. As it was not logistically or economically feasible to conduct additional field experiments for this research, an integrated remote sensing-distributed hydrological modeling strategy was utilized to advance our understanding of the effects of fire and post-fire succession on streamflow dynamics in these ecosystems. A wide range of inputs was derived for a modified version of the distributed, physically-based MIKE-SHE model using remote sensing and geographic information systems (GIS) techniques, including the development of a remote sensing-chronosequence approach for estimating the post-fire recovery sequence of chaparral leaf area index (a key input given that approximately 75% of incoming rainfall is returned to the atmosphere via evapotranspiration). The Monte Carlo-based Generalized Likelihood Uncertainty Estimation (GLUE) methodology provided the framework for model calibration, testing, and predictive uncertainty estimation. Model

simulations were performed using a suite of fire size-weather regime combinations to investigate the impacts of fire on annual and seasonal streamflow dynamics.

Over two-thirds of the observations (comprising over 90% of the total observed flow) in the calibration and test periods were contained within the GLUE-based predictive uncertainty bounds, an acceptable level of model performance relative to total period flow; prediction errors were generally associated with large rainfall and fire events. Model simulation results demonstrated that seasonal and annual streamflow response increased approximately linearly with fire size under both the wet and dry weather regimes. Moreover, the sensitivity of streamflow response to fire size varied with annual rainfall condition and stand age. However, these predictions were largely indistinguishable from the predictive uncertainty associated with the calibrated model used to make them - highlighting the importance of analyzing hydrologic predictions for altered land cover conditions in the context of model uncertainty.