: Geomorphic Response to Peak Flow Increases Due to Forest Harvest Activities, Western Cascades, Oregon
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AB: The effects of forest harvest activities on streamflow is a persistent and often contentious debate. Despite decades of paired-watershed studies at small experimental catchments worldwide, the jury is still out on the magnitude, persistence, and mechanisms responsible for peak flow changes observed following timber harvest. Two recent studies examining long-term streamflow data from the H J Andrews Experimental Forest reached conflicting conclusions on the magnitude and causes of peak flow changes. But no studies have evaluated the geomorphic response to peak flow changes -- a question of great interest in interpreting potential downstream consequences of forest management on channels and ecosystems. We examined four categories of potential responses to peak flow increases: 1) suspended sediment transport; 2) bedload transport; 3) channel morphologic change; and 4) woody debris transport. To evaluate effects on suspended load, we used pre- and post-cutting relationships in peak flow (Q$_{p}$) between treated and control experimental catchments to characterize the magnitude of Q$_{p}$ change as a function of both flow magnitude and time. From this we developed a synthetic hydrograph for the cut watershed as if no peak flow changes had occurred, and calculated the difference in suspended sediment flux between the synthetic and observed hydrograph using the suspended sediment rating curve. Beload transport and channel changes were evaluated using empirical relations between measured values of annual bedload transport and peak flows, and cross-section analyses that determined the magnitude of peak flow change required to initiate bedload transport. The coarse grain size of channels in this area limits the frequency of bedload transport in larger channels to greater than 5-year return period events; such events are not substantially influenced by peak flow changes. A comparable threshold for events capable of delivering and transporting large woody debris similarly limits the effect of Q$_{p}$ changes on wood transport. The most significant geomorphic effects of hydrologic changes due to harvest may be due to increased water availability on hillslopes and roads, leading to increased frequency of mass movements, such as landslides and debris flows.