2021 CASFM Research Grant Winner

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RESEARCH RELEVANCE

This proposal articulates research questions that are deeply relevant to CASFM's flood hazard mitigation and stormwater management objectives. Understanding the post-fire evapotranspiration (ET) response and recovery timeline is critical for portending the effect of wildfire on runoff rates and volumes, baseflow, and downstream water supply. The study builds on a project I completed in 2020 and is geared towards the Upper Colorado River Basin (UCOL) source water area specifically; it will be part of my PhD dissertation but is currently unfunded. If awarded, CASFM's grant monies will go towards my Fall 2021 research labor costs.

PROBLEM STATEMENT

Increases in wildfire activity in the fire-prone western United States pose substantial management and forecasting difficulties to resource managers because fire can alter the terrestrial processes that control water partitioning in the environment. ET is one of these processes that is vulnerable to alteration from fire, but as such it can be a powerful indicator of both hydrologic disturbance and recovery. Understanding the direction, magnitude, and duration of wildfire-induced ET rate change has meaningful implications for water managers and users because ET can comprise a significant portion of the annual water budget. This is turn impacts post-fire water supply portfolios, volume and peak rate of stormwater runoff, baseflow, and water quality due to increased sediment transport capacity. We propose to quantify the direction, magnitude, and duration of fire-induced ET shifts within the 24 areas that burned in the UCOL study area between 1990-2010 (as mapped by the interagency Monitoring Trends in Burn Severity [MTBS] project) by applying the USGS's Simplified Surface Energy Balance (SSEBop) algorithm to satellite-retrieved 30m Landsat land surface temperature data. Following, we will define relationships between that response and potential static and dynamic explanatory variables and will construct post-fire water budgets for UCOL's USGS-gaged basins to determine if a fire-disturbance signal can be detected in annual runoff patterns. Findings will be related back to the complexities surrounding local and regional water supply distributions systems that depend on the forested UCOL source water area. This research is critical to stormwater managers in the Rocky Mountain area who need to understand how fire implicates flood risk, ecologic habitat, and human health and safety.

OBJECTIVES

The overarching objective of this research is to provide post-fire ET rate response and recovery guidelines that allow land managers to apply them to their particular environmental setting.

Our research questions include:

(1) How has wildfire changed the direction and magnitude of ET over space and time in areas mapped as burned by MTBS in the UCOL study area from 1990 to 2010?

(2) Can significant relationships be identified between ET response and select static and dynamic pre- and post-fire explanatory variables? Do these results agree or disagree with findings in Collar *et al.* (in preparation)?

(3) In the USGS-gaged basins included in the UCOL study area, is there a detectable signal between that post-fire ET response and recorded discharge? Were local and/or regional water supply objectives likely implicated?

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Amanda Guedes Salerno
Environmental Engineer, graduated in 2017 from the University of Brasilia, Brazil

Professor Jennifer Bousselot, Colorado State University, Department of Horticulture and Landscape Architecture

PROJECT DESCRIPTION

We will be developing a stormwater green roof project starting in Fall 2021. The research will be at the CSU Spur campus on the building called Hydro, with around 3000 square feet of green roof research space that will be ready in 2022. We intend to analyze the amount of water drained by the system and the time it will take to reach the urban drainage system, the adaptation of the chosen vegetation, and the quality of the drained water, for the purpose of storage and reuse.

Green roofs are a low impact development technology that helps mitigate the effects of urbanization on water quality and quantity by detaining, absorbing and filtering rainfall. It is a technology that brings together social, environmental and economic benefits. The project will be located inside Downtown Denver. Therefore, we will be collecting data to research how these systems can positively impact drainage systems with flood hazards; and studies that will show how we can better manage stormwater and monitor water quality. As CASFM's mission, our project brings a good alternative to new buildings or retrofit projects that are able to reduce the loss of property from flood and storm damage by detaining a greater amount of water, decreasing the runoff coefficient.

The purpose of CSU Spur campus is to build a space where anyone can learn and be connected to our land grant institution. Our project will be in the middle of the city where visitors will be able to see how we can grow food and other vegetation in an unusual space. For the city, we will provide a technology that will detain water and prevent flood hazards, very common in some neighborhoods in Denver. The benefits will also be seen through energy savings, as showed in previous articles with validated results, green roofs can bring increased thermal efficiency to the building. There are many more ways that this technology will benefit people and the environment.

For this research, we already have a custom built bubbler flow meter, which will be installed in the building Hydro. It is from Bousselot's previous research at the EPA building in Denver, Colorado, where rain and snowmelt runoff were measured from both the control roof and the experimental roof precisely. With CASFM funds we will be able to purchase materials and supplies for our research.