Geophysical Research Abstracts, Vol. 7, 06024, 2005
SRef-ID: 1607-7962/gra/EGU05-A-06024

The impact of wildfire on water quantity and water quality: runoff, sediment and nutrient generation and exports

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A severe wildfire burnt 1.3 million ha of the state of Victoria, Australia in January and February 2003. Most of the area was Eucalypt forest containing important water supply catchments. There is a paucity of data in these environments on the spatial and temporal distribution of impacts and the processes driving mobilisation and transport. A number of catchments were instrumented to measure water quality parameters at existing gauging stations over a range of spatial scales. Two small ($<$ 250 ha) research catchments with pre-fire water quality and discharge data are the focus of high resolution (15 minute) measurement of discharge and sediment and nutrient exports, coupled with a program of hillslope experiments to quantify the processes driving changes in runoff and sediment and nutrient generation. These experiments include rainfall simulation, flow shear experiments, unconfined flow experiments, soil water-repellency tests, and catchment soil surveys. These catchments (Slippery Rock Creek and Springs Creek) are located in the East Kiewa River catchment. An adjacent larger catchment (West Kiewa River) with a lower burn severity was also instrumented. Key findings to date are:

- There has been a 6-10 fold increase in Total Suspended Solids (TSS) and Total Phosphorus (TP), and probably Total Nitrogen (TN), from the East Kiewa catchments.
- Bedload exports may have increased by factors of 10-100.
- The changes in suspended sediment and nutrient generation are most likely to be more subdued from the West Kiewa River, as evidenced by the spatially averaged volumes, and the time series of TSS concentrations.
- Preliminary analysis of flow increases appear to be between 40-65% at the East Kiewa catchments and between 23 and 39% at the West Kiewa River. The lower

value in the West Kiewa is consistent with the lower impact of the fire in this catchment. The estimated increases represent 230-490 mm of water yield.

- Flow Duration Curve analysis does not indicate there have been changes in runoff generation processes. This is supported by the results of the rainfall simulation studies.

- Comparison of measured saturated hydraulic conductivity (K_{sat}) and rainfall intensity shows infiltration-excess overland flow would have occurred for a total of only 45 minutes since the fires, in three separate 15 minute periods. This suggests much of the sediment generated was not from broadscale hillslope erosion

- Natural seasonality of water repellency has been measured on unburnt sites, which showed only small differences in hillslope K_{sat} between burnt and unburnt slopes in summer. The unburnt sites then displayed a marked increase in K_{sat} in winter, while the water repellency persisted (although muted) on the burnt areas.

- We hypothesis that much of the sediment load and associated phosphorous was generated from in-stream storages or unprotected riparian areas by increased flows and possible expansion of variable source area runoff producing in the near-stream zones.