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Uncertainty reduction in post-widfire sediment and nutrient load estimation

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Estimation of water quality impacts of wildfire poses particularly difficult questions for load estimation; ie. what is an appropriate sampling interval and estimation method to characterise the short duration but very high magnitude impacts? The uncertainty in estimated loads is rarely reported in the literature and can be generated in three broad error groupings:
1. Measurement uncertainty, associated with errors in measurement and sampling.
2. Knowledge uncertainty, involving our uncertainty in the process/model.
3. Stochastic uncertainty, due to variation in the data. Can be represented by the variance.

Analysis of eight data sets following severe wildfires in SE Australia in 2003 revealed very high uncertainty around load estimates of suspended sediment, total N and P. Measurement uncertainty was minimised by selection of the best load estimation method to match the available data. Knowledge uncertainty was evaluated to some extent by comparison of different load estimation methods for a subset of the data. Stochastic uncertainty was quantified using error calculations and through the use of Monte Carlo simulations.
The estimated increases in sediment loads for the year after the fire were large both in magnitude and variability between sites (from 20 to $\geq$ 1000 fold difference in pre- and post-fire loads). The majority of the total load was associated with event flows. Stochastic uncertainty was very large, with the standard deviation of the factor increases (over the pre fire state) being typically many times greater than the factor increase itself. Alternative load estimation methods produced values that varied by up to a factor of three. This uncertainty often resulted from a small number of extremely high sediment concentration values. The results indicated that the effects of fires on water quality are likely to be very large, and that increasing the precision of load estimates following future fires will require a much more intensive sampling strategy. To this end, a 3 year high resolution data set (15 minute sampling interval of TSS and particulate P and N) was used to evaluate the sampling interval and estimation method to achieve a pre-determined level of uncertainty around load estimates. The methods tested included fixed-interval sampling, storm event sampling and sediment ratings curves. All methods were tested with varying sampling intervals.