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# The effects of hillslope-scale variability in burn severity on post-fire sediment delivery

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With the increasing frequency of wildfire and the costs associated with managing the burned landscapes, there is an increasing need for decision support tools that can be used to assess the effectiveness of targeted post-fire management strategies. The susceptibility of landscapes to post-fire soil erosion and runoff have been closely linked with the severity of the wildfire. Wildfire severity maps are often spatial complex and largely dependent upon total vegetative biomass, fuel moisture patterns, direction of burn, wind patterns, and other factors. The decision to apply targeted treatment to a specific landscape and the amount of resources dedicated to treating a landscape should ideally be based on the potential for excessive sediment delivery from a particular hillslope. Recent work has suggested that the delivery of sediment to a downstream water body from a hillslope will be highly influenced by the distribution of wildfire severity across a hillslope and that models that do not capture this hillslope scale variability would not provide reliable sediment and runoff predictions. In this project we compare detailed (10 m) grid-based model predictions to lumped and semi-lumped hillslope approaches where hydrologic parameters are fixed based on hillslope scale averaging techniques. We use the watershed scale version of the process-based Watershed Erosion Prediction Projection (WEPP) model and its GIS interface, GeoWEPP, to simulate the fire impacts on runoff and sediment delivery using burn severity maps at a watershed scale. The flowpath option in WEPP allows for the most detail representation of wildfire severity patterns (10 m) but depending upon the size of the watershed, simulations are time consuming and computational demanding. The hillslope version is a simpler approach which assigns wildfire severity based on the severity level that is assigned to the majority of the hillslope area. In the third approach we divided hillslopes in overland flow elements (OFEs) and assigned representative input values on a finer scale within single hillslopes. Each of these approaches were compared for several large wildfires in the mountainous ranges of central Idaho, USA. Simulations indicated that predictions based on lumped hillslope modeling over-predict sediment transport by as much as 4.8x in areas of high to moderate burn severity. Annual sediment yield within the simulated watersheds ranged from 1.7 tonnes/ha to 6.8 tonnes/ha. The disparity between simulated sediment yield with these approaches was attributed to hydrologic connectivity of the burn patterns within the hillslope. High infiltration rates between high severity sites can greatly reduce the delivery of sediment. This research underlines the importance of accurately representing soil burn severity along individual hillslopes in hydrologic models and the need for modeling approaches to capture this variability to reliability simulate soil erosion.