Fire in the Earth System Abstracts
Vol. 2 FES-227
Granada, Spain, 4-8 July, 2023

Investigating the Vulnerability of water reservoirs to post-fire water contamination in Portugal.

[1]Nitzsche, Niels, [1]Dias, Luís, [2]Nunes, P. João, [1]Parente, Joana and [3]Schuurman, Joost

[1]*cE3c - Center for Ecology, Evolution and Environmental Changes & CHANGE - Global Change and Sustainability Institute, Faculty of Sciences, University of Lisbon, Portugal*
[2]*Soil Physics and Land Management Group, Wageningen University & Research, the Netherlands; cE3c - Center for Ecology, Evolution and Environmental Changes & CHANGE - Global Change and Sustainability Institute, Faculty of Sciences, University of Lisbon, Portugal*
[3]*Soil Physics and Land Management Group, Wageningen University & Research, the Netherlands;*

Abstract

In recent years, the Mediterranean basin, particularly Portugal, has witnessed a concerning increase in the extent and frequency of wildfires. Beyond their instant threat to human lives, these wildfires have also secondary effects on both humans and ecosystems, including the deterioration of water quality in downstream surface waters. Elevated levels of ash and accelerated erosion rates resulting from wildfires have the potential to introduce an influx of nutrients, sediments, and other water quality-related components, thereby posing a threat to drinking water supplies. To assess this risk, episodes of post-fire water contamination have been identified through changepoint analysis in a dataset of over 60 reservoir water quality time series spanning multiple decades. Further, the influence of possible post-fire water contamination drivers such as fire characteristics, watershed properties, reservoir attributes, and climatic drivers was explored through logistical regression analysis using generalized additive models. These findings were then used to develop an index for water managers based on which post-fire water contamination could be predicted and further to perform a deterministic risk analysis for each of the studied reservoirs based on data from 1990 – 2020.
Our findings indicate that 13.6 % of all wildfires resulted in increased levels of total suspended solids (TSS), which is a key parameter for water supply systems. Notably, the most significant changes occurred during the exceptionally severe fire seasons of 2003 - 2005 and 2017, with the southern reservoirs experiencing the greatest impacts after 2003 - 2005, where large wildfires coincided with major drought. Fire size emerged as the primary driver of post-fire water contamination, while reservoir and climate-related characteristics, such as water levels, also played a significant role in determining elevated TSS or NO3 levels. The risk analysis helped to identify key reservoirs that were at major risk, while generally central Portuguese reservoirs showed elevated risk

because of the high fire activity in the area, whereas the elevated risk in southern Portuguese reservoirs stemmed more from their importance for public water supply.
The outcomes of this study can have implications for numerous case studies and modeling efforts, providing valuable insights for water managers to anticipate and address potential future threats.

Keywords: post-fire hydrology, water quality, suspended sediments, changepoint analysis, logistic regression