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Prediction of Post-fire Water Quality Using the Soil-Water-Assessment-Tool (SWAT)

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Wildfires continue to grow in size, frequency, and severity across the western United States and the world. While fires are a natural disturbance, they can have considerable impacts on water quality in receiving streams. Previous studies on individual fires have observed an increase in various forms of nutrients, ions, sediments, and metals in stream water for different post-fire time periods. Our prior work using 159 wildfires across the western United States from 1984-2012 revealed significant increases in nutrient flux (different forms of nitrogen and phosphorus), major-ion flux, and metal concentrations are the most common changes in stream water quality within the first five years after fire. The current research follows up on this extensive survey of water quality response by developing tools to help quantify and predict nutrient loading. Currently, there are no published studies that attempt to model nutrient response after fire. A hydrologic model, SWAT (Soil and Water Assessment Tool), is developed to quantify forest fire's impact on nutrient loading. SWAT has been widely used to model water quality impacts from land use change, including predicting sediment movement and nutrient loading. SWAT is applied to model dissolved and particulate nutrient loading after two fires: the 2002 Rodeo fire in Arizona and the 2013 West Fork Complex fire in Colorado. The SWAT model is applied to both watersheds and calibrated to current loading conditions. Sub-watersheds with water quality impairments are then identified. Different scenarios employing various best management practices are simulated over the sub-watersheds to identify the most efficient approach to reduce loading of dissolved and particulate nutrients after fire. Improved water quality models will help facilitate management recommendations for water quality mitigation after fire and reduce nutrient loading to downstream water supplies. Prediction of fire impacts on water quality and aquatic ecosystems is critical as we experience more frequent and larger wildfires.