Geophysical Research Abstracts
Vol. 19, EGU2017-5252, 2017
EGU General Assembly 2017

Predicting fire effects on water quality: a perspective and future needs

Hugh Smith (1), Gary Sheridan (2), Petter Nyman (2), Christoph Langhans (2), Philip Noske (2), and Patrick Lane (2)

(1) University of Liverpool, School of Environmental Sciences, Liverpool, United Kingdom (hugh.smith@liverpool.ac.uk), (2) University of Melbourne, School of Ecosystem and Forest Sciences, Melbourne, Australia

Forest environments are a globally significant source of drinking water. Fire presents a credible threat to the supply of high quality water in many forested regions. The post-fire risk to water supplies depends on storm event characteristics, vegetation cover and fire-related changes in soil infiltration and erodibility modulated by landscape position. The resulting magnitude of runoff generation, erosion and constituent flux to streams and reservoirs determines the severity of water quality impacts in combination with the physical and chemical composition of the entrained material. Research to date suggests that most post-fire water quality impacts are due to large increases in the supply of particulates (fine-grained sediment and ash) and particle-associated chemical constituents. The largest water quality impacts result from high magnitude erosion events, including debris flow processes, which typically occur in response to short duration, high intensity storm events during the recovery period.

Most research to date focuses on impacts on water quality after fire. However, information on potential water quality impacts is required prior to fire events for risk planning. Moreover, changes in climate and forest management (e.g. prescribed burning) that affect fire regimes may alter water quality risks. Therefore, prediction requires spatial-temporal representation of fire and rainfall regimes coupled with information on fire-related changes to soil hydrologic parameters. Recent work has applied such an approach by combining a fire spread model with historic fire weather data in a Monte Carlo simulation to quantify probabilities associated with fire and storm events generating debris flows and fine sediment influx to a reservoir located in Victoria, Australia.

Prediction of fire effects on water quality would benefit from further research in several areas. First, more work on regional-scale stochastic modelling of intersecting fire and storm events with landscape zones of erosion vulnerability is required to support quantitative evaluation of water quality risk and the effect of future changes in climate and land management. Second, we underscore previous calls for characterisation of landscape-scale domains to support regionalisation of parameter sets derived from empirical studies. Recent examples include work identifying aridity as a control of hydro-geomorphic response to fire and the use of spectral-based indices to predict spatial heterogeneity in ash loadings. Third, information on post-fire erosion from colluvial or alluvial stores is needed to determine their significance as both sediment-contaminant sinks and sources. Such sediment stores may require explicit spatial representation in risk models for some environments and sediment tracing can be used to determine their relative importance as secondary sources. Fourth, increased dating of sediment archives could provide regional datasets of fire-related erosion event frequency. Presently, the lack of such data hinders evaluation of risk models linking fire and storm events to erosion and water quality impacts.