Rapid Response Tools and Datasets for Post-fire Erosion Modeling: Linking Remote Sensing and Process-based Hydrological Models to support Post-fire Remediation

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ABSTRACT:

Post-fire flooding and erosion can pose a serious threat to life, property and municipal water supplies. Increased runoff and sediment delivery due to the loss of surface cover and fire-induced changes in soil properties are of great concern to both resource managers and the public. To respond to this threat, interdisciplinary Burned Area Emergency Response (BAER) Teams are formed to assess potential erosion and flood risks. These teams are under tight deadlines, as remediation plans and treatments must be developed and implemented before the first major storms in order to be effective. One of the primary sources of information for making these decisions is a soil burn severity map derived from Remote Sensing data (typically Landsat) that reflects fire induced changes in vegetative cover and soil properties. Slope, soils, land cover and climate are also important parameters that need to be considered when accessing risk. Many modeling tools and datasets have been developed to assist BAER teams, but process-based and spatially-explicit empirical models are currently under-utilized relative to simpler, lumped models because they are both more difficult to set up and require spatially-explicit inputs such as digital elevation models, soils, and land cover. We are working to increase the use of models by preparing spatial data sets before the fire season that can be rapidly combined with soil burn severity maps and then used to quickly run more accurate, process-based models for spatially-explicit predictions of post-fire erosion and runoff.

To demonstrate the efficacy of preparing datasets ahead of time, we will present case studies from two recent wildfire events, the 2011 Rock House Fire that burned in western Texas and the 2012 High Park Fire that burned in the Front Range in Colorado. A lack of preparatory work meant useful products could not be produced in a timely manner for the Rock House Fire, however with a little preparation processed based model results were successfully generated for the High Park Fire area.

We have built an online database (http://geodjango.mtri.org/geowepp /) for the state of Colorado that allows users to import current soil burn severity maps into the database. Once the soil burn severity map is in the online database it is combined with land cover and soil datasets in order to generate the spatial model inputs needed for hydrological modelling of burn scars. Model inputs can be created to represent the fire area both in its burned and unburned state. Users download three spatial layers: soils, land cover, and a digital elevation model (DEM) that have been registered and projected for modeling. The soil data is based upon the SSURGO or STATSGO NRCS soil databases, the DEM is from the USGS, and land cover is derived from LANDFIRE existing vegetation type data. Model results are used to improve decision-making activities related to post-fire risk assessment and rehabilitation treatment selection. The new website and datasets deliver all the spatial inputs and parameter files needed for spatial WEPP (Water Erosion Prediction Project) models in mere seconds; previously assembling and formatting this type of data would have taken at least several hours if not multiple days. We are actively expanding our database to include the lower 48 states and we are seeking other post-fire erosion models to support; we currently have plans to create datasets for a post-fire debris flow model and a dry ravel model. Our vision for this project is that advanced GIS surface erosion and mass failure prediction tools will be readily available for post-fire analysis using spatial information from a single online site.