Geophysical Research Abstracts
Vol. 12, EGU2010-7540, 2010
EGU General Assembly 2010

Post-wildfire erosion and mass movement in British Columbia: site-scale soil changes and catchment-scale processes

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Following the severe 2003 wildfire season in British Columbia, a number of damaging debris flow and flood incidents occurred. Such events had not previously been documented in Canada. The British Columbia Forest Service began a process to analyse risks of post-wildfire natural hazards, including a 3-year research project to study processes in several wildfires which occurred in 2007.

The research project, and associated risk analysis work, includes:
- mapping of soil and vegetation burn severity;
- extent and persistence of water repellency in burned areas;
- monitoring the effectiveness of straw mulching treatments to reduce runoff and erosion;
- rainfall simulation experiments to study overland flow generation and soil erosion;
- streamflow, suspended sediment, and bedload monitoring on adjacent burned and unburned catchments;
- investigation of post-wildfire debris flow events.

The study area is in a moist, snow-dominated, heavily forested, mountain landscape. Runoff in this region is dominated by spring snowmelt, and by long-duration, low-intensity rainfalls. High-intensity rainfalls occur rarely, but are less dominant in the hydrologic cycle than at lower latitudes. Since the study began, no high-intensity rainfalls exceeding about the 2-year return period have occurred in the study area. The project includes measurements ranging in scale from 1 m^2 plots, to small tributary catchments (50 ha), to a large catchment (26 km^2). Results to date show that increases in sediment yield at the catchment scale have been barely detectable, and are less than those caused by erosion from roads used for salvage logging. Although erosion on small plots is significantly increased in severely burned areas, sediment yield measured in instrumented catchments decreases downstream, illustrating the importance of ephemeral flow pathways and intermediate storage.

Sometimes debris flows are triggered by increased surface runoff in headwater areas, resulting in a very high sediment yield which is derived mainly from previously stored channel sediment. Several debris flows have occurred in one of the burned areas under study, as well as in earlier burns in the region. Most of these have occurred in steep, dissected terrain which was subject to debris flows before fire, although old logging roads were responsible for one notable event. Increased snow accumulation and more rapid snowmelt in burned areas have been responsible for some debris flows, as have autumn rain-on-snow storms. These observations suggest that engineering treatments, such as road deactivation and improved drainage control, may be at least as important as broadcast erosion control treatments for reducing risks from post-wildfire mass movement.