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Modeling post-fire sediment yield based on two burn scenarios at the Sooke Lake Reservoir, BC, Canada

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Wildfires can have major adverse effects on municipal water sources. Local governments need methods to evaluate fire risk and to develop mitigation procedures. The Sooke Lake Reservoir is the primary source of water for the city of Victoria, BC and the concern is that sediment delivered from upland burned areas could have a detrimental impact on the reservoir and the water supply. We conducted a sediment delivery modeling pilot study on a portion of the Sooke Lake Reservoir (specifically, the Trestle Creek Management Unit (TCMU)) to evaluate the potential impacts of wildfire on sediment delivery from hillslopes and sub-catchments. We used a process-based hydrologic and soil erosion model called Water Erosion Prediction Project geospatial interface, GeoWEPP, to predict the sediment delivery from specific return period design storms for two burn severity scenarios: real (low-intensity burn severity) and worst (high-intensity burn severity) case scenarios.
The GeoWEPP model allows users to simulate streamflow and erosion from hillslope polygons within a watershed. The model requires information on the topographic, soil and vegetative characteristics for each hillslope and a weather file. WEPP default values and several assumptions were necessary to apply the model where data were missing. Based on a 10-m DEM we delineated 16 watersheds within the TCMU area. A long term 100-year daily climate file was generated for this analysis using the CLIGEN model based on the historical observations recorded at Concrete, WA in United States, and adjusted for observed monthly precipitation observed in the Sooke Basin. We ran 100-year simulations and calculated yearly and event-based return periods (for 2, 5, 10, 20, 25, and 50 years) for each of the 16 watersheds.
Overall, WEPP simulations indicate that the storms that are most likely to produce the greatest runoff and sediment load in these coastal, maritime climates with relatively low rainfall intensities are likely to occur in the winter when the soils are not water repellant. The erosion rates varied from 0.34 tonnes/ha/year to 37.3 tonnes/ha/year with the most vulnerable slopes being those associated with steep shallow soils. The summation of the 10-year return period annual delivered sediment from all the watersheds for the worst case scenario during winter months is 17% greater than the total sediment delivery for the real case scenarios. Despite the data limitations, this analysis provides insight into the critical watersheds that will be major source areas of sediment following a wildfire. Watershed managers can use this information to plan and prioritize post-wildfire rehabilitation strategies and actions to minimize the risk of sediment delivery from the hillslopes that generate the greatest amount of sediment.