Predicting post-fire sediment production at the hillslope scale: Efforts to validate RUSLE and Disturbed WEPP in the Colorado Front Range

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Abstract. Wildfires in the Colorado Front Range cause dramatic increases in hillslope-scale sediment yields. Accurate predictions of post-fire sediment yields are needed to guide management decisions and assess the potential impact of soil loss on site productivity and downstream aquatic resources. The Revised Universal Soil Loss Equation (RUSLE) and Water Erosion Prediction Project (WEPP) are the two models that are most commonly used to predict sediment yields following forest fires, but neither model has been extensively tested against field data. In this study we use over 300 plot years of data from 10 fires to test the ability of RUSLE and Disturbed WEPP to predict hillslope-scale sediment production rates after both wild and prescribed fires of various ages.

Both RUSLE and Disturbed WEPP generally over-predicted sediment yields when the measured values were low and under-predicted when sediment yields were high. For both models the predicted sediment yields were poorly correlated with the observed sediment yields ($r^2 \leq 0.18$). We were not able to substantially improve model performance by increasing the soil erodibility (K) factor in RUSLE to account for post-fire soil water repellency, or by changing the sequence of vegetation recovery in Disturbed WEPP. The best version of Disturbed WEPP performed slightly better than the best version of RUSLE. Previous efforts to validate RUSLE and WEPP have reported substantially higher model efficiency for plots in agricultural areas, whereas studies on rangelands have reported similar results to this study. The relatively poor performance of both RUSLE and Disturbed WEPP for burned areas in the Colorado Front Range indicates that more research is needed to quantify the controlling processes and ensure they are accurately represented in the models being used to predict post-fire erosion.

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