Temporal Trajectories of Wildfire Effects and their Relationship to Precipitation in the Columbia River Basin

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Project: PNNL SBR SFA
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This element of the PNNL SFA seeks to understand trajectories of wildfire effects on river corridors and their relationship to precipitation. It will also provide a foundation for understanding relationships between wildfires and river corridor biogeochemistry across watershed features. Wildfires impact rivers across timescales due to variation in precipitation, evapotranspiration, soil hydraulic properties, and pyrogenic inputs. Further, our previous work illustrates that compounding wildfire and precipitation events can drive distinct changes in soil carbon and nitrogen cycles relative to a single event, putatively altering river corridor impacts. Thus, there is a need to understand trajectories of wildfire impacts (e.g., across gradients of time- since-fire) on river corridor biogeochemistry in the context of precipitation regimes.

To improve understanding of how time-since-fire alters the impacts of pyrogenic material transported into river corridors, we will establish four wildfire chronosequences in the Columbia River Basin (CRB) with wildfires in 6 age classes (1990-present). We will schedule seasonal sampling events to align with different hydrologic conditions (four per year). Additional sampling will occur following at least one large precipitation event per year, per chronosequence. Source (upland soil, charcoal), sediment, porewater, and surface water samples will be collected for analysis of key biogeochemical features (e.g., inorganic nutrients and PyOM indicators) as well as biogeochemical process rates in response to leached source material from each wildfire age. We will also conduct rapid response efforts following new wildfires and precipitation events to evaluate immediate impacts of new wildfires and precipitation events.
Rapid response efforts will allow collection of source material, sediment, porewater, and surface water for biogeochemical analyses that would otherwise be inaccessible.

Additionally, to provide a foundation for how watershed features influence relationships between wildfires, precipitation, and biogeochemistry, we will determine key watershed features at each site, such as stream order and discharge, soil physical properties, surrounding landscape slope, and burn area for initial evaluation of how watershed features influence wildfire impacts on river corridors. We will use machine learning (e.g., random forests and support vector machines) to uncover specific watershed features associated with wildfire age that impact biogeochemical processes.

These activities will generate mechanistic knowledge of how time-since-fire impacts river corridor biogeochemistry in the context of precipitation events and watershed features. They will inform the incorporation of wildfire impacts into predictive models from reaction- to basin-scale.