Untangling the Effects of Seasonality and Post-Fire Stream Channel Erosion on the Hydrologic Response of a Burned Mountain Catchment

Michael Gieschen[1] and Peter Nelson[1]

[1]Colorado State University

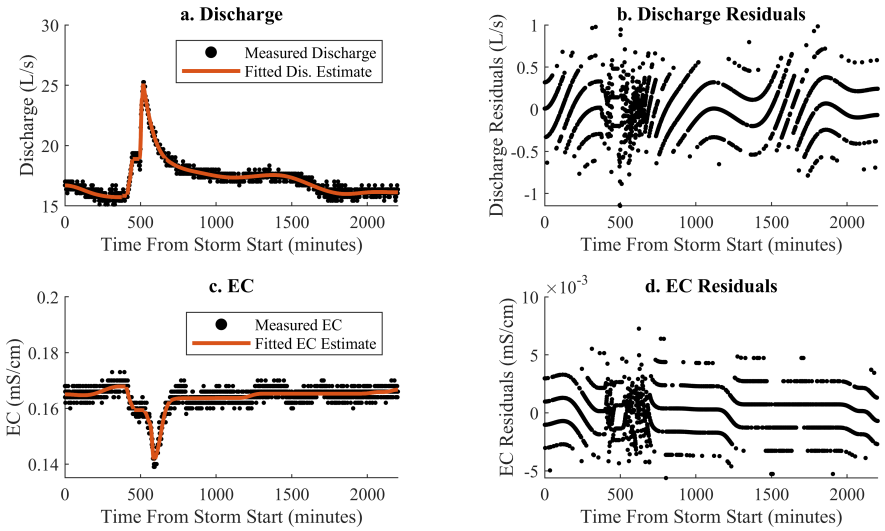
July 22, 2022

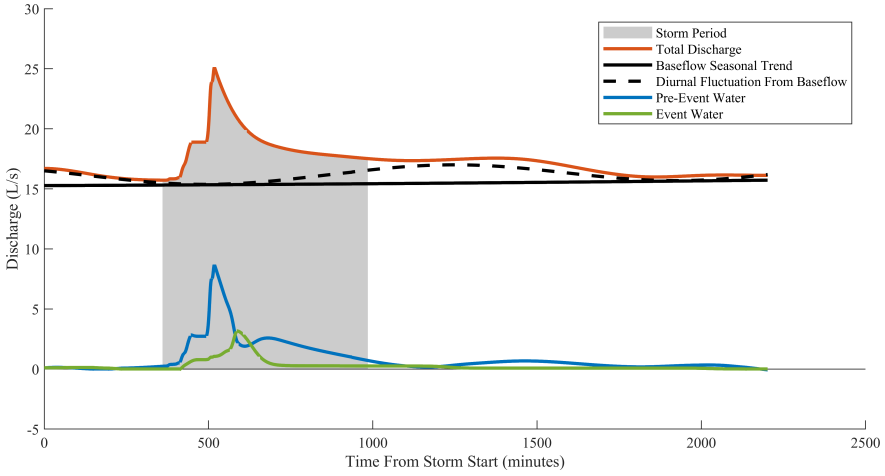
Abstract

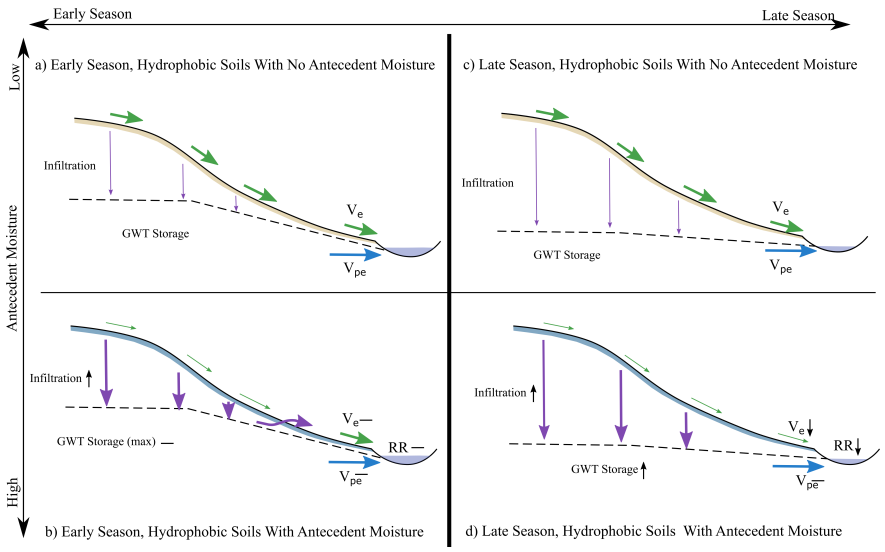
Stream channel incision and deposition are common after wildfire, and these geomorphic changes may impact runoff mechanisms and the composition of pre-event and event water in runoff. To investigate this, we monitored discharge and electrical conductivity at 6 nested sites within a 15.5 km ^{2} watershed in the northern Colorado Front Range that had recently burned, experienced large flooding, and well-documented and significant channel erosion and deposition. Over the study period, the watershed experienced seven precipitation events. For each hydrograph, we separate baseflow from runoff using a new method to characterize and account for the strong diurnal signal in the baseflow. Electrical conductivity is used as a tracer in a two-component end-member mixing analysis to separate the event hydrographs into event and pre-event water. Correlation coefficients were computed between key variables of the hydrologic response (such as runoff ratio, volumes of event and pre-event water) to storm and basin characteristics (including stream channel erosion/deposition, fraction of high/moderate burn severity, precipitation intensity, and antecedent precipitation). The strength and significance of correlations was found to vary seasonally. In the early season, event and pre-event volumes did not vary significantly with basin or storm characteristics. In the late season, antecedent precipitation correlated with a decrease in event runoff ($R^2 = 0.34$) and total runoff ($R^2 = 0.40$), increased precipitation intensity correlated with an increase in event runoff ($R^2 = 0.48$), and local erosion correlated with an increase in pre-event runoff ($R^2 = 0.60$) and total runoff ($R^2 = 0.53$). These findings indicate that seasonality and post-fire stream channel erosion influence the makeup of runoff response, most likely through their impact on the gradient of the near-stream groundwater table.

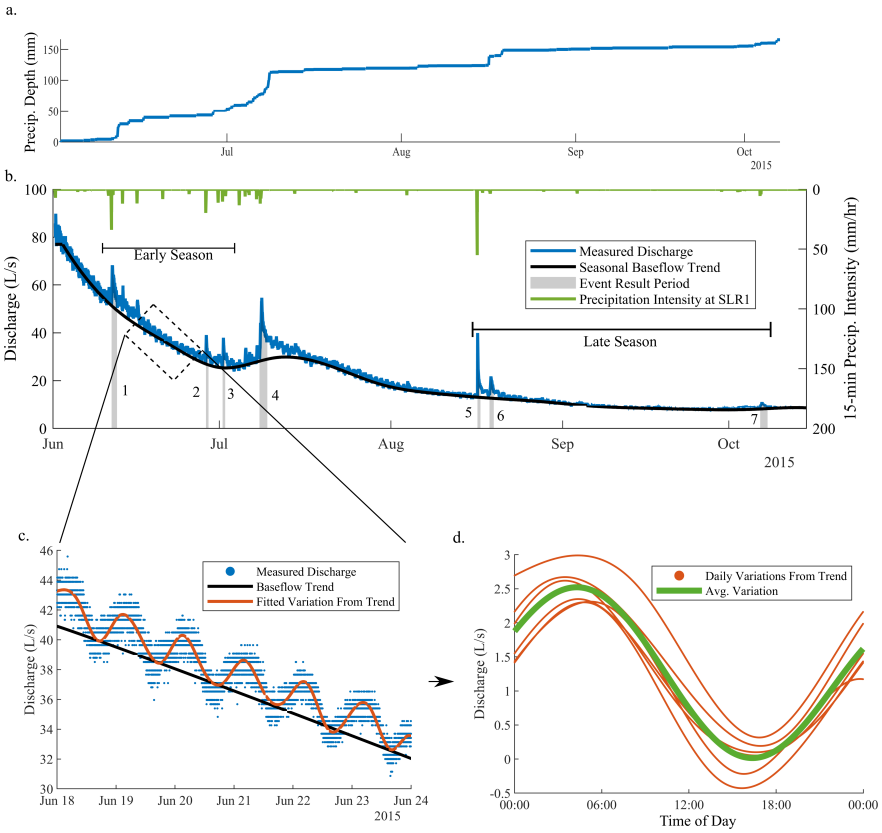
Hosted file

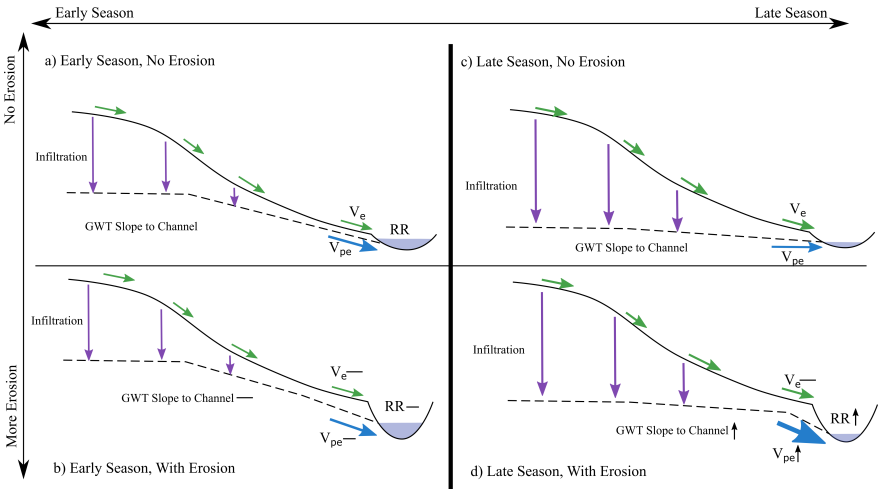
`Untangling Effects of Wildfire on Hydrologic Response- HP Journal Version_Final.docx` available at https://authorea.com/users/496806/articles/578058-untangling-the-effects-of-seasonality-and-post-fire-stream-channel-erosion-on-the-hydrologic-response-of-a-burned-mountain-catchment



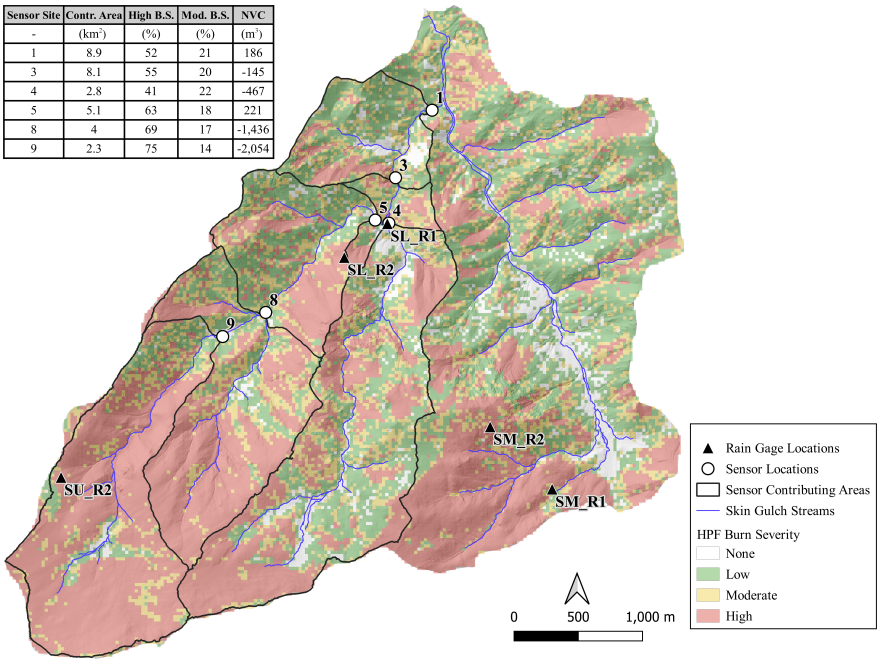








Sensor Site	Contr. Area	High B.S.	Mod. B.S.	NVC
-	(km^2)	(%)	(%)	(m^3)
1	8.9	52	21	186
3	8.1	55	20	-145
4	2.8	41	22	-467
5	5.1	63	18	221
8	4	69	17	-1,436
9	2.3	75	14	-2,054



Hosted file

Table 1 - Description of Variables.xlsx available at https://authorea.com/users/496806/articles/578058-untangling-the-effects-of-seasonality-and-post-fire-stream-channel-erosion-on-the-hydrologic-response-of-a-burned-mountain-catchment

Hosted file

Table 2 - Results Summary.xlsx available at https://authorea.com/users/496806/articles/578058-untangling-the-effects-of-seasonality-and-post-fire-stream-channel-erosion-on-the-hydrologic-response-of-a-burned-mountain-catchment

Hosted file

Table 3 - Results Correlations.xlsx available at https://authorea.com/users/496806/articles/578058-untangling-the-effects-of-seasonality-and-post-fire-stream-channel-erosion-on-the-hydrologic-response-of-a-burned-mountain-catchment