Challenges

Burn Severity

Burn severity is a function of physical and ecological changes caused by fire. Fires burn heterogeneously across landscapes, with unburned and lightly burned patches interspersed among severely burned patches, due to variability in weather and landscape patterns.). Fire spread and severity have been associated with abiotic factors including weather, moisture and slope. Severity can also be highly influenced by biotic conditions including tree size, succession stage and pathogens. Mapping of burn severity provides information to target recovery activities efficiently. Large burned patches may negatively impact wildlife nesting and browsing. Vegetation mortality changes water loss through evapotranspiration, surface flow and subsurface flow. High severity burns often increase hydrophobic soil conditions, leading to increased runoff and erosion compared to less severely burned areas Unburned and low burn areas are seed sources for more severely impacted areas, which usually have fewer surviving and re-sprouting individuals (Cocke, Fulé, & Crouse, 2005).

Hydrologic Response to Fires

Forested watersheds are some of the most important sources of water supply in the world. Maintenance of good hydrologic condition is crucial to protecting the quantity and quality of stream flow on these important lands. Wildfires have the greatest potential to change watershed condition. Wildfires have a major influence on the hydrologic conditions of watersheds. Wild fires influence many forest ecosystems in the world depending and plays a role of variable significance depending on climate, fire frequency, and geomorphic conditions. This is particularly true in regions where high severity fire, steep terrain, high fuel loads, and post-fire seasonal precipitation interact to produce dramatic impacts (Neary, Koestner &Youberg, 2011). “Watershed condition or the ability of a catchment system to receive and process precipitation without ecosystem degradation is a good predictor of the potential impacts of fire on water and other resources (such as roads, recreation facilities, riparian vegetation, and so forth). The surface cover of a watershed consists of the organic forest floor, vegetation, bare soil, and rock. Disruption of the organic surface cover and alteration of the mineral soil by wildfire can produce changes in the hydrology of a watershed well beyond the range of historic variability. Low severity fires rarely produce adverse effects on watershed condition, but high severity fires usually do. Most wildfires are a chaotic mix of severities, but in parts of the world, high severity is becoming a dominant feature of fires since about 1990. Successful management of watershed resources and human populations in a post-wildfire environment require an understanding of the changes in watershed condition and hydrologic responses induced by fire. Flood flows, are the largest hydrologic response and most damaging to many natural and cultural resources” (Neary, Koestner &Youberg, 2011).

Climate change in combination with human intervention and the lack of forest management significantly increase forest fire hazard. Thus, wildfires have emerged as increasingly dominant drivers of ecosystem functioning. This has led to a new awareness about the effects of forest fires, not only in terms of vegetation loss, but also of probable loss of life and property, as well as of changes in the hydrological response. Several studies have pointed out the impact of forest fires on the hydrological cycle, including reduced infiltration rates, reduced evapotranspiration rates and increased overland flow.

Such impact is mainly attributed to the destruction of the vegetation cover and the consequent direct influence on interception, evapotranspiration and overland flow velocity. However, forest fires can also affect hydrological processes indirectly, altering the hydraulic properties of the soil. Fires destroy the top soil organic matter destabilizing the soil structure, and they convert the organic ground cover to soluble ash, and give rise to phenomena such as water repellency. Water repellency is an abnormality in soils, which results from the coating of soil particles with organic substances reducing the affinity shown by the soil for water.

Fire impact on hydrological processes is normally apparent for one or two years after the wildfires. However, in dry areas like Flagstaff, much higher runoff and erosion rates are being noticed even five to ten years after the fire. The period necessary for the hydrological process recovery to the pre-fire conditions greatly depends on the rate of vegetation recovery. Previous studies have shown that the period necessary for runoff and soil erosion to return to background levels depends on the type of species existing prior to fire, because each species has its own specific recovery rate. It has also been found that the amount of litter and vegetation cover is a key factor in reducing post-fire runoff and erosion, and in accelerating the recovery time of burned soils however, in dry areas, water shortage can seriously limit plant growth rate. The plant recovery and the recovery of post-fire hydrological responses may be constrained by factors, which are common in Flagstaff, such as harsh meteorological and hydrological conditions, plant communities with low regeneration potential that have colonized abandoned fields. South-facing slopes have also been reported as particularly sensitive to wildfire impact highlighting the vast spatial and temporal variability.

Pending your response, our team is ready to start collecting data for analyses of this project. The time frame for our full analyses should be no later than December 2013.