FIRE, LAND COVER AND CLIMATE CHANGE: IMPACTS ON RIVER FLOWS IN SEMIARID SHRUBLAND WATERSHEDS

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ABSTRACT

Fires in Mediterranean-Type Ecosystems (MTEs) dramatically alter watershed land cover conditions and initiate vegetation recovery sequences pyric succession) that span many decades. MTE landscapes comprise a complex matrix of stands that are in different stages of pyric succession. This complexity and uncertainty around vegetation long-term recovery rates presents a major challenge to modeling the current and future response of river flows to different fire regimes. These hydrologic uncertainties are amplified by potential change in future climatic conditions.

The proposed project will address the following question that is relevant to all regions of the world with Mediterranean-type climates: **What is the combined effect of potential climate change and modified fire regimes on river flow characteristics that are important for water resources, ecosystem processes and functioning, and property damage?** Increased ignition sources associated with growing human population and expected changes in climatic conditions are likely to increase fire frequencies in shrubland watersheds, typical of MTEs, over the next century. The following general hypothesis is tested for chaparral watersheds in California: **Changes in fire regime and climate will alter aggregate ecosystem conditions giving rise to modified long-term river flow characteristics.** The research hypothesis will be tested using an existing, physically based hydroecological model (RHESSys) applied to two chaparral watersheds near Santa Barbara, California. The research project will include the following related components: 1) *Estimation of chaparral leaf area index (LAI).* Landsat TM data are used to determine time-space variations of shrub LAI. AVHRR data are used to establish intra-annual variations in LAI for stands in the first five years after fire (when annual vegetation species dominate). 2) *RHESSys model calibration, validation, and transportability studies.* While most hydrological models require LAI as an *input*, we propose to use satellite-based estimates of LAI time-space variations in addition to streamflow to evaluate RHESSys performance. 3) H*ypothesis testing using RHESSys under existing and future fire and climate regimes*. A simple procedure is constructed for generating synthetic fire regimes (frequency, location, size, date) that represent future hypothetical conditions. To develop realistic climate change scenarios, we will adopt an empirical downscaling procedure that uses a stochastic weather generator and GCM products.

Results from this study will further our understanding of how indirect anthropogenic modifications to landcover (different fire and climate regimes) are likely to affect water resources and related ecosystems in the heavily populated semiarid MTE regions of the World. In addition, the modeling approach will contribute to our understanding of the carbon cycle in these ecosystems and ultimately will become part of an integrated modeling system for decision support. The remote sensing products (LAI) will provide a valuable time-series data set of this critical variable for other hydrologic or biogeochemical studies and MODIS validation efforts.