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A coherent framework to assess water contamination risk following vegetation fires

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Vegetation fires are one of the most hydrologically significant landscape disturbances, and each year affect ~4% of the global vegetated land surface. Ca. 60% of water for the world's largest cities is supplied from fire-prone or fire-managed ecosystems such as forests, grasslands and peatlands. These cities are therefore exposed to the risk of significant water quality declines following severe wildfires, as several examples in recent years show. This risk may increase in the future due to a combination of a future climate more propitious for fires, and recent trends of afforestation, land abandonment and suppression of small fires.

There is a substantial body of research on the hydrological impacts of fires, demonstrating that they can lead to enhanced runoff and erosion responses, which, combined with the creation of a highly mobile ash layer, can transfer sediment, nutrients, and contaminants such as Polycyclic Aromatic Hydrocarbons and heavy metals to streams and reservoirs. When fires follow prolonged droughts, these impacts may be enhanced by low reservoir water storage leading to reduced contaminant dilution.

However, research to date has typically focused on point and hillslope-scale processes. Existing studies report an enormous variability in both the drivers of post-fire contaminations, such as the type of pollutants or the mobilisation and transport processes; and on the quality issues of concern for end-users and water managers. This results in a limited knowledge base, with regionally diverse case studies, but few unifying points. Therefore, it is still difficult to reliably assess post-fire contamination risks in fire-prone catchments, and to propose effective mitigation strategies.

This presentation discusses a coherent framework to address regional and universal knowledge gaps in post-fire water contamination risk assessment, proposed by Nunes et al. (2018). It divides the risk assessment process in each area in a number of steps:
• identifying contaminants and water assets of concern;
• understanding the dominant processes that govern contaminant mobilisation; and
• mapping the dominant pathways that link contaminants to areas of concern.

It also highlights the dominant limitations in each step, as well as recent advances in addressing each limitation. A coherent framework will support the hydrological research community in maximising the usefulness of existing research, both by ensuring that all meaningful aspects of this problem are approached in a way which addresses the most important quality issues at a given site, and by enabling meaningful comparison between studies at different sites.

Nunes J.P., Doerr S.H., Sheridan G., Neris J., Santín C., Emelko M.B., Silins U., Robichaud P.R., Elliot W.J., Keizer J. 2018. Assessing water contamination risk following vegetation fires: challenges, opportunities and a framework for progress. Hydrological Processes: in press (DOI: 10.1002/hyp.11434).