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Post-fire impact on the water quality of a reservoir: an integrated watershed-reservoir modeling approach

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Wildfires are an increasing threat in the Mediterranean area causing the loss of goods and frequently on the loss of human lives. Not only forest fires are worrisome for their first and visible impacts on vegetation and soil, but also for the secondary impacts on the quality of surface water bodies. Approximately one third of the world's largest cities obtain their drinking water from forest catchments. The removal of vegetation and consequent increase in runoff with high concentration in sediments often leads to increased nutrients and sediment loads to water reservoirs damaging the aquatic ecosystem and human health.

In Portugal, the catastrophic events of Portuguese territory in 2017 occurred in strategic catchments from the water supply point of view. The Castelo de Bode reservoir, located in that area, with a total capacity of 1095 hm^3, supplies the city of Lisbon and surrounding areas (2,000,000 inhabitants). During 2017, more than one hundred thousand hectares of land in the upstream watershed were burned, making it one of the most affected areas in Portugal.

This study focuses on the impacts of the fires on the water quality of Castelo de Bode reservoir. The Soil Water Assessment Tool (SWAT) was first calibrated and validated for simulating streamflow, sediments and nutrients transport. The post-fire impacts were implemented by adjusting land use characteristics (curve number, crop vegetation management factor), and soil properties (soil erodibility), taking into account the different impacts from fire (low, medium, and high severity). The output from this model was then used as input to CE-QUAL-W2 reservoir model. During the calibration phase, it was possible to observe that CE-QUAL-W2 presented some limitations in reproducing water quality parameters, according to the available field measurements in such large reservoir . Therefore, the parameters with the best fit to the measurements at the dam wall were chosen as water quality indicators in the post-fire.

Preliminary results indicated an increase in nutrients and algae concentrations in the year following the 2017 fire events, characterized also by a decrease in the water level due to the base flow reduction at the watershed scale. Although high concentrations of nutrients characterized the reservoir inlet, only phosphate concentration slightly overcame the thresholds limits foreseen in legislation for drinking water close to the dam wall, likely due to the large volume of the reservoir which diluted the inflow concentrations.