The Impacts of Wildfire Disturbance on Hydrobiogeochemical Function

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Project Abstract: *This element of the RCSFA aims to reveal the mechanisms by which wildfires impact biogeochemical cycling in river corridors from reaction to basin scale. We aim to further improve model predictive capacity in watersheds impacted by fire disturbances, important for ascertaining the influence of fire on ecosystem structure and function*. We have recently completed a modeling experiment to evaluate pyrogenic organic matter (PyOM) bioavailability, leveraging a model developed by the RCSFA that uses OM stoichiometry to predict aerobic respiration. The predicted bioavailability for a diversity of literature derived PyOM compounds is comparable to natural OM (NOM) pools in global surface waters and sediments. However, the model-derived carbon use efficiency of PyOM varied dramatically, indicating a large range in PyOM's impact on ecosystem function. For instance, phenolic PyOM and 'Black Carbon' ('BC') molecules had lower metabolic efficiency than other PyOM and NOM compounds, and 'BC' metabolism was also less negatively impacted by oxygen limitation. This work supports current theories that PyOM is more bioavailable than traditionally accepted, supporting growing evidence that it may be an underappreciated driver of river corridor biogeochemistry. Building upon this modeling exercise, we have implemented a large-scale burn severity experiment to identify the impacts of differing burn severities on NOM chemistry. These experiments are focused on recreating fire conditions that will result in analogous burn severities to those observed in the natural environment. This modeling and experimental work is complemented by several ongoing field campaigns, aimed at developing an understanding of the temporal trajectories of wildfire impacts, and relating pyrogenic impacts to watershed features. We have established in-fire and out-of-fire reference sites in the Yakima River Basin – in the 2020 Cold Creek Fire and Evans Canyon Fire burn perimeters – and have sampled surface waters routinely since December 2020. We also highlight the spatiotemporal trends in storm response of five streams spanning a range of landscape characteristics and burn severity impacted by the 2020 Holiday Farm Fire, which burned >700 km^2 of forest in the Willamette River Basin, in collaboration with the Eugene Water and Electric Board (EWEB). We complement EWEB's water quality monitoring efforts by focusing on shifts in dissolved organic matter (DOM) quality during the first storm events following the fire. Hourly sampling during the storms revealed stream-specific responses in the magnitude and timing of DOM concentrations and quality, highlighting a differential response of each stream which overprint the temporal trends in immediate post-fire storm responses.