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Extreme erosion response after wildfire in the Upper Ovens, south-east Australia: Assessment of catchment scale connectivity by an intensive field survey

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South-eastern Australia is generally regarded as one of the world's most fire-prone environments because of its high temperatures, low rainfall and flammable native Eucalyptus forests. Modifications to the landscape by fire can lead to significant changes to erosion rates and hydrological processes. Debris flows in particular have been recognised as a process which increases in frequency as a result of fire. This study used a debris flow event in the east Upper Ovens occurred on the 28th of February 2013 as a case study for analysing sediment transport processes and connectivity of sediment sources and sinks. Source areas were identified using a 15 cm resolution areal imagery and a logistic regression model was made based on fire severity, aridity index and slope to predict locations of source areas. Deposits were measured by making cross-sections using a combination of a differential GPS and a total station. In total 77 cross-sections were made in a 14.1 km2 sub-catchment and distributed based on channel gradient and width. A more detailed estimation was obtained by making more cross-sections where the volume per area is higher. Particle size distribution between sources and sink areas were obtained by combination of field assessment, photography imagery analyses and sieve and laser diffraction. Sediment was locally eroded, transported and deposited depending on factors such as longitude gradient, stream power and the composition of bed and bank material. The role of headwaters as sediment sinks changed dramatically as a result of the extreme erosion event in the wildfire affected areas. Disconnected headwaters became connected to low order streams due to debris flow processes in the contributing catchment. However this redistribution of sediment from headwaters to the drainage network was confined to upper reaches of the Ovens. Below this upper part of the catchment the event resulted in redistribution of sediment already existing in the channel through a combination of debris flows and hyperconcentrated flows. These results indicate that there is a stepwise outflow of sediment influencing long-term erosion rates and landform development.